INTEGRATED NATIONAL ENERGY AND CLIMATE PLAN 2021-2030

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Introduction

The energy and climate policy framework in Spain is determined by the European Union (EU), which – for its part – is acting in line with the requirements of the Paris Agreement reached in 2015 to provide a coordinated international response to the climate change challenge. The EU ratified the Paris Agreement in October 2016, allowing its entry into force in November of that year. Spain ratified it in 2017, thus renewing its commitment to energy and climate change policies.

In this context, in 2016 the European Commission presented its 'winter package', (*'*Clean energy for all Europeans*'* COM(2016) 860 final), which has been implemented through various regulations and directives. These incorporate revisions of and proposals for legislation on energy efficiency, renewable energy, electricity market design, security of supply and governance rules for the Energy Union. This new regulatory and policy framework provides regulatory certainty and creates favourable conditions for undertaking the major investments that are needed. It also encourages European consumers to become active players in the energy transition.

The aim of these initiatives is to facilitate and update compliance with the main binding targets for the EU for 2030, which are set out below:

- 40% reduction in greenhouse gas (GHG) emissions compared to 1990;
- 32% share of renewable energy in total gross final energy consumption;
- 32.5% improvement in energy efficiency;
- 15% electricity interconnection between the Member States.

In addition, on 28 November 2018 the European Commission updated its long-term strategic vision *('*A Clean Planet for All' COM(2018) 773 final), in order for the **European Union to achieve a prosperous, modern, competitive and climate-neutral economy by 2050**.

In order to achieve these objectives in a coordinated way between all EU Member States, the 'winter package' contains a governance regulation. It sets out the planning procedure for achieving the objectives and targets, ensuring the consistency, comparability and transparency of reporting under the United Nations Framework Convention on Climate Change (UNFCCC) and under the Paris Agreement.

Specifically, the **EU requires each Member State to prepare an Integrated National Energy and Climate Plan 2021-2030 (INECP**). The Commission will use the INECPs submitted by each Member State to determine the degree of joint fulfilment and to establish actions to correct any slippages. The Regulation establishes, in turn, an iterative process between the Commission and Member States for the purpose of finalising the Plans in 2019 and their subsequent implementation. It includes a timetable for updating the Plans every five years and requires Member States to submit progress reports every two years (the first of which must be presented by 15 March 2023). Finally, it establishes guarantees to ensure the continuity of the Plan beyond 2030 through the development of a Long-term Low Emission Strategy (2050).

In this international and European context, Spain has shown its commitment to tackling the climate crisis by making the Plan one of its priority areas for policy action. In addition to giving greater certainty to investors and helping to take advantage of opportunities, this commitment is also aimed at protecting the common good and ensuring that the most vulnerable groups are protected.

The INECP 2021-2030 presented in this document is intended to reflect this commitment and Spain's contribution to the international and European effort. Spain's INECP identifies the challenges and opportunities within the five dimensions of the Energy Union: decarbonisation, including renewable energy; energy efficiency; energy security; the internal energy market; and research, innovation and competitiveness. The Plan also gives the necessary signals to provide certainty and direction to all players while also bringing flexibility and manageability to the energy transition and the decarbonisation of the economy. In this way, it is hoped that as many opportunities as possible will be seized for economic development and the creation of jobs resulting from such a transition.

The INECP is divided into two large sections. The first provides details about the process, national objectives, existing policies and measures, and measures that are necessary for achieving the objectives of the Plan, as well as an analysis of its economic, employment and distributive impacts and health benefits. The second section, composed of the Annexes to the main document, comprises the analysis, which provides details on projections, both in the Baseline Scenario (without any new policies) and the Target Scenario (with the INECP), as well as descriptions of the different models that have made the prospective analysis possible and that give robustness to the results.

Spain's INECP 2021-2030 is aimed at making progress with decarbonisation, laying down a firm foundation for consolidating a climate-neutral path for the economy and society by 2050. In this regard, it should be noted that in Spain, three of every four tonnes of greenhouse gases originate in the energy system; therefore, decarbonisation of this system is the central element on which the energy transition will be based. However, the challenges and opportunities associated with this Plan impact on plans and policies in different sectors; inter-administrative coordination will therefore be necessary to make the various policies compatible.

In addition, the INECP is accompanied by the Just Transition Strategy: based on the criteria of equity and solidarity, this is designed to anticipate and manage the impact on regions that host technologies that will be progressively displaced as a result of the transition promoted by this Plan and for people directly involved in them. It is also important to stress that, given the distribution of powers in Spain, it will be essential to ensure continuous coordination between the General State Administration and the autonomous communities, as well as the active involvement of the autonomous communities, in order to ensure that the objectives of this Plan are achieved.

'**Energy efficiency first**' is one of the core principles that has guided the preparation of this Plan. Indeed, the measures envisaged are expected to achieve a 39.5% improvement in energy efficiency by 2030. Specifically, the reduction in primary energy consumption proposed in this INECP is equivalent to improving primary energy intensity by 3.5% each year up to 2030, which will undoubtedly have a positive impact on the Spanish economy as a whole.

The implementation of this Plan will shift the energy system significantly towards greater self-sufficiency, based on efficiently exploiting existing renewable potential in our country, particularly solar and wind energy. This transformation will have a positive impact on national energy security by significantly reducing dependence on fossil fuel imports, which comes at a high economic cost and is subject to geopolitical factors and high price volatility.

In addition, as a result of the implementation of the Plan, in 2030 we expect to have achieved a 42% share of energy end-use from renewables, due to the planned investment in renewable electric and thermal energy sources. This also includes a significant reduction in final energy consumption as a result of savings and efficiency programmes and measures in all sectors of the economy.

This INECP will drive renewable energies, distributed generation and energy efficiency at local level, providing significant opportunities for investment and job creation.

In addition, it is expected that the diversity of stakeholders and the existence of participatory projects both in renewable energy generation and in the energy system as a whole will increase, as a result of own consumption, distributed generation, demand management and the promotion of local energy communities, as well as specific measures aimed at promoting the proactive role of citizens in decarbonisation.

Lastly, and in order to comply with the monitoring and reporting obligations of the INECP, we envisage strengthening coordination between the various public administrations through the National System of Energy and Climate Policies, Measures and Projections, in order to meet the reporting obligations in a timely and effective manner. This system will include preparing and updating the progress reports that our country has to present regularly to the European Union and the United Nations. It will also include information on the interlinkages of the various sectoral plans and policies with the cross-cutting objectives set out in this Plan. This will provide an official source of information making it possible to gauge the degree of compliance with the INECP's policies and measures and identify their contribution to the objectives, and to evaluate their effectiveness.

1. OVERVIEW AND PROCESS FOR ESTABLISHING THE PLAN

1.1 EXECUTIVE SUMMARY

According to the study conducted, the measures provided for in the INECP will allow the following results to be achieved in 2030:

- 23% reduction in greenhouse gas (GHG) emissions compared to 1990[1];
- 42% share of renewables in energy end-use;
- 39.5% improvement in energy efficiency;
- 74% share of renewable energy in electricity generation.

These results will enable progress to be made towards the longer-term objective that has guided the preparation of this Plan, namely to achieve GHG emission neutrality in Spain by 2050, in line with the positions adopted by the European Commission and the majority of Member States. This objective represents a reduction of at least 90% in total gross greenhouse gas (GHG) emissions by 2050 compared to 1990. In addition, the aim is to achieve a 100% renewable electricity system by the same date.

Decarbonisation of the economy and progress in renewable energy

The long-term goal that guided the preparation of the Plan is to **make Spain carbon neutral by 2050**. To that end, the medium-term objective of the Plan is to achieve a reduction in emissions of at least 20% in 2030 compared to 1990. According to the forecast made in the Plan, the measures that it includes will achieve a 23% reduction in emissions. The non-ETS sectors (residential, transport, agriculture, waste, fluorinated gases and industry not subject to emissions trading) will contribute to achieving this target with a 39% reduction by 2030 compared to the levels in 2005, while the sectors subject to emissions trading will contribute with a decrease of 61% compared to 2005.

The path established for the achievement of the objectives set for 2030 is based on the principles of technological neutrality and cost efficiency. To this end, energy modelling work has been carried out with the aim of minimising the costs of providing energy services, given the development of the different technologies and respecting the boundary conditions established in order to meet the objectives of the five dimensions of the Plan.

Given that three out of four tonnes of greenhouse gases originate in the energy system, its decarbonisation is the cornerstone on which the energy transition and decarbonisation of the economy are based. However, the INECP also devotes a great deal of attention to measures to reduce greenhouse gas emissions in other sectors.

[1] This is equivalent to a 38% reduction compared to total gross emissions in 2010 (357,677 MtCO-eq.), in line with the demands made by the IPCC to the international community in its 1.5 ^{0}C Special Report. This objective is fully consistent with a balanced path to climate neutrality in Spain in 2050.

The measures for which the INECP 2021-2030 provides bring down total gross GHG emissions from the 319.3 $MtCO_2$-eq predicted for the year 2020 to 221.8 $MtCO_2$-eq in 2030. The sectors of the economy that, in absolute numbers, will reduce their emissions the most in this period are electricity generation (**36 $MtCO_2$-eq**) and mobility and transport (**27 $MtCO_2$-eq**), in addition to the residential, commercial and institutional sector and industry (combustion)[2] with further decreases of **10 and 7 $MtCO_2$-eq, respectively.** These sectors considered together represent 83% of the emission reductions in the 2021-2030 period.

For the year 2030, the Plan foresees a total installed capacity in the electricity sector of **161 GW**, 50 GW of which will be wind energy; 39 GW solar photovoltaic; 27 GW combined gas cycles[3]; 16 GW hydroelectric energy; 9.5 GW pumping; 7 GW solar thermal electric; and 3 GW nuclear, together with smaller amounts of other technologies. The total installed capacity of renewables for the different years is set out in the INECP. However, the precise breakdown between the technologies presented in this document corresponds to the current projection based on the costs and assumptions considered in the modelling exercise (see Annexes A and B). The actual distribution amongst renewable technologies each year between 2021 and 2030 will depend, in any case, on changes in their relative costs, as well as on the viability and flexibility of their implementation. Consequently, their relative weight may vary, within certain margins, with respect to the figures presented in this Plan.

Therefore, the Plan's forecasts regarding the decarbonisation of the electricity sector are that, as a consequence of the application of European Union market instruments (tCO_2-eq price of EUR 35 in 2030 at constant 2016 prices), coal plants will cease to provide energy to the system by 2030 at the latest, since they will find it difficult to remain competitive.

Renewable electricity generation in 2030 will represent **74% of the total**, consistent with a path towards a 100% renewable electricity sector in 2050. It should be noted that there will be an additional **6 GW** of storage, providing greater capacity for managing generation. Together with the drive for flexibility and demand management, this allows for greater integration of renewable generation into the system, which will contribute to security of supply.

Annex D of the Plan presents reports containing generation dispatch simulations carried out by Red Eléctrica de España (REE), both for the Baseline Scenario and for the Target Scenario. Although the marginal average cost[4] should not be interpreted directly as the electricity price to the consumer, the change in the electricity mix provided for in the INECP 2021-2030 will, according to the REE's simulations, **reduce the marginal average cost of generation by 31 % by 2030, compared to the cost envisaged in the Baseline Scenario.** This will generate savings in the electricity system of EUR 6.109 billion in 2030 compared to the Baseline Scenario.

It is important to highlight that the increase of the renewable generation capacity envisaged in this Plan will require the involvement of the autonomous communities, which are responsible for spatial planning, as well as the drafting of additional management rules regarding the protection of the environment, so that the development of the generation facilities is effective and compatible with the environment and the protection of biodiversity and ecosystem services.

The mobility and transport sector accounted for 26% of emissions in 2017. The reduction of

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[2] Industry-Processes is the only sector of the economy that will increase its emissions (4%) in the period covered by the Plan.

[3] Which correspond to the already existing combined cycles.

[4] Does not include extra-peninsular systems.

27 Mt CO_2 equivalent between 2020 and 2030 equates to a 33% decrease. The main driving force for decarbonising the mobility and transport sector is a **modal shift that will, according to the Plan, affect 35% of the passenger kilometres that are currently travelled in conventional combustion vehicles.** To this end, it is expected that from 2023 onwards the creation of low-emission zones with limited access for the highest-emitting and most polluting vehicles will become widespread across all cities with more than 50,000 inhabitants; the regional administrations and local authorities will have key roles in introducing these measures. Another driver of the decarbonisation of the sector will be the presence of renewable energy in mobility and transport, which will reach **28% in 2030** through electrification (**there will be 5 million electric vehicles in that year**) and the use of **advanced biofuels**.

In the longer term, the necessary measures will be adopted in accordance with European regulations so that new passenger cars and light commercial vehicles, excluding those registered as historic vehicles not intended for non-commercial [*sic*] uses, will gradually see their emissions reduced to **0 g CO_2/km by 2040 at the latest**. To this end, work will be carried out with the automotive sector and measures will be put in place to facilitate the development and penetration of these vehicles. This will include measures to support RDI. It is hoped that in the two decades between 2021 and 2040 the national automotive sector will be able to properly adapt to – and keep pace with – the changes that are envisaged in this sector.

Likewise, the Plan foresees that in the year 2030 the share of renewables in final energy use will be **42%**. As regards the numerator, this will come about owing to the high penetration of electric and thermal renewable energy in all sectors of the economy as a result of measures that ensure visibility and stability in the medium term, greater flexibility and greater participation of citizens in the energy system, as well as specific support measures in those areas where they are needed. As regards the denominator, it will be brought about by the significant decrease in the amount of final energy required by the economy as a result of the progress made in savings and efficiency in all sectors.

The increase in renewable energy use between 2021 and 2030 is substantial in almost all economic sectors, as can be seen from the following data:

- electricity generation: increases from 10,208 to 21,792 ktoe;
- heat pumps: increases from 629 to 3,523 ktoe;
- residential: increases from 2,640 to 2,876 ktoe;
- industry: increases from 1,596 to 1,779 ktoe;
- transport (biofuels): decreases from 2,348 to 2,111 ktoe;
- services and other: increases from 241 to 435 ktoe;
- agriculture: increases from 119 to 220 ktoe.

Ultimately, the share of renewables in energy end-use will increase from an expected **20%** for the year 2020 to **42%** in 2030**.**

In addition, it is expected that the diversity of stakeholders and the existence of participatory projects both in renewable energy generation and in the energy system as a whole will increase, as a result of own consumption, distributed generation, demand management and the promotion of local energy communities, as well as specific measures aimed at promoting the proactive role of citizens in decarbonisation.

Apart from actions in the energy field, the Plan addresses the need to tackle emissions in **non-ETS non-energy sectors**, as well as to take advantage of the GHG absorption potential of natural sinks. The Plan proposes measures for non-energy sectors that can bridge the existing gap between the projected emissions and the commitments that Spain has made for non-ETS sectors in the 2021-2030 period.

Finally, the Plan recognises the long-term climate benefits of the land use, land-use change and forestry (**LULUCF**) sector, and its potential to contribute to the goal of emission mitigation by 2030.

Energy efficiency

The INECP adopts the energy efficiency target of 32.5% as established in the Energy Efficiency Directive as a minimum benchmark, although in the projections of the Plan's Target Scenario the reduction in primary energy consumption — compared to the European baseline scenario established by the PRIMES model in 2007 —is **39.5% by 2030**, so that primary energy consumption will be 98.5 Mtoe in that year[5].

The reduction in primary energy consumption proposed in this Plan is equivalent to **1.9%** every year since 2017, which when linked to an expected annual increase in Gross Domestic Product (GDP) in the same period of **1.7%**, results in **an improvement in primary energy intensity of 3.5% per year until 2030.**

In addition to this objective, the Energy Efficiency Directive requires Member States to demonstrate the achievement of a cumulative end-use energy savings target in the period: firstly, between 1 January 2014 and 31 December 2020, and secondly, between 1 January 2021 and 31 December 2030. This cumulative end-use energy savings target has been calculated in accordance with the provisions of Article 7 of the Directive. For the first period, it amounts to 15,979 ktoe and for the second period, it is equivalent to 36,809 ktoe, which means that new and additional savings equivalent to 669 ktoe/year are achieved every year, from 1 January 2021 to 31 December 2030.

The Plan also proposes that public administrations should set an example in energy saving and efficiency. Thus, it proposes initiatives for achieving the target for renovating public building stock established in the Energy Efficiency Directive (3%) and evaluates and promotes savings that can be obtained by renovating an additional 300,000 m^2/year in the General State Administration. In accordance with the Energy Efficiency Directive, the Plan encourages autonomous communities and local authorities, at least, to adopt the mandatory target for the General State Administration of renovating 3% of the built and heated area of the public building stock, as this will achieve a much more ambitious energy-saving target.

[5] Not including non-energy uses.

This responsible approach by the public sector is completed with the Ecological Public Procurement Plan of the General State Administration, its autonomous agencies and the Social Security management entities (2018-2025).

Energy security

Given the changes in the energy mix that are proposed in this Plan, supplying safe, clean and efficient energy to the different consumer sectors will involve significant technological challenges, which must be addressed from the different dimensions of energy security:

- reduction of dependency, especially on fossil fuel imports;
- diversification of energy and supply sources;
- preparation for possible supply limitations or interruptions;
- increase in the flexibility of the national energy system.

Specifically, and as regards reducing energy dependency, the starting point is energy consumption in 2017 of 132 Mtoe in terms of primary energy, 99 Mtoe of which were, almost entirely, imported fossil fuels.

After application of the measures included in this National Plan, it is foreseen that energy consumption of 104 Mtoe[6] will be achieved in 2030, 67 Mtoe of which will be fossil fuels. Accordingly, renewable energy and energy efficiency action **will lower the degree of dependency on imported energy from 74% in 2017 to 61% in 2030.** In addition to improving national energy security, this will have a very positive impact on the trade balance.

Within the field of energy security, the **security of electricity supply** is of central importance. **The analyses performed by various models indicate that security of electricity supply would be guaranteed with the power generation mix presented in the Target Scenario**. This technical analysis is provided in Annex D 2 *(Guarantee of Supply*: *Probabilistic analysis of coverage under the 2030 Target Scenario*). In addition, the models used in the INECP, which are specific to the electricity sector, are presented in Annex B *(Models*).

As regards the security of electricity supply, the following should be noted in relation to the phasing-out of coal and nuclear power in electricity generation by 2030 (four of the seven reactors will be closed), both of which are envisaged in the Target Scenario of this Plan:

Firstly, this reduction in capacity is offset by the significant penetration of renewable electricity generation technologies, in particular solar and wind technologies (see Chapter 2, Table 2.3. Evolution of the installed capacity of electricity).

Secondly, Spain has combined-cycle gas plants with a capacity totalling 26,612 MW, which, together with storage and demand management, provide back-up capacity when it comes to evolving towards this transition in the electricity mix during the decade 2021-2030.

[6] Including non-energy uses.

Finally, the aforementioned REE reports conclude that the supply under the Target Scenario envisaged in this Plan is fully guaranteed under the most demanding circumstances in terms of weather conditions.

At the same time, and in line with the objective of climate neutrality by 2050, the Plan addresses the need to anticipate and plan, together with the System Operator, the technologies, procedures and mechanisms that will make it possible to guarantee security of supply without greenhouse gas emissions.

The lines of work included in this dimension of the Plan are as follows:

- increasing the electricity interconnection of the systems, which will help to reduce possible negative impacts due to supply constraints or interruptions;
- optimising the use of existing capacity by reducing barriers to the exchange of electricity (see the section on the internal market);
- intensifying contingency planning, which is currently very advanced, in the framework of the different international contexts in which Spain is involved: the International Energy Agency (IEA) and various EU directives and regulations for the electricity and gas sector;
- developing the National Security Strategy and the Energy Security Strategy through the Special Committee on Energy Security;
- adapting to the new European regulation on risk-preparedness in the electricity sector;
- improving the different preventive and emergency plans with regard to the supply of electricity, gas and petroleum derivatives.

Finally, attention has been paid to cybersecurity. In April 2019, Spain adopted its National Cybersecurity Strategy, the purpose of which is to implement the provisions of the 2017 National Security Strategy. Moreover, Spain has had a National Energy Security Strategy since 2015.

This strategy has promoted and strengthened public-private collaboration with the various energy operators, a task that has been coordinated by the Cybersecurity Coordination Office (OCC) of the National Centre for the Protection of Critical Infrastructure and Cybersecurity (CNPIC). The designated critical operators in the field of energy and nuclear industry have also presented their respective Operator Security Plans (OSPs), checking that they are adapted to the current situation of threats and challenges to which critical infrastructure in the energy sector and nuclear industry are subject, and updating the information contained in these plans.

Internal energy market

The Plan’s objectives in relation to the Internal Energy Market dimension respond to the need for a more competitive, transparent, flexible and non-discriminatory energy market with a high degree of interconnection that promotes cross-border trade and contributes to energy security. This requires adequate consumer protection, especially for vulnerable consumers, as well as enhanced competition and effective integration in the European market, with the relevant infrastructure.

With regard to electricity infrastructure, the integration of renewable energy generation necessitates the strengthening and expansion of transport and distribution lines in Spanish territory, including mainland connections, non-mainland systems and interconnections between island systems. The Plan addresses all of these aspects, as well as the development of mechanisms for the management and storage of non-dispatchable electric renewables that will prevent discharges.

The increase in interconnections within the non-mainland electricity systems will have a direct impact on energy and climate, since coal, fuel or diesel power plants play a greater role in the power generation mix of these systems than on the mainland. In this regard, the Plan envisages **that the contribution of fossil fuel plants located in isolated electrical systems will be reduced by at least 50% by 2030.**

At EU level, the degree of interconnection between the Iberian electricity system and the rest of the European continent is below the established targets. **Currently, Spain's interconnection rate is less than 5%** of the generation capacity installed in the system. In 2020, despite the planned interconnections, Spain will be **the only country in the European Union that falls below the 10% target**, so it will be necessary to continue developing new interconnections:

- A new interconnection with Portugal, which will increase the exchange capacity to 3,000 MW.
- New interconnections with France, which will increase interconnection capacity to 8,000 MW:
    - the Bay of Biscay project: between Aquitaine (FR) and the Basque Country (ES);
    - an interconnection between Aragon (ES) and Pyrénées-Atlantiques (FR);
    - an interconnection between Navarre (ES) and Landes (FR).

The Plan foresees continuous regional cooperation with neighbouring countries in, at least, the areas of energy security and the internal market. In this connection, on 9 July 2019, the Spanish Ministry for Ecological Transition and Demographic Challenge (MITECO) held a working session in Madrid attended by representatives of the European Commission, Portugal, France and Spain. In addition to sharing the results of the represented countries' National Plans, relevant aspects of the internal energy market and potential future avenues for cooperation were discussed.

Finally, the Plan promotes various measures to protect and strengthen the role of consumers. With regard to energy poverty, the Plan takes into account the **National Strategy against Energy Poverty**[7] approved on 5 April 2019 by the Council of Ministers. The Strategy, in line with the approach and methodology of the EU Energy Poverty Observatory, is an instrument that will enable the phenomenon of energy poverty to be addressed with an integrated approach and a medium and long-term vision.

Research, innovation and competitiveness

The Energy Union includes a dimension on research, innovation and competitiveness in which the **Strategic Energy Technology Plan (SET Plan)** plays a leading role. This has been the RDI pillar of European energy and climate policy since 2007.

Through the SET Plan, actions for innovation and research in low-carbon technologies are

[7] https://www.miteco.gob.es/es/prensa/estrategianacionalcontralapobrezaenergetica2019-2024_tcm30- 496282.pdf

coordinated among the participating countries, namely the EU Member States as well as Norway, Iceland, Switzerland and Turkey. Financial support for projects arising from the SET Plan is provided by the Horizon 2020 programme. Within the SET Plan framework, the Spanish authorities work in different groups that address the needs for research, innovation and competitiveness (RIC) in sectors such as photovoltaic energy, concentrated solar power, wind power and energy efficiency.

The Ministry of Science and Innovation is responsible for implementing the Spanish Government's policy on scientific research, technological development and innovation; for this reason, it is responsible for implementing this dimension in the energy sector in coordination with MITECO and the other agents involved. Together with the Ministry, the following participate in this task:

- The State Research Agency (AEI), which is responsible for the financing, evaluation, award and monitoring of scientific and technical research activities. The Technological Platforms are a particularly important part of its work.
- The Industrial and Technological Development Centre (CDTI), which aims to increase the competitiveness of Spanish companies by raising their technological level, for which it funds business RIC projects.
- Public Research Organisations, such as the Research Centre for Energy, Environment and Technology (*Centro de Investigaciones Energéticas y Tecnológicas*, CIEMAT), which focus on programme implementation.

The RIC activities aimed at combating climate change and promoting the energy transition are organised in the following lines of work:

- Energy Efficiency, characterised by its cross-cutting nature in terms of the technologies and sectors involved.
- Renewable energy technologies:
    - those in which Spain already has a competitive position, with a high level of participation of its companies, such as wind, solar photovoltaic and solar thermoelectric;
    - renewable fuels for the transport sector, particularly the development of advanced biofuels;
    - others in which Spain has significant natural resources and sufficient local implementation potential to develop technological learning curves: offshore wind energy, biomass, marine energy, waste, as well as low-enthalpy geothermal energy.
- Flexibility and optimisation of the energy system by implementing technologies that provide flexibility to the electricity system, which is essential in order to achieve a high degree of penetration in the non-dispatchable renewable generation system:
    - electricity storage, with and without electric vehicles, and demand-side participation in system operation;
    - thermal storage, particularly linked to solar thermal technologies;
    - hydroelectric storage;
    - chemical storage in the form of hydrogen, either by using electrolysis and consumption in fuel cells, or by injecting it into the network.

- Electric vehicles: batteries and the installation and optimisation of charging points.

As far as **competitiveness** is concerned, Spain is one of the European countries with the highest potential for exploiting renewable energy. It extends over 50 million hectares, including large areas of low population density, and benefits from Mediterranean and Atlantic winds, high levels of sunshine, extensive forests and substantial water resources, and these are complemented by a business, technological, innovation and knowledge network in this area.

Our country has leading international companies in sectors that will be important for the energy transition; it has significant knowledge capital with pioneering institutions such as CIEMAT, the National Centre for Renewable Energy (CENER), the Institute for Energy Diversification and Saving (IDAE), REE's Renewable Energy Control Centre (CECRE), as well as other research centres, universities, technological networks and a strong industrial network in the field of renewable energies.

The INECP allows Spain to aspire to be one of the leading European Union countries in the energy transition. The Spanish economy can benefit greatly from this transformation in terms of competitiveness, in the form of prosperity, energy security, job creation in industry, innovation, technological development and the elimination of energy poverty.

The reduction in electricity costs through the use of renewable technologies will clearly improve the competitiveness of electricity-intensive companies. In addition, this Plan includes the implementation of measures in industry that will initiate changes in production processes and a move towards those that have the best technical improvements available. The planned improvements in energy efficiency also have a positive effect on the industrial and production fabric, on large, small and medium-sized enterprises, as well as on households and individuals.

In order to carry out an exhaustive and systematic analysis of our country's potential in international renewable technology value chains, as well as to map existing technological, industrial and knowledge capacities, an **Industrial Development Plan** will be drawn up, in which the energy transition will be a central element. In this sense, the objective of the Plan will be to lay the foundations so that Spain can fully exploit the potential in terms of bringing about economic development and creating industrial jobs as a result of the energy transition.

The economic, employment, distributive and health impacts of the INECP, 2021-2030

The energy transition set out in this Plan represents an important economic and employment opportunity for our country, as shown by the technical impact analysis (see Chapter 4), the most important conclusions of which are set out below.

The total investments to achieve the objectives of the Plan will amount to EUR 241.412 billion between 2021 and 2030. Of this amount, EUR 196 billion are additional investments compared to the Baseline Scenario (without additional policies). The total investments are distributed between:

- Saving and efficiency: 35% (€83.540 bn)
- Renewable energy: 38% (€91.765 bn)
- Networks and electrification: 24% (€58.579 bn)
- Other measures: 3% (€7.528 bn)

With regard to the source of the investments, a substantial proportion of the total investment will be made by the **private sector (80% of the total)**, mainly linked to the deployment of renewable energy, distribution and transmission networks, and a large part of the saving and efficiency measures. The **public sector** will make the rest of the investment **(20% of the total)**, in actions related to promoting energy saving and energy efficiency, sustainable mobility and the modal shift. In the case of public sector investments, a portion is expected to come from European funds.

The INECP will generate an increase in GDP between **EUR 16.5 billion and EUR 25.7 billion** per year (1.8% of GDP in 2030). This positive impact comes from the economic boost generated by investments in renewable energy, savings and efficiency and networks, on the one hand, and the decrease in the country’s energy bill, on the other. The INECP will also generate a net increase in employment of

253,000 and 348,000 people (a 1.7% increase in employment in 2030). Regarding the trade balance, the Plan will result in **cumulative savings in fossil fuel imports of EUR 67.381 billion between 2021 and 2030**, compared to the Baseline Scenario.

In the case of distributive impacts, **the measures will benefit low-income households, particularly vulnerable groups.** The evaluation confirms how the effect on final consumption increases to a greater extent in the lowest income quintiles, that is, the INECP measures have a gradual effect. The evaluation also shows a positive effect on the most vulnerable consumers, since energy expenditure represents a higher percentage of their disposable income.

Finally, the health benefits to individuals of the measures identified to achieve climate and energy goals have been analysed: in particular, the improvements that result from the reduction of atmospheric pollutants emitted as a result of burning fossil fuels. According to the analysis carried out, **a decrease of around 2,400 premature deaths** is expected in 2030 compared to the Baseline Scenario, with the corresponding economic co-benefits in terms of public health.

Establishing the Plan

The process for establishing the INECP was facilitated by including the energy, climate change and environment areas of competence in a Ministry for Ecological Transition and Demographic Challenge; this has made it possible to align energy and climate change policies and strengthened the governance of the transition. With this starting point and in order to make progress in the five dimensions considered in the Plan, the following steps have been performed:

First, this Plan was considered to be a key element for Spain to adequately and responsibly fulfil the requirements arising from the **Paris Agreement**.

Second, the complete interrelationship and consistency between this Plan and the **2050 Low Emission Strategy** for the Spanish economy, a long-term decarbonisation roadmap that Spain will present this year, 2019, as a result of the obligations assumed by the European Union under the Paris Agreement. In this way, the medium (2030) and long-term (2050) approaches are aligned.

Third, the Plan is presented as part of the Energy and Climate Strategic Framework, accompanied by the **Climate Change and Energy Transition Bill**, which sets minimum targets for emissions reductions for 2030 and 2050, providing predictability and a sense of direction. It is also accompanied by the **Just Transition Strategy**, which, based on solidarity, is designed to anticipate and manage the consequences on those regions and people directly linked to technologies that will be progressively displaced as a result of the energy transition promoted by this Plan.

In addition, the aforementioned **National Strategy against Energy Poverty** has been designed. In this way, and through these five regulatory and policy documents, Spain has provided itself with a complete **Strategic Framework**, laying the foundations for an orderly transformation of the economy and society towards an economically more efficient, and more socially just system, with lower polluting and GHG emissions.

Fourth, the involvement of the different ministries has been sought and achieved through the establishment and regular meetings of the **Interministerial Commission on Climate Change and Energy Transition**, as well as through numerous specific bilateral meetings to discuss and assess the measures and instruments necessary to achieve the objectives of the Plan.

Fifth, coordination with the autonomous communities has been – and will continue to be – encouraged through the **Climate Change Policy Coordination Commission**, in order to identify the interlinkages of this Plan with regional policies, seeking the full involvement of each area of the administration in order to meet its objectives.

Sixth, an extensive participatory process aimed at presenting and communicating the Plan has been carried out, which has revolved around the following elements. Firstly, the **Public Consultation** on the INECP in March and April 2019, which resulted in almost 1,200 comments. Secondly, numerous meetings were held during the second half of 2018 and throughout 2019 with business entities and social and environmental organisations on different aspects related to the Plan. Thirdly, during the first half of 2019, the INECP was presented at a number of public events in which business organisations, trade unions, environmental NGOs and other civil society organisations participated; the needs and opportunities linked to the development of the plan were discussed and explored at these events.

Seventh, the National Plan is also linked to the other major aspect of climate change, namely **adaptation** to the pressures and impacts arising from it (see Annex C for a detailed list of current climate policies in Spain). At the same time, when deploying the significant developments in renewable technologies set out in the Plan, Spain will ensure that it will responsibly **protect its natural heritage**, **particularly by protecting its biodiversity,** which is one of the richest and most valuable in the European Union.

In particular, the implementation of the Plan will take into account the specific measures for the conservation of habitats and species of Community interest that are listed in the management plans for Natura 2000 sites in the autonomous communities. In addition, plans for the reintroduction, conservation and recovery of threatened species at national and autonomous community level will be taken into account, so that the necessary development of renewable technologies foreseen in this INECP is complemented by and in balance with the necessary protection of biological diversity and ecosystem services. **In this respect, the Plan is intended to achieve a harmonious interaction with the Strategic Plan for Natural Heritage and Biodiversity, as well as with the Strategic Plan for the Conservation and Wise Use of Wetlands.**

The measures in the Plan related to the development of water resources will take into consideration the **protection of public water resources**, as well as the status of water bodies. In particular, measures that may affect river systems will have to reconcile planning for the sustainable development of water resources with the **conservation of aquatic ecosystems**.

Eighth, this National Plan is also complemented by the Circular Economy Strategy, which was approved in 2019. The relationships between decarbonisation and the circular economy will, however, be addressed in detail as part of the 2050 Long-Term Strategy.

Ninth, one of the risks of greatest concern to industry in the European Union in relation to climate action is that regulation and the current and future price signals to reduce greenhouse gas emissions will damage its competitiveness if its relative production costs are increased and equivalent measures are not introduced in third countries. This risk is higher for those sectors that are energy-intensive and more open to global competition. Aware of this risk, the European Union has established that the sectors considered to be exposed can receive special treatment so as not to affect their competitiveness. To this end, it drew up a list of sectors included in the CO_2 market (EU ETS). Installations active in these sectors received a higher share of free allowances than other industrial installations in the period 2013-2020, significantly reducing their costs of participating in the EU ETS.

Recently, with a view to the implementation of the EU ETS in the period 2021-2030, the European Commission has prepared an updated list and has decided to maintain the free allocation of emission allowances until 2030. Likewise, Member States have the possibility of compensating the electricity-intensive sectors through state aid programmes to reimburse them for the indirect costs associated with the impact of the price of the emission allowance on electricity. In this regard, it continues to be acknowledged that there is a risk that emissions will be transferred to other regions (carbon leakage), and measures are taken to prevent this risk from materialising.

Tenth, **the Plan has a strong commitment to a gender perspective.** According to recent studies by the International Renewable Energy Agency (IRENA), it is estimated that the percentage of women in all renewable energy jobs internationally is 32%, while the percentage in Spain is 26%. This is a lower percentage than for the economy as a whole and is similar to the percentage in industry as a whole. Given the competition between sectors of the economy to attract talent, the fact that the number of graduates or postgraduates in technical subjects remains constant in Europe, and the need for a skilled workforce in order to implement the Plan, it is clear that the participation of women on equal conditions will increase in the renewable energy sector.

Eleventh, the INECP 2021-2030 is fully connected to the **Sustainable Development Goals** (SDG) agenda. Although the Plan has a particularly direct impact on SDGs 7 and 13 (affordable and clean energy for all and climate action, respectively), interactions with the other SDGs are important, as explained in Annex E, in which the actions envisaged in this Plan are linked to the different Sustainable Development Goals.

Finally, regarding the **analytical basis of the Plan**, a large team of experts was set up with people from different departments of MITECO, which in turn received technical assistance from academic and advanced research centres with extensive experience and knowledge in the fields of economics, energy and climate change, as well as the important collaboration of REE.

1.2 OVERVIEW OF CURRENT POLICY SITUATION

The framework for climate and energy policy in Spain is determined by the international context and European Union policy. In this framework, the Paris Agreement, reached in 2015, is particularly important; it is aimed at maintaining the global average temperature increase below 2 °C compared to pre-industrial levels, and to make efforts to limit it to 1.5 °C[8]. The EU ratified the Agreement in October 2016 (which allowed its entry into force in November 2016) and Spain followed in 2017. The entry into force of this Agreement gave new impetus to energy and climate change policies.

1.2.1 Energy and Climate in the European Union

With a view to the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC), the European Council agreed on the 2030 EU climate and energy policy framework in October 2014. Taking into account this time frame, it set a target of reducing GHG emissions by at least 40% compared to 1990 levels. In addition, amendments were proposed to the **European Union Emissions Trading Scheme** (EU ETS) and measures for sectors not subject to this scheme were proposed, as well as targets for the share of renewables in final energy consumption, improved energy efficiency and interconnections.

In order to achieve these objectives, to accelerate the transition to a low-carbon economy, to comply with the Paris Agreement and to move towards the achievement of the Energy Union in its five dimensions (decarbonisation, energy efficiency, energy security, internal market and RIC), the European Commission prepared a series of legislative proposals presented in 2015 and 2016:

- review of the emissions trading legislative framework for its next trading period (phase 4);
- effort-sharing between the Member States in order to meet the common objective of reducing emissions in sectors not covered by the Emissions Trading Directive (proposal for an EU Regulation);
- inclusion of GHGs and sinks from land use, land-use change and forestry (LULUCF), in the Climate and Energy 2030 framework (proposal for an EU Regulation);
- the set of proposals known as the ‘winter package’[9] that included reviews and legislative proposals on energy efficiency, buildings, renewable energies, electricity market design, security of supply and governance rules for the Energy Union.

The European institutions have already approved most of the aforementioned proposals; these include reviews of and legislative proposals on energy efficiency[10], renewable energy[11], electricity market design[12], security of supply and governance rules for the Energy Union[13].

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[8] The latest report of the Intergovernmental Panel on Climate Change confirmed that the observed increase in the average temperature of the planet exceeds 1 °C compared to the average temperature of the pre-industrial era.

[9] Clean Energy for All Europeans; COM(2016) 860 final.

[10] Directive (EU) 2018/2002 of the European Parliament and of the Council of 11 December 2018 amending Directive 2012/27/EU on energy efficiency.

[11] Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources.

[12] Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU (Text with EEA relevance).

[13] Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and

This new regulatory framework provides regulatory certainty and favourable conditions for investment to take place, empowers European consumers to become players in the energy transition and sets binding targets for the EU by 2030[14]:

- 40% reduction in greenhouse gas (GHG) emissions compared to 1990;
- 32% share of renewable energy in total gross final energy consumption;
- 32.5% improvement in energy efficiency;
- 15% electricity interconnection between the Member States.

As regards the other dimensions of the Energy Union, it should be noted that the form of action in the event of supply limitations is defined under energy security, and objectives are set in order to increase the diversification of energy and supply sources, as well as to reduce energy imports. In the case of Spain, given the prevalence of fossil fuels in the national energy system, it is characterised by high energy dependency, which reaches 73%, well above the EU average (54%). On the positive side, Spain has one of the highest levels of diversification of gas and oil suppliers in Europe. With regard to the internal market, the electricity interconnection target for Member States is set at 15% by 2030.

In research, innovation and competitiveness, national and financing objectives are set for both public and private research and innovation. Finally, with a view to 2050, on 28 November 2018 the European Commission updated its roadmap towards decarbonisation of the economy with the intention of making the European Union carbon neutral **by 2050**[15] (zero net GHG emissions).

1.2.2 Current energy and climate policies and measures relating to the five dimensions of the Energy Union

Decarbonisation of the economy

The decarbonisation policies and measures developed to date are part of the Spanish Strategy on Climate Change and Clean Energy, which was approved by the Council of Ministers on 2 November 2007 and designed for the period to 2020. Subsequently, the entry into force of the new European framework with the definition of objectives for 2020 resulted in an expansion of the aforementioned strategy with new planning instruments, which are listed below (see links to the documents):

- Road map to 2020 for the non-ETS sectors.[16, 17]
- Information on actions in the land use, land use change and forestry sector in Spain[18].
- Report on progress made in the implementation of actions in the land use, land use change and forestry sector in Spain[19].

2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council.

[14] The targets for renewable energy, energy efficiency and electricity interconnection may be revised upwards in 2023.

[15] Communication from the Commission, COM(2018) 773 final, '*A Clean Planet for all. A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy*'.

[16] https://www.miteco.gob.es/images/es/Hoja%20de%20Ruta%202020_tcm30-178253.pdf

[17] https://www.miteco.gob.es/images/es/HojaRuta2020_Fichas_tcm30-178314.pdf

[18] https://www.miteco.gob.es/images/es/acciones_lulucf_espana_def_tcm30-178767.pdf

[19] https://www.miteco.gob.es/images/es/informe_progreso_utucts_es_2017_tcm30-178397.pdf

- National Plan for Adaptation to Climate Change.[20]
- Third work programme of the National Plan for Adaptation to Climate Change.[21]

In the case of GHGs in **non-ETS sectors** (residential, transport, agriculture, waste, fluorinated gases and industry not subject to emissions trading), this capacity was reflected in the Roadmap to 2020 for non-ETS sectors, which was published in September 2014. It consists of an analysis of future emission scenarios and their comparison with the objectives arising from the EU Effort Sharing Decision (Decision No 406/2009/EC), specifically with the objective of reducing non-ETS emissions by 10% in 2020 compared to 2005 levels. The analyses carried out have made it possible to identify the existing gap to achieving this reduction commitment. Accordingly, options and additional action measures are being considered. If they are implemented with the appropriate degree of intensity, they will allow Spain to meet the 2020 objectives in a cost-efficient manner.

The existing policies and measures at national level which have been adopted and/or implemented to date aimed at decarbonisation or which have an impact on GHG reduction, are spread among different sectors and departments. The detailed list of these can be found in Annex C. In addition, there are autonomous communities and local authorities that have put in place ambitious energy and climate plans and measures within their areas of competence.

It is important to note the implementation in non-ETS sectors of the **Climate Projects** promoted through the **Carbon Fund for a Sustainable Economy** (FES-CO_2) and designed to forge a path of transformation for the Spanish productive system towards a low-carbon model, as well as the **Environmental Promotion Plans** (PIMA), which are measures to combat climate change at a national level. The creation of a tax on fluorinated gases that has allowed a rapid transformation in this sector by drastically reducing its emissions is equally noteworthy.

As regards the sectors subject to emission rights trading, the European scheme is regulated by Law 1/2005 of 9 March 2005 as well as by various Royal Decrees that implement it. This scheme affects around **900 industrial and electricity-generation facilities in Spain.** Spain has also been assigned the management of more than 30 active air operators, approximately half of which are foreign.

In the field of renewables, the **Renewable Energy Plan (*Plan de Energías Renovables*, PER) 2011-2020** in force sets targets in accordance with Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources. The PER sets the target of achieving **at least 20.8% of gross final energy consumption from renewable sources by 2020** (39% of total electricity consumption) and a contribution from these sources to the energy consumption of **transport of 11.3%** in the same year, thus exceeding the mandatory minimum targets established for Spain in the Renewable Energy Directive.

In our country, the regulation of the electricity system has undergone continuous regulatory changes, which led to reforms aimed at guaranteeing the economic and financial sustainability of the system in the long term, with the aim of containing the growing tariff deficit. The approval of a global reform of the sector, based on a new income and expenditure system for the different

[20] https://www.miteco.gob.es/es/cambio-climatico/temas/impactos-vulnerabilidad-y-adaptacion/pna_v3_tcm7-12445_tcm30-70393.pdf

[21] https://www.miteco.gob.es/es/cambio-climatico/temas/impactos-vulnerabilidad-y-adaptacion/3PT-PNACC-enero-2014_tcm30-70397.pdf

players in the electricity system, adjusted the remuneration for electricity generation technologies using renewable energy sources, cogeneration and waste and initially discouraged new developments.

However, the need to meet the aforementioned renewable energy objective in 2020 gave a new impetus to their deployment. To this end, a specific remuneration scheme was established in order to encourage production from renewable energy sources, high efficiency cogeneration and waste on the basis of competitive tendering procedures (auctions). Therefore, in 2016 notice was given of the first auction for the specific remuneration scheme for new installations producing electricity from renewable energy sources in the mainland's electricity system. Since then, two more auctions have been carried out and **9,292.4 MW of new renewable capacity** have been assigned as a result.

Likewise, with the approval of **Royal Decree-Law 15/2018**, an exceptional extension was granted to the access permits and electrical connection of renewable energies previously granted that would otherwise have expired on 31 December 2018. By means of this extension, it will be possible to begin operating the renewable installed capacity awarded in the latest auctions in 2020 and contribute to achieving the 20% target by that year.

Additionally, the policy of promoting renewable energies develops and strengthens existing synergies with other measures recently approved in the aforementioned Royal Decree-Law 15/2018 aimed at improving the protection of energy consumers, promoting sustainable mobility through electric vehicles, liberalising recharge activity and boosting renewable electricity own consumption.

With regard to the last point, it should be noted that in Spain own consumption has barely taken off yet, owing to the existence of a series of regulatory barriers that have hindered its economic viability. However, Royal Decree 244/2019, regulating the administrative, technical and economic conditions for own consumption of electricity, aims to make it easier for consumers to obtain cleaner energy at a lower cost.

For its part, support for renewable energy sources for heating, cooling and off-grid electricity generation is mainly put into practice through subsidies for installed capacity from the autonomous communities. In addition, with respect to financial aid for renewable energy, existing programmes for financing projects have continued; these are mostly managed by the IDAE of MITECO. These are integrated actions aimed at promoting the use of renewable energies (solar, biomass and geothermal energy) in the residential and tertiary sectors and encouraging energy savings and the improvement of energy efficiency in existing buildings.

The promotion of the use of biofuels was given fresh momentum most recently in late 2015 (Royal Decree 1085/2015 of 4 December 2015 on the promotion of biofuels) through new minimum and mandatory annual sales or consumption targets (4.3%, 5%, 6%, 7% and 8.5%, for the years 2016, 2017, 2018, 2019 and 2020, respectively). Obligated undertakings can achieve them in a flexible manner through biofuel certificates for either diesel or gasoline.

Finally, it should be noted that among recent initiatives to reduce emissions, a **framework agreement for the coal sector** was reached and signed on 24 October 2018 between the Government, trade unions and representatives of the sector. The main objective of this agreement was **to promote a just transition from coal mining and to promote the sustainable development of mining regions during the 2019-2027 period.** The agreement responds to social repercussions arising from compliance with Decision 2010/787/EU of the European Council, which requires the closure of coal mines in European Union territory or, otherwise, the return of State aid received in the 2011-2018 period.

Energy efficiency

The energy efficiency policy is implemented through the **National Energy Efficiency Action Plan 2017-2020** (which follows on from the National Energy Efficiency Action Plan 2014-2020), which was sent to Brussels in April 2017. This meets the requirement of Article 24(2) of the Energy Efficiency Directive 2012/27/EU of the European Parliament and the Council of 25 October 2012, which requires all Member States of the European Union to submit the first plan by 30 April 2014, and every three years thereafter.

Current measures to promote energy efficiency include a range of legislative and/or economic support actions, aimed at producing a general or specific impact on each consumption sector. The most important structural decision was the establishment of the system of energy efficiency obligations, together with the creation of the **National Energy Efficiency Fund** (FNEE), in order to finance national energy efficiency initiatives (as provided in Royal Decree-Law 8/2014 of 4 July 2014 approving urgent measures for growth, competitiveness and efficiency ratified by Law 18/2014 of 15 October 2014).

The FNEE, which is led by its Monitoring and Control Committee, an interdepartmental body in which the main ministries with competences in this area are represented, is managed by the IDAE. Its purpose is to finance support mechanisms for economic and financial aid, technical assistance, training, information or other measures to increase energy efficiency in the different energy-consuming sectors, in a way that contributes to achieving the national energy-saving target established by the national system of obligations provided for in Article 7 of the Energy Efficiency Directive. This Fund coordinates efficiency measures through calls for proposals co-financed with Structural Funds.

The promotion of energy efficiency in cities has had two main components or lines of action: buildings, on the one hand, and mobility of passengers and goods on the other. The actions to improve energy efficiency of buildings form part of the **long-term strategy for energy upgrading in the building sector in Spain (ERESEE)**, which includes different pieces of legislation. For example, the Technical Building Code[22] (CTE), the Regulation of Thermal Installations in Buildings[23] (RITE) or the Energy Certification System for Buildings,[24] among others. At present, both the CTE and the RITE are being updated as they are scheduled to be updated every five years, and, also to include the new requirements arising from the amendments to the Energy Efficiency Directive (2018/2002/EU) and the Energy Efficiency in Buildings Directive (2018/844/EU).

Within the building sector, the **Aid Programme for the energy upgrading of existing buildings** (PAREER-CRECE Programme) and the JESSICA-FIDAE Fund, which are both managed by the IDAE, are significant. The latter has funded urban projects for energy efficiency and the use of renewable energies.

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[22] Royal Decree 314/2006 of 17 March 2006 approving the Technical Building Code.

[23] Royal Decree 1027/2007 of 20 July 2007 updated by Royal Decree 238/2013 of 5 April 2013 amending certain articles and technical instructions of the RITE.

[24] Royal Decree 235/2013 of 5 April 2013 approving the basic procedure for the certification of the energy efficiency of buildings.

Energy efficiency in cities is coordinated by the public administration through integrated sustainable urban development strategies (SUDS) aimed at urban functional areas.

Actions to improve energy efficiency in transport and sustainable mobility in cities have been aimed at encouraging the modal shift in the mobility of people and goods towards modes that consume less energy per passenger-km or tonne-km; the use of information and communication technologies (ICT) is one of the pillars for the promotion of new mobility services. These also included actions aimed at improving the efficiency of the fleet of vehicles through fleet renewal, especially of last-mile urban distribution vehicles, the gradual incorporation of electric vehicles and other technological advances, as well as actions aimed at the efficient use of the modes of transport.

Additionally, the promotion of high-efficiency cogeneration and urban heating and cooling networks, as well as energy-efficiency measures in transformation, transport, distribution and demand-side participation have been part of the comprehensive strategy for energy-efficiency in cities.

For its part, energy-efficiency in non-urban environments and, therefore, in sectors other than those of construction or transport has benefited from support measures tailored to the specificities of each sector. A policy of financial support for industrial investment has prevailed in industry within the framework of public policy to promote competitiveness. In addition, there have been and currently are aid programmes for SMEs and large companies that are funded by the FNEE. These programmes aim to encourage and promote the performance of actions in the industrial sector that reduce carbon dioxide emissions by improving energy efficiency.

In short, the implementation of measures of the National Action Plan for Energy Efficiency 2017-2020 and previous plans contributed to an improvement in energy efficiency, which was reflected during the period 2004 to 2016 and **quantified as an annual decrease of 2% in final energy intensity.**

Energy Security

As has already been indicated, Spain depends heavily on foreign sources for energy – 73% in 2017 – due to the prevalence in its energy mix of fossil fuels that have to be imported in their entirety, given that national production is almost nil. The imports of hydrocarbons are, therefore, very important in the field of energy security, which is understood as security of supply.

The presence of natural gas in Spain's energy balance is slightly lower than in other EU Member States, due to a milder climate, resulting in a lower penetration of natural gas among domestic consumers and central heating.

As for petroleum products, their presence in the national energy mix is much higher than the EU average, for the following reasons:

- high development of freight transport by road to the detriment of rail transport (2% on average in Spain, compared to an average of 17% in the EU);
- significant consumption of maritime transport compared to Member States that are almost landlocked;

- significant consumption of air transport due to the highly important tourism sector.

With reference to the national production of hydrocarbons, it should be noted that this is practically non-existent. Data for 2017 are as follows:

- Domestic production of natural gas (2017): 23 ktoe (0.09% of needs).
- Domestic crude production (2017): 122,000 tonnes (0.21% of needs).

The main countries of origin for the different sources of energy are the following:

- Electricity: Spain has electricity interconnections with France, Portugal and Morocco.
- Natural gas: in 2017, 53% of imports were made through gas pipelines, compared to 47% in methane tankers (in the form of Liquefied Natural Gas through regasification plants). Currently, the most important international pipelines are Maghreb (Maghreb-Europe), Medgaz (Algeria-Almeria) and the interconnections with France and Portugal. The breakdown of imports of natural gas in 2017 by country of origin was as follows:
    - Algeria (48%)
    - Nigeria (12%)
    - Peru (10%)
    - Qatar (10%)
    - Norway (10%)
    - Other (10%)
- Petroleum products: the main countries of origin for crude oil in 2017 were the following:
    - Mexico (15%)
    - Nigeria (14%)
    - Saudi Arabia (10%)

In view of the foregoing, the relative dependence on the imports of natural gas from Algeria can be highlighted as a possible risk, which is offset by the high level of imports by methane tankers from a wide range of countries of origin.

It may be concluded that Spain has one of the highest levels of diversification of gas and petroleum suppliers in Europe.

Finally, it should be pointed out that regional cooperation for energy supply is an essential element in the stability and prosperity of the countries and regions surrounding Spain. They are the cornerstones of the regional cooperation platform ‘Union for the Mediterranean’, of which Spain is a member. In this connection, at its Ministerial Conference in Italy (1 December 2017), three new energy platforms were approved: one for the gas market, another for the regional electricity market, and a third focused on renewable energy and energy efficiency. The objective was to organise and strengthen dialogue between the Member States of the Mediterranean region, their financial institutions, experts, regional organisations and industry.

Internal energy market: interconnectivity, infrastructure and market

Planning of the electricity transmission infrastructure is governed by the **2015-2020 Electricity transmission network development plan**, which includes the necessary infrastructure to guarantee security of supply in the 2015-2020 planning horizon. It introduces environmental and economic efficiency criteria and establishes security and reliability requirements for the electricity grid, with the aim of increasing the international connection capacity and, as a result, the integration of Spain in the single energy market.

The current plan integrates renewable energies into the network, in order to facilitate the achievement of the targets in this area for 2020, and it is adapted to the demand needs arising from new industrial activity. Investments associated with electricity infrastructure planned for the 2020 horizon are estimated to total EUR 4.554 billion, with an average annual investment of EUR 759 million, of which EUR 143 million are expected to be recovered from ERDF Funds throughout the period.

With reference to cross-border electricity interconnections, work that has been carried out to extend the interconnections with France involved putting a new line into service in the east of the Pyrenees. This has doubled the electricity exchange capacity between Spain and France (from 1,400 MW to 2,800 MW). It has helped to strengthen the security of the two electricity systems and to facilitate the integration of a greater volume of renewable energy, especially wind power from the Iberian system.

However, despite this expansion, the level of electricity interconnection between Spain and France is less than 3% of installed electricity production capacity in Spain. This falls far short of the targets of the Energy Union: **10% of installed electricity production capacity for all Member States by 2020 and 15% by 2030.** With the interconnections planned to date, in 2020 Spain will be one of few European countries with a level of interconnection below 10%. It will therefore be necessary to continue developing new interconnections.

To this end, and in the framework of collaboration initiated with the 2015 Madrid Summit, an increase in the interconnection capacity with France is planned with the following extensions:

- an interconnection between Aquitaine (FR) and the Basque Country (ES), through a submarine cable through the Bay of Biscay, which will allow the interconnection capacity between Spain and France to reach 5,000 MW;
- an interconnection between Aragon (ES) and Pyrénées-Atlantiques (FR) and an interconnection between Navarre (ES) and Landas (FR), which will increase the interconnection capacity between Spain and France to 8,000 MW.

The future planning of the natural gas transmission infrastructure will be carried out once the new regulatory development of the hydrocarbon sector is approved. This will include the procedure for it. So far, the basic regulation is contained in Law 34/1998 of 7 October 1998 on the Hydrocarbons Sector, as well as in the provisions of Articles 79 and 80 of Law 2/2011 of 4 March 2011 on sustainable economy. The reference document is the Plan for the electricity and gas sectors 2008-2016, approved on 30 May 2008 by an Agreement of the Council of Ministers. This document, based on an analysis of the sector and demand forecasts, establishes criteria for developing the basic natural gas network, points of entry, and technical criteria for the design of gas pipelines and storage capacity. In this current plan, the need for new transmission capacity, storage and regasification infrastructure is analysed and identified, designing the main aspects in such a way that a safe and flexible system is established whereby all the gas zones are connected.

With regard to the organisation of the market, Directive 2009/72/EC concerning common rules for the internal market in electricity and Directive 2009/73/EC concerning common rules for the internal market in natural gas provide that if the internal markets in electricity and natural gas are to function properly, **energy regulators need to be able to take decisions in relation to all relevant regulatory issues and to be independent from any other public or private interests**. The European regulatory framework establishes that the regulatory authority shall, inter alia, promote a competitive, flexible, secure and environmentally sustainable internal market; support the development of consumer-oriented systems; encourage energy efficiency and the integration of large and small-scale renewable energy; and ensure that operators and users are granted appropriate incentives to increase energy efficiency. It also states that the regulatory authority's tasks include monitoring the market opening and competition in wholesale and retail markets, as well as removing barriers to the development of own consumption or consumer's access to their own data.

Therefore, Royal Decree-Law 1/2019 of 11 January 2019 on urgent measures to adapt the powers of the National Commission on Markets and Competition to the requirements of EU law, in relation to Directives 2009/72/EC and 2009/73/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in electricity and natural gas, distributed competences in accordance with the EU framework and provided the **National Commission on Markets and Competition (CNMC) with the independence and powers necessary for the exercise of its functions**. Royal Decree-Law 1/2019 establishes that, among other things, the CNMC is responsible for setting the remuneration of the electricity system operator and the technical manager of the gas system, adopting the methodology, remuneration criteria, the regulatory asset base and the current remuneration of gas and electricity transmission and distribution activities; it is also responsible for certain aspects of conditions for access and connection to the electricity and natural gas distribution and transmission networks, and the rules for the operation of the organised markets as regards their regulated component.

Furthermore, in the context of the current energy transition, it is necessary to adopt a clear, stable and predictable regulatory and institutional framework that provides legal certainty to natural and legal persons related to the energy sector; this framework should apply to both vulnerable groups and national and international investors. Therefore, the aforementioned Royal Decree-Law 1/2019 also provides that, prior to the approval of the circulars, MITECO may issue a report on the appropriateness of the proposal in relation to the energy policy guidelines established by the Government, as well as the mechanisms for cooperation with the CNMC in the event of disputes. Indeed, effective cooperation is the key to the development of a clear, stable and predictable regulatory and institutional framework and to providing coherent signals to operators, consumers and investors, in order to achieve the objectives set out in the Clean Energy for All Europeans regulatory framework and in this Plan.

In accordance with the amendments introduced by the aforementioned Royal Decree-Law, in Article 3 and Article 16 of Law 24/2013 of 26 December 2013 on the Electricity Sector:

- The General State Administration will be responsible for regulating the structure of the charges for regulated costs and the charges necessary to cover other electricity system costs.

- MITECO, following an agreement of the Government Delegated Committee for Economic Affairs, will make the necessary arrangements to set the necessary charges, which will be established in accordance with the methodology foreseen to cover the costs of the relevant activities of the system.
- Following a report from the CNMC, the Government will establish the methodology for calculating the charges to be paid by consumers and, where appropriate, by electricity producers. The charges will cover the systems costs determined, without prejudice to the provisions for transmission and distribution tariffs.

Finally, it should be noted that both Royal Decrees are going through parliament; they should regulate the methodology for calculating charges in the electricity and hydrocarbon sectors and establish the variables used to distribute these costs, to ensure that distribution is not discriminatory and complies with the energy policies promoted by the Government. In other words, they should promote efficiency, the decarbonisation of the economy and a just energy transition.

Research, innovation and competitiveness

The MCI is the department of the General State Administration responsible for implementing policy on scientific research, technological development and innovation in all sectors. For this reason, it is responsible for implementing RIC policy in the energy sector and coordinating all the involved agents.

The framework for action in the field of research, development and innovation is defined in two key documents on science, technology and innovation policy: **the Spanish Strategy for Science, Technology and Innovation 2013-2020 (EECTI) and the State Plans for scientific and technical research and innovation.**

The Spanish Strategy for Science, Technology and Innovation 2013-2020 (EECTI) is the instrument that sets out the general objectives to be achieved during the 2013-2020 period relating to the promotion and development of RDI activities in Spain. These objectives are in line with those established by the European Union within the framework programme for financing RDI activities '**Horizon 2020**' for the period 2014-2020, helping to encourage the active participation of the actors of the **Spanish Science, Technology and Innovation System** in the European area. It also includes coordination between the actions of the General State Administration, the autonomous communities and the European Union, at the same time as proposing efficient mechanisms of coordination between the actors of the abovementioned Spanish Science, Technology and Innovation System.

The EECTI establishes priority areas that cover the entire process of development and application of scientific and technological research 'from idea to the market'. Its objectives include guidance on scientific and technical research, technological development and innovation concerning major challenges for Spanish society: health; ageing; the implementation and upholding of the principles of inclusion of the most fragile segments of our society; environmental sustainability; resilience to climate change; energy supply; biodiversity; the transformation of our political and social systems; and the safety of our citizens.

One of the objectives of the EECTI is to guide RIC activities, including fundamental scientific and technical research, technological development and innovation, towards eight major areas that involve important markets for the development of new products and services: 1. Health, demographic change and well-being; 2. Food security and quality; productive and sustainable agricultural activity; sustainability of natural resources, marine and maritime research; 3. Safe, sustainable and clean energy; 4. Intelligent, sustainable and integrated transport; 5. Action on climate change and efficiency in the use of resources and raw materials; 6. Social change and innovation; 7. Digital economy and society; 8. Security, protection and defence.

The State plans for scientific and technical research and innovation, which were prepared by the MCI, with contributions from public research centres, universities, technology centres, business associations, technology platforms and experts from the scientific, technical and business community, are the specific implementation of the abovementioned Strategy 2013-2020. The 2017-2020 Plan (PEICTI 2017-2020), which was approved by the Council of Ministers in December 2017, as well as the plan covering the 2013-2016 period, is made up of four state programmes that correspond to the general objectives established in the Strategy: the promotion of talent and employability; the generation of knowledge and strengthening of the system; business leadership in RDI; and RDI aimed at the challenges facing society.

Finally, within the framework of the European Union's Partnership Agreement with Spain 2014-2020, the Spanish Strategy for Science, Technology and Innovation and the State plans for scientific and technical research and innovation jointly define the national framework for smart specialisation (RIS3), on which the autonomous communities base their research and innovation strategies for smart specialisation.

The Spanish Strategy for Science, Technology and Innovation 2013-2020 is supplemented with sectoral policies. In this regard, coordination is established with the Spanish Strategy for climate change and clean energy, which seeks to fulfil Spain's commitments on climate change and promoting clean energies while improving social welfare, economic growth and environmental protection.

Spain is undergoing a cost-effective energy transformation that allows it to achieve the European targets for GHG emission reduction and decarbonisation of the economy, in accordance with the provisions of the Europe 2020 Strategy and its flagship initiative 'A resource-efficient Europe', which ensures supply and economic growth in Europe, with research and innovation as one of its fundamental pillars.

The SET Plan plays a major role in this process. In September 2015, the Communication from the Commission **'Towards an Integrated Strategic Energy Technology (SET) Plan: Accelerating the European Energy System Transformation'** proposed 10 key actions in line with the priorities of the Energy Union and its fifth pillar on research, innovation and competitiveness. The proposal sought a definitive change in the concept of the European energy system, proposing an integrated system that would move beyond the silos of energy technologies which had been the focus previously.

Spain also cooperates with other Member States through transnational technology cooperation programmes:

- Eureka, and bilateral cooperation programmes, in which the participation of Spanish companies is financed by the CDTI, by means of loans with a non-reimbursable instalment through a non-competitive call that is open all year round.

- Eurostars, for R&I-intensive SMEs. The CDTI provides funding via subsidies in a competitive call for applications. It has set closing dates.
- ERA-Net Cofund scheme, which allows different types of entities to participate in competitive calls for proposals and funds them through grants. It has set closing dates.
- Horizon 2020, open to participation by all types of entities. Annual competitive calls for proposals with set closing dates and funding via grants.

Research and innovation policies are proposed and implemented by the units responsible for funding activities proposed by the Ministry. The Spanish Strategy for Science, Technology and Innovation and its State Plans for RDI are used in implementing them. These include activities such as:

The **AEI**, which was created by Royal Decree 1067/2015 of 27 November 2015 with the aim of being the instrument used to modernise public management of state R&D policies in Spain, is responsible for financing, evaluating, awarding and monitoring scientific and technical research activities. The AEI manages the following programmes of the State Plan: the State programme for the promotion of talent and its employability; the State programme for knowledge generation and institutional and technological strengthening; and the State RIC Programme aimed at societal challenges.

The **CDTI**, a public business entity, which also functions under the MCI, aims to increase the competitiveness of Spanish companies by raising their technological level. It carries out activities to finance business RIC projects (State Programme for Business Leadership), as well as projects to manage and promote Spanish participation in international technological cooperation programmes and support for the creation and consolidation of technology-based companies.

In addition, the main bodies focused on implementing actions subsidised by the AEI are the Public Research Bodies, such as the **Spanish National Research Council (CSIC) or the CIEMAT**, which are attached to the MCI. Among the actions of the AEI, **Technological Platforms** are particularly important. These are forums for teamwork, led by the industry, which integrate all the agents of the Science-Technology-Innovation system (companies, technology centres, public research organisations, universities, R&I centres, associations, foundations, etc.), with the main objective of defining the short, medium and long-term vision of the sector and of establishing a strategic RIC path. Their objectives include:

- encouraging competitiveness, sustainability and growth in the industrial sector and the Spanish scientific-technological sector;
- being a mechanism of RIC transfer to the national and international market;
- directing the creation of jobs and innovative companies through projects and actions.

Finally, the non-profit energy initiative, ALINNE, should be mentioned. This initiative was created to combine and coordinate efforts among all the agents in the energy RIC value chain, in order to respond to the main challenges for RIC policy in the energy sector, thereby contributing to the definition of work guidelines at national level and a European position.

2 OBJECTIVES AND TARGETS

2.1 DECARBONISATION DIMENSION

As previously noted, Spain's long-term objective is to become a **carbon-neutral country by 2050**. For this purpose, a target was set to mitigate at least 90% of gross GHG emissions compared to the reference year 1990. In this sense, the emissions mitigation target for the year 2030 is at least 20% compared to 1990. As a result of the measures mentioned in this Plan, there will be a reduction from **340.2 $MtCO_2$-eq emitted in 2017 to 221.8 $MtCO_2$-eq in the year 2030**, which means that approximately one third of current emissions will be removed between the two years.

To be specific, in the decade between 2021 and 2030, and as a result of the application of the measures of this National Plan (see Chapter 3), the gross total emissions will decrease from 319.3 MtC_2-eq predicted for the year 2020 to 221.8 $MtCO_2$-eq in 2030. The sectors of the economy that will reduce their emissions most in absolute terms during that period are the following:

- electricity generation, 36 $MtCO_2$-eq
- mobility and transport, 27 $MtCO_2$-eq
- residential, commercial and institutional sectors, 10 $MtCO_2$-eq
- industry (combustion), 7 MtCO2-eq

Table 2.1. Evolution of emissions (thousands of tonnes of CO_2 equivalent)

Year	1990	2005	2015	2020*	2025*	2030*
Transport	59,199	102,310	83,197	87,058	77,651	59,875
Electricity generation	65,864	112,623	74,051	56,622	26,497	20,603
Industrial Sector (combustion)	45,099	68,598	40,462	37,736	33,293	30,462
Industrial sector (emissions from processes)	28,559	31,992	21,036	21,147	20,656	20,017
Residential, commercial and institutional sectors	**17,571**	31,124	28,135	28,464	23,764	18,397
Livestock farming	21,885	25,726	22,854	23,247	21,216	19,184
Crops	12,275	10,868	11,679	11,382	11,089	10,797
Waste	9,825	13,389	14,375	13,657	11,932	9,718
Refining industry	10,878	13,078	11,560	12,330	11,969	11,190
Other energy industries	2,161	1,020	782	825	760	760
Other sectors	9,082	11,729	11,991	12,552	11,805	11,120
Fugitive emissions	3,837	3,386	4,455	4,789	4,604	4,362
Product use	1,358	1,762	1,146	1,236	1,288	1,320
Fluorinated gases	64	11,465	10,086	8,267	6,152	4,037
Total	287,656	439,070	335,809	**319,312**	**262,675**	**221,844**

*The data for 2020, 2025 and 2030 are estimates of the Target Scenario of the INECP.

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

The planned decarbonisation in the electricity sector reduces emissions by **36 $MTCO_2$** equivalent. This reduction is the result, firstly, of **the substantial decrease in the importance of coal in electricity generation during the Plan period.** It is possible that nine of the fifteen coal-fired power plants currently in existence (2019) will not be operational at the beginning of the Plan in 2021. This will be as a result of the decision adopted by the companies owning them not to make investments that meet EU requirements regarding polluting emissions. This means that it is expected that at the beginning of the Plan six coal-fired power stations will still be active.

According to the Plan's forecasts, by 2030 coal-fired power stations **will no longer be competitive** given the expected increase in the price of a tonne of CO_2 in the European emissions trading system (EUR 35/tonne), the continued reduction in the costs of using renewable technologies to generate electricity and the relative price of gas. In any case, the transition in the sector will need to be accompanied by support measures for the affected regions in order to ensure that the process is carried out in a fair and supportive manner.

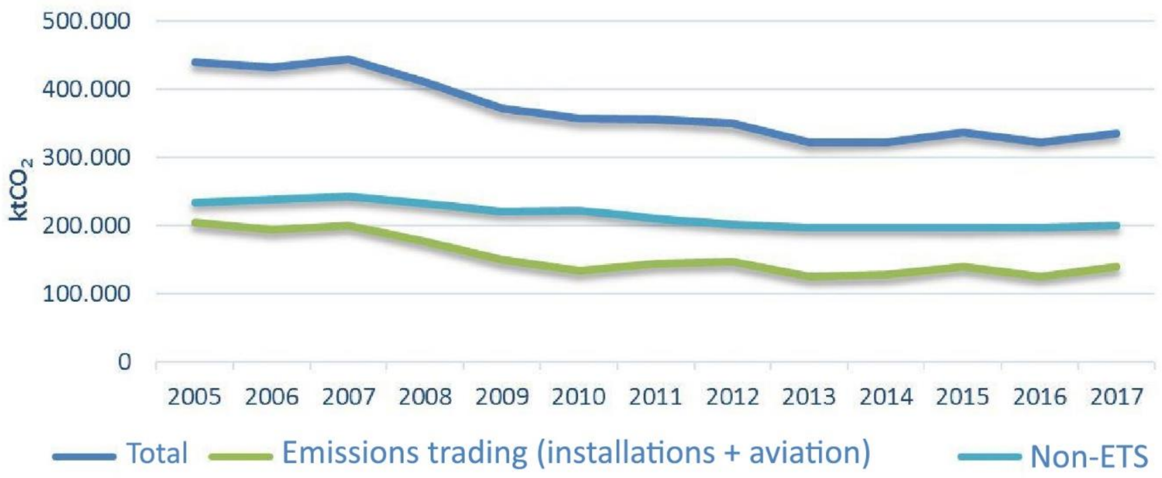
Secondly, the envisaged decarbonisation of the electricity sector will be the result of the significant penetration of renewable technologies set out in the Plan, which will gradually replace fossil fuel energy generation. Renewable electricity generation in 2030 will represent **74% of the total** consistent with a path towards a **100% renewable electricity sector by 2050**.

In the mobility-transport sector, the planned reduction is **27 Mt CO_2-eq**. Above all, this result is a consequence of the important modal shift from the conventional combustion vehicle to public, shared and non-emitting modes of transport, and as a result of the widespread **creation of low-emission zones in cities with more than 50,000 inhabitants starting from 2023**, in which it is planned that access for the most highly emitting and polluting vehicles will be limited. As a consequence of the implementation of the measures to promote the modal shift, it is estimated that **35% of passenger-kilometres that are currently travelled in conventional vehicles will shift to non-emitting forms of transport by 2030.** The expected result of the significant presence of **electric vehicles** by 2030 is: **5 million units**, including cars, vans, motorcycles and buses, as well as the use of **advanced biofuels**.

In the industry sector, all the emissions improvements are achieved in combustion processes, as there has been a slight increase in processes. Mitigation of **7 Mt CO_2-eq** will be achieved and is a consequence of the expected changes in the fuels used in the combustion processes, as well as the continuation of energy efficiency improvements. In the longer term, in the period to 2050, the decarbonisation of industry will require new technological advances that will come from RIC policies; such advances are envisaged in the 2050 Long-Term Low Emission Strategy.

The analysis of decarbonisation foreseen in the INECP is also addressed from the perspective of emissions that are part of the EU ETS system and the non-ETS emissions (residential, transport, agriculture, waste, fluorinated gases and industry not subject to emissions trading). As has already been mentioned, the gross GHG emissions for 2017 were 340.2 million tonnes of CO_2-eq. 39% of these corresponded to sectors covered by emissions trading and 61% to non-ETS sectors.

Figure 2.1. Spain GHG emissions (inventory) 2005-2017 ($ktCO_2$-eq)



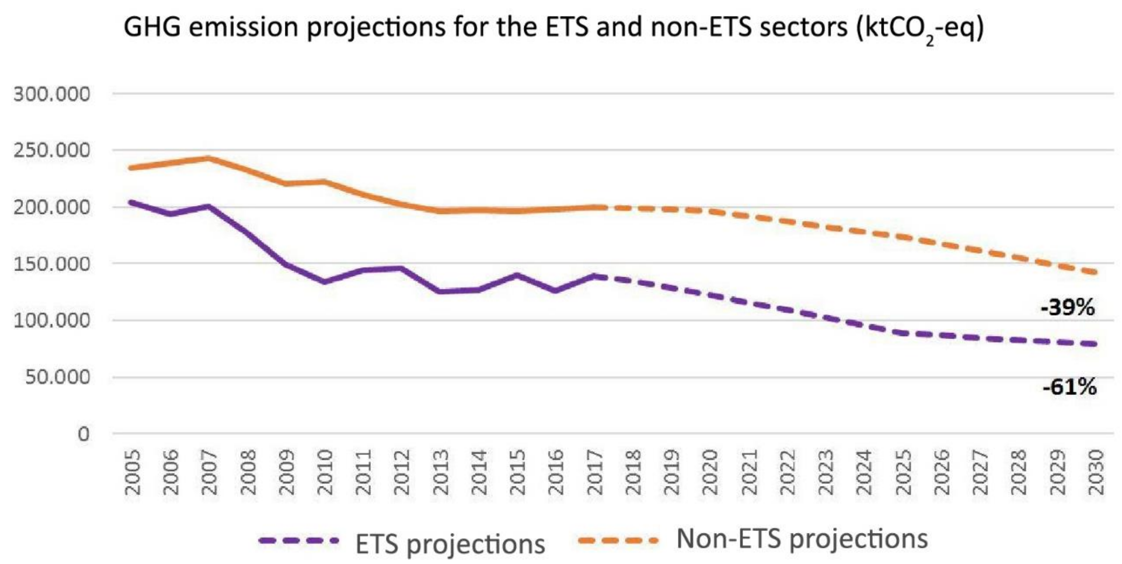
Source: Ministry for Ecological Transition and Demographic Challenge, 2019

The goals established in terms of GHG reduction in this National Plan not only meet the binding objectives set out in EU regulations, but also increase the level of ambition, thereby contributing to the achievement of the emissions reduction target in the European Union as a whole, as well as international commitments which the European Union and Spain have undertaken.

The Plan envisages a **23%** reduction in **GHGs compared to 1990 levels**.

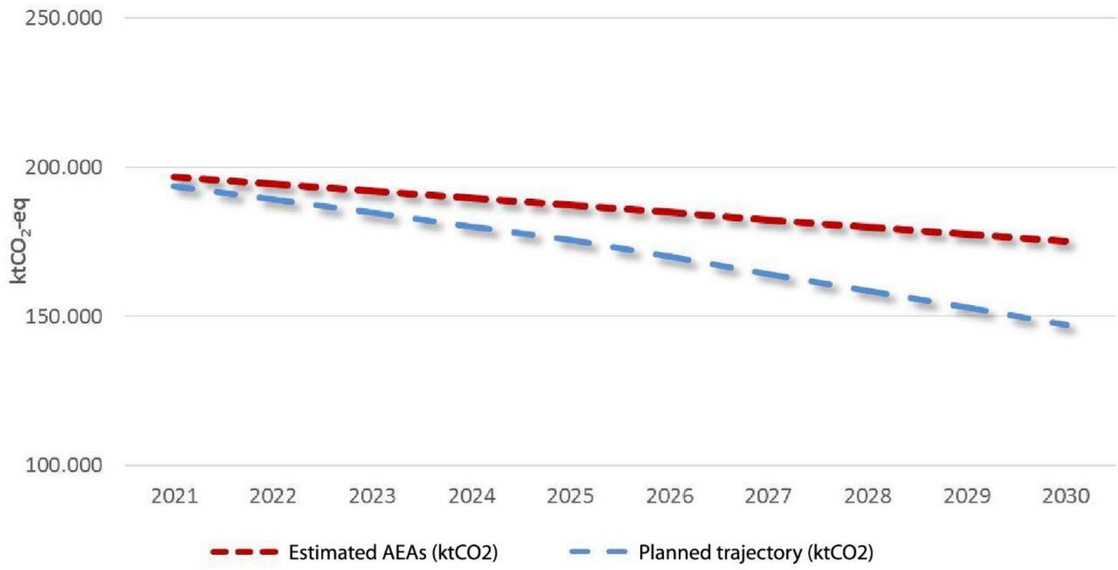
As already indicated above, the measures contained in this INECP **allow a 23% emission reduction to be achieved compared to 1990 levels.** The non-ETS sectors contribute with a 39% reduction by 2030 compared to 2005 levels, while the sectors subject to emissions trading contribute with a reduction of 61% by 2030 compared to 2005.

Figure 2.2. 2030 emissions target. Historical series (2005 - 2016) and planned trajectory



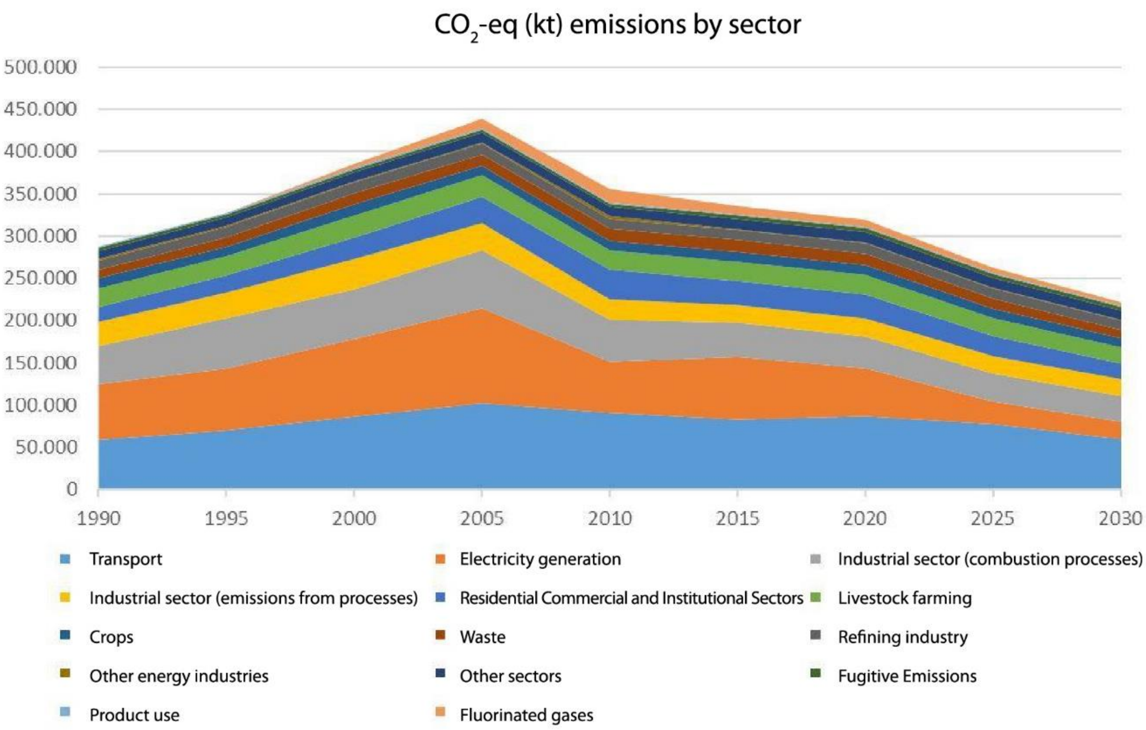
Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Figure 2.3. Emission allocations vs. planned trajectory, 2021-2030



Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Figure 2.4. Emissions of CO2-eq by sector. Historical and projection for 2030 (kt)



Source: Ministry for Ecological Transition and Demographic Challenge, 2019

The inclusion of the land use, land-use change and forestry sector (hereinafter referred to as the LULUCF sector) in the 2030 Climate and Energy Framework is considered to reflect the recognition in the Paris Agreement of the role of energy sources and sinks in climate change action.

Regulation (EU) 2018/842 of the European Parliament and of the Council of 30 May 2018 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No 525/2013 provides that if a Member State exceeds its annual emission allocation, it may make additional use of a quantity up to the sum of total net removals and total net GHG emissions from the combined land accounting categories of afforested land, deforested land, managed forest land, managed cropland, managed grassland and managed wetland (LULUCF categories set out in Regulation EU 2018/841).

In the case of Spain, the total amount of LULUCF that could be used over the period 2021-2030 amounts to 29.1 $MtCO_2$-eq, which is **not expected to be used to meet Spain's commitments to 2030** under this Plan; this does not prevent ambitious policies and measures from being proposed in the sector.

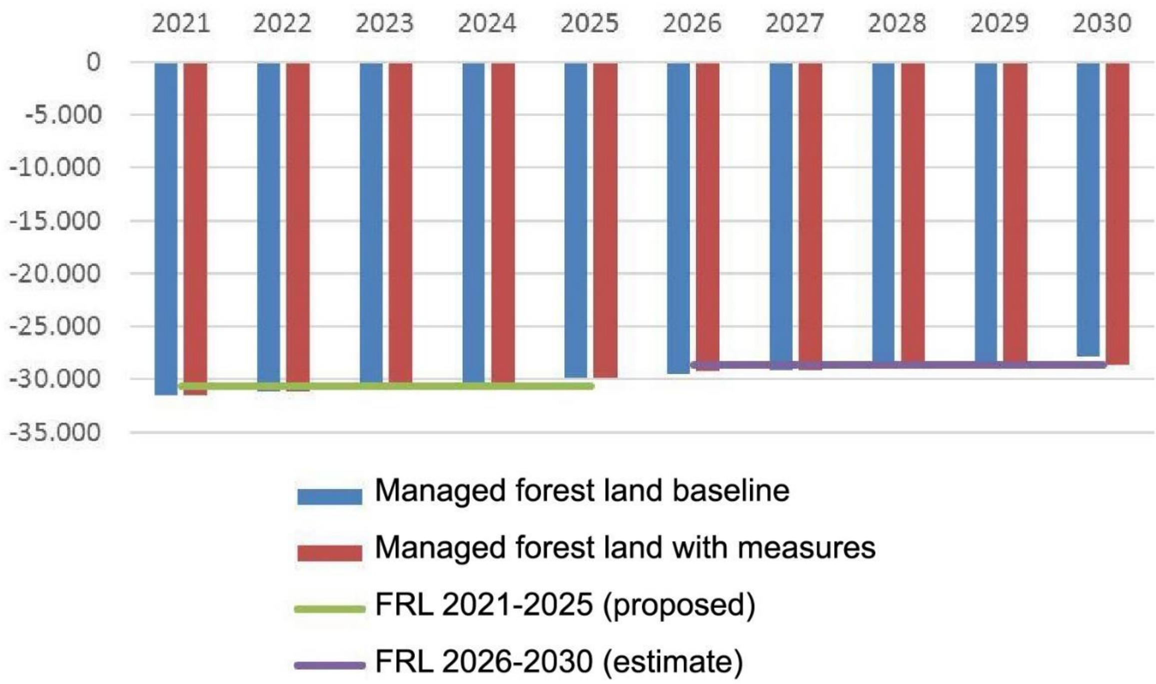
Article 4 of Regulation (EU) 2018/841 of the European Parliament and of the Council of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework establishes the 'no-debit' rule, whereby emissions may not exceed removals in the land accounting categories in the period 2021-2030. The Regulation then sets out the accounting rules for emissions and removals in the categories of afforested land, deforested land, managed forest land, managed agricultural land and managed grassland, including managed wetland from 2026.

The removals on managed forest land, which account for most of the land use removals, depend on a number of natural circumstances on the one hand and on past and present management practices on the other hand, which differ substantially between Member States. The relevant accounting rules therefore provide for the use of a 'forest reference level' (FRL) in each Member State to exclude the effects of natural and country-specific characteristics from the accounting of GHG emissions and removals.

In this respect, Regulation (EU) 2018/841 requires Member States to submit to the Commission their national forestry accounting plans, including a proposed FRL for the period from 2021 to 2025. Spain presented the draft National Accounting Plan on 31 December 2018[25], with a proposed FRL of -30.7 $MtCO_2$-eq[26]. This proposal is under review and the Commission will have to be approve it, if applicable, by adopting a delegated act by 31 October 2020; the final FRL could therefore change.

[25] Accessible at: https://www.miteco.gob.es/es/cambio-climatico/temas/mitigacion-politicas-y-medidas/Estrategia.aspx
[26] Annual average from 2021 to 2025.

Figure 2.5. ***CO_2-eq absorption projections*** **in the LULUCF sector in the period 2021-2030. Comparison with forest reference level (kt)**



Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Taking into account the low rates of deforestation, the effect of previously afforested land (for which a 20-year transition period is considered) and the proposed measures on managed forest land, managed agricultural land and managed grassland, **compliance with the 'no debit' rule established in Article 4** of Regulation (EU) 2018/841 is **expected**, without making use of the flexibilities contained in Articles 11, 12 and 13 of that Regulation.

Table 2.2. LULUCF accounting projection (Regulation (EU) 2018/841)

Category	Estimate 2021-2030 ($ktCO_2$-eq)	Accounting principle 2021-2030	Accounting 2021-2030 ($ktCO_2$-eq)
Deforested land	4,104	KP2 *gross-net*	4,104
Afforested land	-23,479	KP2 *gross-net*	-23,479
Managed forest land	-298,214	FRL (-296,903 $ktCO_2$-eq)	-1,311
Managed agricultural land	-18,324	*Net-net* average 2005-2009 (15,510 $ktCO_2$-eq)	-33,834
Managed grassland	2,254	*Net-net* average 2005-2009 (-13,030 $ktCO_2$-eq)	15,284
Managed wetlands	341	*Net-net* average 2005-2009 (270 $ktCO_2$-eq)	71

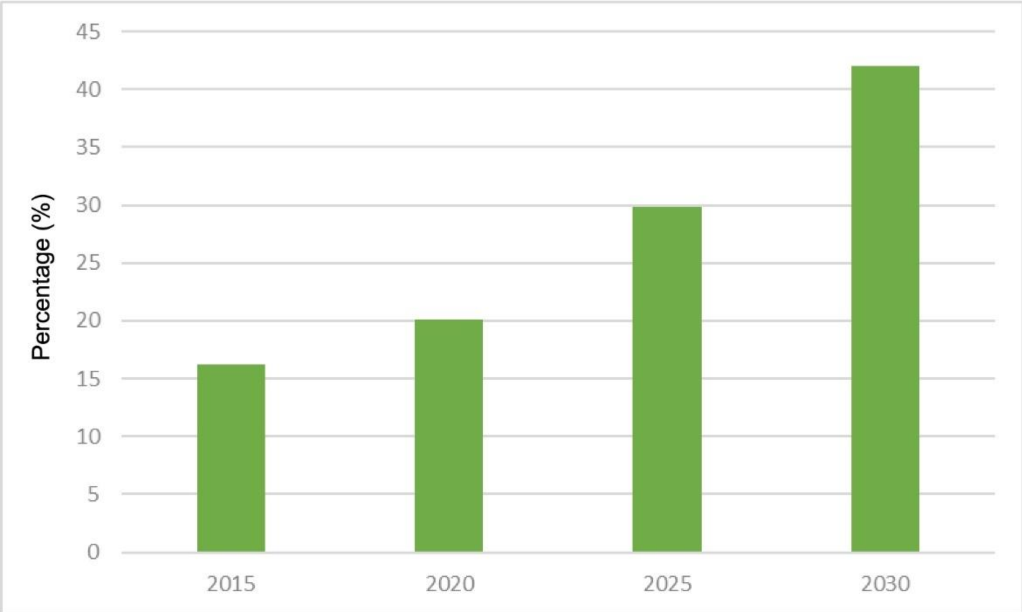
Source: Ministry for Ecological Transition and Demographic Challenge, 2019

2.1.1 Electrification and decarbonisation of the energy system

Three of every four tonnes of GHG originate in the energy system; **their decarbonisation is therefore key to achieving the objectives of this Plan**. In order to achieve this goal, a transition from fossil fuels to efficiency and renewable energy is necessary. Furthermore, it will be necessary to electrify a significant part of the thermal demand and the demand for transport.

As a result of the measures envisaged in this Plan aimed at reducing the use of fossil fuels and promoting renewable energy sources in the three uses of energy – transport, heating and cooling and electricity – **renewables will account for 42% of the total energy end-use in 2030.**

Figure 2.6. Contribution of renewable energy to final energy consumption with the planned set of measures



Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Transport	**As a result of the measures adopted in this Plan, a 28% share of renewable energy sources is achieved in transport through electrification and biofuels, above the 14% required by the European Union in 2030.**

The main aspects of decarbonisation in the transport sector are the modal shift, the deployment of electric mobility and the boost to the manufacture and use of advanced biofuels. The first two aspects are included in this Plan as energy efficiency measures.

Heating and cooling	**Electrification and growth in the use of thermal renewables.**

In the heating and cooling sector, it is expected that, in addition to continuous technological improvement, new players and investment models will emerge to drive decarbonisation. In this respect, the National Plan focuses on renewable energy communities and proposes regulatory development that allows them to exercise their right to generate, consume and sell renewable energy. It also focuses on the promotion of a set of administrative and economic measures. An increase in electricity use for heat generation is also proposed.

According to the Plan's forecasts, the increase in renewable energy in the 2021-2030 period will be very significant in all sectors of the economy, as can be seen from the following data:

- electricity generation: increases from 10,208 to 21,792 ktoe;
- heat pumps: increases from 629 to 3,523 ktoe;
- residential: increases from 2,640 to 2,876 ktoe;
- industry: increases from 1,596 to 1,779 ktoe;
- transport (biofuels): decreases from 2,348 to 2,111 ktoe;
- services and other: increases from 241 to 435 ktoe;
- agriculture: increases from 119 to 220 ktoe.

Ultimately, the presence of renewables in energy end-use will increase
from an expected 20% for the year 2020 to 42% in 2030.

Electricity generation	• **By implementing the measures in the Plan, it will be possible to achieve a 74% share of generation from renewable sources in the electricity 'mix' in 2030.** • **The transition to a decarbonised electricity system involves a significant and sustainable incorporation of renewable sources.**

The achievement of ambitious targets in the field of electricity from renewable energy sources involves a three-pronged strategy: the promotion of large generation projects, the deployment of own consumption and distributed consumption, and measures to integrate renewables into the electricity system and market.

At an international level, the large-scale development of renewable energy in the last decade has led to a substantial reduction in their relative cost to the extent that, currently, in the vast majority of situations, renewable sources – mainly wind power and solar – generate the most cost-efficient electricity when it comes to developing new capacity.

The Plan envisages a total installed capacity in the electricity sector of 161 GW by 2030. With a view to the deployment of renewable technologies planned for the electricity sector, the INECP 2021-2030 considers **auctions to be the main tool for the development of these technologies**, in accordance with Directive 2018/2001 on the promotion of the use of energy from renewable sources.

The design of the auctions is based on the predictability and stability of the revenues in order to facilitate the investment decision and its financing, and priority should be given to those installations that facilitate a more efficient energy transition. In any case, the design of the auction system should take into account, inter alia, the following elements:

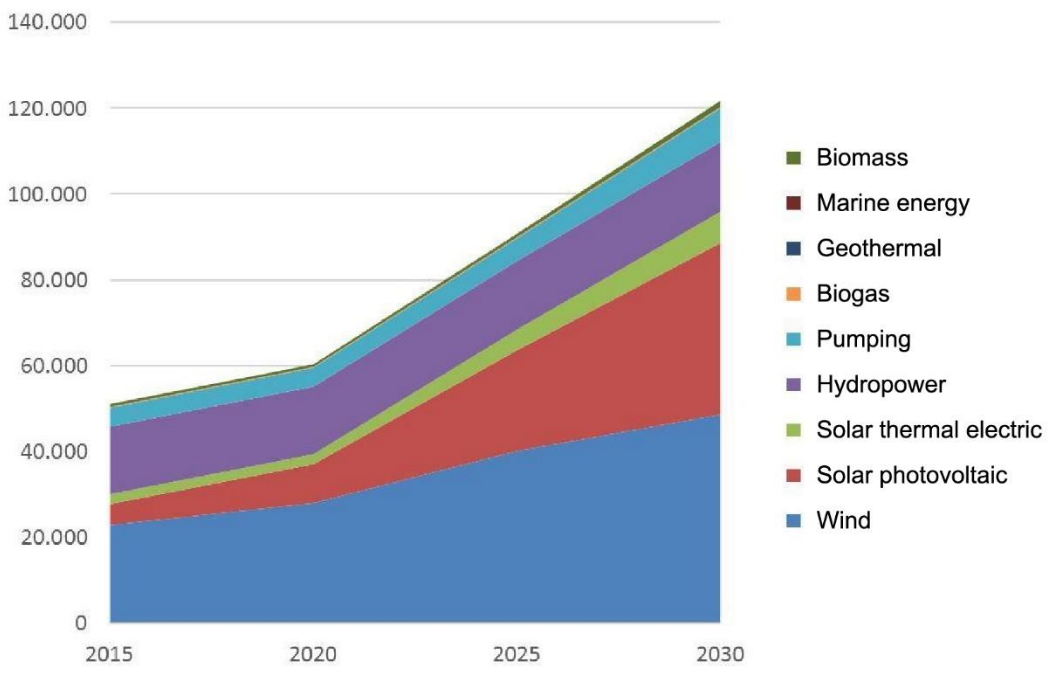
- the effect of lower wholesale market prices at times of high renewable generation;
- the existence of discharges during times of high renewable generation;
- a potential increase in social opposition in some locations, due to a high concentration of projects in areas with greater resources, in addition to a possibly inefficient sharing of co-benefits.

In order to achieve these objectives in the development of renewable energy technologies, it is important to work together with the autonomous communities and economic and social stakeholders in order to identify and eliminate together the barriers to the implementation of renewable energy on the territory, thus guaranteeing viable and efficient development.

The deployment of **renewable own consumption** is also envisaged, facilitated by the existence of renewable resources throughout the national territory, the modularity of the installations, the reduction of costs and a new regulation that simplifies the activity, eliminates tariffs and charges for self-generated energy and allows economic compensation for the surpluses fed into the grid.

The Target Scenario proposed by the Plan represents a considerable increase in renewable generation capacity compared to the current situation.

Figure 2.7. Installed capacity of renewable technologies (MW)



Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Table 2.3. Evolution of the installed capacity of electricity (MW)

Generation system in the Target Scenario (MW)				
Year	**2015**	**2020***	**2025***	**2030***
Wind (onshore and offshore)	22,925	28,033	40,633	50,333
Solar photovoltaic	4,854	9,071	21,713	39,181
Solar thermal electric	2,300	2,303	4,803	7,303
Hydropower	14,104	14,109	14,359	14,609
Mixed Pumped	2,687	2,687	2,687	2,687
Pure Pumped	3,337	3,337	4,212	6,837
Biogas	223	211	241	241
Other renewables	0	0	40	80
Biomass	677	613	815	1,408
Coal	11,311	7,897	2,165	0
Combined cycle	26,612	26,612	26,612	26,612
Cogeneration	6,143	5,239	4,373	3,670
Fuel and Fuel/gas (non-peninsular territories)	3,708	3,708	2,781	1,854
Waste and other	893	610	470	341
Nuclear	7,399	7,399	7,399	3,181
Storage	0	0	500	2,500
Total	**107,173**	**111,829**	**133,802**	**160,837**

*The data for 2020, 2025 and 2030 are estimates of the Target Scenario of the INECP.

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

In the case of cogeneration, the capacity reflected in Table 2.3 corresponds to installed capacity. This heading therefore includes both active and inactive facilities.

In any case, specific distribution by means of renewable technologies between 2021 and 2030 will depend on their relative costs, as well as on the viability and flexibility of their implementation. Therefore, their relative weight may vary, within some margins, with respect to the figures presented here.[27]

The path marked out to achieve the objectives set for 2030 is based on the principles of technological neutrality and cost efficiency. To this end, the energy modelling carried out takes into account the developments in the performance and costs of all the technologies and is based on minimising costs, respecting the boundary conditions for meeting the objectives of the five dimensions of the INECP (see Annexes A and B).

In summary, the Plan proposes a balanced and diverse development of the renewable generation stock, providing medium-term visibility for each technology.

2.1.2 Adaptation to climate change

In 2006, Spain approved its National Plan for Adaptation to Climate Change (PNACC), which is the basic planning tool for promoting coordinated and coherent action against the effects of climate change. Since its approval, the National Adaptation Plan has been implemented through successive work programmes that specify the activities to be carried out at each stage. The first one covered the period between 2006 and 2008, and the second one between 2009 and 2013. The Third Programme, covering the period 2014-2020, is currently in full swing. The Third Programme has been structured into four strategic areas:

[27] With regard to the possible actions in the hydroelectric and hydraulic pumping systems envisaged in this section, the potential hydromorphological effects on rivers, as well as the functioning of the river system and the contributions in the affected sections will be taken into account, since they could affect the 'good water status', an objective included in the Water Framework Directive and the corresponding river basin management plans. In accordance with Article 4(7) of the WFD, the exceptional nature of the action shall be justified.

- generation and analysis of knowledge on impacts, vulnerability and adaptation;
- integration of climate change adaptation into legislation;
- mobilisation of key stakeholders in the sectors included in the Plan;
- signs, evidence and indicators of impacts, vulnerability and adaptation to climate change.

The outline also includes two complementary pillars: (i) administrative coordination and (ii) strengthening of RDI. These pillars acknowledge, firstly, the existence of various territorial levels and sectoral areas in which public administrations must act in a coordinated manner and, secondly, the essential role of research and innovation in the development of adaptation policies.

In 2019, the process of drawing up a new National Adaptation Plan (PNACC-2) began; it will define the objectives, criteria, scope and measures for promoting resilience and adaptation to climate change in Spain for the period 2021-2030. The general objectives for the PNACC-2 include:

- offering a series of tools to facilitate the exploration of future climate scenarios;
- promoting the assessments of impacts and risks arising from climate change and the identification of adaptation measures to minimise them;
- promoting access to available knowledge on the impacts and risks arising from climate change and on mitigation and adaptation measures aimed at limiting them, facilitating training and capacity-building on the subject;
- continuing to promote the integration of adaptation to climate change into the regulations and planning of the different areas of public and private management;
- facilitating the coordination of actions between the different Public Administrations (national, regional and local) while promoting complementarity and efficient use of public resources;
- encouraging the active involvement of Spanish society and mobilising key actors in the development of adaptive responses to climate change.

Furthermore, in its implementation phase the new PNACC-2 will:

- include objectives, commitments and recommendations set out in the Paris Agreement (2015), in the evaluation of the EU Adaptation Strategy (2018) and in the Energy and Climate Governance Regulation.
- consider the recommendations arising from the evaluation of the PNACC-1, which ended in 2019;
- provide guidelines for its implementation through two successive work programmes (2021-2025 and 2026-2030), in which the actions to be carried out will be defined in detail;
- include more than fifty measures, defining compliance indicators for each of them;
- broaden the field of analysis and action, to consider the impacts and vulnerability in Spain due to the effects caused by climate change beyond our borders;
- include a specific section on financing.

As in the first Adaptation Plan, the PNACC-2 will define a set of areas for action on adaptation, including those relating to the energy system. In this field, action will be taken on the risks affecting the various components of the energy system:

- primary energy supply;
- electricity generation;
- transport, storage and distribution of energy;
- electricity demand.

The following table shows a series of risks or threats caused by climate change for the Spanish energy system and some of the measures planned to address them:

Table 2.4. Potential impacts of climate change on the energy system and adaptive measures in the design phase

Component	Key threats	PNACC-2 measures
Primary energy supply	• Reduction in hydroelectric production as a result of reduced river flows. • Reduced productivity of biomass-production oriented agricultural and forest crops due to decreased water availability. • Damage to energy supply infrastructure caused by extreme events.	○ Estimation of the impact of climate change on renewable energy production potential. ○ Incorporation of hydropower potential projections into energy transition planning. ○ Incorporation of biomass production potential projections into energy transition planning. ○ Identification of highly vulnerable infrastructure and promotion of targeted adaptation programmes
Electricity generation	• Lower efficiency in thermoelectric plants due to reduced flow rates and increased cooling water temperature. • Cuts in the water supply for cooling of thermal power plants.	○ Estimation of potential impacts associated with climate change and analysis of adaptation measures.
Transport, storage and distribution of energy	• Reduced efficiency of electricity transmission and distribution lines due to heat. • Damage to the infrastructure of the electrical, gas or petroleum products systems as a result of extreme events. • Vulnerability of LNG terminals, conventional gas and refineries located in coastal areas, due to storms and rising sea levels. • Reduction in producible energy for mixed pumped. • Decreased battery performance due to an ambient temperature increase.	○ Analysis of the impact of climate change on the functionality and resilience of electricity transmission and distribution networks and definition of adaptation measures. ○ Identification of energy infrastructure that is highly vulnerable to extreme events and promotion of specific adaptation programmes.
Electricity demand	• Increase in peak demand for electricity associated with cooling needs.	○ Estimation of the impact of climate change on electricity demand.

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

The analysis above of the risks on the energy system emphasises the close relationship between the adaptation of the energy system and the adaptive management policies relating to a series of resources or economic sectors that are vulnerable to climate change, such as water, the forestry sector, the coasts or transport infrastructure. Table 2.5 gives some examples:

Table 2.5. Examples of interlinkages between the energy system and some areas of work of the PNACC

Water	• The river flow system influences hydropower generation. • Water is a key resource in cooling processes in thermal and nuclear plants. • Water is a resource used in solar thermoelectric production in the thermodynamic cycle, as well as for cleaning mirrors. • Biofuel cultivation requires the use of water. • Water is necessary in the process to obtain hydrogen. • The extraction and mining industry uses water. • The water temperature increases due to the discharge of flows from the cooling of thermal power plants.
Forestry sector	• The main source of biomass production is the forestry sector; its performance is closely dependent on how well forest areas adapt to climate conditions.
Coasts	• Some strategic energy infrastructure is located in coastal areas, such as offshore wind farms and associated electricity extraction infrastructure.
Transport	• Port infrastructure, the operation of which is influenced by factors related to the weather and climate, play an essential role in imports of energy products (fossil fuels and biofuels).
Land	• Land use for renewable technologies, such as solar photovoltaic, energy crops for biofuel production, wind. • Opencast and closed-pit mining for fossil fuels. • Drilling and use of the subsoil for the extraction of hydrocarbons.

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Therefore, the adaptation actions proposed in these areas of work affect the Spanish energy system's levels of resilience to climate change. Some of the lines of work that affect these levels of resilience are shown in the table below:

Table 2.6. Links between the lines of work on adaptation for four areas of the PNACC and the reduction of risks arising from climate change in the energy system

Area of action	Risks	Lines of work
Water	Reduction in hydroelectric production	- Reinforcement of networks for monitoring water resources and their uses. - Updating of water resources projections for various climate change scenarios. - Identification and evaluation of measures to: diversify supply (e.g. obtaining new resources through desalination); reduce demand (efficiency aimed at producing net savings); improve the status of water masses (ecological flow systems, hydromorphological conditions and river connectivity, purification and diffuse pollution).
	Reduction of hydraulics available for plants that use water as a coolant	- Identification of the most suitable areas for the location of solar thermal power plants. - Study of technologies to improve heat removal from the thermodynamic cycle using aerothermal or other cooling technologies.
Forestry sector		- Integrating adaptation into forest management: adaptive criteria in the common basic guidelines for sustainable forest management, in forest management instructions and in standard forest management models. - Review and update of policies and measures with implications for the maintenance and improvement of forest resources: integration of adaptive criteria when revising current Forest Plans and developing new instruments; updating of regions of origin of forest reproductive material taking into account changes in climate conditions; improved knowledge of demographic stability schemes appropriate to the different types of forest ecosystems.
Coasts and marine environment	Damage to energy infrastructure caused by coastal flooding	- Protection strategies that target risk areas, in order to prevent impacts from flooding, erosion, etc., by reducing the hazard and/or exposure. - Accommodation strategies, aimed at reducing vulnerability by modifying land use, introducing specific regulations for infrastructure or adopting measures that increase the preparedness of the elements in question for possible impacts. - Retreat strategies, aimed at the planned abandonment of areas likely to be affected by the impacts of climate change or extreme risks.
Transport infrastructure	Interruption of port operations due to weather- and climate-related events.	- Updating of ocean projections and their effects on the Spanish coast. - Development of climate change adaptation plans for state-owned ports.

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Adaptation measures included in the INECP

Several of the measures introduced in this Plan also involve a transformation of the energy system into a model that is more resilient to climate change. The establishment of this Plan is, in this respect, one of the first steps aimed at building adaptive capacity and providing actions for better adaptation of the energy system. Data collection and projections are a necessary approach to transforming the energy system so that action and policy guidelines can be drawn up, with the aim of achieving a carbon-neutral economy.

In particular, the measures contained in the decarbonisation dimension, and the design of an energy mix with a higher share of renewable energy, improve adaptation as they reduce the negative effects related to the intensive water consumption by thermal and nuclear power plants, and their response to temperature increases. In addition, measures to increase storage capacity through various sources and to manage demand will allow for better adaptation to a possible decrease in water resources for electricity generation.

Similarly, the Plan's energy efficiency principle will lead to a reduction in energy demand in the medium and long term, which involves adaptation to climate change, as the energy system is not subject to high-energy requirements. This Plan includes the implementation of measures in industry that will initiate changes in production processes and a move towards those that have the best technical improvements available.

The other dimensions also include complementary measures that contribute to better adaptation. Improved security of supply, reduced dependence on fossil fuels, together with measures for improving research and competitiveness in low-carbon technologies, contribute to the implementation of an energy system that is resilient to climate change.

Finally, it should be noted that, in order to meet the reporting objectives under the Paris Agreement and international and European regulations, MITECO, in collaboration with other ministerial departments and the autonomous communities, will prepare and publish regular reports on the evolution of the impacts and risks resulting from climate change, as well as on the policies and measures aimed at increasing resilience and reducing vulnerability.

2.1.3 From generation to demand management and storage

The large-scale development of renewable generation makes it necessary to plan its integration into the system. The paradigm of base and peak generation becomes a new one of variability versus flexibility. The Plan seeks to make the system flexible by allowing demand and storage management to contribute to the security and quality of supply, reducing dependence and improving security of supply.

Electricity generation	**Both the development of storage and demand management are promoted to support the integration of renewables in the electricity sector.**

Electricity **demand management** is the series of actions performed directly or indirectly by consumers themselves, Public Administrations, energy distribution and marketing companies, energy services companies and independent aggregators, on consumers' energy demand in order to modify the configuration over time or the level of their energy demands. This contributes to cost reduction, a lower impact on the environment, an improvement in the competitiveness of consumers and efficiency in the use of generation, transmission and distribution systems.

The instruments to promote demand management can be economic incentives, the introduction of more efficient technologies and techniques, or influence on consumer habits. For this reason, we propose developing the **figure of the aggregator and demand management plans,** through which different players can participate in services that are essential to the system.

With regard to **storage**, the National Plan foresees that by 2030 there will be an additional capacity of **6 GW** (pumps and batteries). The precise composition and operation of these will be developed according to technological advances and availability. In addition, the application of new pumping operation procedures will be taken into account.

2.1.4 The role of citizens in the energy transition

At the end of 2016, the 'Winter Package' of the European Commission proposed to place citizens at the centre of the energy transition. In this connection, Directive 2018/2001 on the promotion of the use of energy from renewable sources provides that the Member States must **guarantee consumers the right to produce, consume, store and sell their own renewable energy**, and assess both the barriers and potential of development of **renewable energy communities**.

The proliferation of renewable projects and their possible concentration in locations that have the best resources requires social acceptance. For this purpose, it is necessary for citizens to perceive the benefits of the deployment of renewable energies directly. In this respect, including the social perspective in the set of measures proposed and promoting a proactive role for citizens in the energy transition is necessary.

The transition towards a model based on renewable energies also democratises the energy system and offers new opportunities to citizens, corporations and local authorities, who were only consumers in the conventional model and today can be proactive agents. This participation of new players and the development of own consumption encourage new sources of investment in decarbonisation, better integration and acceptance of energy infrastructures in the territory, the reduction of losses due to transport and distribution, the use of urban space for renewable generation, greater energy awareness in society and the emergence of new business models.

The **right of access to energy** is also another fundamental aspect of the change in the energy model. In this connection, the potential of energy upgrading of buildings and own consumption systems – in particular shared own consumption – to mitigate situations of vulnerability and energy poverty is particularly significant.

Furthermore, knowledge and information are the basis for greater involvement of citizens in the energy field. For this reason, outreach programmes are planned in order to improve citizens' understanding of their relationship with energy, as well as, for example, the right of access to their own energy consumption data in a quick and understandable way.

The INECP 2021-2030 proposes instruments and measures to facilitate and reinforce the role of local energy communities and the role of new players in the energy transition, as well as guaranteeing the right of access to energy.

2.2 ENERGY EFFICIENCY DIMENSION

2.2.1 National energy efficiency objective for 2030

'**Energy efficiency first**' is one of the core principles that has guided the preparation of this Plan.

The important efficiency measures promoted by the Plan are expected to achieve ambitious targets both in terms of emission mitigation (one out of every three tons of CO_2-equivalent will be mitigated by 2030 compared to 2017), and the penetration of renewable energy in final energy consumption. Efficiency measures are central to all sectors of the economy, particularly transport and industry. As a whole, they help to achieve the objectives in a cost-efficient manner while also contributing to the expected positive impacts on the economy and employment (see Chapter 4).

The Energy Efficiency Directive (Directives 2012/27/EU and 2018/2002/EU) establishes a common framework of measures for the promotion of energy efficiency within the European Union with the objective of ensuring the achievement of the main target of improving efficiency by 20% by 2020 and 32.5% by 2030.

Within this common regulatory framework, it is up to each Member State to set an indicative national target for energy efficiency based on primary or final energy consumption, on primary or final energy savings or on energy intensity. In line with previous plans, Spain has chosen to set the indicative target for energy efficiency by 2030 in terms of primary energy consumption.

In this way, this INECP adopts the objective approved by the European Union of improving energy efficiency by 32.5% by 2030, although with the measures put in place and in accordance with the modelling exercise carried out, **it is expected to achieve an improvement of 39.5%[28] in 2030**. This will result in primary energy consumption (not including non-energy uses) of **98.5 Mtoe** during that year (see Figure 2.8).

While the European Union's objective is to improve energy efficiency by 32.5% by 2030 (see Figure 2.8), as a result of the measures provided for in this Plan, an improvement of 39.5% in efficiency is expected with respect to the PRIMES reference scenario.

In view of the target set for 2030, Spain reviewed and updated its energy efficiency improvement objective for 2020 with respect to the objective in the National Action Plan for Energy Efficiency 2017-2020.

In that Plan, the objective for 2020 meant that primary energy consumption should not exceed 122.6 Mtoe. This involved a 24.7% improvement in energy efficiency. In line with this INECP 2021-2030, the 2020 target is now defined as an improvement of 24.2%, which means not exceeding 123.4 Mtoe in terms of primary energy consumption (excluding non-energy uses).

[28] With reference to the projections for 2030 of the European Commission's PRIMES Model (2007), which serves as a reference in the Energy Efficiency Directive to set the indicative target for the European Union's primary energy consumption in 2030.

Table 2.7. Evolution of primary energy consumption, reducing non-energy uses (ktoe)

Year	2015	2020*	2025*	2030*
Coal	13,583	9,084	3,743	2,133
Oil and its derivatives	53,045	55,619	49,302	40,646
Natural gas	24,538	26,690	24,257	24,438
Nuclear energy	14,903	15,118	15,118	6,500
Renewable energy	16,620	20,764	26,760	33,383
Industrial waste		302	303	381
MSW (non-renewable)	252	168	142	66
Electricity	-11	762	-1,202	-3,448
Not including non-energy uses	-4,350	-5,105	-5,400	-5,639
Total	103,975	**123,402**	**113,022**	**98,460**

*The data for 2020, 2025 and 2030 are estimates of the Target Scenario of the INECP.

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

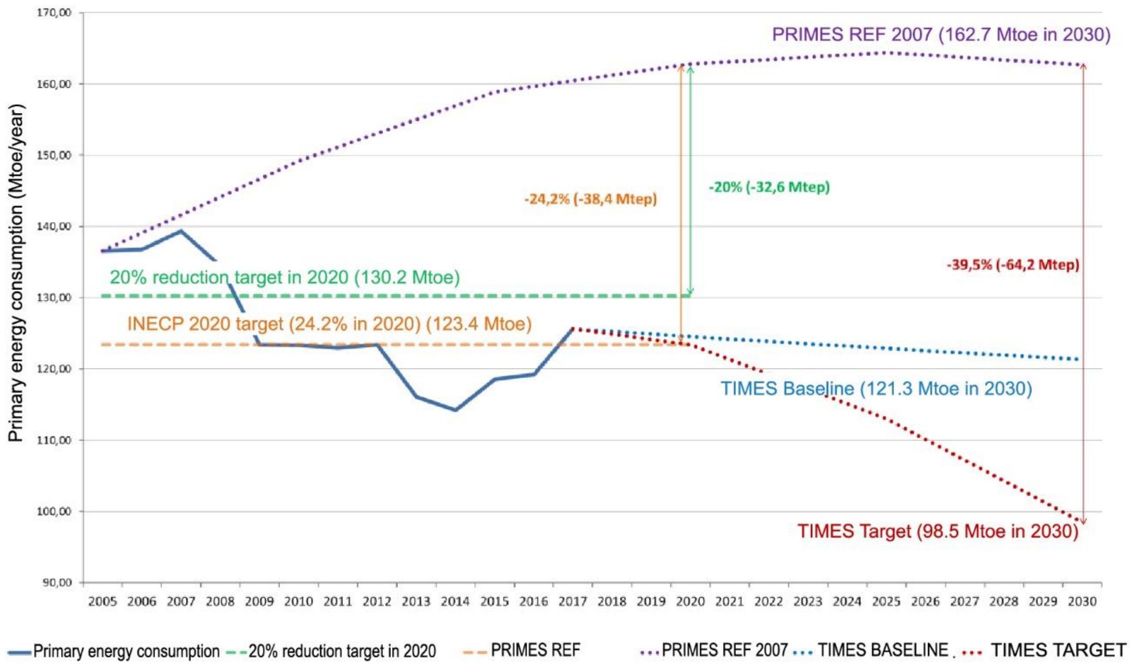
Spain has already embarked on the path towards decarbonisation and intends to adopt regulatory and fiscal measures in order to accelerate the transition towards a low-carbon economy. The collaboration of all the territorial administrations will allow progress in this energy transition process, in which the autonomous communities and the local authorities will play a fundamental role. The model of distribution of competences in Spain, where the General State Administration, the autonomous communities and the local authorities share competences in different areas requires coordination, particularly in certain areas of paramount importance such as urban planning and mobility, in order to transform our cities.

In this regard, this INECP is committed to a modal shift: the reduction of traffic, the use of public transport, sustainable mobility and electrification in terms of energy consumption in the transport sector. It also supports the energy upgrading of the existing building stock; accordingly, cities and their municipal governments must be important active agents of change.

The reduction in primary energy consumption proposed in this INECP is equivalent to 1.9% every year since 2017, which when linked to an expected increase in GDP in the same period of around 1.7% will result in **an improvement in the primary energy intensity of the economy of 3.5% per year until 2030.** This improvement in primary intensity is the result not only of the series of energy efficiency measures in energy end-use (see Chapter 3), but also of energy efficiency improvements in the energy-using products themselves, in energy transmission and distribution, as well as greater penetration of renewable energy in electricity generation fleet.

As a result of the policies and measures in this Plan, the final energy consumption (excluding non-energy uses) will be reduced at a year-on-year rate of 1.1% between 2017 and 2030, up to 73.6 Mtoe.

Figure 2.8. Reduction objective for the consumption of primary energy in Spain excluding non-energy uses (Mtoe/year)



Source: Ministry for Ecological Transition and Demographic Challenge, 2019

2.2.2 Cumulative final energy saving target for 2030

The Energy Efficiency Directive requires Member States to demonstrate the achievement of a cumulative end-use energy savings target in the period: firstly, between 1 January 2014 and 31 December 2020, and secondly, between 1 January 2021 and 31 December 2030.

This cumulative end-use energy savings target has been calculated pursuant to the provisions of Article 7 of Directive 2012/27/EU. For the first period, it amounts to 15,979 ktoe, which is equivalent to 571 ktoe/year of new and additional savings of final energy, assuming that a linear distribution of the objective will be applied throughout that period. In addition, the cumulative end-use energy savings target for the second period amounts to **36,809 ktoe**, which is equivalent to the achievement of new and additional savings of 669 ktoe/year every year from 1 January 2021 to 31 December 2030.

The cumulative end-use energy savings target in this Plan is equivalent to 36,809 ktoe, calculated from 1 January 2021 to 31 December 2030.

This cumulative end-use energy savings target means that new and additional savings of 669 ktoe/year will be achieved, as a result of the application of the provisions of Article 7 of the Energy Efficiency Directive — savings equivalent to 0.8 % of the average annual final energy consumption over the most recent three-year period prior to 1 January 2019. Details of the calculation of annual savings are provided in Annex F.

The main difference between the calculation of the target for the first and the second period is the fact that 0.8% must be applied to the total final energy consumption without excluding the consumption of the transport sector and without the possibility of applying the flexibility mechanisms previously provided for in the first period. As a consequence of the modification of the mechanism for calculating the target in the second period, the Energy Efficiency Directive has increased the level of ambition for Spain by 57%[29] in the period 2021-2030, compared to the cumulative savings under the previous Directive.

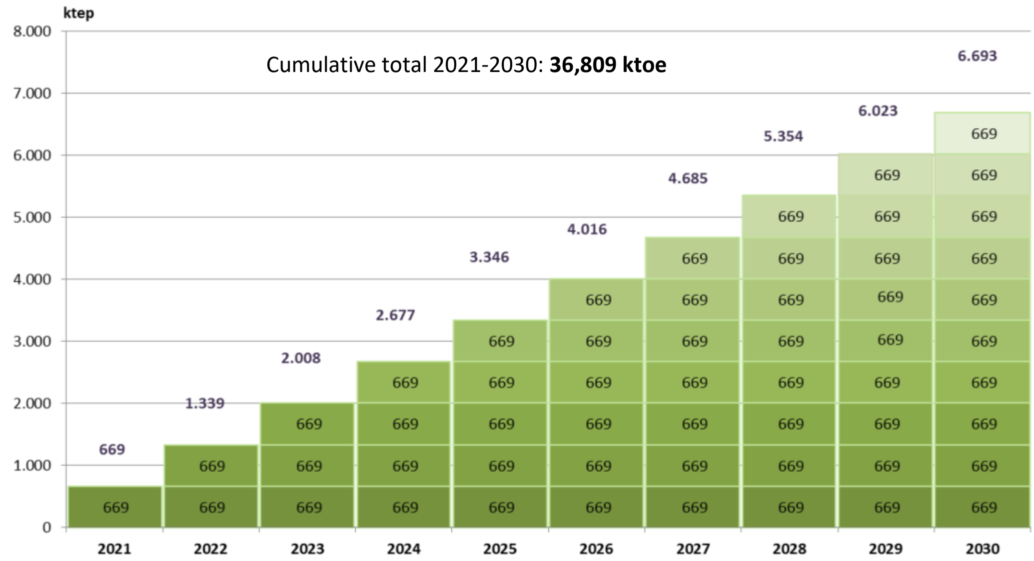
Table 2.8. Evolution of final energy consumption, not including non-energy uses (ktoe)

Year	2015	2020*	2025*	2030*
Coal	1,503	1,440	1,438	1,408
Petroleum products	40,674	41,930	37,153	29,275
Natural gas	13,139	15,119	14,711	13,774
Electricity	19,952	20,534	20,813	21,294
Renewable energy	5,292	6,943	7,195	7,426
Other non-renewables	2	309	309	385
Total	**80,562**	**86,276**	**81,619**	**73,560**

*The data for 2020, 2025 and 2030 are estimates of the Target Scenario of the INECP.

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Figure 2.9. Cumulative final energy saving target: 2021-2030



Source: Ministry for Ecological Transition and Demographic Challenge, 2019

2.2.3 Long-term strategy for building renovation

The long-term strategy for building renovation provided for in Article 4 of the Energy Efficiency Directive was published in 2014 by the Ministry of Public Works (now the Ministry of Transport, Mobility and Urban Agenda, MITMA) ('ERESEE 2014. Long-term strategy for energy upgrading in the building sector in Spain'[30]) and, updated in accordance with the provisions of that article, in 2017: '2017 ERESEE. Update of the Long-term strategy for energy upgrading in the building sector in Spain'[31]. The update carried out by the 2017 ERESEE had a qualitative approach, focusing on the analysis of the impact of measures already adopted to boost energy efficiency in buildings.

[29] The increase in the level of ambition of Article 7 of the Energy Efficiency Directive has been especially relevant for those countries where the transport sector accounts for a larger share of final energy consumption.
[30] https://www.fomento.gob.es/recursos_mfom/pdf/39711141-E3BB-49C4-A759-4F5C6B987766/130069/2014_article4_es_spain.pdf.
[31] https://www.fomento.gob.es/recursos_mfom/pdf/24003A4D-449E-4B93-8CA5-7217CFC61802/143398/20170524REVISIONESTRATEGIA.pdf.

In May 2018, Directive 2018/844/EU substantially amended Directives 2010/31/EU and 2012/27/EU, introducing a new Article 2a in Directive 2010/31/EU on the long-term strategy to support the renovation of the national stock of residential and non-residential buildings, both public and private. A new goal has been established to make the building stock highly energy efficient and decarbonised before 2050 in order to facilitate the cost-effective transformation of existing buildings into nearly zero-energy buildings.

These goals of decarbonising the housing stock by 2050 are adopted in this INECP. Further detail on milestones, indicators and intermediate targets for 2030 and 2040 will be included in EERESEE 2020, which will be presented, as established in the Energy Efficiency Directive, by 10 March 2020.

The objectives for the energy upgrading of buildings to 2030 are summarised in this Plan in Measures 2.6 and 2.8, which are explained in Section 3.2.1. in Chapter 3 ('Policies and measures') of this Plan.

Targets for the energy upgrading of buildings	• **Energy efficiency improvement (thermal envelope) throughout the decade for a total of 1,200,000 homes** • **Energy efficiency improvement (renovation of thermal heating and DHW installations) of 300,000 homes/year**

2.2.4 Energy efficiency target in public buildings

Article 5 of the Energy Efficiency Directive establishes that Member States shall establish and make publicly available an energy inventory[32] of heated and/or cooled buildings owned by the General State Administration. On the basis of this inventory, Member States must **renovate 3% of the building floor area each year**, so that these buildings meet at least the minimum energy performance requirements set in application of Article 4 of the Directive on the Energy Performance of Buildings (Directive 2010/31/EU as amended by Directive 2018/844/EU).

According to the inventory, which was updated and published in December 2018, the renovation target for 2019 was 279,902 m². Energy renovations carried out between 2014 and 2018 covered a floor area of 1,457,075 m², which represents a compliance level of 100% with the renovation target set for that period.

The target for renovating the building stock of the General State Administration required by the Energy Efficiency Directive is estimated at a total of 2,220,000 m^2 for the period covered by this INECP. This estimate does not only take into account the inventoried area, but also the progress of the energy renovations carried out up to 2018 and the consequent reduction of the inefficient area of the General State Administration.

However, to ensure the level of ambition consistent with a decarbonised model in 2050, this Plan evaluates and promotes the savings that could be obtained by renovating 300,000 m^2/year in the General State Administration. The target of renovating 3% per year is also transposed to the other territorial Administrations.

[32] https://energia.gob.es/desarrollo/EficienciaEnergetica/directiva2012/Inventario2018/Inventario-2018-articulo- 5.pdf

Energy efficiency targets for public buildings	• **Energy renovation of the public building stock of the General State Administration above the 3% target derived from Article 5 of the Energy Efficiency Directive (300,000 m²/year)** • **Energy renovation of 3% of the air-conditioned building floor area of the autonomous and local administrations.**

The savings achieved as a result of raising the level of ambition in Article 5 of the Energy Efficiency Directive (which does not require public bodies at regional and local level to achieve a specific percentage of annual renovation, or to prepare an inventory of public buildings) will allow the cumulative final energy saving target derived from Article 7 to be met. This was calculated to be 36,809 ktoe for the whole period (669 ktoe/year, assuming that the effort is spread evenly throughout the whole period).

2.3 ENERGY SECURITY DIMENSION

The INECP 2021-2030 adopts the security objectives set out in Spain's National Energy Security Strategy approved in 2015:

- ensure the diversification of the national energy mix, achieving an adequate representation of energy sources;
- guarantee security of supply in order to ensure access to the necessary resources at all times;
- encourage the use of indigenous sources in order to diversify the energy mix.

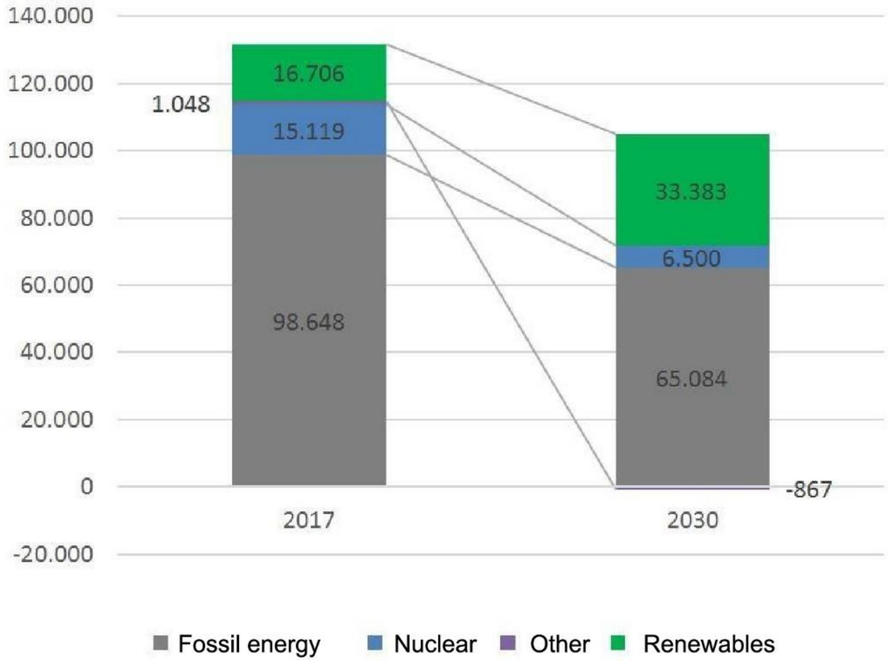
Furthermore, with reference to the changes in the energy mix that are proposed in this Plan, supplying safe, clean and efficient energy to the different consumer sectors will involve significant challenges and technological difficulties, which must be addressed on different levels:

- reduction of energy dependency, especially the importing of fossil fuels;
- diversification of energy and supply sources;
- preparation to cope with constraints or interruptions in the supply of energy sources;
- increase in the flexibility of the national energy system.

With regard to the first aspect, Spain had an energy dependency ratio of 73% in 2015 (see Table 2.9) and the same in 2017, due to the prevalence of fossil fuels in the energy mix (coal, oil and gas), since Spain does not produce significant volumes of these fuels internally.

This dependence on primary energy has major economic repercussions. Thus, in 2017, Spain had a negative balance of foreign trade in energy of over EUR 20 billion. In this respect, this Plan reduces the energy dependency ratio by reducing the importation of fossil fuels, especially coal and oil.

Figure 2.10. Primary energy mix in Spain in 2017 and 2030 (ktoe)



Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Table 2.9. Evolution of the primary energy dependency ratio (ktoe)

Year	2015	2020*	2025*	2030*
National production	33,564	37,499	41,909	40,646
	(27%)	(29%)	(35%)	(39%)
Coal	1,246	1,105	0	0
Petroleum products	236	146	147	148
Natural gas	54	49	49	49
Nuclear	14,903	15,118	15,118	6,500
Renewable energy	16,873	20,611	26,150	33,501
Non-renewable waste	252	470	445	448
Net imported/exported	89,366	91,008	76,513	63,453
	(73%)	(71%)	(65%)	(61%)
Coal	12,337	7,979	3,743	2,133
Petroleum products	52,809	55,473	49,155	40,498
Natural gas	24,484	26,641	24,208	24,389
Electricity	-11	762	-1,202	-3,448
Renewable energy	-253	153	610	119
Total Primary Energy	122,930	128,507	118,422	104,099

*The data for 2020, 2025 and 2030 are estimates of the Target Scenario of the INECP.

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Energy dependency	**As a result of the measures provided for in this INECP 2021-2030, Spain's energy dependency ratio decreases by 12 percentage points, from 73% in 2017 to 61% in 2030.**

Figure 2.11. Energy dependency in Spain in 2017 and 2030

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Within the field of energy security in this INECP, the **security of electricity supply** is of central importance. In Annex D 2 Guarantee of Supply: Probabilistic analysis of coverage under the 2030 Target Scenario, REE provides the corresponding technical analysis. In addition, in Annex B (Models), the specific models used in the electricity sector are presented. The main purpose of the analyses performed by both models was precisely to confirm that the security of electricity supply with the generation mix presented is guaranteed under the most demanding conditions.

With regard to the security of electricity supply in relation to the phase-out of coal in electricity generation by 2030 as a result of market mechanisms (price per tonne of CO_2 on the EU ETS market), as well as the orderly and phased closure of part of the nuclear fleet by that date (four of the seven existing reactors will be closed), as envisaged in the Target Scenario of this Plan, the following should be noted:

Firstly, this reduction in capacity is offset by the significant penetration of renewable electricity generation technologies, in particular solar and wind technologies (see Table 2.3). Evolution of the installed capacity of electricity).

Secondly, Spain has a fleet of 27,531 MW of combined cycle gas plants, which provide significant back-up capacity when it comes to evolving towards this transition in the electricity mix during the decade 2021-2030. In addition, large-scale development of storage and demand management is planned.

Finally, the aforementioned reports/models have exhaustively and thoroughly analysed the security of electricity supply and have concluded that the supply is fully guaranteed in the Target Scenario envisaged in this Plan.

With regard to the diversification of energy sources and supply, Spain's key objective is to develop an adequate primary energy mix that includes technically and economically viable sources for the period to 2030 in order to ensure the continuity of supply, as well as achieving the decarbonisation targets set by this Plan. Furthermore, their geographical origin must continue to be diversified in order to reduce possible risks of interruption to supply as much as possible.

Diversification	**Maximising the diversification of both energy sources and countries of origin of the supply.**

Thirdly, we must continue working to prepare to cope with potential limitations or interruptions to the supply of energy sources, in order to increase the resilience of the national energy system.

Resilience	**Further preparation in order to cope with potential limitations or interruptions to the supply of energy sources**

Due to the low level of energy interconnection with the rest of the European continent, among other factors, Spain has a **solid preparation system to deal independently with limitations or interruptions to energy supply**, as well as preparation plans for the specific risks of the electricity sector.

It should be noted, in this respect, that one of the main functions of the operators of the electricity and gas systems is to guarantee the continuity and security of supply and the correct management of the different networks, carrying out their functions in coordination with all the agents involved.

The objectives corresponding to the three levels of energy security that have been presented respond to needs from the energy supply side.

However, it is also necessary to take advantage of the new possibilities presented by technologies to provide flexibility to the energy system, not only from the supply side but also from the **demand** side.

Flexibility	**Increasing the flexibility of the system while taking advantage of the possibilities from the demand side of the energy-consuming sectors.**

2.4 INTERNAL ENERGY MARKET DIMENSION

The Plan's objectives for the Internal Energy Market dimension respond to the need for a more competitive, transparent, flexible and non-discriminatory energy market with a high degree of interconnection that promotes cross-border trade and contributes to energy security.

At the same time, this market must be focused on consumers and their protection while establishing the necessary conditions to ensure a just transition and address situations of energy poverty.

These objectives are addressed in the following areas (the electric and gas markets are specifically dealt with in each one):

- interconnectivity;
- energy transmission infrastructure;
- integration of the internal energy market;
- implementation of the National Strategy against Energy Poverty.

In relation to the interconnectivity of the electricity market, the interconnections not only improve efficiency of the systems by contributing to a more efficient allocation of generation installations, thus reducing the need for duplicate installations on both sides of the borders, but they are essential for security of supply — particularly in a scenario of high penetration of electricity generation from non-dispatchable renewable sources.

They are also the essential element for achieving an internal electricity market with competitive and homogeneous prices, since they allow supply to be increased (through imports) to those markets where, at a certain time, and depending on existing weather, technical and economic conditions, the price is relatively high, thus moderating prices and bringing them closer to those in export markets at that time.

The economic benefits derived from an adequate degree of electricity interconnection include the following:

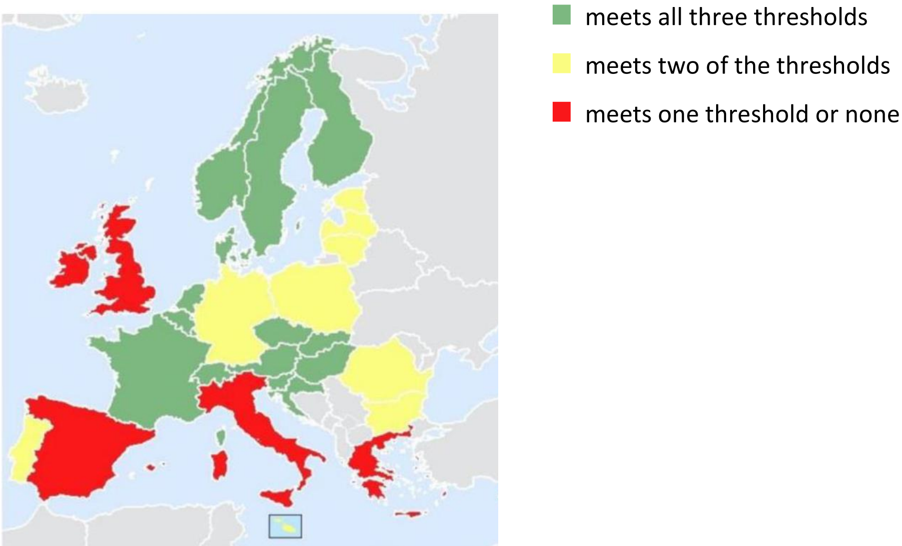
- savings in investments to reinforce the transport and distribution network;
- lower costs derived from the guarantee of immediate services through balancing energies that are mobilised effectively;
- minor discharges of renewable energy (loss of income for producers due to energy being generated that is not consumed, nor can it be exported);
- lower cost of risk coverage compared to the higher volatility of the market price.

In this regard, the level of interconnection of the Iberian electricity system with the rest of the European continent is below the targets established by EU legislation. Currently, the interconnection ratio of Spain is less than 5% of the generation capacity installed in our system. Moreover, if one considers that the Iberian Peninsula can only actually be supported by the Central European system through the French border, the interconnection ratio is 2.8% (after the last interconnection between Spain and France through the eastern Pyrenees, which was put into service in 2015). This means that the Peninsula continues to be very much an 'electric island'.

Additional and more specific thresholds that serve as indicators of the urgency of the necessary action, established by the Commission Communication on strengthening Europe's energy networks (COM(2017) 718) (see Figure 2.12), and recalled in Regulation 2018/1999 on the Governance of the Energy Union and Climate Action, are also not met. These thresholds are:

1. annual price differential exceeding EUR 2/MWh;
2. nominal transmission capacity of interconnectors below 30% of peak load;
3. nominal transmission capacity of interconnectors below 30% of installed renewable generation capacity.

Figure 2.12. Situation regarding the three thresholds included in document COM(2017) 718[33]



Source: Ministry for Ecological Transition and Demographic Challenge, 2019

In short, in 2020 and with the planned interconnections, Spain will be the only country in continental Europe falling below 10% (a target set by the Barcelona European Council in 2002). Subsequently that target was raised to 15% for 2030.

Electricity interconnection	**Achieving an interconnection level of 15% by 2030**

Apart from the measures proposed in Chapter 3, it is important to remember the role of indicative planning, which is a basic tool for safeguarding security of supply, increasing the penetration of renewables and reducing technical restrictions on networks. Its main objectives include increasing the level of interconnections.

[33] The thresholds are: (1) 'additional interconnections should be prioritised if the price differential exceeds an indicative threshold of EUR 2/MWh between Member States, regions or bidding zones'; (2) 'countries where the nominal transmission capacity of interconnectors is below 30% of their peak load should urgently investigate options of further interconnectors'; (3) 'countries where the nominal transmission capacity of interconnectors is below 30% of installed renewable generation capacity should urgently investigate options of further interconnectors'.

In the electricity system, the integration of a significant volume of renewable generation capacity, both on the mainland and in non-peninsular territories, requires reinforcing and expanding the transmission and distribution lines in Spanish territory. This includes existing connections between the mainland and non-peninsular systems and interconnections between island systems. In addition, submarine electricity transmission infrastructure to planned offshore wind farm locations should be considered and planned, in coordination with the Marine Strategies, Maritime Spatial Planning Plans and the applicable sectoral administrative procedures. Likewise, it is necessary to develop management and storage mechanisms for non-dispatchable renewable energies in order to allow the reduction of the discharge of renewable generation.

In the specific case of island territories, the increase in interconnections within their electricity systems will have a direct impact, since coal, fuel or diesel power plants make a greater contribution to the generation mix in these systems than in the mainland mix.

Finally, it is important to highlight the role of the **specific control centre of the electricity system operator (Red Eléctrica de España)**, which optimises the proper integration of renewable energies, cogeneration and waste, allowing them to be monitored in the face of possible variability in predictions and their integration into the balancing services.

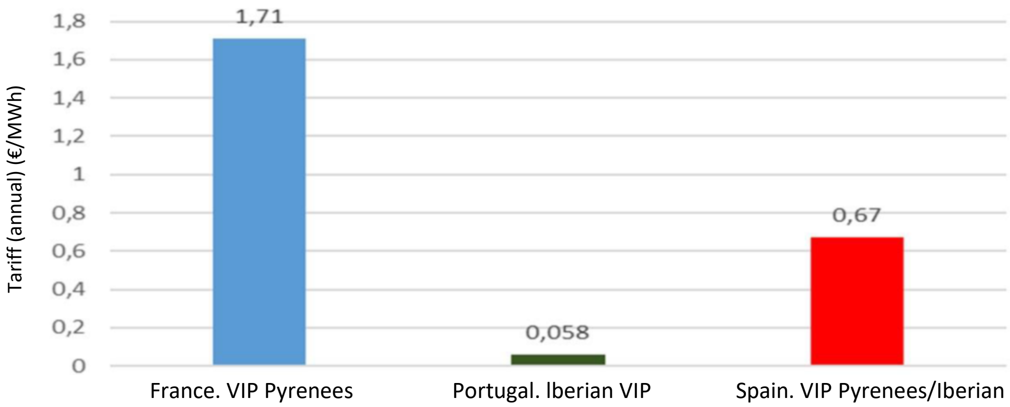
Electric transmission infrastructure	**Integration of renewables and reinforcement in non-peninsular territories.**
Integration of the electricity market	**Making the market work optimally.**

This objective is to be achieved through the storage of electrical energy, the optimisation of the use of water resources and providing information to consumers.

With reference to the gas market, the focus is also on strengthening and developing the market while at the same time protecting the consumer. In this market, optimising the use of the existing interconnection capacity in order to facilitate access to other gas sources and move towards price convergence before developing new infrastructures is considered a priority. This objective will contribute to a reduced gas bill for consumers.

The measures envisaged to optimise the use of interconnections include developing coherent methodologies at regional level for calculating fees for their use, thereby eliminating the current lack of uniformity. In this respect, ACER analyses the use of the interconnection between France and Spain in its *Market Monitoring Report* 2017, concluding that ‘An element of significance is that tariffs at VIP [Virtual Interconnection Point] Pyrenees are among the highest in the EU. This is deemed to disincentivise spot trading.’ Specifically, the exit tariff from the French gas system to the Spanish gas system is 2.5 times higher than the exit tariff from the Spanish gas system.

Figure 2.13. Gas interconnection tariffs with France and Portugal



Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Gas transmission infrastructure: Tariffs and fees

Considering the maturity of the gas system infrastructure, the main objective is to maintain the system's path to an economic surplus in the medium and long term. In this regard, the CNMC has submitted for public consultation the Circulars through which it will approve, firstly, the methodologies for calculating the payment of the operators of the installations and, secondly, the tariffs and fees to be paid for their use. The energy policy guidelines previously adopted by MITECO stress that these circulars should 'ensure the economic and financial sustainability of the gas system'.

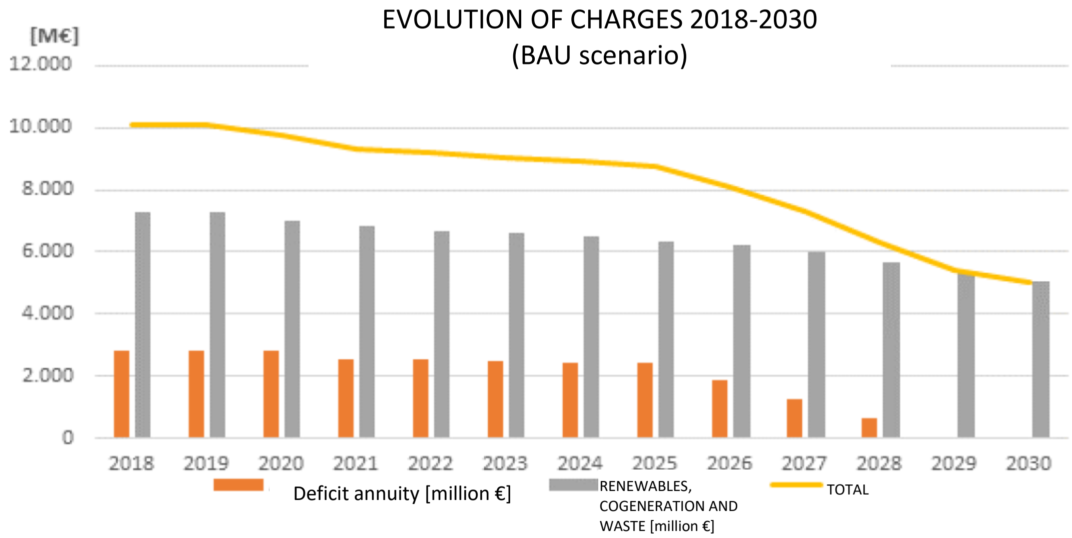
Electricity sector expenditure structure: gradual elimination of outstanding debt

With regard to the status of the outstanding debts in the electricity system from previous years, it should be noted that Article 19 of Law 24/2013 of 26 December 2013 on the Electricity Sector establishes that in the event of a shortfall in income during a financial year, the corresponding tariffs or charges must be revised.

In this regard, work is being done on the new structure and methodology for tariffs, to be implemented by the CNMC and the new structure and methodology for charges, to be implemented by the Government, and which will be subject to the provisions of Law24/2013.

Therefore, the economic balance of the electricity system is expected to be maintained throughout the course of the INECP, **and the payment of annuities for the deficit from previous financial years to end completely in 2028**. The evolution of charges in the electricity system, which include the outstanding deficit annuity, are shown in the following graph:

Figure 2.14. Evolution of electricity system charges 2018-2030



Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Integration of the gas market	Strengthening the market, ensuring the protection of gas consumers

This general objective, in turn, is translated into specific objectives for gas logistics, consumer information and streamlining of administrative procedures.

In relation to the integration of the Spanish and European markets, one of the main tools is optimising the use of interconnections by means of a homogeneous methodology for calculating tariffs for using them, as well as achieving an organised gas market covering the Iberian region, through the conclusion of an international agreement between Spain and Portugal.

Protecting vulnerable consumers	implementation of the National Strategy against Energy Poverty.

The National Strategy against Energy Poverty, which was approved in 2019, is an instrument that enables the phenomenon of energy poverty to be addressed with an integrated approach and a medium- and long-term vision.

The Strategy provides a definition of energy poverty and, in relation to it, of a vulnerable consumer. It has made an initial diagnosis and has characterised the problem by designing official measurement indicators in line with those used by the European Observatory on Energy Poverty (EPOV), which will allow comparison with other Member States. The indicators are available from the consolidated surveys prepared by the National Statistics Institute (Family Budget Survey and Living Conditions Survey). The key indicators are:

Disproportionate expenditure: percentage of households whose energy expenditure in relation to their income is more than double the national average.

1. Hidden energy poverty (HEP): percentage of households whose absolute energy expenditure is less than half the national average.
2. Inability to maintain the home at an adequate temperature.
3. Delayed payment of bills for household supplies.

Additionally, the analysis of these indicators is supplemented with others based in the climatic zone, as well as by variables that characterise the selected populations (size and type of household, income quintile of the consumption unit, activity status of the members of the household unit, etc.).

The IDAE, a public business entity attached to MITECO through the State Secretariat for Energy, has been designated as the body responsible for monitoring and updating the indicators for measuring fuel poverty in Spain.

By 15 October each year, the IDAE will publish the result of the primary indicators in the year in question and a comparative analysis with the other EU Member States.

2.5 RESEARCH, INNOVATION AND COMPETITIVENESS DIMENSION

2.5.1 National objectives for RIC and national funding targets

National objectives for RIC	● **Aligning Spanish policies** with the objectives pursued internationally and by the European Union in terms of energy and climate RIC while taking into account our distinctive features. ● Coordinating the energy and climate RIC policies of the Public Administrations with the other sectoral policies. In particular, **coordinating energy policy and innovation policies**. ● Guiding **research and development towards finding solutions to social challenges** and sustainable development goals. ● Strengthening **technology transfer** from the public system to society and industry to facilitate the ecological transition. ● Promoting **public-private partnership** and business research and innovation. ● **Putting citizens at the centre of the energy and climate transition model** by helping them to take on a greater role.

The objectives of decarbonising the economy and combating and adapting to climate change require technical and economic improvements and new solutions, for which research and innovation are at the core. Governments, as promoters and funders of science, development and innovation, have a key role in defining priority strategic areas, promoting targeted research and development and facilitating the introduction and adoption of new environmentally friendly technologies.

From this perspective, Spanish science has made a firm commitment to protecting the environment and sustainability, as the sustainable development perspective was included in previous State Strategies and Plans for research, development and innovation.

In particular, the current **State Plan for scientific and technical research and innovation 2017-2020** prioritises areas related to sustainability, the energy transition and climate change[34].

[34] These priority areas of research include the development of the next generation of renewable energy technologies; the design of flexible and distributed networks and management systems; the design and development of efficient energy systems; methods of reduction, capture, storage and use of carbon; the treatment of waste for energy purposes; nuclear security; hydrogen technologies (including photoelectrocatalysis); the development of clean combustion technologies; sustainable mobility and the modal shift in transport; the promotion of sustainable building; low-carbon technologies; climate change mitigation and adaptation; climate observation; the integrated and sustainable management of natural systems and resources; sustainable and resilient management of water resources; and areas related to the implementation of the circular economy, among others.

For the new period of strategic planning of science and innovation policies, the dimensions of sustainability, decarbonisation and the fight against climate change will be guidelines, thereby contributing to the achievement of international and EU objectives (Agenda 2030 of the United Nations and the Paris Agreement) from the perspective of science and innovation.

Research, development and competitiveness objectives for energy and climate will be achieved in accordance with the following guiding principles:

- **Coordination**: RIC priorities must be coordinated and aligned with sectoral and regional plans and strategies in order to maximise the impact of policies.
- **Co-responsibility**: The General State Administration and the rest of the public administrations, the private sector and civil society as a whole should embrace advances in science and innovation for the ecological transition.
- **Interdisciplinarity:** The complex and cross-cutting climate challenge requires contributions from and the coordination of different scientific areas and disciplines.

Coordination

It is essential to coordinate the energy and climate RIC policies of all the Public Administrations and coordinate these with the other sectoral policies, and to create the necessary synergies and complementarities. This, in turn, implies the co-responsibility of the competent administrations and the adoption of shared criteria for management, evaluation and, where appropriate, the implementation of co-financing models. This policy coordination should expand to both the sectoral dimension and regional dimension while guaranteeing adequate participation and involvement of stakeholders at all levels of administration (Central, Autonomous Community and Local Administration). In this respect, the autonomous communities play a fundamental role due to their knowledge of the region's resources and strengths, challenges for competitiveness, and scientific and industrial potential.

In this regard, the national and regional strategies for Research and Innovation Strategies for Smart Specialisation (RIS3 strategies) are integrated agendas for territorial economic transformation. The S3 concept appeared in the mid-2000s within European debate, and an expert group (the Knowledge for Growth group) was set up at the request of the DG for Research and Innovation to find solutions to the competitiveness gap observed between the European Union and the United States. According to these experts, this gap should be reduced through the 'intelligent specialisation' of the Member States and regions.

The European Commission sees Smart Specialisation as a key instrument in ensuring cohesion policy's contribution to the Europe 2020 strategy's growth policy; it is aimed at specialisation in potentially competitive and development-driving areas within a global context. Accordingly, the development of Research and Innovation Strategies for Smart Specialisation (RIS3) has been made a requirement for regions and Member States to be eligible for structural funds in the 2014-2020 budget period. Therefore, it is essential that regions identify areas of specialisation that are eligible for EU funding during this period for R&D, innovation and ICT projects.

In this context, the **S3-Energy Platform**, created by the European Commission, is a tool that helps to coordinate and align each region's **Strategies for Smart Specialisation in energy** with energy RDI objectives. This platform also connects and gives visibility to the various national and regional priorities and strategies by facilitating cooperation and preventing fragmented efforts. The **S3**

Energy platform itself includes already active partnerships on bioenergy, marine renewable energy, smart grids, solar energy and sustainable buildings.

Co-responsibility

Achieving the decarbonisation objectives set by the INECP **requires public-private participation and collaboration in research and innovation**. To this end, flexible structures for national and international collaboration, which identify technical challenges and development opportunities, and share investment needs, will be promoted.

In addition to directly financing research and development for energy and climate, the public sector will seek to mobilise private investment by acting as a driver for change from the demand side of the administrations, implementing new public procurement and pre-commercial schemes that facilitate the introduction of new solutions into the market.

Interdisciplinarity

Due to its characteristics, **the climate challenge has a complex and cross-cutting nature that requires knowledge and technical developments from very diverse research disciplines**.

The disciplines needed to address the climate challenge in a comprehensive manner include **scientific-technical areas** such as those related to public health, the study of natural ecosystems, the conservation of cultural heritage, bio-economics and the circular economy, digital development, or smart networks. It is also necessary to consider contributions from the social sciences and humanities that introduce important economic, social and adaptation perspectives.

Similarly, R&D in energy and climate must combine scientific and technical advances at different stages: from basic research, to development and technological and non-technological innovations for the development of new products and services that help to overcome these challenges.

National funding targets

National funding targets	● Spain's objective is to **increase the importance of RDI** in national economic activity, to reach investments of **no less than 2.5% of GDP, and to maintain these levels regardless of economic cycles**. ● A significant part of this investment in RIC will be allocated to energy and climate RIC in line with EU objectives and ambitions in this area. This percentage is currently being evaluated. ● Spain plans to apply to join the **Mission Innovation (MI) Energy Initiative**. As part of the initiative, the participating countries have agreed to try to **double their governments' investment in clean energy research and development in five years** while **encouraging higher levels of private sector investment in clean technologies**.

2.5.2 Specific objectives for clean and low-carbon energy technologies

At a European level, the 'Energy Union' aims to achieve an integrated energy market on a continental scale, with increasing energy interconnection, which promotes competition and the efficient use of resources, including measures to stimulate the use of renewable energy sources that help to decarbonise the energy system within the framework of international agreements on climate change. Achieving these goals will require technologically feasible solutions and innovations, not only in terms of energy efficiency and clean energies but also as regards consumption patterns, eco-design, governance, finance and transport, among others.

Priority objectives for energy and climate R&D in Spain have been defined based on the global objectives of this INECP, those established in the implementation of the SET Plan and consultation with experts from the public and private sectors. Energy R&D objectives can be grouped into four areas:

- the development of clean energy sources (onshore and offshore wind, solar photovoltaic and solar thermal, bioenergy, ocean energy, biomass, geothermal) and energy efficiency, as well as energy vectors like hydrogen;
- competitiveness to improve the effectiveness of the Spanish and European network through the development of a highly digitalised internal energy system and market;
- security of supply, in order to better coordinate national energy supply and demand in an international context; and
- the social and technological drive towards lower energy consumption patterns.

Specifically, the following priority areas and technologies are defined in accordance with the SET Plan, the international commitments made and the particular features and opportunities of Spain's economy, natural resources, industry and geography:

- **Energy efficiency.**
  - **In the case of building** (Action 5 of the SET Plan), improvements will be sought to facilitate the deployment of:
    - heating and cooling systems;
    - the use of renewable energy in urban heating and cooling networks;
    - the use of renewable energy in buildings;
    - renewable energy produced by cities, energy communities and self-consumers;
    - active and passive solutions in the energy upgrading of buildings.
  - **With regard to industry**, priority will be given to implementing innovation and energy competitiveness measures aimed at increasing process efficiency, waste heat recovery, the incorporation of renewable energies and the integration of CO_2 capture technologies to reduce emissions. Special attention will be given to technologies and applications for energy- and resource-intensive industries, (Action 6 of the SET Plan).
- **Energy generation from renewable sources** in which Spain already has a competitive or leadership position with high levels of participation by Spanish companies in the market, in line with the European goal of being a world leader in renewable energies [35] (Actions 1 and 2 of the SET Plan). Two priority objectives are defined in this area of action: increasing the use of the various renewable energies and reducing the cost of these technologies. Specifically:
  - **Photovoltaic Energy**. Development of new materials and technologies; reduction of costs in the development, construction, operation and maintenance of large plants; integration of photovoltaic solar energy into buildings; improvement of the manageability of photovoltaic generation and its integration into the grid.
  - **Concentrated Solar Power.** Technological solutions that allow costs to be reduced and the integration of this technology into the energy system, taking advantage of its capacity to increase the inertia and manageability of the system, are particularly important. Promoting medium-temperature concentrated solar technologies (90 ^{o}C-400 ^{o}C) for industrial heating and cooling is also a priority. In the period to 2050, the development and implementation of the next generation of thermoelectric solar technology will be promoted in order to increase manageability and renewable strength in the system at competitive prices.

[35] On 30 November 2016, the European Commission presented a package of measures to keep the European Union competitive as the clean energy transition is changing the global energy markets. The goals are: putting energy efficiency first, achieving global leadership in renewable energies and providing a fair deal for customers.

- **Biomass.** Technological solutions that optimise the value chain, from obtaining the resource to exploiting it, seeking to reduce costs and improve the efficiency of installations and processes.
- **Offshore wind energy.** Technical advances that allow the costs of this technology to be reduced, with an emphasis on floating solutions and assembly techniques that are less invasive to the marine environment; they will increase the number of potential areas for locating offshore wind farms and accelerate their contribution to decarbonisation goals at a competitive cost. Innovative solutions for onshore wind energy that result in cost reductions and manageability improvements will also be supported.
- **Deep and shallow geothermal energy.** In the case of shallow geothermal energy, given its potential for decarbonisation in buildings, technical developments will be sought to reduce implementation costs, improve land evaluation methods, increase drilling productivity and integrate it into the upgrading of buildings, etc. Deep geothermal energy needs support in order to improve efficiency and reduce costs.
- **Ocean Energy.** The developments made in this energy, in both current and wave technologies, need a boost to increase the TRL to 7, 8 and 9. This requires focusing activities on possible demonstration projects that will generate knowledge and experience in a real marine environment. The long-term strategy for ocean energy includes developing and implementing reliable and competitively priced generation fleets.

- **Technologies that contribute to the flexibility and optimisation of the electricity system as a whole**[36] taking into account the objectives sought: generation based on renewable primary resources (usually variable), support for the inertia of the system, and market potential via international interconnections (including major international lines). Special attention will be paid to manageable renewable energies such as solar thermoelectric energy with thermal storage, biomass and other storage options. Three areas are therefore included:
  - **Generation**: R&I in other technologies that contribute to manageability and are necessary in the transition process.
  - **Storage:** Electricity storage systems and optimising their management. In this area, the development of both mobile and stationary batteries will be especially important. Advances in batteries will require the development of new advanced materials and technologies that offer an alternative scenario to lithium. Collaboration between industry and academic research includes developing pilot lines for the manufacture of new generation batteries, as well as addressing battery sustainability in terms of materials and raw materials, reuse and recycling. (Action 7 of the SET Plan).
  - **Electricity system:** Achieving a **secure and resilient** system in the context of the energy transition will require technological developments in digitisation, power electronics,

[36] The implementation of low-carbon technologies that provide flexibility to the system is essential in order to achieve high penetration rates of intermittent (or flowing) renewables. Without this flexibility, despite offering low generation costs, renewables such as PV, wind and others would have a lower penetration ceiling.

storage, equipment and materials improvements, thus aiming to strengthen smart electricity grids, increasing asset flexibility, and the manageability of renewable energy (Action 4 of the SET Plan).

- **Nuclear energy:** Furthermore, while Spain keeps its **nuclear power plants** in operation it is necessary to continuously strengthen their safety, optimal operation and waste management. Given the scenario of an orderly and phased shutdown of the nuclear fleet envisaged in the INECP throughout the decade from 2025 to 2035, specific research and development efforts are required in this area. Priority areas of research and technologies include long-term secure operation, irradiated fuel and waste management, and the participation and acquisition of know-how. Research and development in the nuclear field will be carried out in collaboration with other EU nuclear countries with experience in fully or partially closing their nuclear facilities. (Action 10 of the SET Plan).
- **Sustainable transport**: implementation of new solutions that are less polluting, safer, better integrated and capable of responding to the demands and uses of society.
- **Renewable fuels** for the transport sector. The development of these technologies is considered a priority because of their application in aviation, mobility, industry and buildings. (Action 7 of the SET Plan).
    - **Development of advanced biofuels**.
    - **Hydrogen production using 100% renewable sources** and its use as stationary storage for large quantities and long periods of time.
- **New services and technologies for consumers, cities and smart communities**. (Action 3 of the SET Plan).
    - **Smart solutions for the energy consumer** that improve and enhance the citizen's status as an energy consumer. In this area, digitalisation technologies are also particularly important.
    - **Smart cities and communities** that integrate the various technologies available in urban environments to improve sustainability and citizens' quality of life. Spain has successful pilot experiences, involving city councils, citizens and service companies, in various cities under the PED *(Positive Energy District*) framework, and this should serve as an example to encourage innovation and replicate the best solutions.

These priorities meet the overall objectives of the INECP without losing sight of our country's starting point and its specific context.

Table 2.10 shows the correlation between the overall objectives of the INECP and the energy and climate R&D priorities:

Table 2.10. Objectives and priorities

<table>
<tr><th>INECP Objectives</th><th>Specific Objectives</th><th>RIC Priorities and Objectives</th></tr>
<tr><td rowspan="4">23% reduction in greenhouse gas (GHG) emissions compared to 1990</td><td>Residential, commercial and services</td><td>- Intelligent solutions for energy consumers.
- Smart cities and communities.
- Heat and cold generation systems.
- The use of renewable energy in urban heating and cooling networks;
- The use of renewable energy in buildings;
- Renewable energy produced by cities, energy communities and self-consumers.
- Active and passive solutions in the energy upgrading of buildings.</td></tr>
<tr><td>Transport</td><td>- Sustainable transport: promote a change of model in the transport system.
- Development of advanced biofuels obtained in a sustainable manner from renewable raw materials.
- Green hydrogen production.
- Batteries for mobility and stationary applications.</td></tr>
<tr><td>Electricity generation</td><td>- Batteries for mobility and stationary applications.
- Priority clean/renewable energy.
- Safe nuclear generation.</td></tr>
<tr><td>Industrial</td><td>- Low-carbon technologies, as a priority.
- Energy innovation and competitiveness.</td></tr>
<tr><td rowspan="2">42% share of renewables in energy end-use</td><td>Innovation in RE technologies in which the country is already in a competitive position</td><td>- Photovoltaic Energy (PV).
- Concentrated Solar Power (CSP).
- Offshore Wind Energy.
- Deep and shallow geothermal energy.
- Ocean Energy.</td></tr>
<tr><td>Technologies that contribute to manageability</td><td>- Concentrated Solar Power (CSP).
- Digitalisation of the electricity system.</td></tr>
<tr><td rowspan="2">39.5% improvement in energy efficiency</td><td>Residential, urban and citizen</td><td rowspan="2">- Digitalisation of the electricity system.
- Intelligent solutions for energy consumers.
- Smart cities and communities.
- Heat and cold generation systems.
- The use of renewable energy in urban heating and cooling networks;
- The use of renewable energy in buildings;
- Renewable energy produced by cities, energy communities and self-consumers.
- Active and passive solutions in the energy upgrading of buildings.</td></tr>
<tr><td>Industrial</td></tr>
<tr><td>74% renewable energy in electricity generation</td><td>Distributed generation</td><td>- Digitalisation of the electricity system to achieve a secure and resilient system.
- Storage systems.</td></tr>
</table>

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

In order to achieve these priorities, Spain is willing to participate in international consortia for research, innovation and industrial implementation. It will be particularly important to take part in future energy ERA-NET projects, in the SET Plan implementation working groups (IWG), as well as in partnerships under Horizon Europe, leading in areas in which Spain has greater scientific and technical capacity and seeking opportunities for complementarity with leading countries in other priority technologies which are less developed in the country.

Specific objectives for climate change science

From the perspective of RIC, it is essential to deepen scientific knowledge of oceans, terrestrial ecosystems and the atmosphere for modelling and evaluation of adaptation and mitigation strategies. Due to their geographical location and importance to the Spanish economy, particular attention should be paid to aspects related to water resources, particularly integrated water management systems, and technologies aimed at the efficient use and reuse of water in irrigation, rural, urban and industrial environments and any activities that make it possible to make progress in the protection of aquatic ecosystems, seas and oceans.

Due to their particular importance and impact on the territory as a whole, technologies and monitoring systems aimed at preventing and mitigating forest fires, protecting and recovering biodiversity, and natural, rural and urban environments should be promoted.

- Obtaining atmospheric, oceanographic and land observation data that feed the models that define these projections.
- Improvement of the accuracy and predictability of the models, to better deal with adaptation to the impact of climate change in our country.
- Creation of climate change scenarios to visualise its impacts, by region and for each of the climate variables.
- Dissemination of scenarios to encourage adaptation by different economic sectors, especially those considered most vulnerable.

RIC activities and objectives targeting climate change are focused on contributing to the overall objectives of the National Plan for Adaptation to Climate Change (PNACC) and fulfilling the commitments of the Paris Agreement and the EU 2030 Climate and Energy Framework, the EU strategy on adaptation to climate change, the 2020 road map for non-ETS sectors, the forthcoming Law on Climate Change and Energy Transition and the future Strategy for decarbonisation of the Spanish economy by 2050.

In addition to meeting these objectives and commitments, the RDI approach to climate change sees the efficient use of natural resources and environmental integrity as a factor in the country’s competitiveness and socio-economic development. Research, development and innovation must facilitate the transition to a production model that reduces pressure on the environment and natural resources, and which sparks the application of less polluting and better-monitored industrial processes.

2.5.3 Competitiveness of the economy

The energy system is a basic pillar of a country's economy. The INECP not only promotes decarbonisation, but it also has a positive effect on the industrial and productive fabric, on large, small and medium-sized enterprises, as well as on households and individuals.

These benefits are the combined result of three main effects that represent a significant improvement in competitiveness:

- A widespread increase in energy efficiency in all sectors, resulting in less energy required per unit of GDP in 2030. The policies included in the Plan foresee an improvement by 2030 of 39.5%, which is equivalent to an annual improvement of 1.9% from 2017 to 2030.
- A significant replacement of imported fossil fuels with indigenous renewable energy sources, which also reduce electricity costs. According to REE's estimates, renewable energy in the electricity sector will enable the average marginal generation cost to be reduced by 30% by 2030, compared to the Baseline Scenario.
- A reduction in external energy dependence that minimises the negative effects of the high volatility of fossil fuel markets. At present, the degree of dependence of our country is 73%, and according to the Plan's forecasts it will reach 61% in 2030.

Spain is one of the European countries with the highest potential for exploiting renewable energy. Extending over 50 million hectares including large areas of low population density, Spain's Mediterranean and Atlantic winds, high levels of sunshine, extensive forests and substantial water resources are complemented by a business, technological, innovation and knowledge network in this area.

The reduction in electricity prices through the use of renewable technologies will clearly improve competitiveness, particularly for electricity-intensive companies. The planned improvements in energy efficiency have a positive effect on the whole industrial and production fabric, on large, small and medium-sized enterprises, as well as on households and individuals.

Our country also has leading international companies in sectors that will be important for the energy transition; it has significant knowledge capital with pioneering institutions such as CIEMAT, CENER, IDAE, REE's CECRE, as well as research centres, knowledge institutions, technological networks and a strong industrial network in the field of renewable energy.

However, in order to carry out an exhaustive analysis of our country's potential in international renewable technology value chains, as well as to map existing technological, industrial and knowledge capacities, an **Industrial Development Plan** will be drawn up, in which all issues related to the energy transition will be a central element.

In short, the INECP allows Spain to aspire to be one of the leading European Union countries in the energy transition. The Spanish economy can benefit greatly from this transformation in terms of the competitiveness of its economy, in the form of prosperity, energy security, job creation in industry, innovation, technological development and the elimination of energy poverty.

3 POLICIES AND MEASURES

This section sets out the policies and measures to achieve the targets. The measures have been grouped according to the five dimensions of the Plan and are shown in the table below.

Table 3.1. Measures from the Plan

INECP Measures	
3.1	**DIMENSION DECARBONISATION**
Measure 1.1.	Development of new facilities for generating electricity using renewables
Measure 1.2.	Demand management, storage and flexibility
Measure 1.3.	Adaptation of electricity grids to integrate renewables
Measure 1.4.	Development of own consumption using renewables and distributed generation
Measure 1.5.	Incorporation of renewables in the industrial sector
Measure 1.6.	Framework for the development of thermal renewable energies
Measure 1.7.	Advanced biofuels in transport
Measure 1.8.	Promotion of renewable gases
Measure 1.9.	Plan for technological renovation in existing projects for electricity generation with renewable energies
Measure 1.10.	Promotion of bilateral renewable electricity contracts
Measure 1.11.	Specific programmes for the use of biomass
Measure 1.12.	Unique projects and strategy for sustainable energy on the islands
Measure 1.13.	Local energy communities
Measure 1.14.	Promoting the proactive role of citizens in decarbonisation
Measure 1.15.	Just Transition Strategy
Measure 1.16.	Public procurement of renewable energy
Measure 1.17.	Training professionals in the renewable energy sector
Measure 1.18.	Revision and simplification of administrative procedures
Measure 1.19.	Generating knowledge, outreach, awareness and training
Measure 1.20.	EU Emissions Trading System
Measure 1.21.	Reduction of greenhouse gas emissions in the agricultural and livestock sectors
Measure 1.22.	Reduction of greenhouse gas emissions in waste management
Measure 1.23.	Reduction of fluorinated greenhouse gas emissions
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3.2	**DIMENSION ENERGY EFFICIENCY**
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Measure 2.3.	Renewal of the vehicle fleet
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Source: Ministry for Ecological Transition and Demographic Challenge, 2019

3.1 DECARBONISATION DIMENSION

It should be noted that the electricity generation and transport sectors are responsible for the greatest reduction in greenhouse gas emissions. In the former, this is a consequence of the measures associated with the deployment of renewable technologies (and the gradual move away from carbon). In the latter, it is a consequence of a range of actions, among which the modal shift towards low-emission or emission-free means of transport stands out, and of the generalised implementation, from 2023, of central zones (‘almendras’ or ‘almonds’) in Spanish cities with more than 50,000 inhabitants, access to which will be increasingly restricted for the most polluting vehicles. In the interest of methodological consistency, this last measure is explained in detail in Section 3.2 (Energy Efficiency Dimension), where it appears as Measure 2.1. Low-emission zones and modal shift measures (promoting more efficient modes of transport).

The Plan proposes 26 measures that seek to decarbonise the economy. Of these, 15 aim to specifically promote a renewable technology or a technology relating to one of the three energy uses; four measures take a cross-cutting approach to all renewable sources, technologies and uses; one measure concerns the application of emissions trading; three measures target non-energy non-ETS sectors; and two measures relate to the land-use, land-use change and forestry (LULUCF) sector. Lastly, there is a measure on taxation.

3.1.1 Measures to promote renewable energy

To achieve the decarbonisation objectives, it is necessary to significantly develop renewable energies in general and renewables in the electricity sector in particular, as well as to electrify a significant proportion of the demand. With the measures proposed below, renewable energies are expected to account for 42% of final energy demand and 74% of production in the electricity system by 2030.

In the case of renewables in the electricity sector, the projections analysed in the Plan account for the entirety of the investment and the operating and maintenance expenditure required to make the planned increase in the use of renewable energies for generating electricity profitable. The design of the market and remuneration mechanisms for the electricity system that will be implemented will determine how these investments and this expenditure will be mobilised, as well as their sources and the mechanisms through which the investments will be recovered.

Measure 1.1. Development of new facilities for generating electricity using renewables

a) Description

Over the 2021-2030 period, the installation of 59 GW of additional capacity for generating electricity using renewables is planned. To this end, it will be necessary to take advantage of the strengths of each available renewable technology.

In the case of mature technologies, their main strength is their demonstrated capacity to make high-energy contributions, minimising the amount of public aid required. Therefore, it makes sense for the development of new facilities to continue to be supported through competitive tendering mechanisms, such as the tender procedures launched in Spain in 2015, adapted as necessary to improve their efficiency and effectiveness.

Furthermore, as regards technologies that have not reached technological maturity (for example, marine energy or, at a more advanced stage, offshore wind energy), it is necessary to adapt the public support mechanisms to the specificities of each technology and of the different territories (in particular those not on the mainland), so as to take account of the fact that they are still unable to compete in terms of generation costs but they could in future contribute new potential and added value to the system by diversifying the technologies, energy sources and location of these.

Finally, participatory citizen projects have additional advantages given their benefits such as having the greatest socio-economic impact or increasing social acceptance and public awareness of the merits of renewable energies. Consequently, it is necessary to develop specific measures to promote them.

b) Objectives addressed

Development of renewable energies, citizen participation and innovation.

c) Mechanisms

The following mechanisms are planned for the development of new renewable energy facilities:

- **Calls for tenders for the allocation of a specific remuneration scheme**

  Regarding the tenders, Article 6 of the Climate Change and Energy Transition Bill, which was submitted to public consultation that began on 22 March 2019, provides the following:

1. Procedures for financial entitlements will be organised annually to promote the construction of at least 3,000 MW of renewable facilities each year. This installed capacity target may be formally reviewed according to the evolution of the decarbonisation of the Spanish energy system.
2. To encourage predictability and stability in the revenue and financing of new facilities generating electricity from renewable energy sources that are built, new remuneration frameworks will be developed by regulation for the generation of electricity from renewable energy sources, based on long-term recognition of a fixed price for the energy generated.
3. The abovementioned remuneration frameworks will be granted through competitive tendering procedures in which the product to be tendered for will be the electricity to be generated and the variable on which it will be offered will be the remuneration price of this electricity.
4. In the competitive tendering procedures that are organised, it will be possible to distinguish between different energy generation technologies depending on their technical characteristics, manageability, location criteria, technological maturity or anything else that may guarantee the transition to a decarbonised economy, in accordance with EU regulations.
5. Until the new remuneration frameworks and their granting procedures are developed via regulations, the calls provided for in paragraph 2 will take place pursuant to Article 14(7) of Law 24/2013 of 26 December 2013 on the Electricity Sector and its implementing regulations.

- **Local participation in renewable generation projects**

  Mechanisms will be established via regulations **to promote a diversity of actors and the existence of participatory citizen projects**, with the aim of promoting both social and territorial cohesion and a just transition, and to take advantage of the opportunities presented by the new decarbonised generation model.

  A support mechanism will be established through which participatory citizen projects can enter into a contract of sale for their electricity at a fixed price tied to the result of the tenders. An annual quota will be reserved for participatory citizen projects and will be granted to the first that request it and comply with the requirements until the energy quota is met. Furthermore, the question will be assessed of whether the projects that join the support mechanism could have public guarantees to facilitate financing and make it cheaper.

  In addition, options will be assessed for designing tenders that favour projects that take into account the social component through, among other things, citizen participation in financing or the existence of a profit-sharing plan, in which part of the revenue is allocated to activities agreed with local agents.

- **Specific programmes for developing technologies**

  Some energy generation technologies (for example, marine energy and energy from offshore wind in deep waters), although they remain uncompetitive, have great potential. For these, a specific tender schedule is proposed with a reduced power capacity that will make it possible to accommodate demonstration or flagship projects. Depending on the specific needs in each case, the tender could be supported with public financing.

  In the case of offshore wind power, the reduction of its generation costs in actual and planned installations in the short term in Europe already shows a high potential in Spain with floating technology on the 2030 horizon. Therefore, the support mechanisms and capacity volumes in the competitive calls for tenders will be adapted to the growing levels of competitiveness of this type of power, paying attention to its contribution to the consolidation and competitiveness of the industrial fabric and its synergies with other strategic sectors (shipbuilding, shipyards, civil engineering, electro-intensive industries).

  In addition, and taking into account the high energy potential and a solid base of companies in the wind energy value chain, the IDAE will coordinate the drafting of a ‘Spanish Strategy for the development of offshore wind energy’, the conclusions and objectives of which may be incorporated into the periodic reviews of this National Plan.

- **Specific programme for territories not on the mainland**

  Aid programmes are planned for new renewable energy facilities, in particular those that can provide a guarantee of power.

  This programme is justified by the fact that the electricity systems in territories not on the mainland are subject to special regulations that mean that conventional backup technologies are being use to a greater extent and that generation costs are higher. Furthermore, investment and operating costs are higher than those of sites on the mainland, such that it would not possible to compete on a level playing field with them as regards renewables tenders.

d) Responsible bodies

The calls for tenders must be made by the Ministry for Ecological Transition (MITECO). MITECO and the Governments of the Canary and Balearic Islands and the cities with a Statute of Autonomy must collaborate on drawing up specific programmes for territories not on the mainland.

Measure 1.2. Demand management, storage and flexibility

a) Description

The integration of the new renewable capacity provided for in this Plan substantially modifies the electricity generation model, evolving from one with centralised generation based on ‘base’ and ‘peak’ with a predominantly passive demand, to a new model where generation variability must be managed using all the tools available for this, both large-scale storage within the generation systems themselves or separate from them, as well as demand management that makes the consumption curve more flexible, adapting it to the generation. On the other hand, new demands arise, such as electric vehicle charging, which through smart management can be an additional tool to facilitate demand and network management.

In fact, increasing the flexibility of the system is one of the actions that contributes to achieving the objectives for electricity generation from renewable sources set out in this INECP. The contribution to further integration of the electricity market is addressed in Measure 4.4.

In addition, depending on the characteristics of the geographical areas, the rapid changes in consumption and generation dynamics can pose challenges for the management of distribution networks. In this sense, distributor use of the services that may be offered by the distributed energy resources in their area emerges as a possible cost-efficient alternative to solve network congestion or other challenges at local level.

In turn, and as stated in Measure 1.14 on promoting the proactive role of citizens in decarbonisation, regulatory changes at Spanish and European level and technological development promote the transition of citizens from being passive consumers to actors and producers, and also enable them to participate in demand management through energy efficiency systems, the provision of electric vehicle charging services or other energy services.

It is necessary to promote and communicate to citizens the tools available to them to become actors in the energy system and to thus benefit from the economic savings available through changes in consumption patterns, while adding value to the system as a whole. Furthermore, in an increasingly digitalised society, the significant deployment of smart meters will enable consumers to access information on their energy consumption data in real time, to become more involved in the energy market and to adjust their consumption according to market signals.

Due to the level of discharges in an electricity system with a high penetration of renewables, this surplus energy represents an opportunity that can be exploited with a complex storage system. There are different technologies for the use of these discharges, through their energy transformation and subsequent storage. Among other alternatives, it would be possible to use the potential renewable discharges for conversion into hydrogen, since there is the possibility of storing this fuel, as well as mixing it with natural gas in the transmission network, which means exploiting the potential for coupling the gas and electricity sectors for joint demand management of both sectors.

All this requires regulatory developments, market organisation and business models to exploit the potential of distributed energy resource management in general, and demand management in particular, both for the benefit of the system to enable the integration of renewables and grid management under the best conditions of cost-efficiency and security of supply, as well as to ensure that consumers, individually or in aggregated form, directly or through other figures, can participate in the provision of these services.

b) Objectives addressed

Activation and promotion of demand management in various sectors (transport, residential, industrial and services sectors); promotion of citizen participation in demand management; boost of the digitalisation of users in the energy sector.

c) Mechanisms

- **Development of the regulatory and legislative framework for demand management**

  It is necessary to determine the technical requirements for participants offering energy from renewable sources, energy storage managers and those providing demand response services, to participate in existing and developing markets. Furthermore, to ensure the participation of small consumers, it is necessary to develop the figure of the aggregator, and in particular the independent aggregator, as well as their right to enter the electricity market without the consent of other participants. This development must address the allocation of clear roles and responsibilities for electricity companies and customers, which will enable the exchange of and access to data on an equal and non-discriminatory basis, while protecting relevant information, and establishing a mechanism for resolving disputes between those providing aggregation services and other market participants, including responsibility for deviations.

- **Development of legislative framework and promotion of storage**

  With regard to storage, 6 GW of additional power is installed (including pumping and other storage technologies), providing greater capacity for managing generation. The decrease in the costs of renewable energy for electricity generation and storage is significantly altering the profitability assumptions for the different technologies, and therefore the future composition of the storage technology mix will depend on technology development and the relative merits of each alternative. In any case, it is necessary to provide for the figure of storage operator in the sectoral legislation to prevent this figure from being penalised by having to be assimilated to a producer/consumer.

  To ensure that the electricity system has the abovementioned storage capacity, the need to establish remuneration frameworks will be analysed. Such frameworks will complement the price signals of the energy markets and the system balance perceived by these installations, taking into account the degree of maturity of the different storage technologies. The design of these mechanisms will be determined by capacity analyses carried out by the system operator over the different time horizons and will be integrated, where appropriate, into any capacity mechanisms developed in accordance with the principles set out in the internal electricity market legislation.

  To contribute to the fulfilment of the renewable energy objectives established by law, the use of non-flowing public water resources to generate electricity in any new concessions granted will prioritise support for the integration of non-dispatchable renewable technologies into the electricity system. To this end, reversible hydropower plants will be promoted in particular to enable the management of renewable production, respecting a flow regime that makes it possible to comply with the environmental flows of the water bodies affected and supporting river basin regulation under conditions of extreme phenomena, so that it is compatible with the efficient management of water resources and their environmental protection. Regulations may enable mechanisms that will make it possible to apply a pumping, storage, and turbination strategy to any new concessions granted in order to maximize the integration of renewable energies, always conditional on the fulfilment of environmental objectives in the river basin plans.

  In addition, it is important to note the increase in thermal storage that will occur, associated with concentrated solar power (CSP) installations. Installations that increase their installed capacity by 5 GW between 2021 and 2030 and that have nine hours of storage using molten salt tanks.

- **Promotion of the coupling of sectors**

  The coupling of sectors, i.e. the alignment with other uses of the energy, such as electric vehicle charging, heat or cold generation for industrial or air-conditioning uses, hydrogen production, etc., makes it possible to introduce manageability in the electricity demand while also responding to other uses of the energy, making it possible to reduce discharges and take advantage of more economical energy for certain uses.

- **Managing distributed energy resources in local markets**

  Development of the legal framework to enable and encourage distribution network operators to obtain flexibility and balancing services from distributed generation suppliers, demand response or energy storage, as a cost-efficient alternative to more conventional network management mechanisms. In this sense, the IREMEL project between IDAE and OMIE analyses the potential and needs associated with this possibility.

- **Options and signals suitable for consumers**

  Users who wish to do so should be able to make choices and act on their energy consumption with a contract associated with dynamic pricing. This should allow them to adjust their consumption according to real-time price signals that reflect the value and cost of electricity or transmission over different time periods. This will require the identification and removal of the legal and administrative barriers that make it difficult for consumers to choose when to consume, store and/or sell self-generated electricity on the market, or to participate in all electricity markets (disproportionate fees or administrative charges, etc.).

  It is also necessary to analyse the possibility of legislative development for bilateral contracts and energy exchanges between self-consumers and consumers through platforms to encourage peer-to-peer exchange and to monitor transactions.

- **Advice, promotion of active clients and activation of other agents involved**

  Information and awareness-raising campaigns for citizens on the possibilities and options available, and the benefits they bring, to promote their participation in the market, responding to price signals. It is also necessary for consumers to have information concerning their energy rights to facilitate the best decision-making on all the options available to them.

- **Development of qualified human resources**

  In line with Measure 1.17 on training professionals in the renewable energy sector, training programmes will be launched for builders, developers, installers and architects, with the intention of promoting the inclusion of any elements necessary to implement demand management measures (home automation, building automation, Internet of things, big data, two-way electric vehicle chargers, storage, systems automation, smart meters, etc.), from the design phase of new buildings (residential and services), and in the refurbishment of existing ones.

- **One-stop shop and simplification of procedures in the processes linked to demand management and the integration of renewable energies**

  The current administrative approval processes may make it difficult to develop demand management. The existence of a one-stop shop that can guide the applicant and act as an intermediary throughout the administrative procedure to apply for and grant permits, will reduce the difficulties and complexity of the processes linked to demand management and integration of renewable energies.

- **Pilot projects for demand and storage management**

  Promotion and development of pilot projects for demand and storage management, new figures that can participate in this management and its application, inter alia, in local energy markets.

d) Responsible bodies

MITECO, IDAE (Institute for the Diversification and Saving of Energy), CNMC (National Commission on Markets and Competition), REE (the Spanish national grid), distribution network operators (electricity and gas), electric vehicle recharging infrastructure operators, regional governments and sectoral associations.

Measure 1.3. Adaptation of electricity grids to integrate renewables

a) Description

The production of electricity in Spain using renewables represented 46% of the installed capacity of the entire generator stock at the end of 2017. In comparison with other European countries, in 2017 Spain was in sixth position in terms of renewable generation capacity, with a renewables share as a proportion of total generation above the European average. This level of penetration is even more commendable, given that the renewable technology with the highest share in the electricity system is wind energy without storage (which contributed 18.2% of the electricity generated in 2017), since this is a technology with low capacity for manageability.

This level of integration of renewables has been possible thanks to **REE's Special Regime Control Centre (CECRE).** CECRE has been a world-leading centre for more than a decade, managing and monitoring, in real time, the energy generated by wind farms, which are assigned to generation control centres that channel the system operator's instructions.

The Plan seeks to cover 74% of electricity consumption with renewables by 2030. To minimise discharges of renewable energy, to link electricity generation and demand, to maximise the use of grid capacity and to reduce the need for fossil-fuelled thermal power stations as a back-up system, it is necessary to strengthen and grow the transmission and distribution lines in Spanish territory, including peninsular connections, non-peninsular systems and interconnections between island systems.

It is equally important to develop the appropriate legislative framework and to promote certain actions that allow progress to be made towards a more flexible electricity system, which minimises discharges and makes better use of existing infrastructure, through the use of storage and demand management and updated connection criteria.

In fact, increasing the flexibility of the system makes it possible to achieve the renewable energy generation objectives set out in this INECP without increasing the capacity of natural gas combined cycles as a backup technology.

b) Objectives addressed

To address the new needs of electricity grids in such a way that they enable the integration of renewables, the participation of new actors and security of supply, both for onshore and offshore infrastructures.

c) Mechanisms

It is necessary for the system to properly accommodate the large renewable energy generation capacity promoted by the Plan in a way that ensures the security of the system. The following actions are planned for this purpose:

- **Adaptation of electricity transmission and distribution network planning**

  The development and strengthening of the electricity transmission and distribution infrastructure must be adapted to the forecast development of renewable generation through the creation of new transmission nodes and the strengthening of existing ones, as well as the development of new international interconnections, transmission infrastructure under water and in systems not based on the mainland. In that regard, it is considered essential that the public and the administrations in the territories where these network infrastructure activities are planned participate in the planning of these activities in order for the plans to be implemented properly.

Specifically, the planning of the transmission network, for which the State is responsible, must take into account that in the coming decades the environment in which it will operate will undergo substantial changes as a result of the factors established in this Plan. In addition to the traditional requirements of security of supply and reliability, of the technical criteria established, as well as the economic criteria, of economic and financial sustainability of the electricity system and the compatibility of the development of the electricity transmission network with environmental restrictions that seek to minimise the overall environmental impact, it is necessary to incorporate the following principles in order to speed up the development of infrastructures to fulfil the objectives of maximising the penetration of renewables into the electricity system, minimising the risk of discharges and in a manner compatible with the safety of the electricity system; renewable energy transmission in areas where there are high levels of renewable resources and where it is environmentally possible to exploit and transport the energy generated, both onshore and offshore; maximising the use of the existing network, renewing, expanding capacity, using new technologies and re-using existing installations; removing existing technical constraints and reducing network losses.

Finally, energy is a factor in the siting of economic activity, so the planning must provide an adequate response to the economy's needs for greater use of electricity by satisfying any new demands identified, including those derived from the development of high-speed rail infrastructure and electric vehicles, thus contributing to the generation of wealth, employment and structuring of the territory.

In addition, the planning procedure will be revised so that it is compatible with new European directives and regulations.

The development of projects in the electricity transmission network with particular effect on the internal market is specifically addressed in Measure 4.3 of this Plan.

- **Digitalisation and management**

The design and operation of the transmission and distribution networks will have to deal with important challenges such as the existence of a greater distributed generation with higher levels of intermittency than the current levels, as well as the transformation of the traditional model of one-directional energy flows from the generation centres towards a model of bidirectional and intermittent flows.

Likewise, to optimise investments in a context of strong penetration of renewables and growing electrification of the economy, the networks will have to carry out a significant digitalisation process that will allow them to improve their monitoring, control and automation systems. Additionally, the digitalisation of networks will make it possible to carry out effective demand management and to integrate new services for consumers such as smart charging systems, storage or demand aggregators.

One mechanism for promoting this is the remuneration schemes for regulated electricity distribution and transmission activities, which enable the necessary progress in digitalisation, encourage innovation and the application of alternative solutions to traditional investments that may entail savings for the system, and recognise the greater level of interaction between network operators and users, all within a context of greater penetration of distributed energy resources connected to the network.

The transmission and distribution system operators will also play an important role in the penetration of new renewable generation so that it can be integrated safely into the system. In this sense, Commission Regulation (EU) 2016/631 of 14 April 2016 establishing a network code on requirements for grid connection of generators sets out the importance of close cooperation between generation installation owners and network operators. The latter will be responsible for verifying the conformity of the technical requirements that must be met by the new electricity generation modules in accordance with the provisions of the abovementioned regulation.

- **Definition of the network connection capacity**

In order to enable the new renewable energy generated to be transferred without oversizing the network it is necessary to review the criteria used to define the access and connection capacity of each node on the network, so that it is according to the maximum permissible power transfer and the associated safety conditions and not according to the peak capacity of the installation to be connected. In addition, incentives should be provided to optimise network connection capacity, including through the hybridisation of renewable and/or storage technologies. Furthermore, it is necessary to guarantee the transparency of the connection capacity available on the network, with the aim of facilitating the development of new renewable capacity in the right locations.

In this sense, the General State Administration and the CNMC will, within the scope of their respective competences, develop the regulatory framework that establishes the conditions and procedures necessary to process and obtain permits for access and connection to the networks. This regulatory development will contribute to achieving the objective of penetration of renewables and will adopt measures aimed at avoiding speculative behaviour for the benefit of any agents interested in developing projects.

- **Operating procedures**

  The operating procedures will be reviewed and updated in line with economic and technological changes.

d) Responsible bodies

General State Administration (MITECO, CNMC, MCI), REE, distributors and managers of distribution networks and autonomous regional administrations.

Measure 1.4. Development of own consumption using renewables and distributed generation

a) Description

Own consumption with renewables brings energy generation closer to its consumption and, therefore, reduces losses, increases the involvement of consumers in the management of their energy and reduces the territorial impact of renewable production. Turning consumers into producers is a way to expand possible future sources of financing for the development of renewables.

The following applications should be highlighted in this regard:

- **Collective own consumption and starting point for local energy communities**

  Collective own consumption, developed in Royal Decree 244/2019, enables several consumers within the same community (residents' association, a neighbourhood, an industrial park, etc.) to benefit collectively from the same nearby generation facilities, located within the community, which means that they can take advantage of the generation capacity and, therefore, of the investment.

  To make the most of this option it is necessary to **streamline the economic and administrative costs involved** and, in particular, to promote **training and capacity-building programmes** for the citizens and communities that can take advantage of collective own consumption so they can have the human and technical resources that will allow them to identify, process, execute and manage the projects, as well as to mobilise the necessary investments. This can entail them forming local energy communities, an objective that is promoted by Measure 1.13 of this Plan.

- **Combating energy poverty**

  As set out in the 2019-2024 National Strategy against Energy Poverty (see Measure 4.11 of this Plan), own consumption systems can be a tool for mitigating energy poverty. In this sense, **the administration's activities relating to the development of public housing estates, access to housing and the activities of the social services** should take account of the potential of own consumption to reduce electricity bills and the energy dependency of vulnerable families and groups. Measures promoting own consumption should also aim to make it affordable for everyone in society and, in particular, for those vulnerable consumers who are excluded from own consumption under market conditions without specific measures.

  Furthermore, collective own consumption schemes and more dynamic energy management mechanisms enable the public administrations and social organisations **to manage situations of energy poverty not only through economic aid but also through the allocation of a share in collective own consumption promoted by these public administrations or social organisations**, which would directly reduce the energy bills of consumers at risk of energy poverty.

- **Own consumption as a measure of competitiveness**

  Energy is a cost factor in the majority of economic activities, for which reason energy price increases or variability can be particularly damaging to the competitiveness of businesses.

  The generalised installation of own-consumption facilities linked to economic activities (particularly in high-energy consumption environments like industrial parks) will enable energy costs to be reduced and stabilised in the long term.

  In this regard, special attention should be paid to the development of own consumption at irrigation facilities, given that this is a sector with intensive energy consumption and that the cost of energy is a fundamental factor in setting the prices of irrigated agricultural products. In order to achieve the successful uptake of this measure, it will be imperative for the administrations and irrigating communities to work together.

Likewise, the involvement of the residential tourism sector will be sought in the promotion of electricity own consumption, due to the improved costs that can be achieved by the industry in the medium term, its knock-on effect on other sectors of the economy and the added value that it brings to the tourist offering in our country faced with European customers who are increasingly concerned about the climate crisis and energy transition.

b) Objectives addressed

Decentralised generation, generation using renewables, and public participation.

c) Mechanisms

The following mechanisms are planned to promote the development of own consumption:

- **National Own consumption Strategy**

  The own consumption objectives will be set out in the future Strategy for the 2021-2030 period. As part of this strategy, the penetration potential will be analysed for each type of consumer (residential, services or tertiary, industrial), so that indicative objectives can be set for the period, which will be ambitious but achievable.

  The required technical-economic sustainability of the electricity system will also be considered, enabling both the distribution networks and the structure of the electricity tariff to be adapted to the new generation scenario. In any case, the deployment of own consumption in Spain will be monitored quantitatively and qualitatively, in accordance with the monitoring mechanisms provided for in Royal Decree 244/2019.

- **Soft financing**

  This facilitates the mobilisation of private investment, enabling the return of financing based on the economic savings made as a result of the own consumption of the energy generated.

- **Management by third parties or the energy services model**

  Under this model, companies specialising in energy services, such as electricity traders, invest in own consumption facilities and maintain them, selling the energy produced to consumers under favourable terms. This avoids the consumer company, family or administration having to make an investment in or take charge of an activity of which they have no experience.

- **Measures to promote local involvement**

  Given the local nature of own consumption markets, it is necessary to implement promotion measures at the municipal, regional or, where applicable, island level, in particular by simplifying processes (e.g. the simple prior notification in the case of installations on buildings that are not protected for heritage purposes) and properly integrating the measures into urban planning instruments. The General State Administration will coordinate the development and monitoring of best practices with local, island and regional bodies for this purpose.

- **Promotion of own consumption in vulnerable sectors**

  Promotion of experiments that take advantage of the potential of own consumption legislation to develop systems in which public or private self-consumers can share their generation surplus with vulnerable households, as well as other specific measures aimed at mitigating fuel poverty.

- **Manual for own consumption in urban environments**

  The IDAE will produce a manual for the implementation of own consumption energy systems in urban environments to facilitate decision-making by municipal authorities.

d) Responsible bodies

Local and autonomous regional administrations, with the general framework defined by the General State Administration, specifically the ministries responsible for energy (MITECO) and finance, and the IDAE.

Measure 1.5. Incorporation of renewables in the industrial sector

a) Description

The introduction of renewable energies in industry contributes to progressing towards the decarbonisation of the economy and the use of competitive energy alternatives.

According to '*La Energía en España 2016*' ['Energy in Spain 2016'], **final energy demand in the industrial sector accounted for around 24% in 2015**. **Renewable energy sources** (primarily biomass) covered **7%** of this demand. There is thus potential for biomass, as well as other thermal renewable energy sources (particularly, biogas and solar thermal energy) to contribute more heavily to the decarbonisation of the industrial sector. As for the possibilities of electricity own consumption in the industrial sector, although it has hardly been developed so far, there is also a potential to be exploited.

When designing the mechanisms, both increasing the penetration of renewables into subsectors that already consume them and diversifying the industrial subsectors will be assessed, given that there is currently a concentration of renewable energy consumption in four very specific subsectors (cement production, pulp and paper production, drinks and tobacco, and timber and timber products).

The progress of energy efficiency and process management in the industrial field is specifically addressed in Measure 2.5.

b) Objectives addressed

To promote the decentralised generation of renewable energies and own consumption in industry.

c) Mechanisms

The following actions are planned for the development of renewable energies in industry:

- **Aid programmes to incorporate renewable energies into industrial processes**

  Aid lines for industries or the heating networks that supply them, depending on the potential, cost and characteristics of the technology and the potential improvement in their carbon footprint.

- **Institutional capacity building**

  The specific incorporation of the energy dimension into industrial policy tools will be promoted (at all levels of the administration).

- **Sectoral agreements**

  Voluntary agreements will be made with specific industrial subsectors to encourage increased consumption of renewable energy.

- **Aid for conducting energy studies, reports and audits that will help the industry to move towards less carbon intensive processes**

  These studies should identify the different technology options in line with the specific process heat requirements of each industrial subsector (on the basis of the documents on the best available techniques developed within the framework of Directive 2010/75 on industrial emissions), their physical, technical and economic potential, and the identification of challenges and proposals for measures.

d) Responsible bodies

MITECO, IDAE, the Ministry of Industry, Trade and Tourism (MINCOTUR), autonomous regional administrations and sectoral associations.

Measure 1.6. Framework for the development of thermal renewable energies

a) Description

Energy consumption for thermal uses in Spain in 2015 accounted for more than 33% of the total final energy consumption. In the same year, the contribution of renewable energies to consumption for heating and cooling was around 16.8%. To achieve the objectives of this Plan, it will be necessary to double this contribution by 2030.

The revised Renewable Energy Directive provides that Member States must implement the necessary measures to increase renewable energy quotas for consumption for heating and cooling by 1.3% annually from the value achieved in 2020 (1.1% if residual heat is not included). The path of thermal renewables envisaged in this Plan would make it possible to exceed this indicative objective. Renewable energy communities can therefore play an important role in achieving this objective, primarily in relation to the development of heating and cooling networks.

With regard to heating and cooling networks, according to the statistics reported in the framework of Article 24(6) of Directive 2012/27/EU, the final energy consumption in heating and cooling networks in Spain in 2017 was 1,777.29 TJ (approx. 42.5 ktoe). Since the final energy consumption in the heating and cooling sector was 28,904.7 ktoe, the share of heating and cooling networks out of the total consumption in the heating and cooling sector was 0.15% (i.e. well below the 2% set out in Article 24(10)(a) of Directive 2018/2001 on the promotion of the use of energy from renewable sources).

However, and given the potential for developing district heating and cooling identified, this Plan considers specific measures, both regulatory and on financial support, to enable district heating and cooling using renewable fuels to play a much more significant role by 2030.

b) Objectives addressed

Promotion of the penetration of renewable energy sources for thermal uses, in particular in the building sector and as regards heating and cooling networks.

c) Mechanisms

- **Assessment of the potential of energy from renewable sources and of the use of waste heat and cold and other uses**, in the framework of Article 14 of Directive 2012/27/EU and Article 15 of Directive 2018/2001/EU. This assessment will be available by 31 December 2020 at the latest and will be carried out in accordance with the provisions of Commission Delegated Regulation (EU) 2019/826 amending Annexes VIII and IX to Directive 2012/27/EU and with the recommendations on the subject to be published by the European Commission.

  This assessment will include, inter alia, an estimate of heating and cooling demand in terms of useful energy and final energy consumption by sector; an identification and/or estimation of the current heating and cooling supply by technology; the identification of any installations (from the capacity thresholds detailed in the Regulation) that generate waste heat or cooling and their potential for providing heating or cooling; a forecast of trends in demand for heating and cooling in order to have an outlook for the next 30 years; an analysis of the economic potential of the various technologies, including heat pumps; and an overview of the legislative and non-legislative measures that will make it possible to achieve this economic potential. The result of this evaluation will be taken into account to update the evolutionary paths of renewable energies in thermal uses in the relevant revisions of this Plan, as well as in the implementation of the mechanisms described below.

- **Mechanisms guaranteeing a minimum share for renewable energies in the thermal uses sector**

  In accordance with Article 23 of Directive 2018/2001/EU, the subjects affected, the eligible projects and how the energy contributions will be accounted for will be determined. The economic compensation that would be contributed by each subject, where appropriate, will also be calculated. This will serve as a source of funds, to be implemented through the aid programmes.

A certificate/guarantee of origin mechanism or similar will be set up to either certify compliance with these measures or voluntarily verify the renewable origin of the thermal energy for actors not subject to the measures.

- **Specific mechanisms related to the building sector, where the Ministry of Transport, Mobility and Urban Agenda (MITMA) plays a fundamental role:**

  - **Integration of thermal renewable energies in building**

    It is necessary to review and increase the energy efficiency and renewable energy requirements in the Technical Building Code (*Código Técnico de la Edificación* — CTE), as well as the minimum requirements to be met by thermal installations, by means of the Regulations on Thermal Installations in Buildings (*Reglamento de las Instalaciones Térmicas en los Edificios* — RITE), for all new buildings and refurbishments.

  - **Aid programmes (loans and subsidies)**

    Aid schemes for installations in buildings or heating networks, depending on the characteristics, potential and cost of each technology and the potential impact on improving the carbon footprint. In particular, specific schemes will be created for:

    - Upgrading existing solar thermal facilities
    - High-efficiency ambient energy equipment to replace obsolete systems
    - Upgrading biomass equipment with other high-performance equipment
    - Geothermal energy facilities with heat pumps and direct use
    - Hybridisation of renewable technologies to achieve 'nearly zero-energy buildings'
    - Integrated, standardised and compact heating and cooling thermal installations.

The specific processing of support for small-scale facilities will be assessed, designing simplified lines through the equipment installer or retailer.

The Ministry of Finance will also analyse the desirability and viability of possible changes to the fiscal framework to send signals with a view to incentivising electrification and the use of renewables for thermal requirements, and avoiding indirect subsidies for fossil fuels.

- **Mechanisms related to the promotion of heating and cooling networks**

  - To **annually collect the information** needed to fulfil the statistical obligations on heating and cooling networks, both existing and new, including at least the installed capacity, technology used, fuel used, energy produced and whether the installation meets the definition of 'efficient district heating and cooling' in the Energy Efficiency Directive (at least 50% renewable energy, 50% waste heat, 75% cogenerated heat or 50% of a combination of such energy and heat).
  - Moreover, mechanisms will be put in place to ensure that information is provided to final consumers about energy efficiency and the share of renewable energy in the heat networks to which they are connected. The possibility of implementing this measure by amending the legislation on existing thermal installations (RITE), as well as the legislation concerning the energy certification of buildings, will be evaluated.
  - **Evaluation of the potential** of these networks in new urban development projects.
  - **Development of renewable energy communities** linked to climate control networks, including technical training at the municipal level.
  - Ensuring that a **cost-benefit analysis** is conducted for each new urban development.
  - **Legislative analysis** and implementation of measures for potential users.

d) Responsible bodies

General State Administration (MITECO, Ministry of Finance and MITMA); local and autonomous regional administrations.

Measure 1.7. Advanced biofuels in transport

a) Description

Transport contributes heavily to greenhouse gas emissions (**27% of the total in 2016**). Consequently, it is a key sector in the decarbonisation process.

Road and rail transport represent almost **one third of total energy consumption**, representing 28,241 ktoe in 2016 (28,368 ktoe according to the methodology established in the Renewable Energy Directive). That year, the contribution of renewable energies in this sector reached **5.3%** (calculated pursuant to the aforementioned methodology).

The revision of the Renewable Energy Directive establishes an overall objective for renewables in transport of **14% by 2030**. Furthermore, specific objectives for advanced biofuels have been set for 2022 (0.2%), 2025 (1%) and 2030 (3.5%). This overall objective for renewable energies and, consequently, the decarbonisation of transport will be achieved by reducing consumption (for example, by promoting a modal shift) and with the contribution of different technologies (primarily biofuels and renewable electricity).

The measures relating to both the modal shift, particularly in the sphere of urban and metropolitan mobility, and the electrification of transport, understood in terms of the vehicle fleet and recharging infrastructure, are explained in more detail in the Energy Efficiency section of this Plan, and therefore this measure is focused on advanced biofuels.

Biofuels are currently the most widely available and widely used renewable technology in transport. Furthermore, in some sectors, such as heavy vehicles (whose consumption is a significant share of the total for road transport) and aviation, they will continue to be the only way to reduce the use of fossil fuels over the coming years.

In order to achieve the objectives for consumption of advanced biofuel, advanced biofuel production must be boosted, as it is still very low. This is due, in some cases, to the limited availability of some of the raw materials required and, in others, to the lack of technological maturity of some of the manufacturing processes involved in producing this type of biofuel.

With the exception of biofuels produced from the raw materials listed in Annex IX to Directive 2018/2001, the rest are expected to be produced from conventional agricultural products or similar.

b) Objectives addressed

Penetration of advanced biofuels in the transport sector.

c) Mechanisms

The following mechanisms are planned in this regard:

- general obligation to sell or consume biofuels;
- adaptation of the certification system to specifically cover advanced biofuels and, in particular, biomethane injected into the network;
- aid programme for advanced biofuel production facilities;
- promotion of facilities for the production of renewable fuels of non-biological origin;
- establishing a specific obligation to sell or consume advanced biofuels for the 2021-2030 period;
- promotion of the consumption of labelled blends of biofuels, through measures that enable this option to be offered at service stations;
- establishing specific consumption objectives for biofuels in aviation.

d) Responsible bodies

MITECO and MCI.

Measure 1.8. Promotion of renewable gases

a) Description

Renewable gases are one of the few renewable energy vectors that can be used both to generate electricity and to cover energy demand in high-temperature industrial processes and in transport.

There are different types of renewable gases and this measure refers mainly but not exclusively to: biogas, biomethane and hydrogen of 100% renewable origin (both the resource and the energy used in the process to obtain it).

To date, the promotion of renewable gases has been limited mainly to biogas. In terms of reducing greenhouse gas emissions, biogas achieves not only the reduction derived from using a 100% renewable fuel[37], but also an additional reduction in non-energy emissions (mainly, CH_4), linked to better management of municipal waste, sewage sludge and waste from both agriculture and livestock as well as the agri-food industry.

The measures implemented to remunerate electricity generation at biogas plants have not achieved the expected results, with the use in Spain far below the existing potential and far from that achieved in other European countries. Primary energy from biogas in the European Union exceeded 16,000 ktoe for the first time in 2016, with Spain's contribution accounting for 1.4%. In recent years, the purification of biogas into biomethane has gained importance as, once certain quality requirements are met, the biomethane can be injected into natural gas networks[38]. This means an improvement in the possibilities of biogas energy use. The European Biogas Association estimates that there are more than 500 biomethane plants with grid injection in the European Union, one of which is in Spain. The second plant is scheduled to start up in the first quarter of 2020.

Biogas is the renewable gas that takes precedence in the short and medium term, due to aspects of technological development, available potential and production costs. After it is upgraded to biomethane, it can have the same uses and users, and uses the same infrastructure as natural gas[39]. It is of particular interest for decarbonising the demand that is usually linked to thermal uses in industry, and is difficult to decarbonise with other renewables. Additionally, its production and use is linked to waste management and the circular economy.

In the long term, the appearance of hydrogen of 100% renewable origin (both the resource and the energy used in the process to obtain it) could be important as a flexible energy vector, allowing the integration of surplus variable renewable electricity and the use of gas infrastructures. Hydrogen can only be considered as a renewable gas when it is obtained using 100% renewable electricity, through processes such as water electrolysis. The use of 100% renewable hydrogen contributes to a twofold objective: on the one hand, to reducing local polluting emissions and greenhouse gases during the entire production and use cycle; on the other hand, to taking advantage of surplus electricity from renewable sources at times of low demand. Its main qualities are the following:

- it could be used in fuel cell electric vehicles without generating local emissions. It can be used in heavy road transport or on ships, etc.;
- its immediate use in industry (without the need to store it) as a substitute for other fossil fuels;

[37] Biogas (CH_4 + CO_2 + other traces) is obtained from the anaerobic digestion of the biodegradable fraction of livestock waste, sewage sludge etc.

[38] Biomethane produced via the anaerobic digestion of waste materials is considered to be an 'advanced' biofuel, i.e. produced from the raw materials under Annex IX.A to the Renewable Energy Directive (Directive 2009/28, amended by Directive 2015/1513). Annex V to Directive 2009/28, on the promotion of the use of energy from renewable sources, establishes that the typical reduction in greenhouse gas emissions resulting from the use of biogas produced from waste is between 80% and 86%, depending on the type of waste concerned.

[39] Given the high global warming potential of methane, it is critical to consider the fugitive emissions of this gas from the various *upgrading* processes, since processes that do not achieve very high methane recovery yields will have associated GHG emissions that are much higher than other renewable gases such as biogas.

- its energy density[40] makes it a suitable energy vector for storing energy (particularly seasonal) and subsequently releasing it gradually;
- it can be converted into synthetic natural gas through CO_2 capture and, in this case, it has no restrictions on being introduced into the natural gas networks.

Additionally, as a result of the reduction in the costs of electricity produced using renewables, and of hydrogen electrolysis and energy recovery technologies, there are also potential opportunities for other renewable gases in the medium and long term.

Finally, depending on technological development, mechanisms will be proposed to promote power to gas or the production of renewable gases through electricity.

b) Objectives addressed

Promotion of renewable gases for use in electricity generation and thermal uses.

c) Mechanisms

The push to use renewable gas focuses on overcoming the main technical and administrative barriers it faces. Such barriers include the following, inter alia:

- high cost of production from renewable sources, much higher than the extraction and processing of fossil fuels or the production of decarbonised (or low carbon) gas from raw materials of fossil origin;
- there is no recognised certificate of origin to guarantee its renewable origin and enhance its consumption;
- the need to clearly establish the rights, obligations and responsibilities of the participants involved in the production, transport and marketing of renewable gas, providing them with the necessary legal certainty to undertake their activity;
- the advisability of defining the conditions for the physical injection (connection) of biomethane and the provision of biomethane transport and distribution service (access);
- a lack of awareness among end users, especially with regard to the safety of its handling and the validity of the equipment, making it necessary to carry out dissemination, information and awareness-raising actions;
- shortage of supply facilities. For example, hydroelectric plants are subject to a complex set of procedures to obtain the required permits, and are regulated as a set of independent facilities. They involve high investments and long recovery periods.

In view of the above barriers, the penetration of renewable gas, including biomethane, 100% renewable hydrogen and other fuels where their manufacture has used only raw materials and energy that are of renewable origin, will be encouraged through the approval of specific plans, including RDI actions both for biogas and hydrogen and for less mature technologies such as power to gas.

To carry out these plans, the situation of renewable gases in Spain will be analysed, taking into account the different degrees of technological maturity of the different options, which will include the following:

- Determining and projecting the theoretical production potential by 2030/2050. Justification of the associated demand, technically viable and economically profitable in comparison with other decarbonisation options, considering benefits based on system flexibility (electricity-gas binomial), as well as the potential to use and exploit the existing natural gas network.
- Defining a strategy for determining the most efficient use and the most effective way to take advantage of this resource.
- Designing aid mechanisms, based on penetration targets that make it possible to use the renewable gas efficiently, supported by a certification system that makes it possible to oversee and monitor targets, as well as flexibility mechanisms that encourage maximum efficiency in achieving the targets in competition with other decarbonisation options.

[40] The energy density of H_2 is equivalent to about one-third the energy density of methane (CH_4).

- Developing regulations that permit the injection of these renewable gases into the natural gas network.
- Determining a system of guarantees of origin for renewable gases that confirms their origin and traceability and the environmental impact associated with their production and use.
- Identifying and removing regulatory barriers that hinder the development of renewable gases, especially power to gas.

d) Responsible bodies

General State Administration (MITECO); local and autonomous regional administrations.

Measure 1.9. Plan for the technological upgrading of existing electricity generation projects with renewable energies

a) Description

Over the 2021-2030 decade, approximately 22 GW of renewable electricity capacity will have come to the end of its statutory useful life. Without a specific plan for the technological upgrading of these projects, it is foreseeable that there will be a reduction in the installed capacity from renewables, which is basically made up of old wind farms and small-scale hydroelectric plants, although the earliest biomass, biogas and photovoltaic facilities would also be affected. With the aim of preventing the loss of their energy contribution, it is necessary to develop a specific plan for the technological upgrading of these facilities.

Existing renewable electricity generation facilities represent a significant asset given their location in places with high energy resources, the existing infrastructure and network connection capacity, as well as the low environmental and territorial impact of developing new projects in locations already used for generating energy.

Upgrading the generators at or repowering existing projects will enable better use of the renewable resource by replacing obsolete or old systems with new higher-powered or more efficient ones. On the other hand, both these mechanisms as well as **hybridisation** through the incorporation of different generation or storage technologies into existing projects will enable better use of the available network connection capacity. In addition, upgrading to systems that comply with the latest network codes reduces the facility's impact on the grid, which will enable a more efficient use of the network and facilitate the connection of new renewable power at that node.

On an environmental level, re-machining, repowering and hybridisation can have a lower impact by concentrating renewable generation in a specific environment, reducing the total number of machines, and thus the project's footprint, and reducing the need for new network layouts.

b) Objectives addressed

Development of renewable energies. Renewal of old renewable facilities to maintain their capacity.

c) Mechanisms

The following mechanisms are planned:

- **Administrative simplification**

  Article 16(6) of Directive 2018/2001 on the promotion of the use of energy from renewable sources stipulates that the repowering of renewable projects must be subject to a simplified and swift permit-granting scheme, lasting no longer than one year. Since existing projects have already undergone administrative processing prior to being authorised, it is necessary to assess, inter alia, the possibility of applying the following simplifications during this processing, while safeguarding the proper integration of the infrastructure into the territory: exemption from the public interest procedure and the procedure for declaring the property and rights affected; exemption from the requirement to submit a new archaeological study, if one was already submitted for the existing facility; reduction of the processing times for environmental impact assessments; reduction of the timescales for notifying other public administrations for administrative authorisation and sending out the technical conditions for the approval of the project; and simplification of the requirements for demonstrating the applicant's capacity.

In the specific case of the environmental impact assessment, the existence of common cases between possible repowering projects makes it advisable to establish relatively homogeneous criteria and conditions for the processing of repowering projects.

- **Setting up coordination committees with the autonomous communities**

  In order to coordinate the administrative simplification described above, the active involvement of the autonomous communities is required, given their powers in the areas of urban planning and the environment and their knowledge of the reality in each territory.

- **Calls for tenders for the allocation of a specific remuneration scheme for technological upgrading projects**

  Specific tenders are proposed for the technological upgrading of renewable facilities that have reached the end of their statutory useful life. Thus, allocated projects that upgrade their equipment and facilities would receive a remuneration in addition to the one from the electricity market. The mechanism envisaged is a competitive tendering procedure, with a multi-annual schedule of tenders, to determine a cost-effective remuneration scheme for the application of public support, accompanied by the administrative measures required to take advantage of existing infrastructure.

  Both generator upgrade projects (with lower or equal capacity to that of the existing facility) and repowering projects (that involve an increase in capacity) will be accepted.

- **Regulation of the end of hydroelectric power station concessions**

  With a view to ensuring the necessary investments and ensuring that power stations do not cease to operate, once existing concessions end, it will be necessary to define the procedures and timescales applicable to these facilities via regulations.

d) Responsible bodies

General State Administration, local and autonomous regional administrations.

Measure 1.10. Promotion of bilateral renewable electricity contracts

a) Description

Globally, cities, communities, companies and individuals are demonstrating their interest in consumption of 100% renewable energy. The GO 100% RE initiative has mapped countries, cities, regions, companies and civil society actors, with a total of more than 62 million people that have made the change or are committed to making the change within the next decade to 100% renewable electricity supply.

The private sector is supporting the energy transition through the demand for renewable energy, with initiatives such as RE100, an international initiative launched during Climate Week NYC 2014, formed by private companies committed to 100% renewable electricity consumption. To date, numerous multinationals have joined the commitment to consume 100% renewable electricity. These companies operate in a wide range of sectors: automotive, clothing, finance, food and drink, IT, pharmaceuticals, property, retail, etc.

One possible mechanism for achieving a 100% renewable electricity supply is to enter into a bilateral contract with an electricity producer. Currently, in Spain, where bilateral contracts have started to take off, the main buyers within this scheme are power-marketing companies.

Although bilateral contracts represent an opportunity to complement other remuneration mechanisms and attract financing, they are not without challenges, such as those related to designing an optimal contract that balances the needs of the producer and the consumer, or the lack of knowledge among potential buyers about the existence of this mechanism.

The contracting of energy efficiency measures in the public sector is addressed separately in Measure 2.12.

b) Objectives addressed

Development of renewable energies and participation of new actors, by promoting the contracting of 100% renewable electrical energy.

c) Mechanisms

In addition to the mechanisms envisaged in the specific measures on public contracting of renewable energy and promoting the proactive role of consumers, mechanisms to encourage long-term bilateral contracting with renewable energy producers will be analysed, as instruments to reduce the risk of these operations or minimum contributions for certain large energy consumers.

d) Responsible bodies

Sectoral associations, MITECO, local and autonomous regional administrations.

Measure 1.11. Specific programmes for the use of biomass

a) Description

The management and use of biomass has added value in addition to its simple energy capacity. In particular, it can revitalise rural areas, mitigate the risk of depopulation and encourage better adaptation to the effects of climate change in some territories. Biomass can also play an instrumental role in terms of achieving a just transition. For this reason, biomass is part of various strategies put forward by the different public administrations beyond the scope of this Plan. Furthermore, waste is a key factor in the circular economy. It is therefore necessary to take steps to enable the linking and achievement of both objectives: a just transition and a circular economy.

For heat and electricity with biomass, it can be expected that the greatest development will occur with biomass of **forest or agricultural origin** (in industry, in general, it is already being used). An additional 1,600 ktoe/year is required for the increase in electricity generation and an additional 411 ktoe/year for thermal uses. In the Renewable Energies Plan (PER) 2011-2020, it was conservatively estimated that the additional potential in Spain is 17,286 ktoe/year, of which 10,433 ktoe/year is sustainable agricultural or forestry waste and the difference is new woody or grassy mass. Consequently, there are more than enough resources.

b) Objectives addressed

Penetration of renewable energy sources and displacement of fossil fuels, participation of new actors and innovation.

c) Mechanisms

Among the specific mechanisms to be implemented, the following stand out:

- **Promotion of energy from biomass with sustainability criteria**
  - Legislative development throughout the biomass value chain.
  - Strategy for the energy use of pruning waste from the agricultural sector.
  - Adaptation to obligations associated with air quality at both new and existing biomass facilities.
  - Strengthening certification and the principle of proximity to the source for biomass use.
  - Dissemination and promotion of high-efficiency, low-emission local heating equipment.
  - Specific training for installers and other professionals in the biomass sector.
- **Economic aid measures linked to:**
  - Biomass logistics plants.
  - Penalising the landfilling of waste. The establishment of agreed principles for the harmonised implementation (and creation, where applicable) of a tax on landfilling municipal and industrial waste, as already exists in various autonomous communities, will be encouraged.
  - Use of biomass in State-owned facilities.

d) Responsible bodies

General State Administration and autonomous regional administrations.

Measure 1.12. Unique projects and strategy for sustainable energy on the islands

a) Description

Before their generalised implementation, all technologies, including energy technologies, have to go through a process of demonstrating their effectiveness and readiness, a process known as 'the valley of death'. This stage, related to the integration of research, innovation and competitiveness (RIC) policies with market development, is often characterised by a substantial increase in the investment required, combined with a low level of technical reliability. Many technological developments fall at this hurdle because they do not have the (public and private) investment required to make the jump from the pilot phase of the project, something that must encourage public administrations and the private sector to join forces through the formation of partnerships. Examples of past efforts include Sotavento in the field of wind energy and Ecocarburantes Españoles in the field of biofuels.

The innovative technologies that must be developed in order to achieve the objectives of the National Plan are covered in more detail under the fifth dimension of this National Plan. As regards this measure, it should be noted that the uniqueness in question refers not only to innovative projects but to the challenges faced as well. For example, these could relate to geographical (being on an island) or market conditions, as in the case of high-temperature geothermal for the large-scale generation of electricity, for which there is no market in Spain despite it being a mature technology, or in the case of offshore wind, which if developed around island territories would involve both types of uniqueness. In addition, a short-term opportunity has been identified that would have the use of these island territories as drivers and 'spearheads' for the deployment of offshore wind, associated with the incorporation of storage requirements and support for the electricity system, with a greater impact on reducing GHG emissions and even avoiding current costs for the electricity system associated with the General State Budget. It is vital for the public sector, in collaboration with the private sector, to spearhead pilot or demonstration projects that demonstrate the viability of, or need for, new models or systems that are still not fully market ready.

b) Objectives addressed

Market development for new renewable energy technologies.

c) Mechanisms

Mechanisms Two main mechanisms are proposed:

- **Development plan for unique projects**
  A programme to drive the IDAE's participation in unique or demonstration projects for which the Institute's contribution or public-private collaboration will be particularly important. The support system best adapted to the development of the project can be used (corporate shareholding, financing, third-party financing (TPF), temporary joint venture, etc.).

- **Sustainable energy on the islands**
  In May 2017, Spain, together with the European Commission and 13 other Member States, signed the Political Declaration on Clean Energy for EU Islands, which recognises the islands' potential to be the architects of their own energy transition and the opportunity to take full advantage of these territories as a testing ground for energy transition technologies or policies that could then be exported to the continent. With this objective in mind, the General State Administration will propose sustainable energy strategies for the Balearic and Canary Islands, in collaboration with their respective autonomous and island governments, which will make it possible to reduce the energy cost overruns in these territories. In particular, these strategies will seek the appropriate territorial integration of renewables and the ability to supply firm power and other services, such as frequency stabilisation or black starts in the event of zero voltage, as well as emissions-free modes of transport and the integration of the change in the energy model into the water cycle.

  It will also be necessary to make progress with the interconnection between the extra-peninsular systems and to reduce the energy dependency of these territories, as stated in Measure 3.2 of this Plan.

d) Responsible bodies

General State Administration (MITECO, IDAE), island autonomous communities.

Measure 1.13. Local energy communities

a) Description

European legislation aims to boost the role of citizens as drivers of the energy transition, and to this end it defines two new legal entities:

- renewable energy community (as defined in Directive 2018/2001 on the promotion of the use of energy from renewable sources);
- citizen energy community (as defined in Directive 2019/944 on common rules for the internal market for electricity).

The term ‘local energy communities’ encompasses both.

Both legal entities, which must be transposed into Spanish law, have two common elements: they must be controlled by partners or members in the vicinity of the projects and their aim must be to provide environmental, economic and social benefits to their partners or members or to the local areas where they operate. Additionally, in the case of renewable energy communities, the partners must be natural persons, SMEs or local authorities (including municipalities).

The main difference between the two entities is that, while the objective of the renewable energy community is to carry out projects of any nature (electric, thermal or transport) provided the energy source is renewable, the citizen energy community has been designed to cover any project related to the electricity sector, including distribution, supply, consumption, aggregation, energy storage, provision of energy efficiency services or the provision of electric vehicle charging services, or other energy services to its members.

With regard to renewable energy communities, the existing barriers and their potential for development will be assessed, among other measures. It should also be ensured that they can produce, consume, store and sell renewable energy, in particular through renewable electricity purchase contracts, as well as have access to all appropriate energy markets, both directly and through aggregation.

With regard to citizen energy communities, among other measures, they should be allowed to own, establish, acquire or lease distribution networks and manage them autonomously, as well as to access all organised markets.

b) Objectives addressed

To facilitate the participation of citizens, SMEs and local authorities in the energy transition.

c) Mechanisms

- The appropriate legislative framework will be developed to define these legal entities and to promote their development, in particular to comply with Article 22 of Directive 2018/2001 and Article 16 of Directive 2019/944. The development of the legislative framework must take into account the roles and cases of existing actors or groups that could set themselves up as local energy communities, such as cooperatives, industrial parks, technology parks, residents’ associations or port areas.
- Elimination of barriers by establishing a one-stop shop that makes it possible to guide the applicant, acting as a facilitator of administrative procedures, as well as promoting the simplification of procedures in processes linked to local energy community projects.
- Promotion of demonstration projects of local energy communities that cover the widest possible range of cases, identifying and enabling viable business models for the different types of projects, enabling them to be developed on a large scale.

- Training and capacity-building programmes for local energy communities to enable them to obtain the human and technical resources required to identify, process, execute and manage the projects, as well as to mobilise the necessary investments.
- Analysis of the creation within the IDAE of an office to promote and support local energy communities that, among other mechanisms, will design and implement specific lines of guarantees and/or financing; provide technical assistance; promote the joint acquisition of equipment and services; and identify and disseminate best practice.

d) Responsible bodies

MITECO and IDAE.

Measure 1.14. Promoting the proactive role of citizens in decarbonisation

a) Description

Citizens are at the centre of the energy transition, since they can: (1) encourage policy adoption and enhance the social and environmental accountability of companies; (2) benefit from the jobs created; and (3) consume, finance, invest in, sell, exchange, manage and produce renewable energy. The transition to a decarbonised energy system is a major technological and social challenge, but also an opportunity to give citizens a central role in the energy sector, in accordance with the Clean energy for all Europeans package.

According to a recent study[41], 30.9% of users in Spain would like to exercise their buying power and choose a new electricity supplier that guarantees that it produces and sells 100% renewable electricity, and is owned by citizens. Citizen financial participation in renewable energy production projects helps to direct household savings towards financing the energy transition. The cited study states that 12.1% of the people consulted would take on the role of an investor citizen who invests their savings by participating in renewable energy generation plants directly, without being a co-owner. 16% would be interested in co-owning a renewable facility financed by private individuals.

These attitudes contribute to a better socio-economic anchoring of renewable energies in the territories, participating in local development, and making it possible to lead people to become aware of or even mobilise on energy issues. The challenge is to promote the proactive role of citizens in the energy transition and more specifically in the deployment of renewable energies.

b) Objectives addressed

To empower citizens and promote their participation in the energy transition.

To improve their ability to choose a 100% renewable supply and encourage companies to redirect their offer towards a more renewable service in order to offer this service to consumers with greater social commitment and more environmental responsibility.

To promote the mobilisation of available funds by citizens to help finance the renewable energy transition or to manage their own energy.

To promote citizen participation in the definition of local, regional and national energy policies.

c) Mechanisms

The following mechanisms are planned:

- **Mechanisms to promote the diversity of actors** and the existence of **participatory citizen projects**. Mechanisms will be established via regulations to promote the diversity of actors and the existence of participatory citizen projects, to promote both social and territorial cohesion and a just transition, and to take advantage of the opportunities presented by the new decarbonised generation model.

[41] Energía colaborativa. El poder de la ciudadanía de crear, compartir y gestionar renovables (Collaborative energy. The power of citizens to create, share and manage renewables); Greenpeace; 2017.

A support mechanism will be established through which participatory projects can enter into a contract of sale for their electricity at a fixed price tied to the result of the tenders. An annual quota will be reserved for these projects, which will be granted to the first that request it and comply with the requirements until the energy quota is met. Furthermore, the question will be assessed of whether the projects that join the support mechanism could have public guarantees to facilitate financing and make it cheaper. In addition, options will be assessed to design tenders that favour projects that take into account the social component through, among other things, citizen participation in financing or the existence of a profit-sharing plan, where part of the revenue is allocated to activities agreed with local agents.

- **Instruments of support and collective financing adapted to the real environment of cities and the rural world**, where competition criteria are considered and where local citizen participation is ensured either directly or indirectly (i.e. cooperatives, residents' associations). Options for the appropriate aggregation of projects will be assessed to facilitate, inter alia, access to European support mechanisms (i.e. ELENA[42]) for the development of renewable projects in general, as well as to green and innovative public procurement tenders.
- **Promotion of action mechanisms in the municipal sphere** to promote associations or partnerships between municipalities and citizen groups, given the existing synergies and the mutual benefits to be achieved. The municipality can be a strategic advisor by co-investing as a partner in participative citizen projects, or even by becoming an infrastructure operator (existing and/or future) with a high effect/impact on the success of the so-called participative citizen projects.
- **Identification and removal of legal, administrative and economic barriers** to the introduction of the direct purchase and sale of renewable electricity between producers and consumers regardless of their size, with the aim of facilitating a greater positive impact of citizen buying power on the energy transition. This guarantees consumers that they are actually paying for renewable energy. In addition, unlike guarantees of renewable origin, total hourly coverage with renewable energies is guaranteed for the consumer.
- **Citizen participation in demand management** (individual or aggregate), through the necessary mechanisms to ensure that the structures of tariffs, tolls and electricity charges are designed to give a favourable signal both for active demand management and for consumption reduction. The promotion of demand management in general is driven by another specific measure in this Plan.
- **Full right of consumers to have real-time access to their energy data at no additional cost and to transfer these data to third parties without any impediment.** With the aim of promoting and facilitating citizen participation in the design and implementation of local, regional and national energy policies, the IDAE will work with public administrations and social actors to generate good practices in these processes, as well as to monitor them over time. Energy literacy and transparency of information on the energy system must be improved in order to make citizen activation a reality. To that end, work will be done with local administrations and civil society to set up information and advisory systems for citizens about their energy, bills, consumption and environmental and social impacts.

d) Responsible bodies

MITECO and IDAE.

[42] https://www.eib.org/en/products/advising/elena/index.htm

Measure 1.15. Just Transition Strategy

a) Description

The energy transition will generate many opportunities for economic development and employment, although in some cases there will be negative impacts, which will be particularly significant in those areas where fossil fuels are important to the local economy. Therefore, during the change process it is necessary to guide the economic sectors affected most, supporting the adaptation of companies and people to the new situation.

The commitment to incorporate just transition policies into climate action measures aimed at transforming modes of production and consumption was agreed by the countries that are parties to the United Nations Framework Convention on Climate Change at COP21. On the other hand, the ILO Guidelines for a just transition were adopted in 2015, providing a framework that countries can use, adopted through consensus, to guide the transition to low-carbon economies.

In order for the just transition to be incorporated into energy transition and decarbonisation policies, the Just Transition Strategy was presented in February 2019 as a solidarity-based guidance strategy, within the Strategic Framework for Energy and Climate, also shaped by the Climate Change Bill and the INECP.

b) Objectives addressed

- To facilitate the exploitation of employment opportunities and the improvement of the competitiveness and social cohesion generated by the energy transition.
- To carry out sectoral plans in the main economic sectors, analysing challenges, opportunities, and threats and designing the necessary measures to carry out their transformation.
- To minimise the negative impacts on vulnerable areas due to the energy transition through just transition agreements, as well as to provide technical and financial support for their implementation, as in the case of the Urgent Action Plan for coal-fired regions and plants undergoing closure.

c) Mechanisms

The Just Transition Strategy is the State-level instrument aimed at the ecological transition of the economy and the adoption of measures to ensure fair treatment for workers affected by the transition.

In order to take advantage of the opportunities, green employment policies, vocational training policies, better guidance for companies and the promotion of transition guidance plans for industry and other sectors are all proposed.

To minimise the negative impacts, the main mechanism is the Just Transition Agreements. The priority objective of these agreements will be maintaining and creating activity and employment in the affected regions, through guidance for sectors and groups at risk; maintaining population in the rural territories; and promoting diversification and specialisation consistent with the socio-economic context of each area. The agreements will give priority to those sectors with the best results in terms of environmental, economic and social sustainability.

For short-term challenges such as the closure of mines and coal-fired power stations that have not made any investments, as well as nuclear power stations without previous conversion plans, the Strategy incorporates a 2019-2021 Urgent Action Plan with the following objectives:

- ensuring that workers who lose their jobs in mining companies that close down receive adequate compensation, such as early retirement or severance pay;
- maintaining, in the short term, employment for the mining regions through the Mine Restoration Plan and the Renewable Energy and Energy Efficiency Plan and other plans to be developed with mining municipalities;
- offering the regions subject to the closure of mines, coal-fired power stations or nuclear power plants the implementation of transitional agreements with the aim of ensuring that the closures do not affect employment and the population at the end of the process.

With these objectives, the Just Transition Agreements will include tools such as:

- guaranteeing the affected territories priority access to part or all of the electricity transmission capacity, as well as priority access to the use of the water covered by concessions;
- promoting energy policy tools such as the possibility of specific renewables tenders for these territories;
- promoting priority access to aid and funds, such as the Support Programme for Productive Industrial Investment (REINDUS), or to State investments for the conservation and enrichment of the historical and architectural heritage.

Finally, among other instruments, the actions of the City Foundation for Energy will be oriented towards promoting measures in the area of Just Transition (see Measure 5.10).

d) Responsible bodies

MITECO, in collaboration with the Ministry of Labour and Social Economy; Ministry of Agriculture, Fisheries and Food (MAPA); MITMA and MINCOTUR, in cooperation with regional and local governments and business organisations, trade unions and other social organisations.

3.1.2 Cross-cutting measures to promote renewable energy

Measure 1.16. Public procurement of renewable energy

a) Description

At present, Framework Agreement 23/2017, formalised on 31 July 2018, on the supply of electricity to the General State Administration, its autonomous bodies, management bodies and common services of Social Security and other public State bodies, and other attached entities, establishes that the supply of electricity will have a 50% guarantee of origin, unless the body concerned has established a higher percentage in the additional requirements.

Furthermore, in December 2018, the Council of Ministers approved the Ecological Public Procurement Plan of the General State Administration, which sets the target of procuring electricity from 100% renewable sources by 2025, for all electricity consumption in the buildings and services of the General State Administration.

Bearing in mind that, in their current design, guarantees of origin do not guarantee new investments in renewable energies, the possibility will be analysed, with a view to the next Framework Agreement, of replacing the requirement of guarantees of origin with the implementation of mechanisms for purchasing electricity from renewable sources through long-term purchase agreements. Such agreements will encourage new installations, as well as innovative formulas that allow, inter alia, the installation of own consumption generation systems in public buildings.

To make further progress on the decarbonisation path, similar objectives need to be promoted in the rest of the public administrations, both regional and local, through the dissemination of information, model specifications and tenders and good practice manuals.

b) Objectives addressed

- Decarbonisation of the electricity supply of the General State Administration and the rest of the public administrations.
- Promotion of new renewable energy generation and pumping installations.

c) Mechanisms

- Design and implementation of new framework agreements for the purchase of 100% renewable energy, as well as the introduction of renewable own consumption systems in public buildings.
- Analysis of the design and implementation of centralised tenders for the purchase of long-term renewable electricity, from new facilities.
- Analysis of the potential of innovative public procurement (see Measure 5.5 of this Plan) for the implementation of renewables in the public sphere.

d) Responsible bodies

Ministry of Finance and MITECO.

Measure 1.17 Training professionals in the renewable energy sector

a) Description

Chapter 4 of the INECP, 'Impact analysis of the policies and measures in the plan', estimates a net annual growth of employment between 253,000 and 348,000.

In 2012, the International Renewable Agency (IRENA) was already reporting that meeting commitments in the field of renewable energies would require qualified professionals throughout the value chain, and it identified the need to increase and improve the training of professionals in renewable energies as one of the main challenges for the sector. The effects of the shortage and poor training of professionals result in a slowdown in the pace of development, economic losses on projects and a worsening of reputation for the technologies concerned.

Both the new and existing professionals in the sector, along with professionals from other sectors affected by the just transition, need high-quality continuous training that will allow them to face the new challenges of the future labour markets.

The autonomous communities are responsible for education and training. Furthermore, a significant proportion of training is currently done within the companies themselves. The Plan initially proposes that the different levels of government work together with associations from the sector and the trade unions to identify the profiles needed to meet the objectives in the Plan, and subsequently promote the adoption of best practices to increase the training of deficient profiles in cooperation with the bodies concerned.

b) Objectives addressed

In anticipation of the implementation of new decarbonisation technologies, it is necessary to anticipate market demands and promote continuous training at the five levels of approved professional qualification, bearing in mind that the Single European Market demands training in professional skills that will facilitate mobility within the EU. The actions below seek to achieve this.

- Improve training. Technology is advancing rapidly and it is necessary to adapt and continuously improve the existing training offer, allowing professional skills to be updated on an ongoing basis to stay competitive in the labour market.
- Increase the offer in training. The Plan envisages new professional profiles related to technologies that are forecast to take off markedly, but where there is hardly any market today, such as new energy storage systems. It is necessary to develop and implement new qualifications and specialities.
- Attract talent. The energy sector needs new talent. Access to new training opportunities must be provided. To that end, on the one hand, labour market opportunities must be disseminated and, on the other, mechanisms must be put in place (scholarships, credits, etc.) so that those who wish to do so may have access to them under equal conditions. It is necessary to spread the possibilities of having a professional career within the new decarbonised economy. A recent study confirms that the renewable energy sector represents an opportunity to attract female talent in particular[43].

c) Mechanisms

- Determination of the professional profiles required throughout the value chain for the technologies associated with the development of the Plan.
- Adaptation of qualification levels to the needs of the labour market resulting from the application of the INECP.
- Awareness-raising and outreach measures will be coordinated to draw future professionals' attention to the job opportunities offered by the energy transition.

[43] *Education and training gaps in the renewable energy sector*; Lucas et al.; Solar Energy 173 (2018) 449–455.

d) Responsible bodies

General State Administration (MITECO, IDAE, the Ministry of Education and Vocational Training, the National Qualifications Institute (INCUAL), the State Public Employment Service (SEPES), the Ministry of Science and Innovation (MCI), autonomous communities, local authorities, energy agencies, renewable sector associations, industrial and services sector associations, training companies, trade unions and professional associations.

Measure 1.18. Revision and simplification of administrative procedures

a) Description

Delays in project implementation make it more expensive to move forward with a project. There is a risk that administrative procedures, in terms of timescales or processes, could prolong or generate uncertainty around whether permits will be granted, without necessarily offering improvements or guarantees as regards environmental or social issues, or adaptation to the local area.

Furthermore, current administrative procedures are not, in general, adapted or designed to handle the deployment of hybrid facilities where different renewable energy generation technologies share the same space, unlocking the opportunities for territorial integration that new technologies or ways of organising installations offer.

In conclusion, **it is necessary to revise the administrative procedures involved with a view to streamlining projects and avoiding unnecessary charges for operators.**

The following must be reviewed:

- how to process new renewable facility projects, including alternative hybrid projects involving different renewable technologies, both for feeding the energy generated into the grid and for partial own consumption;
- the legislative barriers or gaps that hinder the participation of local energy communities in the system.

b) Objectives addressed

- Deployment of onshore and offshore renewable energies, including hybrid projects.
- Deployment of decentralised generation (own consumption and energy communities).
- Streamlining and clarifying administrative procedures for renewable projects.
- Minimising the impact on the territory.

c) Mechanisms

- Setting up round tables with the autonomous communities.

  Identification of best practices in administrative processes at local, regional and state level that are clear, objective, effective and efficient and that deliver value in terms of guaranteeing environmental protection, public interest and the adaptation of the projects to the local reality. This process should be the joint responsibility of all actors to guarantee the equitable development of renewable energy capacity throughout the country.
- Updating administrative procedures.

  The aim will be to adapt the administrative procedures to include procedures for hybrid projects involving different renewable technologies. The administrative procedure for facilities in the marine environment that generate electricity from wind and ocean energy will also be adapted, with particular attention to reducing processing times for test platforms and RDI projects.

- Territorial integration of renewables.

  The fulfilment of the renewable development objectives established in this Plan must be compatible with compliance with the legislation on natural heritage and biodiversity. In any case, additional measures will be promoted, such as the creation of spaces for the conservation and promotion of native biodiversity, with special consideration for species in vulnerable situations.

  To that end, before the Plan commences, the IDAE will draw up a **good practice manual** to mitigate or reduce the environmental and landscape impacts of renewable electricity generation facilities that involve the occupation of large areas of land, with precise recommendations on location, construction and integration, in order to significantly preserve biodiversity, ecosystem services and the landscape.

- Procedure guide.

  To facilitate the application of existing procedures for both developers and the various public bodies involved in these procedures, the IDAE will publish a **guide that brings together in a single document** the various regulations applicable to the processing of renewable energy projects, as well as recommendations and best practice. The document will make it possible to avoid processing errors that require costly and time-consuming corrections, as well as to identify potential improvements for reviewing the procedures themselves.

- Simplification of procedures.

  The administrative procedures for granting the necessary permits for the construction and commissioning of production facilities using renewable energy sources, as well as for facilitating the repowering of existing facilities, will be streamlined, ensuring a simplified and rapid permit-granting procedure. In that regard, the meaning of non-substantial modification will be defined, for the purpose exemption from the obligation to obtain prior administrative authorisation and a construction permit, pursuant to Article 53(2) of Law 24/2013 of 26 December 2013. This will further simplify the authorisation procedures for production facilities.

- Specific authorisation for experimental projects.

  Mechanisms will be developed for the administrative authorisation of projects of an experimental nature or intended for test benches, such as those described in Measure 5.7 of this Plan, so that an enclosure or boundary conditions can be authorised that must be met by the project or the different elements tested as part of it, and so that a completely new procedure is not required when specific elements of the project are modified within the conditions set.

d) Responsible bodies

General State Administration, regional and local administrations.

Measure 1.19. Generating knowledge, outreach, awareness and training

a) Description

One of the challenges facing the Plan is the rapid evolution of technology in the energy sector and in efforts to combat climate change. In order to properly design and implement the Plan's measures and mechanisms, it is essential to establish a mechanism to generate the knowledge required.

The transition to a decarbonised energy system is a technological and social challenge. This measure seeks to anchor the need to decarbonise in the public consciousness and that of the public and private sectors, and to disseminate tools, technologies and practices to reduce fossil fuel consumption, increase the contribution of renewable energy, reduce greenhouse gas emissions and take advantage of the potential of carbon sinks.

b) Objectives addressed

Proactive participation of all actors in the energy transition.

c) Mechanisms

- **Knowledge generation**

Objective and approved qualitative and quantitative data and information are of the utmost importance for decision-making and maintaining the trust both of the sector and of the public in general. MITECO, through the IDAE or other institutional bodies, will work in the area of energy transition with actors in the sector to identify and close information gaps. Studies and analyses will be conducted both on the evolution and potential of energy technologies and on drafting a Spanish strategy for developing offshore wind.

- **Public awareness campaigns**

Studies carried out both by the International Energy Agency (IEA) and the International Renewable Energy Agency (IRENA) show that one of the barriers to the social acceptance of renewables is the persistence of misinformation about them, due, among other factors, to the lack of a united voice and the lack of good communication practices. The mechanisms considered include:

  - public awareness campaigns at the Energy and Environment International Trade Fair (Genera) held annually in Madrid;
  - MITECO, through the IDAE, in close collaboration with MITMA and other institutional bodies, will identify messages and work with communication professionals (journalists and companies in the sector) to identify a common language for renewable energies, dismantle the possible prejudices against them and increase their social acceptance among the public.

- **Sectoral information and training campaigns on energy and climate**

Despite their enormous potential, renewable energies are still poorly understood in some sectors. It is necessary to improve the information available about them, particularly in order that the industrial and services sectors understand the benefits of using them.

Information and training campaigns can be coordinated in collaboration with the target sectors, by signing agreements between administrations, energy agencies, renewable sector associations, industrial associations, technology institutes, professional associations or associations of developers in the services sector. Furthermore, communication and information, as well as training of professionals in the energy efficiency sector, are specifically addressed in Measures 2.15 and 2.16, respectively.

In the past, information campaigns linked to the promotion of programmes for the development of renewable technologies in buildings and industries have had a significant impact in terms of improved user perception of the advantages of using these technologies. These programmes had their own identifying image linked to quality control of the participating companies, in an attempt to ensure the success of the activities.

- **Access to information on consumption**

As set out in Measure 4.6, Data access, giving the public and the productive sectors easy and instant access to their energy consumption data, as well as the opportunity to share this information with third parties, is necessary in order to harness the potential of energy management, the drive for own consumption and the development of new services to facilitate decarbonisation.

- **Strengthening the inclusion of ecological criteria in public procurement**

Public authorities should seek to procure goods, services and works with a reduced environmental impact throughout their life cycle when compared with goods, services and works with the same primary function that would otherwise be procured. The drive towards the use of 'green' criteria in procurement is underpinned by the changes concerning environmental considerations introduced by Law 9/2017 of 8 November 2017 on Public Sector Contracts. The creation of an Interministerial Commission for the incorporation of ecological criteria into public procurement (Royal Decree 6/2018 of 12 January 2018), together with the Ecological Public Procurement Plan (2018-2025), will serve as the driving force. Public procurement in the fields of renewable energy and energy efficiency is specifically addressed in Measures 1.16 and 2.12, respectively.

- **Promoting the calculation of carbon footprints and their reduction**

This will be approached via various means. One of the main ones is to promote the participation of Spanish organisations in calculating carbon footprint, compensation and voluntary carbon dioxide absorption projects created in 2014 by means of Royal Decree 163/2014 of 14 March 2014. This will be promoted through training and the development and dissemination of guides and tools. Other areas of work will involve including the carbon footprint in public procurement, calculating the carbon footprints of ministerial departments and promoting carbon footprint calculation and reduction efforts among Spanish municipalities. Finally, the possibility will be assessed of promoting the calculation and registration of the carbon footprint of specific entities.

d) Responsible bodies

General State Administration (MITECO, IDAE, MCI), autonomous communities, local authorities, energy agencies, renewable sector associations, industrial and services sector associations, training companies, trade unions and professional associations.

3.1.3 Emissions Trading Systems (ETS) sectors

The policies and measures in these sectors fall within the scope of Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC; Directive (EU) 2018/410 of the European Parliament and of the Council of 14 March 2018 amending Directive 2003/87/EC to enhance cost-effective emission reductions and low-carbon investments, and Decision (EU) 2015/1814.

In Spain, the European emissions trading system is governed by Law 1/2005 of 9 March 2005, as well as various Royal Decrees implementing this law. This system affects around **900 industrial and electricity generation installations** in Spain, **as well as more than 30 active aircraft operators**.

Furthermore, through the fourth Additional Provision of Law 1/2005, Spain has implemented Article 27 of Directive 2003/87/EC, which permits Member States to exclude small emitters and hospitals from emissions trading. In 2011, Spain adopted Royal Decree 301/2011 of 4 March 2011, on mitigation measures equivalent to participation in the emissions trading system for the purpose of excluding small-scale installations, which permitted the exclusion of 174 installations over the 2013-2020 period.

Member States also have the option to implement another ETS mechanism relating to compensation for indirect costs. In Spain, the Sixth Additional Provision of Law 1/2005 establishes that the government may create a mechanism for the compensation of indirect costs. This mechanism was created via Royal Decree 1055/2014 of 12 December 2014. Aid is awarded pursuant to this Royal Decree based on the Commission guidelines on State aid in this context (2012/C 158/04).

To date there have been two calls for aid applications: in 2015, EUR 4 million was allocated to compensate for indirect costs incurred in 2015; and in 2017, EUR 6 million was allocated to compensate for indirect costs incurred in 2016 (note the change to a year-end approach). In both cases, the funds available were under 10% of the eligible costs in accordance with the Commission guidelines; however, the 2018 State Budget provides for additional compensation for the recipients of aid from the second call. At the time of drawing up this Plan, the third call is being developed, for costs incurred in 2017, with a budget of EUR 6 million.

Finally, in Spain, the use of income from auctioning emissions allowances is set out in a legally binding regulation. Thus, the Fifth Additional Provision of Law 17/2012 of 27 December 2012, on the State Budget for 2013 provides that this income must be used to finance electricity system costs related to the development of **renewable energies (for 90% and up to EUR 450 million)** and other measures for combating climate change (for 10% and up to EUR 50 million).

To the 23% reduction in greenhouse gases by 2030 compared to 1990 levels, the ETS sectors contribute with a reduction of approximately 60% compared to 2005.

The measures to be implemented in these sectors are set out in section 3.1.2. above, under the energy efficiency dimension, and in the following measure:

Measure 1.20. EU Emissions Trading System

a) Description

Greenhouse gas emissions in the electricity generation and basic industries sector will continue to be governed by the European emissions trading system. The latest reforms introduced by Directive (EU) 2018/410 of the European Parliament and of the Council strengthen this system, positioning it as a key measure for the achievement of EU climate change objectives.

In Spain, the European emissions trading system is governed by Law 1/2005 of 9 March 2005, as well as various Royal Decrees implementing this law. This system affects around 900 industrial and electricity generation installations in Spain, as well as more than 30 active aircraft operators. Greenhouse gas emissions subject to this system make up around 40% of the national total. Looking to the implementation starting from 2021, the national legislative framework will have to be adapted to the latest reforms.

b) Mechanisms

Law 1/2005 of 9 March 2005 and Royal Decrees implementing this law.

c) Responsible bodies

MITECO.

3.1.4 Non-ETS sectors

As indicated in the section on objectives, this Plan deals with the policies and measures required to contribute to the European objective with a reduction in greenhouse gases of at least **23%** by **2030** compared to 1990 levels. These reduction efforts must be shared between sectors subject to the emissions trading system (ETS) (electricity generation, refineries and major industries) and non-ETS sectors that can, in turn, be subdivided into:

- Non-ETS energy; residential, commercial and institutional; transport, and non-ETS industry.
- Non-energy non-ETS; agriculture and livestock farming, waste management and fluorinated gases.

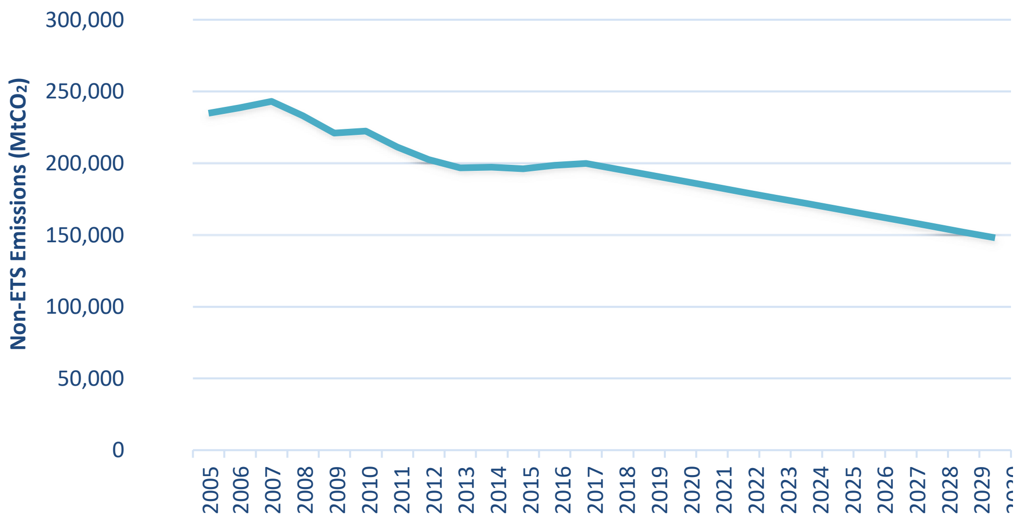
Furthermore, the total gross emissions calculation must take into account the greenhouse gas emissions and removals resulting from land use, land-use change and forestry (LULUCF).

Regulation (EU) 2018/842 of the European Parliament and of the Council of 30 May 2018 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No 525/2013, establishes binding objectives for each Member State for the reduction of greenhouse gas emissions in non-ETS sectors from 2021 to 2030. Accordingly, Spain must reduce its greenhouse gas emissions in non-ETS sectors by 26% by 2030 compared to 2005.

However, the overall reduction of 23% by 2030 compared to 1990 means that in 2030, the non-ETS sectors as a whole will have to contribute a reduction of **approximately 39% compared to 2005 levels** through the measures proposed.

Within this group, the waste management, farming and fluorinated gas sectors (non-energy non-ETS) will contribute with reductions of approximately **28%, 18% and 33%** respectively, compared to 2005 levels.

Figure 3.1. Historic and projected emissions



Source: Ministry for Ecological Transition and Demographic Challenge, 2019

The abovementioned Regulation also defines the methodology for calculating and defining the linear reduction path that should be applied to establish the annual emissions allowances (AEAs) that each member state can issue annually. The emissions reporting cycle for inventories means that until 2020 it will be not possible to apply the methodology to data on non-ETS emissions that have been inventoried and verified. Consequently, the Member States' AEAs will not be set until then.

Furthermore, this Regulation establishes that if a Member State exceeds its annual emissions allowance it will be able to use an additional quantity up to the sum of total net removals and total net emissions of greenhouse gases from the combined accounting categories of afforested land, deforested land, managed cropland and managed grassland (LULUCF). The Regulation also establishes a set of requirements that must be met to be able to make use of this flexibility. **For Spain, the total amount that can be used throughout the 2021-2030 period is 29.1 $MtCO_2$-eq.**

The specific and measurable policies in the **energy sectors** (both non-ETS and ETS) are described in the corresponding sections on the decarbonisation/renewables and energy efficiency dimensions.

It should be noted in this regard, as indicated above, that **transport/mobility will make a decisive contribution to the decarbonisation of the economy envisaged in this Plan.** This sector, after the electricity sector, will mitigate greenhouse gas emissions to the greatest extent, reducing emissions by **27 $MtCO_2$-eq** between the start of the Plan in 2021 and the end of it in 2030. Measure 2.1. under the Energy Efficiency Dimension (3.2) explains that as a consequence of the generalised implementation from 2023 of central zones ('almendras' or 'almonds') in Spanish cities with more than 50,000 inhabitants – access to which will be restricted for the most polluting vehicles – it is intended to achieve a modal shift affecting **35% of the passenger-kilometres currently travelled in conventional vehicles.**

As regards the identification and implementation of the measures outlined below for the **non-energy non-ETS sectors**, these measures were analysed using the M3E model described in Annex B. Models.

Measure 1.21. Reduction of greenhouse gas emissions in the agricultural and livestock sectors

a) Description

The actions identified for the agricultural and livestock sectors are described below, together forming an additional measure for the WAM (With Additional Measures) scenario or Target Scenario of the 2021-2030 INECP.

a.1. Promoting arable crop rotation on unirrigated land

This measure involves promoting arable crop rotation on unirrigated land, including legumes and oilseed, which could replace cereal monocultures.

Arable crops often form part of crop rotation systems and have traditionally been used to conserve and maintain the fertility of the soil, improve pest, disease and weed control, and to maintain the soil's moisture level. The introduction of leguminous plants into crop rotation systems delivers improved nitrogen levels in the soil, improving its structure and fertility. This means that subsequent crops require less nitrogenous fertilisers.

Therefore, growing legumes has a positive effect on climate change mitigation, as it reduces the emissions associated with the use and production of this type of fertiliser. Furthermore, from the perspective of adapting to climate change, it increases the resilience of the soil and crops, and therefore is an appropriate adaptive measure, particularly in unirrigated systems.

In any case, boundary strips and margins will be maintained in the rotations, along with the natural parcels of the agricultural matrix, which, in addition to reinforcing the objective of CO_2 absorption, will improve and increase the preservation of biodiversity (greater plant diversity, greater shelter and food resources), and the rural landscape.

a.2. Adjusting the application of nitrogen to the needs of the crop

The measure proposed involves drawing up a fertilisation plan that takes into account the needs of the crop, so that organic and inorganic fertilisers are used at the correct dosage and at the right time.

The fertilisation plan will include splitting applications, using products that help to control the release of the nutrients and reduce emissions, promoting organic irrigation and, wherever possible, encouraging localised irrigation techniques and optimising machinery use. Furthermore, the judicious use of manure and slurry will be promoted. This will form part of the Circular Economy Strategy, as these materials will be reused in the production chain.

Nitrous oxide (N_2O) emissions resulting from the improper use of fertilisers will be reduced.

a.3. Frequent emptying of slurry from pig housing

This measure involves frequently emptying the pits under the pens at pig facilities. Frequent emptying means emptying them at least once a month. The technique referred to involves clearing the pits at the end of the period or when they are full. Frequently emptying the pits reduces NH_3, CH_4 and N_2O emissions.

These improvements in the management of manure and slurry at housing for different categories of pigs and cattle will reduce the emissions produced inside the housing.

a.4. Covering slurry ponds

This measure involves covering slurry ponds at new pig and cattle facilities.

The quantity of methane generated by a specific manure management system is affected by the degree to which anaerobic conditions are present, the temperature of the system and the time that the organic matter is kept in the system.

Completely covering slurry ponds reduces NH_3 emissions and odours by more than 90%.

a.5. Solid-liquid separation of slurry

The measure proposed involves the solid-liquid separation of slurry, with the solids being stored and the liquid fraction being emptied into uncovered anaerobic ponds in areas with a high concentration of livestock (pig and cattle). This liquid part will be used for irrigation, making use of its value as a fertiliser.

Solid-liquid separation, in addition to enabling better management of manure, will facilitate subsequent processing and reduce greenhouse gas emissions.

Storing the solid fraction has a lower methane conversion factor (MCF) than storing the liquid slurry, and the liquid fraction obtained has a lower volatile solids content compared with the original material which means that methane emissions are reduced.

a.6. Production of compost from the slurry solid fraction

The measure proposed involves producing organic fertiliser (compost) using pig and cattle manure in areas with a high concentration of livestock.

During composting, aerobic bacteria oxidise ammoniacal nitrogen, reducing NH_3 emissions. Moreover, this process enables the waste to be stabilised by means of aerobic fermentation, which produces CO_2 (not taken into account in the final balance as it comes from biomass) and small quantities of CH_4 and N_2O in comparison with other techniques that produce more greenhouse gas.

The compost produced is an organic soil improver that boosts the fertility and condition of the soil, given that it helps to fix carbon in the soil.

Measures aimed at reducing stubble burning will also be adopted with the aim of reducing the harmful health effects of particulate emissions.

b) Mechanisms

Regulatory measures from the Ministry of Agriculture, Fisheries and Food (MAPA) and/or interventions under the Common Agricultural Policy (CAP) Strategic Plan.

c) Responsible bodies

MAPA, jointly with the autonomous communities in accordance with the distribution of the relevant powers in Spain.

Measure 1.22. Reduction of greenhouse gas emissions in waste management

a) Description

The actions identified for the waste sector are described below, together forming an additional measure for the WAM scenario or Target Scenario of the 2021-2030 INECP.

a.1. Domestic or community composting

This essentially concerns recycling bio-waste or the organic fraction of urban waste in situ, by means of domestic or community composting. This measure is aimed at families, schools or residents' associations in rural, semi-urban and urban areas.

The implementation of the measure will involve distributing composters among the target population, as well as an awareness-raising/training campaign in the households and communities involved to ensure the measure's success. As a result, it will be possible to avoid sending bio-waste to landfill, to reduce the collection frequency for the remaining fraction and to obtain high-quality compost.

a.2. Separate collection of bio-waste for composting

The target population of this measure is mainly semi-urban areas and certain urban areas. The universe for this measure is the total amount of organic material and vegetable waste produced by the population, both domestic and major producers that is taken to landfill.

Implementing it will require a new strategy for the collection model, the upgrading of the fleet where applicable and the construction or redevelopment of composting plants depending on the population concerned. The reductions will be the result of redirecting bio-waste destined for landfill and reducing collection frequency.

a.3. Separate collection of bio-waste for biomethanation

This measure concerns the implementation of a separate bio-waste collection system, but in this case it will be taken to a biomethanation plant, for use as a biofuel. The target population is primarily urban, since plants with a capacity over 40,000 tonnes are being considered.

In this case, the mitigation effect has two aspects, one in line with the previous points made in relation to the collection frequency and avoiding landfilling bio-waste, and another that concerns the saving achieved by using a renewable energy.

a.4. Reduction of food waste

The measure proposed involves developing the National Strategy 'More food, less waste', through eight areas of action that will help to reduce food waste at every link along the food production chain, achieving real changes in attitudes, procedures and management systems. These include, among other activities, information/awareness-raising campaigns to publicise guidelines on buying, storing and preparing food responsibly, voluntary agreements, reviewing legislation, developing guidelines and promoting RIC.

This measure is part of efforts to reduce the amount of waste generated. At international level, it is included in the Sustainable Development Goals (SDGs). SDG 12.3 seeks to halve food waste at the consumer level and reduce food losses and waste during primary production, processing and distribution.

The EU has developed a platform to drive the achievement of this goal, and it is also covered in the EU Action Plan for the Circular Economy. At the national level, MAPA, through the household food waste panel, calculated that 1,229,509 tonnes of food was thrown away in 2017.

a.5. Increase in the separate collection of paper at municipal level

This measure involves increasing paper collection and recycling at the municipal level (households, small businesses, HORECA, buildings, banks and offices).

Although in general terms paper can be considered an organic fraction of solid waste, it should be considered separately for several reasons: it has its own collection channel, greater potential for selective collection and recycling and the potential to emit more methane than bio-waste.

Reductions will be achieved by avoiding sending the paper collected to landfill. Furthermore, the reductions derived from using recycled pulp instead of virgin pulp have been taken into account.

This measure involves the selective collection of paper at the municipal level with a particular focus on schools, universities and the administrations, by installing special containers and improving the amounts collected, with the aim of recycling the paper.

a.6. Increase in the separate collection of household used cooking oil

This measure focuses on the separate collection of oil from households, as there is already an adequate level of implementation in hotel and restaurant services. Local authorities would be responsible for implementing a collection model adapted to their municipality.

Used cooking oil is a valuable secondary material for the manufacture of biodiesel. Consequently, this measure not only contributes to the reduction of emissions resulting from poor waste management, but it also offers other benefits such as contributing to the objectives relating to renewable energy and advanced biofuels, and to reducing the risk of water and aquifer contamination.

a.7. Increase in the separate collection of textiles

Although some of this waste stream is collected separately for reuse and recycling, concerns around textile waste have led the EU to define an objective on the separate collection of this material. Textiles represent 6% of the waste fraction taken to landfill in Spain and half of this amount comprises natural fibres.

This measure involves the separate collection of clothes and used textiles, via roadside containers or other facilities, for their reuse and recycling, thus avoiding their being taken to landfill where the natural fibres emit methane as they decompose. Often the implementation of such measures is also associated with other social benefits.

The universe has been estimated on the basis of the description of the waste fraction in the 2016-2022 National Framework Plan for Waste Management (PEMAR).

a.8. Management of biogas leaks from enclosed landfill

For a significant part of its history, waste management in Spain has consisted of landfilling. Consequently, there is a significant inventory of landfill sites that have been enclosed in accordance with legislation, but at which there are still a considerable number of biogas leaks. In these cases, the plan is to cover the surface of the landfill sites with an oxidising layer that contains methanotrophic bacteria able to oxidise the methane that passes through the layer. There are currently several methods that can be adapted to the characteristics of the target landfill sites. The measure involves applying oxidising layers to the surface of the target landfill sites, with the oxidation ratio by area estimated, conservatively, on the basis of studies and projects on the subject.

a.9. Use of woody pruning waste as biomass

This measure involves the use of pruning waste as biomass by cogeneration companies (electricity uses) or in the production of pellets (thermal uses), which will substitute the use of fossil fuels.

CH_4 and N_2O emissions caused by burning woody pruning waste will be reduced. Olive groves and vineyards are being given prime consideration given the large size of their growing areas and the size and volume of pruning waste that they produce.

The extension to other crops will also be examined, taking into account their different uses, whether for food, for improving soil organic carbon or for use as biomass.

This measure will also lead to a significant reduction in particulates and thus contribute to the National Air Pollution Control Programme.

b) Mechanisms

Amendment of Law 22/2011 of 28 July 2011 on waste and contaminated soils to accelerate the transposition of the amended Waste Framework Directive and bring forward the obligatory separate collection of bio-waste to before 31 December 2020 for municipalities with more than five thousand inhabitants and before 31 December 2023 for other municipalities.

Framework project for the regulation of end-of-waste criteria for compost and digestate, of domestic and community composting, and of the requirements for recovering organic waste to the soil using woody pruning waste.

Aid for Waste via the Environmental Promotion Plans (*Planes de impulso al medio ambiente* – PIMA) and the National Framework Plan for Waste Management (*Plan estatal marco de gestión de residuos* – PEMAR).

Draft Royal Decree to include a restriction on landfilling separately collected waste fractions, incorporating the obligatory nature established under Directive (EU) 2018/850 of the European Parliament and of the Council of 30 May 2018 amending Directive 1999/31/EC on the landfill of waste.

2017-2020 'More food, less waste' ('*Más alimento, menos desperdicio*') national strategy, available at www.menosdesperdicio.es.

Strengthening the obligation to separately collect the materials for which separate collection was obligatory under Law 22/2011 of 28 July 2011 (paper, plastic, glass and metal) from places other than households, by reforming Law 22/2011 of 28 July 2011, in order to transpose Directive (EU) 2018/851 amending Directive 2008/98/EC.

Ministerial Order for the development of end-of-waste criteria for separately collected paper waste, and approval thereof.

Ministerial Order for the development of the criteria for determining when fatty acid methyl esters (biodiesel), produced from used cooking oil or animal fats for use as automotive biofuel or as a biofuel in heating equipment, cease to be waste.

Other regulatory measures from MAPA and/or interventions under the Common Agricultural Policy (CAP) Strategic Plan.

c) Responsible bodies

MAPA and MITECO jointly with the autonomous communities in accordance with the distribution of the relevant powers in Spain.

Measure 1.23. Reduction of fluorinated greenhouse gas emissions

a) Description

a.1. Replacement of facilities that use fluorinated gases that have a high Global Warming Potential (GWP) with other facilities that use gases that have a low or no GWP

This involves the replacement of equipment that uses hydrofluorocarbons (HFCs) that have a high GWP (primarily refrigeration/air-conditioning equipment) with alternative equipment that uses refrigerant gases that have a low or no GWP (CO_2, NH_3, hydrocarbons or fluorinated gases with a low GWP such as R-32 or Hydrofluoroolefins (HFOs)). This measure affects the total existing HFC bank.

a.2. Reduction of HFC emissions through measures at existing HFC facilities

This involves reducing the emissions from existing facilities through measures that reduce HFC emissions linked to leaks from this equipment. The measures involve implementing periodic checks, automatic leak detection systems, retrofitting, redeveloping existing high GWP fluorinated gas facilities into compatible low GWP fluorinated gas facilities, and enclosing refrigerator units in commercial refrigeration establishments to reduce the quantity of fluorinated gases used.

a.3. Recovery and management of fluorinated gases at the end of the useful life of the equipment

This involves recovering and managing fluorinated gases at the end of the useful life of equipment that uses them, prioritising their regeneration and recycling over other management options. Recovering the refrigerant gas and managing it properly will prevent the full quantity from being emitted into the atmosphere.

a.4. Promoting the use of mildly flammable refrigerants with a low GWP

This involves reviewing the safety standards on refrigeration and climate control to make it possible to use A2L mildly flammable refrigerants with a low GWP (such as R-32 and HFOs) more extensively, particularly in the domestic air-conditioning sector. The universe covered by the measure is the sales of domestic air-conditioning units in Spain.

b) Mechanisms

- **Tax on fluorinated greenhouse gases** (Law 16/2013 of 29 October 2013, establishing certain measures in the field of environmental taxation and adopting other tax and financial measures).
- **Gradual reduction under a quota system** pursuant to Regulation (EU) No 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006.
- **Royal Decree 115/2017 of 17 February 2017, governing the placing on the market and use of fluorinated gases** and equipment based on them, as well as the certification of the professionals that use them, which establishes the technical requirements for facilities conducting fluorinated gas emitting operations.
- **Voluntary agreement** for the more environmentally-friendly integrated management of the use of SF_6 in the electricity industry.
- Amendment of Royal Decree 138/2011 of 4 February 2011, approving the **Safety Regulation on refrigeration installations and their additional technical guidelines.**

c) Responsible bodies

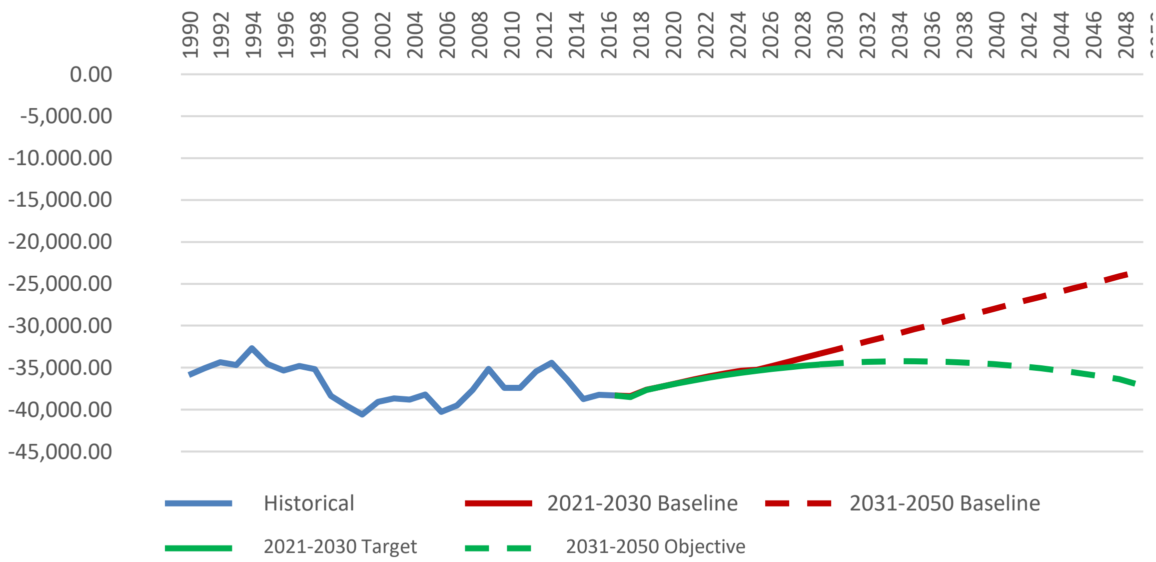
MITECO and MINCOTUR.

3.1.5 LULUCF (Regulation 2018/841)

In the LULUCF sector, the forecasts in the baseline scenario point to a saturation in the capacity of CO_2 removal by natural sinks. This can be attributed to a set of diverse causes, including, in particular, the impacts of climate change on the Spanish forestry sector (increase in temperature and reduced water availability, especially), the scarcity of surface area with specific management instruments to increase CO_2 storage capacity, a low rate of current reforestation or the generalised increase in the risk of desertification throughout the territory.

The measures proposed in forest and agricultural sinks seek to reverse this trend — although, due to the quality itself of the natural sinks, these measures require time to improve the removals generated – at the same time as ensuring the maintenance of the social, ecological and economic functions of the terrestrial ecosystems, as shown in Figure 3.2. It is, therefore, important to consider the effect of these measures in the long term, beyond the year 2030.

Figure 3.2. Evolution of emissions/removals of CO_2-eq in the LULUCF sector Historical and projection for 2030 and 2050 (kt)



Source: Ministry for Ecological Transition and Demographic Challenge, 2019

The proposed measures in forest and agricultural sinks would generate additional removals of **0.96 $MtCO_2$-eq** in **2030** compared to the baseline scenario (0.78 $MtCO_2$-eq in forest sinks and 0.18 $MtCO_2$-eq in agricultural sinks), although, as noted, the effect of these measures is more effective the longer the time frame considered. Their benefit should also be highlighted in other key aspects such as the maintenance and improvement of ecosystem functions or the creation of rural employment.

Considering the accounting rules set out in Regulation (EU) 2018/841 for emissions and removals in the categories of afforested land, deforested land, managed forest land, managed agricultural land and managed grassland (including managed wetlands from 2026, for which it is planned to include long-term measures in line with the Long-Term Strategy for 2050), Spain envisages compliance with the 'no-debit' rule, which ensures that emissions do not exceed removals, calculated as the sum of total emissions and total removals in its territory in the abovementioned accounting categories.

Likewise, with these same accounting rules, Spain expects to exceed the **29.1 $MtCO_2$ over the 2021-2030 period** established in Regulation (EU) 2018/842 as flexibility to achieve the binding annual reductions in GHG emissions.

However, there are no plans to use this flexibility to achieve the commitments made by Spain for 2030 in this plan.

Table 3.2. Projection of LULUCF accounting according to Regulation (EU) 2018/841 of cumulative CO_2-eq emissions/removals in the 2021-2030 period

Category	Estimate 2021-2030 ($ktCO_2$-eq)	Accounting principle 2021-2030	2021-2030 Accounting ($ktCO_2$-eq)
Deforested land	4,104	KP2 *gross-net*	4,104
Afforested land	-23,479	KP2 *gross-net*	-23,479
Managed forest land	-298,214	FRL (-296,903 $ktCO_2$-eq)	-1,311
Managed agricultural land	-18,324	*Net-net* average 2005-2009 (15,510 $ktCO_2$-eq)	-33,834
Managed grassland	2,254	2005-2009 *Net-net* average (13,030 $ktCO_2$-eq)	15,284
Managed wetlands	341	*Net-net* average 2005-2009 (270 $ktCO_2$-eq)	71

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Measure 1.24. Forest sinks

a) Description

The actions identified for forest sinks are described below, together forming an additional measure for the WAM scenario or Target Scenario of the 2021-2030 INECP.

a.1. Regeneration of silvo-pastoral systems

Currently the main problem affecting the conservation of dehesas (shade tree and pasture systems) is the lack of regeneration of the dominant tree species. This is due to several causes such as overgrazing, the lack of planning in silvo-pastoral management, the excessive use of firewood, the excessive burden of game animals, forest fires, and the incidence over recent years of root rot and other factors that cause decay, colloquially grouped under the name dry rot. These factors have led the Spanish dehesas and other silvo-pastoral landscapes to be in a far from ideal state of conservation, with inadequate tree densities.

This measure aims to regenerate the dehesas and other open highlands so they can be considered silvo-pastoral systems and the full sink effect can be taken into account, with the dual purpose of maintaining these ecosystems, which are one of Spain's main natural assets from a social, economic and environmental standpoint, and of avoiding CO_2-related costs and losses, both in tree biomass and in the soil.

a.2. Promoting poplars as replacements for agricultural crops in flood-prone areas

This measure aims to promote, at times, the cultivation of black poplars, considering their importance for the national economy and their environmental contribution in terms of CO_2 removal, together with their potential to help stabilise riverbanks and their ability to withstand regular flooding and waterlogged soil. The latter aspect makes them a suitable crop for flood zones. Furthermore, when they are located between agricultural land and riverbanks, they act as a natural water filter for surface runoff and surplus irrigation water containing fertilisers and plant protection products.

At the same time, this measure is intended to boost the forest sink effect by preferentially developing native and structurally complex formations and species, avoiding as far as possible the orientation towards monocultures. Moreover, in any actions to recover riverside vegetation and stabilise riverbeds to create forest sinks, the Water Framework Directive objective will be respected in relation to maintaining and achieving the good status of water bodies, hydromorphological and riverside vegetation indicators. In other words, whenever possible, the aim will be to recover the native riparian ecosystems.

This measure will involve planting structurally complex native species (and sometimes new poplar groves), in flood-prone areas with a return period of 10 years, based on the risk of floods originating in rivers to economic activity mapped by the National Flood-Prone Area Mapping System (SNCZI).

a.3. Creation of forest areas

Forests play a central role in the global carbon cycle given that they capture carbon from the atmosphere as they grow and store it in their tissues. Given their enormous biomass, forests are one of the biggest carbon sinks. They also produce goods and products that are of great importance to society (biodiversity, protecting the water cycle, jobs, products, etc.).

This measure involves promoting afforestation (the conversion, by direct human activity, of unforested land into forested land over a period of at least 50 years via planting, sowing or human-induced natural regeneration) and reforestation (the conversion, by direct human activity, of unforested land that was once woodland but is currently deforested into forested land via planting, sowing or human-induced natural regeneration).

a.4. Forestry activities to prevent forest fires

We currently have a forest environment that is very prone to fires and the means of extinguishing these fires are reaching the limits of their effectiveness. It is therefore vital that more attention be paid to preventive activities that help to reduce the risk of outbreaks and facilitate efforts to extinguish the fires.

This measure covers the work required to reduce and control the amount of wood fuel, making the forests more resistant to the outbreak and spread of fires and facilitating efforts to extinguish fires when they do occur. The amount of fuel is controlled by breaking the spatial continuity of vegetation, by means of scrub clearing, pruning, thinning, etc., particularly in areas where it is difficult to work with machinery.

Forest fires pose a variety of dangers in addition to the release of the carbon fixed in the biomass and the production of additional emissions (CH_4, N_2O, NO_x and CO) due to incomplete combustion, such as the release of organic carbon from the soil and the consequent erosion, or the public expenditure involved in putting out forest fires.

The working method is based on the application of techniques by specialised personnel who propose and apply specific and balanced measures that serve to control and improve the vegetation, while recognising the interests of the different groups present in the area.

a.5. Controlled grazing in strategic areas to prevent forest fires

This measure is also focused on the prevention of forest fires, but it proposes the integration of planned grazing into fire prevention efforts, as another complementary tool.

Controlled grazing in pastoral firebreaks is a sustainable farming practice in that the livestock helps to reduce the risk of fire and play an important ecological function in Mediterranean forests. Furthermore, its inclusion in the range of forest management tools encourages the local population to be more vigilant and to take more of an interest in forest conservation, promoting collaboration between experts and farmers, which strengthens the social prevention of fires.

Grazing in firebreak areas is, therefore, a useful fire prevention tool that offers very positive environmental and social externalities, making it, ultimately, a valuable land management system.

a.6. Promoting sustainable coniferous forest management, application of thinning schemes to increase carbon removals

Besides increasing forest areas through planting and land use changes, it is possible to increase the biomass storage capacity of already established forest systems by applying particular management techniques.

Thinning, understood as the reduction of the density of individuals of the same species, is an intermediate forestry intervention that is essential in the management of forest systems. Its objectives include reducing competition, improving the individual vigour of the trees, regulating the specific composition of the forest, bringing forward and maximising production at the end of the cycle, and increasing the value and size of the products.

From the point of view of CO_2 fixation there is ample scientific evidence that, even though thinning reduces the number of trees in the forest, the application of specific schemes can increase the total amount of CO_2 removed by the forest throughout its productive cycle.

This measure promotes the development of management plans that include an adequate thinning plan, quantifying the improvement involved in terms of CO_2 removals, without quantifying other associated benefits (improvements in forest health, reduction in forest fires, etc.).

a.7. Hydrological-forest restoration in areas at high risk of erosion

Hydrological-forest restoration incorporates the range of actions required to conserve, defend and recover the stability and fertility of the soils, regulate runoff, reinforce channels and slopes, contain sediment and in general defend the soil against erosion, actions that seek to retain organic carbon in the soils and that have other synergistic effects such as defending against desertification, drought and flooding, conserving and recovering biodiversity and enriching the landscape.

This measure involves the construction of structures intended to correct and stabilise watercourses in areas at high risk of erosion (according to the map of desertification risk in the **National Action Plan to Combat Desertification**), but not the reforestation of this land as these activities are covered in a separate measure.

b) Mechanisms

- Interventions that may be developed as part of the upcoming CAP Strategic Plan in Spain.
- The inclusion, where applicable, of interventions in the third-generation River Basin Management Plans and the flood risk management plans.
- Harmonisation of the fees for the use of public water resources to incentivise poplar planting in designated areas.
- Promotion of public-private financing instruments aimed at boosting the creation of territorial contracts that could implement forest fire prevention measures.
- Analysis and study of the tax regime linked to forests to promote the active management of forest areas and consequently reduce the risk of forest fires.
- Promotion of public-private financing instruments aimed at stimulating the creation of territorial contracts that could implement measures to facilitate grazing in forest landscapes.
- Promoting intermediate forestry measures to better secure forest products with greater added value and enable the energy recovery of forest waste.
- Development and implementation of the **Plan of Priority Actions for Hydrological-Forest Restoration**.
- Development and implementation of the **National Soil Inventory**.

c) Responsible bodies

MAPA and MITECO, jointly with the autonomous communities, in accordance with the distribution of the relevant powers in Spain.

Measure 1.25. Agricultural sinks

a) Description

The actions identified for agricultural sinks are described below, together forming an additional measure for the WAM scenario or Target Scenario of the 2021-2030 INECP. They are also important for the synergies they show for a better adaptation of the agricultural sector to the impacts of climate change and are therefore aligned with the National Plan for Adaptation to Climate Change.

a.1. Promoting conservation agriculture (direct sowing)

This measure involves applying conservation agriculture techniques that increase the amount of CO_2 removed by agricultural soils and reduce emissions from diesel-powered agricultural machinery. The measure is appropriate both in terms of mitigating and adapting to climate change, as it encourages the soil to act as a carbon sink and also improves its resilience. Farmers will need to be trained for it to be implemented.

a.2. Maintenance of plant cover and the incorporation of pruning waste into the soil for woody crops

This measure involves maintaining live plant cover between the crop rows and incorporating woody pruning waste into the soil. These two agricultural practices are compatible and synergistic.

Greenhouse gas reductions are achieved, on the one hand, by not tilling the soil, as is traditionally done, and on the other, by avoiding the uncontrolled burning of pruning waste. Besides reducing emissions, agricultural benefits are obtained (by improving soil structure and productivity), as well as environmental benefits (by increasing the amount of organic carbon in the soil and the associated biodiversity and by protecting the soil from erosion) and economic benefits (by reducing the amount of fertiliser required).

b) Mechanisms

Other regulatory measures from MAPA and/or interventions under the CAP Strategic Plan.

c) Responsible bodies

MAPA, jointly with the autonomous communities, in accordance with the distribution of the relevant powers in Spain.

3.1.6 Taxation

Measure 1.26. Taxation

a) Description

In line with the Change Agenda approved by the Spanish Council of Ministers held on 8 February 2019, at which the need to 'adapt the tax system to the 21st Century' was expressed, as was the need for a 'new green approach to taxation — aligning taxation with environmental impact', the Ministry of Finance will lead an in-depth study and, where applicable, take the corresponding steps to update those elements of the tax system that could systematically incentivise a low-carbon and climate-resilient economy, through the progressive and generalised internalisation of the environmental externalities that occur in the generation and use of energy, as well as in the execution of the main economic activities that emit greenhouse gases and increase the vulnerability of the Spanish economy to the foreseeable impacts of climate change.

3.2 ENERGY EFFICIENCY DIMENSION

3.2.1 Measures for compliance with the obligation to save energy. Sectoral approach

Article 7 of the Directive on Energy Efficiency (Directives 2012/27/EU and 2018/2002/EU of the European Parliament and of the Council) establishes the obligation to demonstrate cumulative final energy savings up to 2020 and 2030, with the latter calculated from 1 January 2021 until 31 December 2030, in accordance with the cumulative scheme applied in the Directive's first implementation period, from 1 January 2014 to 31 December 2020.

This cumulative savings target must be reached by implementing a system of energy efficiency obligations on energy providers or through the application of alternative measures of a regulatory, fiscal, or economic nature, or related to information and communication, which must be executed by the public authorities.

In this section of the INECP, we present the **ten principal energy efficiency measures** designed to meet the final energy saving obligation arising from the application of Article 7 of the Directive on Energy Efficiency.

Spain accepts the commitment of meeting this energy-saving target and proposes measures to ensure a uniform annual effort throughout the period in question, from 1 January 2021 to 31 December 2030, such that the mechanisms for action included in this Plan, as well as the public support identified as necessary, have the goal of ensuring **the demonstration of new and additional final energy savings equivalent to 669 ktoe/year.**

The system of energy efficiency obligations is regulated in Spain through Law 18/2014 of 15 October 2014, approving urgent measures for growth, competitiveness and efficiency. This Law also created the **National Energy Efficiency Fund**, with no legal personality, as an instrument for implementing mechanisms for financial and economic support, technical assistance, training and information, and other measures intended to increase energy efficiency across all sectors. The National Energy Efficiency Fund will extend its validity to **31 December 2030**, in accordance with the approved Energy Efficiency Directive review.

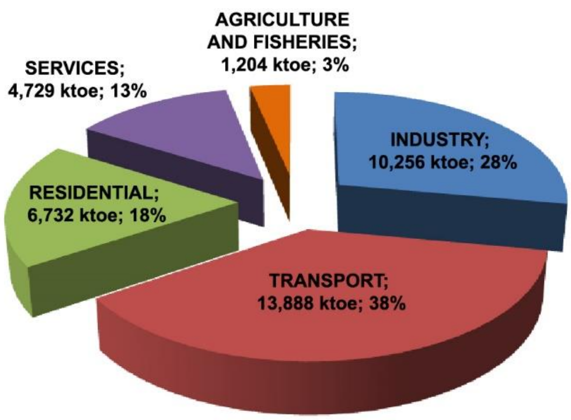
In addition to the mechanisms that could be developed with the resources of the National Energy Efficiency Fund, the Target Scenario of this Plan considers **regulatory and fiscal mechanisms** to enable the greatest and fastest market penetration of efficient technologies, the greatest electrification of transport and energy demand in construction, the active participation of demand in managing the energy system, own consumption and distributed generation, and also a greater contribution of thermal renewable energies to the coverage of final energy demand.

In particular, it highlights measures for energy efficiency and energy saving in the rail, maritime and air transport sectors, not considered in the measures developed with the resources of the National Energy Efficiency Fund. As a result of the investments considered in the Infrastructure, Transport and Housing Plan (PITVI) for 2012-2024 and successive years of the Ministry of Public Works (currently MITMA), greater energy efficiency will be promoted for the conventional rail system, to make it more efficient and competitive, and directing it towards covering the daily metropolitan transport needs of people and goods, as far as possible. In parallel, energy efficiency measures will be promoted for air and maritime transport.

Moreover, the Ministry of Finance will lead an exhaustive analysis on the potential complete review of the environmental tax policy of Spain. There is a general consensus that it is an instrument with great potential to facilitate the transition to a low-carbon economy. The fundamental objective is the internalisation of the negative externalities derived from the use of certain fuels or technologies, so that in the decision-making process the energies or technologies with the lowest environmental impact are selected. This review of environmental tax policy will enable Spain to move rigorously and efficiently towards an environmentally sustainable economic model.

The Energy Efficiency Dimension of this Plan presents 17 energy efficiency measures, of which 10 have been designed, taking a sectoral approach, with the aim of meeting the energy-saving obligation arising from Article 7 of the Energy Efficiency Directive. The transport sector is highlighted, with four measures that will significantly contribute to the cumulative final energy-saving target for the 2021-2030 period, with almost 14 Mtoe of savings. The transport sector is followed by the industrial and residential sectors, with 10.3 Mtoe and 6.7 Mtoe of savings, respectively. The services sector and agriculture and fisheries are those with the lowest contributions, with 4.7 Mtoe and 1.2 Mtoe, respectively:

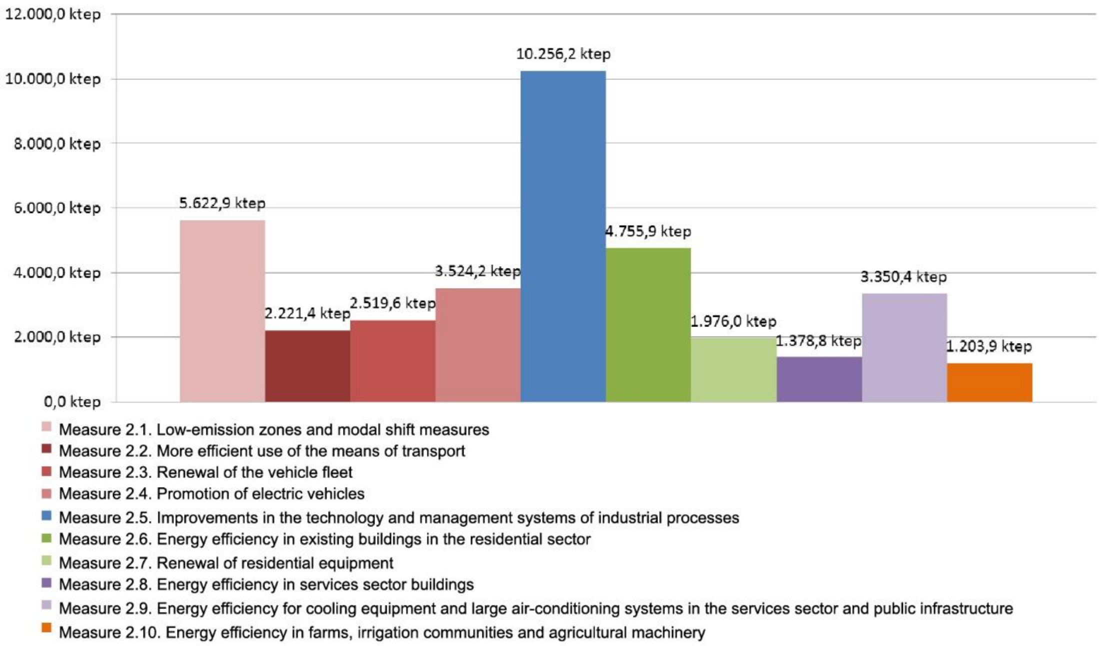
Figure 3.3. Cumulative final energy saving by sector in Spain 2021-2030 (ktoe)[44]



Source: Ministry for Ecological Transition and Demographic Challenge, 2019

[44] The quantification of energy savings included in this chapter includes those necessary to ensure compliance with the energy-saving target associated with Article 7 of the Energy Efficiency Directive, formulated in terms of cumulative final energy saving from 1 January 2021 to 31 December 2030. Spain agrees to meet this cumulative energy-saving target, which will be translated into a greater or lesser volume of annual savings in each of the financial years, depending on whether the energy-saving and energy-efficiency measures are concentrated in the first or second half of the decade. The objective of decarbonisation of the Spanish economy by 2050 will require increased enforcement of energy-saving and energy-efficiency measures, particularly with regard to transport and the reduction of traffic in urban and inter-urban environments, with regard to the cumulative energy-saving target of Article 7.

Figure 3.4. Cumulative final energy saving by measure in Spain 2021-2030 (ktoe)



Source: Ministry for Ecological Transition and Demographic Challenge, 2019

In Annex F, more detail is provided on these policies and measures that will enable Spain to meet the challenge posed by such a quantitative leap in the achievement of energy savings.

The 10 measures mentioned above are subdivided into instruments, some of which were already planned and implemented in the previous period and learning has been gleaned from the experience. Others will be implemented for the first time in the 2021-2030 period, such as the green tax reform, the new Climate Change and Energy Transition Act, the new Sustainable Mobility and Public Transport Financing Act, the review of the amendment of the legislation affecting the maximum mass and length of road freight transport, the new municipal by-laws to restrict access to city centres for the most emitting and polluting vehicles and the promotion of the renewal of delivery fleets, among other fleets.

With respect to instruments that had already been used previously, such as lines of aid for transport electrification or energy upgrading of housing, budgets are being stepped up to achieve the leap in scale needed to achieve the objectives.

In addition, we must consider that these sectoral measures are complemented by the horizontal and financial measures defined in sections 3.2.2 and 3.2.4 below.

Transport sector

Measure 2.1. Low-emission zones and modal shift measures

a) Description

The objective of this measure is to reduce final energy consumption and carbon dioxide emissions by acting on urban and metropolitan transport by means of significant changes in modal distribution, with greater use of the most efficient modes of transport, and less use of private vehicles with low occupation, encouraging shared use, as well as modes of transport that do not consume energy, such as walking and cycling. In this sense, it is important to stress the importance of good urban design for the purpose of encouraging less polluting and less emitting modes. It is particularly important at the time of undertaking new developments in order for the sustainable mobility variable to be incorporated from the very start of the design modification.

The measure is intended to reduce the use of private vehicles, so this INECP considers it feasible to reduce passenger traffic (passengers/km) in urban environments by 35% by 2030, and to reduce inter-urban transport by approximately 1.5% annually; remote working, shared vehicles, the use of non-motorised vehicles and shared public transport will enable these targets to be achieved. It is of great importance to enable adequate funding of public transport that will make it possible to improve quality and service, attract more users and in this way contribute to improving air quality in urban environments.

To encourage changes in transport demand, it is necessary to make the most of the opportunities offered by the digitalisation that comes from information and communication technologies (ICT) applied to mobility management (fleet management, parking, traffic restrictions, autonomous vehicles, etc.), as well as the concept of mobility as a service (MaaS), as opposed to payment for ownership. The new generations, users and companies of the future, are growing up in this environment.

The main driving force behind the modal shift is the establishment, from 2023 in all towns and cities with more than 50,000 inhabitants within Spanish territory, of low-emission zones, i.e. the delimitation of zones with limited access for the most polluting vehicles with the highest emissions. This measure, one of the most important in this Plan, aims to transform towns and cities to ensure greater quality of life by improving air quality. The measure includes a wide range of actions of different types to enable the investment in infrastructure that will enable the necessary modal shift to take place. The proactive involvement of local authorities will be decisive in this measure.

In that regard, this measure is defined with a broad approach, beyond the scope of the actions that have been implemented since 2015 financed from the National Energy Efficiency Fund. In this Plan, the participation and coordination of all the regional administrations, and also the support of private initiatives and financial entities in particular, are fundamental for raising investment. Therefore, the drive to develop regional legislation in the autonomous communities with regard to transport, in coordination with the terms established at national level, will be one of the priorities.

It is also important to pay due attention to the Land Use and Sectoral Plans, since provisions and criteria are adopted at this higher level of planning that then take shape in infrastructure and urban development projects where the modes of mobility and transport have been heavily influenced. All this is consistent with MITMA's Spanish Urban Agenda.

Specifically, its execution will be promoted through public support programmes for the measures contained in the **Sustainable Urban Mobility Plans** that must be implemented by the local authorities (with the support of other regional administrations, and where applicable, the General State Administration) and the **Workplace Travel Plans** implemented by companies.

This measure is consistent with the sustainable transport priorities established in Articles 102 and 103 of Law 2/2011 on Sustainable Economy.

b) Expected cumulative and annual energy savings for each measure and/or quantity of energy savings in relation to any intermediate period

The estimated savings for this measure are **5,622.9 ktoe of cumulative final energy savings in the 2021-2030 period**, out of a total 13,888 ktoe that represent the total for the transport sector.

c) Responsible bodies

The public authorities responsible for the execution and follow-up of the measure are MITECO/IDAE and MITMA (in coordination with other ministerial departments with cross-cutting responsibilities in the area of transport), together with the autonomous communities, and, in particular, local authorities.

d) Target sectors

This measure is aimed at town and city councils, regional councils, and other extra-municipal bodies for regional representation, as well as public or private workplaces and companies or activity centres (airports, train stations, industrial complexes, education or health centres, universities, leisure parks, shopping centres, etc.). It is also aimed at transport authorities and companies, as well as logistics centres.

e) Eligible actions

Eligible actions are those that achieve a reduction in CO_2 emissions and final energy consumption, by means of significant changes in modal distribution through:

Implementation and development of Sustainable Urban Mobility Plans (PMUS): with measures such as the universalisation, from 2023 in all cities with more than 50,000 inhabitants in Spain, of the delimitation of central areas with restricted access for the most emitting and polluting vehicles (a measure also included in the Climate Change and Energy Transition Bill).

Likewise, regulations on the occupation of public land will be promoted with sustainable mobility criteria, traffic restrictions at times of greater pollution, the promotion of car sharing, the regulation of parking, the promotion of the use of bicycles, the improvement and promotion of public transport, etc.

The implementation and development of Workplace Travel Plans (PTT): with measures such as shared transport services within companies, the promotion of bicycles, public transport, remote working, etc.

f) Mechanisms

The mechanisms for action that will enable the planned energy-saving targets to be achieved are as follows:

Legislative measures: the future Law on Climate Change and Energy Transition. Amendment of Article 103 of Law 2/2011 on Sustainable Economy (‘Development of Transport Plans in Companies’), requiring its implementation in companies with more than 250 employees (large companies) and the creation within these companies of the role of Transport Coordinator, in order to increase the number of companies with a Transport for Work Plan.

Other legislative measures include those implementing the relevant regional laws on transport within the scope of the autonomous communities’ powers, as well as in municipal by-laws, particularly among communities with more than 50,000 residents, concerning restrictions on private transport, parking management, shared vehicles, traffic calming, traffic lanes reserved for public transport and other measures intended for sustainable transport.

Finally, **the Law on Sustainable Mobility and Financing of Public Transport** will be drawn up at national level. This law will comprehensively address the needs of society with regard to the new models and requirements related to mobility and will pay special attention to generating sufficient economic resources to provide public transport — especially in metropolitan areas — with financial resources to offer a high-quality service and facilitate the urban modal shift to which this Plan has committed.

Public support programmes: programmes to promote the implementation of the measures and actions contained in the Sustainable Urban Mobility Plans and the Workplace Travel Plans; the design of financial instruments that will make it possible to mobilise the necessary investments in rail infrastructure to increase the share of transport of goods by rail. This measure is consistent with MITMA's planning objectives, seeking to improve the energy efficiency of the conventional rail system.

An example of this is the **2019-2025 Strategic Plan for Integral Support for the Automotive Sector**, which MINCOTUR presented, following talks with the sector, and which seeks to help the sector during the energy transition.

Information: preparation and updating of guides and manuals on sustainable urban transport; maintaining a platform aimed at citizens and transport managers on the IDAE website, which includes these guides, as well as useful information to promote the implementation of the Sustainable Urban Mobility Plans and the Workplace Travel Plans; support for the creation of mobility observatories in different areas of action, forums and work groups on sustainable mobility.

Communication: conducting specific communication and information campaigns to support this modal shift and the rational use of private vehicles for urban travel; developing and promoting institutional campaigns for the promotion of public transport and support for new sustainable transport, including the granting of awards and commendations to exemplary projects.

g) Financial requirements and public support

This measure has high financial requirements. The estimated public investment is **EUR 3.14 billion** over the 10 years of the Plan, assuming that all municipalities implement a PMUS in the 2021-2030 period, prioritising the less investment-intensive measures.

This investment could be co-financed using the ERDF funds under the Operational Programme for the 2021-2030 period. In addition to this investment needed to enable a successful modal shift and the transformation of the urban model, there must be a significantly smaller amount — around **EUR 265 million** — to promote the implementation of Transport for Work plans in companies, through public aid.

The actions included in the Sustainable Urban Mobility Plans will be accomplished using public finances from the relevant administrative bodies (where applicable, taking the framework of the national and European programmes into account) and in the case of Transport for Work plans, public spending is estimated to be 50% of the investment, equivalent to EUR 132.5 million.

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Measure 2.2. More efficient use of the means of transport

a) Description

The objective is to reduce final energy consumption and carbon dioxide emissions by promoting actions for the more rational use of the means of transport, including improved management of vehicle fleets on the roads, implementing efficient driving techniques for professional drivers (with potential fuel savings of around 10%) and standardising loads and dimensions for the transport of goods by road to surrounding countries.

In this regard, it is important to highlight the notable increase in the urban distribution of goods within cities, caused by the boom in e-commerce that generates a large number of deliveries of small loads that require a high number of trips and a multitude of delivery vehicles. This affects traffic congestion, energy consumption, pollution and GHG emissions.

It is also considered that a significant percentage of the vehicle fleet in 2030 will be used through shared mobility services, resulting in fewer vehicles in the fleet, as well as a shift from a culture of vehicle ownership to one of shared service.

This measure is consistent with the 2012-2024 Infrastructure, Transport and Housing Plan from the Ministry of Public Works (currently MITMA), which seeks to improve the energy efficiency of the conventional rail system through technological improvements and better energy use, as well as promoting energy efficiency measures in air and maritime transport.

b) Expected cumulative and annual energy savings for each measure and/or quantity of energy savings in relation to any intermediate period

The target for this measure is **2,221.4 ktoe of cumulative final energy savings** in the 2021-2030 period, out of a total 13,888 ktoe that represents the total for the transport sector.

c) Responsible bodies

The public authorities responsible for the execution and follow-up of the measure will continue to be MITECO/IDAE, MITMA, together with the autonomous communities, following a model of joint management and joint financing of the measures and actions for energy efficiency that respects the distribution of the relevant responsibilities in Spain.

d) Target sectors

This measure is aimed at public and private companies and bodies with vehicle fleets for road or rail transport of people or goods, or public works and services vehicles.

e) Eligible actions

Eligible actions include the application of energy audits to vehicle fleets, the installation of centralised technology systems and applications intended to improve efficiency, and the delivery of fleet management courses for staff, as well as training for professional drivers in efficient driving techniques for industrial vehicles, as well as on rail transport.

> **Legislative measures**: review of the necessary regulations to standardise the loads and dimensions of national lorries with those of neighbouring countries. An increase in the average load of these vehicles from 2021 will lead to a consequent reduction in the number of vehicles per kilometre and consumption for the same mass transported.
>
> Prior to the adoption of this measure, MITMA, together with the actors involved, will analyse the impact of the maximum permitted mass and size limits on road freight transport costs, including external costs, all within the framework of the legislation in force. MITMA will also analyse the influence of this measure on the functionality of the road network and durability of pavements, and in particular on the structural capacity of the crossings (bridges and viaducts) that make up the road network.

Incorporation into municipal by-laws of aspects that facilitate the rationalisation of last mile distribution, including the progressive incorporation of more efficient and less polluting vehicles to carry out such distribution.

f) Mechanisms

Public support programmes: aid programmes through grants aimed at companies.

Voluntary agreements: agreements signed with sectoral associations and accreditation of companies with efficient fleet management systems.

Communication: development of demonstration and promotion activities aimed at companies.

g) Financial requirements and public support

The measure aims to raise a total investment amount of EUR 73 million, with EUR 22 million of public support.

Measure 2.3. Renewal of the vehicle fleet

a) Description

The objective of this measure is to improve the energy efficiency of the vehicle fleet by promoting the upgrade to more energy-efficient vehicles. The average age of vehicles is around 12 years. New vehicles on the market, regardless of their power source, are more efficient, and therefore their addition to the fleet gradually reduces overall consumption. By encouraging the purchase of more efficient vehicles, savings will be made in addition to those obtained through natural replacement of the vehicle fleet. Special emphasis should be placed on the renewal of vehicles in urban delivery fleets, as well as taxi services, as these do the most mileage in city centres by far.

b) Expected cumulative and annual energy savings for each measure and/or quantity of energy savings in relation to any intermediate period

The objective of the measure is a saving in addition to that arising from the natural replacement of the vehicle fleet (considered in the projections of the Baseline Scenario included in this INECP) equivalent to **2,519.6 ktoe of cumulative final energy savings** during the 2021-2030 period, out of a total 13,888 ktoe that represents the total for the transport sector, by promoting the upgrading of the fleet to more efficient vehicles.

In the case of passenger cars, vehicles classified as A or B according to the IDAE's energy classification will be specially promoted (without prejudice to the promotion of an alternative classification based on technologies, according to the Directorate-General for Traffic's criteria). In the remaining categories, we will try to ensure that only vehicles that achieve a minimum proven reduction in average annual CO_2 emissions of 25% benefit from the measures.

c) Responsible bodies

The public authorities responsible for implementing and monitoring the measure are the Ministry of Finance, which is in charge of the tax reform of the General State Administration, local authorities and the autonomous communities, which are responsible for certain taxes affecting vehicles, such as the Motor Vehicle Tax (IVTM) and the Special Tax on Certain Means of Transport (IEDMT) or registration tax.

d) Target sectors

This measure is aimed at the general public and companies with vehicle fleets.

e) Eligible actions

The purchase of more efficient vehicles.

f) Mechanisms

Taxation: The Ministry of Finance, in collaboration with local authorities, in the line already initiated by the General Tax Directorate, will analyse the convenience, viability and time periods for reform of the current Motor Vehicle Tax, levied by the local authorities, which taxes the ownership of roadworthy vehicles, according to the type of engine or fuel.

This Plan considers it necessary to re-orientate the weighting of the current rates using criteria based on the emission of pollutants, which could be based on the European Standard or the environmental ratings of the Directorate-General for Traffic, in order to penalise older vehicles, which generate more emissions and pollution as well as consuming more and therefore emitting more CO_2.

At the same time, the Ministry of Finance will analyse a green tax reform for the automotive sector, so that consumer purchasing decisions are guided towards vehicles with lower pollutant emissions and lower GHG emissions.

Legislative measures: In coordination with local authorities, we will promote the application of traffic restriction and parking management measures on public highways by local councils, so that the oldest vehicles, which have the highest fuel consumption and pollutant emissions, will be penalised.

Financing programmes: Creation of financing instruments, through collaboration agreements with financial entities, aimed at SMEs and self-employed people in the goods transport and taxi services sector, to encourage the renewal of their vehicles as they may have difficulty in finding financing through ordinary channels, encouraging such renewal to be directed towards low-emission technologies.

g) Financial requirements and public support

The total related investment, by individuals and companies, is estimated to be EUR 76.68 billion[45] for the 2021-2030 period.

Measure 2.4. Promotion of electric vehicles

a) Description

The objective of this measure is to reduce the energy consumption of the vehicle fleet by electrifying the fleet. This will mainly be done with electric vehicles (defining electric vehicle as both vehicles with batteries and hydrogen fuel cell vehicles), making a greater penetration of renewable energies in the transport sector possible.

The current penetration of electric vehicles in the fleet is very low (54,079 vehicles in 2018, including battery electric vehicles, plug-in hybrid electric vehicles and extended-range electric vehicles) and barely noticeable for fuel cell vehicles. Increasing their number will provide a series of advantages for manufacturers, in terms of compliance with the CO_2 reduction targets of EU regulations, compliance with the urban air quality requirements indicated in Directive 2008/50/EC of the European Parliament and of the Council, reduced dependency on petroleum products, and improved demand management by acting on the curve of electricity system charging, provided that smart charging is promoted.

The mass electrification of vehicles will only be obtained when price parity is reached between electric vehicles and motor vehicles. According to manufacturers' estimations, this parity could be reached by 2025, due to the expected reduction in the price of batteries. This measure and Measure 2.3 establish the basis for new passenger cars and light commercial vehicles, excluding those registered as historic vehicles not intended for non-commercial [*sic*] use, to gradually reduce their emissions, so that no later than 2040, they will be vehicles with emissions of **0 g CO_2/km,** in accordance with European regulations.

[45] The total related investment was calculated taking the total price of the new vehicles into account.

On the other hand, it is estimated that by 2030, a significant percentage of electric vehicles will be used through Mobility as a Service (MaaS), which will encourage achieving significant percentages of electric vehicles in the fleets.

A key aspect for the progressive incorporation of electric vehicles will be the deployment of the public recharging infrastructure. In this regard, on 9 December 2016 the National Action Framework was adopted in response to the transposition of Directive 94/2014 of 29 September 2014 on the deployment of alternative fuels infrastructure. The National Action Framework meets the indicative target of the abovementioned Directive of having at least one charging point for every 10 electric vehicles. At present, the public electric vehicle charging service is liberalised in Spain and it is the companies themselves (and since the enactment of Royal Decree Law 15/2018 of 5 October 2018, any consumer) who are responsible for deploying the public charging service according to demand and the interests of the sector.

However, the various public administrations, each in its own area of action, must ensure that deployment is carried out in an orderly manner and in response to existing demand, for which purpose economic, regulatory and information measures will be implemented to facilitate the development of this infrastructure. In this sense, the Climate Change and Energy Transition Bill provides for establishing the obligation to install at least one public charging point at service stations with sales of petrol and diesel fuel greater than or equal to 5 million litres per year, which (once approved) will provide a significant boost to the public electric vehicle charging network. At the same time, the autonomous regional administrations are drawing up their own plans for the development of electric vehicles in which they also promote the creation of a charging network accessible to all users.

The development of the electric vehicle and its recharging infrastructure also has an impact on the energy security dimension (see Measure 3.4), as well as on the contribution of services to the electricity system through aggregation that allow for a greater integration of renewables (see Measures 1.2 and 4.4).

b) Expected cumulative and annual energy savings for each measure and/or quantity of energy savings in relation to any intermediate period

The measure will provide annual savings proportional to the number of electric vehicles introduced into the fleet, which will occur progressively. This INECP considers that **a fleet of 5,000,000 vehicles** will be reached **in 2030** (passenger cars, vans, buses and motorcycles), and therefore **accumulated final energy savings** over the 2021-2030 period are estimated at **3,524.2 ktoe/year**, out of a total of 13,888 ktoe that represents the total for the transport sector.

c) Responsible bodies

The public authorities responsible for the execution and follow-up of the measure will continue to be MITECO/IDAE (in coordination with other ministerial departments and, in particular, with MINCOTUR and the Ministry of Finance), together with the autonomous communities, following a model of joint management and joint financing of the measures and actions for energy efficiency that respects the distribution of competences in Spain. The local authorities will be administrative bodies contributing to the measure as a result of exercising their relevant powers concerning monitoring air quality in cities.

d) Target sectors

This measure is aimed at the general public and companies with vehicle fleets.

e) Eligible actions

The eligible actions for this measure include:

- The purchase of new electric vehicles.
- The deployment of recharging infrastructure for electric vehicles.

f) Mechanisms

The mechanisms for action that will enable the planned energy-saving targets to be achieved are as follows:

Legislative measures: to adapt the regulations on construction requirements for new buildings, in particular the Technical Building Code, to the provisions of Articles 8(2), 8(3) and 8(5) of Directive (EU) 2018/844 of the European Parliament and of the Council amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency, which establishes the conditions for developing the minimum infrastructure necessary for the smart charging of electric vehicles in building car parks. This adaptation must be carried out in line with the necessary amendments to the legislation and promotion plans to allow both slow and fast charging on roads and services sector buildings, in order to enable electric vehicle development in line with the figure of five million established by this INECP for the year 2030.

Public support programmes: aid programmes through grants that multiply the budgets available under the previous programmes (MOVELE, MOVEA, MOVALT, MOVES) to individuals and companies for the purchase of electric vehicles, as well as the installation of charging points.

The Seventeenth Additional Provision ('Financing of actions to support energy-efficient and sustainable transport') of the General State Budgets for 2017 states that, with effect from 2017 and for an indefinite period, the Government is authorised to establish a system of aid for actions to support transport based on criteria of energy efficiency, sustainability and promotion of the use of alternative energy, including the creation of appropriate energy infrastructure; this authorisation has enabled the allocation, both in 2017 and in 2018, of EUR 50 million annually to incentivise measures related to more sustainable transport, including the purchase of electric vehicles and the necessary recharging infrastructure, both public and private.

The budgets provided by the autonomous communities and local authorities will be added to this budget with the aim of incentivising the purchase of less polluting vehicles and the deployment of recharging infrastructure.

Taxation: the Ministry of Finance will analyse the appropriateness and feasibility of a tax reform in the automotive sector, aimed at internalising the environmental externalities of fossil fuels, which could consider, among other things, reforming the Special Tax on Certain Means of Transport (IEDMT) or vehicle registration tax to update the CO_2 emission thresholds above which the tax[46] or other taxes on the purchase or use of the vehicle are paid.

The reform would bring forward the date of price parity between combustion vehicles and electric vehicles, which would contribute to accelerating the use of electric vehicles beyond the requirements of the Regulation on CO_2 emissions for passenger vehicles and light vans, encouraging citizens to purchase zero-emission vehicles.

Communication: design of an ad hoc communication strategy focused on providing information on electric vehicles, the price and location of recharging points, the supply and provision of vehicles, etc.

It is important to mention the ongoing European projects in which Spain is participating: PSA 'Data collection related to recharging/refuelling points for alternative fuels and the unique identification codes related to e-Mobility actors' and PSA 'Fuel price comparison', both financed by the European CEF call for proposals in which 16 European countries participate. The first project will provide a national access point to the charging point network, both electric and hydrogen, with a visual map of these points available on the geoportal of MITECO website, as well as identifying them with a unique code, providing their coordinates and other relevant information for citizens. The second will provide citizens with information that will allow them to compare the refuelling costs of different types of vehicles, thus meeting the requirements of Directive 2014/94/EU.

[46] 74% of vehicles currently registered are not liable for this tax as they are not over the limit of 120 g CO_2/km.

The communication strategy will use the channels with the greatest impact, both specialist and general: MITECO geoportal, web platforms, smartphone applications, social networks, workshops and events.

g) Financial requirements and public support

The total investment associated with the use of electric vehicles will be approximately EUR 132.403 billion[47]. The estimated public financial support to develop this measure in the 2021-2025 period, meaning an aid line of EUR 200 million/year in the 2021-2025 period (with funds from the General State Budget and the autonomous communities), totals EUR 1 billion. In the 2025-2030 period, it is estimated that price parity will have been reached and no public support will be required.

Industrial sector

Measure 2.5. Improvements in the technology and management systems of industrial processes

a) Description

This measure aims to facilitate the use of final energy-saving technologies, mainly in small to medium enterprises (SMEs) and large companies in the industrial sector, particularly for facilities not included in the EU emissions trading scheme (EU ETS). This measure will improve the energy efficiency of industrial processes and guarantee final energy savings (and consequently, significant reductions in GHGs), thanks also to the implementation of energy management systems.

On one hand, the measure promotes the achievement of a greater volume of investment in the replacement of industrial equipment and facilities with poor energy performance by equipment and facilities with high energy efficiency or, directly, with the best available technologies (BAT); it will also consider the replacement of auxiliary energy-consuming systems. On the other, it also promotes the achievement of a higher number of investments in the implementation of energy management systems in industry. These systems should include activities for measuring energy consumption variables and the installation of features to monitor and control process parameters, as well as the implementation of IT and digital systems for analysis, monitoring and control. The aim is to achieve optimal functioning of the facilities, reduce energy consumption and costs, and provide information rapidly and precisely, which is necessary to improve the energy management of industrial facilities. In all cases, the energy management systems should comply with the UNE-EN ISO 50001 Standard on energy management systems or a substitute for this where applicable.

This measure has been designed in a similar way to the programmes to promote energy efficiency in the industrial sector launched in Spain by the National Energy Efficiency Fund, from May 2015 to 2019.

The improved energy efficiency of equipment, systems and industrial processes is another objective in addition to those included in this INECP, which aims to achieve the energy transition while ensuring an improvement in competitiveness and employment. The programmes to promote industrial competitiveness that were implemented during the previous implementation period of Directive 2012/27/EU of the European Parliament and of the Council, using the method of repayable loans, on behalf of the ministerial departments with responsibility for industrial policy, have directed public aid to production processes that are advanced, efficient and environmentally friendly, in a way that is consistent with the energy and climate strategy and has synergy with the measures to promote the use of renewable energy sources in industry.

[47] The total related investment was calculated taking the **total amount of new vehicles into account**. This concept is **not used in the economic impact evaluation of the INECP** (see chapter 4). The abovementioned evaluation only considers the difference between the investment made in a conventional vehicle when it is replaced (Baseline Scenario) and the investment made under the Plan's Target Scenario when purchasing an electric vehicle (more expensive than the previous one). This difference is considered to be the 'economic impact of the Plan' and obviously it is a much smaller amount than that obtained by considering the total cost of the new vehicle.

Raising new investment in equipment, systems and processes and implementing energy management systems in the form described, as a consequence of authorised public funds, will lead to new and additional final energy savings in the industrial sector during the new implementation period of the Energy Efficiency Directive, which corresponds to the period covered by this INECP. The public funds will come either from the National Energy Efficiency Fund, or from the General State Budget or European funds. In this last case, these public budgets can be directly channelled to the promoters or industrial companies through ad hoc programmes or through the National Energy Efficiency Fund, which can be used as a priority intervention tool in the public sector to raise investment in energy efficiency.

Furthermore, the incorporation of renewable energies in the industrial field is specifically addressed in Measure 1.5.

b) Expected cumulative and annual energy savings for each measure and/or quantity of energy savings in relation to any intermediate period

The measure aims to achieve **10,256 ktoe of cumulative final energy savings** during the 2021-2030 period.

c) Responsible bodies

The public authorities responsible for the execution and follow-up of the measure will continue to be MITECO/IDAE (in coordination with other ministerial departments with responsibility for industrial policy) together with the autonomous communities and local councils, following a model of joint management and joint financing of the measures and actions for energy efficiency that respects the distribution of competences in Spain.

d) Target sectors

This measure is aimed at companies in the industrial sector, preferably manufacturing, as well as energy providers that make investments on behalf of clients within this sector.

e) Eligible actions

The eligible actions include those which achieve a reduction in CO_2 emissions and final energy consumption, by improving technology in industrial equipment and processes and implementing energy management systems.

By analogy with the programmes to be implemented during the first period of the Energy Efficiency Directive, any actions considered economically unfeasible will not be eligible, defining ‘unfeasible’ as any action where the basic recovery period for the eligible investment exceeds the useful life of the facility executed.

f) Mechanisms

The mechanisms for action that will enable the planned energy-saving targets to be achieved are as follows:

Public support programmes: aid programmes through grants or repayable low-interest loans within the framework of Community regulations on State aid.

Voluntary agreements: voluntary agreements signed with representative associations in sub-sectors with more intense energy use can promote the more rapid adoption of efficient technologies in the industrial sector.

g) Financial requirements and public support

The total related investment is estimated to be **EUR 7.37 billion, with public support of EUR 1.647 billion.**

Residential sector

Measure 2.6. Energy efficiency in existing buildings in the residential sector

a) Description

The measure aims to reduce the energy consumption of existing residential buildings used for housing through energy upgrade activities. The upgrade should enable the building's energy rating to be improved. This measure must be entirely consistent with the **Long-term building renovation strategy,** developed by MITMA, which will be updated in 2020, in compliance with Article 2a of Directive 2010/31/EU of the European Parliament and of the Council and the **State housing plan**, which is the basic tool for promoting urban and rural regeneration and renewal that has been implemented in collaboration with the autonomous communities.

This INECP considers that the energy efficiency certification of buildings (Royal Decree 253/2013 of 5 April 2013) constitutes a very useful tool for the promoters of upgrade activities with regard to new investments in existing buildings, whatever their use. However, and insofar as improving the energy rating of buildings can be achieved by acting on their thermal envelope or on the thermal installations for heating and/or air-conditioning and domestic hot water (DHW), this Plan **prioritises investment in the thermal envelope** (facades, roofs and walls) with regard to improving the thermal installations, considering that the reduction in thermal demand should first be addressed in order to avoid heating and/or air-conditioning equipment that is oversized to meet that demand.

The description given of the measure takes the **Programme of aid for the energy upgrade of existing buildings** as a reference point. It was launched in Spain in October 2013 under the title of the PAREER programme, extended in May 2015 as PAREER-CRECE, and in force until 2018 under the name PAREER II. This programme is considered to have been a successful experience, precisely due to the fact that more than 85% of the funds channelled to energy upgrade projects have been for actions to improve the energy efficiency of the thermal envelope (PAREER-CRECE). This programme may be promoted in the new implementation period of the Energy Efficiency Directive due to the existence of **upgrade offices** in certain regions that identify projects and provide technical advice to communities and owners for developing proposals. Public aid through grants and financing is then provided for the part not covered by the subsidies.

The basis of public support will be the building's energy efficiency certificate, which must include a description of the energy features of the building as a starting point for conducting an energy assessment. This certificate will contain information on all the features subject to intervention from an energy perspective (thermal envelope, thermal installations for heating, air-conditioning and domestic hot water, lighting and monitoring and management systems), as well as information on the normal conditions of operation and occupation, the conditions for thermal comfort and indoor air quality, etc.

Each certificate should include recommendations to improve the optimal or profitable levels of energy efficiency of the building, or part of it, which can include an estimate of the time periods for the return on investment during their life span.

b) Expected cumulative and annual energy savings for each measure and/or quantity of energy savings in relation to any intermediate period

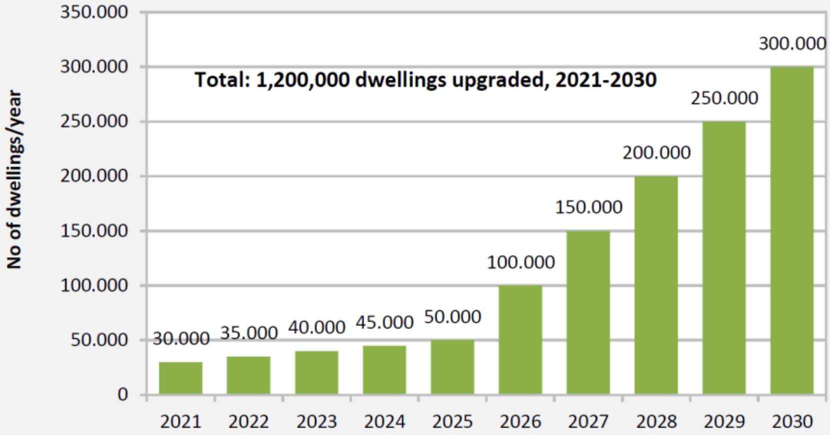
The measure aims to achieve **4,755.9 ktoe of cumulative final energy savings** during the 2021-2030 period.

These savings will be the result, firstly, of acting **on the thermal envelope of 1,200,000 dwellings** throughout the period, starting with 30,000 dwellings per year in 2021 and finishing with 300,000 dwellings per year by 2030.

This quantitative planning is indicative, and the decisive factor for the targets of this Plan are the total energy savings achieved. The exact ratios for the upgrading of dwellings that will be undertaken for each year will be defined precisely in the future **Long-term strategy for energy upgrading in the building sector in Spain,** which is the responsibility of MITMA.

Secondly, they will result from **the renovation of thermal installations (centralised and personalised) in more than 300,000 dwellings per year.**

Figure 3.5. Annual indicative forecast of dwellings with an energy upgrade, 2021-2030



Source: Ministry for Ecological Transition and Demographic Challenge, 2019

c) Responsible bodies

The public authorities responsible for the execution and follow-up of the measure will continue to be MITMA, the Ministry of Finance and MITECO/IDAE, together with the autonomous communities, following a model of joint management and joint financing of the measures and actions for energy efficiency that respects the distribution of competences in Spain.

d) Target sectors

The beneficiaries of this measure will be the owners of existing buildings for housing purposes, whether they are legal or natural persons, public or private, communities of owners or groups of communities of owners of residential buildings for housing purposes, or companies which operate, lease or hold concessions for residential buildings for housing purposes, and in all cases, the energy providers.

e) Eligible actions

Eligible actions will be those which achieve a reduction in CO_2 emissions and final energy consumption, by improving the services that have more weight in the energy consumption of buildings, such as heating, cooling and the production of domestic hot water, where the use of information and communication technologies (ICT) shows itself to be an important tool to manage energy and improve energy efficiency:

- **Thermal envelope**: action will be taken on the thermal envelope of buildings to achieve a reduction in demand for the heating and cooling of buildings. The energy efficiency actions may be applied to facades, roofs, floors, external woodwork, windows and solar protection, etc.
- **Thermal installations**: action will be taken on the thermal installations for heating, air-conditioning, production of domestic hot water and ventilation, governed by the Regulation on Thermal Installations in Buildings. The measure covers the incorporation of renewable energy sources to meet demand, in accordance with the targets for final renewable energy consumption considered in this Plan.

The actions may include, but are not limited to, the following:

- the replacement of equipment for the production of heat and cold, and the transport of heat-carrying fluids, including upgrading the thermal insulation of pipeline networks and appliances, to reduce losses in the transport of fluids;
- the installation of systems of cost-free cooling from external air and of heat recovery from extracted air;
- systems of automation and/or control and regulation of equipment and/or facilities, for energy-saving purposes, as well as systems to account for, remotely manage and digitalise energy consumption;
- new installations of centralised systems of urban or district heating and cooling, or systems which serve several buildings, as well as the upgrading and extension of existing systems.

f) Mechanisms

The mechanisms that will enable the planned energy-saving targets to be achieved are as follows:

Taxation: the Ministry of Finance will lead an exhaustive analysis of taxation in the residential sector to internalise the positive externalities entailed by improving the energy efficiency of the buildings related to this sector.

Legislative measures: the transposition into national legislation of the new requirements for energy efficiency and renewable energies established by the new European Directives for new and existing buildings in the residential sector will be a necessary condition for the success of the planned support and financing programmes to promote the upgrading of housing.

In addition, it is proposed to **review the Horizontal Property Law in order to give residents' associations a legal form that will enable them to access the private financing available on the market.** Legislative measures established by the autonomous communities within the scope of their responsibilities in relation to housing and other matters will also be relevant.

Public support programmes: aid programmes through grants and financing for the energy upgrade of existing residential buildings, improving the energy rating. The programmes will prioritise actions that affect a high number of buildings: actions of urban regeneration and upgrading that affect areas identified as priority areas (districts) within the framework of housing policy.

These programmes will include programmes ('Renove Plans') aimed at actions or interventions that do not affect the entire building, only the individual homes of private owners to upgrade the sealing of gaps (windows and woodwork), roofs and facades independently, boilers and heaters, etc.

In any case, the public support will be linked to compliance with social criteria, obtaining high levels of energy ratings or improvements by 2 or more letters, and the implementation of comprehensive actions that simultaneously act on the thermal envelope and on the thermal installations of buildings.

Financing programmes: creation of financing instruments, through collaboration agreements with financial institutions, aimed at residents' associations, to encourage the upgrading of their buildings as they may have difficulties in finding such financing through ordinary channels.

Training: the training of the agents involved in the energy upgrade process (planners, project managers and those responsible for external monitoring of energy standards) is essential for the successful implementation of public support programmes. In addition, training on energy efficiency should be strengthened in the financial institutions that are key agents in driving new investments.

Information: guides and manuals on aspects related to the energy upgrade will be developed and updated. Likewise, observatories, forums and work groups will be strengthened, maintaining a web platform aimed at companies and agents from the sector that includes good practices concerning energy upgrading.

Communication: specific information and communication campaigns will be conducted, which may include campaigns aimed at the creation of local or regional upgrade offices.

g) Specific measures or individual actions on energy poverty

The development of this measure will be carried out in line with the 2019-2024 National Strategy against Energy Poverty (see Measure 4.11 of this Plan) and the Just Transition Strategy, both approved in 2019. Interventions that take place in households in a situation of energy poverty will have higher aid intensities.

h) Financial requirements and public support

The total estimated public support for the development of this measure in the 2021-2030 period amounts to
EUR 5.509 billion, which will largely come from European structural and investment funds under the new financial framework, and which will make it possible to mobilise an investment volume of
EUR 22.431 billion in the whole period.

Measure 2.7. Renewal of residential equipment

a) Description

The objective of this measure is to reduce energy consumption through the improved energy efficiency of household appliances, or more generically, household devices that consume energy.

Given that a significant number of domestic power-driven devices, and household appliances in particular, are renewed at the end of their life span, this is considered to be a good time to encourage buyers to replace them with appliances with a higher energy efficiency rating, from among those available on the market.

The new and additional savings derived from this measure (additional to those that will be obtained from application of the Eco-design Directives) will be those associated with bringing forward the decision to upgrade equipment (in relation to the time when it would have been replaced, following natural replacement levels), and the fact that the measure will stimulate the purchase of equipment with energy performance above the average of that on the market in each year of the implementation period of this Plan.

The priority will be appliances whose energy consumption makes up a large part of consumption in the home, such as fridges, fridge-freezers and freezers, washing machines, dishwashers, ovens and cookers.

With a national estimated quantity of **76 million appliances** (fridges, freezers, washing machines, dishwashers and televisions), the measure aims to achieve savings as a consequence of improving the energy ratings (with reference to the energy label) with regard to the benchmark category in the market at the time the replacement is made.

Considering that 6.6 million new white goods are sold each year, the target proposed implies the market penetration of 2,443,000 appliances/year of the highest category of energy efficiency.

b) Expected cumulative and annual energy savings for each measure and/or quantity of energy savings in relation to any intermediate period

The target for this measure is to achieve **1,976 ktoe of cumulative final energy savings** during the 2021-2030 period.

c) Responsible bodies

The public authorities responsible for the execution and follow-up of the measure will be MITECO/IDAE, together with the autonomous communities, following a model of joint management and joint financing of the measures and actions for energy efficiency that respects the distribution of competences in Spain.

The Public Administrations will collaborate to implement this measure among consumers and users, who must always play an active role by signing up to voluntary agreements.

d) Target sectors

This measure is aimed at the domestic sector.

e) Eligible actions

The actions proposed in this Plan are mainly communication actions to promote the awareness and use of more efficient household appliances, awareness of energy ratings and their importance as a decisive factor in the responsible and efficient purchase and use of household equipment. These communication actions will form part of a general strategy that will be of a permanent nature, aimed at citizens as the principal actors.

f) Mechanisms

The mechanisms for action that will enable the planned energy-saving targets to be achieved are as follows:

Voluntary agreements: voluntary agreements signed with associations of manufacturers, distributors and retailers of household appliances, in order to coordinate information and communication campaigns and actions in relation to consumers, as well as the training of sales staff.

Training: training activities will be designed and implemented in relation to this measure, which as a guideline may include, but are not limited to, training courses on energy efficiency for household appliances, aimed both at sellers of household appliances and citizens, organised in collaboration with associations of manufacturers, retailers and consumers, both on site and virtually.

Information: up-to-date information on energy ratings will be provided on the IDAE website, to promote information among end users of more energy-efficient appliances and systems.

Communication: we propose the implementation of a specific aid line for actions that contribute to promoting the **purchase of more efficient household appliances**, particularly highlighting energy savings and environmental commitment in the related communications. It should be consistent with the general communication strategy for the Plan, based fundamentally on information, training and segmented dissemination through the digital ecosystem (own and others' social networks, blogs, expert and sectoral forums) with advertising support that is also segmented.

This line of communication will be developed continuously over time, intensifying to coincide with peak purchasing periods, in coordination with associations of manufacturers, distributors and retailers, supporting them from IDAE to activate their own communication initiatives.

Additionally, communication actions will be developed focused on the **efficient and responsible use of equipment**.

g) Specific measures or individual actions on energy poverty

The development of this measure will be carried out in line with the 2019-2024 National Strategy against Energy Poverty (see Measure 4.11) and the Just Transition Strategy, both approved in 2019. Interventions that take place in households in a situation of energy poverty will have more aid.

h) Financial requirements and public support

The public financial support will be used for communication campaigns.

Services sector

Measure 2.8. Energy efficiency in services sector buildings

a) Description

This measure aims to reduce the energy consumption in existing buildings used for services, owned publicly or privately, through energy upgrade activities that will improve their energy rating.

As stated in Measure 2.6 of this Plan, on improving the energy efficiency of existing buildings in the residential sector, the certification of energy efficiency (Royal Decree 253/2013 of 5 April 2013) is a very useful tool for the promoters of upgrade activities when making new investments in existing buildings.

The measure includes two different mechanisms:

1) extending the General State Administration’s obligation to renovate public buildings (included in Article 5 of Directive 2012/27/EU) to autonomous community and local administrations;
2) the energy upgrading of buildings through public support programmes and financing similar to the Aid programme for the energy upgrade of existing buildings (PAREER), in force since October 2013.

The first refers to the extension of the mandate contained in Article 5 of Directive 2012/27/EU **to all autonomous regional and local administrations**, ensuring fulfilment of the proactive and responsible role of the public sector and resulting in a saving on the energy bill of the public administrations.

The second refers to the continuation of public support programmes and financing for the energy upgrade of buildings in the services sector (similar to the PAREER programme).

b) Expected cumulative and annual energy savings for each measure and/or quantity of energy savings in relation to any intermediate period

The target for this measure is to achieve **1,378.8 ktoe of cumulative final energy savings** during the 2021-2030 period. These savings will be the result of the energy renovation of 5 million m^2/year of public and private building stock.

c) Responsible bodies

The public authorities responsible for the execution and follow-up of the measure will be MITECO/IDAE, together with the autonomous communities and local administrations, following a model of joint management and joint financing of the measures and actions for energy efficiency that respects the distribution of the relevant responsibilities in Spain.

d) Target sectors

This measure is aimed at existing buildings used for services, publicly owned by any administration, as well as privately owned. The beneficiaries of the aid programmes will be the owners or holders of existing buildings, whether they are legal or natural persons. In the event that the aid beneficiaries are legal persons of a private nature, the programmes will be adjusted to the regulations on State aid.

e) Eligible actions

Eligible actions for building upgrades will be those that achieve a reduction in CO_2 emissions and final energy consumption, by improving any services with a greater weight in the energy consumption of buildings, such as heating, cooling and the production of domestic hot water:

- **Thermal envelope**: action will be taken on the thermal envelope of buildings to achieve a reduction in demand for the heating and cooling of buildings. The energy efficiency actions may be applied to facades, roofs, floors, external woodwork, windows and solar protection, etc.
- **Thermal installations**: action will be taken on the thermal installations for heating, air-conditioning, production of domestic hot water and ventilation, governed by the Regulation on Thermal Installations in Buildings. The measure covers the incorporation of renewable energy sources to meet demand, in accordance with the targets for final renewable energy consumption considered in this Plan.
- **Lighting systems**: action will be taken on the indoor lighting systems of buildings, adapting them to the energy efficiency values required depending on how each zone is to be used; implementing lighting regulation and control systems based on the activity in each zone of the building and adapting lighting levels depending on the sunlight available.

f) Mechanisms

The mechanisms that will enable the planned energy-saving targets to be achieved are as follows:

Legislative measures: extension of the mandate arising from Article 5 of Directive 2012/27/EU to all public administrations.

Public support programmes: aid programmes through grants and financing for the energy upgrade of services sector buildings, improving energy ratings.

Training: training for agents involved in the energy upgrade process (planners, project managers and agents responsible for external monitoring of energy standards, as well as those in charge of designing and managing energy facilities in public buildings) is essential for the successful implementation of public funding programmes. In addition, training on energy efficiency should be strengthened in the financial institutions that are key agents in driving new investments.

Information: guides and manuals on aspects related to the energy upgrade will be developed and updated. Likewise, observatories, forums and work groups will be strengthened, maintaining a platform aimed at companies and agents from the sector on the IDAE website with databases and good practices concerning energy upgrading.

Communication: specific information and communication campaigns will be conducted.

g) Financial requirements and public support

The total estimated public financial support to implement this measure in the 2021-2030 period is **EUR 2.166 billion**, which, to a large extent, will come from European structural and investment funds corresponding to the new financial framework, which will **mobilise approximately EUR 3.671 billion of investment.**

Measure 2.9. Energy efficiency for cooling equipment and large air-conditioning systems in the services sector and public infrastructure

a) Description

The objective of this measure is to reduce electricity consumption in the services sector, and it can be divided into two:

1) measures to upgrade large air-conditioning systems, cooling equipment and refrigeration and freezing compartments;
2) measures to improve the energy efficiency of publicly owned infrastructure, mainly street lighting systems and water treatment, purification and desalination facilities.

The first aims to reduce consumption in refrigeration systems for the storage and conservation of perishable products in refrigerated warehouses and logistics facilities supplying urban areas, large air-conditioning systems for services sector buildings (airports, hospitals, shopping centres, offices, etc.) and in small installations, units and deep-freeze boxes used in grocery stores, shops and retail areas.

The second aims to make Spanish street lighting compliant with Royal Decree 1890/2008 of 14 November 2008, approving the Energy Efficiency Regulation for street lighting, by regulating maximum lighting levels based on the activities carried out in particular areas and the impact of lighting on other areas, as well as increasing the minimum energy efficiency of light sources.

In addition, it aims to improve the energy efficiency of facilities for the treatment, supply and purification of water, by reforming existing facilities and introducing criteria for energy efficiency and low energy consumption in the specifications of calls for tender related to purification projects.

b) Expected cumulative and annual energy savings for each measure and/or quantity of energy savings in relation to any intermediate period

The measure aims to achieve **3,350.4 ktoe of cumulative final energy savings** during the 2021-2030 period.

c) Responsible bodies

The public authorities responsible for the execution and follow-up of the measure will be MITECO/IDAE, together with the autonomous communities and local authorities, where applicable, following a model of joint management and joint financing of the measures and actions for energy efficiency that respects the distribution of competences in Spain.

d) Target sectors

The measure is aimed at the services sector, either natural or legal persons owning large refrigeration (more than 70 kWe) or air-conditioning systems and the owners of small installations, through units and deep-freeze boxes, in grocery stores, shops and retail areas. In relation to public infrastructure, the measure is aimed at the local authorities and concession holders for the management of municipal public services.

e) Eligible actions

Eligible actions are those that achieve a reduction in CO_2 emissions and final energy consumption, by improving energy efficiency through:

- **Sub-measure 1.** Cooling equipment.

  Cooling equipment that improves energy efficiency through the incorporation of monitoring and control systems, the recovery of condensation and/or evaporation heat, and other equipment with high energy-saving capacity (multi-layer or capacity for variation of the condensation and/or evaporation temperatures). In the case of refrigeration units, the installation of covers or doors and replacement of lighting systems by new systems with lower energy consumption and heat dissipation.

- **Sub-measure 2.** Public lighting and water infrastructure.

  Replacement of bulbs with more energy efficient ones, improving the reflective and directional quality of the light and installation of systems to regulate the light flow of light sources and switching on and off, enabling variation throughout the night based on citizens' needs.

  In the case of facilities for the treatment, purification and desalination of water, improving efficiency by reforming the facilities for pumping and treating water, and generally, applying any upgrade that will mean a reduction in energy consumption.

f) Mechanisms

The mechanisms for action that will enable the planned energy-saving targets to be achieved are as follows:

Public support programmes: aid programmes through grants and financing for this type of equipment and infrastructure. In the case of actions on publicly owned infrastructure, these programmes will have the additional technical assistance necessary for defining the technical specifications and public procurement.

g) Financial requirements and public support

The total estimated public budget required to develop this measure in the 2021-2030 period is **EUR 3.947 billion** for a volume of **mobilised investment of EUR 6.333 million**.

Agriculture and fisheries sector

Measure 2.10. Energy efficiency in farms, irrigation communities and agricultural machinery

a) Description

The measure aims to reduce the consumption of energy on farms, in irrigation communities and agricultural machinery through the modernisation of existing facilities and upgrading of machinery and/or replacement of tractors and seeding machines. The measures will be implemented in synergy with those aimed at the promotion of renewables in this sector — in this last case, giving continuity to the PIMA TIERRA Plan, launched in 2014, which has enabled improvement in the energy ratings of tractors and agricultural machinery (following the methodology developed by the Agricultural Mechanics Section and the IDAE).

b) Expected cumulative and annual energy savings for each measure and/or quantity of energy savings in relation to any intermediate period

The target for this measure is to achieve **1,203.9 ktoe of cumulative final energy savings** during the 2021-2030 period.

c) Responsible bodies

The public authorities responsible for implementing and monitoring the measure will be MITECO/IDAE, together with the autonomous communities.

d) Target sectors

This measure is aimed at the owners of farms and the owners or holders of tractors or agricultural machinery.

e) Eligible actions

Networks for capturing, storing, transporting, distributing and applying irrigation water will be eligible, as well as energy-consuming facilities in agricultural buildings and agricultural machinery.

f) Mechanisms

The mechanisms for action that will enable the planned energy-saving targets to be achieved are as follows:

Public support programmes: aid programmes through grants and financing aimed at farms and owners of agricultural machinery.

Information: the development of guides and training workshops mainly aimed at irrigation communities.

g) Financial requirements and public support

The total estimated public financial support to implement this measure in the 2021-2030 period is **EUR 929 million,** which will mobilise more than **EUR 3.896 billion of total investment.**

3.2.2 Horizontal measures in relation to energy efficiency

As discussed in section 2.2.1, the reduction in primary energy consumption proposed in this INECP is equivalent to an improvement in the primary energy intensity of the economy of 3.5% per year up to 2030. This improvement in primary intensity is the result not only of the catalogue of energy end-use efficiency measures to comply with Article 7 of the Energy Efficiency Directive, but also of considering other technological, regulatory and social developments.

These include energy efficiency improvements resulting from technological developments; compliance with new regulations and directives; an increase in the vehicle occupancy rate in urban areas due to the penetration of vehicle sharing; savings in the air, maritime and rail sectors resulting from sectoral policies; improved efficiency in energy distribution; greater penetration of renewable energies in the electricity generation fleet, etc.

In addition, six horizontal measures are proposed that will have an impact on the achievement of the energy efficiency objectives detailed below.

Measure 2.11. Promotion of energy services

a) Description

The role of energy providers was incorporated into the Spanish legal order by means of Royal Decree-Law 6/2010 of 9 April 2010 on measures to promote economic recovery and employment. Since then, Spain has approved plans and programmes with the main objective of promoting the procurement of energy providers by the public sector, as part of the duty of proactive responsibility towards the common good incumbent on it.

The recent publication of the Eurostat guide on accounting for Energy Performance Contracts (EPCs) has enabled the removal of one of the main barriers making it difficult for public administrations to invest in the energy upgrade of their buildings (among other possible improvements in energy efficiency) in a scenario characterised by the need to maintain control of the public deficit.

b) Expected cumulative and annual energy savings for each measure and/or quantity of energy savings in relation to any intermediate period

The objective is to achieve improved energy efficiency during the 2021-2030 period via savings and efficiency actions through energy service companies.

c) Responsible bodies

The public authorities responsible for implementing and monitoring the measure will continue to be MITECO/IDAE, together with the autonomous communities and, especially, local authorities.

d) Target sectors

This INECP considers energy service providers to be part of the new business fabric required to achieve the energy efficiency targets proposed for 2030. Following this principle, the different regional administrations, through the energy agencies — either IDAE, at national level, or others at autonomous community or local level — will provide new contract templates adapted to the recommendations of Eurostat and compliant with the new Public Sector Contracts Law.

Within the private sector, the procurement of energy services with different contract templates is a reality that will be strengthened in the time frame of this Plan by the removal of regulatory and administrative barriers to own consumption. The new regulations on own consumption will enable the appearance of the roles of energy prosumer and aggregator, and ultimately of new business models based on the generation of energy from renewable sources and the reduction of demand.

e) Eligible actions

Eligible actions are those that achieve a reduction in CO_2 emissions and final energy consumption, both primary and final.

f) Mechanisms

The mechanisms that will make it possible to achieve the expected savings will be focused on: legislative measures that develop new contract models, promoting these companies in the different aid programmes, as well as information and communication.

Measure 2.12. Public sector: proactive responsibility and energy-efficient public procurement

a) Description

Proactive responsibility

In addition to procuring renewable energies (Measure 1.16), the regional administrations must take proactive responsibility for the promotion of energy efficiency, leading the process of energy transition to a decarbonised economy by 2050.

Energy-efficient public procurement

Spanish legislation has a regulatory framework that promotes the use of energy saving and efficiency criteria in the procurement processes for goods, services and buildings by the public administrations[48].

The Ecological Public Procurement Plan of the General State Administration, its autonomous bodies and Social Security management entities (2018-2025), approved on 7 December 2018, has been added; it is defined as an instrument for promoting and facilitating economic growth based on the establishment of a circular, low-carbon economy.

Furthermore, Directive (EU) 2019/1161 of the European Parliament and of the Council of 20 June 2019 amending Directive 2009/33/EC on the promotion of clean and energy-efficient road transport vehicles has been adopted. This will oblige the contracting authorities of public administrations to have a minimum number of ‘clean’ vehicles in their fleets.

b) Expected cumulative and annual energy savings for each measure and/or quantity of energy savings in relation to any intermediate period

The objective is to achieve improved energy efficiency during the 2021-2030 period via savings and efficiency actions in the public sector.

c) Responsible bodies

The public authorities responsible for the implementation and monitoring of the measure will continue to be
MITECO/IDAE, together with the autonomous communities and, especially, local authorities.

[48] Law 15/2014 of 16 September 2014 on rationalisation of the Public Sector and other administrative reform measures, the thirteenth additional provision of which includes certain energy efficiency requirements for the purchase of goods, services and buildings for public administrations included in the State Public Sector, and Law 9/2017 of 8 November 2017 on Public Sector Contracts, which requires the creation of assessment criteria that include environmental, social and innovation criteria aligned with the European policy on green public purchasing.

d) Target sectors

The public sector.

e) Eligible actions

Eligible actions are those that achieve a reduction in CO_2 emissions and energy consumption, both primary and final.

f) Mechanisms

In this INECP, the mechanisms are summed up in the upgrading of 300,000 m^2/year in the General State Administration, above the 3% required by the Energy Efficiency Directive. In addition, achieving the improvement of energy efficiency by 39.5% by 2030 requires the adoption by the remaining regional administrations of at least the mandatory objective for the General State Administration, of upgrading 3% of the built and air-conditioned surface area of the public building stock.

In this respect, this National Plan considers an upgrade of 3,390,000 m^2/year of autonomous community and local authority public buildings to be achievable. It will therefore be necessary to promote cooperation between the managers of public buildings at national level and at autonomous community level[49].

Specifically for the building stock of the General State Administration, the following actions are proposed:

- The prior definition and scheduling of upgrade actions for the building stock of the National State Administration, including annual targets for each Ministerial Department, in a way that guarantees that the annual upgrade target of 3% of the surface area is achieved[50]. These actions should be planned and financed with the European funds envisaged up to 2023 in Thematic Objective 4 (Low Carbon Economy) of Spain's Multi-regional Operational Programme and future operational programmes.
- Maintaining the inventory of General State Administration buildings through the web platform known as the 'IT system for Energy Management of Buildings of the General State Administration' (*Sistema Informático de Gestión Energética de Edificios de la Administración General del Estado*, SIGEE-AGE) and strengthening of the network of energy managers and supervisors assigned to the organisations and buildings of the General State Administration.
- The launch of information and training activities aimed at the managers and supervisors of the buildings of the General State Administration through specialist publications, virtual platforms and social networks.
- Promotion of own consumption and the use of renewable energies in public buildings and the procurement of energy service providers.
- Innovative public procurement mechanisms (Measure 5.5) should contribute to the advancement of energy efficiency in the public sector.

[49] The autonomous regional and local administrations are pioneers in the procurement of energy providers and in the use of energy performance contracts and public-private partnerships to finance energy efficiency actions. All the autonomous communities are implementing or planning to implement energy efficiency plans in their public buildings.

[50] From 2014 to 2018, 1,457,075 m_2 were renovated, which represents a 105% achievement of the upgrade targets established in Article 5 of the Energy Efficiency Directive.

Measure 2.13. Energy audits and management systems

a) Description

Spain has transposed the Energy Efficiency Directive through Law 18/2014, mentioned above in relation to Article 7 of the Directive, and Royal Decree 56/2016 of 12 February 2016, which transposes the Directive with regard to energy audits, accreditation of energy providers and energy auditors and promoting efficiency in the supply of energy. Royal Decree 56/2016 imposes an obligation on large companies to conduct energy audits every four years, or as an equivalent to this obligation, the implementation of a system of energy or environmental management.

The audits must be conducted by duly qualified energy auditors (Article 4 of Royal Decree 56/2016). The inspection must be carried out on a random selection of at least a statistically significant proportion of the energy audits performed in each four-year period. In order to facilitate the conduct of the inspection, the Administrative Register of Energy Audits has been created, which is public and free of charge. It had received information on 35,000 energy audits by 3 December 2018.

b) Expected cumulative and annual energy savings for each measure and/or quantity of energy savings in relation to any intermediate period

The objective is to achieve improved energy efficiency during the 2021-2030 period via savings and efficiency actions.

c) Responsible bodies

The autonomous communities and the autonomous cities of Ceuta and Melilla are the administrations responsible for establishing and applying the independent inspection systems on companies liable for the obligation.

d) Target sectors

The business sector.

e) Eligible actions

Eligible actions are those that achieve a reduction in CO_2 emissions and energy consumption, both primary and final.

f) Mechanisms

The programmes of public aid and support for financing defined in Section 3.2.1 of this Plan with a sectoral focus will use the obligatory energy audits as the main assessment tool to define the eligible investment required to achieve the savings. They will also promote energy audits in small and medium-sized enterprises that are not affected by the obligatory nature of the Directive.

Measure 2.14. Training professionals in the energy efficiency sector

a) Description

Point 4 of the INECP, 'Impact analysis of the policies and measures in the plan', estimates a net growth in employment of between 253,000 and 348,000 people with respect to the Baseline Scenario. These data include the increase in employment relating to the energy efficiency dimension, which is estimated at between 56,000 and 100,000 jobs. The aim of this measure is to identify both professional and academic training needs, arising from the expected growth in all sectors related to improving energy efficiency.

b) Expected cumulative and annual energy savings for each measure and/or quantity of energy savings in relation to any intermediate period

The aim is to achieve improved energy efficiency over the 2021-2030 period.

c) Responsible bodies

The bodies responsible for designing and implementing this measure include bodies from the General State Administration, such as the Ministry of Education and Vocational Training, the Ministry of Universities, MCI, MITECO, SEPES and INCUAL, that technical bodies such as the IDAE will collaborate with, as well as other administrations and organisations, autonomous communities, local authorities, energy agencies, sectoral associations for energy saving and efficiency, renewable sector associations, training companies, trade unions and professional associations, among others.

d) Target sectors

The training sector, both professional and academic.

e) Mechanisms

The sectors identified in the energy efficiency dimension (transport, residential industry, services, and agriculture and fisheries) are in a continuous process of technological improvement related to energy saving and efficiency, making it essential to provide continuous training and refreshers for qualified personnel. It is therefore necessary to promote continuous training at both professional and academic qualification levels, developing and implementing new qualifications and specialities where necessary.

As with the cross-cutting measures proposed in the decarbonisation dimension, in terms of training, the Plan proposes working on identifying the professional profiles needed to increase energy efficiency in Spain and thus achieve the energy efficiency objectives set out in this Plan.

The process starts by determining the professional profiles needed throughout the value chain associated with the energy efficiency improvement measures in the Plan. Qualification levels will then be adapted to the needs of the labour market resulting from the application of the INECP. Work will be done with associations from the sectors identified in the energy efficiency dimension and trade unions so as to promote the formation of those profiles that are deficient.

It is also necessary to improve the energy-efficiency technology knowledge of the professionals who can assist in the development of energy efficiency in a cross-cutting manner. This is the case, inter alia, with professionals from financial institutions, where a better knowledge of these technologies among the financial intermediaries that direct the investments would make it possible to increase financing for energy efficiency projects.

At the same time, measures will be established to promote and provide information on the employment opportunities offered by the investments in energy savings and efficiency that will take place during the energy transition.

Given the speed at which energy- and environment-related technologies are developing, it is necessary to monitor and continuously adapt the measures adopted, in accordance with possible technological changes of an innovative nature.

Measure 2.15. Communication and information concerning energy efficiency

a) Description

The communication and information measures included in this INECP must address the requirements established in Articles 12 and 17 of the Energy Efficiency Directive, as well as leading to the necessary transformation of energy consumption habits required by the process of transition to a decarbonised economy by 2050.

b) Expected cumulative and annual energy savings for each measure and/or quantity of energy savings in relation to any intermediate period

The aim is to achieve improved energy efficiency over the 2021-2030 period.

c) Responsible bodies

MITECO, through the IDAE, will have a central role in defining and applying the Plan's communication strategy. The IDAE has regularly developed institutional communication campaigns that have made it possible to demonstrate energy savings within the framework of Article 7 of the Energy Efficiency Directive, and it has developed audio-visual projects, publications and training platforms aimed at consumers in different sectors. The IDAE also has experience with the creation and management of social network profiles in relation to energy efficiency.

d) Target sectors

All energy-consuming sectors and the financial sector.

e) Mechanisms

The main vector of the communication strategy of this Plan is the fight against climate change and the close link between energy consumption and polluting emissions, with special emphasis on local pollution and transforming the models of towns and cities. Insofar as this Plan is based on the willingness to design a just transition to a new energy model, the communication strategy should provide information in a way that is easy to access by the most vulnerable consumers, to enable them to participate in the necessary social transformation and reduce energy poverty.

In addition, this Plan proposes actions aimed at financial institutions as the agents needed to mobilise the additional EUR 83.54 billion of investment with respect to the Baseline Scenario, which will make it possible to improve energy efficiency by 2030. These actions should improve the awareness of the financial agents to reduce the perception of investment risk for energy efficiency and saving which often penalises the promoters of this type of project and limits their access to finance.

Measure 2.16. Other measures to promote energy efficiency: the transition to highly efficient co-generation

a) Description

Co-generation has a strong presence in the industrial sector, where approximately 92% of the installed capacity is located, the remaining 8% being found in the services and residential sectors. The fuel mainly consumed by co-generation plants is natural gas, which represents 84% of electricity production and 86% of heat production, although there are also facilities that consume other conventional fuels or renewables.

It is estimated that 2,400 MW of co-generated capacity will have exceeded its regulatory life span by 2030, and the priority financial rules will no longer apply. The age of existing facilities, as well as the necessity, in some cases, of redesigning them to adapt to new circumstances in the processes, means a potential loss of efficiency in terms of better outputs from the current turbines and engines.

On the other hand, the large-scale introduction of renewable power generation technologies established in the National Plan sets a challenge for co-generation as a support system that contributes to the stability of the system, and offers the flexibility that the operation of the electricity system will require in order to reach the established targets for energy generation from renewable sources.

Based on the above, a measure is proposed for the 2021-2030 period that promotes high-efficiency co-generation for a total of 1,200 MW with an optimised design based on: useful heat, electrical own consumption, flexibility of operation with regard to the electricity system and high efficiency, which would contribute to all the objectives set out in this Plan.

b) Expected cumulative and annual energy savings for each measure and/or quantity of energy savings in relation to any intermediate period

This measure represents a saving of 1,471 ktoe of cumulative primary energy during the 2021-2030 period.

c) Responsible bodies

The calls for tenders must be made by the Ministry for Ecological Transition (MITECO). MITECO and the Autonomous Governments of the Canary and Balearic Islands and the cities with a Statute of Autonomy must collaborate on drawing up specific programmes for territories not on the mainland.

d) Target sectors

This measure is aimed at companies in sectors that realise a co-generation installation.

e) Mechanisms

The mechanism set out is the competitive tendering procedure, with a multi-annual schedule of tenders, in order to determine a cost-effective remuneration scheme for the application of public funding, supported by the necessary administrative measures to take advantage of the existing infrastructure.

The need for facilities to be very highly efficient will be included in the application criteria for tenders, with design optimisation based on useful heat and electric own consumption, and flexibility of operations with regard to the requirements of the system operator.

Given the importance of the own consumption of both useful heat and electricity in the design of the installation and in obtaining the required efficiency rates, inspection plans will be carried out to ensure the effective use of the heat contributed to the process by co-generation, as well as the levels of electricity own consumption.

3.2.3 Energy efficiency in gas and electricity infrastructure

Spain has introduced measures to remove tariff incentives that undermine the efficiency of the generation, transmission, distribution or supply of energy or that hinder participation in the response to demand, in market stability or in the procurement of ancillary services. It has recently eliminated barriers to own consumption so that the energy system can begin the gradual transition to a model of distributed electricity generation, usually of low capacity.

Since Law 24/2013 of 26 December 2013 on the Electricity Sector was approved, and as a result of the approval of Royal Decree 216/2014, progress has been made on improving the participation of small consumers in the efficiency of the system and the response to demand. Royal Decree 1048/2013 has introduced incentives that contribute to reducing losses in networks; the first is intended to ensure continuous improvement in the level of losses in order to achieve an increase in remuneration without penalties, while the second is intended to reduce fraud.

This INECP accepts the conclusions and proposals of the evaluation reports on the energy-efficiency potential of gas and electricity infrastructure approved by the National Commission on Markets and Competition in June 2016.

The measures considered to promote energy efficiency in the national electricity infrastructure include promoting design criteria based on efficiency, increasing line and cable sections, improving capacity factors and increasing voltage, upgrading substations, optimising the low-voltage network and the grid system, demand management, optimising the use of smart meters and reducing fraud.

Particularly for gas infrastructure, both for transmission and distribution networks and in regasification plants, a mechanism has been established to identify losses in the facilities, in order to incentivise the reduction of these by the owners.

3.2.4 Financial measures

Measure 2.17. Financial measures: National Energy Efficiency Fund

a) Description

The National Energy Efficiency Fund constitutes the main instrument to support national initiatives on energy efficiency during the application of the current INECP. This Fund, created by Article 72 of Law 18/2014, will be in force from 2021 until 31 December 2030.

Article 20 of the Energy Efficiency Directive enables Member States to create a National Energy Efficiency Fund, and the revised Directive 2012/27/EU expressly recognises that the parties bound by the framework of the system of energy efficiency obligations set out in Article 7, will be able to comply with the energy saving obligation through financial contributions to this Fund of a quantity equivalent to that of the investments required by compliance with the obligations arising from that Article.

The Fund can receive contributions from other sources, from the General State Budgets and principally from the European structural and investment funds (ERDF Funds) to promote a low-carbon economy. Returns on the ERDF funds can be expected for the 2014-2020 programming period (considering that Spain's Multi-regional Operational Programme had EUR 2.104 billion for a low-carbon economy and that the projects will be able to be executed for the different investment priorities identified up to 2023) and the future programming period up to 2030. In addition, the National Energy Efficiency Fund will have resources derived from the return on the loans granted within the framework of calls already implemented since 2015 (Annex F contains more information about the National Energy Efficiency Fund).

In total, **this INECP will mobilise EUR 83.54 billion of additional investment in energy efficiency**, satisfying the 'energy efficiency first' principle that must inform policies to combat climate change. This will require nearly EUR 30 billion of public funds (national and European), in the form of direct public aid and public support for the financing of energy efficiency projects.

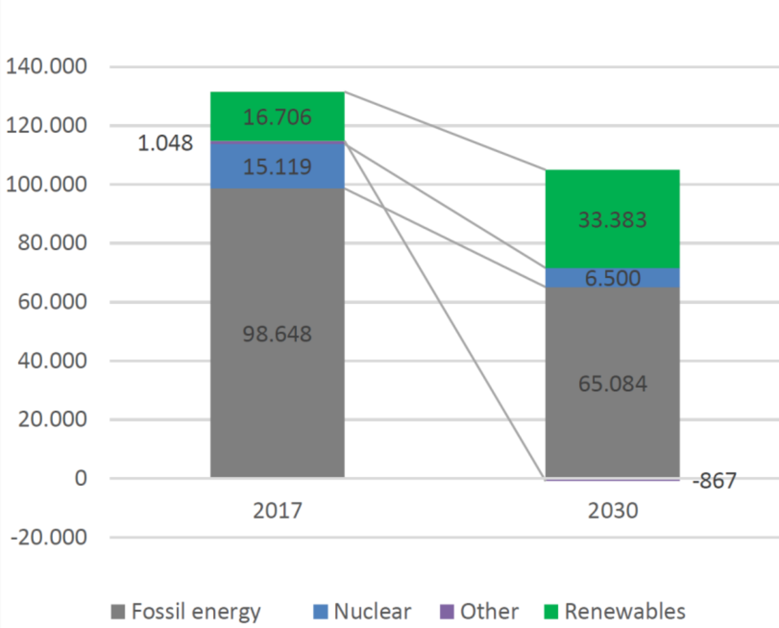
This Plan aims to **revitalise and integrate financial institutions as the necessary agents** to mobilise investments in energy efficiency and renewable energies, given that the energy transition must take place with the cooperation of all the public and private agents and all the Regional Administrations, regardless of their nature.

3.3 ENERGY SECURITY DIMENSION

The reduction of energy dependency with regard to the importation of fossil fuels will be based, uniquely, on two vectors. On the one hand, through the implementation of energy use efficiency measures (corresponding to Section 3.2. of this Plan: Energy efficiency policies and measures. See also Annex F for more detail). On the other hand, through the development of national renewable energy sources, with all the implications of this in terms of control over primary resources, for which Spain has a high potential, given our geographic and climatic features, particularly for solar and wind power. The measures relating to this aspect can, therefore, mostly be found in Section 3.1. (Decarbonisation policies and measures).

As a result of that set of efficiency measures on efficiency in energy use and a strong push for indigenous renewable technologies, the importing of fossil fuels in physical units goes from 98,648 (thousands of tonnes of oil equivalent, ktoe) in 2017 to 65,084 ktoe in 2030, a decrease of 34%. This will significantly reduce the energy dependency ratio, which goes from 74% in 2017 to 61% in 2030, increasing national energy security.

Figure 3.6. Mix of primary energy in Spain in 2017 and 2030 (ktoe)



Source: Ministry for Ecological Transition and Demographic Challenge, 2019

This increase in the contribution from indigenous sources is enhanced by the availability of national technology, which is in a position to take advantage of the opportunity that this Plan represents in economic terms and as regards employment generation. The measures set out in Section 3.5 will also contribute to this objective. (Policies and measures for research, innovation and competitiveness). Furthermore, we must not forget the diversification of supply sources, to ensure the availability of a wide range of geographical origins, so that geopolitical instability in producer countries or maritime transport routes does not have a significant impact on supply.

Thus, a considerable number of the energy security dimension policies and measures fall within the scope of the Special Committee on Energy Security (created by Agreement of the National Security Council (Order PRA/30/2018 of 22 January 2018)). This Committee is a support body to the National Security Council as provided for in Article 20(3) of Law 36/2015 of 28 September 2015 on National Security, which is responsible for exercising the functions assigned by the

Council in the area of energy security and within the framework of the National Security System.

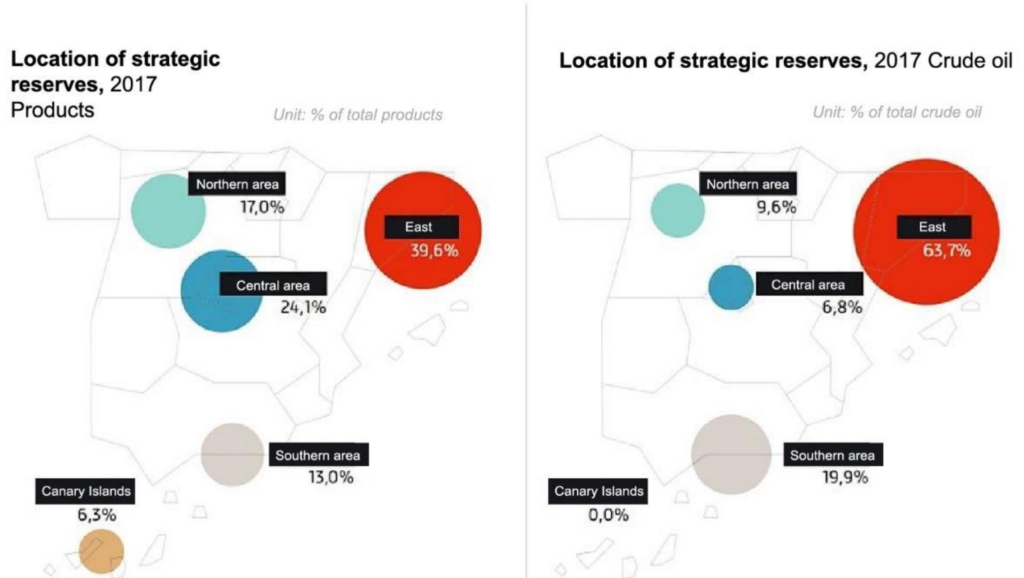
Among the tasks entrusted are the assessment of risks and threats, the analysis of possible crisis scenarios, especially those likely to lead to a situation of National Security interest in the field of energy security, as well as the evaluation of the results of their implementation, all in coordination with the directly competent bodies and authorities and with the Specialist Situation Committee.

Objective 2 of the National Energy Security Strategy states the need to
‘consider all the energy sources to maintain a balanced mix, which accurately reflects all the specificities of Spain and enables it to reach a certain guarantee of supply, at competitive prices, and within a sustainable model in which clean energies steadily take on greater importance’.

Specifically, with regard to hydrocarbons, the reference standard is Royal Decree 1716/2004 of 23 July 2004, which regulates the obligation to maintain the existing minimum security requirements, the diversification of natural gas supply and the Corporation of Strategic Reserves of Petroleum Products (*Corporación de Reservas Estratégicas de Productos Petrolíferos* – CORES), which plays the role of ‘Central Stockholding Entity’), in accordance with the obligation set out in Council Directive 2009/119/EC to maintain a minimum level of reserves of crude oil or petroleum product. This Royal Decree also established the obligation to maintain minimum security stocks of natural gas.

With regard to their geographical location, in 2017 the strategic reserves of petroleum products were distributed throughout the national territory as shown in the figure below.

Figure 3.7. Location of strategic reserves in Spain in 2017



Source: CORES

Other emerging risks: cybersecurity

The cybersecurity objective in the Annual 2018 National Security Report is defined as follows: 'to ensure the secure use of information and communication networks and systems by strengthening capacities to prevent, detect and respond to cyberattacks by enhancing and adopting specific measures to help promote a secure and reliable cyberspace.'

An area of strategic relevance for National Security is Critical Infrastructure. In the 2013-2018 period, a clear trend has been observed in the increase in the number of incidents recorded in this area, mainly malware and exploitation of system vulnerabilities, with more than 2,300 incidents in critical operators, with the financial, energy and transport sectors being the most affected, accounting for more than 50% of incidents.

Council Directive 2008/114 of 8 December 2008 on the identification and designation of European critical infrastructures and the assessment of the need to improve their protection is implemented by Law 8/2011 of 28 April 2011 establishing measures for the protection of critical infrastructure and by Royal Decree 704/2011 of 20 May 2011 approving the Regulation on the protection of critical infrastructure. Pursuant to this Royal Decree, the designated critical operators in the field of energy and nuclear industry have also presented their respective Operator Security Plans (OSP), checking their adjustment to the current situation of threats and challenges to which critical infrastructure in the energy sector and nuclear industry are subject, and updating the information contained in these plans. An important step in the field of cybersecurity in Spain was the reform of the Criminal Code in 2015, which included important amendments on the crimes related to computer sabotage, in compliance with Directive 2013/40/EU of the European Parliament and of the Council of 12 August 2013 on attacks against information systems and replacing Council Framework Decision 2005/222/JHA.

The existence of regulations for the Protection of Critical Infrastructure in Spain since 2011 has also made it possible to transpose Directive 2016/1148 of the European Parliament and of the Council of 6 July 2016 concerning measures for a high common level of security of network and information systems across the Union (the NIS Directive), in a quick and simple manner due to having used the same procedures and accumulated knowledge to carry out this implementation. The entry into force of Royal Decree-Law 12/2018 of 7 September 2018 on network and information system security has transposed the aforementioned NIS Directive into Spanish law, giving a significant boost to the cybersecurity of essential services in the energy field.

In addition to this regulatory update, in April 2019, Spain approved its National Cybersecurity Strategy, the function of which is to develop the provisions of the 2017 National Security Strategy in the field of cybersecurity. This replaced the previous one, approved in 2013. It should also be noted that since 2015, Spain has had a **National Energy Security Strategy**, which, in view of the significant regulatory, technological and energy policy changes that have taken place in recent years, will probably be updated shortly.

Public-private collaboration has also been strengthened and reinforced with the various energy operators, a task that has been coordinated by the Cybersecurity Coordination Office (*Oficina de Coordinación Cibernética* – OCC) of the National Centre for the Protection of Critical Infrastructure and Cybersecurity (*Centro Nacional de Protección de Infraestructuras Críticas y Ciberseguridad* – CNPIC), concerning the communication of cyber incidents. Also of note is the work done in this area by the National Institute for Cybersecurity (*Instituto Nacional de Ciberseguridad* – INCIBE), an agency attached to the Ministry of Economic Affairs and Digital Transformation (*Ministerio de Asuntos Económicos y Transformación Digital* – MINECO).

Finally, Commission Recommendation (EU) 2019/553 of 3 April 2019 on **cybersecurity in the energy sector** should also be noted. This Recommendation sets out the key issues in this area, calling on Member States to include them in national legislation and to report regularly to the European Commission on their implementation status. Spain is preparing to systematically implement the recommendations on real time requirements for energy infrastructure, on what are referred to as cascade effects and on the appropriate combination of legacy and state-of-the-art technology.

In particular, the following actions are planned to address potential cybersecurity risks:

- incorporating cybersecurity risk analysis into national regulations on security of hydrocarbon supply, with special attention to operators of essential services;
- incorporating this same analysis into the Preventive Action Plans, Emergency Plans and the National Risk Assessment of the Spanish Gas System, established in accordance with Regulation 2017/1938;
- conducting emergency simulation exercises related to cyber attacks.

To improve the efficiency of minimum security stock maintenance, the following measure is formulated:

Measure 3.1. Maintenance of minimum security stocks of petroleum products and gas

a) Description. Oil

The obligation to maintain minimum security stocks of petroleum products in Spain currently amounts to 92 days' worth of calculable sales or consumption, which must be maintained at all times. Of these 92 days, the Corporation of Strategic Reserves of Oil Products (*Corporación de Reservas Estratégicas de Productos Petrolíferos* – CORES), maintains 42 days (strategic stocks), while the industry maintains the remaining 50 days (industry reserves).

Minimum stocks of oil products in April 2019 were 16.429 million tonnes held in the form of:

- Crude and raw materials: 34.3% of the total.
- Oil products (gasoline, kerosene, diesel and fuel oil): 65.7% of the total.

These reserves represented 102.2 days of net imports, according to the calculation methodology set out in Directive 2009/119/EC, exceeding the European obligation of 90 days. The reserves were kept exclusively on national territory.

b) Liable parties. Oil

The parties liable for maintenance of minimum security stocks of petroleum products are:

- Wholesale petroleum product operators.
- Retail distribution companies (for the part not supplied by wholesale operators, or other retail distributors).
- Consumers (for the part not supplied by wholesale operators or retail distributors).
- The maintenance obligation for petroleum products comprises three product groups:
  - Gasolines: automotive and aviation gasoline.
  - Middle distillates: automotive gas oils, other gas oils, aviation kerosene and other kerosene.
  - Fuel oils.

The obligation for each product must be maintained in that product or another product belonging to the same group, but there is also the possibility of maintaining stocks in the form of raw materials, albeit with a ceiling for each group.

Spanish and Community legislation provides for the possibility of maintaining reserves in other Member States.

c) Description. Gas

The obligation to maintain minimum security stocks of natural gas in Spain currently amounts to 20 days of firm sales or consumption in the previous calendar year, which must be maintained in full by the obligated parties and in underground storage.

CORES is the agency in charge of controlling the maintenance of minimum security stocks; however, it does not maintain strategic stocks of natural gas.

The mobilisation of minimum security stocks of petroleum products and natural gas, if necessary, is the responsibility of the Government. The natural gas reserves in April 2019, which include the minimum obligatory maintenance stocks and commercial stocks, were 28,113 GWh, distributed among the following facilities:

- regasification plants: 8,803 GWh (31.3% of the total);
- underground storage: 19,310 GWh (68.7% of the total). All these

stocks are held on national territory.

d) Liable parties. Gas

In terms of the minimum security stocks of natural gas, under the abovementioned Article 98 of Law 34/1998 of 7 October 1998, the parties liable to maintain such stocks are the following:

- natural gas traders, for their firm sales in national territory;
- direct consumers on the market, for the part of their consumption that is firm and not supplied by authorised traders.

e) Mechanisms

A public consultation process was launched in February 2019 to amend the current regulations on maintaining minimum security stocks of oil and gas products. The main objective is to establish minimum security stock obligations to ensure a sufficient level of security of supply and to comply with international obligations in the most efficient way. Efficiency is determined by location, cost, liable parties and products subject to obligation, among other aspects.

Special attention should be paid to the energy dependency of non-mainland regions. In particular, the Canary Islands, with a current dependency on petroleum as a primary energy source of 98 % and with an isolated electricity system, requires a major effort for interconnection between the islands, as well as greater development of technologies to support decarbonisation (both of these aspects are included in other dimensions of this Plan).

Measure 3.2. Reducing dependency on petroleum and carbon in the islands

a) Description

As explained in the decarbonisation dimension, the design and implementation of sustainable energy strategies in the islands will be promoted. In addition, the contribution to the electricity mix of fossil fuel power stations located in the Canary Islands by 2030 will be reduced by at least 50% compared to the current situation, 2019, and therefore a specific plan will be prepared after the final approval of the INECP.

In the case of the Balearic Islands, the existing coal-fired power station will close two of its four generator sets by 2020, leaving the remaining two as a reserve until the effective integration of the Balearic electricity system into the mainland system.

b) Responsible bodies

The public authorities responsible for implementing and monitoring the measure will be MITECO, together with the respective autonomous communities.

c) Mechanisms

The current planning for the electricity transmission network, with a 2015-2020 horizon, proposes ambitious investments in the electricity transmission network in non-mainland territories with various objectives, including interconnections between systems that allow for increased security of supply and reduced generation costs, as well as greater integration of renewable electricity generation.

The current planning envisages an interconnection of the non-mainland territory of the autonomous city of Ceuta with the Iberian Peninsula, with an updated commissioning date after 2020. Similarly, a second electricity interconnection between the Iberian Peninsula and the Balearic Islands is planned for a period after 2020.

Projects that have not been put into service will be re-examined and taken into consideration for the new planning of the transmission network with the horizon of 2021-2026.

There will also be a need for mechanisms to promote renewable generation that take into account the specific features of these territories and make it possible to take advantage of the savings in system costs that the introduction of renewable energies entails, in line with the provisions of Measure 1.12 of this Plan.

d) Financial requirements and public support

At present, MITECO and REE are jointly carrying out the planning for the transmission network up to 2026. No detailed information is therefore available in this respect beyond that contained in the impact analysis chapter.

With regard to enhancing the diversification of national energy sources, this will be carried out while monitoring technical progress, and includes the following measure.

Measure 3.3. Alternative fuel recharging points

a) Description

We will continue to promote the installation of alternative fuel recharging points.

b) Impact of the measure

In conjunction with other measures in the field of transport, the aim is to achieve greater electrification of this sector and increase the use of alternative, carbon-free fuels as a guideline for achieving emission reductions in the transport sector.

c) Responsible bodies

The public authorities responsible for implementing and monitoring the measure are MITECO, MINCOTUR, together with the autonomous communities and, especially, local authorities.

The electricity distribution companies also have a fundamental role in the deployment of electric vehicle recharging infrastructures.

d) Target sectors

This measure is aimed at the electricity, transport and renewable fuel production sectors.

e) Mechanisms

Directive 2014/94/EU of 22 October 2014 on the deployment of alternative fuels infrastructure and Royal Decree 639/2016 of 9 December 2016 establishing a framework of measures for the implementation of alternative fuel infrastructure, which transposes it. The specific case of electric vehicles is addressed in Measure 2.4 of this Plan.

f) Financial requirements and public support

The impact analysis chapter analyses these costs.

In the preparation plan to address limitations or interruptions to energy source supply, the following measures will contribute to achieving the stated objectives:

Measure 3.4. Promoting regional cooperation

a) Description

The increase in the physical electricity interconnections with neighbouring energy systems contributes to reducing the possible impact of limitations or interruptions in the national supply of energy sources. In addition, it encourages optimising the use of existing capacity by reducing barriers to energy exchange.

In this respect, we note that the regulatory authorities maintain continuous contact with their regional counterparts for the appropriate implementation of European regulations through the Agency for the Cooperation of Energy Regulators (ACER) and other working groups.

On the other hand, the market operators work together to facilitate the integration of the markets as reflected, in the case of electricity, in Spain’s participation in the continuous intra-day market.

In addition, the system operators maintain regular contact at regional level to analyse and ensure the security of supply, implement European regulations and ensure the effective use of international interconnections through the European Network of Transmission System Operators for Electricity (ENTSO-E) and other working groups.

In addition, although this question is considered in greater detail in the internal energy market dimension, we note that the increase in capacity of electricity interconnections with France significantly contributes to reducing the isolation of the Iberian peninsula from the rest of Europe.

b) Impact of the measure

Improved coordination between neighbouring countries in the field of energy.

c) Responsible bodies

MITECO.

d) Target sectors

The entire energy sector.

e) Mechanisms

Regular meetings with France and Portugal to address energy security, as well as the most important issues in the field of energy that have occurred in each period.

Measure 3.5. Extension of contingency plans

a) Description

Internally, the Spanish energy system is now in an advanced position with regard to its preparation for contingencies. In this respect, we note the role of Law 8/2011 of 28 April 2011, establishing measures for the protection of critical infrastructure, and the Implementing Regulation for this, based on European standards. However, it is necessary to extend this preparation, in the context of the different international domains to which Spain is committed: the International Energy Agency (IEA) and various EU directives and regulations for the electricity and gas sector.

In the electricity sector, the objective of preventive and emergency plans is to prevent the unfolding of incidents that may have significant repercussions on supply or generating units, minimise the scope and the scale of incidents once they occur, as well as to return the electricity system to normal operating status after severe incidents that have caused power cuts. With this goal, a general and zonal security analysis will be conducted to evaluate the risk of supply failure that could arise from our own production resources, taking into account the availability of fuels, hydro-electric reserves in reservoirs and water availability, with several assumptions about both demand and availability of the generating units.

At European level, we note the recent approval of the Regulation establishing a network code for emergencies and restoration of supply[51], which gives details of a series of requirements to safeguard the security of supply, conditions to be met by the agents, listing of responsible persons and priority users, rules for suspension and restoration, settlements and testing plans. This Regulation, together with the proposal of the European Parliament for risk preparedness in the electricity sector, included in the European Commission package ‘Clean Energy for All Europeans’, will enable harmonisation of risk preparedness at European level and improvement in its general security.

With regard to the gas sector, the Preventive Action Plan and Emergency Plan will be updated in application of Regulation (EU) 2017/1938 of the European Parliament and of the Council concerning measures to safeguard the security of gas supply. Both documents were sent to the European Commission in March 2019.

The Preventive Action Plan minimises the risks identified in order to guarantee gas supply to all gas market customers, especially protected customers. On the other hand, the Emergency Plan contains the actions to be carried out in the event of an emergency in the gas system to guarantee supply to all customers in the gas market and especially to protected customers.

These plans are drawn up on the basis of the National Risk Assessment, which must ensure compliance with the rules on infrastructure and supplies imposed by Regulation (EU) 2017/1938. The main conclusions of the current Risk Assessment of the Spanish gas system are as follows:

- None of the risks identified and analysed poses a gas supply problem for protected customers.
- The N-1 principle and input capacity are incorporated as design criteria in the Mandatory Planning for the gas sector in Spain. Therefore, given the infrastructure anticipated within the timeframe analysed, the value of the N-1 formula laid down in Annex I to Regulation (EU) 2017/1938 for the Spanish gas system is greater than 100%, and it is thus not necessary to apply measures other than those used in normal operation.
- The greatest potential risk identified for the Spanish gas system would be the total failure of the main supplier (Algeria). It should be noted that up to now this failure has not occurred. Imports from this source were even maintained during the period of instability in the country in the 1990s, and therefore this event is considered improbable.

The Spanish gas system Risk Assessment, Preventive Action Plan and Emergency Plan must be updated every four years.

The following modifications are also planned in order to establish objectives and measures for natural gas supply security at regional level, so that:

[51] COMMISSION REGULATION (EU) 2017/2196 of 24 November 2017, establishing a network code on electricity emergency and restoration

- The infrastructure standard (N-1) of Article 5 of Regulation (EU) 2017/1938 must be complied with at regional level, taking the existing level of interconnection into account.
- The supply standard of Article 6 of Regulation (EU) 2017/1938 must be followed at regional level, taking into account the imposition of different national demands and the existence of different national measures taken to meet them.
- The Preventive Action and Emergency Plans will be developed at regional level.

To comply with the foregoing, regions must be established that are distinct from the risk groups created in Annex I to the abovementioned regulation.

b) Impact of the measure

Improving the country's energy security.

c) Responsible bodies

The public authority responsible for implementing and monitoring the measures is MITECO.

d) Target sectors

This measure is aimed at the energy sector as a whole.

e) Mechanisms

The main actions will be aimed at:

1) developing the National Security Strategy, through the Special Committee on Energy Security;
2) adapting to the new European regulation on preparation for risks in the electricity sector;
3) improving the various preventive and emergency plans with regard to the supply of electricity, gas and petroleum derivatives.

In the petroleum products sector, the following actions are considered necessary:

- Updating the Contingency plan for crisis situations in the petroleum markets: confidential document, prepared by CORES and regularly updated according to the criteria established by the IEA, which have established four action phases, from major to minor severity with regard to potential difficulties of supply of crude oil and petroleum products.
- Updating the Plan for demand restriction measures in the event of a crisis in the petroleum market: confidential document, prepared in 2015 by the MERCOP (Measures to Restrict the Consumption of Petroleum) group, specifically created for this purpose, including various ministerial departments and bodies of the General State Administration.
- Participating in emergency exercises regularly conducted by the European Commission and the International Energy Agency. Spain's participation in the simulated emergency situation ERE 9, conducted in 2018, can be cited as an example.

In addition, with the aim of reaching a certain level of energy security at regional level within the EU framework, it is necessary to establish objectives and measures for supply security of petroleum products at regional level, so that:

- the obligation to store 90 days' worth of consumption or 60 days' worth of imports of crude oil and petroleum products can be met at regional or EU level;
- the proportionality of the level of obligation and the methodology for accounting for existing supplies are reviewed, tailoring both to the reality of the global oil market and the state of the art;
- the form of compliance with the obligation is reviewed, so that the methodology for accounting for existing stocks encourages them to be composed of finished products;
- the form of compliance with the obligation is reviewed, so that the methodology for accounting for existing stocks encourages them to be located near to consumption centres, taking transport times into account;
- general standards for the process of authorisation of an operator's compliance with the obligations by using storage reserves located in other Member States are established.

While these general standards are introduced, Spain plans to approve a Ministerial Order to implement Article 11(2) of Royal Decree 1716/2004, in order to establish a unique procedure for authorising the storage of countable reserves for other Member States within national boundaries, avoiding the need for new bilateral agreements. However, various procedures for the bilateral agreements already signed (with France, Portugal, Italy, Ireland, Malta) will continue to exist and be necessary so that their national liable parties meet their obligations through storage reserves in other Member States.

Measure 3.6 Planning for safe operation of a decarbonised energy system

a) Description

Although the forecasts in this Plan allow the guarantee of supply to be fulfilled by 2030, consistency with a decarbonised economy and a 100% renewable electricity sector by 2050 makes it necessary to anticipate and identify the barriers, requirements and opportunities for operation with full guarantees of supply to the electricity system under these conditions.

It should be noted that a transformation of the Spanish energy system as thorough and ambitious as that presented in this Plan brings a series of challenges that cannot only be addressed from the supply side. In particular, the decisive commitment to renewable energies in the electricity generation sector entails a greater variety of generating profiles. This variety of supply can be compensated for by the development of various large-scale energy storage solutions, still on the supply side (hydraulic pumps or batteries or other), as well as increased firmness and manageability of specific renewable generation technologies, and also on the demand side through the promotion of different solutions to give the system flexibility. These actions are set out in 'Measure 1.2. Demand management, storage and flexibility'.

In the same area, technological advances have enabled the existence of a series of technological solutions that have still not been fully explored in the electricity sector regulations, but they are required to play an important role in ensuring the continuity of electricity supplies: in particular, any the optimisations that enable the intensive use of information and communication technologies in the energy system.

Thus, also contributing to the internal energy market dimension, we will adapt the regulations on:

- Distributed generation and storage of electricity. This measure includes all the developments in relation to own consumption (see Measure 1.4 of this Plan).
- Further progress in the elimination of barriers related to electric vehicles, such as the recent elimination of the role of charge managers (see Measure 2.4).
- Boosting forms of aggregated generation, demand responsiveness (including interruptibility) and storage (virtual power plants).
- Participation of renewable technologies in more services of the electricity system: deviation management, regulation services, etc. (see Measure 4.4).

The real and gradual integration of the service of interruptibility demand management in the adjustment service markets results in the more frequent use of this service, and therefore in a reduction of electricity consumption at prices increasingly comparable to those observed today by the generating undertakings that participate in the adjustment services.

Along these lines, Royal Decree-Law 20/2018 of 7 December 2018, on urgent measures to promote economic competitiveness in the sector of industry and commerce in Spain, lays down the mandate to prepare and approve an 'Electro-intensive Consumer Statute' that recognises the specificities of industrial electricity consumers with high use of electricity, high use at times of low electricity demand and a stable and predictable consumption curve.

This statute will also meet economic criteria, acting on situations in which the application of the service implies a lower cost than the adjustment services of the system. Thus, for the application of the interruptibility service by economic criteria, it will be checked that the implementation of the capacity reduction option, taking all the associated settlement into account, will result in a reduction of the total cost of the energy to be managed at that time. In addition, certain measures have been adopted to make the criteria allowing implementation of the capacity reduction options more flexible when their settlement is less costly than the activation of other market mechanisms.

In compliance with Regulation (EU) 2017/1938, we plan to establish and regularly update the list of critical electric power stations supplied by gas and their volumes of consumption, so that these volumes can be taken into account if another Member State requests the application of solidarity measures. With this goal, a working group will be created together with the electricity System Operator, the System Technical Manager and the Competent Authority in accordance with Regulation (EU) 2017/1938.

With regard to the participation of renewables in electricity system services, Spain is one of the pioneering countries for including renewable energies in the various adjustment services. Since February 2016, these facilities can participate in the adjustment service markets of the system, after passing the authorisation tests. From the start of 2018, almost half of wind power generation has been authorised for participation in deviation management services and tertiary regulation: this demonstrates that sufficient progress has been made in the integration of renewables into these services. In that regard, it is worth highlighting the role played by the system operator, whose control centre currently enables the observation and control of power generating stations of more than 1 MW and 10 MW, respectively.

b) Target sectors

This measure is aimed at the energy sector as a whole.

c) Mechanisms

Following the principle of technology neutrality, MITECO, the CNMC and the System Operator will identify the technologies, procedures and mechanisms that will make it possible to guarantee the supply without greenhouse gas emissions, with sufficient anticipation that makes it possible to guarantee the supply while following the path towards climate neutrality in 2050 and avoiding the need for new investments in fossil technologies to guarantee the supply.

d) Responsible bodies

The public authorities responsible for the implementation and monitoring of the measure are: MITECO, the System Operator and the CNMC.

In conclusion, it should be noted that there is a close connection between the energy security dimension and the other dimensions addressed in this Plan:

- The internal market dimension, with which it shares instruments such as electric and gas interconnections, or demand management.
- Research, Innovation and Competitiveness (RIC), as developments in batteries or power-to-gas depend on the more economical implementation of these technologies, which will be key in the future of supply security.
- With regard to the decarbonisation dimension, the high use of renewables in the system creates challenges for managing them, as well as integrating them into transmission and distribution networks.
- The energy efficiency dimension, since various solutions in this domain, such as local energy networks, also lead to system resiliency.

3.4 INTERNAL ENERGY MARKET DIMENSION

Regional cooperation

Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action sets out the obligation for Member States to cooperate with neighbouring Member States in the development of the INECP, in Article 12. In compliance with this article, and as a continuation of the meeting held on 1 March in France on the French INECP, a working session on regional cooperation was held in Madrid on 9 March 2019, organised by the Spanish MITECO. Representatives from Portugal, France and the European Commission, as well as Spain, participated.

The French, Portuguese and Spanish Plans were presented during the session. The transmission system operators of the three countries as well as the European Commission and the European Network of Transmission System Operators for Electricity (ENTSO-E) took part. A session was also held on electricity, gas and possibilities of developing joint renewable energy projects. The following figure shows the meeting agenda:

Figure 3.8. Agenda of the Regional Cooperation Meeting

MINISTRY FOR ECOLOGICAL TRANSITION

Regional cooperation meeting (France, Portugal, Spain and the European Commission)
Madrid, July 9th, 2019 **Ministry for Ecological Transition**
(Plaza San Juan de la Cruz s/n, 3rd Floor, Sector A, Madrid)

AGENDA	
09:30-10:00 | Reception	
SESSION 1: NATIONAL ENERGY AND CLIMATE PLANS (NECP)	
10:00-11:00	**Introduction and welcome.** Minister for the Ecological Transition **Spanish NECP** • Presentation. • TSO analysis on the NECP.
11:00-11:30	Coffee break
11:30-13:00	**Portuguese NECP.** • Present**ation.** • **TSO analy**sis on the NECP. **French NECP.** • Pre**sentation.** • **TSO a**nalysis on the NECP. **Recommendations on the NECPs.** *European Commission* **Vision on the** 2030 **horizon.** *ENTSO-E.*
13:00-14:30	Lunch
SESSION 2: REGIONAL COOPERATION	
15:00-16:00	**Internal Energy Market** *(short presentations followed by open debate)* 1. **Electricity. Generation adequacy and risk preparedness.** **2. Natural Gas. Development of market integration.**
16:00-16:30	Coffee break
16:30-17:30	**Internal Energy Market** *(short presentations followed by open debate)* 3. **Opening of the support schemes for electricity from renewable energy sources to producers located in neighbouring countries.** **4. Cross border renewable energy Project development.**
CLOSING SESSION	
17:30-18:00 **| Wrap-up**	

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

The main conclusions reached at the abovementioned meeting were the following:

- All three Member States share a long-term vision for carbon neutrality by 2050, including broad penetration of renewable energy, reduction of energy consumption, end-use electrification and significant retrofitting of buildings.
- The European Commission noted the importance of the Integrated National Energy and Climate Plans as a key reference for investors and stakeholders. It also stressed that regional cooperation is one of the pillars for effective implementation of INECPs.
- The involvement of electricity system operators is considered very relevant for the proper implementation of INECPs.
- In relation to risk preparation, the three Member States present acknowledge the work of ENTSO-E and will share risk plans in the future.
- For the development of the interconnections, the active involvement of the transmission system operators was considered important by the attendees, as well as the social acceptance of the projects.
- Storage and interconnections are considered to be complementary to achieving climate objectives.
- Good practice in the decarbonisation and energy efficiency dimensions will be exchanged to increase cooperation between the Member States present.
- Finally, the possible joint development of cross-border projects will be analysed. However, for the time being, neither Portugal nor France are considering opening national support schemes for electricity generation from renewable sources.

In short, the meeting held on 9 July 2019 was the regional cooperation mechanism implemented in this Plan, and it is expected to be the first in a series of collaborations in different energy and climate areas, which will help the implementation of the INECPs in each of the States.

Measures concerning the Internal Energy Market Dimension

With regard to the interconnectivity of the electricity system, we will continue to work on what was agreed in the Madrid Declaration - Summit for Energy Interconnections, held by Spain, France, Portugal, the European Commission and the European Investment Bank in Madrid on 4 March 2015, and ratified in June 2018 in the Lisbon Declaration.

In the Madrid Declaration, a common strategy was adopted for the development of electricity transmission activities and a new high-level Regional Group for South-West Europe was created for the promotion and supervision of interconnection projects. This strategy was ratified in the Lisbon Declaration.

In the area of the internal market dimension, the main measures are described below.

Measure 4.1. Increased electricity interconnection with France

a) Description

Building the following essential interconnections:

- Bay of Biscay Project: Interconnection between Aquitaine (FR) and the Basque Country (ES). This will allow the interconnection capacity between Spain and France to reach 5,000 MW.
- Interconnection between Aragon (ES) and Atlantic Pyrenees (FR) and interconnection between Navarre (ES) and Landes (FR). This will increase the interconnection capacity between Spain and France up to 8,000 MW.

Interconnections are the main infrastructure element that enables progress in the internal energy market, since they make it possible to exchange electricity with neighbouring countries at competitive and homogeneous prices and they reduce the volatility of national markets.

They are important for energy security and improve the efficiency of electricity systems by contributing to a more efficient allocation of generation, reducing the need for duplicate installations across borders. Finally, they play an essential role in achieving energy and climate objectives by allowing greater integration of non-dispatchable renewable technologies into the grid.

b) Impact of the measure

The most important of these projects, the Bay of Biscay project, was considered in the 2017 Projects of Common Interest (PCIs)[52] as an interconnection between Aquitaine (FR) and the Basque Country (ES). This is an interconnection that is 370 km in length (110 km in Spain and 260 km in France), of which 90 km are terrestrial and 280 km are undersea, with an estimated cost of EUR 1.75 billion. This project will allow the capacity of the interconnection between Spain and France to reach 5,000 MW (5% of installed capacity).

The others, also included in the list of 2017 PCIs, are outlined below:

- Interconnection between Aragon (ES) and Pyrenees Atlantic (FR). There are 150 km planned on the Spanish side, and the estimated cost is EUR 1.2 billion.
- Interconnection between Navarre (ES) and Landes (FR). There are 80 km planned on the Spanish side, and the estimated cost is EUR 1.2 billion.

[52] COMISSION DELEGATED REGULATION (EU) 2018/540 of 23 November 2017 amending Regulation (EU) No 347/2013 of the European Parliament and of the Council as regards the Union list of projects of common interest.

c) Responsible bodies

The public authority responsible for approving and monitoring the measure is MITECO, in collaboration with the French government. The execution is carried out by REE together with the electricity transporter in France, RTE.

d) Target sectors

This measure is aimed at the electricity sector.

e) Mechanisms

The current transmission network planning, with a 2015-2020 horizon, includes the abovementioned interconnections in a post-2020 horizon. These projects will be examined and taken into consideration for the new planning of the transmission network with the 2021-2026 horizon. The inclusion of these installations in Annex 2 of the abovementioned planning currently in force enables the relevant administrative procedures to be initiated.

f) Financial requirements and public support

The ‘Connecting Europe Facilities’ (CEF) programme, created under Regulation EU 1316/2013 of the European Parliament and of the Council of 11 December 2013, plays an important role in the financing of electricity interconnections (Measures 4.1 and 4.2), as well as of other PCI infrastructures. It is designed to promote infrastructures of special European interest by means of financial aid from the EU through competitive calls for proposals or applications for funding submitted by the bodies responsible for building these infrastructures, always with the approval of each Member State.

In relation to the Bay of Biscay project, the project promoters (REE and RTE) applied for EUR 800 million CEF funds in the 2017 call. A decision was made on the call in early 2018 with the award of EUR 578 million. According to the abovementioned cost allocation, EUR 350 million went to France and the remaining EUR 228 million to Spain.

Measure 4.2. Increased electricity interconnection with Portugal

a) Description

The Spanish electricity system’s connection with Portugal is more fluid, as the process that led to the creation of the Iberian Electricity Market (MIBEL) involved close cooperation between the governments of both countries. As a result, from the start in July 2007, MIBEL has been one of the most liquid markets in Europe, providing multiple benefits for the consumers of both countries, in a framework of participation open to all interested parties under conditions of equality, transparency and objectivity.

Even so, given that in 2017, 6.7% of the hours were not matched in the daily market due to congestion in the interconnection with Portugal, it is considered appropriate to increase the exchange capacity between Spain and Portugal up to 3,000 MW. The project comprises the following facilities on the Spanish side, located in the provinces of Ourense and Pontevedra:

- 400 kV DC power line, with input and output at Beariz on the Cartelle-Mesón do Vento line;
- Beariz 400 kV transmission substation;
- 400 kV DC power line, Beariz-Fontefria;
- Fontefria 400 kV transmission substation;
- 400 kV DC power line, Fontefria-Portuguese border.

b) Impact of the measure

Interconnections are the element that enables progress in the internal energy market, since they make it possible to exchange electricity with neighbouring countries at competitive and homogeneous prices and they reduce the volatility of national markets. They are equally important for the energy security dimension and improve the efficiency of electricity systems by contributing to a more efficient allocation of generation installations by reducing the need for duplicate installations across borders. Finally, they play an essential role in achieving energy and climate objectives by allowing greater integration of non-dispatchable renewable technologies into the grid.

c) Responsible bodies

The public authority responsible for approving and monitoring the measure is MITECO, in collaboration with the Portuguese government. REE is responsible for the implementation.

d) Target sectors

This measure is aimed at the electricity sector.

e) Mechanisms

The current transmission network planning, with a 2015-2020 horizon, includes this international interconnection.

Projects that have not been put into service will be re-examined and taken into consideration for the new planning of the transmission network with the horizon of 2021-2026.

f) Financial requirements and public support

This new interconnection with Portugal, also included in the 2017 list of PCIs, is intended to increase the capacity for interchange between the two countries to 3,000 MW, at an estimated cost of EUR 128 million.

Measure 4.3. Electricity transmission infrastructure other than the 'Projects of Common Interest' (PCIs)

a) Description

As previously stated, the Energy Planning document, 2015-2020 Development Plan for the Electricity Transmission Network, submitted to the Congress of Deputies on 29 September 2015 and approved on 16 October 2015 by agreement of the Council of Ministers, is currently in force. In March 2019, the process to develop the new planning, with a 2021-2026 horizon, was initiated.

In this area, the following are proposed as projects to be developed in addition to the PCIs:

- 400 kV Abanto/Güeñes-Ichaso axis.
- Actions in the metropolitan area of Barcelona.
- Pyrenean region. Moralets.
- Mequinenza axis interconnection.
- 220 kV JM Oriol-Los Arenales-Cáceres-Trujillo network mesh axis.
- 220 kV Valencia capital network mesh.
- Strengthening of the 220 kV axis between La Plana and Morvedre.
- Strengthening of the 400 kV network between Castellón and Valencia.
- Connection between Mallorca and Menorca, currently a service force, planned for 2021.

The development of any actions that may affect neighbouring electricity systems will be carried out in cooperation with the relevant TSOs to minimise the potential effects and impacts on both electricity systems.

In line with the provisions of Measure 1.3 of this Plan, the guiding principles for the 2021-2026 planning of the electricity transmission grid are, in addition to the general principles established in Article 9 of Royal Decree 1955/2000 of 1 December 2000 regulating the activities of transmission, distribution, marketing, supply and authorisation procedures for electricity installations, the following:

1. The implementation of the energy and climate commitments set out in this Plan.
2. The maximisation of renewable penetration in the electricity system, minimising the risk of discharges, and in a way that is compatible with the safety of the electricity system.
3. The transfer of renewable energies in areas where there are high levels of renewable resources and where it is environmentally possible to exploit and transport the energy generated.
4. The contribution, as far as the electricity transmission network is concerned, to ensuring the security of supply of the electricity system.
5. The compatibility of the development of the electricity transmission network with the environmental restrictions required by the Strategic Environmental Assessment of the INECP.
6. The removal of existing technical restrictions on the electricity transmission network.
7. Compliance with the principles of economic efficiency and the principle of economic and financial sustainability of the electricity system.
8. The maximisation of the use of the existing network, renewing, expanding capacity, using new technologies and reusing existing facilities.
9. The reduction of losses for the transport of electrical energy to consumption centres.

b) Impact of the measure

Traditionally, the planning of the electricity transmission network consists of a binding part, the network infrastructures to be built, and an indicative part with demand and generation projections. On this occasion, the indicative part is this INECP. The binding planning of the electricity transmission network will therefore be adapted to the fulfilment of the objectives of this Plan and its forecasts for demand and generation fleet.

The energy transition process requires adequate planning of the electricity transmission network to allow the mass integration of new renewable generation at the pace necessary to achieve the objectives in the medium and long term, ensuring the safe operation of the electricity system at minimum cost to consumers. In this sense, the adequate design and planning of the same plays an essential role in the integration of a greater amount of intermittent electricity generation, enabling the connection of more generation. It is also expected that distributed generation from renewable sources and own consumption will become increasingly important over the coming years.

In addition, the transformation of the energy model will lead to a change in the generation mix as a result of the replacement of emitting and contaminating generation technologies and the incorporation of new clean and renewable technologies, which in turn will lead to a change in the energy flows through the transmission network and in the management of these flows.

On the other hand, in order to minimise the environmental impact, to optimise the investments already made and to maximise the use of the existing electricity corridors, priority should be given to the improvement and updating of the existing network as opposed to new routes and infrastructure. These actions can be carried out by increasing the capacity of the network through repowering, setting up multiple circuits and using new technologies. This will be done by putting the necessary security of supply and reliability of the electricity transmission network first at all times.

It should also be noted that the network planning aims include the elimination of structural technical restrictions that cause economic inefficiencies in the system and an extra cost in the price of energy paid by consumers, as well as the minimisation of losses caused by the existence of long-distance energy flows to supply large consumption centres.

Finally, it should be borne in mind that energy is an important factor in the siting of economic activity, so the planning must provide an adequate response to any new demand needs identified, including those derived from the development of high-speed rail infrastructure, thus contributing to the generation of wealth, employment and structure for the territory.

c) Responsible bodies

The public authority responsible for approving and monitoring the measures is MITECO. The TSO REE is responsible for the implementation.

d) Target sectors

This measure is aimed at the electricity sector.

e) Mechanisms

The projects included in the transmission network planning currently in force, with the 2015-2020 horizon, which have not been put into service will be re-examined and taken into consideration for a new planning of the transmission network with the horizon 2021-2026. In March 2019, the process of drawing up the new plan, with a 2021-2026 horizon, was initiated by Order TEC/212/2019 of 25 February 2019 initiating the procedure for making proposals for the development of the electricity transmission grid with a 2026 horizon.

f) Financial requirements and public support

The proposed development of the transmission network must comply with the principles set out in the abovementioned Law 24/2013 of 26 December 2013, including the economic and financial sustainability of the electricity system as provided for in Article 13 of the abovementioned Law, respecting in all cases the annual investment limits established by Royal Decree 1047/2013 of 27 December 2013, which establishes the methodology for calculating the remuneration of electricity transmission activity.

Measure 4.4. Integration of the electricity market

a) Description

Progress in the integration of the electricity market consists of various initiatives, which are outlined below.

1. Increasing the contribution of renewable energies to adjustment and balancing services. The necessary measures will be provided for storage development and demand management, also contributing to the energy security dimension.
2. Adopting the necessary measures to promote the decarbonisation of the economy with the aim of coal-fired power plants minimising their (unlikely) energy contribution to the electricity system by 2030.
3. Implementing the necessary measures to improve the capacity to manage hydroelectric power, in order to maximise the integration of renewable energies (this measure is supplemented by the increase in energy storage, within the energy security dimension).
4. Promoting the participation of consumers in the electricity market. The new European internal market directive and regulation provide incentives to respond to demand and, under this legislation, the market will evolve towards a design that provides effective price signals through which the active participation of demand and the possibility of its aggregation are guaranteed.
5. Analysing the development of capacity mechanisms compatible with the new European directives and regulations that will contribute to meeting the objectives of this Plan, open to the participation of all resources that are in a position to provide the necessary capacity, including energy storage and demand management.
6. Promoting own consumption and distributed generation (Measure 1.4). In this regard, Royal Decree 244/2019 of 5 April 2019 was recently approved, regulating the administrative, technical and economic conditions for the own consumption of electrical energy. This Royal Decree aims to achieve a strong boost for own consumption.
   In addition, it should be noted that this law has partly transposed the provisions of the Renewable Energy Directive.

7. Developing, in accordance with the new European internal market directive and regulation, energy storage as a means to guarantee electricity supply; it will be considered that this can offer multiple services with different characteristics and advantages. Thus, generation, demand and storage will be able to contribute their firmness and flexibility, with the appropriate mechanisms, ensuring supply at all times (see Measure 1.2).

b) Impact of the measure

Based on the great effort made by Spain in the deployment of smart meters launched in 2008 and completed at the end of 2018, consumers have a basic tool for understanding their hourly consumption, becoming active consumers, and adjusting to prices in the electricity market. Therefore, consumers can adjust their demand to times when the market prices are lower, contributing in this way to shifting the demand curve and thus facilitating a reduction in electricity prices.

In that regard, it is essential to continue making progress within an enabling framework that supports the promotion of own consumption and renewable energy communities. In this respect, the provisions of Royal Decree-Law 15/2018 of 5 October 2018 on urgent measures for the energy transition and consumer protection will be developed, by means of Royal Decree 244/2019 of 5 April 2019 regulating the administrative, technical and economic conditions for the own consumption of electricity , based on the search for the greatest simplicity possible in the technical and administrative requirements, so that they do not create a barrier to the development of own consumption.

Royal Decree-Law 15/2018 of 5 October 2018 has abolished the figure of charge manager and charging activity has been liberalised, so that any consumer can provide charging services. In addition, the managers of ports, airports and rail infrastructure, in their role as consumers, can provide electricity supply services to vessels, aircraft and railways, and services inherent to the provision of that service, enabling vessels and aircraft to stop consuming fuel while they are located in these facilities. This will contribute to the objective of achieving low-emission transport.

On the other hand, the abovementioned Royal Decree-Law 15/2018 of 5 October 2018 amended the regulation of own consumption in Spain so that consumers-producers, and society as a whole, can benefit from the advantages that this activity entails, in terms of lower network needs, greater energy independence and lower greenhouse gas emissions.

In addition, it is necessary to move forward with a favourable framework for adequate access to consumption data by consumers, such as the promotion of own consumption and local energy communities as set out in the following measures: 1.4. The development of own consumption using renewables and distributed generation, 1.13. Local energy communities and 1.14. Promoting the proactive role of citizens in decarbonisation, included in this Plan.

c) Responsible bodies

The public authorities responsible for implementing and monitoring the measure will be MITECO and the autonomous communities.

d) Target sectors

This measure is aimed at the electricity sector.

e) Mechanisms

Further regulatory development, including the transposition of European regulations, as well as the planning exercise foreseen in Action 3.6.

For the specific aspect of electricity consumer protection and improving competitiveness in the retail sector, the following measure is proposed:

Measure 4.5. Protecting electricity consumers and increasing competition

a) Description

The Energy Union has placed electricity consumers at the centre of its policies. Energy is a critical commodity, essential for full participation in modern society. The transition to clean energy must therefore also be fair to those vulnerable sectors, regions or segments of society that may be affected by the energy transition.

In the future, all EU consumers will have the right to generate electricity either for their own consumption, to store it, share it or sell it to the market. These changes will make it easier for households to get involved in the energy system, better control their consumption and respond to price signals. The new market rules will ensure a high level of protection and good data management. In addition, new services, such as demand response, will help many individuals and families significantly reduce their energy bills.

b) Mechanisms

This measure is considered in the specific aspect of electricity consumer protection and improving competitiveness in the retail sector. It consists of the following initiatives:

1. Establishing a dynamic framework of standards which can be adapted to the constant development of the sector and which protects the most vulnerable consumers by promoting competitive and transparent prices. To do this, the necessary reforms in the design and operation of the electricity market will be analysed. In addition, new smart tariff designs will be studied that will promote demand management and the rational use of infrastructure, and will contribute to the decarbonisation objectives.
2. Facilitating consumers' understanding of the offers and the conditions of supply procurement, enabling them to make better decisions about electricity consumption, to achieve more efficient behaviour and a less harmful impact on the environment.
3. Furthering the promotion of free competition between electricity providers.

c) Responsible bodies

The public authorities responsible for implementing and monitoring the measure will be MITECO, together with the autonomous communities and the CNMC.

d) Target sectors

This measure is aimed at the electricity sector.

Measure 4.6. Data access

a) Description

Detailed, accessible and comprehensible information on their energy consumption is crucial to enable citizens and businesses to take decisions on their energy consumption and on choosing more efficient tariffs and investments, and to enable existing or new entrants, such as aggregators, to offer them various energy services and to perform the functions for which they are empowered by Directive 2019/944/EU on common rules for the internal market for electricity. In addition, the availability of information on aggregate consumption by public administrations is necessary to enable them to evaluate the effectiveness of energy policies and measures.

Following the deployment of smart electricity metering systems (which in Spain in 2018 were already 93% implemented), different data management models currently exist or are being developed in the Member States. For example, in Estonia and Denmark, a central data platform has already been established, managed by an independent body, with another option being that the platform operator are the distribution system operators themselves. Regardless of the management model, it is important that transparent rules are in place by virtue of which these data can be accessed under non-discriminatory conditions and ensure the highest level of accessibility, usability, cybersecurity and protection, as well as the impartiality of the entities that process them.

As existing technologies already allow this and as stated in Article 20 of Directive 2019/944/EU, consumers should have access to their data in near real time (compared to the hourly data collected today in Spain, in countries such as France data is collected every 30 minutes, in Belgium and Slovakia every 15 minutes, and in Italy, Greece and Poland in near real time).

Moreover, to ensure a transition that covers all energy uses, it is necessary for the consumer and the administration to have data on thermal energy consumption.

b) Objectives addressed

To enhance the awareness and the leading role of citizens in the energy transition, the development of innovative energy services such as, inter alia, aggregation, and the analysis of the effectiveness of policies and support measures by the public administration, through adequate access to electricity consumption data.

c) Mechanisms

Creation of the data access platform that makes use of, at least, the data from existing meters, and that guarantees the following:

- ease of use for citizens both for checking their consumption data as well as for authorising third-party access;
- compliance with data protection regulations;
- access to the data in near real time and to historical consumption data;
- access by the administration to aggregated data by geographical area and consumer type;
- relevant information for consumers such as that relating to tariff periods or power requirements.

Development of thermal energy information systems that allow users to easily and comprehensibly access their own data, as well as access by the administration to aggregate data.

d) Responsible bodies

General State Administration (MITECO/IDAE, MINECO and Ministry of Consumer Affairs), CNMC, REE and distribution companies.

With regard to the Spanish gas market, its reinforcement and development is considered essential in the next decade. This requires the following initiatives:

Measure 4.7. Integration of the gas market

a) Description

In line with Measure 4.4, but focused on the gas sector, the following initiatives are proposed to improve market integration:

1. Establishment of the logistics model of regasification plants through the approval of the CNMC Circular establishing the mechanisms for access and allocation of capacity to be applied in the natural gas system and its subsequent development. In this way, it is hoped to maximise the flexibility of the system by allowing progress towards a model that allows the purchase and sale of LNG without distinction as to the plant in which it is physically located.
2. Expansion of the measures for promoting liquidity (mandatory negotiation in the organised market of natural gas for certain purposes, market creators).
3. Taking advantage of the storage capacity for LNG in Spanish plants, as well as their capacity for regasification, to convert them into a physical hub at EU level, both for natural gas and renewable gas or hydrogen.

b) Impact of the measure

This measure will be implemented by the national regulatory authority, the CNMC, within the scope of its powers and within the framework of Law 8/2015 of 21 May 2015. This law created the organised market for gas (MIBGAS) and appointed the market operators, with the objective of filling the gap for an organised secondary wholesale market, which will provide a transparent price signal and boost competition in the sector.

As for the electricity market, the entrance of new providers is also proposed for gas, as well as a reduction in the administrative burden for providers of natural gas in their relations with the administration.

c) Responsible body

The public authority responsible for implementing and monitoring the measure is MITECO.

d) Target sectors

This measure is aimed at the gas sector.

Measure 4.8. Protection of gas consumers

a) Description

In the area of consumer protection, responding to the overall objective of providing consumers with the necessary information so that they can make their natural gas consumption decisions independently, the following initiatives are proposed:

1. Simplifying connection: introducing the possibility of execution by the applicants themselves, through amendment of Article 25 of Royal Decree 1434/2002.
2. Simplifying the process of changing provider: introducing a process that prevents delays and extending the powers of review of the regulator, through the amendment of Articles 41 and 42 of Royal Decree 1434/2002.
3. Reducing fraud: strengthening the role of distributors in the detection of fraud and communication procedures with providers, through the amendment of Articles 61 and 62 of Royal Decree 1434/2002.

4. Implementing smart meters: technical and financial analysis of the potential implementation of smart meters for consumers, supplied at a pressure equal to or lower than 4 bar, based on the report to be prepared by the CNMC in compliance with additional provision four of Order ETU/1283/2017 of 22 December 2017.
5. Prevent the suspension of supply in extreme weather situations, as established in the 2019-2023 National Strategy against Energy Poverty.

b) Impact of the measure

This measure will provide consumers with the ability to know at all times the volumes of gas consumed and their environmental footprint (emissions, proportion of renewable gas consumed, real-time consumption, online invoice availability, etc.).

c) Responsible body

The public authority responsible for implementing and monitoring the measure is MITECO.

d) Target sectors

This measure is aimed at the gas sector.

Measure 4.9. Improving the competitiveness of the retail gas sector

a) Description

The following initiatives are proposed:

1. Imposing new obligations on the dominant operators in the natural gas sector, based on their retail market share.
2. Creating a single central point of statistical reporting to the General State Administration for providers, based in the State Secretariat for Energy, which in turn will provide the information required by other bodies (CNMC, CORES).
3. Simplifying the electronic procedure for setting up new providers.

In this regard, it is worth noting the effect of measures such as those contained in Royal Decree Law 15/2018, consisting of the introduction of an exemption from the Excise Duty on Hydrocarbons for energy products used in the production of electricity in electric power stations or the co-generation of electricity and heat in combined power stations.

b) Impact of the measure

Together with the above, this measure will improve consumers' ability to know at all times the volumes of gas consumed and their environmental footprint (emissions, proportion of renewable gas consumed, real-time consumption, online invoice availability, etc.).

c) Responsible bodies

The public authority responsible for implementing and monitoring the measure is MITECO.

d) Target sectors

This measure is aimed at the gas sector.

Measure 4.10. Development plan for gas demand management

a) Description

Geographical areas will be selected where preventing the potential interruption of supply to unprotected clients could be essential in order to safeguard energy security. In addition, this demand management plan must pre-select unprotected clients with a sufficient volume of consumption and economic activity to support these mechanisms.

b) Impact of the measure

As a consequence of the plan, national regulations will be developed by the CNMC and MITECO, within the scope of their respective competences, in order to have these mechanisms approved within the established time frame. In particular, the main tools include the following:

- Interruptible tariff: possibility of interruption of supply to clients subject to this type of transmission and distribution tariff, for a lower amount than the fixed tariff, with the option of reducing the demand to be satisfied by the system in the event of lack of supply or saturation of gas pipelines in extreme conditions.
- Demand management systems: the development of demand management systems is planned, allowing unprotected consumers to relinquish volumes of contracted gas, putting them on the market at a fixed price through competitive procedures, in accordance with Regulation (EU) 2017/1938.

c) Responsible body

The public authority responsible for implementing and monitoring the measure is MITECO.

d) Target sectors

This measure is aimed at the gas sector.

Measure 4.11. Combating energy poverty

a) Description

The 'Clean Energy for All Europeans' package suggests tackling energy poverty at its root, through targeted social policies and energy efficiency measures such as insulation of social housing.

It also puts forward that energy poverty is a major challenge across the EU and is caused by low income and energy inefficient housing. It sets out a new approach to protecting vulnerable consumers, which includes helping Member States to reduce energy costs for consumers by supporting energy efficiency investments.

As part of the energy union governance process, Member States should assess the number of households in fuel poverty in their integrated national energy and climate plans, taking into account the household energy services needed to ensure basic living standards in the national context, existing social policy and other relevant policies, as well as the Commission's indicative guidelines on appropriate indicators, including geographical dispersion, based on a common approach to fuel poverty. If a Member State finds that a significant number of households are in such a situation, it should include in its plan an indicative national target for reducing that number.

The integrated national energy and climate progress report should include:

1. information on progress towards the national indicative target of reducing the number of households living in fuel poverty;
2. quantitative information on the number of households living in fuel poverty and, where available, information on policies and measures to address the problem.

The Commission will share the data communicated by the Member States with the EU Energy Poverty Observatory (EPOV).

In this context, the measures adopted by the Commission on energy efficiency urge Member States to take energy poverty into account by requiring that a share of energy efficiency measures be implemented as a priority in households affected by energy poverty and in social housing. Their long-term building renovation strategies should also contribute to alleviating this poverty. The European Commission wants to strengthen the positive effect of the social aspects of energy efficiency. Any measure that improves living conditions, or increases people's participation in it, and saves money, is particularly important for low-income families who cannot heat their homes adequately, let alone afford renovation or upgrading to make more efficient use of energy.

The Directive concerning common rules for the internal market in electricity approved in June 2019 highlights the importance of the Member States adopting the measures necessary to protect vulnerable consumers and those in a situation of energy poverty, in the context of the internal market in electricity. Such measures may differ according to the specific circumstances in each Member State, and may include social or energy policy measures related to the payment of electricity bills, to investment in the energy performance of residential buildings, or to consumer protection, such as safeguards against disconnection.

In the national context, energy poverty in Spain is a complex phenomenon where the approach calls for multidisciplinary analysis and coordinated actions of the different policies by the public authorities. The **'National Strategy against Energy Poverty' (ENPE)** approved in April 2019 provides a framework for action and a framework for the actions to be carried out in this area. To this end, an approach has been adopted that combines measures of a more performance-oriented and palliative nature, to be implemented in the short term, with other more structural and developmental measures to improve energy efficiency, aimed at the medium and long term. The Strategy has been drawn up within a framework of collaboration, advice and participation from representatives of the different administrative bodies (State, autonomous community and local), as well as experts and entities from the third sector, who will also be present during its subsequent implementation.

In line with the European guidelines, the ENPE includes a definition of fuel poverty and vulnerable consumer (‘*Fuel poverty is the situation in which a household cannot meet its basic needs for energy supplies, as a result of insufficient income, and which, where appropriate, may be aggravated by having an energy-inefficient dwelling; a vulnerable consumer is a consumer of electrical or thermal energy who is in a situation of fuel poverty and who may benefit from support measures established by the administrations*’).

In order to parameterise the situations, the ENPE selects the four official indicators of the EU Energy Poverty Observatory (EPOV):

1. High share of energy expenditure in income (2M): proportion of households whose share of energy expenditure in income is more than twice the national median share.
2. Low absolute energy expenditure (M/2): share of households whose absolute energy expenditure is below half the national median.
3. Inability to keep home adequately warm: share of (sub)population not able to keep their home adequately warm.
4. Arrears on utility bills: share of (sub)population having arrears on utility bills.

Additionally, the analyses of these indicators are complemented by other secondary indicators and are crossed with certain variables to characterise the population.

The ENPE also sets a target for each of the EPOV indicators: to fall by at least 25% by 2025, seeking to go further and reach 50% of their current values.

The lines of actions outlined in the ENPE operational pan, specified in 19 measures, are profiled through four fundamental focuses. The focuses around which the ENPE is articulated are the following:

I. **Improve knowledge**.

Periodic monitoring of the indicators by the annual updating of the four indicators by the National Statistics Institute (INE), which will provide specific information on their values disaggregated by climate zone. Moreover, the IDAE will be the body responsible for publishing the results, as well as carrying out the comparative analysis with the other European Union Member States and with the targets set at national level.

II. Improve the response to the current situation.

The planned performance measures are key mechanisms for the short-term protection of vulnerable consumers, enabling them to meet payments for their energy supplies.

The creation of a new social energy bond is thus planned, granted on the basis of disposable income criteria. The income thresholds to be set may be relaxed for certain categories of particularly vulnerable consumers, with particular attention being paid to households with children. The direct granting of aid may be considered for those groups receiving benefits whose granting is linked in advance to low income levels.

The mechanism will be based on three principles:

1. Universality of supply sources: the new aid will be integral to all energy supplies, both electrical and thermal.

2. Automation: granting will be simplified by direct verification of the requirements by a public administration that collects information from all the bodies involved, avoiding the need for the consumer to process the application.

3. Coordinated management with other public administrations: all the administrations will be involved in the implementation of the aid in a coordinated manner and respecting the established distribution of competences.

Social services will be required to apply the precautionary principle associated with Minimum Essential Supply, so that the supply of the most vulnerable households is not disrupted for a period of time.

One of the measures envisaged will be to prohibit the interruption of energy supply to vulnerable consumers in extreme weather situations.

III. **Create a structural change for the reduction of energy poverty.**

This focus includes structural and energy efficiency measures, centred on achieving an improvement in the equipment and conditions of the buildings and homes of vulnerable consumers.

They are a key element in tackling fuel poverty because they seek permanent change in households to reduce their dependence on other loan measures. Measures such as improving energy efficiency and residential equipment are included (Measures 2.6 and 2.7 of this Plan), as well as own consumption installations aimed at vulnerable consumers (Measure 1.4).

IV. **Consumer protection and social awareness measures.**

These are actions that seek to empower consumers, professionals and other actors linked to energy poverty through a better knowledge of rights, obligations, possibilities and alternatives in the field of energy consumption.

The first element is generally raising awareness of the need to eradicate energy poverty in modern societies.

It also includes developing a protocol so that primary care professionals can detect situations of energy poverty.

b) Objectives addressed

The reduction of energy poverty in Spain, as well as the reduction of the impact that this situation has on part of the population.

Table 3.3. Energy poverty targets

Indicator (%)	2017	Minimum target for 2025	Desired target for 2025
High share of energy expenditure in income (2M)	17.3	12.9	8.6
Low absolute energy expenditure (M/2)	11.5	8.6	5.7
Inability to keep home adequately warm	8	6	4
Arrears on utility bills	7.4	5.5	3.7

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

c) Mechanisms

For the preparation of the National Strategy against Energy Poverty, the following is proposed:

- **The problem has been assessed and characterised.**

  A definition of energy poverty and vulnerable consumers has been put together in line with the regulation established by the Electricity Directive and the Governance Regulation.

  The corresponding statistical instruments have been used, together with the consultation and participation of public bodies and private actors to obtain a representation of the situation in Spain.

- **Official measurement indicators have been designed.**
  This previous analysis has made it possible to establish the needs and places of action that the ENPE must cover. The development of these indicators will be subject to continuous analysis and will serve as a basis for comparison with the other European Union Member States.
- **Objectives have been established to reduce energy poverty in the medium and long term.**
- **Measures have been designed to achieve the objectives.**

d) Responsible bodies

The General State Administration (MITECO/IDAE, MINECO, National Institute of Social Security) autonomous regional and local administrations, sectoral associations, National Statistical Institute.

3.5 RESEARCH, INNOVATION AND COMPETITIVENESS DIMENSION

The future 2021-2028 Spanish Science, Technology and Innovation Strategy will incorporate a Strategic Action on Energy and Climate Change, as well as including this in its development plans, and assign an amount of funding for Research, Innovation and Competitiveness (RIC) in energy and climate. This point signifies a change with regard to the current structure of state planning of Research, Development and Innovation (RDI), as the calls for funding are evaluated and determined strictly based on criteria of excellence, without defining the levels of funding for sectors or specific challenges or alignment with the country's strategic challenges.

3.5.1 Policies and measures to achieve the national objectives

To ensure coverage of the Plan's requirements with regard to science, technology and innovation, and given the non-specific nature of the current RDI planning, the instruments of those financing the Spanish system of science and technology can be used for actions on energy and climate. It is considered necessary to carry out a continuous and dynamic strategic analysis, to establish the priorities in research and innovation in our country. This is a long-term reflection, given the volume of new technologies needed to carry out the energy transition and the high maturation time required for RDI.

Measure 5. 1. 1. Strategic action on energy and climate

a) Description

The legislation governing the Spanish Research, Development and Innovation system provides for the creation of frameworks and instruments to promote horizontal and strategic sectors or technologies as a matter of priority under the umbrella of a Strategic RDI Action. Through these actions, coverage is provided for the most decisive and relevant commitments in terms of RDI.

The Strategic Action on Energy and Climate Change has the objectives of promoting RIC for the energy transition and of accelerating the full decarbonisation of the economy by 2050, the implementation of a model of sustainable development and resilience to climate change that provides the economic and regulatory signals that give stability and security to investors and other economic players.

In particular, a sustainable energy model that encourages the use of renewable energy sources, energy efficiency, the development of clean combustion technologies or emerging technologies, progress in the areas of sustainable mobility and the modal shift in transport, promotion of sustainable building and mitigation of non-energy emissions, promotion of efficiency and sustainability in the storage of raw materials for new technologies, as well as climate observation and adaptation to climate change.

This action includes integral management of all the necessary programmes. To ensure coordination of the activities and the achievement of the established objectives, this commitment will define specific objectives, and will establish a budgetary commitment applicable throughout the period of the future Strategy on Science, Technology and Innovation and the Plans that implement it.

b) Objectives

- To provide the necessary flexibility to facilitate international collaboration and the implementation of the SET Plan lines.
- To prevent duplication and ensure continuity of the priority lines of research and the communication of results to the public administrations.
- To improve the transfer of knowledge and scientific excellence.
- To promote innovation in the private sector.

- To increase the returns of European programmes on energy and climate change.

c) Mechanisms

- 2021-2027 State Strategy on Science, Technology and Innovation.
- 2021-2024 State Plan on Scientific and Technical Research and Innovation.

d) Responsible body

The MCI, coordinated with MITECO.

This measure is aligned with the strategies for smart specialisation to improve knowledge exchange between political agents and the interested parties, above all supporting the participation of SMEs.

Measure 5.2. Implementation of the SET Plan

a) Description

The mission of the SET Plan (European Strategic Energy Technology Plan) consists of accelerating the development and deployment of low-carbon technologies[53].

Within the framework of the SET Plan, the MCI coordinated with MITECO, and in close coordination with CIEMAT and CDTI, works in groups that address RIC needs in: solar photovoltaic energy, concentrated solar power, wind power, geothermal power, ocean technologies, carbon capture, storage and use, bioenergy and biofuels, batteries, new materials and technologies for energy efficiency in buildings, energy efficiency in industry, smart energy systems, smart and sustainable cities, etc.

To implement the 10 priority actions identified in the SET Plan, 14 Temporary Working Groups (TWGs) will be established with the mission of developing an implementation plan[54] for each of the technologies represented in each group. Spain participated in all the TWGs and led the one on Concentrated Solar Power (CSP).

Once the implementation plans were adopted, the TWGs were gradually replaced by the formation of Implementation Working Groups (IWGs). As with the Concentrated Solar Power TWG, Spain led the CSP Implementation Group.

b) Objectives

The SET Plan was developed based on the fifth pillar of the Energy Union, with the following priorities:

- Europe must be a global leader in the development of the next generation of renewable energies;
- we must facilitate the participation of consumers in the energy transition;
- efficient energy systems will be established;
- more sustainable transport systems will be promoted.

[53] To do this, the necessary actions and strategic priorities have been identified to accelerate the transformation of the energy system in an effective way, identifying duplication and synergies at European and national level, coordinating national and European efforts in research and project financing. We understand the SET Plan as a roadmap for coordinated research to develop a portfolio of technologies that are low in carbon emissions, clean, efficient, affordable and with large-scale market penetration.

[54] The Implementation Plans include the specific RDI actions needed to reach the stated objectives, and the financing and mechanisms needed for their implementation. This process is led by the countries participating in the SET Plan, in close collaboration with the EC and with a very active role by research centres and industry.

c) Mechanisms

Facilitate the launch of the actions identified in the SET Plan Implementation Plans.

As mentioned above, the future 2021-2028 Science, Technology and Innovation Strategy will include a Strategic Energy and Climate Action that will provide the necessary flexibility to facilitate international collaboration and the implementation of the lines of the SET Plan.

d) Responsible bodies

The MCI, coordinated with MITECO.

Measure 5.3. Network of Excellence in Energy and Climate

a) Description

The existing centres and units of excellence in our country stand out both for the quality of their scientific and technical research and for the strength of their collaboration with the productive fabric, giving them the character of strategic technological and innovation partners, with an outstanding impact on business investment in RDI.

The energy and climate network will constitute the platform for centres and units of excellence and will be used to exchange experiences and collaboration, optimise resources, disseminate results and promote research and innovation activities.

b) Objectives addressed

To strengthen the transfer and management of knowledge in open and flexible collaborative RDI environments in which the interaction, dissemination of ideas and adoption of shared objectives and models favours the development of new ideas and encourages their transfer to new commercial and non-commercial applications.

c) Mechanisms

- Cervera Transfer Project Programme for collaboration between companies and technology centres or innovation support centres at national level in Cervera priority technologies related to energy and climate[55].
- Cervera Aid Programme for technology centres or innovation support centres at national level in Cervera priority technologies related to energy and climate.
- Creation of an alliance of excellence in the technological offer in energy and climate formed by the different research bodies not included in the Cervera Network belonging to programmes of the State Plan (Severo Ochoa Centres, María de Maeztu Units of Excellence, and any future centres that may be created), as well as the Cervera Network itself related to energy and climate.

d) Responsible body

CDTI, AEI, MITECO and MCI.

[55] The Cervera Network mainly focuses on the development of R&D lines grouped into 10 thematic areas. Energy and climate are also found in a direct or indirect way in several of the proposed lines. Two aid programmes have been set up from these lines: for companies with technology centres/innovation support centres at a national level, and for networked clusters of technology centres/innovation support centres. Both instruments specify the participation of technology centres or innovation support centres at State level that are registered in the Technology Centre Registry. Research institutes are thus excluded from the Cervera Network.

Measure 5.4. Increasing, coordinating, improving and efficiently using scientific and technological infrastructure and equipment in energy and climate

a) Description:

The identification of synergies and scientific and technical capacity, and the coordination of national infrastructure (ICTS) with the main European research infrastructure (ESFRI) represents one of the strategic vectors of the Spanish RDI policy as it enables the available technology for energy services and products to be improved.

b) Objectives

- To promote the first level of RDI, supported by the network of unique scientific and technical infrastructures (ICTS) in Spain and the European Strategy Forum on Research Infrastructures (ESFRI) in which Spain participates.
- To support the development, consolidation, access and use of the research infrastructures by agents of the Spanish Science, Technology and Innovation System, as well as increasing the interest and participation of the private sector in RDI activities.
- To strengthen the capacity for RDI in the Spanish Science, Technology and Innovation System, and drive scientific and technical convergence between different regions through the development, maintenance and updating of the ICTS.
- To contribute to the progress of science and technological development through the launch and operation of research infrastructure, facilitating the processing, analysis and use of the data generated and promoting access and storage.
- To promote the interconnection between distributed and virtual research infrastructure (e-infrastructure), as well as the development of shared advanced services, contributing to European initiatives in this area.
- To support the purchase, maintenance and updating of the scientific and technical equipment needed for the execution of high-impact, relevant RDI activities.

c) Mechanisms

Aid for infrastructure and scientific and technical equipment through the State programme for generating knowledge and scientific and technological strengthening of the RDI system in the 2017-2020 State Plan on Scientific, Technical and Innovation Research. A programme of similar characteristics is planned in the next State Plans on Scientific, Technical and Innovation Research up to 2030.

d) Responsible body

AEI.

Measure 5.5. Public procurement in green innovation

a) Description

The public procurement of innovative technology consists of purchasing goods or services that do not exist at the time of acquisition, but that can be developed within a reasonable time period. This purchase requires the development of new or improved technology in order to meet the requirements of the acquirer.

Pre-commercial public procurement is a procurement of research and development services (R&D), fully paid for by the procuring entity, in which the public purchaser does not keep the results of the R&D for its own exclusive use, but shares with the companies the risks and benefits of the R&D needed to develop innovative solutions that go beyond what is available on the market.

The public procurement of innovation is set out in Article 44(3) of Law 14/2011 of 1 June 2011 on Science, Technology and Innovation. Moreover, Law 9/2017 of 8 November 2017 on Public Sector Contracts created two new procedures intended to promote the public procurement of innovation: the ‘partnership for innovation’ procedure and the ‘tender with negotiation procedure’.

This measure is aligned with the strategies for smart specialisation to improve knowledge exchange between political agents and interested parties, above all supporting the participation of SMEs.

b) Objectives addressed

- To develop the capacity of the administration to act as a driver of business innovation, managing its demand for products and services.
- To promote innovation from the demand side, i.e. strengthening innovative companies by incentivising the private sector to make proposals with greater added value to provide solutions for strategic government projects.
- To promote public-private collaboration.
- To improve public services.

c) Mechanisms

The public aid that forms part of the State Programme for RDI aimed at the social challenges of the 2017-2020 State Plan on Scientific, Technical and Innovation Research, is strengthened through other measures for promoting innovation, based on innovative public procurement instruments. Through the Horizon 2020 programme, the European Commission will subsidise the preparation and realisation of joint cross-border public procurement of innovative technology and pre-commercial public procurement.

Specifically, this refers to aid for the development of innovative products or services in the area of energy and climate acquired by public purchasers through the Innovative Public Procurement mechanism.

There are several types of financial support for which public buyers in Spain can apply: the INNODEMANDA and INNOCOMPRA programmes.

Innovative public procurement can also reinforce Measures 1.16 and 2.12 on public procurement in the areas of renewable energy and energy efficiency, respectively.

d) Responsible bodies

CDTI, the MCI; and the relevant public administrations.

Measure 5.6. Strengthening public venture capital for technology transfer in energy and climate

a) Description

Public venture capital is a financing instrument that facilitates the development and growth of companies based on new technological developments. For this reason, it is appropriate for the promotion of solutions to energy and climate challenges.

b) Objectives addressed

- To promote the venture capital industry as a driver of technological innovation.
- To strengthen the transfer of technology from public research centres to society.

c) Mechanisms

The **Public Venture Capital Firm – Innvierte**. It will launch two new funds to encourage the development of business innovation and entrepreneurship:

- Co-investment fund: Innvierte will participate in the capital of innovative companies with disruptive technologies.
- Technology Transfer fund: This fund will specialise in investing in early-stage science and technology-based companies, promoting the transfer of scientific knowledge to the productive fabric.

In line with initiatives at European level, Spain will test new financing focuses to support high-risk innovation with a major impact in the domain of clean energy (such as Priority Technology Initiatives, First of a Kind – FOAK – projects, etc.) in order to promote the entrepreneurial spirit and assimilation by the market of innovative low-carbon solutions that are efficient from an energy perspective.

d) Responsible bodies

CDTI, MCI and MITECO.

Measure 5.7. New instruments to support research and innovation in energy and climate

a) Description

Under the umbrella of the Strategic Action for Energy and Climate, it is proposed to develop new instruments to promote research and technological innovation.

The legislation on the energy sector, and in particular the electricity sector, has to evolve in order to facilitate the energy transition. These developments should facilitate the increasing expected contribution from distributed energy resources and the emergence of new players, such as active customers, for which digitalisation technologies are expected to play a key role.

One tool that has been developed in countries around us to test innovative product, service and business model concepts before translating them into the legislative framework has been to create regulatory demonstration projects, where, in a controlled space and under the supervision of the corresponding supervisory authority, hypotheses are verified and their impact evaluated, so that the legislation developed can be based on the lessons learned. In the framework of these regulatory demonstration projects, it is possible to temporarily suspend certain existing rules to be able to assess the potential for innovative solutions, without restrictions.

In this respect, Article 21 of the draft CNMC circular establishing the methodologies regulating the operation of the electricity generation market and the management of the system’s operation includes a proposal on regulatory demonstration projects that is fully aligned with this measure.

Another added advantage of this type of project is its capacity to retain and attract talent in the field of innovation (business, university, etc.) at national level, in the ecosystem formed to develop testing.

On the other hand, in the context of new energy and climate priorities and actions, industrial policy will be affected by new profiles of demand for raw materials that will change significantly, and it must be ensured that innovations in the field of advanced technologies are not hampered by the unavailability or volatility of mineral raw materials on the market.

b) Objectives addressed

- To develop new instruments appropriate to the particular needs of the technological development for energy transition and the fight against climate change.
- To promote the development and financing of projects to foster RDI activities in the management of natural resources, raw materials and adaptation to climate change.

c) Mechanisms

The new mechanisms and instruments considered include:

- **Technology demonstrators**: to facilitate the incorporation of innovative technologies and test their manageability in a real environment, making use of the tendering mechanisms established in this Plan. Specific procedures for administrative authorisation will also be developed in accordance with Measure 1.18 of this Plan.
- **Regulatory demonstration projects (sandbox):** The appropriate regulatory framework will be developed that will include, inter alia, the participation rules (including the general requirements for access and the general framework of testing protocols to be concluded between the promoter and the competent authority), the system of guarantees and protection for participants, and the exit and post-project effects rules.
- **Micro-Missions**: Research and development projects aimed at overcoming specific technical and economic limitations of new energy technologies and solutions for climate change.
- **Blockchain and climate change**. In four areas: ensuring the traceability of products in supply chains that are currently complex and opaque; automating and strengthening the monitoring, reporting and verification (MRV) of the environmental impact of projects; environmental impact of cryptocurrencies and the creation (or participation if any exist) of a coalition between companies, start-ups, research centres and agencies that are working at the intersection between blockchain and climate change.
- Raw materials: Research projects aimed at updating the information on raw material reserves in Spain and their future demand according to technological needs.

d) Responsible bodies

CDTI, AEI, MCI, REE, MITECO, Biodiversity Foundation (*Fundación Biodiversidad*), Geological and Mining Institute of Spain (*Instituto Geológico y Minero de España* – IGME).

Measure 5.8. Social innovation for the climate

a) Description

Climate change is generating new and unpredictable social, environmental and economic scenarios. Citizen science and social innovation, placed at the service of the new challenges, generate opportunities for constant improvement. Indeed, social innovation is key to fulfilling the Agenda 2030 and addressing challenges such as the energy transition and the climate crisis**.** In this respect, collaborative consumption, product durability and the prevention of programmed obsolescence, together with intelligent management of technological innovation, offer possible paths in this direction.

b) Objectives addressed

- To support the realisation of social and urban innovation projects, understood as the development, implementation and/or validation of innovative methodologies or technologies aimed at solving climate problems.
- To promote information, dissemination, awareness and sensitisation actions aimed at the acquisition of habits and attitudes in line with efficiency, sustainability, co-responsibility and cooperation.
- Use of methodologies such as: new participatory research approaches and best practices; green nudges; gamification/games; design thinking.
- Urban transformation through the social economy that seeks to promote productive initiatives by focusing on five sectors: mobility, production, consumption, energy and care.

c) Mechanisms:

- Creation of creative proposals/calls based on science.
- Promoting an alliance between clusters, researchers and entrepreneurs in social innovation for the climate.
- Promoting collaborative crowdfunding to boost eco-entrepreneurs for the climate.

d) Responsible bodies:

MCI, MITECO, IDAE, Biodiversity Foundation, Autonomous Authority for National Parks (*Organismo Autónomo Parques Nacionales* – OAPN).

Measure 5.9. Reducing bureaucracy and administrative burdens

a) Description

In the public actions managed by the different ministerial departments with competences in science and technology, the participation of different executing agents in research and development activities is common.

The bureaucratic procedures and administrative burdens required for the financing and implementation of the various projects related to research and innovation in the fields of climate change, energy, biodiversity, the green economy and employment may be limiting and may not facilitate a rapid and effective response to the constant changes and developments in these fields.

Excessive organisational obstacles not only hinder the progress of scientific research and technological innovation and demonstration activities, but also cause a drain of talent and knowledge, due to competing at international level with universities and research centres with more resources and funding.

b) Objectives addressed

To achieve the science, technology and innovation budget targets set in the INECP by ensuring agility, flexibility and stability as well as public investment in climate and energy science, technology and innovation.

To **promote the incorporation of talent** in organisations and entities in the field of RDI in energy and climate, encouraging the best researchers and technologists to join and consolidate their careers, in a context of budgetary and financial stability and to focus their efforts on achieving the objectives of research, development and innovation.

c) Mechanisms

- Making the hiring of labour staff by executing agents more flexible, in order to speed up the management of labour contracts made by these bodies and the duration of these contracts over the time horizon of the projects.

- In the area of economic and financial management, the internal control of the agents will be the ongoing financial control.

d) Responsible bodies

MCI, MITECO and relevant public administrations.

Measure 5.10. Relaunching CIUDEN, the City Foundation for Energy

a) Description

The Foundation was created in 2006. It is an organisation attached to the Government of Spain to execute RDI programmes related to energy and the environment and to contribute to economic development in the district of El Bierzo (province of Leon).

b) Objectives addressed

Promotion of Just Transition actions and promotion of economic and social development and employment in the mining districts of Castile and Leon through research actions and activities in renewable energies and energy storage and efficiency.

c) Mechanisms

- Focusing the research action of CIUDEN.
- Align the CIUDEN Plan for economic and technological transformation with the Just Transition Strategy (see Measure 1.15), so that it can play a significant role in revitalising the mining areas of Castile and Leon, while also acting as the body representing the policy of MITECO on the issues it considers necessary in order to achieve these objectives in other areas.
- Creation of a Strategic Assessment Committee that will develop an action plan where the development of new renewable energies will play an important role and where institutions, companies and local agents will be called on to get involved.

d) Responsible bodies

MITECO.

Measure 5.11. Information system on Science, Technology and Innovation for monitoring financing

a) Description

Article 11 of Law 14/2011 of 1 June 2011 on Science, Technology and Innovation establishes the creation of the Information system on Science, Technology and Innovation (*Sistema de Información sobre Ciencia, Tecnología e Innovación* – SICTI) as an instrument for capturing data and analysis for the development and monitoring of the Spanish Science, Technology and Innovation Strategy, and its implementing plans.

All the public aid granted under the State Plans for Scientific, Technical and Innovation Research, as well as the information about the beneficiaries of this aid, will be included in the abovementioned Information system.

The State Plans, through the corresponding Annual Action Plans, as well as the financing planned during this year, will include indicators for monitoring these actions. These indicators will determine the level of achievement of the objectives defined for each action and may have a short-, medium- or long-term temporal component.

b) Objectives addressed

To achieve detailed monitoring of the resources used for research and innovation in energy and climate and the actual impact achieved.

c) Mechanisms

Annual Action Programme for RDI activities.

d) Responsible bodies

The MCI in coordination with the ministerial departments with RDI activities.

Measure 5.12. RIC to adapt the Spanish energy system to climate change

a) Description

In the field of adaptation, the major themes in RIC continue to revolve around two essential components: **I)** the recognition of risks and impacts arising from climate change and **II)** the development and testing of adaptive solutions.

b) Objectives addressed

In order to adapt the Spanish energy system to climate change, it is considered necessary to develop specific RDI in the following areas:

In energy production:

- Estimation of the impact on renewable energy production potentials, with special attention to hydropower and biomass production.
- Development of electricity supply infrastructures capable of withstanding a greater incidence of extreme climate events and promotion of specific adaptation programmes for those that are currently most vulnerable.
- Due to the decrease in river flows, development of thermoelectric plants with alternative or more efficient cooling systems.

In transport, storage and distribution of energy:

- Development of new electricity distribution materials with greater inertia against high temperatures.
- Development of gas or oil product distribution infrastructures with greater resilience to extreme events.
- Modelling of the new peaks in the demand for electricity and the energy supply mixes needed to meet it.

c) Mechanisms

These RIC objectives are part of the current 2017-2020 State Plan for Scientific, Technical and Innovation Research, which already includes areas such as the design of flexible management networks and systems that should be part of the future 2021-2024 State Plan for Scientific, Technical and Innovation Research.

d) Responsible bodies

MITECO together with the MCI.

Measure 5.13. Unique long-term programmes on science and technology that are strategic in the area of energy and climate

a) Description

It is necessary to encourage stable cooperation, in terms of RDI, between companies and public and private research bodies, in order to carry out large projects that increase the scientific and technological capacity of national research groups, and position them to have more efficient access to international research programmes.

The Singular and Strategic Projects are a set of interrelated RDI activities that promote the integration of scientific and technological agents and promote technology transfer. They include generic research activities, technological developments, technology demonstration, dissemination and implementation of complementary actions aimed at promoting the implementation of the results obtained.

They must be projects that meet the requirement of uniqueness, due to their objective, approach or the destination of the results, and they must be strategic in nature as a result of the benefit they seek, either because they encourage the competitiveness of the productive sector or because of their socio-economic interest on the domestic scene.

b) Objectives addressed

To mobilise greater participation of small and medium-sized enterprises in major industrial research projects.

To extend the culture of stable and medium-term cooperation in research and technological development between the agents of the science-technology-business system.

To extend and optimise the joint use, by companies, public research organisations and innovation and technology centres, of existing public and private research infrastructures in Spain.

c) Responsible bodies

MCI, MITECO and competent administrations.

Measure 5.14. Increasing Spanish participation in European research and innovation funding programmes

a) Description

There are a large number of European, national and regional policies and instruments to promote innovation and inter-regional cooperation on energy and climate (inter alia, the European Fund for Strategic Investments, the InvestEU programme, the innovation fund, Horizon Europe).

Spain participates in collaborative and competitive international research and development programmes and is the country with the fourth highest level of participation in the European Commission's RDI programme (Horizon 2020).

In the area of energy and climate, Spain is the second most active country in the societal challenge 'Climate action, environment, resource efficiency and raw materials' and the third in Societal Challenge 3, 'Secure, Clean and Efficient Energy'.

b) Objectives addressed

To facilitate and promote the successful participation of research groups and companies in our country in international programmes for the promotion of RIC and to continue collaborating in European and transnational research efforts and projects.

c) Mechanisms

- Designation of National Contact Points (NCPs): to facilitate and encourage the participation of Spanish entities in European research and innovation funding programmes in the area of energy and climate (Horizon Europe, LIFE, Innovation Fund), National Contact Points will be designated both horizontally (legal and financial affairs NCPs) and thematically.
- Support for the participation of Spanish research groups in European energy and climate forums.

d) Responsible bodies

MCI and MITECO.

Measure 5.15. Supporting the participation of Spanish research groups in international energy and climate forums

a) Description

The Council decision on Horizon 2020 explicitly includes the contribution to multilateral processes and initiatives in its Annex I, point 2 on Complementary and cross-cutting issues and supporting measures. In Societal Challenge 5, 'Climate action, environment, resource efficiency and raw materials', Horizon 2020 re-emphasises that the activities will enhance the European Union's participation in and contribution to multilateral processes and initiatives.

b) Objectives addressed

To support the participation of Spanish research groups in international energy and climate forums. To contribute to multilateral processes and initiatives in this regard.

c) Mechanisms

Creation of support lines for the participation of Spanish research groups in international forums, beyond the European ones, on energy and climate.

d) Responsible bodies

MCI and MITECO.

Measure 5.16. Promoting the Mission Innovation initiative

a) Description

In parallel to the COP21 climate conference in Paris, world leaders launched Mission Innovation, an international partnership to accelerate clean energy innovation and provide a long-term global response to the challenges of climate change. By joining Mission Innovation, 23 countries and the European Commission (on behalf of the EU) committed to doubling funding for clean energy research and innovation up to around USD 30 billion per year by 2021.

On the same occasion, a group of investors from 10 countries announced their intention to bring innovation from the laboratories to the market by investing an unprecedented volume of long-term capital in initial technology development projects in the Mission Innovation member countries, giving rise to the Breakthrough Energy coalition.

In December 2017, during the One Planet Summit in Paris, Breakthrough Energy announced the testing of public-private partnerships with five members of Mission Innovation, including the European Commission.

b) Objectives addressed

To promote public-private partnerships in climate and energy transition financing.

c) Mechanisms

Encouraging and promoting the participation of Spanish companies in the Breakthrough Energy Coalition.

Encouraging and promoting the participation of investors in the Breakthrough Energy Coalition.

d) Responsible bodies

MCI and MITECO in collaboration with the relevant public administrations.

Measure 5.17. European innovation financing mechanisms

a) Description

There are a large number of European, national and regional policy programmes and instruments to encourage innovation and promote inter-regional cooperation on energy and particularly on climate, inter alia, the European Fund for Strategic Investments (EFSI).

b) Objectives addressed

Mobilisation of European funds to finance the RIC dimension of the INECP.

c) Mechanisms

- The **European Fund for Strategic Investments 2.0** focuses on investments in all sectors in order to contribute to achieving the objectives of the Paris Agreement and help realise the transition to an economy that is efficient in the use of resources, circular and low in carbon. At least 40% of the EFSI projects under the infrastructure and innovation chapter should contribute to the fulfilment of the EU climate action commitments. The **InvestEU** programme will strengthen this focus.
- In line with initiatives at European level, Spain will test new financing focuses to support high-risk innovation with a major impact in the domain of clean energy (such as Priority Technology Initiatives, First of a Kind – FOAK – projects, etc.) in order to promote an entrepreneurial spirit and assimilation by the market of innovative solutions that are efficient from an energy perspective.
- The **Innovation Fund**, within the framework of the EU emission trading scheme, will support the demonstration on a commercial scale of advanced technologies in the area of renewable energies and energy efficiency in industry.

d) Responsible bodies

MCI and MITECO in collaboration with the relevant public administrations.

Measure 5.18. International cooperation

a) Description

Global challenges require a global response based on cooperation between governments. The decarbonisation of energy systems is an international priority and there is a proliferation of initiatives that jointly address certain aspects of the energy transition.

b) Objectives addressed

To optimise Spanish participation in international RIC forums on energy and climate issues.

c) Mechanisms

- **Mission Innovation – Accelerating the Clean Energy Revolution**
  Spain intends to apply to participate in Mission Innovation (MI) Energy, a global initiative of 23 countries and the European Union to accelerate innovation on clean energy. As part of the initiative, the participating countries have agreed to try to double their governments' investment in that area for five years, while encouraging higher levels of private sector investment in renewable technologies.

- **Cooperation with Latin America**
  Creation of thematic networks and strategic projects for RDI, in cooperation with Latin American countries, in practically all areas of renewable energies, micro-networks and storage. These projects are mainly carried out under the framework of the Ibero-American Programme of Science and Technology for Development (CYTED) or the common interest group of Europe and the Community of Latin American and Caribbean States (EU-CELAC) through joint actions financed by the various funding agencies for science, technology and innovation.

  In addition, Spain currently participates in various programmes of technical cooperation and technological development in countries of Latin America and the Caribbean, Asia and Africa in the fields of renewable energies, environment and purification and detoxification of water. It carries out special activity in thematic networks for knowledge exchange and development of projects, mainly in the fields of renewables and micro-networks.

  Spain also participates in the EUROCLIMA programme, a regional programme financed by the European Union that contributes to improving the knowledge of political decision-makers in Latin America on the problems and consequences of climate change. In its current phase, EUROCLIMA+ includes thematic areas such as the resilient production of food aimed at Universities and national and regional research organisations, among other bodies.

- **Cooperation within the framework of the United Nations**
  CIEMAT leads Capacity Creation projects within the framework of the United Nations (UNIDO), for the promotion of renewable technologies, energy-efficient systems, mitigation and resilience measures on climate change in Small Island Developing States in the Pacific, the Caribbean, Africa and the Indian Ocean.

d) Responsible bodies

MCI and MITECO.

As well as the stated measures, coordination with the business sector and the promotion of public-private collaboration is essential. One of the actors in this context will be the Alliance for Energy Research and Innovation (ALINNE).

The 2008-2011 RDI Plan recognised energy and climate change among the five strategic actions that ‘must be coordinated through specific actions that address a collection of instruments and programmes in an integrated way (human resources, projects, infrastructure, etc.) to achieve the proposed objectives’. In the successive annual work programmes, this commitment was reiterated, emphasising the need to group and coordinate the various programmes in a common strategy, improving coordination both with European programmes and the autonomous communities. To achieve these objectives, the ALINNE initiative was created.

Currently, ALINNE is a non-profit initiative to combine and coordinate efforts among all the agents of the RDI energy value chain to provide a response to the main challenges of RDI policy in the energy sector, contributing to the definition of work guidelines at national and European level. The consideration of a Strategic Action on Energy and Climate is reviving the source of this initiative, whose activity is recognised and considered in the INECP.

3.6 INTERLINKAGES BETWEEN POLICIES AND MEASURES

This chapter has presented the different policies and measures as appropriate to the implementation category in line with the dimensions considered in the Regulation on the Governance of the Energy Union and Climate Action. However, there are synergies between all the measures set out in this Plan, as the dimensions of decarbonisation, energy efficiency, security of supply, internal market and research, innovation and competitiveness are interrelated.

Throughout the Plan, ‘***energy efficiency first***’ has been considered one of its guiding principles, since an increase in energy efficiency leads to a reduction in energy needs, contributing, in turn, to the decarbonisation of the system, through the reduction of emissions, as well as to the reduction of energy dependency. In turn, a smaller scaling of energy needs in the productive sectors increases competitiveness by reducing energy costs and contributing to the internal market dimension.

In the matrix of interlinkages between policies and measures presented in this section, it can be seen that the research, innovation and competitiveness dimension cuts across all other dimensions, since any improvement in these aspects will help to achieve the objectives set.

Table 3.4. Interlinkages between policies and measures

			Decarbonisation						Energy efficiency					Energy security			Internal energy market					RIC
			GHG emissions		Renewable energy																	
			ETS	Non-ETS	%	RES-T	RES-H&C	RES-E	Services and public sector	Industry	Transport	Residential	Agriculture	Energy dependency reduction	Fossil importation reduction	Security of supply	Administrative simplification	Interconnections	Transport and distribution networks	Energy cost	Energy poverty	
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Decarbonisation	1.1	Development of new facilities for generating electricity using renewables																				
	1.2	Demand management, storage and flexibility																				
	1.3	Adaptation of electricity grids to integrate renewables																				
	1.4	Development of own consumption using renewables and distributed generation																				
	1.5	Incorporation of renewables in the industrial sector																				
	1.6	Framework for the development of thermal renewable energies																				
	1.7	Advanced biofuels in transport																				
	1.8	Promotion of renewable gases																				
	1.9	Plan for the technological upgrading of existing electricity generation projects with renewable energies																				
	1.10	Promotion of bilateral renewable electricity contracts																				
	1.11	Specific programmes for the use of biomass																				
	1.12	Unique projects and strategy for sustainable energy on the islands																				
	1.13	Local energy communities																				
	1.14	Promoting the proactive role of citizens in decarbonisation																				
	1.15	Just Transition Strategy																				
	1.16	Public procurement of renewable energy																				
	1.17	Training professionals in the renewable energy sector																				
	1.18	Revision and simplification of administrative procedures																				
	1.19	Generating knowledge, outreach, awareness and training																				
	1.20	EU Emissions Trading System																				
	1.21	Reduction of greenhouse gas emissions in the agricultural and livestock sectors																				
	1.22	Reduction of greenhouse gas emissions in waste management																				
	1.23	Reduction of fluorinated greenhouse gas emissions																				
	1.24	Forest sinks																				
	1.25	Agricultural sinks																				
	1.26	Taxation																				

			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
			ETS	Non-ETS	%	RES-T	RES-H&C	RES-E	Services and public sector	Industry	Transport	Residential	Agriculture	Energy dependency reduction	Fossil importation reduction	Security of supply	Administrative simplification	Interconnection	Transport and distribution networks	Energy cost	Energy poverty	**RIC**
Energy efficiency	2.1	Low-emission zones and modal shift measures																				
	2.2	More efficient use of the means of transport																				
	2.3	Renewal of the vehicle fleet																				
	2.4	Promotion of electric vehicles																				
	2.5	Improvements in the technology and management systems of industrial processes																				
	2.6	Energy efficiency in existing buildings in the residential sector																				
	2.7	Renewal of residential equipment																				
	2.8	Energy efficiency in services sector buildings																				
	2.9	Energy efficiency for cooling equipment and large air-conditioning systems in the services sector and public infrastructure																				
	2.10	Energy efficiency in farms, irrigation communities and agricultural machinery																				
	2.11	Promotion of energy services																				
	2.12	Public sector: proactive responsibility and energy-efficient public procurement																				
	2.13	Energy audits and management systems																				
	2.14	Training professionals in the energy efficiency sector																				
	2.15	Communication and information concerning energy efficiency																				
	2.16	Other measures to promote energy efficiency: transition to high efficiency cogeneration																				
	2.17	Financial measures: National Energy Efficiency Fund																				
Energy security	3.1	Maintenance of minimum security stocks of petroleum products and gas																				
	3.2	Reducing dependency on petroleum and carbon in the islands																				
	3.3	Alternative fuel recharging points																				
	3.4	Promoting regional cooperation																				
	3.5	Extension of contingency plans																				
	3.6	Planning for safe operation of a decarbonised energy system																				

			1 ETS	2 Non-ETS	3 %	4 RES-T	5 RES-H&C	6 RES-E	7 Services and public sector	8 Industry	9 Transport	10 Residential	11 Agriculture	12 Energy dependency reduction	13 Fossil importation reduction	14 Security of supply	15 Administrative simplification	16 Interconnections	17 Transport and distribution networks	18 Energy cost	19 Energy poverty	20 RIC
Internal Market	4.1	Increased electricity interconnection with France																				
	4.2	Increased electricity interconnection with Portugal																				
	4.3	Electricity transmission infrastructure other than the 'Projects of Common Interest' (PCIs)																				
	4.4	Integration of the electricity market																				
	4.5	Protecting electricity consumers and increasing competition																				
	4.6	Data access																				
	4.7	Integration of the gas market																				
	4.8	Protection of gas consumers																				
	4.9	Improving the competitiveness of the retail gas sector																				
	4.10	Development plan for gas demand management																				
	4.11	Combating energy poverty																				
Research, innovation and competitiveness	5.1	Strategic action on energy and climate																				
	5.2	Implementation of the SET Plan																				
	5.3	Network of Excellence in Energy and Climate																				
	5.4	Increasing, coordinating, improving and efficiently using scientific and technological infrastructure and equipment in energy and climate																				
	5.5	Public procurement in green innovation																				
	5.6	Strengthening public venture capital for technology transfer in energy and climate																				
	5.7	New instruments to support research and innovation in energy and climate																				
	5.8	Social innovation for the climate																				
	5.9	Reducing bureaucracy and administrative burdens																				
	5.10	Relaunching CIUDEN, the City Foundation for Energy																				
	5.11	Information system on Science, Technology and Innovation for monitoring financing																				
	5.12	RIC to adapt the Spanish energy system to climate change																				
	5.13	Unique long-term programmes on science and technology that are strategic in the area of energy and climate																				
	5.14	Increasing Spanish participation in European research and innovation funding programmes																				
	5.15	Supporting the participation of Spanish research groups in international energy and climate forums																				
	5.16	Promoting the Mission Innovation initiative																				
	5.17	European innovation financing mechanisms																				
	5.18	International cooperation																				
		Totals	49	46	59	35	38	50	43	40	39	38	36	60	59	58	26	12	23	48	15	37

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

4 IMPACT ANALYSIS OF POLICIES AND MEASURES

4.1 Introduction

This section includes the main results obtained in the evaluation of the economic, employment, social and public health impact of the measures and actions envisaged in this Plan.

The study, following the Governance Regulation, differentiates between a Baseline Scenario (with no additional measures) and a Target Scenario (with additional measures). In the Baseline Scenario, by 2030 the greenhouse gas (GHG) emissions in Spain increase by 5.6% compared to 1990, while they decrease by 23% in the Target scenario.

The impact analysed in this study is the effect of the policies and measures established in the INECP that make it possible to achieve this decarbonisation objective, together with the other measures associated with the other dimensions of the INECP.

4.2 Methodology

The analysis of the economic impact of the INECP has been carried out using the DENIO economic model, which uniformly integrates the information from the policies introduced in the TIMES-SINERGIA energy model. The main results of this analysis are presented in this section. However, there is a more complete and exhaustive study that includes all the information related to the economic impact and that is available to the public[56].

DENIO is a Dynamic Econometric Input-Output model of the Spanish economy, which has its origin in the FIDELIO model from the European Commission's Joint Research Centre (JRC). The model was developed by the Basque Centre for Climate Change (BC3) in collaboration with the Centre of Economic Scenario Analysis and Research (CESAR). This model makes it possible to simulate the effect of a wide range of economic, fiscal, energy or environmental policies.

DENIO is characterised by a detailed description of the Spanish economy in terms of sectors (74 sectors), households (22,000 households representative of the national population) and 16 consumption categories. The model also includes detailed public sector accounts, including the income and expenditure of the public administrations, as well as the deficit and public debt. This model was estimated econometrically using the latest data available from the National Statistical Institute, the Bank of Spain and EUROSTAT.

In addition, the information about the changes in air pollutant emissions (obtained by the Inventory Unit of MITEC]), was entered in the TM5-FASST air quality model. The TM5-FASST model is a global model developed by the JRC that makes it possible to analyse the effects, in terms of health, resulting from different emissions scenarios or paths. Using meteorological and atmospheric chemistry information, the model analyses how the atmospheric emissions from a certain source generate concentrations of pollutants, exposure in the population and, consequently, damage to health and premature deaths.

[56] The full study is available on the MITECO website: https://www.miteco.gob.es/es/

The model has previously been used by BC3 to conduct studies on co-benefits of mitigation for health together with the World Health Organization (WHO). Moreover, inter alia, it has been used by the Organisation for Economic Co-operation and Development (OECD) to project the economic costs associated with air pollution. In this work, and to be consistent, the model has been calibrated with the harm to health reported by the WHO in Spain.

A brief technical description of the DENIO (together with the integration of the microeconomic information into the model) and TM5-FASST models can be found in Annex B of the INECP.

Finally, as in any prospective study, it has been necessary to make different assumptions and projections for 2030. For example, the evolution of GDP and population up to 2030 has been taken directly from the macroeconomic scenario prepared by MINECO. Moreover, the projections for 2030 regarding investment costs for renewables, the prices of energy goods and CO_2 allowances are those recommended by the European Commission for all Member States for the preparation of their respective INECPs. The variation in the cost of electricity has been estimated by REE, based on data provided by the State Secretariat for Energy.

4.3 ESTIMATED INVESTMENTS FROM THE INECP, 2021-2030

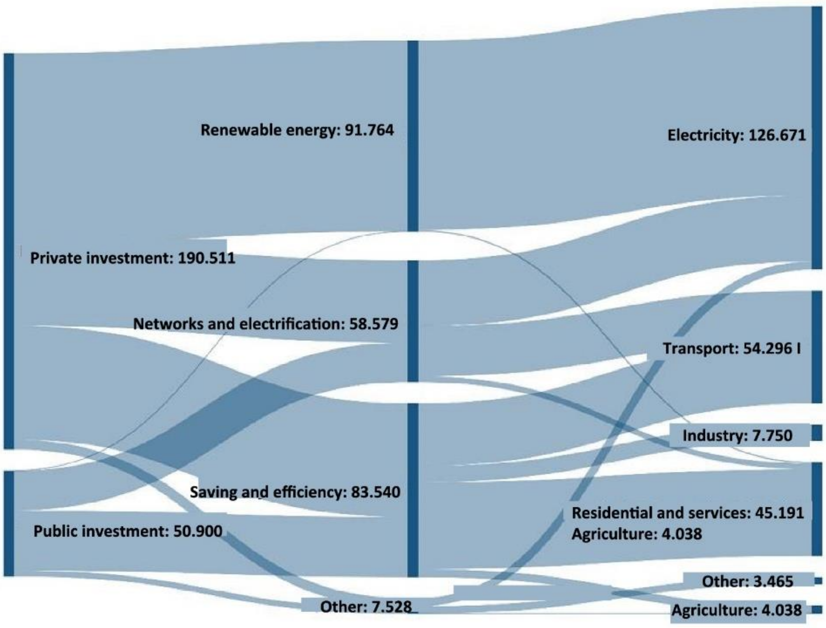
A very significant part of the economic impacts results from the (additional) investments associated with the INECP. These investments have been quantified using different sources. The investments associated with energy-saving measures and energy efficiency come from the IDAE. The investments associated with renewables and heat pumps come from estimates made by the State Secretariat for Energy using the TIMES-SINERGIA model. The information on investments in transmission and distribution networks and interconnections comes from different sources, including REE. The information regarding the investment of the non-energy non-ETS sectors comes from the Spanish Office for Climate Change (*Oficina Española de Cambio Climático*). BC3 has made the appropriate estimations for any matters regarding which there was no information, as is the case of the investments in recharging points or investments associated with the electrification of transport.

Once this information is added, it is estimated that **the total investments needed to achieve the INECP targets will amount to EUR 241 billion (€ bn) between 2021 and 2030**. These investments can be grouped by measures or core levers of the energy transition, and would be distributed as follows (see Figure 4.1):

- Saving and efficiency: 35% (€83.540 bn)
- Renewable energy: 38% (€91.765 bn)
- Networks and electrification: 24% (€58.579 bn)
- Other measures: 3% (€7.528 bn)

Of these total investments, €196 bn can be considered as additional investments compared to the Baseline. These additional investments are those that can be imputed to the INECP and those that will therefore generate the economic impact. The total and additional investments differ because in the Baseline Scenario there are also investments such as in the case of renewables in the electricity sector, for example, where an installation with new renewable capacity is being considered to meet the increase in demand and also the investments in associated networks.

Figure 4.1. Flow of investments from the INECP (€ bn)



Source: Basque Centre for Climate Change, 2019

Taking the source of the investments into account, **a very substantial part of the total investment would be made by the private sector (80% of the total)**, mainly linked to the deployment of renewables, distribution and transmission networks, and a large part of the saving and efficiency measures. The rest would be made by the **public sector (20% of the total)**, in energy saving and energy efficiency measures, and in actions associated with promoting sustainable mobility and modal shift. In the case of public sector investments, a portion is expected to come from European funds.

4.4 RESULTS

The results obtained come from adding the flow of additional investments, the energy mix and the energy prices from the TIMES-SINERGIA model to the DENIO model. Before explaining the main results, it is important to make three preliminary considerations:

- The investments made using public funds (except investment from European sources) must be financed using other budget lines so that they make it possible to maintain the budgetary equilibrium. The analysis done has been included in the deficit-reduction path agreed in the Stability and Growth Pact, which entails reducing the deficit to zero in 2022 and then maintaining the budgetary equilibrium to also reduce the public debt on the path set out to 2032. Likewise, in the case of households, it is assumed that the total amount of indebtedness remains constant and that, therefore, the additional investments made by households are financed through savings or by reducing spending.

- It is considered that there are no restrictions on investment for companies and that investment will take place at the usual cost of capital. This is compatible with medium- and long-term regulation and planning that provides security and certainty to investors. Moreover, it is considered that these additional investments do not 'crowd out' other investments from the private sector. This is consistent with the current situation in Spain, which has a high idle capacity and unemployment rate, and, in general, with the situation in the euro area, which has historically low interest rates.

- The study assumes that the degree of external competitiveness does not change. In other words, companies maintain a capacity to respond to market conditions that is similar to the current one, not higher or lower, in a context where other neighbouring countries are also introducing policies geared towards complying with the Paris Agreement.

4.4.1 Macroeconomic impacts

The macroeconomic impacts are determined by two main effects. The first is the 'new investment' effect, which generates an economic boost throughout all the sectoral supply chains. The second is the effect resulting from the 'energy shift': this includes the economic boost resulting from the energy saving (including the reduction in the price of electricity), which makes it possible to increase spending on other products and services, and from the shift in the energy mix, which replaces imported fossil fuels with renewables that generate greater added value within the country.

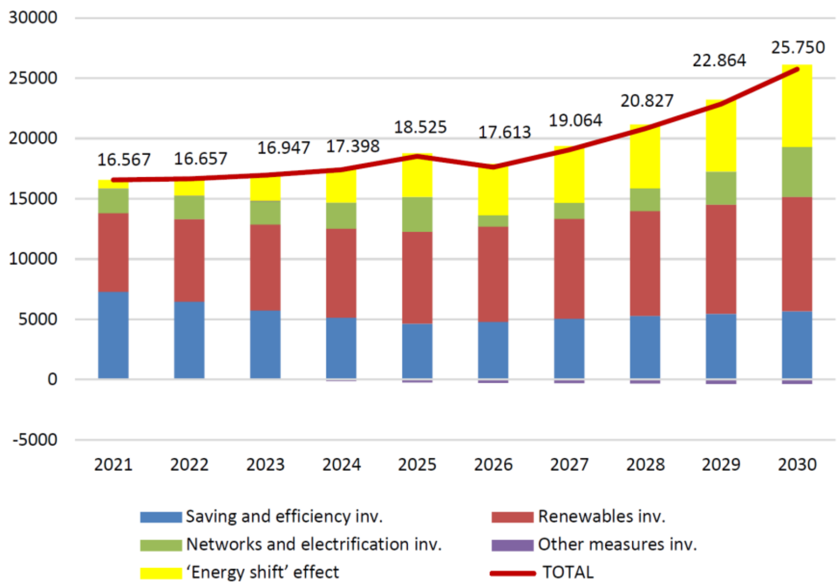
- The **'new investment'** effect produces a very notable impact, especially in the initial years of the Plan. It is important to note that not every investment turns into added value and job creation, since one part (around 20% and depending on the sectors) requires goods that are imported, something the model allows for capturing in detail and that is included in the results. Moreover, the impact of the investments is not permanent; it will only take place during the years in which the investments are implemented.

- The **'energy shift' effect** also creates a result that is more pronounced towards 2030, when the policies are encouraging the reduction of energy consumption and energy prices are higher. In fact, fossil fuel imports are reduced by EUR 67 billion between 2021 and 2030 compared to the Baseline Scenario. These impacts, unlike those associated with the investments, do remain over time.

Figure 4.2 shows the effect on GDP disaggregated by measure type; the impact associated with the INECP is the difference between the GDP in the Target scenario compared to the Baseline.

The INECP will generate an increase in GDP between EUR 16.5 and 25.7 bn per year (1.8% of GDP in 2030). The positive impact comes mainly from the economic boost generated by new investments in renewables, savings and efficiency, and networks, and from the effects of the 'energy shift' that generate an increasing impact at the end of the decade.

Figure 4.2. Impact on GDP by measure type (€ m)



Source: Basque Centre for Climate Change, 2019

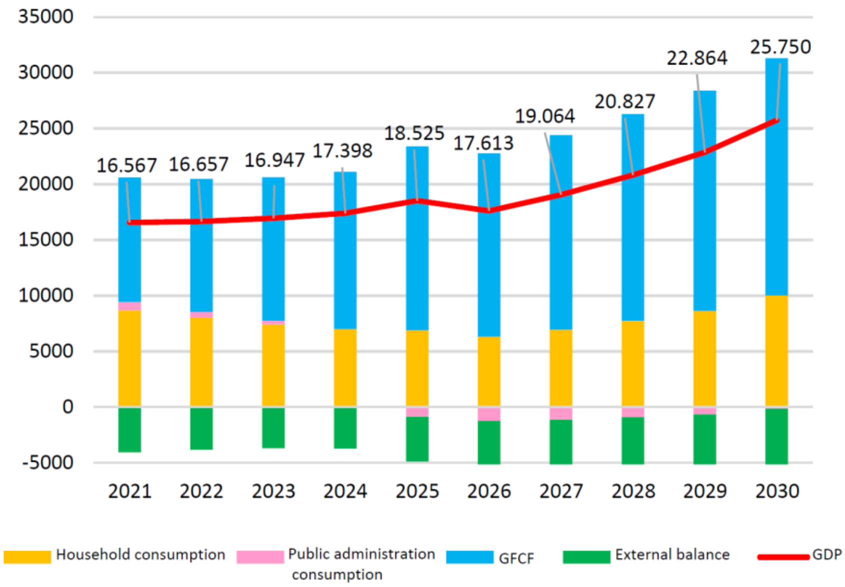
Figures 4.3, 4.4 and 4.5 show the impacts on GDP from the demand side, supply side and income side.

The GDP from the demand side (Figure 4.3) shows that the increase in GDP is mainly channelled towards gross fixed capital formation (GFCF), as could be expected given the investments considered in the Plan. Household final consumption also increases steadily since the increase in GDP resulting from the investments generates an increase in compensation of employees and in the gross operating surplus, which, in turn, has a positive impact on household disposable income and household consumption.

There is also a positive impact on public administration consumption as the increase in tax revenue makes it possible to increase spending, keeping the deficit constant.

Finally, the negative external balance simply reflects the closing hypothesis of the chosen model in which exports remain constant, while imports grow thanks to the increase in economic activity. The exception is energy imports, which decrease due to lower domestic consumption of coal and oil.

Figure 4.3. Impact on GDP: demand (€ m)



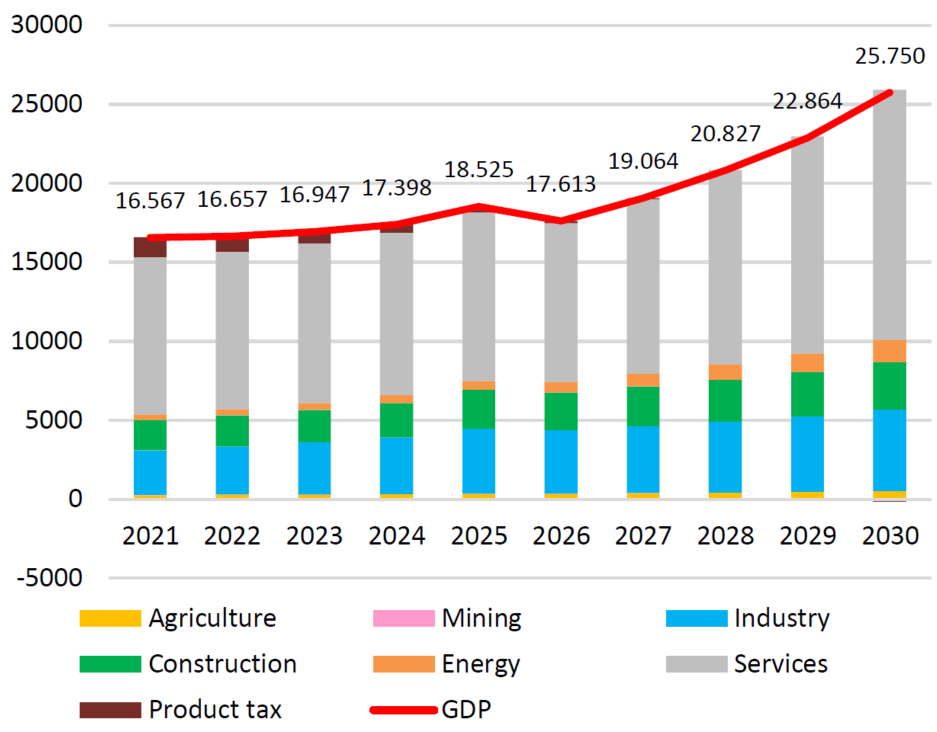
Source: Basque Centre for Climate Change, 2019

Figure 4.4 shows the change in GDP based on the supply side, which makes it possible to see the sectors where this increase in added value originates.

Firstly, a net increase should be noted in all major sectors, with the sole exception of mining. **The added value of the industrial sector grows substantially** (between EUR 2.8 bn in 2021 and EUR 5.1 bn in 2030), mainly boosted by the deployment in renewables, networks and electrification of transport and renewal of the vehicle fleet. The energy sector also increases its activity due to replacing imported energy with indigenous renewable energy (between EUR 345 m and EUR 1.4 bn). The value added of the construction sector also increases notably (between EUR 1.9 bn in 2021 and EUR 3 bn in 2030) as a result of the investments in housing upgrades and the development of all the infrastructure needed to develop renewables or electric vehicles.

Finally, the service sector takes up a significant part of the increase in the added value given its weight in the Spanish economy (it represents 65% of the GDP). This increase in activity is explained by the increase in the services directly associated with the Plan, and also by the indirect and knock-on effect resulting from the increased economic growth.

Figure 4.4. Impact on GDP: supply (€ m)



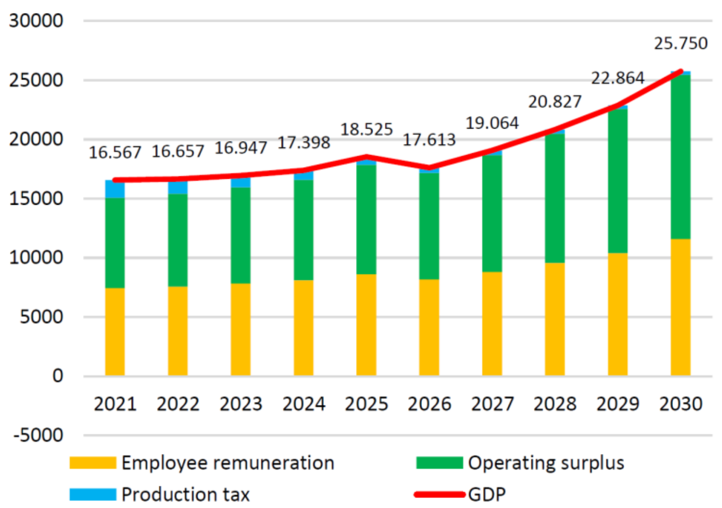
Source: Basque Centre for Climate Change, 2019

Finally, the impact on GDP based on the income side (Figure 4.5) makes it possible to see the distribution of income generated between capital and labour.

Gross operating surplus increases notably (between EUR 7.6 bn and EUR 13.8 bn) since part of the impact comes from investments channelled towards capital-intensive industries (industry, construction, energy).

Employee remuneration also increases very significantly (between EUR 7.4 bn and EUR 11.5 bn) mainly as a result of job creation. Finally, it should be noted that the gross operating surplus also includes mixed incomes that include the income from small or individual enterprises and also from self-employed persons.

Figure 4.5. Impact on GDP: income (€ m)



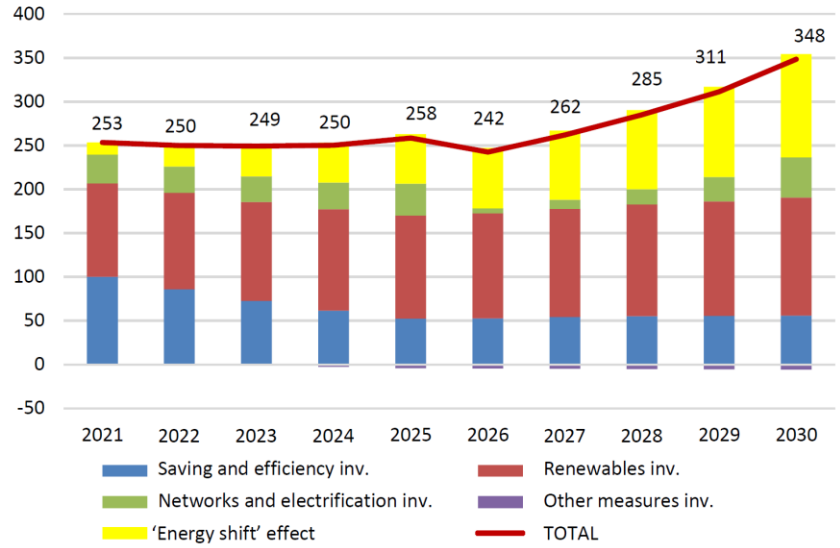
Source: Basque Centre for Climate Change, 2019

4.4.2 Employment impacts

Figure 4.6 shows the effect on employment between the Target Scenario and the Baseline disaggregated by measure type. **The INECP generates a net increase in employment of 253,000 and 348,000 people per year (a 1.7% increase in employment in 2030).** The unemployment rate would decrease compared to the Baseline Scenario, by between 1.1% and 1.6%. As in the case of the impact on GDP, the employment comes from the new investments in renewables, saving and efficiency, and networks and, from 2025, the effect resulting from the energy shift.

Investments in renewables would generate between 107,000 and 135,000 jobs/year, while investments in energy saving and efficiency would generate between 56,000 and 100,000 jobs/year. Investments in networks and electrification of the economy would generate 46,000 jobs/year by 2030. The energy shift would indirectly generate up to 118,000 jobs/year in 2030. Finally, the negative impact associated with disinvestments is also shown, considered in nuclear power plants and coal from 2025 in relation to the Baseline.

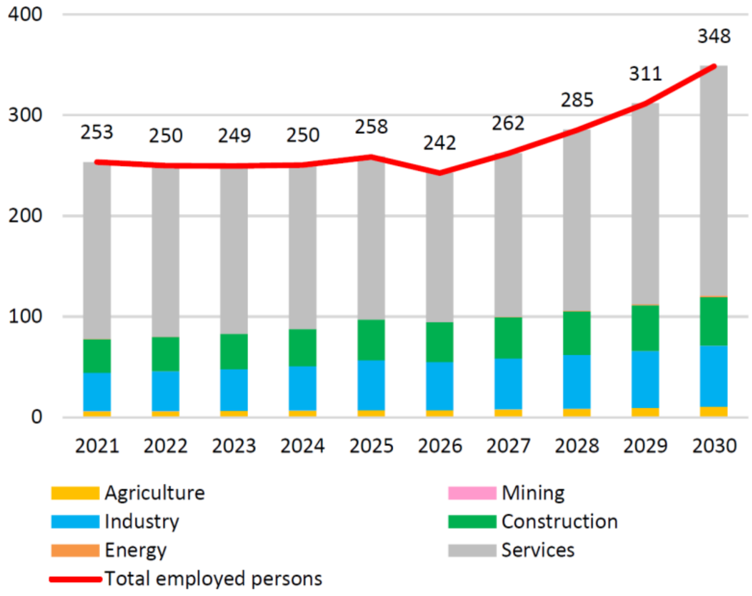
Figure 4.6. Impact on employment by measure type (thousands of people/year)



Source: Basque Centre for Climate Change, 2019

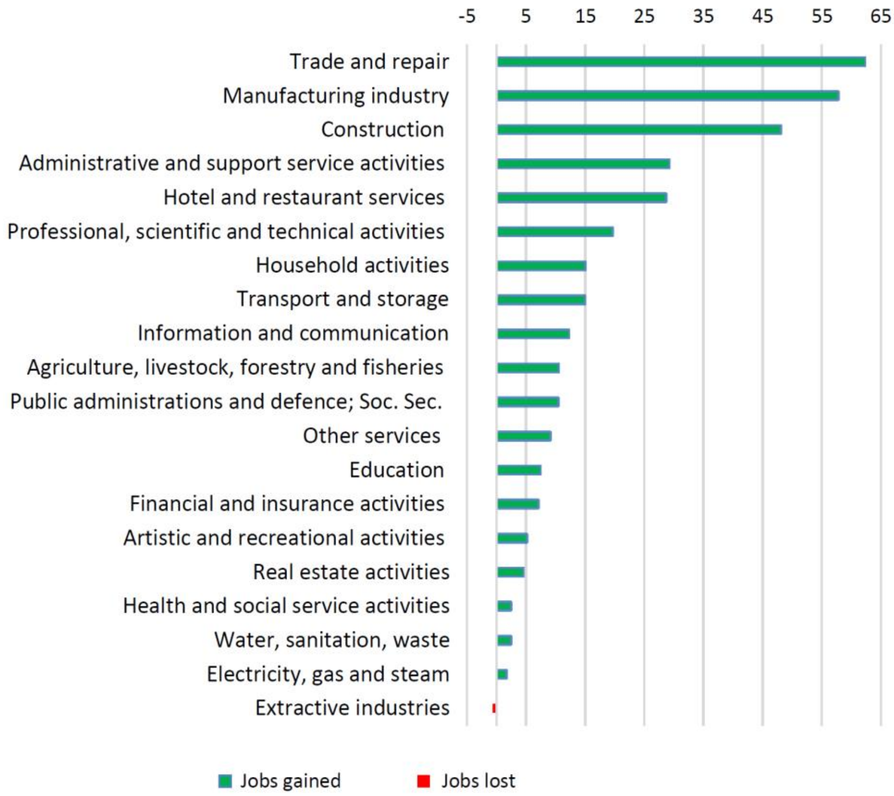
Figure 4.7 shows the net jobs generated by major sectors. As in the case of GDP, net employment is positive, except in the case of the mining sector. **Employment in the industrial sector increases by 38,000 to 61,000 people/year, while in construction it increases by 33,000 to 48,000 people/year.** Finally, in the service sector it increases in a more notable way, by 175,000 to 228,000 people/year, as a result of the services associated with the new investments and due to the shift in consumption structure.

Figure 4.7. Impact on employment by sector (thousands of people/year)



Source: Basque Centre for Climate Change, 2019

Figure 4.8. Impact on employment by industry (thousands of people/year)



Source: Basque Centre for Climate Change, 2019

Finally, Figure 4.8 shows the impact on employment in 2030 for the industries in the national accounts (National Classification of Economic Activities). The industries that would generate most employment would be trade and repair (62,300 jobs), **manufacturing industry (57,800 jobs) and construction (48,100 jobs).**

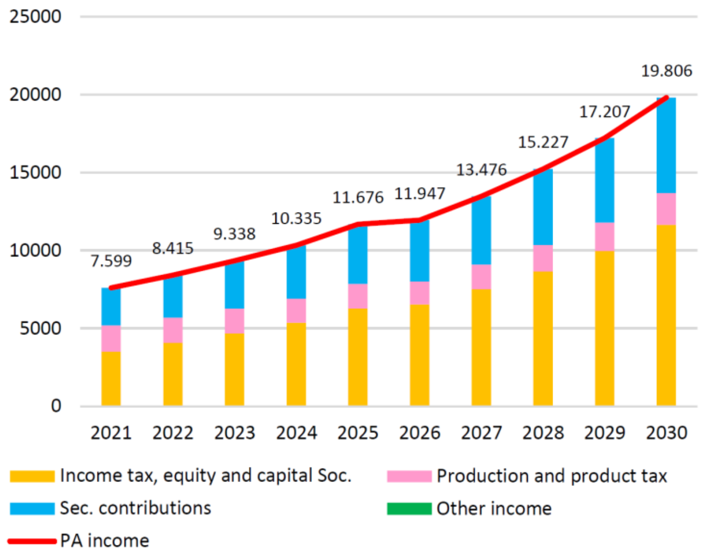
The electricity sector would have net job creation (1,700 jobs), including the loss of employment associated with the decrease in activity and disinvestment in coal and nuclear plants. The only industry, according to this aggregation, that obtains a net loss of employment is mining and quarrying (-700 jobs), resulting from the decrease in coal mining activity.

4.4.3 Impacts on public administrations

This section shows the economic impact on the public administration accounts. Figure 4.9 shows how, as a result of the increase in economic activity, government revenues increase significantly (between EUR 7.6 and EUR 19.8 bn at current prices) and all without altering the tax rates. In particular, taxes on income, wealth and capital would increase by between EUR 3.4 bn and EUR 11.6 bn, and contributions to Social Security between EUR 2.4 bn and EUR 6.1 bn. Although the revenue would decrease for some taxes, such as taxes on energy and hydrocarbons, this would be offset by an increase in revenue through other channels.

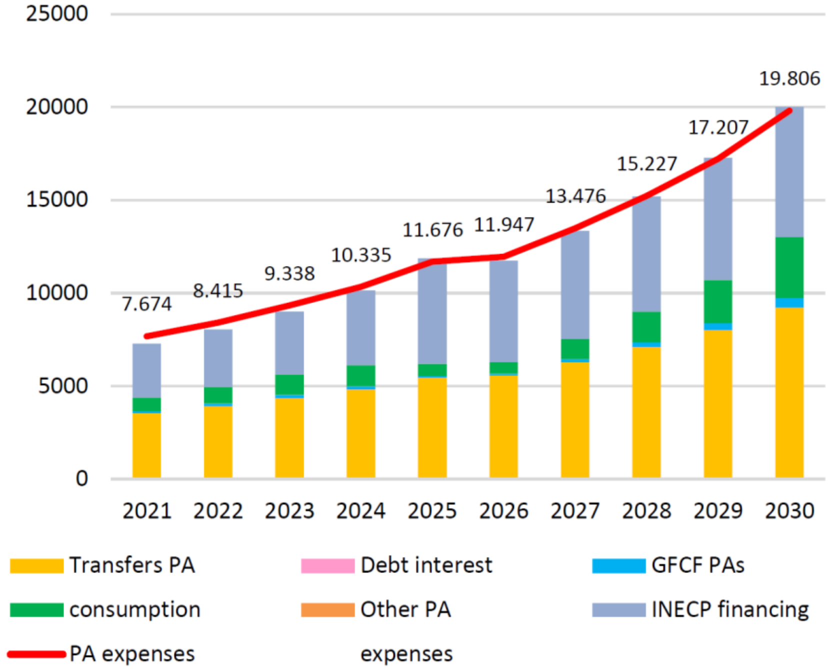
Similarly, this increase in revenue would allow a similar increase in public expenditure, as shown in Figure 4.10. In fact, the increase in revenue would make it possible to cover all the expenses linked to the public financing of the INECP itself, between EUR 2.9 bn and EUR 6.9 bn, and to free up a significant amount of resources for other expenses and transfers. In total, an additional EUR 4.7 bn to EUR 12.8 bn would be available to the public sector for other expenses, investments or transfers not associated with the INECP.

Figure 4.9. Impact on public administration (PA) accounts: income (€ m)



Source: Basque Centre for Climate Change, 2019

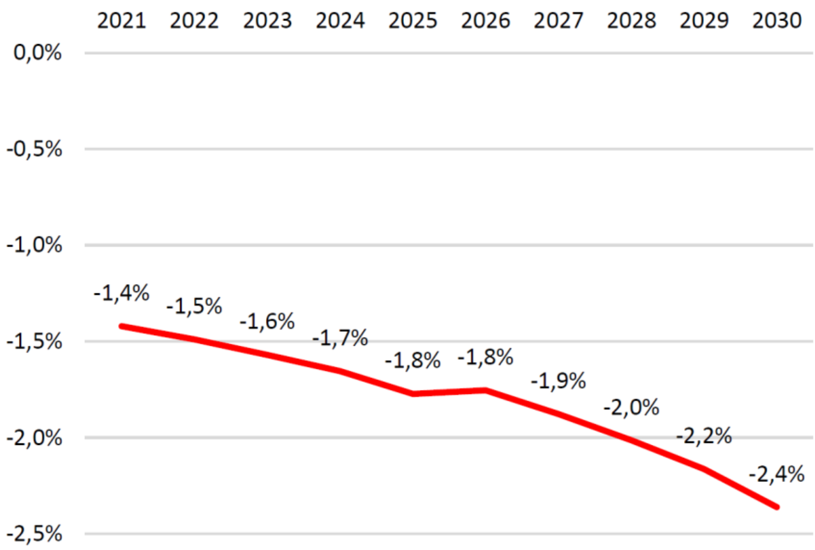
Figure 4.10. Impact on public administration (PA) accounts: expenditure (€ m)



Source: Basque Centre for Climate Change, 2019

Finally, it is important to note that the increase in public spending is exclusively due to the knock-on economic impact of the INECP and not from generating more deficit and debt, as one of the constraints that have been introduced is compliance with the Stability and Growth Pact. In fact, compliance with the deficit path combined with the higher level of economic activity allows the ratio between debt and GDP to decrease by 2.4% in 2030 compared to the Baseline Scenario (Figure 4.11).

Figure 4.11. Debt/GDP ratio (% compared to Baseline)



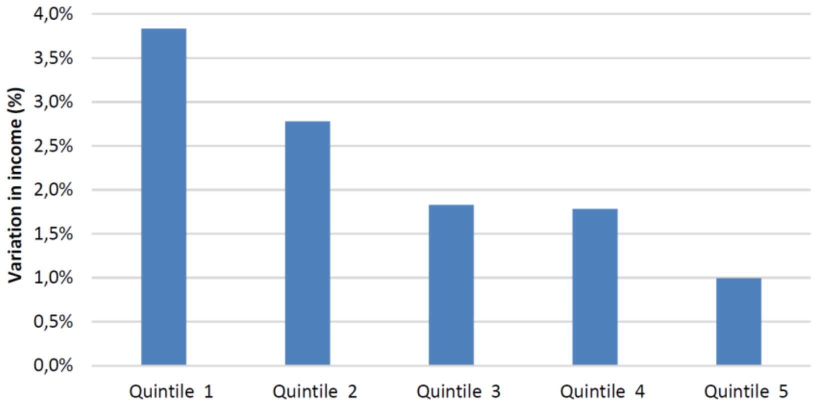
Source: Basque Centre for Climate Change, 2019

4.4.4 Social impacts

In the case of the social impacts, the results obtained for a whole set of indicators make it possible to conclude that the measures[57] in the INECP **favour households with a lower income and, especially, vulnerable groups**.

Figure 4.12 shows the effect on household disposable income by income quintile ratio, where quintile 1 groups the 20% of households with the lowest income and quintile 5 the 20% of households with the highest. The figure shows that the measures in the INECP have a progressive effect. Disposable income increases in all quintiles, resulting from the increased economic growth, but it increases to a greater extent in the quintiles with lower income, due in part to the effects of the aid received by these groups. Quintiles 1 and 2 see their disposable incomes increase by 3.8% and 2.8%, while quintiles 4 and 5 increase their income by 1.8% and 1%, respectively.

Figure 4.12. Variation in disposable income in 2030 by income quintiles (%)

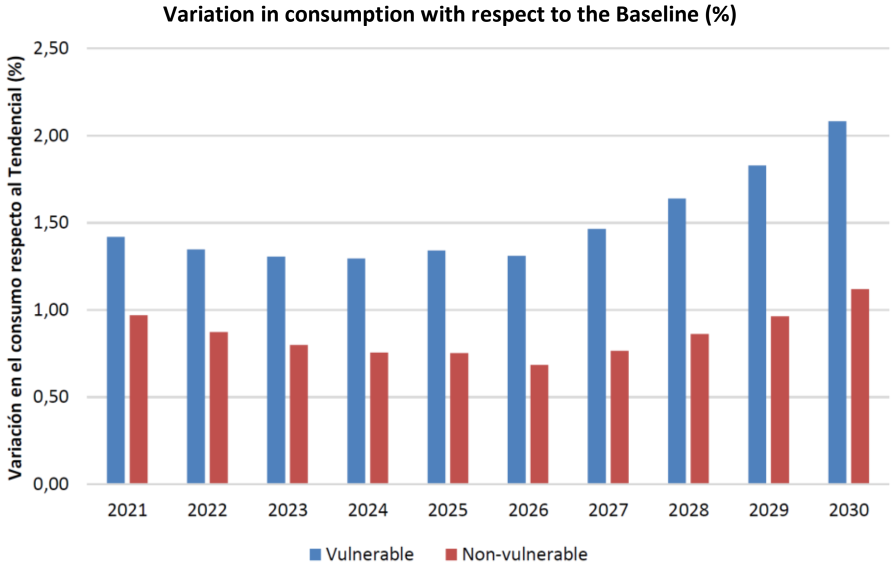


Source: Basque Centre for Climate Change, 2019

Figure 4.13 shows the effect of the INECP on the spending of vulnerable households, as defined in Royal Decree-Law 15/2018 of 5 October 2018. The figure shows an increase in spending of both vulnerable households and non-vulnerable households, with the effect on vulnerable households being more positive as they benefit in a more significant way, not only from the energy saving and reduction of the energy bill, but also due to the aid associated with the Plan towards lower-income households. Vulnerable households increase their spending in 2030 by 2.1% and non-vulnerable households increase it by 1.1%.

[57] The policies analysed in the INECP have included the design of some measures with redistributive impact such as aid related to housing upgrades, the promotion of own consumption for vulnerable households and extending the current special heating discount ('bono de calefacción').

Figure 4.13. Variation in final consumption between vulnerable and non-vulnerable households (%)



Source: Basque Centre for Climate Change, 2019

4.4.5 Impacts on pollution and public health

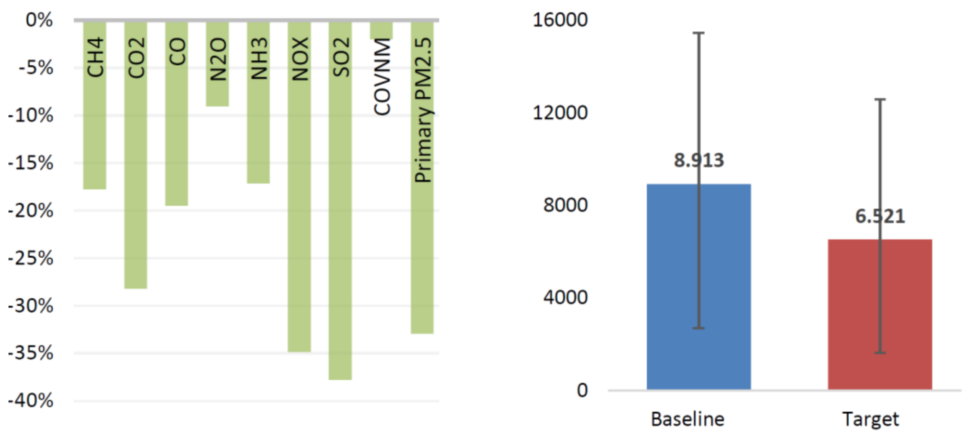
According to the WHO, in 2010 there were a total of 14,042 premature deaths caused by air pollution in Spain. The pollutants that caused the most effects on health are fine particulate matter (PM2.5) and ozone (O_3).

PM2.5 emissions are the leading cause of premature death resulting from pollution, causing problems in the respiratory (lung cancer), cardiovascular or brain (ischaemic attacks) systems. As regards ozone (O_3), although it is usually associated with damage to farming systems, it also produces significant effects on health, related to respiratory diseases.

The measures set out in the INECP manage to reduce both GHG emissions and those of the leading primary pollutants that generate final concentrations of PM2.5 and O_3. Figure 4.14a shows the decrease in emissions calculated by the MITECO Inventory Unit based on the new energy mix.

Primary emissions of PM2.5, the most harmful to health, decrease by 33% as a result of using cleaner technologies. Moreover, sulphur dioxide (SO_2) and nitrous oxides (NO_x), the main pollutants for the formation of secondary PM2.5, decrease by 38% and 35%, respectively. The reduction of SO_2 is mainly due to the decrease in coal consumption in the electricity sector, and in the case of NO_x due to the improvement in the efficiency of internal combustion engines and the electrification of transport.

Figure 4.14. a) Change in emissions in 2030 compared to the Baseline Scenario
b) Premature deaths in Spain due to air pollution in 2030



a) Variation in emissions (%) **b) Premature deaths (persons)**

Source: Basque Centre for Climate Change, 2019

These reductions in the emission levels of air pollutants are associated with significant improvements in terms of environmental quality, which translate into a reduction of damage to health in the form of fewer premature deaths. As Figure 4.14b shows, premature deaths from air pollution in 2030 are **reduced by about 2,400 people**, going from 8,913 in the Baseline Scenario to 6,521 in the Target Scenario, a reduction in percentage terms of 27%.

4.4.6 Sensitivity analysis

This section includes a sensitivity analysis on fossil fuel prices[58] as at 2030 that have been used to carry out this study. The sensitivity analysis has only been done on the DENIO model.

In this exercise, the central scenario of the European Commission is compared with two other alternative scenarios with a range of +/-25% in all fossil fuel prices. For example, in the case of oil, and according to the International Renewable Energy Agency (IRENA), a scenario complying with the Paris Agreement would mean a 20% overall reduction in oil consumption as at 2030 compared to current levels, a drop in demand that should contain the rise in prices. However, other organisations such as the International Energy Agency (IEA) indicate that there could currently be an investment 'gap', which could reduce the supply and push up prices. This sensitivity analysis makes it possible to evaluate a greater range of future solutions regarding which there is high uncertainty.

Table 4.1 sets out the results of the sensitivity analysis regarding GDP and the macroeconomic picture. It is observed that a lower increase in fossil fuel prices means a reduction of the impact in terms of GDP, and vice versa. A 25% reduction in prices compared to those in the central scenario generates an 18% reduction of the Plan's impact in GDP terms, while a 25% increase entails an increase of 9%.

[58] These prices have been recommended by the European Commission.

The change in fossil fuel price ultimately affects the reduction of energy bills resulting from the saving and efficiency measures. Thus, in an environment of high energy prices, the expected energy bill savings will be greater, which will lead to a greater expansionary effect of the INECP. The opposite would occur in a low price environment.

Table 4.1. Analysis of energy price sensitivity on GDP in 2030.
Target Scenario with respect to the Baseline (€ bn)

	Scenario p-25%	Central Scenario	Scenario p+25%
GDP	21.891	25.750	28.036
Final Consumption	4.447	10.026	12.712
Gross Fixed Capital Formation	20.547	21.265	21.717
Exports		0	0
Imports	3.103	5.391	6.394

Source: Basque Centre for Climate Change, 2019

Table 4.2 shows the results in terms of employment by major sector categories. Net job creation would go from 348,000 people/year in the central scenario in 2030 to a range between 318,000 and 366,000 people/year. A 25% reduction in fossil fuel price generates a 10% reduction in job creation, while a 25% increase entails an increase of 5%. The reasons behind this higher/lower increase are the same as those mentioned with regard to GDP.

Table 4.2. Analysis of energy price sensitivity on net employment in 2030.
Target Scenario with respect to the Baseline (thousands)

	Scenario p-25%	Central Scenario	Scenario p+25%
Total	318	348	366
Agriculture and fisheries	10	11	11
Mining	-1	-1	-1
Industry	58	61	62
Construction	46	48	50
Energy	1	1	1
Services	204	228	243

Source: Basque Centre for Climate Change, 2019

Finally, it is important to note that the future prices of fossil fuels will not only have an effect on the energy bill, they will also have an effect, for example, on the energy and electricity mix, on the degree of profitability of the investments or on other variables, such as the GDP growth assumed in the Baseline Scenario itself. These effects are beyond the scope of this sensitivity analysis, which has been limited to changes in the DENIO economic model.

4.4.7 Conclusions

The results of this impact analysis lead to the conclusion **that the effect of the INECP is an economic opportunity with significant economic, employment, social and public health benefits**. Below are some conclusions with the main figures that support this conclusion:

- The INECP will mobilise EUR 241 billion of **investment** in Spain between 2021 and 2030, which will generate a significant expansionary effect on the economy.
- The **Gross Domestic Product (GDP**) will increase by between EUR 16.5 and 25.7 billion between 2021 and 2030, an increase of 1.8% in 2030 with respect to the Baseline, both because of the investments planned and because of the greater energy savings and efficiency and the lower importation of fossil fuels.
- The measures to be implemented will generate between 253,000 and 348,000 new **jobs** between 2021 and 2030 (non-cumulative annual employment), an increase of 1.7% in 2030 over the Baseline Scenario. Investments in renewables alone will generate between 107,000 and 135,000 jobs over the decade, benefiting manufacturing, construction, and services associated with the renewable sector.
- The INECP will allow savings of **EUR 67 billion up to 2030 compared to the Baseline Scenario**, due to the reduction in demand for imported fossil fuels, which will also improve **energy security** as this source is replaced by indigenous energies.
- The INECP will favour **lower income households and vulnerable groups**, which will see their income and consumption increase by a greater proportion than other households.
- Finally, the measures will have a very positive impact in terms of **health**. The improvement in air quality with the measures foreseen in the Plan will prevent the premature death of around 2,400 people in Spain in 2030, a reduction of 27% compared to the Baseline Scenario.

ANNEXES

ANNEX A. CURRENT SITUATION AND PROJECTIONS: BASELINE SCENARIO AND TARGET SCENARIO

A.1. PROJECTED EVOLUTION OF MAIN EXOGENOUS FACTORS INFLUENCING ENERGY SYSTEM AND GHG EMISSION DEVELOPMENTS

This first section outlines the main macroeconomic variables that were considered in the foresight exercise that was done in the Plan, following as far as possible Regulation 2018/1999 on the Governance of the Energy Union and Climate Action.

Macroeconomic forecasts: GDP and population growth

The projection of the GDP variable was provided by MINECO, updated to the latest revision of the 2018 Stability Programme. The values are in the table below.

Table A.1. Projection of Spain's GDP

Projection of Spain's Gross Domestic Product (€ bn at constant 2016 prices)				
Years	2015	2020	2025	2030
GDP	1.071	1.223	1.334	1.421

Source: Ministry of Economic Affairs and Digital Transformation

The projection of the GDP beyond the horizon set out in the stability programme corresponds to the macroeconomic scenario, established based on the Spanish economy's input-output tables. This scenario, which forecasts a 16% growth in GDP in the decade 2020-2030, uses as a starting point the population trend set out in the European Commission report: *The 2018 Ageing Report: Economic and Budgetary Projections for the EU Member States (2016-2070)*[59].

The population projection set out in the Plan is the one included in the abovementioned 2018 Ageing Report, in order to thus ensure consistency between the GDP and population projections. As can be observed in the table below, the Spanish population will undergo 1% growth in the next decade.

Table A.2. Spanish population projection

Spanish population projection (thousands of people)				
Years	2015	2020	2025	2030
Population	46,450	46,582	46,803	47,155

Source: European Commission

The number of dwellings is projected on the basis of the above population projections, using the Spanish National Statistical Institute's persons per dwelling occupancy rate. This path is consistent with that used in the future update of the 'Long-term strategy for energy upgrading in the building sector in Spain'.

In addition to the above, it is estimated that the total number of households matches the total number of dwellings. In other words, it is considered that all dwellings are inhabited. This

[59] https://ec.europa.eu/info/sites/info/files/economy-finance/ip065_en.pdf

hypothesis was prepared taking into account that this study is carried out to project energy consumption in future, and the main consumption situations will be in inhabited dwellings.

The trajectory of the total number of dwellings is shown below.

Table A.3. Projection of the number of dwellings

Projection of the number of dwellings (thousands of dwellings)				
Years	**2015**	**2020**	**2025**	**2030**
Number of dwellings	18,346	18,585	19,252	19,820

Source: European Commission, Spanish National Statistical Institute (INE).

It should be pointed out that the number of dwellings includes upgraded, new and existing dwellings, assuming different hypotheses for the Baseline Scenario and the Target Scenario. The details of the measures associated with the upgrade of dwellings are available under heading A3 regarding the energy efficiency dimension.

Sectoral changes expected to impact the energy system and GHG emissions

No notable sectoral changes are expected according to the macroeconomic scenario produced by MINECO. The table below shows the relative weight of the major sectors of the Spanish economy with regard to the total. Despite the fact that only values in the year 2030 are shown in the table below, these percentages remain practically constant throughout the entire period analysed.

Table A.4. Percentage of the total gross value added for Spain in the year 2030 that corresponds to each economic sector

Representativeness of the economic sectors with regard to the total gross value added for the year 2030	
Agriculture	3%
Industry	17%
Construction	8%
Services	72%

Source: Ministry of Economic Affairs and Digital Transformation

Global trends: international fossil fuel prices and emission allowance price

The Spanish energy system falls within the global trends and energy markets, and therefore the baseline variable values considered were those recommended by the European Commission.

The values used for the international fossil fuel prices, and their projections up to 2030, are presented below.

Table A.5. International fossil fuel prices

International fossil fuel prices (€ at constant 2016 prices/barrel of oil equivalent)				
Years	**2015**	**2020**	**2025**	**2030**
Oil	46.65	69.17	91.47	100.77
Gas	40.40	44.15	56.08	60.99
Coal	11.71	16.58	18.36	22.04

Source: European Commission

In line with the fuel price development hypothesis from the table above, the European Commission also provided international prices for projecting the cost of emission allowances.

In the case of CO_2 emission allowances traded in the European market system (ETS), the development of its prices is an exogenous variable in the model, and therefore the recommended parameters were used, presented in the table below.

Table A.6. Projection of CO_2 emission allowance cost[60]

International prices of greenhouse gas emission allowances (Units: € at constant 2016 prices/tCO_2)				
Years	**2015**	**2020**	**2025**	**2030**
Emission allowance cost	7.8	15.5	23.3	34.7

Source: European Commission

Technology cost developments

TIMES-SINERGIA, the analytical model used for projections of the energy system, is a bottom-up model, so the costs of the different energy technologies are a fundamental input for making an appropriate projection of the model's different output variables.

The data provided by the European Commission's JRC were given priority in order to ensure the consistency of the relative prices between the different technologies in the Capacity model. Commonly accepted international sources were used for any data not available from the two sources cited, adapting the values where appropriate to the usual typology in the Spanish energy system.

The cost developments of the different technologies have been taken from various international sources and, where available, from expert national sources. As a summary, the main sources are presented, broken down by the sector under consideration:

[60] Data recommended by the European Union for the Baseline Scenario. Values from the 'Recommended EU ETS carbon prices' are applied.

Table A.7. Data sources for technology cost developments

Data sources	
Sector	**Data source**
Transport	EU Reference Scenario 2016, Energy, transport and GHG emissions Trends to 2050 Input data to PRIMES model, 2016
Residential	Energy Technology Data Source, IEA ETSAP - Technology Brief, 2012
Services	JRC. Input data to POTEnCIA Model, 2018
Generation of electricity	JRC. Power generation technology assumptions, developed to serve as input to the POTEnCIA
Industry	Energy Technology Data Source, IEA ETSAP - Technology Brief, 2010-2015

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

For heating and cooling days, these parameters have not been used in the modelling, and therefore the projections provided by the European Commission have not been used.

A.2 DECARBONISATION DIMENSION

Once the main exogenous variables have been explained, the Baseline and Target Scenarios are then described for the different dimensions included in the Plan. This section begins with decarbonisation, which in turn comprises two areas: GHG emissions and promotion of renewable energy.

A.2.1 Greenhouse gas emissions and removals

The target of reducing GHG emissions by 20% compared to 1990 is a key element in the design of the INECP. Achieving this level of decarbonisation is only possible if it is accompanied by measures of the other dimensions that are interlinked with the reduction of emissions, such as the target of final energy production from renewable sources or the principle of energy efficiency first.

For more details about GHG emissions, please see the end of this annex.

The tables below show the total GHG emissions corresponding to the Baseline and Target Scenarios of the INECP, detailed by sector.

Table A.8. Total emissions projection in the Baseline Scenario

Emissions projection in the Baseline Scenario (thousands of tonnes of CO_2 equivalent)						
Years	**1990**	**2005**	**2015**	**2020**	**2025**	**2030**
Transport	59,199	102,310	83,197	89,762	90,721	88,193
Electricity generation	65,864	112,623	74,051	57,013	42,228	43,025
Industrial Sector (combustion)	45,099	68,598	40,462	38,234	36,889	33,512
Industrial sector (emissions from processes)	28,559	31,992	21,036	21,697	22,003	22,166
Residential Commercial and Institutional Sectors	17,571	31,124	28,135	28,314	26,326	23,393
Livestock farming	21,885	25,726	22,854	23,218	23,167	23,116
Crops	12,275	10,868	11,679	11,404	11,412	11,419
Waste	9,825	13,389	14,375	13,832	13,060	12,209
Refining industry	10,878	13,078	11,560	13,070	12,837	11,870
Other energy industries	2,161	1,020	782	814	733	760
Other sectors	9,082	11,729	11,991	12,577	12,943	13,222
Fugitive Emissions	3,837	3,386	4,455	5,036	5,034	4,731
Product use	1,358	1,762	1,146	1,237	1,298	1,340
Fluorinated gases	64	11,465	10,086	8,267	6,152	4,037
Total	**287,656**	**439,070**	**335,809**	**324,476**	**304,804**	**292,994**

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

The table below shows the GHG emissions corresponding to the Target Scenario of the INECP.

Table A.9. Total emissions projection in the Target Scenario

Emissions projection in the Target Scenario (thousands of tonnes of CO_2 equivalent)						
Years	**1990**	**2005**	**2015**	**2020**	**2025**	**2030**
Transport	59,199	102,310	83,197	87,058	77,651	59,875
Electricity generation	65,864	112,623	74,051	56,622	26,497	20,603
Industrial Sector (combustion)	45,099	68,598	40,462	37,736	33,293	30,462
Industrial sector (emissions from processes)	28,559	31,992	21,036	21,147	20,656	20,017
Residential, commercial and institutional sectors	17,571	31,124	28,135	28,464	23,764	18,397
Livestock farming	21,885	25,726	22,854	23,247	21,216	19,184
Crops	12,275	10,868	11,679	11,382	11,089	10,797
Waste	9,825	13,389	14,375	13,657	11,932	9,718
Refining industry	10,878	13,078	11,560	12,330	11,969	11,190
Other energy industries	2,161	1,020	782	825	760	760
Other sectors	9,082	11,729	11,991	12,552	11,805	11,120
Fugitive emissions	3,837	3,386	4,455	4,789	4,604	4,362
Product use	1,358	1,762	1,146	1,236	1,288	1,320
Fluorinated gases	64	11,465	10,086	8,267	6,152	4,037
Total	287,656	439,070	335,809	**319,312**	**262,675**	**221,844**

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

In addition, the emissions are shown disaggregated between those subject to the emission trading system and those that are excluded (diffuse emissions). The tables below outline the disaggregated results for the Target Scenario.

Table A.10. Emissions projection in emissions trading systems sectors

Emissions projection in the Target Scenario in emissions trading systems sectors (thousands of tonnes of CO_2 equivalent)					
Years	**2005**	**2015**	**2020**	**2025**	**2030**
Transport	4,013	2,481	3,145	3,265	3,290
Electricity generation	100,042	69,465	53,010	23,702	17,876
Industrial Sector (combustion)	56,007	35,073	33,084	29,167	26,667
Industrial sector (emissions from processes)	29,005	18,066	17,961	17,484	16,864
Residential, commercial and institutional sectors	51	156	173	155	130
Livestock farming	0	0	0	0	0
Crops	0	0	0	0	0
Waste	0	0	0	0	0
Refining industry	12,948	11,444	12,207	11,849	11,079
Other energy industries	622	477	503	464	464
Other sectors	0	0	0	0	0
Fugitive emissions	1,514	2,590	2,832	2,749	2,570
Product use	0	0	0	0	0
Fluorinated gases	0	0	0	0	0
Total (ETS)	204,201	139,751	**122,915**	**88,834**	**78,940**

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Table A.11. Emissions projection in the diffuse sectors

Emissions projection in the Target Scenario in diffuse sectors (thousands of tonnes of CO_2 equivalent)					
Years	**2005**	**2015**	**2020**	**2025**	**2030**
Transport	98,297	80,716	83,912	74,386	56,585
Electricity generation	12,582	4,586	3,612	2,795	2,727
Industrial Sector (combustion)	12,591	5,390	4,653	4,126	3,795
Industrial sector (emissions from processes)	2,988	2,970	3,186	3,172	3,153
Residential, commercial and institutional sectors	31,073	27,980	28,291	23,609	18,266
Livestock farming	25,726	22,854	23,247	21,216	19,184
Crops	10,868	11,679	11,382	11,089	10,797
Waste	13,389	14,375	13,657	11,932	9,718
Refining industry	131	116	123	120	112
Other energy industries	398	305	322	296	296
Other sectors	11,729	11,991	12,552	11,805	11,120
Fugitive emissions	1,872	1,865	1,957	1,854	1,792
Product use	1,762	1,146	1,236	1,288	1,320
Fluorinated gases	11,465	10,086	8,267	6,152	4,037
Total (Non-ETS)	234,869	196,058	**196,397**	**173,841**	**142 903**

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

As can be seen in the tables above, the main reductions of GHG emissions take place in the electricity generation and transport sectors. The residential, commercial and institutional sector also makes an important contribution to meeting the emissions reduction target.

In conclusion, the key target established in this Plan is to reduce GHG emissions by at least 20% in 2030 compared to 1990. However, the result of the optimisation made using the TIMES model was 23%, with a 31% reduction in GHG emissions between 2020 and 2030.

A.2.2 Renewable energy

Below are the results and projections of the contribution from the generation of energy using renewable energy sources to final energy consumption.

As stated before, it is important to note that the Plan's key objective is compliance with the mitigation of GHG emissions up to at least a 20% reduction compared to 1990.

Contribution of renewables in gross final energy consumption

The total percentage of renewable energy in gross final energy in 2016 was 17.3%. Regarding the calculation method, the indications established in Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources were followed, as were the amendments introduced in this calculation in Directive 2018/2001 of the European Parliament and of the Council of 11 December 2018.

Table A.12 and Table A.13 present the results in the Baseline and Target Scenarios, respectively.

Table A.12. Percentage of renewable energy in final energy consumption in the Baseline Scenario

Percentage of renewable energy in final energy consumption in the Baseline Scenario							
Years		2015*	2020	2022	2025	2027	2030
End-use renewable energy consumption (excluding renewable electricity consumption)	Agriculture (ktoe)	4,310	119	136	163	179	204
	Industry (ktoe)		1,600	1,632	1,680	1,711	1,757
	Residential (ktoe)		2,732	2,603	2,410	2,384	2,345
	Services & Other (ktoe)		242	230	212	204	192
	Transport (ktoe)	176	2,422	2,427	2,434	2,403	2,358
Energy supplied by heat pumps (ktoe)		353	627	1,272	2,239	2,638	3,237
Renewable electricity generation (ktoe)		8,642	10,160	10,841	11,863	12,517	13,498
Total renewable energy (ktoe)		13,481	17,902	19,141	20,999	22,036	23,592
Final energy corrected with electricity system losses, aviation consumption and energy supplied by heat pumps (ktoe)		83,361	89,321	90,846	91,500	91,362	91,155
Percentage of renewable energy in final energy consumption		**16%**	**20%**	**21%**	**23%**	**24%**	**26%**

** The 2015 data are real; the rest are projections prepared by MITECO*

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Table A.13. Percentage of renewable energy in final energy consumption in the Target Scenario

Percentage of renewable energy in final energy consumption in the Target Scenario							
Years		2015*	2020	2022	2025	2027	2030
End-use renewable energy consumption (excluding renewable electricity consumption)	Agriculture (ktoe)	4,310	119	148	192	203	220
	Industry (ktoe)		1,596	1,624	1,667	1,711	1,779
	Residential (ktoe)		2,640	2,623	2,598	2,709	2,876
	Services & Other (ktoe)		241	279	337	376	435
	Transport (ktoe)	176	2,348	2,369	2,401	2,285	2,111
Energy supplied by heat pumps (ktoe)		353	629	1,339	2,404	2,851	3,523
Renewable electricity generation (ktoe)		8,642	10,208	12,438	15,784	18,187	21,792
Total renewable energy (ktoe)		13,481	17,780	20,821	25,383	28,324	32,736
Final energy corrected with electricity system losses, aviation consumption and energy supplied by heat pumps (ktoe)		83,361	88,548	86,081	85,023	82,050	77,589
Percentage of renewable energy in final energy consumption		**16%**	**20%**	**24%**	**30%**	**34%**	**42%**

** The 2015 data are real; the rest are projections prepared by MITECO*

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

In Table A.13 above, it can be seen that in the Target Scenario, the percentage of renewable energy in gross final energy consumption totals 42% in 2030, while it would total 26% in the Baseline Scenario. In other words, as a result of implementing the measures set out in this Plan, there is a 16-point increase in the presence of renewable energy in final energy consumption.

The main reasons for this increase are outlined below:

- **In the Baseline Scenario**, the largest contribution to the increase in the renewable percentage comes from the components of renewable electricity generation and heat pumps.

- **In the Target Scenario:**
    - The contribution from renewable electricity generation from the Target Scenario is almost double the Baseline Scenario, thanks to the policies promoting renewable generation.
    - The contribution from heat pumps increases by 8.8% with respect to the Baseline Scenario.
    - Unlike the Baseline Scenario, in the Target Scenario there are increases in the use of final renewable energy in all sectors, i.e. agriculture, industry, residential and services.
    - According Table A.13, seemingly, the only sector where the use of end-use renewable energy decreases is transport. In reality, this is due to the fact that the figure shown does not include the electricity contribution, which is included under the electricity generation heading. Therefore, the high penetration of electrically-propelled vehicles is not directly reflected in this table, but is instead included within renewable electricity generation.
    - The gains in energy saving and efficiency increase the contribution from renewable energy in percentage terms, because of their effect on reducing final energy consumption.

The sectoral disaggregation of renewable energy is shown below.

Renewable energy in heating and cooling applications

Heating and cooling applications include the following sectors: residential, service and industrial. Table A.14 shows the results from this contribution.

Table A.14. Percentage of renewable energy in heating and cooling

Percentage of renewable energy in heating and cooling applications				
Years	2015*	2020	2025	2030
Baseline Scenario	17%	18%	22%	25%
Target Scenario	17%	18%	25%	31%

**The 2015 data are real; the rest are projections prepared by MITECO Source: Ministry for Ecological Transition and Demographic Challenge, 2019*

In the results from the table above, and in a manner consistent with the development of the global percentage, the Target Scenario shows a higher percentage of renewable energy in heating and cooling. The main conclusions in this regard are presented below:

- The promotion of the use of end-use renewable energy, such as biomass, biogas and solar thermal energy, has a significant impact on the increase in this percentage.
- The increased use of heat pumps for air conditioning also has a significant impact. This effect is especially noted in the Target Scenario, since it is more economically viable to introduce heat pumps in dwellings.

Transport

Table A.15 shows the percentages of renewable energy in the transport sector with respect to their final energy consumption. To this end, both the percentages obtained by direct calculation, i.e. determining the ratio of the contribution of renewables in transport to total final consumption in this sector, and the percentages obtained by applying the considerations of Directive 2018/2001 on the promotion of the use of energy from renewable sources have been represented. In the latter, corrections are applied to aviation final consumption, and multipliers to advanced biofuels and biogas and renewable electricity.

Table A.15. Percentage of renewable energy in the transport sector

Percentage of renewable energy in the transport sector					
Calculation method	**Scenario**	**2015***	**2020**	**2025**	**2030**
Directive 2018/2001	Baseline Scenario	1%	10%	10%	11%
	Target Scenario	1%	10%	15%	28%
Straight percentage	Baseline Scenario	1%	7%	7%	7%
	Target Scenario	1%	7%	8%	11%

** The 2015 data are real; the rest are projections prepared by MITECO*

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

As can be observed in the table above, the compulsory national target of 14% for the share of renewable energy in transport for 2030, established in Directive 2018/2001 on the promotion of the use of energy from renewable sources, is met comfortably, reaching a percentage of 28% in 2030.

On the other hand, it is important to note that compliance with the 2020 target of 10% renewable energy in transport is verified in both the Baseline Scenario and the Target Scenario. This is achieved mainly through the use of biofuels.

It should be noted that the percentage of renewable energy in transport corresponding to 2015 is reduced due to the fact that the biofuel sustainability certification procedure was still not approved. For this reason, the consumption of biofuels without sustainability certification could not be included in the calculation of this percentage. This situation is apparent when analysing the information available on actual biofuel consumption for 2016, the figure for which is 5.3%.

The main differences between both scenarios are analysed next, resulting in a very significant increase in the presence of renewable energy in transport:

- **Modal shift to more efficient modes of transport.** The change of mode of transport in the Target Scenario towards collective means of transport results in a much more efficient sector.
- **Accelerated introduction of electrified vehicles in the Target Scenario.** In 2030, there will be about 3 million electric passenger cars and over 2 million motorcycles, light trucks and buses in the vehicle fleet. These vehicles will total 5 million units. The introduction of electric mobility is gradual, going from the current values until it reaches this figure in 2030. It is important to bear in mind that electrified vehicles count in the percentage of renewable energy in transport in the proportion to which the electricity mix generates

electricity using renewable energy sources.

- **Increase in mobility by means of electrified rail transport.** This also has significant importance, provided that, as in the point above, the electricity generation comes from renewable energy sources.
- **Use of advanced biofuels and biogas**. The contribution of these fuels produced from the raw materials listed in Annex IX, part A of Directive 2018/2001 meets the minimum requirement.

Table A.16 shows the different limits established in Directive 2018/2001 on the promotion of the use of energy from renewable sources, as well as the degree of compliance with these limits. As can be seen from the data presented, the minimum and maximum levels set by the Directive for the contribution of biogas and biofuels in 2030 are met.

Table A.16. Compliance with limits set in Directive 2018/2001 in the transport sector

Compliance with limits set in Directive 2018/2001						
	Component	2015*	2020	2025	2030	2030 Objective
Article 27(1)(b)	Biogas and biofuels Annex IX, part B	0%	0.5%	1.7%	1.7%	Maximum 1.7%
Article 25.1	Advanced biogas and biofuels Annex IX, part A	0%	0.9%	1.6%	3.7%	Minimum 3.5%
Article 26. 1	Biofuels produced from food and feed crops	0%	6.9%	6.8%	6.8%	Maximum 7%

** The 2015 data are real; the rest are projections prepared by MITECO*

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Renewable energy in the electricity sector

This section begins with the results related to the generation of renewable energy in the electricity generation system, which are shown below:

Table A.17. Percentage of renewable energy in the electricity generation sector

Percentage of renewable energy in electricity generation					
Calculation method	Scenario	2015*	2020	2025	2030
Directive 2018/2001	Baseline Scenario	37%	41%	48%	53%
	Target Scenario		42%	64%	86%
Straight percentage	Baseline Scenario	38%	41%	47%	52%
	Target Scenario		42%	60%	74%

** The 2015 data are real; the rest are projections prepared by MITECO*

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

In a similar way to the previous section, Table A.17 presents the percentages of renewable generation in the electricity sector with respect to final energy, applying the direct ratio calculation, as well as under the methodology established in Directive 2018/2001. In the latter case, a renewable contribution of 74% is achieved by 2030, a value obtained simply by dividing the renewable energy supplied by the system by the total energy.

Below is a more detailed explanation of the electricity sector, since this is one of the most important components contributing to the decarbonisation of the energy system, as well as to meeting the renewable energy target.

Electricity sector

Firstly, the installed capacity of the different generation technologies is presented in the Baseline Scenario.

In the Baseline Scenario, the total installed capacity in Spanish territory increases from 114.5 GW in 2020 to 126 GW in 2030, representing a 10% increase during this period (11.7 GW). The main increases come from wind (onshore and offshore) and solar photovoltaic technologies, with around 10 GW each. It should be underlined that 100% of the nuclear thermal capacity remains in operation at the end of the period in this Baseline Scenario, compared to the installed capacity in 2020. In the case of coal, the closure of a series of plants scheduled for the end of 2020 is incorporated as a result of the application of European standards. This fact is reflected in the figure for 2025, and this capacity is maintained until the end of the decade.

Table A.18. Electricity generation system in the Baseline Scenario

Generation system in the Baseline Scenario (MW)				
Years	**2015**	**2020**	**2025**	**2030**
Wind (onshore and offshore)	22,925	28,033	33,033	38,033
Solar photovoltaic	4,854	8,921	13,921	18,921
Solar thermoelectric	2,300	2,303	2,303	2,303
Hydroelectric power	14,104	14,109	14,109	14,109
Mixed Pumping	2,687	2,687	2,687	2,687
Pure Pumping	3,337	3,337	3,337	3,337
Biogas	223	211	211	211
Biomass	677	613	613	613
Coal	11,311	7,897	2,165	2,165
Combined cycle	26,612	26,612	26,612	26,612
Cogeneration	6,143	5,239	4,373	2,470
Fuel and Fuel/gas (non-peninsular territories):	3,708	3,708	3,708	3,708
Waste and other	893	610	470	341
Nuclear	7,399	7,399	7,399	7,399
Total	**107,173**	**111,679**	**114,940**	**122,909**

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

In the case of cogeneration, the capacity reflected in Table A.18 and Table A.19 corresponds to installed capacity. This heading therefore includes both active and inactive facilities.

In the Target Scenario, total installed capacity increases to 161 GW in 2030, representing an increase of 44% during this period (49 GW), as well as 30% more than in the same year in the Baseline Scenario.

Similar to what was shown in the Baseline Scenario, the main increases come from wind (onshore and offshore) and solar photovoltaic technologies, with approximately 22 GW and 30 GW respectively. It must be remembered that although the renewable energy totals are agreed by the INECP, the relative figures from the different technologies are indicative and liable to modification according to technological developments, costs and availability of different technologies. Likewise, these figures include different typologies of existing and future technologies, e.g. including, but not limited to: distributed generation and conventional generation capacity, onshore and offshore wind capacity, large photovoltaic generation plants and small individual installations.

Table A.19. Electricity generation system in the Target Scenario

Generation system in the Target Scenario (MW)				
Years	**2015**	**2020**	**2025**	**2030**
Wind (onshore and offshore)	22,925	28,033	40,633	50,333
Solar photovoltaic	4,854	9,071	21,713	39,181
Solar thermoelectric	2,300	2,303	4,803	7,303
Hydroelectric power	14,104	14,109	14,359	14,609
Mixed Pumping	2,687	2,687	2,687	2,687
Pure Pumping	3,337	3,337	4,212	6,837
Biogas	223	211	241	241
Other renewables	0	0	40	80
Biomass	677	613	815	1,408
Coal	11,311	7,897	2,165	0
Combined cycle	26,612	26,612	26,612	26,612
Cogeneration	6,143	5,239	4,373	3,670
Fuel and Fuel/gas (non-peninsular territories):	3,708	3,708	2,781	1,854
Waste and other	893	610	470	341
Nuclear	7,399	7,399	7,399	3,181
Storage	0	0	500	2,500
Total	**107,173**	**111,829**	**133,802**	**160,837**

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Also of note is the rise of hydraulic pumping and solar thermoelectric technologies (with nine hours of storage), with an additional capacity of 3.5 GW and 5 GW, respectively. This capacity, which offers greater power dispatch capability, will be complemented by the staggered introduction of storage devices (batteries) into the system, the aim of which must be to reduce wastage and maximise the production capacity of non-dispatchable renewable technologies. These batteries will have a capacity equivalent to approximately 2.5 GW in 2030, with a maximum of two hours' storage at full charge.

There was an increase in other renewable technologies in the period under consideration, reaching a value of 80 MW, including geothermal and marine energy.

In sum, renewable capacity is increased by about 59 GW in the period 2021-2030, and total renewable capacity in 2030 is 122.7 GW.

On the other hand, in the period 2021-2030 there is a decrease in the installed capacity of the nuclear power plants greater than 4 GW (the capacity corresponding to four reactors of the seven currently in operation). This decrease is part of the organised, phased and flexible closure plan for the existing nuclear reactors, which foresees the closure of another three reactors in the period between 2031 and 2035.

There is also the termination of electricity generation from any coal-fired power plants that may continue to operate beyond 2020 (a maximum of five or six of the 15 currently in existence), by 2030 at the latest. In any case, it is not totally ruled out that part of the installed capacity will be maintained where investments have been made to comply with the Community framework although, given the current circumstances in the sector, a decrease in the installed capacity of coal-fired power plants is expected.

The main reason for this termination prior to 2030 will be the difficulty for coal-fired power plants to continue to be profitable in a setting that is strongly conditioned by the European response to climate change, in which the price of a tonne of CO_2 will be at least EUR 35. At any rate, the termination of electricity generation at coal-fired power plants is considered essential for achieving this National Plan's key target of mitigating GHG by at least 20% in 2030 as compared to 1990.

It should also be noted that there are plans to repower the entire renewable system currently in existence after its service life ends, maintaining the **renewal and hybridisation measures in existing projects** included in the present INECP.

It must be stated that the primary objective of the electricity system is to guarantee the electricity supply to consumers, in optimal conditions of service quality and security. According to the feasibility studies carried out in relation to the proposed generation system, **it will not be necessary to install additional backup thermal capacity as a supplement to the generation mix obtained with the TIMES-Sinergia model[61].**

In any case, as system operator, REE will at all times seek to ensure the correct operation of the transmission and distribution networks, as well as the guarantee of electricity supply.

Finally, as explained above, the high penetration of renewable capacity in the electricity generation system will be accompanied by the following actions:

- promoting the necessary network infrastructure;
- maximising the use of the available access capacity by means of efficient capacity allocation procedures;
- simplifying the administrative and environmental processing for installation authorisations, so that this processing does not turn into an obstacle for the construction of generation installations and the infrastructure needed to commission them, especially in the case of repowering;
- reviewing the operation of the electricity market, if this is considered necessary, as a mechanism to encourage the maximum use of the country's renewable generation potential.

Having explained the generation system, the results regarding electricity generation are shown below[62]:

[61] As can be confirmed in Annex D, the electricity generation system resulting from the TIMES-Sinergia model has been analysed by Red Eléctrica de España.

[62] The generation values corresponding to 2015 are based on the values reported to Eurostat for that year, having made the necessary estimations according to the breakdown presented.

Table A.20. Gross electricity generation in the Baseline Scenario

Gross electricity generation in the Baseline Scenario* (GWh)				
Years	2015	2020	2025	2030
Wind (onshore and offshore)	49,325	60,022	71,522	83,022
Solar photovoltaic	8,302	16,034	25,032	34,030
Solar thermoelectric	5,557	5,608	5,608	5,608
Hydroelectric power	28,140	28,288	27,935	27,581
Pumping	3,228	4,640	4,640	4,640
Biogas		813	829	1,024
Geothermal energy/	743	0	0	0
Marine energy		0	0	0
Coal	52,281	32,826	12,549	10,189
Combined cycle	28,187	31,000	44,133	51,289
Coal cogeneration	395	78	0	0
Gas cogeneration	24,311	22,382	19,148	9,905
Petroleum products cogeneration	3,458	2,463	1,767	982
Other	216	2,563	2,024	1,838
Fuel and Fuel/Gas (NPT)	13,783	10,141	10,141	10,141
Renewables cogeneration	1,127	988	1,060	1,151
Biomass	3,126	4,757	4,750	4,713
Cogeneration with waste	192	160	122	84
Municipal solid waste	1,344	918	799	355
Nuclear	57,196	58,039	58,039	58,039
Total	**280,911**	**281,720**	**290,097**	**304,593**

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Table A.21. Baseline Scenario electricity mix

Baseline Scenario electricity mix (GWh)				
Years	2015	2020	2025	2030
Gross electricity generation	281,021	282,172	290,097	304,593
Consumption in generation	-11,270	281,720	-9,554	-9,488
Net electricity generation	269,751	-10,398	280,543	295,105
Consumption in pumping	-4,520	271,323	-6,445	-6,445
Export	-15,089	-6,445	-13,421	-25,828
Import	14,956	-9,251	18,385	23,486
Demand in power plant busbars[63]	265,098	18,111	279,062	286,318
Consumption in energy transformation sector	-6,501	273,738	-6,967	-6,698
Transmission and distribution losses	-26,509	-7,466	-25,615	-26,173
Final electricity demand from non-energy sectors	232,088	**241,021**	**246,480**	**253,448**

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Main conclusions related to the Baseline Scenario:

- The final electricity demand in Spain increases by 5.2% during the period covered, going from 232 TWh in 2020 to 253 TWh in 2030.
- The net balance at the border is import for the year 2020, amounting to 8.86 TWh, turning into export in 2030, amounting to 2.34 TWh.

[63] Demand in power plant busbars defined as energy injected into the network from generation centres and imports, deducting consumption in pumping and exports.

- The percentage of renewable generation in the electricity sector for 2020 stands at 41%, increasing to 52% in 2030, i.e. 11 percentage points difference.

Table A.22. Gross electricity generation in the Target Scenario

Gross electricity generation in the Target Scenario* (GWh)				
Years	2015	2020	2025	2030
Wind (onshore and offshore)	49,325	60,670	92,926	119,520
Solar photovoltaic	8,302	16,304	39,055	70,491
Solar thermoelectric	5,557	5,608	14,322	23,170
Hydroelectric power	28,140	28,288	28,323	28,351
Storage	3,228	4,594	5,888	11,960
Biogas		813	1,009	1,204
Geothermal energy	743	0	94	188
Marine energy		0	57	113
Coal	52,281	33,160	7,777	0
Combined cycle	28,187	29,291	23,284	32,725
Coal cogeneration	395	78	0	0
Gas cogeneration	24,311	22,382	17,408	14,197
Petroleum products cogeneration	3,458	2,463	1,767	982
Other	216	2,563	1,872	1,769
Fuel/Gas	13,783	10,141	7,606	5,071
Renewables cogeneration	1,127	988	1,058	1,126
Biomass	3,126	4,757	6,165	10,031
Cogeneration with waste	192	160	122	84
Municipal solid waste	1,344	918	799	355
Nuclear	57,196	58,039	58,039	24,952
Total	**280,911**	**281,219**	**307,570**	**346,290**

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Table A.23. Target Scenario electricity mix

Target Scenario electricity mix (GWh)				
Years	2015	2020	2025	2030
Gross electricity generation	281,021	281,219	307,570	346,290
Consumption in generation	-11,270	-10,528	-10,172	-10,233
Net electricity generation	269,751	270,690	297,398	336,056
Consumption in pumping and batteries	-4,520	-6,381	-7,993	-15,262
Export	-15,089	-9,251	-26,620	-48,325
Import	14,956	18,111	12,638	8,225
Demand in power plant busbars	265,098	273,170	275,424	280,694
Consumption in energy transformation sector	-6,501	-7,552	-6,725	-6,604
Transmission and distribution losses	-26,509	-25,161	-25,022	-24,868
Final electricity demand from non-energy sectors	232,088	**240,457**	**243,677**	**249,222**

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Main conclusions related to the Target Scenario:

- Final electricity demand increases from 240.5 TWh in 2020 to 249.2 TWh in 2030, rising by 4%.
- The net balance at the border is clearly export in 2030, totalling 40 TWh. This balance is driven by the high penetration of renewable capacity in the system.
- The percentage of renewable generation in the electricity sector experiences a 32-percentage-point increase during this period, going from 42% in 2020 to 74% in 2030.

Thus, looking at both scenarios together, Baseline and Target, for 2030, it is important to highlight the main differences:

- Total installed capacity of 124 GW compared to 161 GW, i.e. over 36 GW more of installed capacity in the Target Scenario compared to the Baseline Scenario.
- Net increase of renewable capacity of 62.3 GW in the Target Scenario compared to the 20 GW in the Baseline Scenario.
- Organised, phased and flexible closure of nuclear facilities, affecting four reactors during the Plan's validity period. Similarly, the termination of electricity generation by coal-fired power plants. On the other hand, the service life of all nuclear facilities is extended in the Baseline Scenario and it is assumed that coal-fired power plants that remain after 2021 are fully operational.
- Higher gross electricity demand in the Target Scenario, amounting to 38.3 TWh (12% increase compared to the Baseline).
- Higher percentage of renewable generation in the electricity sector in the Target Scenario: 74%, equivalent to 23 percentage points above what would be achieved in the Baseline Scenario.
- The net balance at the border strengthens its exporting role in the Target Scenario.

A.3 ENERGY EFFICIENCY DIMENSION

This heading refers to the effects of the energy efficiency policies and measures of the different sectors of the economy. It has been mentioned before that one of the vectors that has guided the development of the Plan is to reduce GHG emissions, while two main directions can be distinguished within the proposed measures to do this:

- The replacement of fossil fuels with other energy sources that are less polluting or more energy efficient.
- Reducing energy consumption to satisfy the same demands or, in other words, increasing energy efficiency, which is the subject of this section.

A.3.1 Primary energy consumption

The tables below set out the aggregate primary energy for all sectors both for the Baseline Scenario and for the Target Scenario.

Table A.24. Primary energy consumption including non-energy uses in the Baseline Scenario

Primary energy consumption including non-energy uses in the Baseline Scenario (ktoe)				
Years	2015	2020	2025	2030
Coal	13,583	10,351	4,997	4,506
Oil and its derivatives	53,045	54,950	53,773	51,758
Natural gas	24,538	27,144	30,012	30,259
Nuclear energy	14,903	15,118	15,118	15,118
Renewables	16,620	20,866	23,562	25,132
Industrial waste		288	307	322
MSW (non-renewable)	252	168	142	66
Electricity	-11	762	427	-201
Total	122,930	129,647	128,337	126,959

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Table A.25. Primary energy consumption including non-energy uses in the Target Scenario

Primary energy consumption including non-energy uses in the Target Scenario (ktoe)				
Years	2015	2020	2025	2030
Coal	13,583	9,084	3,743	2,133
Oil and its derivatives	53,045	55,619	49,302	40,646
Natural gas	24,538	26,690	24,257	24,438
Nuclear energy	14,903	15,118	15,118	6,500
Renewables	16,620	20,764	26,760	33,383
Industrial waste		302	303	381
MSW (non-renewable)	252	168	142	66
Electricity	-11	762	-1,202	-3,448
Total	122,930	**128,507**	**118,422**	**104,099**

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

These are the main conclusions with regard to the tables above:

- The consumption of petroleum products and natural gas in **2015** exceeds 60% of the total. The policies and measures included in the Plan succeeded in reducing this dependency on hydrocarbons in the country's energy mix.
- **In the Baseline Scenario**, primary energy consumption in 2030 increases by approximately 3% starting from 2015.
- **In the Target Scenario:**
    - The impact of the policies and measures to decarbonise the economy is reflected, as well as the significant introduction of renewables in the primary energy mix. The reduction in primary energy consumption in 2030 compared to 2015 is 15%, which contrasts with the increase recorded in the Baseline Scenario for the same period mentioned previously.
    - Consumption from renewables doubles in 2030 compared to 2015.
    - Coal consumption decreases to practically one-tenth of the 2015 consumption, due mainly to the gradual closure of coal-fired power plants.
    - Petroleum product consumption drops by 23% compared to 2015, while natural gas remains at similar levels.
    - The consumption of energy from nuclear technology is decreasing, accompanying the scheduled, phased and organised closure of power plants.

A.3.2 Final energy consumption

The total final energy consumption projections for each of the sectors included in the model are shown below: industry, residential, service and transport.

Table A.26. Final energy consumption including non-energy uses in the Baseline Scenario

Final energy consumption including non-energy uses in the Baseline Scenario (ktoe)				
Years	2015	2020	2025	2030
Coal	1,503	1,525	1,586	1,644
Petroleum products	40,674	42,290	41,859	40,184
Natural gas	13,139	15,203	16,357	16,482
Electricity	19,952	20,582	21,049	21,646
Renewable energy	5,292	7,115	6,898	6,856
Other non-renewables	2	295	313	326
Non-energy	4,350	5,122	5,442	5,691
Total	84,912	**92,133**	**93,504**	**92,829**

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Table A.27. Final energy consumption including non-energy uses in the Target Scenario

Final energy consumption including non-energy uses in the Target Scenario (ktoe)				
Years	2015	2020	2025	2030
Coal	1,503	1,440	1,438	1,408
Petroleum products	40,674	41,930	37,153	29,275
Natural gas	13,139	15,119	14,711	13,774
Electricity	19,952	20,534	20,813	21,294
Renewable energy	5,292	6,943	7,195	7,426
Other non-renewables	2	309	309	385
Non-energy	4,350	5,105	5,400	5,639
Total	84,912	**91,382**	**87,019**	**79,199**

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

The main comments on final energy consumption are presented below:

- The main difference between the Baseline and Target Scenarios is that final energy consumption increases in the former and decreases in the latter. The Target Scenario shows a very significant decrease, around 30%, in petroleum product consumption. Owing to all the proposed measures, the Spanish economy will be more efficient in 2030 and less dependent on oil.
- Regarding the Target Scenario:
    - Final energy consumption decreases by around 7% between 2015 and 2030, despite the fact that the economic path is always growing. This means that, with the proposed measures, progress will be made in decoupling economic growth and energy consumption.
    - Electricity consumption increases by around 7%.
    - The estimated final petroleum product consumption for 2030 decreases by 28% compared to the actual 2015 data. However, natural gas consumption increases by around 5%.
    - Renewable energy consumption increases by around 40%.

In conclusion, the needs of the Spanish economy in 2030 will be satisfied in a more efficient manner in energy terms.

Industrial Sector

The following tables set out final energy consumption in the industrial sector.

Table A.28. Final energy consumption in the industrial sector (excluding non-energy uses) for the Baseline Scenario

Final energy consumption in the industrial sector (excluding non-energy uses) for the Baseline Scenario (ktoe)				
Years	2015	2020	2025	2030
Coal	1,404	1,437	1,546	1,604
Petroleum products	2,718	2,190	2,067	2,033
Natural gas	6,895	7,445	7,825	7,664
Electricity	6,539	7,172	7,586	8,200
Renewable energy	1,346	1,600	1,680	1,757
Other non-renewables	0	288	307	322
Total	18,902	20,131	21,011	21,579

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Table A.29. Final energy consumption in the industrial sector (excluding non-energy uses) for the Target Scenario

Final energy consumption in the industrial sector (excluding non-energy uses) for the Target Scenario (ktoe)				
Years	2015	2020	2025	2030
Coal	1,404	1,360	1,423	1,408
Petroleum products	2,718	2,035	1,680	1,387
Natural gas	6,895	7,310	7,294	7,202
Electricity	6,539	7,167	7,290	7,414
Renewable energy	1,346	1,597	1,667	1,779
Other non-renewables	0	302	303	381
Total	18,902	19,771	19,657	19,570

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

As regards industry in the Target Scenario, the following can be highlighted:

- Decrease in final energy consumption compared to the Baseline Scenario, as a consequence of energy efficiency policies and measures.
- This decrease in final consumption translates directly into coal and petroleum products, thus contributing to reducing the industrial sector's GHG emissions.

Residential

The following tables set out final energy consumption in the residential sector.

Table A.30. Final energy consumption in the residential sector (excluding non-energy uses) for the Baseline Scenario

Final energy consumption in the residential sector (excluding non-energy uses) for the Baseline Scenario (ktoe)				
Years	**2015**	**2020**	**2025**	**2030**
Coal	89	49	0	0
Petroleum products	3,001	2,236	1,351	459
Natural gas	3,022	3,827	4,485	4,783
Electricity	6,025	5,937	5,913	5,763
Renewable energy	2,745	2,732	2,410	2,345
General total	14,882	**14,782**	**14,159**	**13,350**

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Table A.31. Final energy consumption in the residential sector (excluding non-energy uses) for the Target Scenario

Final energy consumption in the residential sector (excluding non-energy uses) for the Target Scenario (ktoe)				
Years	**2015**	**2020**	**2025**	**2030**
Coal	89	49	0	0
Petroleum products	3,001	2,236	1,240	285
Natural gas	3,022	3,929	4,005	3,750
Electricity	6,025	5,884	5,762	5,482
Renewable energy	2,745	2,640	2,598	2,876
General total	14,882	**14,739**	**13,605**	**12,394**

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Several conclusions can be drawn from the data presented in the tables above. Firstly, final energy consumption decreases in the Target Scenario compared to the Baseline. Similarly, there is a reduction in fossil fuel consumption and coal is eliminated, while, on the other hand, the contribution of renewable energy increases.

Services and other

The following tables set out final energy consumption in the services and other sector.

Table A.32. Final energy consumption in the services and other sector (excluding non-energy uses) for the Baseline Scenario

Final energy consumption in the services and other sector (excluding non-energy uses) for the Baseline Scenario (ktoe)				
Years	**2015**	**2020**	**2025**	**2030**
Coal	29	39	40	40
Petroleum products	1,111	1,042	714	447
Natural gas	2,819	3,544	3,661	3,552
Electricity	6,406	6,469	6,505	6,600
Renewable energy	156	242	212	192
Other non-renewables	2	7	6	4
General total	10,523	**11,343**	**11,137**	**10,834**

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Table A.33. Final energy consumption in the services and other sector (excluding non-energy uses) for the Target Scenario

Final energy consumption in the services and other sector (excluding non-energy uses) for the Target Scenario (ktoe)				
Years	**2015**	**2020**	**2025**	**2030**
Coal	29	30	15	0
Petroleum products	1,111	1,096	807	527
Natural gas	2,819	3,485	3,132	2,636
Electricity	6,406	6,481	6,328	6,229
Renewable energy	156	241	337	435
Other non-renewables	2	7	6	4
General total	10,523	**11,340**	**10,625**	**9,830**

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

The main conclusions drawn from the services and other sector are the increase in efficiency, as well as increased consumption of renewable energy. This all results in the reduction of petroleum product and natural gas consumption in the Target Scenario compared to the Baseline Scenario.

Transport

The following tables set out final energy consumption in the transport sector.

Table A.34. Final energy consumption in the transport sector (excluding non-energy uses) for the Baseline Scenario

Final energy consumption in the transport sector (excluding non-energy uses) for the Baseline Scenario (ktoe)				
Years	2015	2020	2025	2030
Petroleum products	31,657	34,766	35,622	35,103
Natural gas	328	257	286	415
Electricity	480	492	521	549
Renewable energy	958	2,422	2,434	2,358
Total	33,423	37,936	38,862	38,425

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Table A.35. Final energy consumption in the transport sector (excluding non-energy uses) for the Target Scenario

Final energy consumption in the transport sector (excluding non-energy uses) for the Target Scenario (ktoe)				
Years	2015	2020	2025	2030
Petroleum products	31,657	34,507	31,507	25,299
Natural gas	328	265	180	90
Electricity	480	490	866	1,555
Renewable energy	958	2,348	2,401	2,116
Total	33,423	37,610	34,954	29,059

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

The main conclusions that affect final energy consumption in the transport sector are presented:

- Firstly, there is a decrease in final energy consumption brought about by the measures to increase efficiency in the use of vehicles, the introduction of new, more efficient vehicles and modal shift policies.
- Similarly, there is a significant decrease in the consumption of petroleum products, which are replaced with electricity.
- Finally, gas consumption is lower in the Target Scenario than in the Baseline Scenario. This is due to the fact that the final consumption of the whole sector is considerably lower, and therefore compliance with the decarbonisation targets is achieved by using electrified vehicles, as well as through the decrease in the demand for fossil fuel vehicles due to the different modal shifts proposed.

Electrification of the economy

There are several measures implemented in this Plan that contribute to the electrification of the economy. In a context where electricity generation has a high renewable contribution, the electrification of the economy contributes to decarbonisation.

Electrification of final energy consumption (excluding non-energy uses and international aviation) undergoes a strong increase in the Target Scenario as a result of the measures implemented in this

Plan. In the Target Scenario, in 2030, electrification increases by 17.5% compared to the Baseline. Taking the year 2015 as a reference, the increase in electrification is 21.5%.

Sectorally, the largest contribution to electrification in the Target Scenario compared to 2015 is in transport, with a relative increase of 335% between the two years. In the residential sector, the increase is 10%, while there is also an improvement in electrification in the other sectors.

A.3.3 Energy intensity

The following table shows the energy intensity values for primary energy as well as final energy for both scenarios.

It can be seen that in the Baseline Scenario, there is already an improvement in energy intensities. In other words, the energy system is becoming more efficient in this 'status quo' scenario. Nevertheless, the additional efficiency policies and measures have a prominent effect in the Target Scenario.

In this case, energy intensity values are achieved that entail a decrease of approximately 30% in final energy and 36% in primary energy compared to the 2015 values. The energy intensity in 2015 was 115 toe/EUR m in primary energy, and 79 toe/EUR m in final energy.

Table A.36. Energy intensities for primary and final energy in the Baseline and Target Scenarios

Energy intensities for primary and final energy in the Baseline and Target Scenarios (toe / € m base year 2016)					
	Years	2015	2020	2025	2030
Baseline Scenario	Primary energy intensity	115	106	96	89
	Final energy intensity	79	75	70	65
Target Scenario	Primary energy intensity	115	105	89	73
	Final energy intensity	79	75	65	56

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

A.4 ENERGY SECURITY DIMENSION

This section analyses the effects of the country's primary energy mix on security of energy supply. The consumption of hydrocarbons (oil and natural gas) in primary energy accounts for approximately 60% of the total at present. For this reason, and considering that indigenous hydrocarbon production is residual, the supply of these types of fuels is fundamental for the country's energy security, defined as security of supply.

To reduce the exposure to risks that could represent a decrease in the supply of these fuels, two routes have been followed that are complementary to the other targets in this Plan:

- Firstly, an increase in the country's energy efficiency will reduce the total energy demand, and therefore less energy will be needed to meet this demand.
- Secondly, and to increase the effect of the above, in the Target Scenario there is significant replacement of fossil fuels with other indigenous fuels (almost entirely renewables).

It has been possible to see these two effects in the sections above that have explained the Spanish economy's primary and final energy consumption.

On the other hand, this section also analyses the external dependency of the electricity generation sector. This sector is also dependent on hydrocarbon consumption, although to a lesser extent than the rest of the economy.

A.4.1 Current energy mix, domestic energy resources, import dependency

The sections above have presented the different primary sources that form the origin of the energy supply to Spain, as well as the breakdown and future projection. The following observations can be made regarding security of supply based on these sources:

- The presence of natural gas in the Spanish energy mix is slightly lower than in other EU Member States, which can be explained, inter alia, by the following reasons:
    - a milder climate, resulting in lower penetration of natural gas among domestic consumers and central heating;
    - greater significance of natural gas in the generation of electricity, which means that its presence in final energy is clearly lower than the share in primary energy.
- As for petroleum products, their presence in the national energy mix is higher than the EU average. This can be explained by the following reasons:
    - a high development of freight transport by road at the expense of rail transport (2% on average in Spain, compared to 17% in the EU);
    - significant consumption for maritime transport compared to inland Member States;
    - significant consumption for air transport due to the importance of the tourism sector.

With reference to the national production of hydrocarbons, it should be noted that this is practically non-existent. Data for 2017 are as follows:

- **Domestic production of natural gas (2017):** 400 GWh (0.11% of total requirements). Domestic production is considered to be not only production from hydrocarbon deposits, but also the injection of biogas into the transmission network.
- **Domestic crude production (2017):** 0.12 tonnes (0.21% of requirements).

The main countries of origin for the different sources of energy are the following:

- **Electricity:** Spain has electricity interconnections with France, Portugal, Andorra and Morocco. Details of the imports and exports with these countries can be found in the table below.

Table A.37. Monthly physical international exchanges by border*

Monthly physical international exchanges by border (GWh)				
		2010	2015	2017
Inputs	Andorra	0	0	0
	France	1,983	9,131	15,564
	Portugal	3,189	5,811	8,190
	Morocco	34	14	8
	Total	5,206	14,956	23,763
Outputs	Andorra	264	264	233
	France	3,514	1,807	3,099
	Portugal	5,823	8,077	5,505
	Morocco	3,937	4,941	5,756
	Total	13,539	15,089	14,594
Balance *	Andorra	-264	-264	-233
	France	-1,531	7,324	12,465
	Portugal	-2,634	-2,266	2,685
	Morocco	-3,903	-4,927	-5,748
	Total	-8,333	-133	9,169

**Positive value: import balance; Negative value: export balance.*
Source: Red Eléctrica de España

- **Natural gas:** in 2017, 53% of imports were made through gas pipelines, compared to 47% in methane tankers in the form of liquefied natural gas (LNG) through regasification plants. The breakdown by country of origin of natural gas imports in 2017 was as follows:
    - Algeria (48%)
    - Nigeria (12%)
    - Peru (10%)
    - Qatar (10%)
    - Norway (10%)
    - Others (10%)

In light of the above, the relative dependence on the importation of natural gas from Algeria can be highlighted as a possible risk, which is offset by the high level of imports by methane tankers from a wide range of countries of origin.

- **Petroleum products:** the main countries of origin of crude oil in 2017 were the following. As can be seen, the diversification in the sources of oil origin is much higher than the diversification for gas:
  - Mexico (15%)
  - Nigeria (14%)
  - Saudi Arabia (10%)

A.4.2 Projections of development for the energy mix, domestic energy resources, import dependency with the existing policies and measures

The projection to 2030 is presented below for the breakdown of primary energy according to indigenous production and imports for the Baseline and Target Scenarios.

Table A.38. Evolution of the primary energy dependency ratio. Baseline Scenario (ktoe)

Origin of the primary energy, Baseline Scenario (Units: ktoe)				
	2015	**2020**	**2025**	**2030**
National production	**33,564 (27%)**	**37,189 (29%)**	**38,713 (30%)**	**40,878 (32%)**
Coal	1,246	736	0	0
Petroleum products	236	146	147	148
Natural gas	54	49	49	49
Nuclear	14,903	15,118	15,118	151,118
Renewable energy	16,873	20,685	22,951	25,174
Non-renewable waste	252	456	449	388
Net imported/exported	**89,366 (73%)**	**92,458 (71%)**	**89,623 (70%)**	**86,081 (68%)**
Coal	12,337	9,615	4,997	4,506
Petroleum products	52,809	54,804	53,626	51,610
Natural gas	24,484	27,096	29,963	30,209
Electricity	-11	762	427	-201
Renewable energy	-253	181	611	-43
Total Primary Energy	122,930	**129,647**	**128,337**	**126,959**

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Table A.39. Evolution of the primary energy dependency ratio. Target Scenario (ktoe)

Origin of the primary energy, Target Scenario (Units: ktoe)				
	2015	2020	2025	2030
National production	**33,564 (27%)**	**37,499 (29%)**	**41,909 (35%)**	**40,646 (39%)**
Coal	1,246	1,105	0	0
Petroleum products	236	146	147	148
Natural gas	54	49	49	49
Nuclear	14,903	15,118	15,118	6,500
Renewable energy	16,873	20,611	26,150	33,501
Non-renewable waste	252	470	445	448
Net imported/exported	**89,366 (73%)**	**91,008 (71%)**	**76,513 (65%)**	**63,453 (61%)**
Coal	12,337	7,979	3,743	2,133
Petroleum products	52,809	55,473	49,155	40,498
Natural gas	24,484	26,641	24,208	24,389
Electricity	-11	762	-1,202	-3,448
Renewable energy	-253	153	610	-119
Total Primary Energy	122,930	**128,507**	**118,422**	**104,099**

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Compared to the situation in 2017, where the external energy dependency ratio is 73%, the Target Scenario represents a reduction of 12 percentage points, reaching 61%. Progress will thus be made in reducing one of the most important structural weaknesses of the national energy system.

In addition, the importing of fossil fuels decreases by an even greater percentage than energy dependency. This effect is achieved due to the combination of the two effects mentioned at the beginning of this section: the reduction in overall energy consumption through the use of energy efficiency, and the replacement of the use of hydrocarbons with indigenous fuels (especially renewables and largely thanks to an increased electrification of the sectors).

With all of the above, a substantial improvement is projected on the 2030 horizon for the trade balance, provided that the policies and measures included in the Plan are complied with. Specifically, there is a shift from a net importation of 95,945 ktoe between coal, natural gas and oil in 2017 to 67,020 ktoe in 2030 (a 30% reduction).

With regard to electricity, the increase in the installed capacity from renewable energy sources increases security of the supply due to the use of indigenous sources and the increase in the diversification of sources. The Target Scenario achieves a figure of 74% of electricity generated using renewable energy sources. In terms of its relationship with security of supply, note should be taken of the increase in interconnections with France. This increase is planned to progressively move towards the targets set by the EU of an interconnection capacity of at least 15% of the installed capacity of each Member State. This point is analysed in greater detail in the next chapter.

A.4.3 Cybersecurity

The definition of the cybersecurity objective in the Annual National Security Report 2018 is: 'to ensure the secure use of information and communication networks and systems by strengthening capacities to prevent, detect and respond to cyberattacks by enhancing and adopting specific measures to help promote a secure and reliable cyberspace.'

An area of strategic relevance for National Security is **Critical Infrastructure**. In the 2013-2018 period, a clear upward trend was observed in the number of incidents recorded in this area, mainly malware and exploitation of system vulnerabilities, with more than 2,300 incidents in critical operators, with the financial, energy and transport sectors being the most affected, accounting for more than 50% of the cases.

An important step in the field of cybersecurity in Spain was the reform of the Criminal Code in 2015. This included important amendments on the crimes related to computer sabotage, in compliance with Directive 2013/40/EU of the European Parliament and of the Council of 12 August 2013, on attacks against information systems and replacing Council Framework Decision 2005/222/JHA.

The existence of regulations for the Protection of Critical Infrastructure in Spain since 2011 has also made it possible to transpose Directive 2016/1148 of the European Parliament and of the Council of 6 July 2016 concerning measures for a high common level of security of network and information systems across the Union (the **NIS Directive**), in a quick and simple manner due to having used the same procedures and accumulated knowledge to carry out this implementation. The entry into force of **Royal Decree-Law 12/2018 of 7 September 2018 on network and information system security** has transposed the aforementioned NIS Directive into Spanish law, giving a significant boost to the cybersecurity of essential services in the energy field.

In addition to this regulatory update, in April 2019, Spain approved its **National Cybersecurity Strategy**, the function of which is to develop the provisions of the 2017 National Security Strategy in the field of cybersecurity. This replaced the previous one, approved in 2013. It should also be noted that Spain has had a **National Energy Security Strategy** since 2015. In view of the major regulatory, technological and energy policy changes that have taken place in recent years, it is expected to be updated shortly.

This strategy has also strengthened and reinforced public-private collaboration with the various energy operators, a task that has been coordinated by the Cybersecurity Coordination Office (*Oficina de Coordinación Cibernética* – OCC) of the National Centre for the Protection of Critical Infrastructure and Cybersecurity (*Centro Nacional de Protección de Infraestructuras Críticas y Ciberseguridad* – CNPIC). Likewise, the designated critical operators in the field of energy and nuclear industry have presented their respective Operator Security Plans (OSP), checking their adjustment to the current situation of the threats and challenges to which critical infrastructure in the energy sector and nuclear industry are subject, and updating the information contained in these plans.

Finally, Spain has taken note of the **Commission Recommendation** to Member States on Cybersecurity in the Energy Sector dated 3 April 2019, and is preparing to systematically implement the recommendations on real time requirements for energy infrastructure, on what are referred to as cascade effects and on the appropriate combination of legacy and state-of-the-art technology.

A.5 INTERNAL ENERGY MARKET

This dimension analyses the various components that make up the internal energy market. Interconnectivity, energy transmission infrastructure and the integration of the energy market are highlighted due to their importance.

The two markets referred to in this section are electricity and gas. The international exchanges in the electricity market take place via interconnections between countries. International exchanges of gas, on the other hand, take place via gas pipelines or using tankers that transport liquefied natural gas. These international exchanges are fundamental for progressing towards a unified European energy market.

A.5.1 Interconnectivity

A.5.1.1 Electricity system interconnectivity

Current interconnection level and main interconnections

Spain is currently electrically interconnected with the Member States Portugal and France, as well as with Andorra and Morocco, which are not part of the EU.

The main characteristics of the interconnections with the various countries mentioned are explained below:

- The **interconnection with France** consists of five lines: Hernani-Argia 400 kV, Arkale-Argia 220 kV, Biescas-Pragnères 220 kV, Vic-Baixas 400 kV and Santa Llogaia-Baixas 400 kV.

  The Santa Llogaia-Baixas line is direct current and went into operation in October 2015 through the eastern Pyrenees. It is highly important as it made it possible to double the electrical exchange capacity with this country, reaching a total of 2,200-2,800 MW. It is also important given its influence on the quality and security of the supply and on the capacity for integrating renewable energy. Despite this latest line, the need to increase Spain’s capacity for interconnection with the European system continues to be a priority for the Spanish electricity system.

- The **interconnection with Portugal** is formed of 11 lines: Cartelle-Lindoso 400 kV 1 and 2, Conchas-Lindoso 132 kV, Aldeadavila-Lagoaça 400 kV, Aldeadavila-Pocinho 1 and 2,220 kV, Saucelle-Pocinho 220 kV, Cedillo-Falagueira 400 kV, Badajoz-Alcáçovas 66 kV, Brovales-Alqueva 400 kV, Rosal de la Frontera-V.Ficalho 15 kV and Puebla de Guzmán-Tavira 400 kV. These lines have a total exchange capacity of between 2,200 and 3,000 MW.

  There are plans to increase this capacity by constructing a new 400 kV line through Galicia between Fontefría (Spain) and Vilafría (Portugal), which will allow a total exchange capacity of about 4,300 MW to be reached together with the other existing lines.

- The **interconnection with Andorra** is via the 110-kV Adrall-Margineda line.
- Finally, the **interconnection with Morocco** is via two underwater 400-kV lines, which in total provide an exchange capacity of about 800 MW.

Commercial exchange capacity and ratio for electricity interconnection

The total capacity for effective exchange between two countries not only depends on the nominal capacities of the cross-border lines but also the related network, the distribution of electricity flows with the other interconnections and the location of the generation centres and consumption points. For this reason, the sum of the nominal capacities of the cross-border lines may be significantly lower than the total effective capacity.

The exchange capacity values of the mainland Spanish system with France, Portugal and Morocco are shown below for the period from 2013 to 2018, according to the information provided by the system operator.

The exchange capacity values available to the system operator are considered and two values are given, one with the 70th percentile[64] (in line with ENTSO-E[65]) and another with the maximum value (this makes it possible to see more clearly the increase in interconnection capacity in the same year in which this capacity improved).

Table A.40. Commercial capacity for electricity exchange

Commercial capacity for electricity exchange (MW)				
	NTC France -> Spain		NTC Portugal -> Spain	
	70th percentile	Maximum value	70th percentile	Maximum value
2013	1,200	1,300	2,000	2,400
2014	1,200	1,300	2,100	2,900
2015	1,300	2,950	3,000	4,000
2016	2,750	3,500	2,800	3,900
2017	2,850	3,500	3,200	4,000
2018[66]	2,900	3,600	3,500	4,000

Source: Red Eléctrica Española

The values of the interconnection ratios presented below were calculated applying the following additional considerations assumed by REE and based on those defined by ENTSO-E:

- To calculate the ratio of the mainland Spanish system, the borders with France and Portugal are considered. Morocco is not considered, as it is not subject to the obligations and commitments at European level.
- To calculate the Iberian Peninsula ratio, only the France-Spain border is considered.
- For the purposes of calculating the numerator, the sum of the import capacities from Spain is considered for the period taken into account. The import capacity values are obtained from the hourly Net Transfer Capacity (NTC) values published on eSIOS[67].

[64] The 70th percentile is the value normally used to determine the exchange capacity of international interconnections. This percentile is used to leave a certain safety margin.
[65] ENTSO-E, *the European Network of Transmission System Operators for Electricity*, represents 43 transmission system operators (TSOs) from 36 European countries.
[66] Up to 15 June 2018
[67] eSIOS is the information system of the Spanish system operator (REE). https://www.esios.ree.es/es

- The installed capacity value is the value corresponding to the start of the period considered.

Table A.41. Development of Spain-Portugal installed electricity generation capacity

Year	Installed capacity (MW) Spanish Peninsular System[68]	Installed capacity (MW) Portuguese System
2013	102,378	18,494
2014	102,908	17,792
2015	102,827	17,776
2016	103,287	18,563
2017	102,371	19,518
2018[11]	101,207	19,800

Source: Red Eléctrica Española

Table A.42. Electricity interconnection ratio

Year		70th percentile	Maximum	Observations
		Electricity interconnection ratio		
2013	**Spain**	3.1%	3.6%	
	Iberian Peninsula	*1.0%*	*1.1%*	
2014	**Spain**	3.2%	4.1%	May 2014: Placing in service of the Spain-Portugal southern interconnection (Puebla de Guzmán-Tavira)
	Iberian Peninsula	*1.0%*	*1.1%*	
2015	**Spain**	4.2%	6.8%	June 2015: Placing in service of the Spain-France interconnection through Catalonia (Santa Llogaia-Baixas)
	Iberian Peninsula	*1.1%*	*2.5%*	
2016	**Spain**	5.4%	7.2%	
	Iberian Peninsula	*2.3%*	*2.9%*	
2017	**Spain**	5.9%	7.3%	
	Iberian Peninsula	*2.4%*	*2.9%*	
2018[69]	**Spain**	6.3%	7.5%	
	Iberian Peninsula	*2.4%*	*2.9%*	

Source: Red Eléctrica de España

[68] Includes the installed capacity in the Balearic Island system from the placing in service of the Peninsula-Mallorca link
[69] Up to 15 June 2018

Projections of interconnector expansion requirements

The Council of Ministers Agreement of 16 October 2015 approved the document ‘Energy Planning. Electricity Transmission Network Development Plan 2015-2020’ (Planificación Energética. Plan de Desarrollo de la Red de Transporte de Energía Eléctrica 2015-2020), provided for in Article 4 of Law 24/2013 of 26 December 2013 on the Electricity Sector and published by Order IET/2209/2015 of 21 October 2015. This plan replaces the part corresponding to the electricity transmission network in the document ‘Electricity and Gas Sector Planning 2008-2016’ (‘Planificación de los Sectores de Electricidad y Gas 2008-2016’), approved by the Council of Ministers on 30 May 2008.

The 2015-2020 plan includes a new 400-kV line through Galicia, called Fontefría-Vilafría, to boost the **Spain-Portugal interconnection**.

Likewise, to improve the **Spain-France interconnection**, a 550-MVA phase shifter was included on the 2015-2020 horizon, located in Arkale between the Arkale substation (Oiartzun, Gipuzkoa) and Argia (France). This is a key element for increasing the capacity for exchange with Europe and the security of supply. This system, declared a Project of Common Interest by the European Union and placed in service on 30 June 2017, involved an investment of EUR 20 m.

In addition, Annex II of the 2015-2020 planning document sets out, **on a non-binding basis,** the electricity transmission network infrastructure that it is considered necessary to place in service during the years following its planning horizon (after 2020). The inclusion of an installation in this Annex makes it possible to start the relevant administrative procedures for the abovementioned installations.

Since it has a longer time horizon for implementation, this Annex sets out the following interconnections with France:

- underwater interconnection with France via the Bay of Biscay: Gatika-Cubnezais;
- interconnection through the western Pyrenees: two alternatives, one for interconnection with France from Ichaso, the other via Navarre (Muruarte);
- interconnection through the central Pyrenees via Aragon (Ejea de los Caballeros).

The system operator continues to manage the projects in these three future interconnections. The consultation and public participation stage for the interconnection via the Bay of Biscay, which is the interconnection with the highest degree of progress, closed in March 2018.

Likewise, the abovementioned Annex II of the planning includes a new Spain-Andorra interconnection, via the double-circuit overhead 220 kV line between the Adrall substation and the Andorran border.

With the placing in service of the underwater interconnection with France via the Bay of Biscay, it will get a 5,000 MW interconnection with the rest of Europe. Once the trans-Pyrenean projects are placed in service, this interconnection will reach 8,000 MW. It is important to note that the European interconnection targets would still not be reached despite this significant growth in interconnection capacity.

A.5.1.2 Gas system interconnectivity:
Current interconnection level and main interconnections

Spain currently has six physical interconnections, four with EU Member States and two with third countries.

Interconnections with France
There are two physical interconnections with France, via the municipalities of Irún (Gipuzkoa) and Larrau (Navarre). Both are managed as a single interconnection or virtual point (VIP Pirineos). The transmission capacities are as follows:

- France-Spain direction: 165 GWh/day firm + 65 GWh/day interruptible.
- Spain-France direction: 225 GWh/day.

Over the course of 2017, the net importation via this interconnection was 43 TWh, which represents a daily net flow of 121 GWh/day in the North-South direction, although with marked seasonality. The usual flow is therefore France-Spain, although it may be reversed on particular occasions.

It is worth bearing in mind that the interconnection capacity of Spain, and in the Iberian Peninsula as a whole, is counted among the smallest in the EU. In 2017, the maximum demand was recorded on 5 December, with 1,772 GWh/day. For that specific day, the firm interconnection capacity with France could only contribute 9% of the demand, a percentage that would be able to reach up to 13% taking into account the interruptible capacity.

Interconnections with Portugal
There are two physical interconnections with Portugal, via the municipalities of Badajoz and Tuy (Pontevedra). Like the interconnection with France, these are managed as a single interconnection or virtual point (VIP Ibérico). The transmission capacities are as follows:

- Portugal-Spain direction: 80 GWh/day.
- Spain-Portugal direction: 144 GWh/day.

Over the course of 2017, the net exportation via this interconnection was 30 TWh, which represented a daily net flow of 82 GWh/day.

Interconnections with Algeria
There are two physical interconnections with Algeria, both one-way in an import direction:

- The Maghreb-Europe Gas Pipeline, which crosses Morocco and enters Spain via the municipality of Tarifa (Cádiz), with a transmission capacity of 444 GWh/day.
  Over the course of 2017, the importation via this interconnection was 86 TWh, which represented a net flow of 237 GWh/day.
- The Medgaz gas pipeline, which enters Spain via the municipality of Almería, with a transmission capacity of 290 GWh/day, which could be increased by an additional 25% with investments in Algerian territory.
  Over the course of 2017, the importation via this interconnection was 75 TWh, which represented a net flow of 205 GWh/day.

A.5.2 Energy transmission infrastructure

A.5.2.1 Electricity transmission infrastructure

Key characteristics of the existing transmission infrastructure for electricity

In accordance with the information provided by REE, the length of the total national transmission network, as at 31 December 2017, was 43,930 km. Moreover, there were 5,719 busbar connections in substations. For its part, the installed transmission capacity increased to a national total of 86,654 MVA.

The breakdown of lines by voltage level and considering their distribution between the Peninsula and the island systems or non-peninsular territories is shown below.

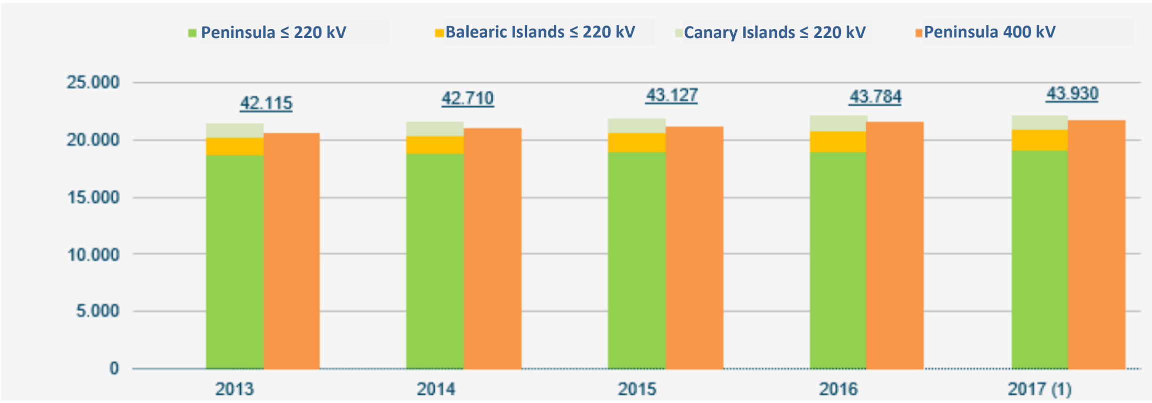
Table A.43. Transmission network installations in Spain

	400 kV	≤ 220 kV			
	Peninsula	Peninsula	Balearic Islands	Canary Islands	Total
Total lines (km)	**21,728**	**19,039**	**1,808**	**1,355**	**43,930**
Overhead lines (km)	21,611	18,264	1,089	1,080	42,045
Subsea cable (km)	29	236	540	30	835
Underground cable (km)	88	539	179	245	1,051
Transformation (MVA)	**80,208**	**613**	**3,273**	**2,560**	**86,654**

Provisional data pending audit in progress.

Source: Red Eléctrica de España

Figure A.1. Development of the transmission network length



Source: Red Eléctrica de España

Table A.44. Development of the transmission network of 400 and ≤ 220 kV (km of circuit)

Year	400 kV	≤ 220 kV
1978	5,732	13,258
1979	8,207	13,767
1980	8,518	14,139
1981	8,906	13,973
1982	8,975	14,466
1983	9,563	14,491
1984	9,998	14,598
1985	10,781	14,652
1986	10,978	14,746
1987	11,147	14,849
1988	12,194	14,938
1989	12,533	14,964
1990	12,686	15,035
1991	12,883	15,109
1992	13,222	15,356
1993	13,611	15,442
1994	13,737	15,586
1995	13,970	15,629
1996	14,084	15,734
1997	14,244	15,776

Year	400 kV	≤ 220 kV
1998	14,538	15,876
1999	14,538	15,975
2000	14,918	16,078
2001	15,364	16,121
2002	16,067	16,296
2003	16,592	16,344
2004	16,841	16,464
2005	16,846	16,530
2006	17,052	16,753
2007	17,191	16,817
2008	17,765	17,175
2009	18,056	17,307
2010	18,792	17,401
2011	19,671	18,001
2012	20,109	18,370
2013	20,639	18,643
2014	21,094	18,782
2015	21,184	18,922
2016	21,619	19,010
2017 (1)	21,728	19,039

Source: Red Eléctrica de España

In addition, the transmission network has the following reactive energy and voltage control elements, reactors and capacitors:

Table A.45. Reactive energy and voltage control elements in the transmission network

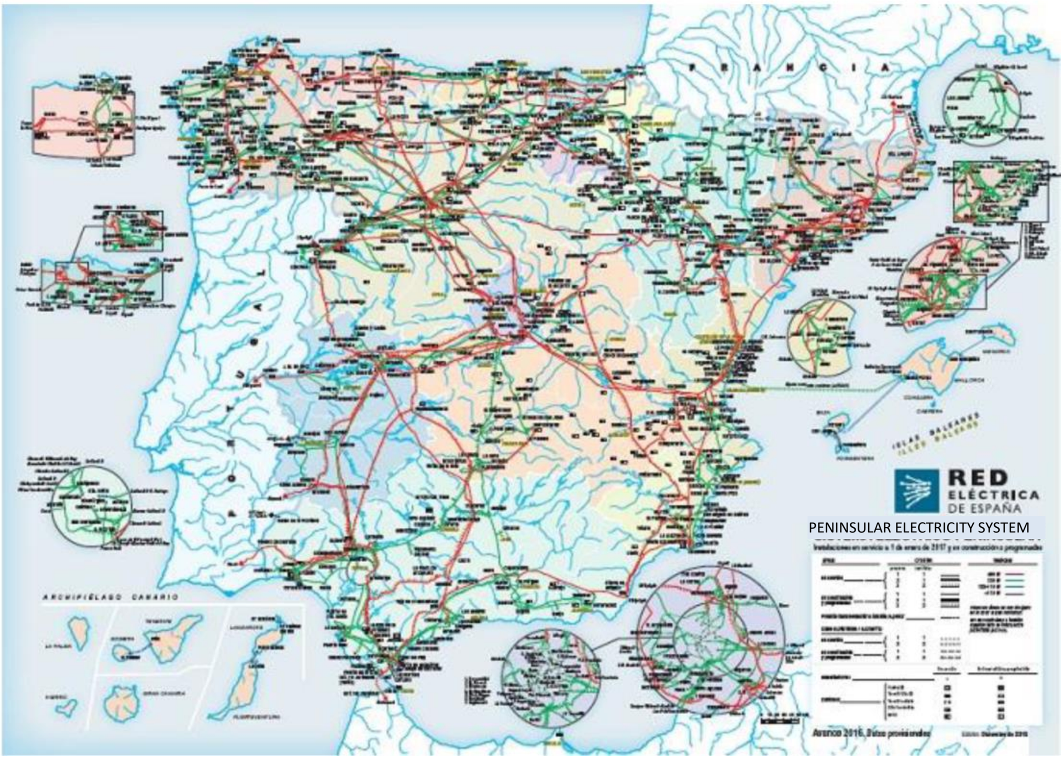
	400 kV	≤ 220 kV			
	Peninsula	Peninsula	Balearic Islands	Canary Islands	Total
Reactors (MVAr)	**9,050**	**3,414**	**373**	**0**	**12,837**
Number of units	62	54	17	0	133
Capacitors (MVAr)	**200**	**1,100**	**0**	**0**	**1,300**
Number of units	2	11	0	0	13

Source: Red Eléctrica de España

The map of the Spanish electricity system is shown below[70].

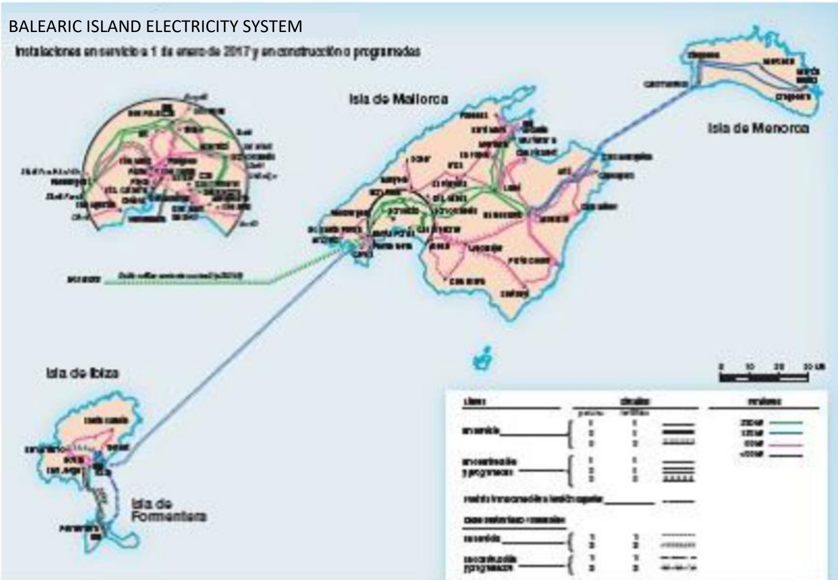
[70] For more details, please see the TSO's web page: http://www.ree.es/es/actividades/gestor-de-la-red-y-transportista/mapas-de-la-red

Figure A.2. Map of the Peninsular electricity system



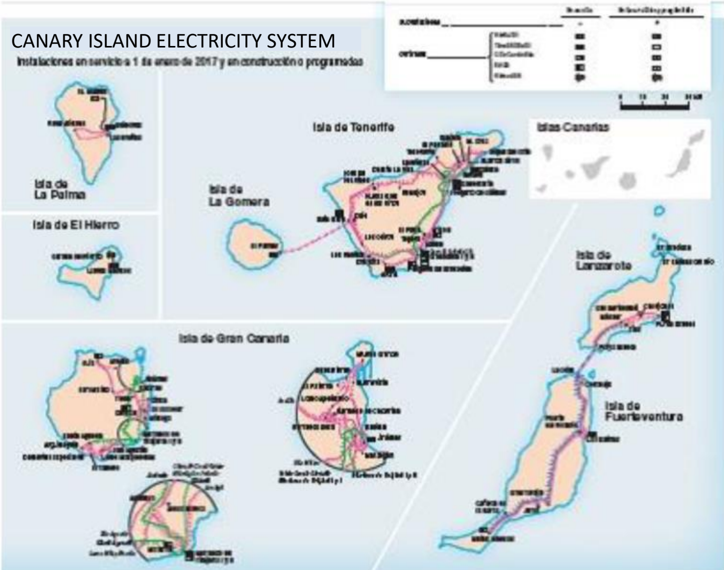
Source: Red Eléctrica de España

Figure A.3. Map of the Balearic Island electricity system



Source: Red Eléctrica de España

Figure A.4. Map of the Canary Island electricity system



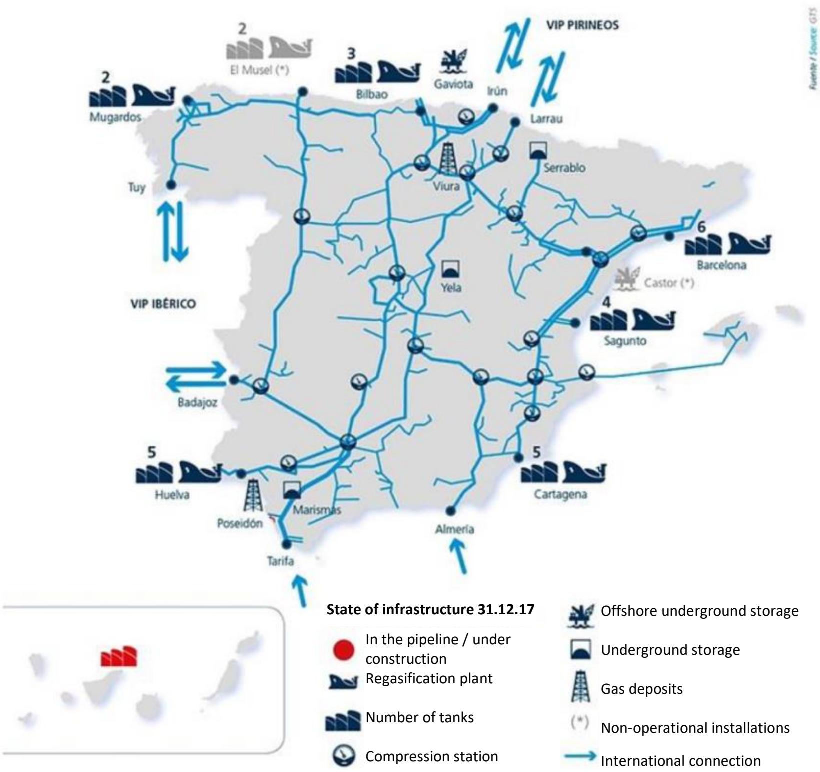
Source: Red Eléctrica de España

A.5.2.2 Gas transmission infrastructure

Key characteristics of the existing transmission infrastructure for gas

Spain has a gas transmission network with sufficient capacity to cope with the needs of supply and delivery to the distribution network in the medium term.

Figure A.5. Gas infrastructure map



Source: Sedigas

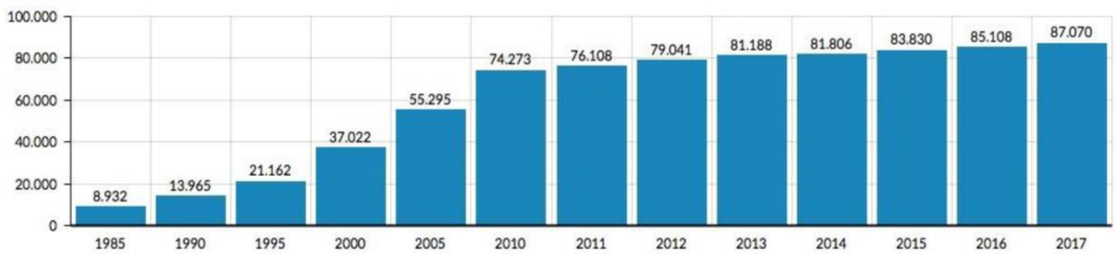
Gas pipeline network

Law 34/1998 on the hydrocarbons sector established the following definitions:

- Gas pipelines for primary transmission of natural gas at high pressure: any gas pipelines with a maximum design pressure equal to or higher than 60 bar.
- Gas pipelines for secondary transmission: any gas pipelines with a maximum design pressure between 60 and 16 bar.
- Distribution gas pipelines: any gas pipelines with a maximum design pressure equal to or less than 16 bar and any others that, regardless of their maximum design pressure, are intended for conducting the gas to a single consumer starting from a gas pipeline in the basic network or secondary transmission pipeline.

As at the end of 2017, there were 11,369 km of primary transmission gas pipeline, 1,992 km of secondary transmission gas pipeline and 74,000 km of distribution gas pipeline, with the transmission and distribution network totalling 87,000 km. The majority of this network is newly built, as shown in the figure below.

Figure A.6. Development of the natural gas transmission and distribution network length (km)



Source: Sedigas

As regards the transmission network, during the 2017 financial year only two secondary transmission gas pipelines were put into operation:

- the Yeles-Seseña gas pipeline, with a maximum working pressure of 59 bar, length of 9 km and diameter of 8”;
- the Villacarrillo-Villanueva del Arzobispo gas pipeline with a maximum pressure of 49.5 bar, length of 12 km and diameter of 8”.

Lastly, the gas pipeline network has 19 compressor stations that make it possible to transport the gas from the system’s various points of entry to its final destinations, as shown in figure A.5 below.

Regasification plants

At the end of 2017, the gas system had six operational regasification plants, with the following aggregate characteristics:

- Regasification capacity: 1,900 GWh/day
  The plants’ average production in 2017 was 496 GWh/day.
- LNG storage capacity: 3.3 million m^3 of LNG (22.5 TWh). The average filling level of the tanks during 2017 was 9.8 TWh.

The table below shows the operational regasification plants and their technical characteristics:

Table A.46. Regasification plants

Regasification plant	Maximum vaporisation capacity	LNG Storage		Loading capacity of tanks	Berthings	
	Nm³/h	No of tanks	m³ LNG	GWh/day	No of berthings	m³ LNG
Barcelona	1,950,000	6	760,000	15	2	266,000
Huelva	1,350,000	5	619,500	15	1	180,000
Cartagena	1,350,000	5	587,000	15	2	266,000
Bilbao	800,000	3	450,000	5	1	270,000
Sagunto	1,000,000	4	600,000	103	1	266,000
Mugardos	412,800	2	300,000	103	1	266,000
Total	**6,862,800**	**25**	**3,316,500**	**71**	**8**	**Up to 270,000**

Source: Enagás GTS

Underground storage

At the end of 2017, the gas system had four underground storage facilities, operated as a single storage facility for the purposes of commercial contracting, with the following characteristics:

- Useful storage capacity: 31.7 TWh, excluding cushion gas.
- Stocks varied in 2017 between 17 TWh (February) and 25 TWh (October), of which 17 TWh corresponded to strategic stocks.
- Maximum injection capacity: 127 GWh/day.
- Maximum extraction capacity: 215 GWh/day (most favourable point of the decline curve).

A.5.3 Electricity and gas markets, energy prices

A.5.3.1 Electricity markets and prices

The development of the components of the final price of energy in recent years is shown below.

Table A.47. Average final electricity price components. Peninsular demand. Prices in power plant busbars.

Years	Daily market	Intraday	Adjustment services	Technical restrictions	Payments by capacity	Interrup.	Total
2007	41.08	0.00	0.94	1.34	3.90	0.00	**47.26**
2008	65.91	0.00	0.94	1.66	1.07	0.00	**69.57**
2009	38.17	-0.02	0.85	1.85	2.49	0.00	**43.33**
2010	38.46	-0.02	1.21	2.55	3.49	0.00	**45.68**
2011	50.97	-0.06	1.12	2.09	6.10	0.00	**60.22**
2012	48.84	-0.04	2.04	2.58	6.09	0.00	**59.52**
2013	46.23	-0.06	2.30	3.29	6.04	0.00	**57.80**
2014	43.46	-0.04	1.93	3.76	5.93	0.00	**55.05**
2015	51.67	0.00	1.30	2.98	5.03	1.98	**62.95**

Source: National Commission on Markets and Competition (Comisión Nacional de los Mercados y la Competencia)

A.5.3.2 Gas markets and prices Current situation of the gas market. Supplies

In the structure of supplies and flows of gas at entry points, the importance of LNG provision (around 40%) stands out, as well as the weight of Algeria as the main supplier country (48% in 2017).

The customs records published by the tax office and analysed by the National Commission on Markets and Competition in its Monitoring Report on the Natural Gas Market in Spain (*Informe de Supervisión del Mercado de Gas Natural en España*) show the following facts for 2017:

- the average cost of supplies was EUR 17.55/MWh, compared to EUR 15.58/TWh in 2016;
- there is a high correlation between the gas supply prices and the Brent barrel price, given that the price of the majority of Spanish gas traders' long-term contracts, especially with Algeria, is indexed to the price of oil. This explains the price increase in 2017 compared to 2016.

Wholesale market

Defined as the market made up of the transactions carried out by traders in the Spanish gas system, as these transactions are made in regasification plants, underground storage facilities (managed as a single storage facility) or the virtual balancing point (PVB) of the gas pipeline network.

The Spanish wholesale market is characterised by the following:

- The prominence of the over-the-counter market, in which 97.5% of transactions were concentrated in 2017.
- Less trading activity than in other Member States due to the reduced capacity for interconnection with France and, therefore, the reduction of arbitrage opportunities.
- The importance of LNG transactions in regasification plant tanks, forming six additional hubs for the PVB, with the most liquidity being concentrated in the Barcelona plant.

- A significant concentration of the market in a small number of companies. In 2016, the share of transactions notified to the technical system operator by the five companies with the most activity in the market was 45%.

The main figures characterising the wholesale gas market in Spain are the following:

- The total gas traded on the wholesale over-the-counter market in 2017 was 515 TWh, 150% of national demand, distributed over 177,000 transactions. The majority of these volumes, around 60%, are negotiated at the PVB, with the remaining 38% corresponding to regasification plant tanks and barely 2% to underground storage facilities.
- For their part, the transactions made on the organised wholesale market (MIBGAS), represented a volume of 13.38 TWh, 3.8% of national demand, distributed over 67,500 transactions. For the moment, only products delivered at the PVB are traded on MIBGAS.

As regards the marginal price of the wholesale market, it can be considered that its dynamics are influenced by the following prices:

- The price of LNG in regasification plant tanks, including the regasification tariff. Logically, the price of LNG in the tanks depends in turn on evolution in the price of the raw material, the cost of methane tanker transport and the unloading tariff.
- The price of the flexible volumes of Algerian gas transported via the Maghreb and Medgaz gas pipelines, indexed to the price of oil.
- The price of the gas in the Southern France balancing area (TRS hub), including the French network output tariff and Spanish network input tariff.

Therefore, the price on the wholesale market is especially sensitive to LNG price movements, as well as price developments in the main EU hubs, although this influence is dampened by the reduced interconnection capacity and high price of the French network output tariff. It is precisely the price at the TRS hub, which is equally sensitive to LNG prices and increased by the cost of tariffs, that is closest in the long term to the price on the Spanish market.

Organised wholesale market

MIBGAS, the organised gas market, began its operations on 15 December 2015; it is where spot products with delivery at the PVB are traded. There was a significant increase in the number of participants, the volume and number of offers and transactions in the period up to December 2017:

Table A.48. Operations of MIBGAS, the organised gas market

Operations on MIBGAS			
PARAMETER	**2016**	**2017**	**2018***
Number of registered agents	44	65	71
Average daily number of active agents	27	34	45
Volume traded (GWh)	6,566	13,376	11,285
Churn rate (volume traded/national demand)	2.05%	3.81%	6.31%
Intraday product volume (D) (GWh)	2,309	6,299	4,481
Daily product volume (D+1) (GWh)	2,635	4,107	3,010
Daily product volume (M+1) (GWh)	1,005	1,702	2,355

Period* **(January-June)

Source: Organised wholesale gas market[71]

As can be observed in the table above, in 2018 a degree of relative maturity was reached in the number of registered and active agents, but the volume of gas traded continued to grow. This trend is especially striking in the case of the monthly product, which in the first half of 2018 exceeded the volume of gas matched in the entire 2017 financial year.

Moreover, the tracking of the gas target model metrics carried out by MIBGAS, the market operator, in its 2017 annual report, shows how these metrics are still relatively far from those marked by the EU's more developed markets, although they made significant progress during the 2017 financial year.

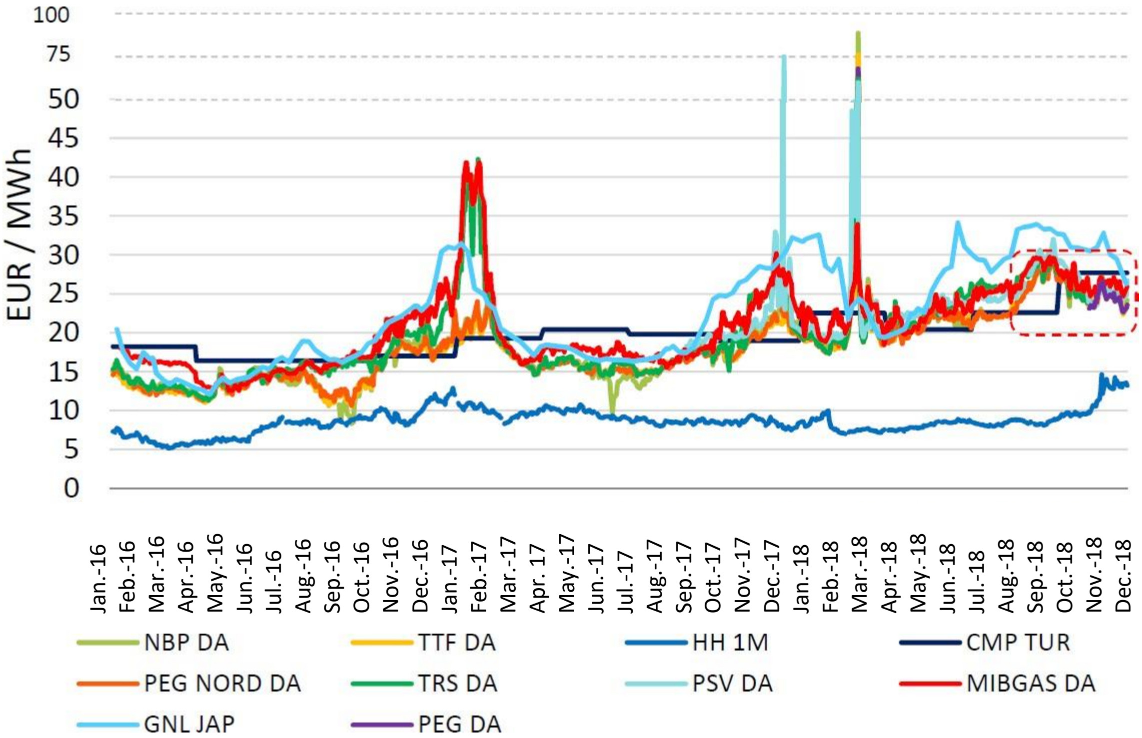
In relation to price development, the month of January 2017 shows how, under certain circumstances, the prices of the markets in southern Europe (MIBGAS and TRS) were decoupled from those of the rest of the continent, maintaining average price differentials of EUR 15/MWh with the reference hubs for more than one month. The following circumstances came together in this specific episode:

- a cold spell in France and the Iberian Peninsula, with the resulting increase in the domestic gas demand;
- the unavailability of nuclear power plants in France, with the resulting increase in imports of electricity from other Member States, including Spain;
- an increase in the electricity demand in Spain due to the increase in exports, with combined-cycle power stations being used for the most part, increasing the gas demand for the electricity sector;
- the purchase of gas by Spanish traders on the spot market, both in southern France and on the global LNG market.

The graph below shows the development of gas prices.

[71] Agent number data as at 31.12.2016 and 31.12.2017; 30.06.2018. Other parameters included during the reference financial year

Figure A.7. Gas market price development



Source: Ministry for Ecological Transition and Demographic Challenge, 2019

The decoupling phenomenon took place again between October and December 2017, with notably higher prices in the Iberian Peninsula and southern France.

However, during the early months of 2018, the disconnection of MIBGAS with respect to other Community hubs as a result of the reduced physical interconnection capacity and high tariffs had positive results for the Spanish wholesale market. In effect, the tensions recorded between 28 February and 1 March on the continental markets were barely felt by MIBGAS. Specifically, the daily product price on MIBGAS reached EUR 34/MWh compared to EUR 89/MWh on NBP, EUR 76/MWh on TTF, EUR
68/MWh on PEG Nord, and EUR 62/MWh on TRS.

In any case, as can be observed throughout the historical series, the episodes in which the disconnection of the Iberian Peninsula's markets determines lower prices than in the rest of the continent are isolated and short-lived, with a structurally higher gas price being demonstrated.

Retail

This market is defined as the set of transactions that have taken place between traders and final consumers.

The main characteristics of the Spanish retail market are as follows:

- a low proportion of supply points with respect to the population, with low penetration in the domestic segment due to the climate;
- high business concentration, with a high market share of the incumbent operator that maintains most of the distribution network;

- a final sales price of gas that is higher than the EU average.

The main indicators of this market in 2017 are the following:

- number of customers: 7.8 million;
- number of traders with sales to final customers: 71 traders, belonging to 54 holding companies.

The market shares are set out in the table below.

Table A.49. Operator shares on the retail gas market

Operator shares on the retail market	
Holding company	**Share of sales volume**
Gas Natural Fenosa	39.6%
Endesa	16.6%
Unión Fenosa Gas	8.2%
Iberdrola	6.8%
Cepsa	5.0%
EDP	2.4%

Source: National Commission on Markets and Competition

The Herfindahl-Hirschman Index[72] (HHI) value is 2,034, having recorded an improvement in the last financial year.

The business concentration in the domestic/commercial segment is even more marked, as Gas Natural Fenosa has an HHI of 3,076 in terms of number of customers. Gas Natural Fenosa concentrates 54% of customers and 50% of sales share.

In contrast, there is less concentration on the industrial gas market (HHI 2,134) and the market for electricity generation (HHI 1,631).

Business concentration has been stable for the past six years, with Gas Natural Fenosa between 40% and 47%, followed by Endesa, which has been between 15% and 17%. There has been a decrease in market share of the five biggest traders, from 84% to 76% of aggregate share, as a result of the growth of small traders.

- Rate of supplier change: 9.5% This has remained relatively stable since 2013.
- Number of cut-offs due to non-payment: 19,000 (2.43 cut-offs for every 1,000 customers). This has dropped significantly since 2016.

Two basic tariff types coexist on the retail market:

- a regulated tariff for consumers connected to pressures lower than 4 bar, with annual consumption under 50,000 kWh/year: 21% of the total customers and 2% of the sales volume;
- the free market: 79% of the total customers and 98% of the sales volume.

[72] Index used to analyse the level of concentration in a market. The higher the index level, the higher the degree of concentration. An unconcentrated market is usually considered one with values under 1,000, while 1,000 to 1,800 is considered moderately concentrated and above 1,800 is concentrated.

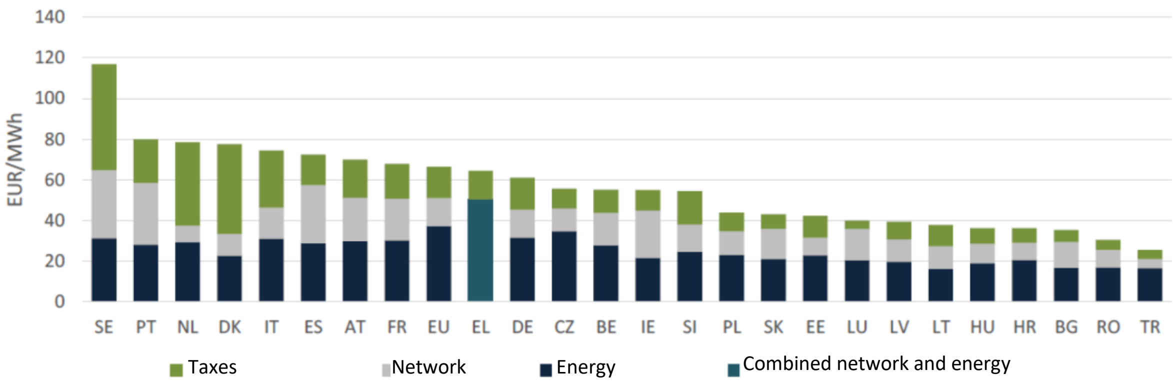
In reference to the final prices for consumers, the CNMC concludes that 'in general, on the domestic market the gas supply offers are, for the most part, referenced to the development of the tariff of last resort'.

The annual cost of the gas supply for a consumer entitled to the tariff of last resort (TUR) was as follows at the end of 2017:

- TUR1: EUR 221.38/year for a consumer with a consumption of 2,500 kWh/year.
- TUR2: EUR 619.50/year for a consumer with a consumption of 9,000 kWh/year.

According to the gas price comparison for a domestic consumer (in the 2,500-5,000 kWh/year band) done by the European Commission, it is confirmed that the price in Spain is the seventh highest in the EU, due to both a higher price of the raw material and the cost of the networks.

Figure A.8. Price of natural gas for a domestic consumer in the EU in 2017 (€/MWh)



Source: Energy prices and costs in Europe, European Commission, 2019

Projections of price development with current policies and measures

The price of gas in Spain on the Plan's projection horizon corresponds with the international price hypotheses for this fuel recommended by the European Commission.

A.5.4 Main components of the price of electricity and gas

In terms of electricity, at present the final electricity customer's bill comprises:

The cost of the energy, which includes:

- the cost on the daily, intraday and balancing markets;
- the cost of the capacity payments;
- the cost of the interruptibility demand management service on the Peninsula;
- the costs of remuneration to market and system operators.

The access tariffs to cover the costs of the system, which presently include both the access tariffs by which the cost of the transmission and distribution networks is compensated, as well as other charges that basically cover the following items:

- the specific remuneration system for renewables and cogeneration;

- the generation cost overrun in the electricity systems of non-peninsular territories;
- the remuneration of the regulator;
- the tariff deficit annuities;
- the cost of the interruptibility demand management service in the electricity systems of non-peninsular territories.

The marketing margin that may be applied to the billing for energy and/or capacity. The cost of renting the metering equipment.

Electricity taxes and VAT.

- Currently, the electricity tax is 5.1127% of the energy and capacity billing.
- VAT is 21% of the total bill, including the equipment rental cost and electricity tax.

In terms of natural gas, once every six months Spain sends Eurostat the average domestic and industrial natural gas price by consumption band. This information is obtained from the weighted national average by sales of the prices, which the natural gas traders send to MITECO.

The price is currently broken down into price with tax, price without VAT and price without tax; nevertheless, work is being done on a future breakdown into three components: energy and supply, networks and taxes, charges and fees. As an example, the average prices sent to Eurostat for the first half of 2018 (latest available) are detailed below.

Table A.50. Average price of domestic and industrial natural gas by consumption bands

Average price of domestic and industrial natural gas by consumption bands First half of 2018					
Domestic consumption band	**Annual consumption (GJ)**		**Price without tax (€/kWh)**	**Price without VAT (€/kWh)**	**Price with tax (€/kWh)**
D1		< 20	0.0701	0.0724	0.0876
D2	≥ 20	< 200	0.0526	0.055	0.0665
D3		≥ 200	0.0443	0.0466	0.0564
Non-domestic consumption band	**Annual consumption (GJ)**		**Price without tax (€/kWh)**	**Price without VAT (€/kWh)**	**Price with tax (€/kWh)**
I1		< 1,000	0.0367	0.0372	0.045
I2	≥ 1.000	< 10.000	0.0349	0.0354	0.0429
I3	≥ 10.000	< 100,000	0.0285	0.029	0.0351
I4	≥ 100,000	< 1,000,000	0.0241	0.0247	0.0299
I5	≥ 1,000,000	< 4,000,000	0.023	0.0236	0.0285
I6		≥ 4,000,000	0.0229	0.0234	0.0283

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

A.5.5 Nuclear energy in Spain

A.5.5.1 Orderly and phased closure of nuclear installations

The companies that own the nuclear installations and the National Radioactive Waste Company (Empresa Nacional de Residuos Radioactivos, Enresa), the public company responsible for managing the aforementioned waste and the work of decommissioning and dismantling the reactors, have unanimously agreed on an orderly and phased schedule for the closure of the seven nuclear reactors that remain active, an agreement that has been approved by the Government.

Following the consensus reached between the different actors involved, four reactors will be closed in stages during the period of validity of this INECP. The remaining three will do so before the end of 2035.

The orderly and phased closure of nuclear installations is compatible with the full guarantee of the electricity supply, as is confirmed in the reports of Red Eléctrica de España (see Annex D.2).

It is also fully compatible with the key objective of this INECP to achieve at least 20% emission mitigation by 2030 compared to 1990. If the reactors had been shut down at the end of their 40-year design service life, all nuclear installations would have been shut down before 2030. According to the sensitivity analyses carried out with the TIMES-Sinergia model, under these circumstances it would not have been possible to achieve the above-mentioned objective of 20% emissions mitigation compared to 1990 in a cost-effective manner.

Moreover, as a result of the aforementioned agreement between the parties, there is a sufficiently wide time scale for the process to be carried out under ideal conditions, both technically and in terms of the availability of human teams. Finally, it should be pointed out that the agreed time frame will allow the existing fund for the closure and dismantling of the facilities (Enresa) to be duly capitalised.

A.5.5.2 Security of fuel supply

The INECP 2021-2030 establishes the forecasts regarding the development of the contribution of nuclear energy to the energy mix, on the basis of which the Seventh General Radioactive Waste Plan (7th GRWP) will be drawn up.

The assurance of fuel supply to nuclear power plants until their closure is guaranteed by the Euratom Treaty itself and by the European Supply Agency (ESA), which oversees all fuel assembly supply contracts established by power plant operators in the EU.

A.5.5.3 General Radioactive Waste Plan

Article 38 bis of the Law on Nuclear Energy (LEN), Law 25/1964 of 29 April 1964, (amended by the ninth final provision of Law 11/2009 of 26 October 2009), establishes that the management of radioactive waste and spent nuclear fuel and the dismantling and decommissioning of nuclear facilities constitutes an essential public service reserved for the State, and Empresa Nacional de Residuos Radioactivos, S.A (Enresa) is entrusted with the management of this public service. Its activities and financing system are currently set out in Royal Decree 102/2014 of 21 February 2014 for the responsible and safe management of spent nuclear fuel and radioactive waste.

Similarly, Law 11/ 2009 of 29 October 2009 regulating listed companies for investment in the real estate market lays down that the financing system for this public service shall be carried out by means of a system of fees payable by the producers of radioactive waste.

In the Spanish radioactive waste management system, the GRWP is the official document that considers the strategies, the necessary actions and the technical solutions to be implemented in the short, medium and long term, aimed at the appropriate management of radioactive waste, the dismantling and decommissioning of nuclear and radioactive facilities and the other activities related to the above, including the economic and financial measures required to carry them out. The 6th GRWP currently in force was approved by the Government in June 2006. Work on the 7th GRWP is well advanced. This new GRWP will include financial and strategic aspects related to the dismantling of nuclear facilities and the management of radioactive waste.

The draft 7th GRWP in the final drafting phase of the proposal to MITECO by Enresa considers the schedule for the orderly closure of the nuclear power plants currently in operation between 2025 and 2035, consistent with that defined in the INECP 2021-2030.

The draft 7th GRWP evaluates and updates all future costs of activities associated with the abovementioned strategies and in accordance with the closure schedule. In this regard, the system for the management of radioactive waste and spent fuel, including the dismantling and decommissioning of nuclear facilities, has a financing system based on the principle of ‘polluter pays’, which is based on fees paid by the waste generators and fed into what is known as the ‘Fund for the financing of GRWP activities’, in accordance with the sixth additional provision of Law 54/1997 of 27 November 1997 on the Electricity Sector, as amended by Law 11/2009 of 26 October 2009.

In accordance with the Law, the levy rates and tax items for determining the rate of these fees may be reviewed by the Government by means of a Royal Decree, on the basis of an updated economic and financial report on the cost of the corresponding activities.

A.5.6 Description of energy subsidies (including fossil fuels)

The Spanish coal sector has undergone in-depth restructuring in recent years within the framework established by EU legislation (Decision 2010/787/EU of 10 December 2010 on State aid to facilitate the closure of uncompetitive mines, with aid to mining undertakings to cover losses for the financial year being eliminated from 31 December 2018, as provided for in Article 3 of that Decision).

In addition, in accordance with Decision 2010/787/EU, the subsidies to the coal mining companies that are maintained in 2019 are aid to cover the exceptional costs associated with the closure of mining operations: social aid (early retirement and redundancy) and aid for environmental restoration projects. Therefore, in 2019, no subsidies for coal production are envisaged.

All energy prices in Spain are liberalised, except for certain supplies to domestic consumers where, for some products such as Liquefied Petroleum Gas (LPG), a system of regulated maximum prices is maintained for both bottled and piped LPG.

a) Tax credits

Energy products in Spain are subject to VAT at a normal rate of 21% and exceptions apply to certain uses, such as in commercial aviation and international navigation. In addition, energy products sold in the country are subject to various taxes, such as mineral oil tax, the excise duty on electricity and the excise duty on coal.

Spain applies certain subsidies to the use of energy products as fuel or motor fuel. The mineral oil tax paid for the use of diesel in agriculture and livestock farming is partially refunded; the same for professional use such as the transport of goods, passengers and taxis with certain limits. Exemptions from this tax are governed by Articles 9 and 51 of Law 38/1992 of 28 December 1992 on Excise Duty. The reduced tax rates set out in Article 50 of that law also apply, and are differentiated according to use. In particular, the following reduced rates for hydrocarbon uses are envisaged:

- Gas oil used as fuel in vehicles of Article 54(2) of Law 38/1992 (stationary engines, special vehicles, agricultural vehicles) and, in general, as fuel (heating): 96.71 euros per 1,000 litres;
- LPG intended for uses other than fuel uses: 15 euros per tonne;
- natural gas intended for uses other than fuel uses, as well as natural gas intended for use as fuel in stationary engines: 0.65 euros per gigajoule;
- natural gas intended for uses for professional purposes provided that they are not used in cogeneration processes and direct or indirect electricity generation: 0.15 euros per gigajoule;
- kerosene intended for uses other than fuel uses: 78.71 euros per 1000 litres;
- biodiesel for use as fuel in the uses set out in Article 54(2) and, in general, as fuel, and biomethanol for use as fuel: 96.71 euros per 1000 litres;

b) Other Energy subsidies

Note, as reflected in Table A.51:

1. the existence of an aid scheme for renewable energy, cogeneration and waste, a specific remuneration scheme that guarantees reasonable profitability in order to compete with the other technologies;
2. capacity-based mechanisms (incentive for long-term investment and incentive for environmental investment).

Therefore, in accordance with the above, the following table lists all energy subsidies in force at this date, in particular fossil fuels and measures and plans for their progressive elimination.

Table A.51. Energy subsidies 2019

Category	Description	Legal Basis in 2019	Non-reduced assimilation rate	Rate	Quantification of aid*	Extinction plans
			Energy subsidies 2019 - Taxes			
Reduced tax rates	Reduced tax rate on diesel used as fuel in vehicles mentioned in Art. 54(2) (agriculture)	Law 38/1992 on excise duty Art. 50	0.379	0.09671	€0.28229/l	
	Reduced rate Diesel used as fuel (heating)	Law 38/1992 on excise duty Art. 50	0.379	0.09671	€0.28229/l	
	LPG intended for uses other than fuel uses	Law 38/1992 on excise duty Art. 50	57.47	15	€42.47/t	
	Natural gas intended for uses other than fuel uses, as well as natural gas intended for use as fuel in stationary engines	Law 38/1992 on excise duty Art. 50	1.15	0.65	€0.5/GJ	
	Natural gas intended for uses for professional purposes provided that they are not used in cogeneration processes and direct or indirect electricity generation	Law 38/1992 on excise duty Art. 50	1.15	0.15	€1/GJ	
	Kerosene intended for uses other than fuel uses	Law 38/1992 on excise duty Art. 50	0.378	0.07871	€0.29929/l	
	Biodiesel for use as fuel in the uses set out in Article 54 (agriculture and livestock farming) and in general as fuel	Law 38/1992 on excise duty Art. 50	0.379	0.09671	€0.28229/l	
	Biomethanol for use as fuel	Law 38/1992 on excise duty Art. 50	0.379	0.09671	€0.28229/l	
Exemptions and refunds	Exemption from excise duty for energy products supplied for use as fuel in air navigation other than private pleasure flying	Law 38/1992 on excise duty Art. 9			The entire amount of the excise duty applied to mineral oil (Impuesto Especial a los Hidrocarburos, IEH) (kerosene: EUR 0.378/l)	
	Exemption from mineral oil excise duty for use as fuel for rail transport, construction, modification, testing and maintenance of aircraft and vessels, dredging of waterways and ports, injection into blast furnaces for chemical reduction, additions to coal used as the main fuel	Law 38/1992 on excise duty Art. 51			The entire amount of IEH (based on fuel)	
	Exemption from excise duty in the manufacture and import of mineral oil intended for use in non-recreational air and sea transport, in electricity generation or cogeneration in power plants, in the manufacture or import of biofuels or biofuels for research and other purposes	Law 38/1992 on excise duty Art. 51			The entire amount of IEH (based on fuel)	
	Refund of excise duty on mineral oil used for purposes other than motor fuel or heating oil.	Law 38/1992 on excise duty Art. 52			The entire amount of IEH (based on fuel)	
	Refund of tax for supplying diesel fuel to vessels for navigation other than private pleasure craft	Law 38/1992 on excise duty Art. 52			The entire amount of IEH (based on fuel)	
	Tax refund for the use of mineral oil in pilot projects for the technological development of less-polluting products or products mixed with other contaminated products	Law 38/1992 on excise duty Art. 52			The entire amount of IEH (based on fuel)	
	Partial refund of excise duty on mineral oil for diesel for professional use (applies to certain vehicles for use in the transport of goods, passengers and taxis)	Law 38/1992 on excise duty Art. 52 bis 6(a)			€0.049/l	
	Partial refund of excise duty on mineral oil for diesel used in agriculture and livestock farming	Law 38/1992 on excise duty Art. 52 ter	0.379	0.06371	€0.31529/l	

Category	Description	Legal Basis in 2019	Non-reduced assimilation rate	Rate	Quantification of aid*	Extinction plans
Energy subsidies 2019 – Other Energy subsidies						
Aid scheme for renewable energy, cogeneration and waste	Specific remuneration scheme for renewable energy installations ('State aid SA.40348'), approved by Commission Decision C(2017) 7384 final. It guarantees reasonable profitability in order to compete with the other technologies.	Law 24/2013, Royal Decree 413/2014, Order IET/1045/2014, subsequent Orders regulating the assignment and aid scheme procedure.			It is very variable depending on the technology and the start-up year of the facilities.	Spain undertook not to apply it to new allocation procedures beyond 10 June 2024 without further prior approval by the Commission.
Capacity mechanisms, in particular with fossil fuels	1. Long-term Investment Incentive: payment by capacity of EUR 10,000 euros/MW/year for 20 years, currently only charged by the most recent gas combined-cycle plants, as well as a couple of hydroelectric plants (as these are the technologies that have been put into service in the last 20 years)	Order ITC/2794/2007 of 27 September 2007 revising electricity tariffs from 1 October 2007				1. Long-term Investment Incentive: payment by capacity of EUR 10,000 euros/MW/year for 20 years, currently only charged by the most recent gas combined-cycle plants, as well as a couple of hydroelectric plants (as these are the technologies that have been put into service in the last 20 years)
	2. Environmental Investment Incentive: Long-term investment incentive for investments in environmental improvements in production units that use coal as their main fuel. EUR 8,750/MW/year for 10 years	Order ITC/3860/2007 of 28 December 2007, revising electricity tariffs from 1 January 2008 (additional provision 2)			€8,750/MW/year for 10 years Total cost in 2019: €25.3 m	To be terminated, closed for new investments. 2020 will be the last year with payments for this item (€6 m)

** The quantification of the aid in the case of reduced tax rates has been calculated as the difference between the rate applicable to hydrocarbon consumption without subsidies and the reduced rate*

A.6 RESEARCH, INNOVATION AND COMPETITIVENESS

This section shows the current status, as well as the projects for the areas related to research, innovation and competitiveness, a fundamental aspect of a long-term energy policy.

A.6.1 Level of public and private spending on research and innovation

State financing of research, innovation and competitiveness for energy transition and climate change is coordinated and executed by means of various instruments and bodies, all attached to the Ministry of Science and Innovation.

This financing can be broken down into financing for research, innovation and competitiveness projects and for public research and development infrastructure. It is channelled via:

- The Centre for the Development of Industrial Technology (Centro Desarrollo Tecnológico e Industrial, CDTI): financing of corporate research, innovation and competitiveness projects.
- Spanish Research Agency (Agencia Estatal de Investigación, AEI): financing for training and attracting research personnel; basic and applied research projects, both national and within the European Research Area or 'ERANETs'.
- MCI itself: financing of public-law research bodies.

In the case of the CDTI, in the context of the State Plan and using the year 2017 as reference, approved 84 R&D projects in the area of energy, developed by companies with different forms of aid (refundable aid, partially refundable aid and grants). This aid overall has given rise to a total investment of more than EUR 109 m and public contribution commitments amounting to EUR 76 m[73].

Within the sectoral area of energy, research, innovation and competitiveness to promote renewables and emerging technology accounts for 64.7% of the projects approved, 57.1% of public contribution commitments and 68.1% of the total business investment budget. These sectoral investments in energy represent 6% of the total operations financed and 9% of the contribution commitment. It is notable that there is a route and potential for great development in this direction.

Moreover, CDTI is also responsible for managing the company INNVIERTE ES, S.A., S.C.R., whose mission is to promote the investment of risk capital in the Spanish technology sector, boosting innovative or technology-based companies (mainly small and medium-sized enterprises) and facilitating the stable participation of private capital in the long term by means of investment in public-private vehicles.

[73] 2017 aid schemes through grants: CIIP (Eurostars projects), Interempresas Internacional sub-programme; INNO, Innoglobal Grants Programme; SERA, Eranet; and SNEO, Neotec grants. The Feder-Innterconecta Programme was not organised for 2017. Permanent CDTI schemes: ID (individual R&D projects), which includes R&I projects, CIEN (large strategic projects in cooperation), strategic projects, EUREKA, IBEROEKA projects, etc.; LIC (technology innovation projects)

The investments in the risk capital vehicles supported by INNVIERTE in the area of energy and environment, as at December 2017, are shown in the table below.

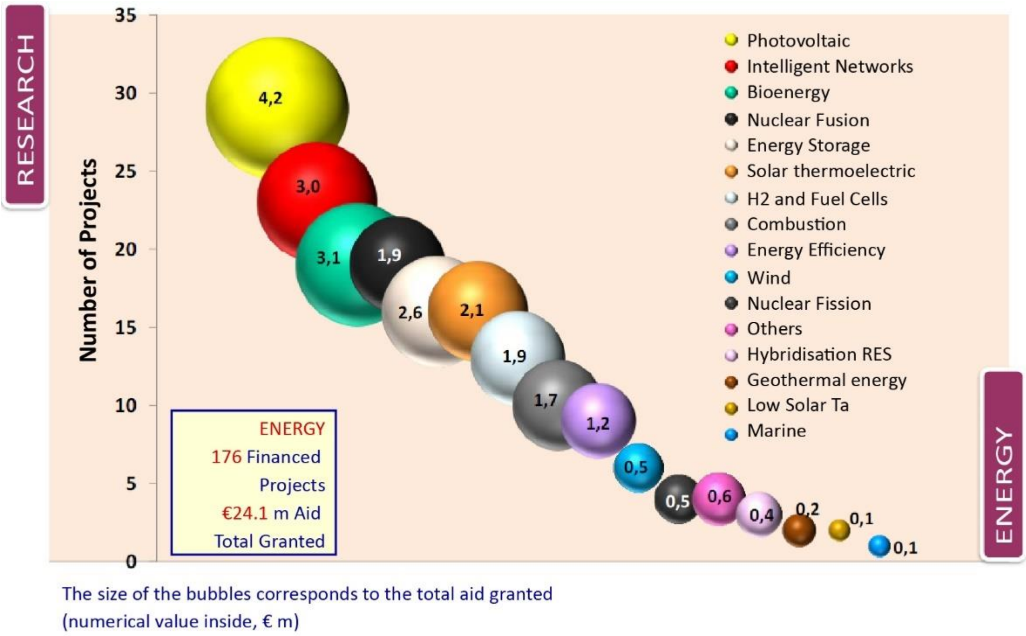
Table A.52. INNVIERTE programme investments in energy and environment

Leading company	Portfolio companies	Funds received by investees (€)
AGBAR	7	10,726,957
Iberdrola	2	1,200,000
Repsol	4	5,507,822

Source: The Centre for the Development of Industrial Technology

The Spanish Research Agency (Agencia Estatal de Investigación, AEI), for its part, manages the financing of the research and development carried out by public research centres and universities, as well as public-private partnership. In particular within the national RIC programme geared towards Societal Challenges, and specifically for 'Research Challenges' RIC projects in Challenge 3: efficient, secure and clean energy, in the years 2014, 2015 and 2016, a total of 176 projects were financed with EUR 24.1 m in total aid granted.

Figure A.9. Financing of energy projects from the Partnership Challenges national research, innovation and competitiveness programme (€ m)



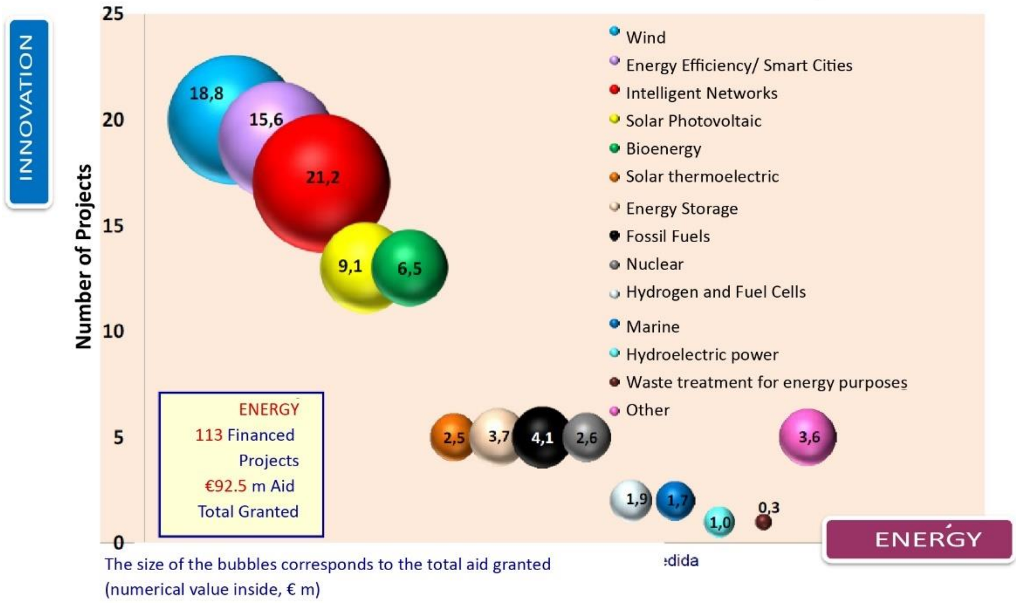
Source: Spanish Research Agency

The largest number of projects financed correspond to photovoltaics, followed by electricity/smart networks, bioenergy, nuclear fusion, energy storage and solar thermoelectric. Next are projects related to hydrogen and fuel cells, combustion/$CO_2$and energy efficiency.

Finally, there are smaller lines including wind, nuclear fission, geothermal energy and low-temperature solar, and just one financed project related to marine energy. It should be noted that the classification by thematic lines has been made considering the predominant technology in each project, which does not prevent some of them from also including other technologies. Lastly, it is worth highlighting the existence of three projects consisting of research on hybridisation of renewables.

Moreover, within the same national programme, but in the Challenges – Partnership scheme (public-private partnership), in Challenge 3: efficient, secure and clean energy, in the years 2014, 2015 and 2016, a total of 113 projects were financed with EUR 92.5 m in total aid granted.

Figure A.10. Financing of energy projects from the Partnership Challenges national research, innovation and competitiveness programme (€ m)



Source: Spanish Research Agency

Historically, we find two broad clearly differentiated blocks:

In the first of these, with the higher number of projects financed and more aid granted, are the topics of wind energy, energy efficiency/smart cities (these have been considered jointly given the impossibility of separating them), electricity/smart networks, solar photovoltaic and bioenergy.

In the second block, very much behind the first in terms of number of projects financed, are solar thermoelectric (these are normally small projects related to the resource), energy storage (it is possible that some of the electricity network projects will also include this topic in part), fossil fuels, nuclear fission energy, hydrogen and fuel cells, marine energy, hydroelectric power and others.

A.7 GOVERNANCE REGULATION 2018/1999 ANNEX TABLES

A7.1 Annex I Part 2 Baseline Scenario Table

Table A.53. Parameters, variables and balances of the Baseline Scenario

			2015	2020	2025	2030
	1. Parameters and general variables					
1	**Population**	**millions**	**46.45**	**46.58**	**46.80**	**47.15**
2	**GDP (constant 2016)**	**Billion EUR**	**1,070.71**	**1,223.4**	**1,333.8**	**1,421.4**
4	**Number of households**	**millions**	**18.35**	**18.58**	**19.25**	**19.82**
5	**Size of households**	inhabitants/household	**2.53**	**2.51**	**2.43**	**2.38**
7	**Passenger-km**	**millions pkm**				
	Buses	millions pkm	54,869.30	60,591.52	62,193.01	63,396.52
	Cars	millions pkm	469,924.14	518,517.95	532,222.84	542,522.04
	Motorcycles	millions pkm	36,400.03	43,386.11	44,532.84	45,394.61
	Rail	millions pkm	33,069.61	36,712.32	37,682.66	38,411.87
	Aviation	millions pkm	**Not avail.**	**Not avail.**	**Not avail.**	**Not avail.**
	Internal Navigation	millions pkm	**Not avail.**	**Not avail.**	**Not avail.**	**Not avail.**
8	**Transport of freight**	**millions tkm**				
	Road	millions tkm	256,689.00	285,048.39	302,872.16	316,688.53
	Rail	millions tkm	10,811.61	11,656.31	12,385.17	12,950.15
	Internal Navigation	millions tkm	**Not avail.**	**Not avail.**	**Not avail.**	**Not avail.**
9	**International importprices**[74]	**EUR/GJ**				
	Oil	EUR/GJ	8.02	11.90	15.73	17.33
	Gas	EUR/GJ	6.95	7.59	9.64	10.49
	Coal	EUR/GJ	2.01	2.85	3.16	3.79
10	**Prices of coal in ETS**[74]	**EUR/tonne CO_2**	**7.80**	**15.50**	**23.30**	**34.70**
11	**Assumptions about the exchange rates of the euro and the US dollar (if applicable)**	**Dollar/EUR**	**1.12**	**1.16**	**1.20**	**1.20**
12	**Number of heating degree days**		**N/A**	**N/A**	**N/A**	**N/A**
13	**Number of cooling degree days**		**N/A**	**N/A**	**N/A**	**N/A**
14	**Cost assumptions of technologies used in modelling for the main relevant technologies**		**See Table A.7**	**See Table A.7**	**See Table A.7**	**See Table A.7**
	2. Energy balances and indicators					
	2.1 Energy supply					
1	**Indigenous production per fuel type**	**ktoe**	**33,564.01**	**37,189.27**	**38,713.45**	**40,878.03**
	Coal	ktoe	1246.00	736.12	0.00	0.00
	Crude oil and petroleum products	ktoe	236.00	145.78	146.89	147.99
	Natural gas	ktoe	54.00	48.66	49.03	49.40
	Nuclear energy	ktoe	14,903.00	15,118.17	15,118.17	15,118.17
	Renewable energy sources	ktoe	16,873.00	20,684.73	22,950.80	25,174.50
	Waste	ktoe	252.01	455.80	448.57	387.97
2	**Net imports by fuel type**[75]	**ktoe**	**95,422.50**	**92,457.65**	**89,623.30**	**86,081.08**
	Coal	ktoe	10,239.91	9,614.54	4,996.80	4,506.32
	Crude oil and petroleum products	ktoe	61,815.40	54,804.46	53,625.84	51,609.86
	Natural gas	ktoe	23,774.87	27,095.73	29,962.65	30,209.16
	Electricity	ktoe	-11.44	761.82	426.83	-201.38
	Renewable energy sources	ktoe	-369.25	181.11	611.18	-42.88
3	**Dependence on imports from third countries**	**%**	**73.00%**	**71.312%**	**69.83%**	**67.80%**
4	**Main import sources (countries) with the main energy vectors (including gas and electricity)**[76]					
	First country of origin of electricity imports (FR)	% of the total imports	61%		83.88%	87.41%
	Second country of origin of gas imports (Portugal)	% of the total imports	39%		16.12%	12.59%
5	**Gross domestic consumption by type of fuel**	**ktoe**	**122,929.54**	**129,646.92**	**128,336.75**	**126,959.11**
	Coal	ktoe	13,583.20	10,350.66	4,996.80	4,506.32
	Crude oil and petroleum products	ktoe	53,044.59	54,950.24	53,772.73	51,757.85
	Natural gas	ktoe	24,538.11	27,144.38	30,011.68	30,258.56
	Nuclear energy	ktoe	14,903.20	15,118.17	15,118.17	15,118.17
	Electricity	ktoe	-11.44	761.82	426.83	-201.38
	Renewable energy sources	ktoe	16,619.87	20,865.84	23,561.98	25,131.62
	Waste	ktoe	252.01	455.80	448.57	387.97
	2.2 Electricity and heat					
1	**Gross electricity production**	**GWhe**	**280,911.00**	**281,720.46**	**290,097.29**	**304,592.65**
2	**Gross electricity production by fuel**	**GWhe**				

[74] In line with Commission recommendations.

[75] Including electricity and divided between intra- and extra-European imports.

[76] Only electricity imports are included.

		Units	2015	2020	2025	2030
	Nuclear energy	GWhe	57,196.00	58,039.00	58,039.00	58,039.00
	Coal	GWhe	52,676.00	33,004.14	12,649.62	10,290.18
	Crude oil and petroleum products	GWhe	17,241.00	12,604.28	11,907.91	11,122.80
	Natural gas	GWhe	52,498.00	55,844.20	65,203.86	62,931.17
	Biomass and waste	GWhe	5,789.00	6,823.25	6,730.71	6,303.39
	Hydroelectric (excluding pumping)	GWhe	28,140.00	28,288.21	27,934.69	27,581.18
	Wind	GWhe	49,325.00	60,021.53	71,521.53	83,021.53
	Solar	GWhe	13,859.00	21,642.62	30,640.68	39,638.74
	Geothermal and other renewable energy sources	GWhe	743.00	813.06	829.10	1,024.48
	Pumping	GWhe	3,228.00	4,640.18	4,640.18	4,640.18
	Other	GWhe	216.00	0.00	0.00	0.00
3	**Share of electricity generation from cogeneration in the total[77]**	**%**	10.50%	10.13%	8.28%	4.55%
4	**Electricity generation capacity by source[78]**	**GW**	**107.17**	**111.68**	**114.94**	**122.91**
	Nuclear energy	GW	7.40	7.40	7.40	7.40
	Coal	GW	11.36	7.96	2.18	2.18
	Crude oil and petroleum products	GW	4.27	4.24	4.08	3.93
	Natural gas	GW	31.76	31.40	30.63	28.86
	Biomass and waste	GW	1.95	1.08	1.04	0.93
	Hydroelectric (excluding pumping)	GW	16.79	15.75	15.75	15.75
	Wind	GW	22.93	28.03	33.03	38.03
	Solar	GW	7.15	11.22	16.22	21.22
	Geothermal and other renewable energy sources	GW	0.22	0.21	0.21	0.21
	Pumping	GW	3.34	4.39	4.39	4.39
	Other	GW	0.00	0.00	0.00	0.00
5	Heat generation through thermal installations	GWhe	0.00	Not avail.	Not avail.	Not avail.
6	Heat generation through cogeneration plants[79]	GWhe	33,409.00	34,204.08	28,493.28	15,793.38
	2.3 Processing sector					
1	**Fuel contributions for the generation of thermal energy**	**ktoe**	23,692.22	18,583.33	15,428.37	15,014.37
	Coal	ktoe	11,868.32	7,201.14	3,011.57	2,452.99
	Crude oil and petroleum products	ktoe	3,563.87	3,098.48	2,270.77	2,163.22
	Natural gas	ktoe	8,260.04	8,274.68	10,144.18	10,396.86
2	**Fuel contributions for other conversion processes**	**ktoe**		9,157	8,836	8,218
	2.4 Energy consumption					
1	**Primary energy consumption (excludes non-energy consumption)**	**ktoe**	**118,579.80**	**124,524.77**	**122,894.33**	**121,268.41**
1	**Final energy consumption (includes non-energy consumption)**	**ktoe**	**84,542.00**	**92,132.53**	**93,504.15**	**92,828.79**
2	***Final energy consumption by sector (excludes non-energy consumption)***	**ktoe**				
	Industry	ktoe	18,901.00	20,131.27	21,010.67	21,579.11
	Residential	ktoe	14,882.00	14,781.81	14,158.55	13,350.02
	Services	ktoe	10,524.03	11,343.19	11,136.60	10,833.98
	Transport	ktoe	33,423.00	37,936.47	38,862.34	38,424.83
	Agriculture	ktoe	2,501.16	2,817.64	2,893.57	2,950.15
	Passenger transport	ktoe		25,892.10	26,441.68	25,523.26
	Freight transport	ktoe		12,044.37	12,420.66	12,831.54
3	***Final energy consumption by fuel (includes non-energy consumption)***	**ktoe**				
	Coal	ktoe	1,503.28	1,525.43	1,585.59	1,644.02
	Crude oil and petroleum products	ktoe	40,674.41	42,289.54	41,858.77	40,183.65
	Natural gas	ktoe	13,139.40	15,203.30	16,357.39	16,482.25
	Electricity	ktoe	19,951.68	20,581.87	21,049.46	21,646.37
	Heat	ktoe				
	Renewable energy sources	ktoe	5,291.99	7,114.88	6,897.96	6,856.25
	Waste	ktoe	2.41	295.37	312.56	325.55
4	**Final non-energy consumption**	**ktoe**	4,349.73	5,122.14	5,442.43	5,690.70
5	**Primary energy intensity of the general economy[80]**	**toe/EUR million**	**114.81**	**105.98**	**96.22**	**89.32**
	2.6 Investments					
	Energy-related investment costs compared to GDP[81]	% of GDP		0.34		0.31
	2.7 Renewable energy					
1	**Gross final energy consumption from renewable sources and the share of renewable energy in gross final energy consumption and by sector and technology[82]**	**%**				
	Share of renewable energy in final gross energy consumption	**%**	**16.00%**	**20.04%**	**22.95%**	**25.88%**
	Heating and cooling	%	16.84%	17.96%	21.69%	25.07%
	Electricity	%	37.00%	41.32%	47.50%	52.75%
	Transport	%	1.00%	10.10%	10.04%	10.89%

		Units	2015	2020	2025	2030
	Contribution of final renewable energy consumption in transport to the general objective	%		2.71%	2.66%	2.59%
	Contribution of biofuel and biogas included in Section A of the list in Annex IX[83]	%		1.78%	1.55%	1.78%
	Contribution of biofuel and biogas included in Section B of the list in Annex IX[83]	%		0.23%	0.35%	0.84%
	Contribution of biofuels consumed in transport produced from food crops	%		6.75%	6.93%	6.35%
	Gross final renewable energy consumption in heating and cooling	ktoe	4,663.00	5,319.50	6,703.16	7,735.53
	Production of renewable energy	ktoe	8,642.00	10,159.83	11,862.66	13,498.14
	Gross final renewable energy consumption in transport	ktoe	176.00	2,422.38	2,433.65	2,357.97
	Total gross final renewable energy consumption	ktoe	13,481.00	17,901.71	20,999.47	23,591.64
	Share of biofuels from food crops	%		6.75%	6.93%	6.35%
	Share of advanced biofuels	%		2.02%	1.91%	2.62%
	3. Indicators related to emissions and absorption of GHG					
1	**GHG emissions by sector (ETS, Regulation on the distribution of efforts and LULUCF)**	**t CO_2-eq**	**335,809,458**	**324,475,532**	**304,804,134**	**292,993,633**
	ETS Emissions (2013 ETS areas)	t CO_2-eq	139,751,465	125,168,662	109,785,991	106,694,596
	Regulation on the distribution of efforts (in the 2013 areas)	t CO_2-eq	196,057,993	199,306,870	195,018,143	186,299,037
	LULUCF (accounted for according to the requirements of EU legislation)	t CO_2-eq	-44,097,664	-41,423,989	-39,750,945	-36,021,456
2	GHG emissions by IPCC sector and by gas (when relevant, broken down into ETS and RRE)	t CO_2-eq	*Please use for reporting on GHG emissions by IPCC sector and gas the same excel template as used for reporting on Annex XII to Commission Implementing Regulation (EU) 749/2014 (IPArticle23_table1), next due 15.3.2019. It is provided as a separate file.*			
	Transformation, primary energy and exchanges	t CO_2-eq	16,796,815	18,920,018.00	18,604,614.00	17,361,019.00
	Agriculture	t CO_2-eq	34,532,980	34,622,675.00	34,578,946.00	34,534,945.00
	Generation of electricity	t CO_2-eq	74,050,523	57,013,146.00	42,228,410.00	43,024,908.00
	Industry (combustion)	t CO_2-eq	40,462,329	38,233,671.00	36,888,827.00	33,512,444.00
	Industry (processes)	t CO_2-eq	21,036,000	21,697,375.00	22,002,913.00	22,165,517.00
	Residential	t CO_2-eq	17,212,310	16,705,507.00	15,345,116.00	13,426,858.00
	Services	t CO_2-eq	10,923,001	11,608,447.00	10,981,128.00	9,965,735.00
	Transport	t CO_2-eq	83,197,462	89,761,816.00	90,720,773.00	88,193,394.00
3	**Coal intensity of the general economy**	**t CO_2-eq/GDP (million EUR)**	**313.633**	**265.235**	**228.529**	**206.136**
4	**Indicators related to CO_2 emissions**	**t CO_2-eq/MWh**				
a	**Carbon intensity of electricity and steam production**	**t CO_2-eq/MWh**	**0.264**	**0.202**	**0.146**	**0.141**
b	**Carbon intensity of final energy demand by sector**	**t CO_2-eq/toe**	**4.188**	**3.729**	**3.461**	**3.362**
	Industry	t CO_2-eq/toe	3.254	2.977	2.803	2.580
	Residential	t CO_2-eq/toe	1.157	1.130	1.084	1.006
	Services	t CO_2-eq/toe	1.038	1.023	0.986	0.920
	Passenger transport	t CO_2-eq/toe		2.366	2.334	2.299
	Freight transport	t CO_2-eq/toe				
5	**Parameters related to emissions other than CO_2**					
a	**Livestock**	**1,000 head**				
	Dairy cattle	1,000 head	848.7	816	798	779
	Non-dairy cattle	1,000 head	5,359.8	5,558	5,563	5,568
	Pigs	1,000 head	27,677.9	29,228	30,280	31,331
	Sheep	1,000 head	16,026.4	15,160	14,155	13,151
	Poultry	1,000 head	127,143.1	131,016	131,260	131,504
b	**Inputs of nitrogen resulting from the application of synthetic fertilisers**	**kt nitrogen**	**1,068**	**1,000**	**970**	**940**
c	**Inputs of nitrogen resulting from the application of manure**	**kt nitrogen**	**670**	**691**	**665**	**641**
d	**Nitrogen fixed by nitrogen-fixing crops**	**kt nitrogen**	**NE**	**NE**	**NE**	**NE**
e	**Nitrogen in crop residues that return to soil**	**kt nitrogen**	**120**	**123**	**126**	**129**
f	**Area of cultivated organic soils**	**hectares**	**NO**	**NO**	**NO**	**NO**
g	**Municipal solid waste generation (MSW)**	**t**	**21,158,000**	**21,754,011**	**20,786,549**	**19,819,088**
h	**Municipal solid waste (MSW) deposited in landfills**	**t**	**12,129,000**	**9,789,305.0**	**7,074,752.0**	**4,360,199.0**
i	**Proportion of CH_4 recovered from the total CH_4 generated in landfills**	**%**	**18.0%**	**18.0%**	**20.0%**	**20.0%**

All parameters and variables in green:
Already requested under current legislation (Monitoring Mechanism Regulation (MMR), Renewable Energy Sources (RES) Directive or Energy Efficiency Directive)

All parameters and variables in red:
These should be provided considering the results of complementary tools as standard models of the energy system.

All parameters and variables in orange:
These correspond to indicators that must be calculated with parameters and variables already available in the Excel file provided.

N/A Not applicable. They have not been used. **Not avail.** Not available.

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

A.7.2 Annex I Part 2 Target Scenario Table

Table A.54. Parameters, variables and balances of the Target Scenario

			2015	2020	2025	2030
	1. Parameters and general variables					
1	**Population**	**millions**	**46.45**	**46.58**	**46.80**	**47.15**
2	**GDP (constant 2016)**	Billion EUR	**1,070.71**	**1,223.35**	**1,333.77**	**1,421.36**
4	**Number of households**	**millions**	**18.35**	**18.58**	**19.25**	**19.82**
5	**Size of households**	inhabitants/household	**2.53**	**2.51**	**2.43**	**2.38**
7	**Passenger-km**	**millions pkm**				
	Buses	millions pkm	54,869.30	60,591.52	86,187.56	112,101.04
	Cars	millions pkm	469,924.14	518,517.95	480,630.82	426,725.07
	Motorcycles	millions pkm	36,400.03	43,386.11	44,147.96	44,716.05
	Rail	millions pkm	33,069.61	36,712.32	61,685.81	87,131.54
	Aviation	millions pkm	Not avail.	Not avail.	Not avail.	Not avail.
	Internal Navigation	millions pkm	Not avail.	Not avail.	Not avail.	Not avail.
8	**Transport of freight**	**millions tkm**				
	Road	millions tkm	256,689.00	284,979.52	291,692.97	293,815.70
	Rail	millions tkm	10,811.61	11,653.49	23,259.61	34,811.06
	Internal Navigation	millions tkm	**Not avail.**	**Not avail.**	**Not avail.**	**Not avail.**
9	**International import prices**[74]	**EUR/GJ**				
	Oil	EUR/GJ	8.02	11.90	15.73	17.33
	Gas	EUR/GJ	6.95	7.59	9.64	10.49
	Coal	EUR/GJ	2.01	2.85	3.16	3.79
10	**Prices of coal in ETS**[74]	**EUR/tonne CO_2**	**7.80**	**15.50**	**23.30**	**34.70**
11	**Assumptions about the exchange rates of the euro and the US dollar (if applicable)**	**Dollar/EUR**	**1.12**	**1.16**	**1.20**	**1.20**
12	**Number of heating degree days**		**N/A**	**N/A**	**N/A**	**N/A**
13	**Number of cooling degree days**		**N/A**	**N/A**	**N/A**	**N/A**
14	**Cost assumptions of technologies used in modelling for the main relevant technologies**		**See Table A.7**	**See Table A.7**	**See Table A.7**	**See Table A.7**
	2. Energy balances and indicators					
	2.1 Energy supply					
1	**Indigenous production per fuel type**	**ktoe**	**33,564.01**	**37,498.88**	**41,908.84**	**40,646.01**
	Coal	ktoe	1,246.00	1,105.00	0-	0-
	Crude oil and petroleum products	ktoe	236.00	145.78	146.89	147.99
	Natural gas	ktoe	54.00	48.66	49.03	49.40
	Nuclear energy	ktoe	14,903.00	15,118.17	15,118.17	6,499.65
	Renewable energy sources	ktoe	16,873.00	20,611.47	26,149.96	33,501.45
	Waste	ktoe	252.01	469.80	444.79	447.51
2	**Net imports by fuel type**[75]	**ktoe**	**95,422.50**	**91,008.06**	**76,513.46**	**63,452.85**
	Coal	ktoe	10,239.91	7,978.66	3,743.02	2,133.22
	Crude oil and petroleum products	ktoe	61,815.40	55,473.35	49,155.31	40,497.57
	Natural gas	ktoe	23,774.87	26,641.30	24,207.51	24,388.87
	Electricity	ktoe	-11.44	761.82	-1,202.20	-3,447.98
	Renewable energy sources	ktoe	-396.25	152.94	609.82	-118.83
3	**Dependence on imports from third countries**	**%**	**73.00%**	**70.82%**	**64.61%**	**60.95%**
4	**Main import sources (countries) with the main energy vectors (including gas and electricity)**[76]					
	First country of origin of electricity imports (FR)	% of the total imports	61%		78.72%	86.11%
	Second country of origin of gas imports (Portugal)	% of the total imports	39%		21.28%	13.89%
5	**Gross domestic consumption by type of fuel**	**ktoe**	**122,929.54**	**128,506.94**	**118,422.30**	**104,098.86**
	Coal	ktoe	13,583.20	9,083.66	3,743.02	2,133.22
	Crude oil and petroleum products	ktoe	53,044.59	55,619.13	49,302.20	40,645.56
	Natural gas	ktoe	24,538.11	26,689.95	24,256.54	24,438.27
	Nuclear energy	ktoe	14,903.20	15,118.17	15,118.17	6,499.65
	Electricity	ktoe	-11.44	761.82	-1,202.20	-3,447.98
	Renewable energy sources	ktoe	16,619.87	20,764.41	26,759.78	33,382.62
	Waste	ktoe	252.01	469.80	444.79	447.51
	2.2 Electricity and heat					
1	**Gross electricity production**	**GWhe**	**280,911.00**	**281,218.68**	**307,570.17**	**346,289.61**
2	**Gross electricity production by fuel**	**GWhe**				
	Nuclear energy	GWhe	57,196	58,039.00	58,039.00	24,952.30
	Coal	GWhe	52,676.00	33,338.69	7,877.66	101.00
	Crude oil and petroleum products	GWhe	17,241.00	12,604.28	9,372.64	6,052.25
	Natural gas	GWhe	52,498.00	54,135.47	42,463.35	48,589.88
	Biomass and waste	GWhe	5,789.00	6,823.25	8,143.50	11,596.02
	Hydroelectric (excluding pumping)	GWhe	28,140.00	28,288.21	28,322.57	28,351.39

		Units	2015	2020	2025	2030
	Wind	GWhe	49,325.00	60,669.96	92,925.71	119,519.87
	Solar	GWhe	13,859.00	21,912.57	53,377.43	93,661.38
	Geothermal and other renewable energy sources	GWhe	743.00	813.06	1,160.12	1,505.33
	Pumping	GWhe	3,228.00	4,594.20	5,523.20	8,310.19
	Other	GWhe	216	0.00	365.00	3,650.00
3	Share of electricity generation from cogeneration in the total77	%	10.50%	10.15%	7.19%	5.21%
4	**Electricity generation capacity by source**78	**GW**	**107.17**	**111.83**	**133.80**	**160.84**
	Nuclear energy	GW	7.40	7.40	7.40	3.18
	Coal	GW	11.36	7.96	2.18	0.02
	Crude oil and petroleum products	GW	3.38	4.24	3.16	2.07
	Natural gas	GW	31.59	31.40	30.63	30.06
	Biomass and waste	GW	1.48	1.08	1.24	1.73
	Hydroelectric (excluding pumping)	GW	16.79	15.75	16.00	16.25
	Wind	GW	22.93	28.03	40.63	50.33
	Solar	GW	7.15	11.37	26.52	46.48
	Geothermal and other renewable energy sources	GW	0.22	0.21	0.28	0.32
	Pumping	GW	3.34	4.39	5.26	7.89
	Other	GW	0.00	0.00	0.50	2.50
5	Heat generation through thermal installations	GWhe	0.0	Not avail.	Not avail.	Not avail.
6	Heat generation through cogeneration plants79	GWhe	33,409.00	34,204.08	26,088.82	20,027.37
	2.3 Processing sector					
1	**Fuel contributions for the generation of thermal energy**	**ktoe**	**23,692.22**	**18,364.39**	**9,899.87**	**8,756.25**
	Coal	ktoe	11,868.32	7,280.30	1,881.85	49.35
	Crude oil and petroleum products	ktoe	3,563.87	3,099.34	1,758.28	1,127.21
	Natural gas	ktoe	8,260.04	7,975.73	6,257.89	7,578.51
2	**Fuel contributions for other conversion processes**	**ktoe**		8,956	8,282	7,787
	2.4 Energy consumption					
1	**Primary energy consumption (excludes non-energy consumption)**	**ktoe**	**118,579.80**	**123,401.72**	**113,022.29**	**98,459.82**
1	**Final energy consumption (includes non-energy consumption)**	**ktoe**	**84,542.00**	**91,381.69**	**87,018.82**	**79,199.15**
2	***Final energy consumption by sector (excludes non-energy consumption)***	**ktoe**				
	Industry	ktoe	18,901.00	19,770.89	19,657.35	19,570.10
	Residential	ktoe	14,882.00	14,738.58	13,604.89	12,393.66
	Services	ktoe	10,524.03	11,339.53	10,625.29	9,830.30
	Transport	ktoe	33,423.00	37,609.82	34,953.82	29,058.87
	Agriculture	ktoe	2,501.16	2,817.64	2,777.46	2,707.18
	Passenger transport	ktoe		25,717.57	24,083.18	19,724.40
	Freight transport	ktoe		11,892.25	10,870.64	9,334.47
3	***Final energy consumption by fuel (excludes non-energy consumption)***	**ktoe**				
	Coal	ktoe	1,503.28	1,440.48	1,438.10	1,407.55
	Crude oil and petroleum products	ktoe	40,674.41	41,930.45	37,153.00	29,274.50
	Natural gas	ktoe	13,139.40	15,119.13	14,710.70	13,773.80
	Electricity	ktoe	19,951.68	20,533.87	20,813.29	21,293.61
	Heat	ktoe				
	Renewable energy sources	ktoe	5,291.99	6,943.16	7,194.91	7,425.53
	Waste	ktoe	2.41	309.37	308.81	385.11
4	**Final non-energy consumption**	**ktoe**	**4,349.73**	**5,105.22**	**5,400.01**	**5,639.04**
5	**Primary energy intensity of the general economy**80	**toe/EUR million**	**114.81**	**105.04**	**88.79**	**73.24**
	2.6 Investments					
	Energy-related investment costs compared to GDP81	% of GDP		1.83%		1.86%
	2.7 Renewable energy					
1	**Gross final energy consumption from renewable sources and the share of renewable energy in gross final energy consumption and by sector and technology**[84]	**%**				
	Share of renewable energy in final gross energy consumption	**%**	**16.00%**	**20.08%**	**29.85%**	**42.19%**
	Heating and cooling	%	16.84%	17.86%	24.72%	31.23%
	Electricity	%	37.00%	41.58%	63.81%	85.14%
	Transport	%	1.00%	10.07%	14.92%	27.87%
	Contribution of final renewable energy consumption in transport to the general objective	%		2.65%	2.82%	2.72%
	Contribution of biofuel and biogas included in Section A of the list in Annex IX83	%		0.90%	1.58%	3.69%
	Contribution of biofuel and biogas included in Section B of the list in Annex IX83	%		0.55%	1.66%	1.66%
	Contribution of biofuels consumed in transport produced from food crops	%		6.95%	6.83%	6.83%

[84] The intermediate trajectories are in Table A.13.

		Units	2015	2020	2025	2030
	Gross final renewable energy consumption in heating and cooling	ktoe	4,663.00	5,224.82	7,197.40	8,833.07
	Production of renewable energy	ktoe	8,642.00	10,207.79	15,784.39	21,791.55
	Gross final renewable energy consumption in transport	ktoe	176.00	2,347.79	2,401.14	2,111.15
	Total gross final renewable energy consumption	ktoe	13,481.00	17,780.40	25,382.92	32,735.77
	Share of biofuels from food crops	%		6.95%	6.83%	6.83%
	Share of advanced biofuels	%		1.44%	3.24%	5.35%
	3. Indicators related to emissions and absorption of GHG					
1	**GHG emissions by sector (ETS, Regulation on the distribution of efforts and LULUCF)**	**t CO_2-eq**	**335,809,458**	319,312,134	262,672,088	221,837,347
	ETS Emissions (2013 ETS areas)	t CO_2-eq	139,751,465	122,914,869	88,834,184	78,940,475
	Regulation on the distribution of efforts (in the 2013 areas)	t CO_2-eq	196,057,993	196,397,266	173,837,904	142,896,872
	LULUCF (accounted for according to the requirements of EU legislation)	t CO_2-eq	-44,097,664	-41,423,989	-39,750,945	-36,021,456
2	GHG emissions by IPCC sector and by gas (when relevant, broken down into ETS and RRE)	t CO_2-eq	*Please use for reporting on GHG emissions by IPCC sector and gas the same excel template as used for reporting on Annex XII to Commission Implementing Regulation (EU) 749/2014 (IPArticle23_table1), next due 15.3.2019. It is provided as a separate file.*			
	Transformation, primary energy and exchanges	t CO_2-eq	16,796,815	17,944,056	17,332,355	16,313,056
	Agriculture	t CO_2-eq	34,532,980	34,628,465	32,302,027	29,975,278
	Generation of electricity	t CO_2-eq	74,050,523	56,621,874	26,496,741	20,603,033
	Industry (combustion)	t CO_2-eq	40,462,329	37,736,277	33,293,382	30,461,845
	Industry (processes)	t CO_2-eq	21,036,000	21,147,212	20,655,754	20,016,856
	Residential	t CO_2-eq	17,212,310	16,914,000	13,928,560	10,601,375
	Services	t CO_2-eq	10,923,001	11,550,232	9,835,458	7,795,215
	Transport	t CO_2-eq	83,197,462	87,057,663	77,650,530	59,875,489
3	**Coal intensity of the general economy**	**t CO_2-eq/GDP (million EUR)**	**313.633**	**261.014**	**196.942**	**156.079**
4	**Indicators related to CO_2 emissions**	**t CO_2-eq/MWh**				
a	**Carbon intensity of electricity and steam production**	**t CO_2-eq/MWh**	**0.264**	**0.201**	**0.086**	**0.059**
b	**Carbon intensity of final energy demand by sector**	**t CO_2-eq/toe**	**4.188**	**3.701**	**3.218**	**3.016**
	Industry	t CO_2-eq/toe	3.254	2.978	2.744	2.579
	Residential	t CO_2-eq/toe	1.157	1.148	1.024	0.855
	Services	t CO_2-eq/toe	1.038	1.019	0.926	0.793
	Passenger transport	t CO_2-eq/toe		2.315	2.222	2.060
	Freight transport	t CO_2-eq/toe				
5	**Parameters related to emissions other than CO_2**					
a	**Livestock**	**1,000 head**				
	Dairy cattle	1,000 head	848.7	816.2	797.7	779.3
	Non-dairy cattle	1,000 head	5,359.8	5,557.6	5,562.7	5,567.7
	Pigs	1,000 head	27,677.9	29,228.0	30,279.7	31,331.4
	Sheep	1,000 head	16,026.4	15,159.6	14,155.4	13,151.2
	Poultry	1,000 head	127,143.1	131,016.3	131,260.2	131,504.2
b	**Inputs of nitrogen resulting from the application of synthetic fertilisers**	**kt nitrogen**	**1,068**	**1,000**	**970**	**940**
c	**Inputs of nitrogen resulting from the application of manure**	**kt nitrogen**	**670**	**691**	**665**	**641**
d	**Nitrogen fixed by nitrogen-fixing crops**	**kt nitrogen**	**NE**	**NE**	**NE**	**NE**
e	**Nitrogen in crop residues that return to soil**	**kt nitrogen**	**120**	**123**	**126**	**129**
f	**Area of cultivated organic soils**	**hectares**	**NO**	**NO**	**NO**	**NO**
g	**Municipal solid waste generation (MSW)**	**t**	**21,158,000**	**21,754,011**	**20,786,549**	**19,819,088**
h	**Municipal solid waste (MSW) deposited in landfills**	**t**	**12,129,000**	**9,789,305**	**7,074,752**	**4,360,199**
i	**Proportion of CH_4 recovered from the total CH_4 generated in landfills**	**%**	**18.0%**	**18.0%**	**20.0%**	**20.0%**

All parameters and variables in green:
Already requested under current legislation (Monitoring Mechanism Regulation (MMR), Renewable Energy Sources (RES) Directive or Energy Efficiency Directive)

All parameters and variables in red:
These should be provided considering the results of complementary tools as standard models of the energy system.

All parameters and variables in orange:
They correspond to indicators that must be calculated with parameters and variables already available in the provided Excel file.

N/A Not applicable. They have not been used. **Not avail.** Not available.

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

A.7.3. Annex V, *Monitoring Mechanism Regulation* (MMR) Tables

Table A.55. Greenhouse gas emissions (broken down into EU ETS and effort sharing sectors)

	Submission Year			**2019**
	MS (Member State)			**ES**
Category (1,3) Scenario (WEM, WAM, WOM)	**2015**	**2020**	**2025**	**2030**
	CO_2 (kt)	**CO_2 (kt)**	**CO_2 (kt)**	**CO_2 (kt)**
Total excluding LULUCF WEM	271,727.20	262,425.61	245,670.61	236,857.92
Total including LULUCF WEM	229,210.44	226,740.88	212,755.86	204,883.02
Total excluding LULUCF WAM	271,727.20	257,500.82	207,462.64	173,401.22
Total including LULUCF WAM	227,124.15	215,673.58	167,317.18	136,993.37
	N_2O (kt)	**N_2O (kt)**	**N_2O (kt)**	**N_2O (kt)**
Total excluding LULUCF WEM	56.21	56.37	56.64	57.01
Total including LULUCF WEM	57.30	57.18	57.42	57.76
Total excluding LULUCF WAM	56.21	56.32	53.98	51.94
Total including LULUCF WAM	57.30	57.13	54.76	52.69
	CH_4 (kt)	**CH_4 (kt)**	**CH_4 (kt)**	**CH_4 (kt)**
Total excluding LULUCF WEM	1,486.38	1,475.67	1,440.08	1,400.20
Total including LULUCF WEM	1,493.60	1,482.19	1,446.59	1,406.72
Total excluding LULUCF WAM	1,486.38	1,466.75	1,314.96	1,152.93
Total including LULUCF WAM	1,493.60	1,473.26	1,321.47	1,159.44
	HFC (kt CO_2e)	**HFC (kt CO_2e)**	**HFC (kt CO_2e)**	**HFC (kt CO_2e)**
Total excluding LULUCF WEM	9,856.11	8,007.08	5,873.90	3,740.73
Total including LULUCF WEM	9,856.11	8,007.08	5,873.90	3,740.73
Total excluding LULUCF WAM	9,856.11	8,007.08	5,873.90	3,740.73
Total including LULUCF WAM	9,856.11	8,007.08	5,873.90	3,740.73
	PFC (kt CO_2e)	**PFC (kt CO_2e)**	**PFC (kt CO_2e)**	**PFC (kt CO_2e)**
Total excluding LULUCF WEM	94.01	97.76	102.47	105.66
Total including LULUCF WEM	94.01	97.76	102.47	105.66
Total excluding LULUCF WAM	94.01	97.76	102.47	105.66
Total including LULUCF WAM	94.01	97.76	102.47	105.66
	SF_6 (kt CO_2e)	**SF_6 (kt CO_2e)**	**SF_6 (kt CO_2e)**	**SF_6 (kt CO_2e)**
Total excluding LULUCF WEM	221.75	254.71	275.33	295.94
Total including LULUCF WEM	221.75	254.71	275.33	295.94
Total excluding LULUCF WAM	221.75	254.71	275.33	295.94
Total including LULUCF WAM	221.75	254.71	275.33	295.94
	NF_3 (kt CO_2e)	**NF_3 (kt CO_2e)**	**NF_3 (kt CO_2e)**	**NF_3 (kt CO_2e)**
Total excluding LULUCF WEM	N/A	N/A	N/A	N/A
Total including LULUCF WEM	N/A	N/A	N/A	N/A
Total excluding LULUCF WAM	N/A	N/A	N/A	N/A
Total including LULUCF WAM	N/A	N/A	N/A	N/A
	Total GHGs (ktCO_2e)	**Total GHGs (ktCO_2e)**	**Total GHGs (ktCO_2e)**	**Total GHGs (ktCO_2e)**
Total excluding LULUCF WEM	335,809.46	324,475.53	304,804.13	292,993.63
Total including LULUCF WEM	293,798.08	289,194.05	272,283.92	261,405.13
Total excluding LULUCF WAM	335,809.46	319,312.13	262,675.26	221,843.89
Total including LULUCF WAM	291,711.79	277,888.15	222,924.32	185,822.44
	Total ETS GHGs (ktCO_2e)	**Total ETS GHGs (ktCO_2e)**	**Total ETS GHGs (ktCO_2e)**	**Total ETS GHGs (ktCO_2e)**
Total excluding LULUCF WEM	137,270.03	122,025.21	106,369.61	103,065.29
Total including LULUCF WEM	137,270.03	122,025.21	106,369.61	103,065.29
Total excluding LULUCF WAM	137,270.03	119,769.68	85,569.52	75,650.07
Total including LULUCF WAM	137,270.03	119,769.68	85,569.52	75,650.07
	Total ESD GHGs (ktCO_2e)	**Total ESD GHGs (ktCO_2e)**	**Total ESD GHGs (ktCO_2e)**	**Total ESD GHGs (ktCO_2e)**
Total excluding LULUCF WEM	196,057.99	199,306.87	195,018.14	186,299.04
Total including LULUCF WEM	196,057.99	199,306.87	195,018.14	186,299.04
Total excluding LULUCF WAM	196,057.99	196,397.27	173,841.08	142,903.42
Total including LULUCF WAM	196,057.99	196,397.27	173,841.08	142,903.42

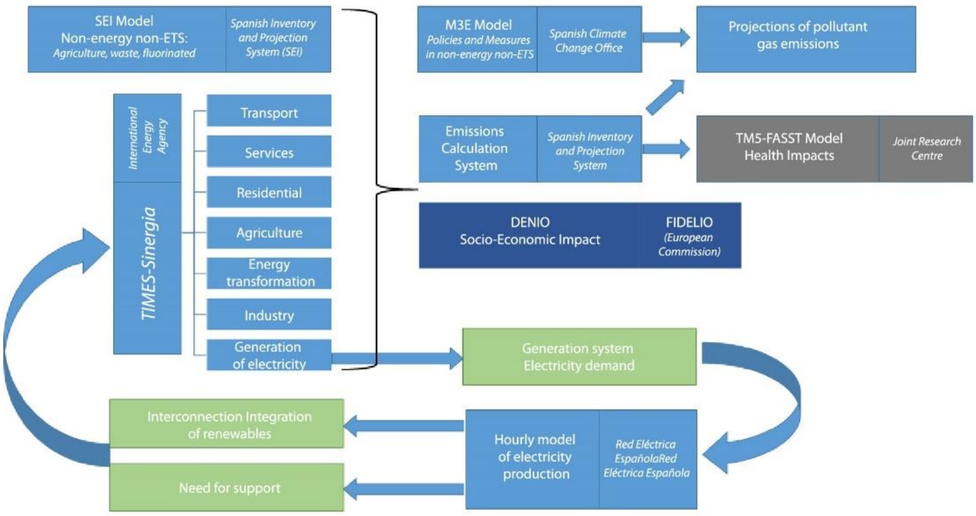
Source: Ministry for Ecological Transition and Demographic Challenge, 2019

ANNEX B. MODELS

B.1. MODELLING OF THE ENERGY SYSTEM

The modelling of the energy system for the INECP 2021-2030 was completed with the TIMES-SINERGIA (Sistema Integrado para el Estudio de la Energía, Integrated System for the Study of Energy) tool of the Directorate-General for Energy Policy and Mines. In addition, higher order models were used to determine the effects of a high penetration of renewable energies in the electricity system, in order to make the results compatible with an adequate security of supply. The other model used, which will be described later in this section, is the REE model.

Figure B.1. Methodology



Source: Ministry for Ecological Transition and Demographic Challenge, 2019

While TIMES-SINERGIA covers the entire energy system, the other complementary models are specifically dedicated to the representation of the electrical system. In addition, they include specific features of the electricity system that are not captured by the TIMES-SINERGIA model, such as the inclusion of hourly periods for power generation and the incorporation of technical restrictions of the system's generation units.

The joint use of all the models makes it possible to assess backup needs, energy exchange at interconnections, as well as other technical issues resulting from the integration of high inputs of renewable energies into the electricity system, such as discharges, or adjustments in conventional combined-cycle generation. The figure represents the bidirectional interaction between the TIMES-SINERGIA energy system model and the REE model. According to the results of the generation system in terms of installed capacity and generation of each technology, together with the electricity demand outputs obtained in the TIMES-SINERGIA model, they were evaluated by the REE model. Subsequently, the outputs of this model have determined the operating requirements of the conventional and technology generation systems, subsequently integrating the results into TIMES-SINERGIA. With this exercise, the technical restrictions considered in the specific electricity generation model are incorporated into the general model of the energy system.

B.1.1. TIMES-SINERGIA DGPEM Model

The Integrated MARKAL-EFOM System (TIMES) tool was used in drafting the INECP to analyse the energy system and its outlook. TIMES was developed by the International Energy Agency within the framework of the ETSAP (Energy Technology Systems Analysis Program) for the development of energy and environmental analyses.

TIMES has been used to model the energy system in more than 60 countries and is a tool widely used in Europe, for example, in Italy, Portugal, Finland and Norway.

In the case of Spain, the TIMES-Spain model was developed by the Energy, Environment and Technology Research Centre (Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas — CIEMAT) taking 2005 as the base year.

The Directorate-General for Energy Policy and Mines (DGPEM), which reports to the State Secretariat for Energy of MITECO, has carried out the necessary work to use TIMES as a tool for energy forecasting and analysis in the preparation of the INECP, adapting TIMES-Spain. The new model was named TIMES-SINERGIA (Integrated System for the Study of Energy).

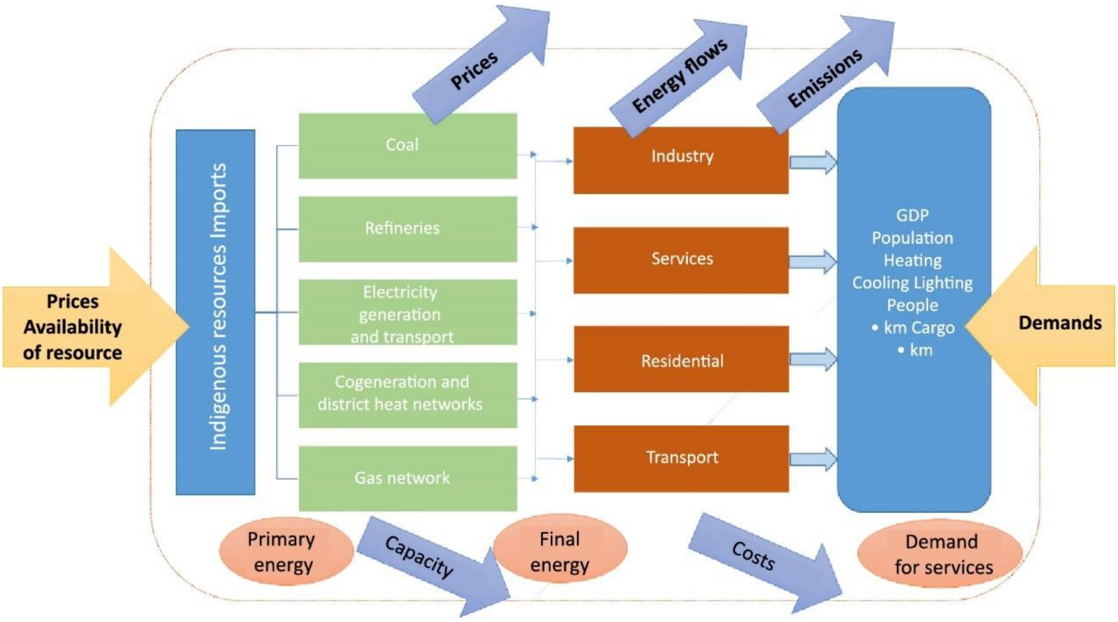
TIMES is a bottom-up mathematical model generator. This means that the model starts from each of the components of the energy system and then obtains the data at an aggregated level. The TIMES model generator combines two complementary approaches, one technical and the other economic. It is based on the linear optimisation of the energy system, seeking a solution under the minimum cost principle.

It has a detailed characterisation of energy technologies and demands for energy services such as passenger-km for the transport sector, or production in tonnes for the industrial sectors. For the different scenarios presented in the model, TIMES covers the demand for energy services through a combination of operational and investment decisions, minimising the cost of the energy system over the time frame analysed.

Some of the most relevant model results are the consumption and production of energy goods and services, flows, and prices and costs of energy goods. It also provides GHG emissions and air pollutants and is therefore suitable not only for the study of the energy system, but also in an integrated manner for the analysis of environmental policies.

The figure shows the inputs and outputs of the TIMES-SINERGIA model, where it can be seen that based on parameters of service demand, energy prices and resource availability, the model determines the capacity to be installed, energy consumed, emissions and process prices.

Figure B.2. Diagram of TIMES-SINERGIA inputs and outputs



Source: International Energy Agency

TIMES-SINERGIA Model Structure

The model uses a detailed database that enables the current and future energy system to be defined, by modelling the different sectors related to energy consumption. In this way, the national energy structure is characterised through:

- Definition of the Base Year. It includes all the variables, energy products, and their energy flows for the year 2016. In this way, real historical data characterising the national energy system are entered. This definition includes data on primary consumption, final consumption and transformation sector. Likewise, all existing technologies, with all their characteristics, of each and every one of the economic sectors — electricity generation, industry, transport, residential, services, agriculture and other — are modelled.

- Demand Projections. In addition, the future demands for energy services, prices and products of the model's input variables are included. These data allow future scenarios to be implemented for subsequent energy analysis.

- The parameters that characterise both existing and future technologies are their efficiency; the utilisation factor, which reflects the average hours of use of each technology compared to the annual total; the existing system; the useful life; and the investment, operating and maintenance costs.

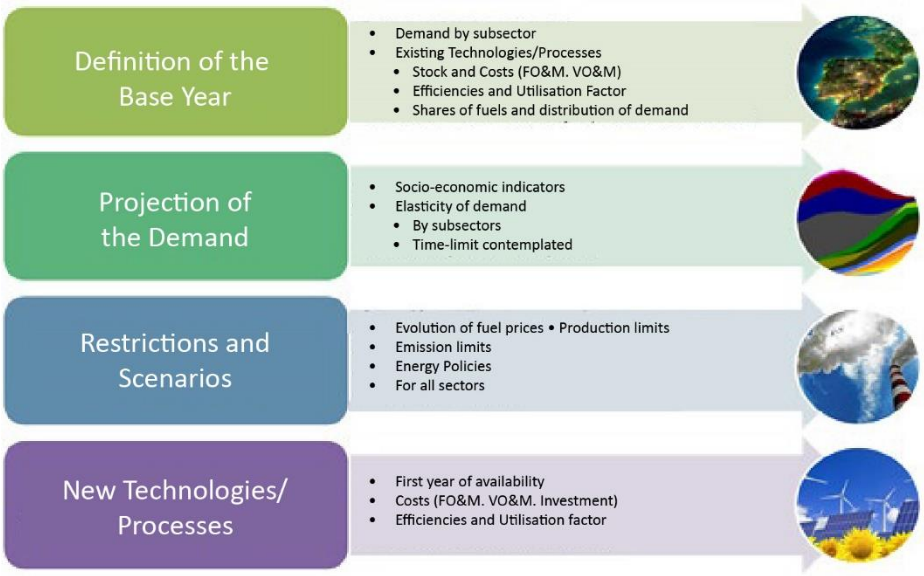
- New technologies and processes. The model also considers the different alternatives to meet future demands. To do this, an extensive database, including a portfolio of future technologies, is available. These new technologies will enter the energy system by replacing the current ones at the end of their useful life, or through the implementation of other environmental or technical assumptions for their replacement.

- Restrictions. They enable the effect of policies and measures, environmental or physical restrictions, as well as other determinants in the projections to be incorporated into the model.

- Scenarios. They enable different snapshots of the energy system to be represented for subsequent analysis. Through the study of different scenarios, it will be possible to analyse different alternatives for future development and evaluate the influence of the different energy policies adopted.

A diagram with the TIMES-SINERGIA data structure is shown below.

Figure B.3. TIMES-SINERGIA data structure



Source: International Energy Agency

In the following figure, the different parameters that characterise the technologies are shown.

Figure B.4. Parameters that characterise the technologies in TIMES-SINERGIA

Source: International Energy Agency

In TIMES-SINERGIA two types of scenarios were considered: the reference energy system or Baseline Scenario and the Target Scenario. The Baseline Scenario considers the evolution of the national energy sector in the event that the policies and measures proposed in the INECP are not implemented. The Target Scenario poses the same evolution, but for the case in which the policies and measures proposed to achieve the targets are complied with.

General modelling

Spatial and temporal resolution in TIMES-SINERGIA

The TIMES-SINERGIA model consists of a single region, corresponding to Spain. The time frame analysed starts from 2016, defined as the base year. In addition, historical data from 2017 are used to calibrate the model and then in 5-year periods, the years 2020 to 2040.

TIMES-SINERGIA reflects the variability of the demands throughout the year and the day by means of time slices. Hence, it is possible to simulate the form of electricity demand, as well as the production curves of renewable energies. These time periods correspond to the different seasons of the year (spring-R, summer-S, autumn-F, winter-W), subdividing them into sections: day-D, night-N, peak-P (coinciding with the hours of greatest electricity demand in each season) and trough, or valley-V (including the hours with the lowest electricity demand).

In this way, the time structure of each year is divided into sixteen time slots; for example, one would be summer and night. These time divisions are used both to model the demands of energy technologies and to represent the generation profiles.

Table B.1. Time periods. Annual distribution

Seasons	No of days	Fraction of the year	DD/MM
R	92	0.25	21/03-20/06
S	92	0.25	21/06-20/09
F	91	0.25	21/09-20/12
W	90	0.25	21/12-20/03

Source: International Energy Agency

Table B.2. Time periods. Daily distribution of the number of hours

	D	P	N	V
R	10	3	5	6
S	10	3	5	6
F	10	3	5	6
W	10	3	5	6

Source: International Energy Agency

Table B.3. Time periods. Time slots

	D	P	N	V
R	09:00-11:00 15:00-21:00	12:00-14:00	22:00-00:00 07:00-08:00	01:00-06:00
S	09:00-11:00 15:00-21:00	12:00-14:00	22:00-00:00 07:00-08:00	01:00-06:00
F	09:00-18:00	19:00-21:00	22:00-00:00 07:00-08:00	01:00-06:00
W	09:00-18:00	19:00-21:00	22:00-00:00 07:00-08:00	01:00-06:00

Source: International Energy Agency

Estimated emissions

The emissions of the energy sectors, both derived from combustion (CRF 1A activity) and fugitive emissions (CRF 1B activity), as well as emissions arising from industrial processes (CRF 2A, B and C activities) were carried out using the activity variables projected as a result of the scenarios generated by the TIMES-SINERGIA model.

Complementarily, emissions from the rest of the non-energy sectors (agriculture (CRF 3), waste (CRF 5) and product use (CRF 2D-2H)) and emissions and absorptions linked to land use, changes in land use and forests (LULUCF-CRF 4) were projected, on a case-by-case basis, according to national forecasts of the main activity variables representative of each sector.

Emissions and, where appropriate, absorptions were estimated for each of the GHGs regarding the projections of the activity variables, by applying calculation methodologies similar to those implemented in the National Emissions Inventory, consistent with international methodological guidelines. The 2018 edition of the National Greenhouse Gas Emissions Inventory, corresponding to the 1990-2016 series, was used as a reference for the calculation of projected emissions.

The estimates of projected emissions were made jointly and consistently both for GHGs (CO_2, CH_4, N_2O and fluorinated gases) and for emissions of associated atmospheric pollutants (NH_3, COVNM, PM2.5, SOx, NOx and CO), which will be included in the Atmospheric Pollution Monitoring Programme (*Programa de Control de la Contaminación Atmosférica*).

The reference year of the projected series is the reported year, 2016. The geographical coverage used was unique for the entire national territory, assuming characteristics and average parameters. Historical data from the National Emissions Inventory (1990-2016) were used for the analysis of emission trends and emission factors (direct and implicit). The time frame projected was 2017-2040 with annual time periods. As reference methodological guidelines, the 2006 IPCC Guidelines and the EMEP/EEA 2016 Methodological Guidelines were used, as in the National Emissions Inventory.

Baseline data and macroeconomic assumptions

The database on which the TIMES-SINERGIA model is based draws on a variety of sources. For historical data, in the case of energy variables, the energy balances published by Eurostat are used as a starting point, which in turn are compiled from data provided by the national statistical system. In the data on historical energy production and consumption in the industrial sector, statistics from the General State Administration, available in the Spanish Emissions Inventory System, are used.

In addition, in order to design future scenarios, projections are made of the demands for end-use energy services. To this end, macroeconomic variables such as GDP, GDP per capita or number of households are used to determine elasticity or the relationship of energy service demand with these macroeconomic variables. Finally, using the GDP evolution projections, the input values of the model are determined for the demands for energy services in future time periods, considering both the evolution of macroeconomic variables and their elasticities with demand.

The prices of the CO_2 emission rights subject to the European ETS[85], as well as those of the main energy vectors (coal, gas and crude oil) are those recommended by the European Commission for the development of the Plans.

Sectoral modelling

By aggregating their demands, TIMES represents each of the energy-consuming sectors in order to determine their primary and final energy needs and characterise the electricity generation demands and production needs of the energy transformation sector.

Residential sector, services and other sectors

The residential, services and 'other' sectors include the coverage of the demands of the residential sector, which includes energy needs in the domestic sphere; and the services and 'other' sectors, which include the demands for energy services originating in buildings with public and private economic activity (commercial, health, public, workplaces, among others), as well as the 'other' sector, which represents the sectors of economic activity not included in the rest of the TIMES-SINERGIA breakdowns, modelled in an aggregate manner.

The residential and services sectors break down their demands for energy services according to final energy uses, including the categories of heating, cooling, lighting, hot water, kitchens and diverse electrical and electronic equipment (white goods, brown goods and other equipment specific to the use of each building). In addition, the demands for public lighting are included.

For the residential sector, three types of housing are included: single-family housing, multi-family housing with collective heating and/or domestic hot water systems and multi-family housing with individual heating and/or domestic hot water systems. A distinction is also made between existing and newly built or upgraded housing. This reflects the differences in energy consumption patterns for the different types of buildings considered, as well as the diversity of technologies installed in each type.

In the case of the service sector, no distinction is made according to the type or use of building. The modelled technologies are analogous to those of the residential sector, although on a larger scale.

The modelled technologies in the residential and services sectors are detailed below, classifying them according to the coverage of the corresponding energy service:

a) **Heating.** Stoves, convectors, fireplaces, solar panels and heat pumps are included. In turn, these technologies are divided according to the fuel or energy source used (coal, propane, gas oil, gas, solar, electricity, geothermal, aerothermal, hydrothermal or renewable heat generation).

[85] ETS: Emissions Trading System.

b) **Cooling.** Aerothermal, geothermal and hydrothermal heat pumps, absorption machines and solar cooling were modelled.

c) **DHW (Domestic Hot Water).** The model includes mixed boilers, water heaters, thermos flasks and heat pumps. There are different technologies of each type according to the fuel or energy source used (coal, propane, gas oil, gas, solar, electricity, geothermal, aerothermal, hydrothermal or renewable heat generation).

d) **Lighting in buildings and public lighting.** Incandescent, halogen, LED and fluorescent lamps are used.

e) **Kitchens.** In the residential sector, it includes technologies that run on different fuels (wood, coal, gas, propane or butane and electricity). In the case of the service sector, a generic technology called 'kitchen equipment' is included, which includes a variety of equipment used in service sector kitchens such as the kitchens themselves, but also ovens, steamers, hot tables, among others.

In addition, some of the technologies mentioned above simultaneously cover several demands for energy services. This is the case for gas boilers that are used for both heating and domestic hot water demands; for heat pumps, which can be used for heating and cooling, and which could also meet domestic hot water demands.

Each of the technologies indicated is characterised by a series of parameters that are detailed below. These parameters configure their energy performance:

- **Efficiency:** its evolution over time is defined by means of learning curves in such a way that the efficiency improvement paths are studied throughout the periods considered.
- The **availability factor**, given by a ratio that reflects the average hours of use of each technology compared to the annual total.
- The **existing stock** that characterises the number of units of each technology.
- The **useful life** of each technology.
- The **costs.** It includes both **investment** costs for new technologies and **operating and maintenance** costs for new and existing technologies.

In addition to the above, in the residential sector the equipment included in the white goods and brown goods categories has been modelled in an aggregate manner. Similarly, this approach was applied for other uses associated with building use in the services sector.

The initial data and assumptions for the residential sector, services and other sectors with the greatest influence on the results of the model are derived from the change in the number of households, both existing and newly built; or the building floor area in the services sector, whether existing, new or renovated.

Transport sector

The transport sector is an energy-consuming sector that brings together the demands for mobility energy services, both for people and goods. These service demands are expressed in millions of passenger-km or millions of tonne-km for the different modes of transport: road, rail, sea and air.

Within the TIMES-SINERGIA model, different categories of vehicles can be distinguished to meet these demands for energy services. At the same time, within these categories, each vehicle is differentiated according to the type of fuel it uses, these being gas, electricity, diesel, gasoline, biofuels, and compressed or liquefied natural gas. In particular, the mixture of bio-fuels with traditional fossil fuels has been considered.

The different types of vehicles according to the demand for the energy services they satisfy, including both existing and future technologies, are detailed below:

a) **Road transport.** This includes the various types of transport of goods and persons:
    - <u>**Passenger cars.**</u> Demand is divided into short and long distance.
    - <u>**Motorcycles and quadricycles.**</u> It is assumed that they are primarily involved in short-distance demand.
    - <u>**Buses.**</u> Urban and interurban buses were modelled.
    - <u>**Heavy load (lorries).**</u> This includes vehicles of more than 3.5 tonnes that cover the demand for transporting goods.
    - <u>**Light load (vans).**</u> This includes vehicles with less than 3.5 tonnes of load used primarily for the transport of goods over short distances (urban environment).

b) **Transport by rail.** This includes vehicles running on rails powered by electricity or diesel.
    - <u>**Passenger trains.**</u> This includes long and medium-distance trains, as well as commuter trains.
    - <u>**Freight trains.**</u>
    - <u>**Metros and trams.**</u> All the vehicles are electric and satisfy the demand for urban transport.

c) **Transport in aviation and shipping.** The <u>national and international aviation and shipping</u> demands are modelled in an aggregated manner. In addition, energy in marine and aviation <u>bunkers</u> is included.

The parameters that characterise the functioning of the transport sector technologies are:

- **Efficiency:** its evolution over time is defined by means of learning curves in such a way that the efficiency improvement paths are studied throughout the periods considered.
- The **availability factor**, given by a ratio that reflects the average hours of use of

each technology compared to the annual total.

- The **activity factor**, which indicates the vehicle occupancy rate, in terms of tonnes for goods, or passengers.
- The **existing stock** that characterises the number of units of each technology.
- The **useful life** of each technology.
- The **costs.** It includes both **investment** costs for new technologies and **operating and maintenance** costs for new and existing technologies.

The data and starting assumptions of the transport sector that most influence the results of the model are the penetration of new technologies, especially those that use alternative fuels, as well as the biofuels mix in the transport sector.

Industrial Sector

In this sector, end-use energy demands are determined from the production in physical units (tonnes) of industrial products. To this end, it was divided into relevant subsectors in terms of consumption, for which both the technologies used in industrial processes and the demands related to each of these processes are included, whether they are heat or electricity demands. Industrial production is an input to the model, determined by the evolution of GDP. With this macroeconomic parameter and the elasticity that relates it to industrial production, sectoral production is determined.

The sectors considered for individual modelling are:

- iron and steel;
- aluminium, copper and other non-ferrous metals;
- ammonia, chlorine and other chemicals;
- cement, lime, glass and other non-metallic minerals;
- paper.

Additionally, for the rest of the industrial sectors, an aggregate modelling is completed, including the economic activities of the industrial sector not included in the previous classifications.

Cogeneration has been included in this sector, providing end-use energy for both thermal and electricity uses. Different technologies are included depending on the energy source they use, including coal, refinery gas, fuel oil, natural gas, biomass, waste and biogas.

Each of the technologies indicated is characterised by a series of parameters that are detailed below.

- Production ratios: **indicate the relationship between the production of physical units and energy consumed.**
- **Existing fleet.**

- **Percentages of fuel consumption:** are used in the case of technologies that can consume different fuels.
- **Investment, operating and maintenance costs.**
- **Useful life.**
- **Electrical and thermal efficiency.**
- **Coefficient of distribution between the energy discharged into the grid and the heat produced** for cogeneration.
- The **availability factor**, given by a ratio that reflects the average hours of use of each technology compared to the annual total.

The most relevant initial data and assumptions for the industrial sector are related to the evolution of production and the industrial processes used.

Agricultural sector

Includes agriculture, livestock, forestry and fishing. The sector is included in the model in aggregate form, characterised according to its energy consumption profile for the different fuels and energy used. Only their behaviour as energy consumers is modelled in these sectors.

Primary energy, transformations and exchanges sector

The primary energy, transformations and exchanges sector, unlike the sectors described above, represents the energy transformations necessary to convert primary energy into final energy; i.e., it represents a part of the energy transformation sector, excluding the electricity generation sector, which is modelled in detail and described under the next heading. The sector comprises primary production, i.e., the extraction of fuels, crude oil, natural gas and coals (coal, anthracite and lignite), as well as potential for the generation of national renewable sources: biomass, waste, waste heat, hydroelectric power, wind, solar and geothermal energy.

In addition to this, account is taken of industries associated with energy transformation or secondary energy production, which includes coke ovens, refineries, biofuel production and the transmission of electrical energy.

In addition, in order to supply primary energy, the system considers the supply through the importing of fuels. Similarly, exports by region are included.

Electricity generation sector

The model is based on the generation system existing in base year 2016, and it satisfies the electricity demand of the other sectors, seeking the economic optimum of the global energy system in the time frame considered. In order to do so, it installs new generation capacity where necessary, taking into account all the costs and operating characteristics related to the different technologies considered.

The generating technologies, both existing and new, were modelled, by defining their characteristics: the operating profile, maximum annual operating hours, efficiency, investment costs, operating and maintenance costs, useful life of the technologies, fuel costs, fuel distribution by technology, consumption in ancillary systems, emissions costs, and their evolution in the time frame considered.

It should be noted that in TIMES-SINERGIA the electricity system is modelled as a single node system, including non-mainland territories, although account is taken of the losses inherent in the transport and distribution network, as well as the different cross-border connections and the expected increase in their capacity.

Finally, it is necessary to establish a series of contour restrictions, mainly related to the characteristics and operation of generation technologies, in an attempt to approximate the behaviour of the model to reality.

A series of generation technologies existing in the base year (2016) were considered, as well as a series of new technologies - those that came into service from 2016.

Existing technologies considered are classified into:

- Conventional generation facilities:
  - nuclear;
  - coal;
  - combined gas cycle;
  - fuel/gas (non-peninsular territories);
  - municipal solid waste (MSW) (half of the generation of this technology is considered renewable, due to the biodegradable fraction of MSW).
- Renewable energy generation and pumping installations:
  - biomass;
  - biogas;
  - solar thermoelectric;
  - solar photovoltaic;
  - wind (onshore and offshore);
  - hydroelectric power;
  - hydraulic pumping systems;
  - municipal solid waste (MSW) (half of the generation of this technology is considered renewable, due to the biodegradable fraction of MSW).

In relation to the new technologies considered in the model, it has been assumed that these will be solely and exclusively renewable energy generation and storage facilities. In addition to new existing-technology facilities (commissioned after 2016), the following technologies, not present in the base year generation system, were included:

- New generation technologies with renewable energies and storage:
  - solar thermoelectric with more than 9 hours of storage;
  - batteries with 2 hours of storage;
  - marine energy technologies;
  - geothermal energy.

The parameters that characterise the electricity-generation technologies are:

Operating profiles

The different generation technologies have a defined operating profile through the availability factor. This is expressed as a percentage and relates the hours when the technology is available during a period to the total hours of that period.

In TIMES-SINERGIA, the availability factor indicated for each technology corresponds to an upper limit referring to the maximum operating hours of each technology during the period considered; therefore, it refers more to a maximum usage factor thereof, rather than availability.

In TIMES-SINERGIA the following types of availability factors are defined:

- Annual availability factor: this annual factor, expressed as a percentage, indicates the relationship between the maximum operating hours of the technology in a year and the total annual hours.

- Availability factor per period (time slice): this factor per period, also expressed as a percentage, indicates the relationship between the maximum operating hours of the technology in a given period and the total hours of the same period.

The definition of availability factors by time period is especially relevant in the case of renewable energy generation technologies, which will have greater or lesser availability depending on the availability of the renewable resource they use as an energy source. Thus, there will be technologies that are less available at times when electricity demand is high, and others, on the other hand, where their greater availability coincides with peak demand hours, depending on the season of the year and the period considered.

In the case of conventional generation technologies, availability factors per period are usually constant; in this case, they provide information on the hours when the technology ceases to be available due to maintenance activities, technical restrictions or other causes unrelated to the availability of the resource.

Efficiency

The efficiency data of thermal generation installations, both conventional and renewable, were obtained from the data reported to Eurostat, and are considered constant over the entire time frame. No consideration is given to possible declines in performance over the course of the project. In technologies where more than one fuel is consumed, an efficiency is indicated for each fuel.

For new technologies not present in the base year generation system, the efficiencies provided by the Joint Research Centre (JRC) were considered.

In the case of renewable energy generation technologies (solar photovoltaic, wind, hydroelectric power except pumping and sea energy), an efficiency equal to 100% was considered.

Investment, operating and maintenance costs

Another parameter that defines generation technologies is cost, which, in turn, is divided into investment costs (only for new installations), fixed operation and maintenance costs and variable operating and maintenance costs, as well as their variation over the time frame considered. These costs do not include costs associated with taxes, tariffs, fuels, etc.

Useful life

The useful life considered for renewable energy generation installations is that established in Order 1045/2014 of 16 June 2014, which approves the remuneration parameters of standard installations applicable to certain installations producing electrical energy from renewable energy sources, cogeneration and waste, with the following exceptions:

- A useful life of 25 years is considered for the new installed wind capacity, both for onshore and offshore facilities.
- In the case of hydroelectric installations, the extension of the useful life over the entire time frame is considered.

The following criteria were taken into consideration for non-renewable technology installations:

- Nuclear: the Baseline Scenario considers the extension of the useful life of these power plants over the entire time frame considered. The Target Scenario considers an orderly and progressive closure of the installed capacity of this technology.
- Coal: coal-fired power plants that have completed the necessary work to bring them into line with European emission standards by 2020 (around 4.53 GW) will continue to operate until 2030.
- Combined gas cycle: a useful life of 40 years is considered.
- Fuel/gas (non-peninsular territories): It is considered that the installed capacity of the fuel/gas power plants in 2016 will be halved by 2030.

In relation to the useful life and decrease in the generation capacity of the different technologies present in the generation system in the base year (2016), in order to establish the closure of the installations of the aforementioned generation system, the date of their commissioning was taken into account to reflect a decrease in capacity in line with their useful life. Thus, the capacity of the different existing technologies considered will be progressively reduced (according to their commissioning), and replaced, if necessary, by the capacity to generate new technologies available in the system from 2016 onwards.

Consumption in generation

Consumption in generation represents the ancillary consumption of the different technologies. This was introduced in the TIMES-SINERGIA model as a percentage of the total electrical energy produced by each type of technology.

Transmission and distribution network losses

As mentioned above, the model simplifies the electricity system grid, considering it as a single node, although the efficiencies associated with this grid are established, making it possible to model the existing losses in the transmission and distribution of electricity in high, medium and low voltage grids, such as the losses associated with the transformation processes from high to medium voltage and from medium to low voltage. These losses are modelled with efficiency coefficients associated with high voltage (0.989), medium voltage (0.974) and low voltage (0.916).

Interconnections

In TIMES-SINERGIA, the following considerations were taken into account to model the interconnections:

- Interconnections with Morocco and Andorra: a constant net export balance per time period is considered, calculated as the average of the real values for the years 2014, 2015, 2016 and 2017.
- Interconnections with Portugal and France: both import and export capacity with these countries was considered jointly. With regard to interconnection capacity with France, it should be noted that the projected increases in this capacity were taken into account, reaching 5,000 MW in 2025 and 8,000 MW in 2030.

Renewable energy technology penetration

A maximum limit is established on the input of new generation power corresponding to photovoltaic and wind (onshore and offshore) technologies during the 2020-2030 period.

Coupled thermal generation

A minimum of constant thermal generation provided by all nuclear, coal and combined-cycle power plants is considered. In addition, part of this minimum will correspond to the sum of combined-cycle and coal production, of which another part will be provided exclusively by combined-cycle power plants.

Calculating availability factors

The availability factors, both annual and per time period, were calculated for existing renewable technologies, from actual hourly production data for each technology. The availability factors for 2014 were obtained from the actual hourly production data for the aforementioned year, while for subsequent years, an average for the years 2014, 2015, 2016 and 2017 is assumed, and in the case of water technology, the data for 2015 is assumed, which is considered a year close to an average hydrological year.

In hydroelectric installations with more than 10 MW of power and in pumping installations, these factors per period were increased with the aim of giving the different generation systems greater capacity to adapt these technologies in subsequent years.

For the rest of the technologies, different annual availability factors were considered, adapted to the real availability of each technology arising from stoppages due to recharging, maintenance, unscheduled unavailability, etc.

Repowering

It is considered that the capacity of wind, solar photovoltaic, solar thermoelectric, biomass, biogas and urban solid waste technologies that reach the end of their useful life will be repowered to a greater or lesser degree depending on the technologies.

B.1.2. Model used by Red Eléctrica de España

The analysis of the scenarios defined for the Spanish electricity system consists of the simulation of the generation dispatch and the guarantee of supply for the analysis of coverage in the Spanish peninsular electricity system. The studies use a simplified model of the European system in which each modelled electricity system (offer zone) is represented as a single node interconnected with its neighbouring systems with the commercial exchange capacity value deemed available to the market (NTC - Net Transfer Capacity). The European model used corresponds to that analysed in the studies carried out by ENTSO-E for the drafting of the European Ten Years Network Development Plan (TYNDP).

The simulations use as a base assumption a market model of perfect competition in electricity generation and, therefore, do not include the possible strategies of the generators to maximise their profits. The offer of each generator will be the variable cost of its generation. The optimal generation dispatch is obtained by minimising the variable cost of generation on condition that the electricity demand is supplied in all countries and throughout the time period analysed.

The model used considers variable generation costs based on a forecast of fuel prices, estimated operating and maintenance costs for each technology and CO_2 emission costs. Fixed generation costs, costs of dismantling generating units currently in service and not considered in the scenario to be evaluated, possible costs of extending the useful life of generating units or other factors (tariffs, taxes) that may form part of the generation's supply strategy are not considered. Renewable generation is considered in the zero-variable cost model.

A simplified system model is used in which the different modelled systems (price zones) are represented as a network of nodes interconnected by the commercial exchange capacity available to the market (NTC – Net Transfer Capacity) according to the physical interconnections that exist between each of them. In general, the model uses a constant value of commercial exchange capacity between the modelled systems at all times on the simulation time frame and therefore does not take into account variations that would correspond to different operating situations or reductions in their value due to unavailability of the transmission network or other circumstances. However, in the case of the interconnections of the Spanish peninsular electricity system, variations in exchange capacity corresponding to situations of unavailability of interconnections are taken into account.

Within each price zone, the analysis carried out considers a single node, i.e., no losses or possible generation limitations due to elements of the internal network of each system are considered. It is important to stress that the model assumes that the transmission network of the Spanish peninsular system will have sufficient capacity to evacuate all the modelled generation and transport it to the points of consumption; and that the variables of the electricity system are kept within the ranges established by the regulations, in order to achieve the level of safety demanded by them. This will require the development and adaptation of that grid, so that renewable discharges or possible additional needs for thermal generation due to possible restrictions in the internal network are minimised, so that only a reasonable minimum of distortions to this single-node assumption are introduced.

The model individually considers the operating parameters of each thermal generation unit, its availability and failure rates. Hydroelectric generation is modelled consistently with historical production series and wind, photovoltaic and thermosolar generation, using climatic historical series as a primary resource. In each scenario, a complete simulation of the generation dispatch of the European system modelled during each hour of the year was carried out, respecting all group restrictions (start-up restrictions, stoppage restrictions, loading and unloading times, etc.) while minimising the total variable cost.

As a result, the marginal cost values and the exchange balance values resulting from the total variable cost minimisation process in the set modelled, respecting the established exchange capacity values, are obtained, with a detailed schedule over a year. Cogeneration is considered in the model, as is renewable generation, with zero variable cost, which gives them priority for dispatch over other technologies.

It is very important to stress that cost results should not be interpreted as prices and energy exchange results only consider the marginal cost difference between systems.

In the simulations presented, a restriction on coupled thermal generation of a minimum value sufficient to guarantee the dynamic stability of the electricity system has been implemented. This minimum necessary generation corresponds to the technical minimum of five nuclear and five thermal units, coal or combined cycle for the scenarios with a horizon of 2025 and the baseline scenario of 2030 and three nuclear and seven combined-cycle units for the scenario with a target horizon of 2030. In case of unavailability of nuclear units, equivalence rules are applied to guarantee a contribution to dynamic stability that is similar to other thermal technologies.

The simulation results in renewable generation values and indicators on the percentage of renewables in electricity generation and electricity demand in the Spanish mainland system. In addition to the value of the share of renewable generation in the electricity production mix, the study calculated the estimated values of the share of renewable generation in the final energy in the Spanish mainland system.

The PLEXOS electrical systems simulation software package was used to run the simulations described above. The PLEXOS tool developed by Energy Exemplar is a software package for modelling electrical systems. It integrates a modelling engine of electricity markets consisting of optimising the global generation cost to determine the optimal solution to the economic dispatch to cover demand. It takes into account the exchange capacities between nodes or areas and considers these capacities as technical restrictions of the system and is able to incorporate additional restrictions as an assumption of minimum synchronous generation.

PLEXOS also includes a tool for analysing demand coverage that enables the system's demand coverage needs to be identified using probabilistic methodology. This tool enables the simulation of a high number of climatic years and situations of scheduled or unexpected unavailability of generation by means of the Monte Carlo method. The usefulness of this tool for coverage and economic dispatch analysis of the electricity system is based on the following factors:

- Linear optimisation systems. PLEXOS is able to function generate the problem of economic dispatch to always obtain a valid solution. Their computing systems are robust and solid, although they require great computing capacity. In any case, they guarantee a high consistency in the solutions.

- PLEXOS has the ability to incorporate complex constraints on the problem of generating cost optimisation into economic dispatch studies. These restrictions can model possible technical restrictions in the system (overloads, minimum coupled generation, reservations, etc.) or restrictions applicable to generators, in their generation limits or in their supply to the market, allowing complex supplies to be modelled. This enables PLEXOS to model power systems with great detail and precision.

- PLEXOS' ability to perform hydro-thermal coordination in economic dispatch makes it possible to carry out complex studies to minimise thermal generation costs through hydroelectric generation or optimised management of pumping or battery storage resources. This resource is important for economic dispatch and demand coverage analyses for the Spanish peninsular electricity system.

B.2 NON-ENERGY EMISSION MODELS

B.2.1. NON-ENERGY SECTOR PROJECTIONS

Introduction

As a complement to the modelling of the energy system for the INECP 2021-2030, carried out with the TIMES-SINERGIA model (see Annex B.1.1), the emissions of the rest of the non-energy sectors and the emissions and absorptions of the LULUCF sector were projected, on a case-by-case basis, according to national forecasts of the main activity variables representative of each sector.

On the projections of the activity variables, emissions and, where appropriate, absorptions were estimated for each of the GHGs by applying calculation methodologies consistent with those implemented in the National Emissions Inventory (2006 IPCC Guidelines and EMEP/EEA 2016 Methodological Guidelines). The 2018 edition of the National Greenhouse Gas Emissions Inventory, corresponding to the 1990-2016 series, was used as a reference for the calculation of projected emissions.

The reference year of the projected series is the reported year, 2016. The geographical coverage used was unique for the entire national territory, assuming characteristics and average parameters. Historical data from the National Emissions Inventory (1990-2016) were used for the analysis of emission trends and emission factors (direct and implicit). The time frame projected was 2017-2040 with annual time periods.

The estimates of projected emissions were made jointly and consistently both for GHGs (CO_2, CH_4, N_2O and fluorinated gases) and for emissions of associated atmospheric pollutants (NH_3, COVNM, PM2.5, SOx, NOx and CO), which will be included in the Atmospheric Pollution Monitoring Programme (*Programa de Control de la Contaminación Atmosférica*).

The following is a brief description of the main features of the systems for calculating emission projections for the most relevant non-energy sectors: agriculture, waste, product use and land use, land-use change and forestry (LULUCF).

Agricultural sector projections

The estimation of projected emissions from the agriculture sector was carried out in a manner consistent with the calculation system applied in the 2018 edition of the National Greenhouse Gas Emissions Inventory, corresponding to the 1990-2016 series and based on the 2006 IPCC methodological guidelines using a level 2 methodological approach based on country-specific data. The reference year of the projected series is the reported year, 2016.

The two fundamental sets of data entry into the system that were taken into account in the projections are the livestock population and the consumption of inorganic fertilisers on fertilised cultivated area.

Forecasts of the evolution of the livestock population for beef, dairy cattle, sheep, pigs (white and Iberian), poultry, goats and horses for the projected period were provided by the Ministry of Agriculture, Fisheries and Food, based on historical data and market forecasts of livestock production.

For each livestock population, in addition to the census data, parameters relating to enteric fermentation and the country's own manure management were taken into account for the estimation of projected emissions in a manner consistent with the National Emissions Inventory. These data are based on zootechnical documents with specific data for Spain for each productive species and current data and forecasts on manure management systems. These calculations are carried out in a coordinated manner that is consistent with the emissions estimate derived from the application of manure to soils as an organic fertiliser (CRF 3Da2a activities), or emissions arising from grazing activities (CRF 3Da3 activities).

To estimate projected emissions derived from crop management (CRF 3C, D, F, G and H activities), both the total cultivated areas (including rice) and the total quantity and type of inorganic fertilisers applied to the field as fertilisers were taken into account. These practices also took into account the current degree of implementation of available technical improvements and their foreseeable future evolution. The arable area used is consistent with inventory data in the latest edition of the National Emissions Inventory, as well as the data on the use and application of inorganic fertilisers, which in turn, are consistent with the National Balances on the use of Nitrogen in Spanish Agriculture (BNAE).

For the scenario with additional measures, the policies and measures described in the corresponding chapter of this report were taken into account.

The projected emission estimates for all agricultural activities were made jointly and consistently both for GHGs (CO_2, CH_4 y N_2O) and for emissions of associated atmospheric pollutants (NH_3, COVNM, PM2.5, SOx, NOx y CO) to be included in the Air Pollution Control Programme.

Projections of the Waste sector

For the projection of emissions derived from the management and treatment of waste, the historical inventory data were used as starting data (since 1950 for landfills and since 1990 for the rest of activities). These data are consistent with the official national series (Subdirectorate-General for Waste of MITECO and INE) and those published in EUROSTAT.

The evolution forecasts of total waste generation (CRF 5A, B and C1 activities), as well as the distribution of the management and treatment systems at national level for the Baseline Scenario were provided by the competent unit of MITECO. For the scenario with additional measures, the policies and measures described in the corresponding chapter of this report were taken into account.

With regard to emissions arising from wastewater treatment CRF 5D activity), the projection was linked to the projection of the national population, considering that the activity has reached maturity in terms of its development (maximum percentages of treated population, volume of treated water, protein consumption, equilibrium in the treatment systems and maximum efficiencies in the capture of the CH_4 generated and its use).

The calculation of emissions was carried out in a manner consistent with the methodologies used in the National Emissions Inventory (based on the 2006 IPCC methodological guidelines and normally with Tier 2 methodological approaches).

Product Use Sector Projections

This sector mainly includes activities related to the use of lubricants and solvents (CRF 2D activity) and the use of fluorinated gases (CRF 2F and G activity).

The projection of the variables of activities linked to the use of lubricants and solvents was linked through elasticities to the GDP and population projections determined in the general macroeconomic context of the National Plan.

For emissions of fluorinated gases in refrigeration and air conditioning activities, foaming agents and firefighting equipment, projections were made according to objectives of Regulation (EU) No 517/2014 on fluorinated gases which provides for a reduction of 2010 emissions by two-thirds by 2030 and sales of 2014 F-gases by 79% by the year 2030.

The variety of activities considered within the CRF 2G category (SF6 in electrical and medical equipment, N_2O in anaesthesia and aerosols (whipped cream), tobacco consumption and fireworks) was projected by linking the activities directly to GDP.

No policies or measures beyond those currently in place were taken into account for the construction of the scenario with additional measures.

The projected emissions estimate was carried out in a manner consistent with the methodologies used in the National Emissions Inventory (based on the 2006 IPCC Methodological Guidelines and normally with tier 2 methodological approaches).

LULUCF sector projections

The projections of absorptions and emissions from the land use, land-use change and forestry (LULUCF) sector were made by applying the same calculation model used in the National Emissions Inventory in its 2018 edition (1990-2016 series and reference year 2016). This calculation system applies the 2006 IPCC methodological guidelines and makes use of data series of available area uses and changes from 1970 to 2016.

The land use change matrices for the period 2017-2040 were built on trends observed in historical data. Only additional areas were included in the reforestation for the construction of the scenario with additional measures according to the measures described in the corresponding chapter of this report.

The forecasts of consumption and use of wood products were based on historical inventory data linked to GDP. For transitions between crops, the incidence of forest fires, the growth of forest biomass or the implementation of agricultural soil conservation practices (activities with notable impact on emission and absorption estimates in the LULUCF sector of the Spanish Inventory), different future projection approaches based on historical data from the National Inventory and historical trends were applied.

The forest reference level for the period 2021-2025 was set using data from the reference period (2000-2009) of the National Forest Inventory as described in the National Forest Accounts Report and as provided for in Regulation (EU) 2018/841 of the European Parliament and of the Council of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land-use change and forestry in the 2030 climate and energy framework.

The accounting for LULUCF absorption was also carried out in accordance with Regulation (EU) No 2018/841.

B.2.2. M3E MODEL DESCRIPCION

The M3E model (Modelling of Mitigation Measures in Spain) is a model that enables the joint evaluation of sectoral mitigation measures and which has been used for the evaluation of the contribution of measures from diffuse non-energy sectors to the objectives of this Plan, i.e., agriculture and livestock, waste management, and fluorinated gases.

The input variables are defined for each measure included in the model and for each year analysed, always taking into account that the assigned values refer to the unit defined for the specific measure, such as m^2 of dwelling, t of bio-waste, 1 million passenger-km, etc. These variables are grouped into the following categories:

- definition of the measure;
- investment;
- operation and maintenance;
- time frame;
- CO_2 mitigation – energy;
- field of application of the measure;
- type of measure.

Other common variables such as energy costs and CO_2 costs, discount rate etc. are pre-configured in the model.

The model identifies mitigation by measure in the years in which it applies to a potential universe. It also deducts from the universe in each year those units (dwellings, vehicles, etc.) on which it has already acted in previous years.

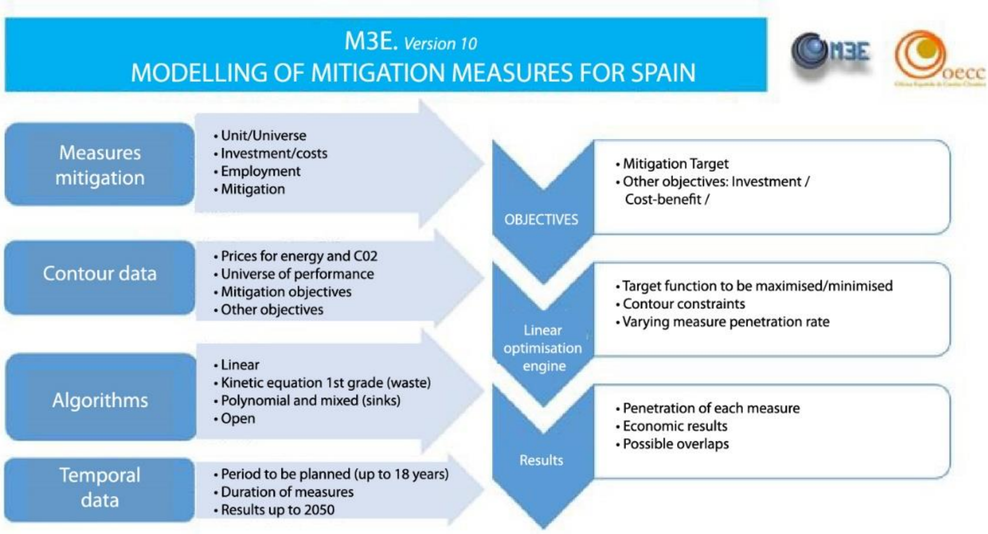
According to the type of the measure, it estimates mitigation with predefined equations (negative exponential in the case of waste, polynomial in the case of sinks, etc.).

M3E, based on input data, applies an optimisation problem-solving engine to search for an objective (minimise a cost), complying with a series of constraints such as meeting the mitigation objective and proposing degrees of application of realistic measures within maximum and minimum values. A common use is to meet the chosen mitigation target and minimise a function composed of the cost of applying the measures, which may also include the use and cost of CO_2.

The model is supported in an Excel format that gives flexibility for the incorporation and modification of data in the future, as well as its management by staff to ensure the future continuity of revisions.

Based on the input data and the execution of the optimiser, for each year, it searches for the cost-effective combination of measures within the possible ranges of application that enable the mitigation objective to be reached. The net present value (NPV) and the marginal abatement cost (MAC) per tonne of CO_2 are used as the cost of each measure.

Figure B.5. Structure of the M3E Model



Source: Spanish Climate Change Office

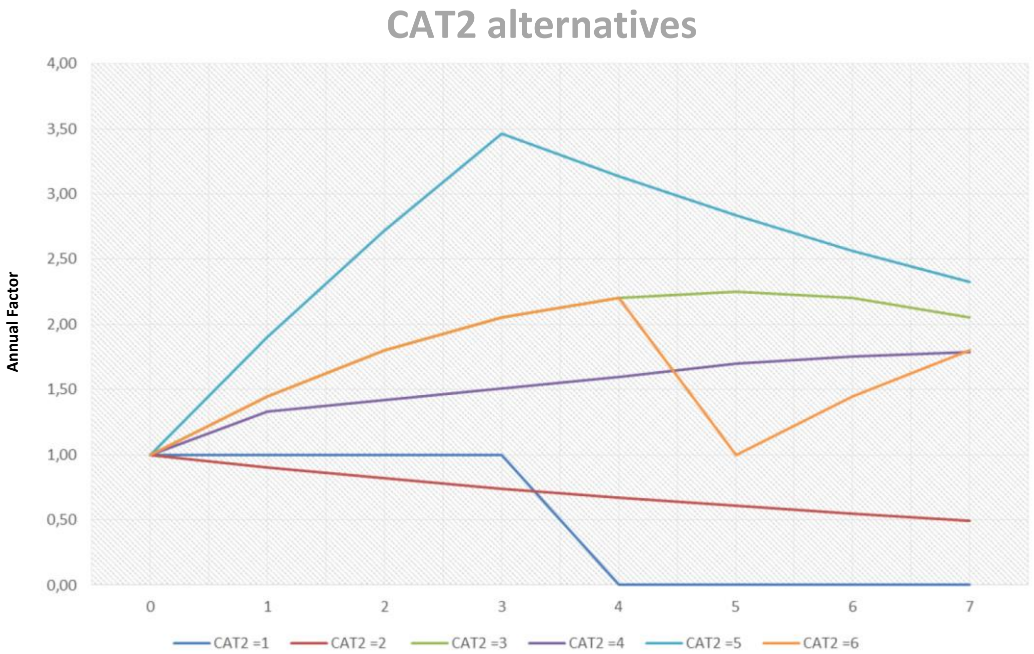
Taking into account the penetration percentage determined by the linear optimiser, the spreadsheet provides total results for each year and measurement of the following variables:

- mitigation in diffuse sectors ($MtCO_2$/year);
- mitigation in ETS sectors ($MtCO_2$/year);
- total mitigation ($MtCO_2$/year);
- investment in the year (€ m);
- annual O&M expenses (€ m/year);
- total cost (€ m);
- energy savings (kWh/year);
- employment per investment (persons/year);
- O&M employment (persons/year);
- local economic activity in year of installation (€ m);
- local economic activity in successive years (€ m);
- pay back;
- tax revenue by investment (€ m);
- annual fiscal balance (€ m);
- possible co-benefits (2 variables to be defined).

With this output information, the graphs and tables illustrating the results obtained are subsequently drawn up.

In addition, the model evaluates aspects such as the possible overlapping of measures that could result in double counting of the mitigation produced. Sensitivity analysis of key parameters is possible.

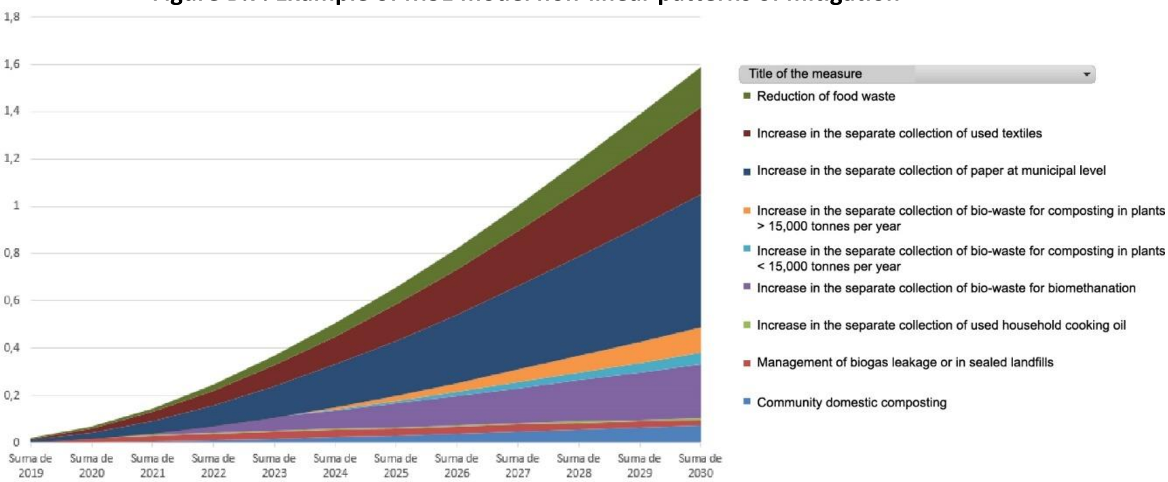
Figure B.6. Example of M3E model sensitivity analysis



Source: Spanish Climate Change Office

A unique feature of the M3E model is the possibility of defining non-linear mitigation patterns over time. These patterns occur in non-energy sectors such as waste management and forest sinks. The figure shows the flexibility of alternatives when adopting the mitigation pattern of a possible measure.

Figure B.7. Example of M3E model non-linear patterns of mitigation



Source: Spanish Climate Change Office

The graphic and numerical outputs of the model are easily adaptable to the required information needs and can be exported to other models.

The information on measures and compliance is adapted to the communication needs required by the new governance system.

B.3 IMPACT ANALYSIS MODELS

B.2.2. DENIO MODEL DESCRIPCION

The DENIO model was used in this study for the analysis of the economic impact of the different measures and scenarios of the INECP. DENIO is a dynamic neo-Keynesian econometric model and represents a hybrid between an econometric input-output and a computable general equilibrium (CGE) model. It is characterised by the integration of institutional rigidities and frictions that cause fiscal policies and investments to have a different impact in the short term than in the long term. In the long run, the economy always converges towards full employment equilibrium and in that equilibrium phase the model works in a similar way to a CGE model. Unlike a CGE model, DENIO explicitly describes a path of adjustment towards this equilibrium.

DENIO is a disaggregated model with a list of 74 sectors, 88 products, 22,000 types of households and 16 categories of consumption. The model equations were estimated econometrically using data from INE, Banco de España and EUROSTAT. The model is calibrated for base year 2014.

DENIO is inspired by the Fully Interregional Dynamic Econometric Long-term Input-Output Model of the European Commission — FIDELIO (Kratena et al., 2013, Kratena et al. 2017). The FIDELIO model was used by the European Commission to analyse the economic impact of the Clean Air Package (Arto et al., 2015). A model with these characteristics was also used in the Basque Country (DERIO: Dynamic Econometric regional Input-Ouput model) to analyse the economic impact of the 2050 Climate Change Strategy of the Basque Country.

The economic growth in DENIO is in the long term driven by the growth of total factor productivity (TFP) to which a path of prices, and therefore, export competitiveness corresponds. Exports are exogenous and adjust in the Baseline Scenario to the path of GDP growth provided by the MINECO. Imports are endogenous and there is no equilibrium condition on the external balance.

In DENIO there are two mechanisms that determine the Keynesian characteristic of the model in the short term and the long-term CGE characteristic: (i) the heterogeneity of the marginal propensity to consume with respect to disposable income, according to the situation of the financial sector; and
(ii) the effect on wages/prices when the economy is at or below the equilibrium unemployment rate (NAIRU). The marginal propensity to consume also varies according to income groups. This was derived from estimates of the consumption sensitivity to long-term income (Kratena, et al., 2017).

The household demand sub-model comprises three levels at which the demand made by the 22,000 types of households for a total of 16 expenditure categories is determined. At the first level, the demand for durable goods (dwellings and vehicles) and the total demand for non-durable goods are derived. The second level links energy demand (in monetary and physical units) with the stock of durable goods (houses, vehicles, household appliances), taking into account the energy efficiency of the stock. At the third level, nine categories of demand for non-durable consumer goods are determined in a flexible demand system - Almost Ideal Demand System. Finally, total household expenditure in these 16 consumption categories (at purchase prices) is transformed into a consumption vector of 88 products at basic prices using a product/expenditure bridge matrix and the valuation matrices provided by the INE. The model is estimated using micro-data from the Household Budget Survey and the Living Conditions Survey drawn up by the INE.

The model's Input-Output core is based on 2014 Origin and Destination tables (latest available) prepared by the INE. The production model links the production structures (Leontief technologies) of the 74 sectors and 88 products to a Translog model with four production factors (capital, labour, energy and other intermediate inputs). The demand for the energy factor is divided into 25 types which in turn are linked to the model in physical units (terajoules and tonnes of CO_2). The set of energy categories in the energy substitution model is directly linked to two parts of the model: (i) the physical energy accounts (terajoules) by industry (74+ households) and type of energy (25) from Eurostat and (ii) the energy products and industries from the Origin and Destination tables in monetary units. For this purpose, a series of implicit prices are used, which link energy uses/production in physical units (TJ) and in monetary terms. The high level of detail in the energy model makes it possible to link the DENIO model with bottom-up models in the energy/electricity sector (such as TIMES-SINERGIA).

The labour market is specified through wage curves, where wage increases by industry depend on productivity, the consumer price index and the distance to full employment. The demand for intermediate inputs is modelled in three steps. First, the Translog model estimates the total demand for intermediates in each productive sector. Secondly, this demand is disaggregated by using the productive structures of the Input-Output framework's Table of Origin. Finally, the intermediate demand is divided into domestic and imported products. Capital formation is also endogenous and is derived from the capital demand by sector of the Translog model, by applying the product/sector capital formation matrix. The model is closed by internalising parts of public expenditure and investment to comply with the medium-term stability programme for public finances. This model-locking mechanism is part of the public sector module. This module integrates several components of endogenous income: income taxes (with variable rates depending on the income of each household), wealth, capital, products and production and social security contributions. In expenditure, transfers are endogenous and grow at the rate of GDP. Interest payments on public debt are also endogenous and depend on the path of public debt. Government consumption and investment are endogenous because of the model closure described above.

For the INECP simulations, the DENIO model has been used in combination with the TIMES-SINERGIA bottom-up model. Specifically, data such as the energy and electricity mix, energy intensity and efficiency by sector, prices and investments are taken from this model to analyse the economic impacts on key variables such as employment, GDP, trade balance, income distribution, inflation, etc.

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B.3.2 INTEGRATION OF MICRODATA IN DENIO

DENIO incorporates the microdata of the households that represent the entire Spanish population, which makes it possible to evaluate the microeconomic effects and the distributive impacts and their impact at the social level.

The main database used to integrate the 22 000 households in the model is the 2014 Household Budget Survey (HBS). The HBS is a cross-sectional survey representative of the entire Spanish population that compiles annual information on consumption patterns and socioeconomic characteristics of Spanish households. Thus, through the consumption structure of the HBS, the households collected from said survey in DENIO are included. It is worth mentioning that the HBS provides a population factor for each household surveyed. This population factor allows us to increase the consumption of each household and therefore bring the analysis closer to all households in Spain.

However, as expected, the integration of microdata into such a model is not immediate and it was necessary to include data from other statistical sources, as well as to make some assumptions. One of the main limitations of HBS is its scarce information on household incomes, as well as their origin. Although the Household Budget Survey contains information on monthly household income, this variable has a high non-response rate and, as some studies show, tends to under-represent household income (López-Laborda et al. 2016). Thus, in order to calculate the income of each household, the savings estimates calculated for Spain were applied to the total expenditure of each household. The use of savings estimates by income level was chosen for two reasons. The first is that the Household Budget Survey was used for its calculation. The second is that household savings estimates are pre-set at different income levels (quintiles, to be more specific). In this way, using the savings rates per income quintile in the HBS respects the inequality structure existing in Spain.

Finally, it has also been necessary to estimate the origin of the household incomes introduced in the model. In DENIO each household consumes according to the consumption structures of each one of the consumption nodes and according to their available income. This disposable income depends on different sources of income. In DENIO, to calculate the disposable income of households, the following eight sources of income are taken into account: (1) wages and salaries; (2) gross operating surplus; (3) social contributions; (4) public sector transfers; (5) property income and dividends; (6) interest paid on debt; (7) wealth taxes and personal income tax; and (8) other income.

Given that this information is not included in the HBS, the sources of origin of household income were completed using information from the Living Conditions Survey (LCS). The LCS, as well as the HBS, is a cross-sectional survey representative of the entire Spanish population, and its main objective is to provide a reference source on comparative statistics on income distribution and social exclusion in Europe (INE 2018b).

To complete the sources of income in the HBS, the income structure (taking into account the income sources included in DENIO) of the LCS 2014 was calculated by income group, more specifically by income ventile. Once the average structure of the sources of income by ventile of the LCS was calculated, these same structures are applied to the HBS households according to the income ventile to which each household corresponds.

At the end of the previously detailed process, we have the following information for each of the households to be integrated: consumption patterns, total income, origin of said income and characteristics collected in the Household Budget Survey. Thus, there are 22,000 households prepared to be integrated into DENIO.

Finally, integration is carried out through the expenditure and income structures of the 22,000 households, but respecting the values of the national accounts incorporated into DENIO.

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B.3.3 SPECIFICATION OF AIDS DEMAND MODEL

For the specification of the node of consumption of non-durable goods, an estimation of a demand model was carried out to calculate the substitution price elasticities, as well as the elasticities of income of the different goods that make up this node. These elasticities are then used to apply the parameters corresponding to the non-durable goods demand function. For the estimation of the demand model for these goods, the widely known 'Almost Ideal Demand System' (AIDS), proposed in 1980 by Deaton and Muellbauer (1980), was used. The main advantage of this methodology is that it allows a first-order approach to an unknown demand system. In addition, AIDS models satisfy the axioms of consumer theory and do not impose restrictions on the utility function. More specifically, its logarithmic approach (LAIDS) has been followed, which for a group of goods *n* can be defined as:

$$W_i = \alpha_i + \sum_{J=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln\left({}^{Y_i}/_{\tilde{p}}\right) + t + \sum_{d=1}^{7} d_d + e_{it} \qquad [1]$$

where W_i represents the percentage of consumption of good i (over total consumption of goods included), αi is the constant, p_j is the price of good j, $\tilde{p}$ refers to the Stone Price Index, Y is income (so $Y/\tilde{p}$ represents real income), t is a trend variable that captures the effect of time (taking values of 1 for 2006 and 11 for 2016). Finally d_d is a set of 'd' dummy variables or control variables that capture the effect of different characteristics of the households included: years of crisis (i.e., years subsequent to or prior to 2008); autonomous community where it resides; professional status of the main breadwinner; number of household members; sex of the main breadwinner; age of the main breadwinner, and how urbanised the household is. Finally e_{it} is the error term. The sum and homogeneity constraints of equation [1] are as follows:

$$\sum_{i=1}^{n} \alpha_i = 1 \qquad [2]$$

$$\sum_{j=1}^{n} \gamma_{ij} = 0 \qquad [3]$$

$$\sum_{i=1}^{n} \beta_i = 0 \qquad [4]$$

The symmetry condition is given as:

$$\gamma_{ij} = \gamma_{ji} \qquad [5]$$

Finally, the sum of W_i must also satisfy the following:

$$\sum_{i=1}^{n} W_i = 1 \qquad [6]$$

The AIDS model is carried out to analyse the demand for non-durable goods, including 9 different groups of goods: (1) food and beverages; (2) clothing and footwear; (3) non-durable household goods (furniture, carpets, crockery, etc.); (4) medical expenses; (5) telecommunications; (6) education; (7) hotels and restaurants; (8) financial services; and (9) other non-durable goods. Since the AIDS model is composed of a system of dependent equations, the equation corresponding to group 9 was eliminated in the estimation process to avoid problems with uniqueness. The elasticity matrix of the AIDS model was calculated using the following expressions:

Marshallian Own-Price Elasticity: $$\varepsilon_{ii} = \frac{\gamma_{ii}}{w_i} - \beta_i - 1 \qquad [7]$$

Marshallian Cross-Price Elasticity: $$\varepsilon_{ij} = \frac{\gamma_{ij}}{w_i} - \beta_i \qquad [8]$$

Income elasticity: $$\theta_i = \frac{\beta_i}{w_i} + 1 \qquad [9]$$

The data used in the estimation process were taken from the microdata of the Household Budget Survey (HBS) (INE, 2018). The HBS is a cross-sectional survey representative of all Spanish households that compiles annual information on consumption patterns and socioeconomic characteristics of households. The HBS collects annual information from about 20,000 households. HBS data for the period 2006-2016 were used to estimate AIDS. One of the main limitations of the estimation carried out is the lack of a continuous household survey, since the HBS is a cross-cutting survey for each year; for this reason, the cross-data for each of the years included in the estimation were used, i.e., the data were not transformed into a continuous time series. In estimating equation [1], household expenditure is used as an income proxy because household incomes are underrepresented in expenditure surveys (see for example Wadud et al., 2009 or López-Laborda et al. 2018) and also because expenditure is a variable closer to permanent vital income and suffers fewer variations throughout the life of individuals (Poterba, 1991). Given that the expenditure groups analysed are made up of different goods and products, the national statistics do not have specific prices for the selected groups, and for this reason it was necessary to construct a price index per group based on the consumer price indices (CPI, INE 2018) of each expenditure subgroup. For this purpose, a Stone Index was constructed for each expenditure group based on the price indices by autonomous community in base year 2006 for each subgroup. One of the main advantages of this process is that it allows for the introduction of heterogeneity in the prices of each expenditure group and individual, and thus facilitates the estimation of the AIDS demand model.

The price and income elasticities obtained are shown in Table B.4. The last column of the table represents income elasticities, while the rest represents price elasticities. The main diagonal (darker colour) of the matrix shows the own-price elasticities, while the remaining elements are cross-priced. As can be seen, and as one would expect, the own-price elasticities have a negative sign, while income elasticities are positive.

Table B.4 Price elasticities (own and cross) and income elasticities

	Food	Textiles	B_Household	Health	Communication	Education	Catering	Financial_Serv	Other	Income
Food	-1.76	0.83	0.39	0.89	-0.08	-0.09	0.69	0.13	-0.65	0.58
Textiles	2.71	-2.29	-1.27	-1.36	0.27	0.71	-0.45	-0.32	0.72	1.34
B_Household	1.30	-1.73	-0.23	-1.45	0.78	0.17	-1.42	0.23	1.19	1.30
Health	4.83	-2.18	-1.72	-2.14	1.22	0.74	-1.88	0.28	-0.36	1.41
Communication	-1.29	0.45	0.84	1.11	-0.70	-0.87	0.05	0.52	-0.88	0.58
Education	-5.99	4.58	0.83	2.89	-3.94	-1.92	1.84	1.23	-0.63	1.89
Catering	1.31	-0.32	-0.70	-0.78	-0.05	0.14	-1.65	-0.34	0.91	1.39
Financial_Serv	-0.07	-0.36	0.25	0.26	0.47	0.28	-0.58	-0.59	-0.51	0.74
Other	-1.94	0.39	0.46	-0.18	-0.43	-0.11	0.84	-0.29	-0.23	1.37

Source: Basque Centre for Climate Change, 2019

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B.3.4 DESCRIPTION OF TM5-FASST

The TM5-FASST is a global air quality source-receptor model (AQ-SRM) developed by the Joint Research Centre (JRC) of the European Commission in Ispra, Italy. It enables the analysis of the effects in terms of health or ecosystem damage derived from different scenarios or emission pathways. Through meteorological or chemical-atmospheric information, the model analyses how emissions from a given source affect different receptors (in cells) in terms of concentration, exposure and, consequently, premature deaths. All documentation on this model can be found in Van Dingenen et al., 2018. It has been used to carry out different studies at a global or regional level, among which are Kitous et al., 2017 and Markandya et al., 2018. It has also been used by institutions such as the OECD to project the future possible effects in terms of health (OECD, 2016).

The concentration levels of a given pollutant are calculated using the following linear equation:

$$C_{ij}(x, y) = c_j(y) + A_{ij}(x, y)E_i(x) \qquad (1)$$

This equation defines the concentration level of a pollutant j in the receptor/cell and derived from the emission of the precursor i emitted at source x (i.e. C_ij (x,y)) as the sum of a spatial constant (c_j) plus the emission of the precursor i at source x, multiplied by a source-receptor coefficient (A_ij (x,y)) reflecting the relationship between source **x** and the receptor **y**.

These coefficients, which represent the different relationships between sources and receptors/cells, have previously been calculated by applying a 20% disruption in emissions over a reference scenario and calculating concentration levels as explained in equation (1). Although the model covers the entire world using 1x1 (100 km) cells, this process was performed for 56 regions (sources). Thus, each of these coefficients, for each receptor, can be defined by the following equation:

$$A_{ij}(x, y) = \Delta C_j(y)/\Delta E_i(x) \qquad (2)$$

Where $\Delta E_i(x)$= 0.2 * $e_i(x)$, with $e_i(x)$ being the emissions in the reference scenario.

It should be borne in mind that in addition to the fact that gases emitted at a certain source x may affect different receptors y, each precursor may also indirectly affect the concentration levels of more than one pollutant j. For example, emissions of NOx (a precursor gas) affect not only the formation of PM2.5 particles in the atmosphere, but also ozone (O_3) levels.

Therefore, the level of total concentration of the pollutant j in the receptor (the cell) y, which results from the emission of all its precursors i, in all sources x is defined as:

$$C_j(x, y) = c_j(y) + \sum_x \sum_i A_{ij}(x, y)[E_i(x) - e_i(x)] \qquad (3)$$

Once the concentration levels of pollutants have been obtained, the model makes it possible to analyse different effects derived from these levels, such as the impacts of pollution on health, possible damage to agricultural systems, or depositions in the Arctic. However, this study focuses on the effects of fine particulate matter (PM2.5) and ozone concentration levels on human health.

These effects are calculated as premature deaths from exposure to these pollutants (PM2.5 and O_3), taking into account the various causes defined in Forouzanfar et al., 2016a, including cardiovascular diseases, respiratory diseases, embolisms or lung cancer. The parameters and calculation of premature deaths from disease are detailed in Burnett et al., 2014.

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ANNEX C. MAIN ELEMENTS OF THE FIGHT AGAINST CLIMATE CHANGE IN SPAIN

Table C.1. Summary table of the main elements of the fight against climate change in Spain

MAIN ELEMENTS OF THE FIGHT AGAINST CLIMATE CHANGE IN SPAIN						
Name	**Sector/s**	**Objective and/or activity concerned**	**GHG**	**I**	**S**	**Year I.**
INTERSECTORAL POLICIES AND MEASURES						
Operational programmes of the autonomous communities	Intersectoral	Regional development and emission reductions, especially under Thematic Objective 4 'Promoting the transition to a low-carbon economy in all sectors'.	CO_2; CH_4; N_2O; HFC	EC	I	2014
Clima Projects	non-ETS	Reduce emissions in diffuse sectors and encourage the development of a low-carbon economic activity.	GHG	EC	I	2012
Carbon footprint recording, offsetting and CO_2 absorption projects	Intersectoral	Promote the calculation of carbon footprints by Spanish organisations.	GHG	I	I	2014
Operational programme for sustainable growth 2014-2020	Intersectoral	Sustainable growth within the ERDF framework. Low-carbon economy, urban development and sustainable growth measures are highlighted.	CO_2	EC	I	2015
Implementation of the European Emissions Trading System	ETS	Achieve the reduction of GHG emissions from the energy and industry sectors, through the allocation ceiling of emissions by sector. Objective: Achieve a 21% reduction in EU ETS emissions by 2020 compared to 2005 levels.	CO_2; N_2O; PFC	EC	I M	2005
Use of the Kyoto Protocol Flexibility Mechanisms	Intersectoral	Obtain emission reduction units to facilitate compliance with the Kyoto Protocol, for possible use in both ETS and non-ETS. No provision is currently made for the use of these credits to meet our commitments.	CO_2	M AV	A	2013
European Union CCS Directive	Intersectoral	Regulations for the geological storage of CO_2 under safe conditions for the environment, in order to contribute to the fight against climate change.	CO_2	N	A	2009
Financing of demonstration projects. NER 300 programme	Intersectoral	Promoting the construction of CO_2 capture and geological storage projects and innovative renewable energy technologies within the EU. Up to 38 projects.	CO_2 N_2O PFCs	RDI	D	2013
SECTORAL POLICIES AND MEASURES						
Energy sector						
Energy Saving and Diversification Investment Fund (FIDAE)	Other Energy	Aims to finance sustainable urban development projects that improve energy efficiency and/or use renewable energy.	CO_2	EC	E	2011
Savings and Efficiency Action Plan 2014-2020	Other Energy	Achieve final energy savings for the period 2014-2020.	CO_2	P	I	2014
Electricity and Gas Sectors Planning 2014-2020	Energy	Meet the 2020 targets for energy efficiency, renewable energy and the environment.	CO_2	P	I	2014
Renewable Energy Plan (REP) 2011-2020	Other Energy	Encourage the use of renewable energy sources.	CO_2	P	I	2011
Industrial Sector						
Voluntary agreement SF6 - electricity sector	Industrial	Reduction of emissions of fluorinated gases	SF_6	AV	I	2015
Royal Decree 115/2017 on fluorinated gases	Industrial	Reduction of emissions of fluorinated gases	PFCs SF6, HFC	N	I	2017
National tax on fluorinated greenhouse gases	Industrial	Replace fluorinated gases with other substances; reduction of emissions of fluorinated gases.	PFCs; SF_6; HFC	F	I	2014
Integrated Pollution Prevention and Control	Industrial	Integration of environmental authorisations for industrial activities.	GHG	N	I	2003

MAIN ELEMENTS OF THE FIGHT AGAINST CLIMATE CHANGE IN SPAIN						
Name	**Sector/s**	**Objective and/or activity concerned**	**GHG**	**I**	**S**	**Year I.**
Transport Sector						
ADIF 2014-2020 Energy Efficiency and Savings Master Plan - High Speed	Transport	Energy saving measures and improvement of energy efficiency at high speed.	CO_2	N, P	I	2014
ADIF 2014-2020 Energy Efficiency and Savings Master Plan	Transport	Energy saving measures and improvement of energy efficiency.	CO_2	N, P	I	2014
Framework Agreement for the design, supply and/or installation of energy-efficient lighting systems	Transport Energy	Improvements in the efficiency of airport lighting systems.	CO_2	AV	I	2015
Carbon footprint accreditation at airports	Transport	Obtaining and renewing carbon accreditation at various airports.	CO_2	AV	I	2011
Supply of electricity at 400 Hz to aircraft at airports	Transport Energy	Promote the use of electricity for parked aircraft.	CO_2	P	I	2016
Progressive incorporation of renewable energies in airports	Transport Energy	Use alternative energy sources and diversify energy production at airports.	CO_2	Other	I	2000
Optimisation of aircraft taxiing movements	Transport	Minimise aircraft time and travel at the airport.	CO_2	AV	I	2014
Renewal of fleets of heavy goods and passenger vehicles and agricultural tractors	Transport	Finance the replacement of heavy duty vehicles of companies (with less than 3,000 employees).	CO_2	EC	I	2016
Tendering of concessions for the regular transport of passengers by road	Transport	Establish energy efficiency and pollutant requirements in concession specifications.	CO_2	N	I	2014
Incorporation of criteria encouraging the use of less polluting ground handling equipment	Transport	Encourage the use of less polluting equipment.	CO_2	Other	I	2015
Aid for the implementation of vehicle fleet management systems	Transport	Implementation of efficient vehicle fleet management systems.	CO_2	EC	I	2015
Aid for the financing of urban mobility plans and business mobility plans	Transport	Development of urban mobility plans (modal shift).	CO_2	EC	I	2014
Efficient Vehicle Incentive Programme PIVE PLANS (PIVE I, II, III, IV, V, VI, VII and VIII)	Transport	Renewal of the fleet of light vehicles with more efficient ones.	CO_2	EC	E	2012
Efficient driving courses in road transport	Transport	Efficient driving in road transport.	CO_2	ED	I	2015
Integrated Strategy for the Promotion of Electric Vehicles in Spain and MOVELE and MOVEA Plans (from 2016)	Transport	Encourage the penetration of electric vehicles, aimed at promoting alternative technologies.	CO_2	EC	I	2010
Plan to Promote the Environment - PIMA Transport [PIMA Transporte]	Transport	Renewal of the road transport fleet.	CO_2	EC	E	2014
Plan to Promote the Environment - PIMA Air Plans [PIMA Aire] (I, II, III and IV)	Transport	Renewal of the commercial vehicle fleet.	CO_2	EC	E	2013
Royal Decree 1085/2015 of 4 December 2015 on the promotion of Biofuels	Transport	Establish the path for the introduction of biofuels in transport by 2020.	CO_2	N	I	2017
Management and service delivery programme	Transport	Efficiency and rationalisation in the use of resources.	CO_2	P	I	2012
Investment action programme	Transport	Infrastructure planning with an intermodal approach, enhancing the most efficient mode in each corridor.	CO_2	P	I	2012
Regulation, control and monitoring programme	Transport	Enable the development and implementation of the policies established in each of the modes of transport.	CO_2	N	I	2012

MAIN ELEMENTS OF THE FIGHT AGAINST CLIMATE CHANGE IN SPAIN						
Name	**Sector/s**	**Objective and/or activity concerned**	**GHG**	**I**	**S**	**Year I.**
Spanish Logistics Strategy	Transport	Promote the Spanish logistics sector, improve the efficiency and sustainability of the transport system and develop an intermodal network.	CO_2	N, P	I	2013
Promotion of urban mobility plans	Transport	Local authorities to approve mobility plans	CO_2	EC	I	2014
Transport voucher	Transport	Promotion of collective employee transport.	CO_2	F	I	2010
Registration tax: Law 38/1992 of 28 December 1992 on excise duty	Transport	Tax levied according to the level of CO_2 emissions.	CO_2	F	I	2008
National Action Framework for Alternative Energy in Transport	Transport	Promotion of alternative fuels in transport by 2020.	CO_2	N	I	2017
Cataloguing of the vehicle fleet according to the level of emissions	Transport	Identify the category of vehicles so that town councils can develop environmental policies.	CO_2	N	I	2015
Ecodriving: Order INT/2229/2013, Regulating Access to Registration Permits	Transport	Include efficient driving in the programme to get a driver's licence.	CO_2	ED	I	2014
Amendment of the General Traffic Regulations (in process)	Transport	Amend the general speed limits set for vehicles on different types of roads.	CO_2	N	P	2017
Motorways of the Sea	Transport	Modal shift in freight from road to ship.	CO_2	P	I	2010
Efficiency measures in port management	Transport	Efficient use of the general public lighting service in ports.	CO_2	AV	I	2016
Port Accessibility Investment Plan	Transport	Promote port connectivity and maritime-rail intermodality.	CO_2	P	I	2017
Supply of liquefied natural gas (LNG) in ports	Transport	Promotion of the use of LNG in maritime transport.	CO_2	N, P, R&I EC	I	2016
Electricity supply to ships mooring in ports	Transport Energy	Promote the use of electricity for ships at berth in ports.	CO_2	EC	I	2016
RENFE Energy Sustainability Plan 2011-2020	Transport	Management tool to improve energy efficiency and productivity.	CO_2	N, P, I	I	2011
RENFE Energy Efficiency Plan 2015-2025 Passengers	Transport	Reduce energy consumption and costs.	CO_2	N, P	I	2015
Residential, Commercial and Institutional (RCI) Sectors						
Plan to Promote the Environment for the promotion of energy upgrade of hotel facilities - PIMA Sol	RCI	Stimulate the energy upgrade of hotel facilities.	CO_2	EC	E	2013
Plans for the Renovation of Tourist Facilities	RCI	Renovation and improvement of tourist establishments under sustainability and energy efficiency criteria.	CO_2	EC	I	2009
State Financial Fund for the Modernisation of Tourism Infrastructure	RCI	Financially support plans for the renewal, modernisation and comprehensive conversion of mature tourist destinations.	CO_2	EC	I	2005
Upgrading of the General State Administration buildings	RCI	Energy upgrade of the building stock.	CO_2	P	I	2015
Regulation of Thermal Installations in Buildings (RITE)	RCI	Increase the minimum energy efficiency requirements for heating and air-conditioning systems in buildings.	CO_2	N	I	2013
Grant programme for the energy upgrade of existing buildings (PAREER-CRECE Programme)	RCI	Improvement of the thermal envelope, thermal and lighting installations, use of renewable energies.	CO_2	EC	I	2013
Technical Building Code (CTE)	RCI	Greater energy efficiency demands and the incorporation of renewable energies.	CO_2	N	I	2013
Law 8/2013 on Urban Renovation, Regeneration and Renewal	RCI	Facilitate the approval of projects for the energy upgrade of buildings and urban regeneration.	CO_2	N	I	2013
State Housing and Upgrade Plan and State Plan for the Promotion of Urban Renting, Building Upgrades, Regeneration and Renewal (2013-2016)	RCI Energy	Improvement of the thermal envelope, air-conditioning systems, installation of renewable energies and energy efficiency.	CO_2	P	I	2013
Energy Certification of New and Existing Buildings	RCI Energy	Royal Decree 235/2013 of 5 April 2013 approves the basic procedure for the certification of the energy efficiency of buildings and dwellings, and their improvement.	CO_2	N	I	2013

MAIN ELEMENTS OF THE FIGHT AGAINST CLIMATE CHANGE IN SPAIN						
Name	**Sector/s**	**Objective and/or activity concerned**	**GHG**	**I**	**S**	**Year I.**
Agricultural sector						
Maritime and fisheries operational programme	Agricultural	Several measures contribute to Thematic Objective 4 'Promoting the transition to a low-carbon economy in all sectors'.	CO_2	EC	I	2014
Plan to Promote the Environment - PIMA Land [PIMA Tierra] (renewal of tractor fleet)	Agricultural	Renewal of the fleet of tractors for more efficient ones with less emissions	CO_2	EC	E	2014
Ecodriving of tractors	Agricultural	Reduction of emissions due to good driving practice.	CO_2	ED	I	2014
National programme for promoting crop rotation on unirrigated land	Agricultural	Reduce emissions through better use of resources and best practice.	N_2O; CO_2	EC	E	2010
Strategy to support organic production	Agricultural	Promotion of measures which can contribute to the development of organic production.	N_2O; CO_2	P	I	2014
Greening or Green payment	Agricultural	Payment for climate- and environment-friendly agricultural practices (crop management, enhancing biodiversity, carbon sequestration).	CO_2; CH_4; N_2O	EC	I	2015
Plan to Reduce the Use of Nitrogen Fertilisers	Agricultural	Reduction in the use of nitrogen fertilisers and, therefore, a reduction in emissions, either during their manufacture or their application in the field.	N_2O	ED	I	2007
National Programme for Rural Development (PNDR) 2014-2020	Agricultural Forestry	Prevention of and restoration after major fires, conservation of forest genetic resources, conservation of forest carbon.	CO_2; CH_4; N_2O	P	I	2015
Rural Development Programmes by Autonomous Community 2014-2020	Agricultural Forestry	Reduction of emissions by different measures: management of crops, pastures, soils and livestock, reduction of fertilisation, conservation of forest carbon, forest management and prevention of deforestation.	CO_2; N_2O; CH_4	P	I	2014
Forestry Sector						
Four per thousand initiative for soil organic carbon augmentation and food security	Agricultural Forestry	Increase the organic carbon content of soils.	CO_2	P	P	2017
Restoration of forest cover and extension of wooded area	Forestry	Afforestation	CO_2	N, P	I	1990
Sustainable forest management	Forestry	Sustainable forest management.	CO_2 CH_4; N_2O	N, P	I	1990
Waste Sector						
Plan to Promote the Environment - PIMA Waste [PIMA Residuos]	Waste	Promote the collection and treatment of organic matter, the capture of biogas and its use.	CH_4; N_2O	EC	E	2015
'More food, less waste' strategy	Waste	Reduction of food waste.	CH_4; N_2O	I	I	2013
State Waste Prevention Plan 2014-2020	Waste	Reduce waste generation.	CH_4; N_2O	P	I	2014
State Waste Framework Plan 2016-2022	Waste	Implement the Waste Management Hierarchy.	CH_4; N_2O	P	A	2016

I = AV, voluntary agreement; EC, economic; ED, education; F, fiscal; I, information system; RDI, research, development and innovation; N, normative/regulatory; M, market; P, plans and programmes.

S = A, adopted; I, implemented; P, planned; E, expired (if still having an effect).

S.D. indicates no data, **N.C.** non-quantifiable, and **I.O.** integrated at another level.

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

ANNEX D. RED ELÉCTRICA DE ESPAÑA REPORTS

D.1. STUDIES OF 2025 AND 2030 BASELINE AND TARGET SCENARIOS

The purpose of this document is to show the results of the generation dispatch of the 'Baseline' and 'Target' scenarios updated by MITECO within the INECP for the 2025 and 2030 time frames.

It also includes a brief description of the methodology and model used, as well as the adaptation of assumptions of the national scenarios defined by MITECO for use in the European studies model.

Methodology

The analysis of the scenarios defined for the Spanish electricity system consists of the simulation, under the assumptions that will be described later, of the generation dispatch in Europe, in a similar way to the studies that are carried out by ENTSO-E for the drafting of the European Ten-Year Network Development Plan (TYNDP).

The studies use a simplified model of the European system in which each modelled electricity system (offer zone) is represented as a single node interconnected with its neighbouring systems with the commercial exchange capacity value deemed available to the market (NTC - Net Transfer Capacity).

Within each offer zone, the generation dispatch calculation considers a single node, i.e., no losses or possible generation limitations due to elements of the internal network of each system are taken into account.

It is important to stress that the model assumes that the transmission network of the Spanish peninsular system will have sufficient capacity to evacuate all the modelled generation and transport it to the points of consumption; and that the variables of the electricity system are kept within the ranges established by the regulations, in order to achieve the level of safety demanded by them. This will require the development and adaptation of that grid, so that renewable discharges or possible additional needs for thermal generation due to possible restrictions in the internal network are minimised, in such a way that only a reasonable minimum of distortions to this single-node assumption are introduced.

In general, the model uses a constant value of commercial exchange capacity between the modelled systems at all times on the simulation time frame and therefore does not take into account variations that would correspond to different operating situations or reductions in their value due to unavailability of the transmission network or other circumstances. However, in the case of the interconnections of the Spanish peninsular electricity system, variations in exchange capacity corresponding to situations of unavailability of interconnections are taken into account.

The simulations use as a base assumption a perfectly competitive market in electricity generation, and therefore do not include the possible strategies of the generators to maximise their profits: the supply of each generator is equal to its estimated variable cost and the generation dispatch is obtained by minimising the variable cost of generation in the European system as a whole, under the condition of supplying the demand for electricity in all the systems in the time frame analysed.

Variable generation cost values are based on forecasts of fuel prices, estimated operating and maintenance costs for each technology, and CO_2 emission costs. Fixed generation costs, costs of dismantling generating units currently in service and not considered in the scenario to be evaluated, possible costs of extending the useful life of generating units or other factors (tariffs, taxes) that may influence the generation's supply strategy are not considered.

Cogeneration, renewable generation and in general, all non-dispatchable generation is considered with zero variable cost, which gives them dispatch priority over the other conventional thermal generation technologies.

For the purposes of generation dispatch calculation, each conventional thermal generation unit is modelled with its operating parameters, availability and accidental failure rates. Hydroelectric generation is modelled consistently with historical production series and wind, photovoltaic and thermosolar generation, using climatic historical series as a primary resource. Similarly, cogeneration and other generations are modelled on historical data.

For each scenario, a complete generation dispatch simulation of the European system modelled during each hour of the year is carried out, respecting all group restrictions (start-up, stoppages, loading and unloading times, etc.) while minimising the total variable cost. In the simulations presented, a restriction on coupled thermal generation of a minimum value sufficient to guarantee the dynamic stability of the electricity system has been implemented. This minimum necessary generation corresponds to the technical minimum of five nuclear and five thermal units, coal or combined cycle for the scenarios with a horizon of 2025 and the baseline scenario of 2030 and three nuclear and seven combined-cycle units for the scenario with a target horizon of 2030. In case of unavailability of nuclear units, equivalence rules are applied to guarantee a contribution to dynamic stability that is similar to other thermal technologies.

As a result, the energy values generated by each thermal unit and modelled generation technology, and the marginal cost and exchange balance values resulting from the total variable cost minimisation process in the modelled set, respecting the exchange capacity values, are obtained with a detailed schedule. Using these results, the total value of renewable generation and the fraction it represents of electricity generation and demand in the Spanish mainland system are calculated.

It is very important to note that cost results should not be interpreted as prices and that the results obtained from the exchange of energy between interconnected systems are only the result of the marginal cost difference between these systems with the limitation of the commercial exchange capacity value considered in the scenario.

Adaptation of the scenarios defined by MITECO to the European model.

Firstly, the European scenario used as the basis for the study includes the assumptions provided by MITECO, which constitute the basis for calculating the variable unit cost of electricity generation of each thermal generation technology. These new variable costs are applicable to the entire generation fleet considered in the European model.

The European scenarios used as the basis for the studies described in this report are ENTSO-E's Best Estimate 2025 scenario (BE2025) for the scenarios on the 2025 horizon and the Distributed Generation scenario (DG2030) for the scenarios on the 2030 horizon.

The inclusion in the European model of each scenario proposed by MITECO for the Spanish electricity system requires the adaptation of assumptions relating to the installed generation capacity of each technology and its dispatch characteristics in order to determine the values corresponding to the scope of the Spanish mainland electricity system, as well as the conversion of power values to net values. The assumptions obtained from the scenario which is henceforth called the adapted peninsular scenario.

Finally, in the European scenario used as a basis, the generation system in the Spanish area is replaced by the adapted peninsular scenario obtained in the process above. At this point, it should be noted that the installed generation assumption in the other systems maintains the original generation system of the European scenario, so that the results obtained only include the assumptions of the INECP in Spain. The proposal-defining process of energy and climate plans by the EU member states, as in Spain, is in the drafting stage and therefore, the electricity generation dispatch simulations at European level of the set of scenarios included in the energy and climate change plans of the Member States could offer different results, depending on the degree of overlap of these with the scenarios currently available within the scope of the TYNDP.

Two possible scenario paths were defined by MITECO in order to carry out the simulation of the generation dispatch:

- Baseline Scenario
- Target Scenario

For each of these paths, the scenarios corresponding to 2025 and 2030 time frames will be simulated.

Assumptions of the scenarios defined by MITECO and values of the corresponding adapted scenario.

This section presents the assumptions of the scenarios defined by MITECO and, where appropriate, the corresponding values of the adapted peninsular scenario. The variable generation cost assumptions are used for all the generation installed in the European model.

Variable generation costs

To determine the variable cost values of the thermal generation technologies, the following fuel cost and CO_2 emission cost values are used for the 2025 and 2030 horizons set in the MITECO scenarios. For the other fuels, the values of the scenario used as the base from TYNDP2018 are maintained.

Table D.1 Fuel prices and CO_2 emissions considered for the 2025 and 2030 horizon

		MITECO scenarios		ADAPTED scenarios	
		2025	**2030**	**2025**	**2030**
	Nuclear			0.47	0.47
	Lignite			1.1	1.1
	Hard Coal	3.2	3.8	3.2	3.8
	Gas	9.6	10.5	9.6	10.5
	Light oil			18.7	21.8
	Heavy oil			15.3	17.9
	Oil shale			2.3	2.3
€/tonne	**CO_2 price**	**23.3**	**34.7**	**23.3**	**34.7**

Source: Red Eléctrica de España

In Table D.2, the emission factors of each technology used in the European-wide model are included according to the criterion established in TYNDP 2018.

For the generation dispatch simulations carried out in this study, the emission factor considered for cogeneration, electrical part, is 0.268 t/MWh and 0.264 t/MWh in 2025 and 2030, respectively, values calculated on the basis of the information provided by MITECO.

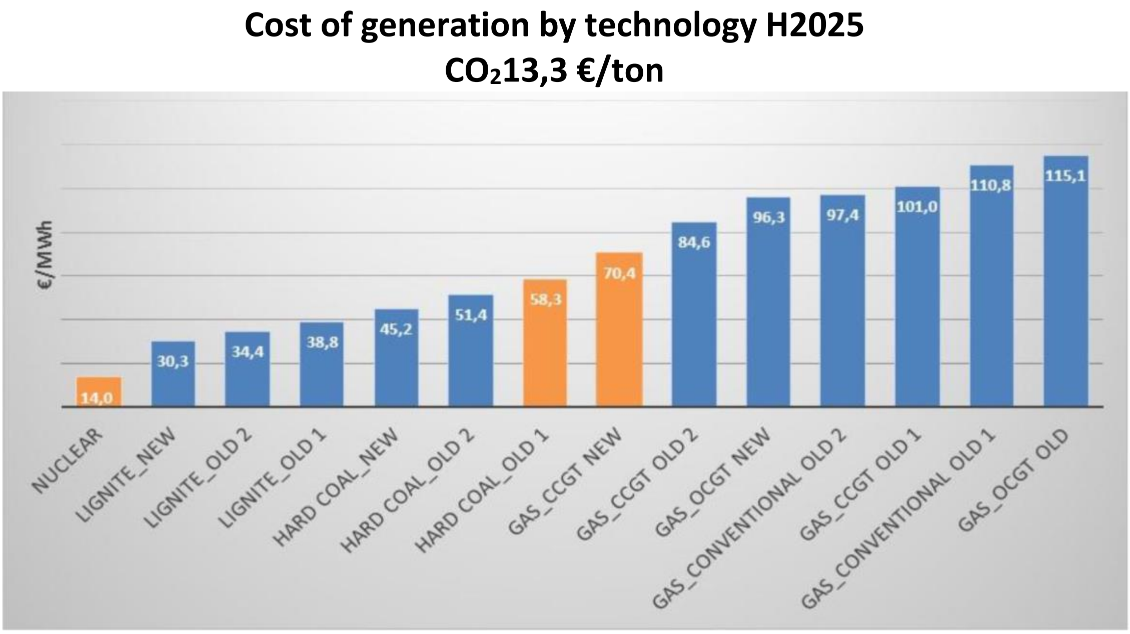
Table D.2. Emission factors by technology. TYNDP 2018

Fuel	Rate	CO_2 emission factor	CO_2 emission factor
		kg/net GJ	t/MWh
Nuclear	-	0	0.000
Hard Coal	Old 1	94	0.970
Hard Coal	Old 2	94	0.848
Hard Coal	New	94	0.738
Hard Coal	CCS	9.4	0.089
Lignite	Old 1	101	1.042
Lignite	Old 2	101	0.912
Lignite	New	101	0.793
Lignite	CCS	10.1	0.096
Gas	Conventional old 1	57	0.572
Gas	Conventional old 2	57	0.502
Gas	CCGT old 1	57	0.514
Gas	CCGT old 2	57	0.429
Gas	CCGT new	57	0.355
Gas	CCGT CCS	57	0.040
Gas	OCGT old	57	0.588
Gas	OCGT new	57	0.490
Light oil	-	78	0.805
Heavy oil	Old 1	78	0.805
Heavy oil	Old 2	78	0.704
Oil shale	Old	100	1.245
Oil shale	New	100	0.926

Source: Red Eléctrica de España

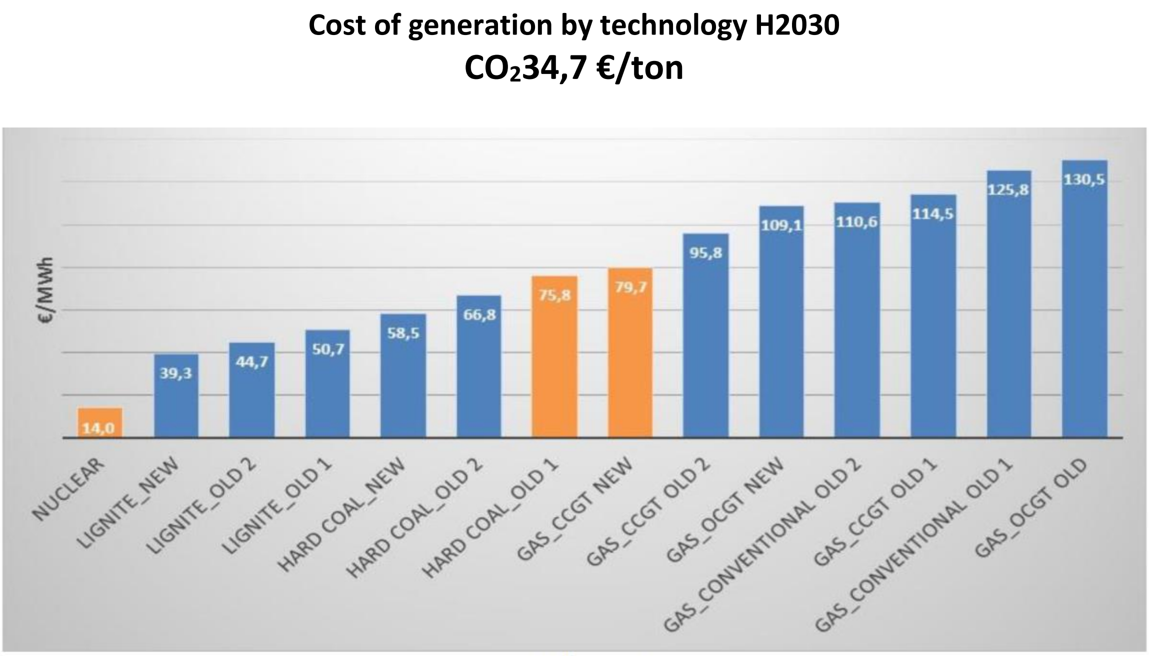
As a result of the previous assumptions of fuel prices and CO_2 emissions, the variable generation costs of the generation technologies considered in the European scenario are obtained. These are presented in Figure D.1 and Figure D.2. In these figures, the technologies installed in the Spanish peninsular system are those represented in orange.

Figure D.1. Cost of generation of H2025 scenarios by technology. Price of CO_2 €23.3/t



Source: Red Eléctrica de España

Figure D.2. Cost of generation of H2030 scenarios by technology. Price of CO_2 €34.7/t



Source: Red Eléctrica de España

Hours of renewable generation operation

Table D.3 shows the operating hours obtained from the information provided by MITECO for the Spanish system. In the event of spillage, the number of operating hours may be reduced.

Table D.3. Annual operating hours per technology

Technology	Annual operating hours MITECO			
	2025 Target	2030 Target	2025 Baseline	2030 Baseline
Onshore wind energy (1)	2,100/2,300/2,500	2,100/2,300/2,500	2,100/2,300/2,100	2,100/2,300/2,100
Offshore wind energy	3,100	3,100	-	-
Existing solar thermal	2,558	2,558	2,558	2,558
Future solar thermal	3,594	3,594	-	-
Photovoltaic	1,800	1,800	1,800	1,800
Cogeneration and other (2)	4,825	4,609	5,145	4,845
Other RES (2)	6,780	7,055	6,771	6,963

(1) Depending on the type of wind energy (existing/repowered/new)

Source: Red Eléctrica de España

Electricity demand

In order to establish the forecast electricity demand values, the national values provided by MITECO were adapted to values for the Spanish peninsular system in the different scenarios and time frames analysed. In the rest of the electricity systems, the values of the ENTSO-E scenario for the 2025 horizon (Best Estimate 2025) and the Distributed Generation (DG) scenario for the 2030 horizon are used.

The values considered in the model - adapted peninsular scenario - for the Baseline Scenario path are shown in Table D.4. The values corresponding to the Target Scenario path are shown in Table D.5.

Table D.4. Demand values MITECO H2025 and H2030 Baseline Scenario.

Electricity demand	MITECO Baseline Scenario (national)		Peninsular Baseline Scenario ADAPTED	
	2025	2030	2025	2030
Demand at power station busbars National (TWh)	279.1	286.3	279.1	286.3
Demand at power station busbars Peninsular (TWh)	-		262	268
Peninsular peak demand (MW)	-		46,885	49,624

Source: Red Eléctrica de España

Table D.5. Values of electricity demand MITECO H2025 and H2030 Target Scenario

Electricity demand	MITECO Target Scenario (national)		Peninsular Target Scenario ADAPTED	
	2025	2030	2025	2030
Demand at power station busbars National (TWh)	274.8	280.4	274.8	280.4
Demand at power station busbars Peninsular (TWh)			258	263
Peninsular peak demand (MW)			46,454	47,768

Source: Red Eléctrica de España

Installed generation system

In the baseline scenarios, the most relevant aspects regarding the generation system considered by MITECO are the maintenance of the nuclear installations currently in service and the reduction of the generation system using coal in comparison with the current one by 2025, remaining unchanged in the period 2025-2030. Moderate growth in wind (onshore and offshore) and solar photovoltaic generation is considered, while the current thermosolar generation system is maintained in both horizons. Cogeneration reduces its capacity gradually from the value currently in service to the 2030 horizon.

Table D.6. Installed capacity of MITECO H2025 and H2030 Baseline Scenario

Technology (data in MW)	Baseline Scenario MITECO (national)		Baseline Scenario Peninsular ADAPTED	
	2025	2030	2025	2030
Nuclear	7,400	7,400	7,117	7,117
Imported coal	2,115	2,115	2,085	2,085
National coal	50	50	0	0
Combined cycle	27,530	27,530	24,560	24,560
Hydroelectric power	15,750	15,750	15,750	15,750
Pumping	4,390	4,390	4,390	4,390
Wind (only onshore)	33,030	38,030	31,726	36 ,350
Solar photovoltaic (*)	13,890	18,890	13,274	18,144
Solar photovoltaic isolated own consumption	30	30		
Solar thermoelectric	2,300	2,300	2,300	2,300
Biogas	210	210		
Biomass	610	610		
Marine energy	0	0		
Geothermal energy	0	0		
Other RES	820	820	820	820
Coal cogeneration		0		
Gas cogeneration	3,750	2,020		
Petroleum products cogeneration	360	200		
Renewables cogeneration	250	240		
Waste cogeneration	20	10		
MSW	160	60		
Similar to cogeneration	280	250		
Cogeneration and other	4,820	2,790	4,820	2,790
Fuel/Gas (NPT)	2,790	2,790		
Storage	0	0	0	0
Total	**114,915**	**122,885**	**106,842**	**114,306**

(*) Includes PV and PV for own consumption

Source: Red Eléctrica de España

In relation to the generation system considered by MITECO in the Target Scenario, it is worth mentioning the gradual reduction of the nuclear generation system, considering that three nuclear generation units will be available in 2030 out of the seven currently available; and the gradual closure of the coal generation system until its disappearance in the 2030 horizon. It is considered that there will be a strong growth of the generation system using renewable energies, mainly in wind and solar photovoltaic generation, compared to the system currently in service. A new solar thermal generation facility is predicted during the period under consideration. Cogeneration is gradually reduced compared to the current value.

Table D.7. Installed capacity of MITECO H2025 and H2030 Target Scenario

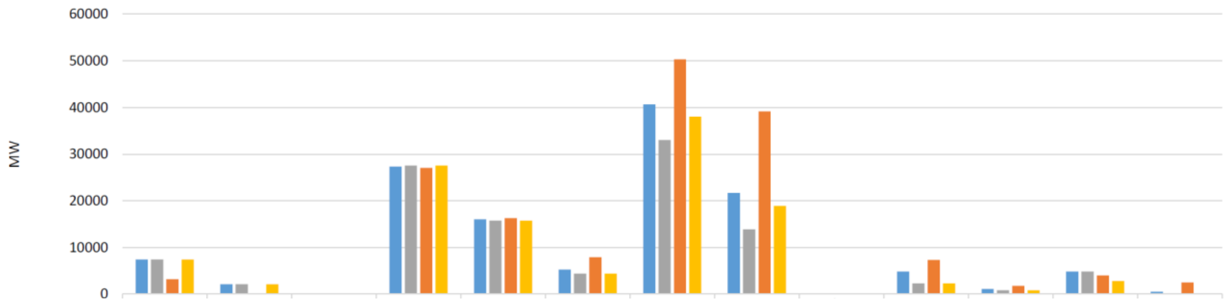
Technology (data in MW)	Target Scenario MITECO (national)		Target Scenario Peninsular ADAPTED	
	2025	2030	2025	2030
Nuclear	7,400	3,180	7,117	3,050
Imported coal	2,115	0	2,085	0
National coal	50	0	0	0
Combined cycle	27,300	27,070	24,560	24,560
Hydroelectric power	16,000	16,250	16,000	16,250
Pumping	5,260	7,890	5,260	7,890
Wind (onshore and offshore) (*)	40,630	50,330	39,226	48,550
Solar photovoltaic (**)	21,680	39,150	21,064	38,404
Solar photovoltaic isolated own consumption	30	30	30	0
Solar thermoelectric	4,800	7,300	4,800	7,300
Biogas	240	240		
Biomass	810	1,410		
Marine energy	25	50		
Geothermal energy	15	30		
Other RES	1,090	1,730	1,090	1,730
Coal cogeneration		0		
Gas cogeneration	3,755	3,220		
Petroleum products cogeneration	360	200		
Renewables cogeneration	250	240		
Waste cogeneration	20	10		
MSW	160	60		
Similar to cogeneration	280	250		
Cogeneration and other	4,825	3,980	4,825	3,980
Fuel/Gas (NPT)	2,090	1,400		
Storage	500	2,500	500	2,500
Total	**133,770**	**160,810**	**126,557**	**154,214**

(*) For the Adapted Scenario only offshore wind is considered in 2030 (**) Includes PV and PV for own consumption

Source: Red Eléctrica de España

In Figure D.3, the net capacity values corresponding to each generation technology in the Spanish peninsular electricity system are included in the scenarios analysed.

Figure D.3. Installed capacity in the Spanish Peninsular System MITECO H2025 and H2030 Baseline and Target Scenarios



	Nuclear	Imported coal	Coal (national)	Combined cycle	Hydroelectric	Pumping	Wind	Solar photovoltaic	Solar PV for own consumption	Solar thermoelectric	Other RES	Cogeneration and other	Storage
TARGET 2025	7,400	2,115	50	27,300	16,000	5,260	40,630	21,680	30	4,800	1,090	4,825	500
2025 BASELINE	7,400	2,115	50	27,530	15,750	4,390	33,030	13,890	30	2,300	820	4,820	0
2030 TARGET	3,180	0	0	27,070	16,250	7,890	50,330	39,150	30	7,300	1,730	3,980	2,500
2030 BASELINE	7,400	2,115	50	27,530	15,750	4,390	38,030	18,890	30	2,300	820	2,790	0

Technology

2025 OBJECTIVE 2025 BASELINE 2030 TARGET 2030 BASELINE

Source: Red Eléctrica de España

Ability to exchange with neighbouring electricity systems

The exchange capacity values with France and Portugal are those given in the TYNDP2018 in the 2025 and 2030 horizons.

Table D.8. Spain-France, Spain-Portugal and Spain-Morocco interconnection values

NTC (MW)	MITECO Baseline and Target Scenarios 2025	2030
ES-->FR	5,000	8,000
FR-->ES	5,000	8,000
ES-->PT	4,200	4,200
PT-->ES	3,500	3,500

Source: Red Eléctrica de España

The exchange between Spain and Morocco is modelled with an exchange profile having an annual balance of 0 GWh.

Results of scenarios analysed for the 2025 horizon

The complete results of the simulations of the 2025 Baseline and Target Scenarios are presented in Figure D.4 and Figure D.5, respectively. A comparison of the results obtained for the 2025 Baseline and Target Scenarios is provided in Table D.9.

Table D.9. Comparative results of H2025 Baseline and Target Scenarios of the INECP

Scenarios	H2025 Target (1)	H2025 Baseline (2)	Differences (1)-(2)
DEMAND [TWh] (*)	**258**	**262**	**-4**
GENERATION [GWh]	**273,384**	**256,386**	**16,997**
Nuclear [GWh]	**50,616**	**51,617**	**-1,001**
% of total generation	18.5%	20.1%	-1.6%
Installed capacity [MW]	7,117	7,117	0
Equiv. hours p.c.	7,112	7,253	-141
Coal [GWh]	**10,171**	**10,820**	**-650**
% of total generation	3.7%	4.2%	-0.5%
Installed capacity [MW]	2,085	2,085	0
Equiv. hours p.c.	4,878	5,190	-312
Combined cycle [GWh]	**11,541**	**33,184**	**-21,643**
% of total generation	4.2%	12.9%	-8.7%
Installed capacity [MW]	24,560	24,560	0
Equiv. hours p.c.	470	1,351	-881
Hydroelectric [GWh]	**32,435**	**32,484**	**-49**
% of total generation	11.9%	12.7%	-0.8%
Installed capacity [MW]	21,260	20,140	1,120
Equiv. hours p.c.	1,526	1,613	-87
Wind [GWh]	**87,716**	**68,293**	**19,423**
% of total generation	32.1%	26.6%	5.4%
Installed capacity [MW]	39,226	31,726	7,500
Equiv. hours p.c.	2,236	2,153	84
Solar PV [GWh] (**)	**36,618**	**23,851**	**12,767**
% of total generation	13.4%	9.3%	4.1%
Installed capacity [MW]	21,064	13,274	7,790
Equiv. hours p.c.	1,738	1,797	-58
Solar thermal [GWh]	**13,633**	**5,766**	**7,867**
% of total generation	5%	2.2%	2.7%
Installed capacity [MW]	4,800	2,300	2,500
Equiv. hours p.c.	2,840	2,507	333
Other RES [GWh]	**7,378**	**5,552**	**1,826**
% of total generation	2.7%	2.2%	0.5%
Installed capacity [MW]	1,090	820	270
Equiv. hours p.c.	6,769	6,771	-2
Cogen and others [GWh]	**23,276**	**24,818**	**-1,542**
% of total generation	8.5%	9.7%	-1.2%
Installed capacity [MW]	4,825	4,820	5
Equiv. hours p.c.	4,824	5,149	-325
STORAGE BALANCE [GWh]	**-1,436**	**-646**	**-790**
Consumption pumping and batteries [GWh]	6,157	2,585	3,571
Production batteries [GWh]	4,086	1,939	2,146
Production pumping [GWh]	635	0	635
GENERATION RENEWABLES [GWh]	**177,780**	**135,947**	**41,833**
Discharge renewables (GWh)	4,248	142	4,106
INTERCONNECTIONS			
Net balance [GWh] (+ export from SPAIN)	**13,805**	**-6,357**	**20,162**
FRANCE [GWh]	5,011	-8,078	13,089
PORTUGAL [GWh]	8,793	1,721	7,073
Congestion (% hours) ES-FR			
ES ->FR	39.14%	19.8%	19.3%
FR ->ES	23.12%	39.2%	-16%
Congestion (% hours) ES-PT			
ES ->PT	8.46%	1.5%	7%
PT -> ES	1.78%	1.7%	0.1%
AVERAGE SPREAD ES-FR [€/MWh]	**15**	**7.8**	**7.2**

Scenarios	H2025 Target (1)	H2025 Baseline (2)	Differences (1)-(2)
SYSTEM COSTS			
Marginal cost [€/MWh]	55.9	68.8	-12.9
Variable generation cost [€/MWh]:	56.5	68.9	-12.5
Total annual cost variable generation [€ m]	14,581	17,942	-3,490
INCOME CONGESTION SPAIN [€ m]	251	130	122
TOTAL COST VARIABLE [€ m per year]	**14,330**	**17,942**	**-3,612**
Share indicators RES (%)			
RES/demand	69%	52%	17%
RES/Gen total	65%	53%	12%

Notes: **(*)** Includes self-consumed demand.
(**) Includes generation of PV and PV for own consumption
Average marginal cost (€/MWh): Demand weighted energy acquisition cost.
Variable generation cost (€/MWh): Cost of energy acquisition plus the cost of additional thermal generation necessary to reach the minimum dispatchable synchronous generation threshold.
Total annual cost variable generation (€ m): Total cost of energy acquisition plus the total cost of additional thermal generation.

Source: Red Eléctrica de España

From the point of view of the production balance, the main differences are due to the fact that the Baseline Scenario considers a higher demand for busbars, together with lower renewable and storage capacity. This results in a higher thermal generation of both cycles and coal, and a lower generation of renewables, compared to the Target Scenario.

With regard to interconnections, the balance between Spain and France changes from an import balance, included in the Baseline Scenario, to an export balance in the Target Scenario, because in the latter the amount of cheaper ‘exportable’ energy is greater than in the case of the Baseline Scenario.

In terms of costs, as a result of the above, the Target Scenario presents a cost reduction of around EUR 13/MWh in terms of both marginal and variable cost.

Figure D.4. Results of H2025 Baseline Scenario

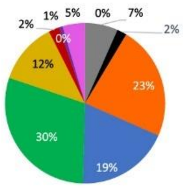
H2025 Baseline Scenario . Energy and Climate Change Plan.

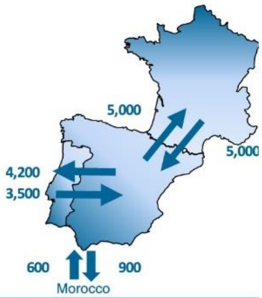
Mainland Spain | Minimum synchronous generation: 5N+5 Thermal | *Code 03_2025*

Demand in ES (TWh):	262	Peak demand (MW):	46,885

Installed capacity in Spain (MW) | **Exchange capacity (MW)**

	MW	%
Nuclear	7,117	7%
Coal	2,085	2%
Cycles	24,560	23%
Hydroelectric (+ pumping)	20,140	19%
Wind	31,726	30%
Solar PV	13,274	12%
Solar thermal	2,300	2%
Solar thermal storage 9h	0	0%
Other RES	820	1%
Cogeneration and other	4,820	5%
Batteries	0	0%
Total electricity system	**106,842**	**100%**



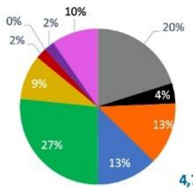


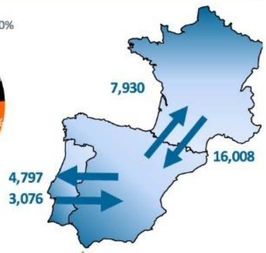
Additional information:

Generation without emissions in ES (MW) (Renewables (including pumping)+nuclear)	***75,377***	*71%*	*of the total electricity system*
RES in mainland Spain (MW)	***68,260***	*64%*	*of the total electricity system*
RES in Portugal (MW)	***16,681***	*77%*	*of the total electricity system*
RES in Europe (%)	*60%*	***Minimal synchronous thermal generation (MW): 5N+5 Thermal***	

Generation balance (GWh). Mainland Spain | **Balance for yearly exchanges (GWh)**

	GWh	%	Hours utilisation
Nuclear	51,617	20%	7,253
Coal	10,820	4%	5,190
Cycles	33,184	13%	1,351
Hydroelectric power	32,484	13%	1,613
Wind	68,293	27%	2,153
Solar PV	23,851	9%	1,797
Solar thermal	5,766	2%	2,507
Solar thermal storage 9h	0	0%	0
Other RES	5,552	2%	6,771
Cogeneration and other	24,818	10%	5,149
Generation	**256,386**	**100%**	





Storage balance	**-646**
Storage consumption	*2,585*
Production pumping	*1,939*
Production batteries	*0*

Export profile with Morocco: 0

Balance ES-FR	*-8,078*	
Balance ES-PT:	*1,721*	
Net Balance + Morocco:	***-6,357***	***ES IMPORT***
CONGESTION (% hours)	→	←
ES-FR	19.8%	39.2%
ES-PT	1.5%	1.7%
Spread ES-FR (€/MWh):	***7.8***	

Additional information:

RES in Portugal (GWh)	***29,174***	*60%*	*of electricity generation*	*56% of the demand*
RES in Spain (GWh)	***135,947***	*53%*	*of electricity generation*	*52% of the demand*
RES in Europe (GWh)	*1,690,008*			*49% of the total demand*

Congestion income (€ m): *130*

Discharges (GWh) | **Energy not supplied (GWh)**

Spain	142		**Spain**	0	
	0.14%	*of the producible wind and solar*		0	*Hours*

Costs in Spain

Variable Cost (€/MWh):	*68.9*
Average marginal cost (€/MWh):	*68.8*
Other:	
Total min. sychronous additional generation cost (€ m)	*27*
Total annual cost var generation (€ m):	*18,071*

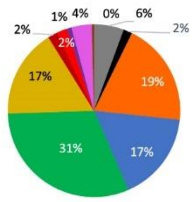
Source: Red Eléctrica de España

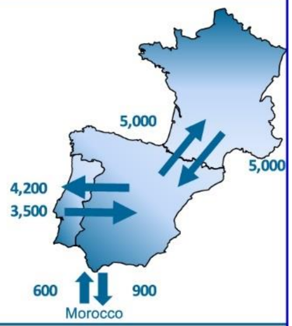
Figure D.5. Results of H2025 Target Scenario

Mainland Spain		Minimum synchronous generation:	5N+5 Thermal	Code 01_2025
Demand in ES (TWh):	258	Peak demand (MW):	46,454	

Installed capacity in Spain (MW) — **Exchange capacity (MW)**

	MW	%
Nuclear	7,117	6%
Coal	2,085	2%
Cycles	24,560	19%
Hydroelectric (+ pumping)	21,260	17%
Wind	39,226	31%
Solar PV	21,064	17%
Solar thermal	2,300	2%
Solar thermal storage 9h	2,500	2%
Other RES	1,090	1%
Cogeneration and other	4,825	4%
Batteries	500	0%
Total electricity system	**126,527**	**100%**



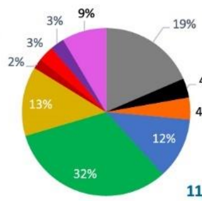


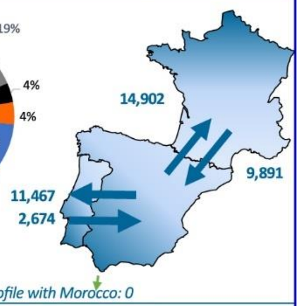
Additional information:

Generation without emissions in ES (MW) *(Renewables (including pumping)+nuclear)*	***94,557***	*75%*	*of the total electricity system*
RES in mainland Spain (MW)	***87,440***	*69%*	*of the total electricity system*
RES in Portugal (MW)	***16,681***	*77%*	*of the total electricity system*
RES in Europe (%)	***61%***		***Minimal synchronous thermal generation (MW): 5N+5 Thermal***

Generation balance (GWh). Mainland Spain — **Balance for yearly exchanges (GWh**

	GWh	%	Hours utilisation
Nuclear	50,616	19%	7,112
Coal	10,171	4%	4,878
Cycles	11,541	4%	470
Hydroelectric power	32,435	12%	1,526
Wind	87,716	32%	2,236
Solar thermal	36,618	13%	1,738
Termosolar	5,371	2%	2,335
Solar thermal storage 9h	8,262	3%	3,305
Other RES	7,378	3%	6,769
Cogeneration and other	23,276	9%	4,824
Generation	**273,384**	**100%**	
Storage balance	**-1,436**		
Storage consumption	*6,157*		
Production pumping	*4,086*		
Production batteries	*635*		





Export profile with Morocco: 0

Balance ES-FR	*5,011*	
Balance ES-PT:	*8,793*	
Net Balance + Morocco:	***13,805***	***ES EXPORT***
CONGESTION (% hours)	→	←
ES-FR	39.1%	23.1%
ES-PT	8.5%	1.8%
Spread ES-FR (€/MWh):	***15.0***	

Additional information:

RES in Portugal (GWh)	***29,175***	*69%*	*of electricity generation*	*56% of the demand*
RES in Spain (GWh)	***177,780***	*65%*	*of electricity generation*	*69% of the demand*
RES in Europe (GWh)	***1,721,651***			***50% of the total demand***
			Congestion income (€ m):	*251*

Discharges (GWh)			**Energy not supplied (GWh)**		
Spain	4,248		**Spain**	0	
	2.99%	*of the producible wind and solar*		0	*Hours*

Costs in Spain

Variable Cost (€/MWh):	*56.5*
Average marginal cost (€/MWh):	*55.9*
Other:	
Total min. sychronous additional generation cost (€ m):	*142*
Total annual cost var generation (€ m):	*14,581*

Source: Red Eléctrica de España

Results of scenarios analysed for the 2030 horizon

The complete results of the simulations of the 2030 Baseline and Target Scenarios are presented in Figure D.6 and Figure D.7, respectively. A comparison of the results obtained for the 2030 Baseline and Target Scenarios is provided in and Table D.10.

Table D.10. Comparative results of H2030 Baseline and Target Scenarios of the INECP

Scenarios	H2030 Target (1)	H2030 Baseline (2)	Differences (1)-(2)
DEMAND [TWh] (*)	**262.7**	**268.2**	**-5.5**
GENERATION [GWh]	**306,943**	**271,935**	**35,008**
Nuclear [GWh]	**22,034**	**51,630**	**-29,596**
% of total generation	7.2%	19.0%	-11.8%
Installed capacity [MW]	3,050	7,117	-4,067
Equiv. hours p.c.	7,224	7,255	-31
Coal [GWh]	**0**	**9,942**	**-9,942**
% of total generation	0.0%	3.7%	-3.7%
Installed capacity [MW]	0	2,085	-2,085
Equiv. hours p.c.	0	4,768	-4,768
Combined cycle [GWh]	**27,617**	**40,676**	**-13,059**
% of total generation	9.0%	15.0%	-6.0%
Installed capacity [MW]	24,560	24,560	0
Equiv. hours p.c.	1,124	1,656	-532
Hydroelectric [GWh]	**32,376**	**32,484**	**-108**
% of total generation	10.5%	11.9%	-1.4%
Installed capacity [MW]	24,140	20,140	4,000
Equiv. hours p.c.	1,341	1,613	-272
Wind [GWh] (**)	**109,464**	**78,947**	**30,517**
% of total generation	35.7%	29.0%	6.6%
Installed capacity [MW]	48,550	36 ,350	12,200
Equiv. hours p.c.	2,255	2,172	83%
Solar PV [GWh] (***)	**65,180**	**32,564**	**32,616**
% of total generation	21.2%	12.0%	9.3%
Installed capacity [MW]	38,404	18,144	20,260
Equiv. hours p.c.	1,697	1,795	-98
Solar thermal [GWh]	**19,785**	**5,767**	**14,018**
% of total generation	6.4%	2.1%	4.3%
Installed capacity [MW]	7,300	2,300	5,000
Equiv. hours p.c.	2,710	2,508	203
Other RES [GWh]	**12,088**	**5,709**	**6,378**
% of total generation	3.9%	2.1%	0.8%
Installed capacity [MW]	1,730	820	1,190
Equiv. hours p.c.	6,987	6,963	-472
Cogen and others [GWh]	**18,399**	**14,215**	**-3,577**
% of total generation	6.0%	5.2%	16,494
Installed capacity [MW]	3,980	2,790	9,621
Equiv. hours p.c.	4,623	5,095	3,296
STORAGE BALANCE [GWh]	**-4,964**	**-1,387**	**-3,577**
Consumption pumping and batteries [GWh]	22,042	5,549	16,494
Production batteries [GWh]	13,782	4,161	9,621
Production pumping [GWh]	3,296	0	3,296
GENERATION RENEWABLES [GWh]	**238,892**	**155,472**	**83,421**
Discharge renewables (GWh)	13,776	176	13,600
INTERCONNECTIONS			
Net balance [GWh] (+ export from SPAIN)	**39,317**	**2,342**	**36,975**
FRANCE [GWh]	27,125	-2,054	29,179
PORTUGAL [GWh]	12,192	4,396	7,796

Scenarios	H2030 Target (1)	H2030 Baseline (2)	Differences (1)-(2)
Congestion (% hours) ES-FR			
ES ->FR	53.21%	17.74%	35.5%
FR ->ES	8.55%	15.09%	-6.5%
Congestion (% hours) ES-PT			
ES ->PT	7.96%	2.03%	5.9%
PT -> ES	0.65%	2.68%	-2.0%
AVERAGE SPREAD ES-FR [€/MWh]	**23.4**	**4.9**	**18.4**
SYSTEM COSTS			
Marginal cost [€/MWh]	53.2	77.5	-24.3
Variable generation cost [€/MWh]	56	77.8	-21.6
Total annual cost variable generation [€ m]	14,759	20,868	-6,108.9
INCOME CONGESTION SPAIN [€ m]	579	166	412.4
TOTAL COST VARIABLE [€ m per year]	**14,180**	**20,701**	**-6,521**
Share indicators RES (%)			
RES/demand	91%	58%	33%
RES/Gen total	78%	57%	21%

Notes: **(*)** Includes self-consumed demand.
(**) In the Target Scenario, onshore and offshore wind generation is included.
(***) Includes generation of PV and PV for own consumption
Average marginal cost (€/MWh): Demand weighted energy acquisition cost.
Variable generation cost (€/MWh): Cost of energy acquisition plus the cost of additional thermal generation necessary to reach the minimum dispatchable synchronous generation threshold.
Total annual cost variable generation (€ m): Total cost of energy acquisition plus the total cost of additional thermal generation.

Source: Red Eléctrica de España

From the point of view of the production balance, the main differences are due to the fact that the Baseline Scenario considers a higher demand for busbars, together with lower renewable and storage capacity. This results in a higher thermal generation of cycles and coal (the latter disappears from the mix in the Target Scenario), and a lower generation of renewables, in relation to the Target Scenario.

With regard to interconnections, the balance of Spain with France in the Target Scenario is higher than in the Baseline Scenario due to the greater amount of cheaper energy in Spain that is exported largely to France.

In terms of costs, as a result of the above, the Target Scenario presents a cost reduction of around EUR 24/MWh and EUR 22/MWh, respectively, in terms of both marginal and variable cost.

Figure D.6. Results of H2030 Baseline Scenario

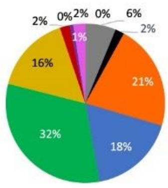
H2030 Baseline Scenario. Energy and Climate Change Plan.

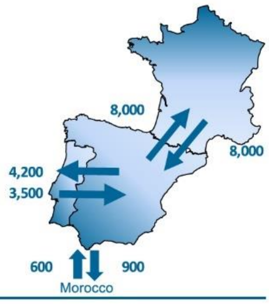
Mainland Spain — Minimum synchronous generation: 5N+5 Thermal — *Code 04_2030*

Demand in ES (TWh): 268 — Peak demand (MW): 49,624

Installed capacity in Spain (MW) — **Exchange capacity (MW)**

	MW	%
Nuclear	7,117	6%
Coal	2,085	2%
Cycles	24,560	21%
Hydroelectric (+ pumping)	20,140	18%
Wind	36,350	32%
Solar PV	18,144	16%
Solar thermal	2,300	2%
Solar thermal storage 9h	0	0%
Other RES	820	1%
Cogeneration and other	2,790	2%
Batteries	0	0%
Total electricity system	**114,306**	**100%**



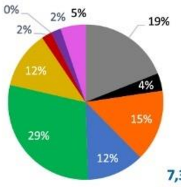


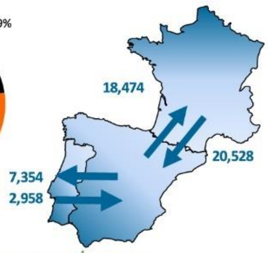
Additional information:

Generation without emissions in ES (MW) (Renewables (including pumping)+nuclear)	***84,871***	*74%*	*of the total electricity system*
RES in Mainland Spain (MW)	***77,754***	*68%*	*of the total electricity system*
RES in Portugal (MW)	***22,239***	*81%*	*of the total electricity system*
RES in Europe (%)	*70%*	***Minimal synchronous thermal generation (MW): 5N+5 Thermal***	

Generation balance (GWh). Mainland Spain — **Balance for yearly exchanges (GWh)**

	GWh	%	Hours utilisation
Nuclear	51,630	19%	7,255
Coal	9,942	4%	4,768
Cycles	40,676	15%	1,656
Hydroelectric power	32,484	12%	1,613
Wind	78,947	29%	2,172
Solar PV	32,564	12%	1,795
Solar thermal	5,767	2%	2,508
Solar thermal storage 9h	0	0%	0
Other RES	5,709	2%	6,963
Cogeneration and other	14,215	5%	5,095
Generation	**271,935**	**100%**	





Storage balance	**-1,387**
Storage consumption	*5,549*
Production pumping	*4,161*
Production batteries	*0*

Export profile with Morocco: 0

Balance ES-FR	*-2,054*	
Balance ES-PT:	*4,396*	
Net Balance + Morocco:	***2,342***	***ES EXPORT***
CONGESTION (% hours)	→	←
ES-FR	17.7%	15.1%
ES-PT	2.0%	2.7%
Spread ES-FR (€/MWh):	***4.9***	

Additional information:

RES in Portugal (GWh)	***38,310***	*71%*	*of electricity generation*	*64%*	*of the demand*
RES in Spain (GWh)	***155,472***	*57%*	*of electricity generation*	*58%*	*of the demand*
RES in Europe (GWh)	*2,188,898*			*53%*	*of the total demand*

Congestion income (€ m): *166*

Discharges (GWh) — **Energy not supplied (GWh)**

Spain	176		**Spain**	0	
	0.15%	*of the producible wind and solar*		0	*Hours*

Costs in Spain

Variable Cost (€/MWh):	*77.8*
Average marginal cost (€/MWh):	*77.5*
Other:	
Total min. sychronous additional generation cost (€ m)	*85*
Total annual cost var generation (€ m):	*20,868*

Source: Red Eléctrica de España

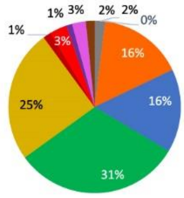
Figure D.7. Results of H2030 Target Scenario

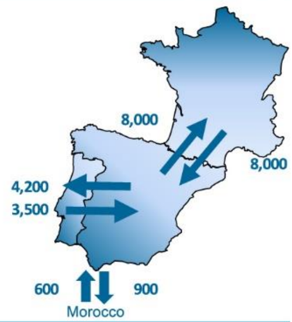
H2030 Target Scenario Energy and Climate Change Plan.

Mainland Spain	Minimum synchronous generation	3N+7 Thermal	*Code 01_2030*
Demand in ES (TWh): 263	Peak demand (MW): 47,768		

Installed capacity in Spain (MW) — **Exchange capacity (MW)**

	MW	%
Nuclear	3,050	2%
Coal	0	0%
Cycles	24,560	16%
Hydroelectric (+ pumping)	24,140	16%
Wind	48,550	31%
Solar PV	38,404	25%
Solar thermal	2,300	1%
Solar thermal storage 9h	5,000	3%
Other RES	1,730	1%
Cogeneration and other	3,980	3%
Batteries	2,500	2%
Total electricity system	**154,214**	**100%**



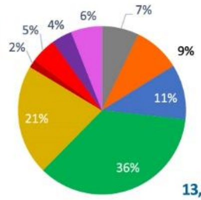


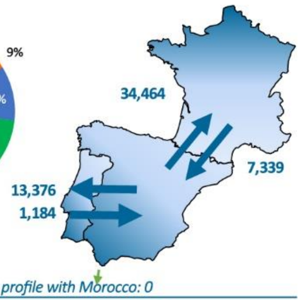
Additional information:

Generation without emissions in ES (MW) *(Renewables (including pumping)+nuclear)*	***123,174***	*80%*	*of the total electricity system*
RES in Mainland Spain (MW)	***120,124***	*78%*	*of the total electricity system*
RES in Portugal (MW)	***22,239***	*81%*	*of the total electricity system*
RES in Europe (%)	*71%*		***Minimal synchronous thermal generation (MW): 3N+7 Thermal***

Generation balance (GWh). Mainland Spain — **Balance for yearly exchanges (GWh)**

	GWh	%	Hours utilisation
Nuclear	22,034	7%	7,224
Coal	0	0%	0
Cycles	27,617	9%	1,124
Hydroelectric power	32,376	11%	1,341
Wind	109,464	36%	2,255
Solar PV	65,180	21%	1,697
Solar thermal	4,629	2%	2,013
Solar thermal storage 9h	15,156	5%	3,031
Other RES	12,088	4%	6,987
Cogeneration and other	18,399	6%	4,623
Generation	**306,943**	**100%**	





Storage balance	**-4,964**
Storage consumption	*22,042*
Production pumping	*13,782*
Production batteries	*3,296*

Export profile with Morocco: 0

Balance ES-FR	*27,125*	
Balance ES-PT:	*12,192*	
Net Balance + Morocco:	***39,317***	***ES EXPORT***
CONGESTION (% hours)	→	←
ES-FR	53.2%	8.6%
ES-PT	8.0%	0.7%
Spread ES-FR (€/MWh):	***23.4***	

Additional information:

RES in Portugal (GWh)	***38,263***	*82%*	*of electricity generation*	*64%*	*of the demand*
RES in Spain (GWh)	***238,892***	*78%*	*of electricity generation*	*91%*	*of the demand*
RES in Europe (GWh)	*2,249,614*			*55%*	*of the total demand*

Congestion income (€ m): *579*

Discharges (GWh) — **Energy not supplied (GWh)**

Spain	13,776		**Spain**	0	
	6.62%	*of the producible wind and solar*		0	*Hours*

Costs in Spain

Variable Cost (€/MWh):	*56.2*
Average marginal cost (€/MWh):	*53.2*
Other:	
Total min. sychronous additional generation cost (€ m):	*783*
Total annual cost var generation (€ m):	*14,759*

Source: Red Eléctrica de España

ANNEX D.2. GUARANTEE OF SUPPLY: PROBABILISTIC ANALYSIS OF COVERAGE UNDER THE 2030 TARGET SCENARIO

The methodology used and the results of the coverage studies of the Spanish peninsular electricity system for the 2030 Target Scenario defined by MITECO within the INECP to verify guaranteed supply in the scenario with respect to demand coverage are described below.

The probabilistic methodology used is also briefly described. This coincides with that developed at European level in ENTSO-E[86] for MAF (Medium-term Adequacy Forecasts) analyses[87]. The meaning of the demand coverage indices is also explained.

Probabilistic coverage analysis methodology

The coverage analysis in the 2030 Target Scenario consists of simulating the system's demand coverage requirements using the probabilistic methodology used in the coverage studies carried out by ENTSO-E in the studies on medium-term coverage analysis (MAF).

Demand coverage refers to the capacity of available generation resources to supply electricity demand in the system at all times during the year under study and consists of the existence of sufficient resources to satisfy both consumer demand and the operational requirements of the electricity system. This capacity to supply demand is quantified by determining the values corresponding to the scenario under study for the different coverage indicators, which will be detailed later on.

The studies use a simplified model of the European electricity system in which each system (offer zone) is represented as a single node interconnected with its neighbouring systems with the commercial exchange capacity value deemed available to the market. No account is taken of losses or possible limitations in generation evacuation or supply losses due to congestion or unavailability of the internal network elements of each system.

The generation and storage system is established in this scenario by means of a deterministic estimate of the installed capacity in the system of each of the generation and storage technologies together with a series of operating and unavailability hypotheses which determine their availability to generate or consume electricity in each of the hours of the scenario under study.

The studies are carried out taking into account the countries belonging to ENTSO-E. The European model analysed is 2030DG, Distributed Generation in 2030, used in the Ten-Year Network Development Plan exercise for 2018[88]. This distributed generation scenario corresponds to a scenario of prosumers as central figures in the System, small-scale renewable generation, large-scale implementation of batteries and an empowered

[86] European Network of Transmission System Operators for Electricity.

[87] https://docstore.entsoe.eu/Documents/SDC%20documents/MAF/MAF_2018_Methodology_and_Detailed_Results.pdf

[88] https://tyndp.entsoe.eu/tyndp2018/

society committed to the energy and power transition, which changes its consumption habits and its energy vector towards electricity.

Based on this European model, the Spanish model is updated with the new INECP data, and the other countries are left with the same data used for the ENTSO-E analysis. The inclusion in the European model of the 2030 Target Scenario for the Spanish electricity system requires the adaptation of assumptions relating to the installed generation capacity of each technology, as well as the conversion of power values to net values.

The results of the probabilistic studies depend on a series of variables that can be considered independent of each other: principally the unscheduled unavailability of the interconnections between neighbouring systems and the unscheduled unavailability of the generating units; and other variables that depend on the weather, and which therefore can neither be considered nor modelled as independent of each other, mainly the values of demand and production capacities for hydroelectric, photovoltaic and wind power.

The stochastic uncertainty dependent on climate variables is modelled by a 34-year climate series used in ENTSO-E (1982-2015).

Each selected climate year consists of the combination of the meteorological variables recorded in that year relating to temperatures, wind, solar irradiation and availability of hydroelectric resources extrapolated to the estimated demand and renewable generation, taking into account the energy demand in an average year estimated for that year, and the hydroelectric, wind and solar generation capacities estimated in the Target Scenario for that year. These data provide hourly series for a full year of system demand and renewable generation with a profile corresponding to that climate year. The average demand considered in the study is the peninsular electricity demand deterministically estimated in the INECP’s 2030 Target Scenario.

The stochastic uncertainty dependent on the unscheduled unavailability of the generating units is modelled by means of Monte Carlo simulations. These are draws that randomly assign the hourly patterns of chance unscheduled unavailability of generators and interconnection lines affecting the availability of generating units to each hour. For each climate year in the series, 20 draws are simulated (N=20), making a total of 680 different simulations for each hour of the year, i.e. the simulation of 680 possible years corresponding to the year 2030, with the assumptions of the Target Scenario for that year.

For this probabilistic analysis, minimum power-frequency control reserves have been included in all European countries. According to the ENTSO-E MAF methodology, these reserves are modelled for most countries as additional demand so as not to reduce thermal capacity. The power frequency control reserve used in Spain is 1,280 MW, representing 3% of the peak demand and slightly higher than the largest thermal group modelled.

The tool used to determine coverage indicators includes a market model simulation engine, which calculates the marginal generation costs for the different systems as part of a problem to minimise the cost of generation. This engine is used in the analysis of demand coverage to determine the flows through the interconnections between the different systems by means of simulations that determine the calculation of generation dispatch. The simulations use a market with perfect competition in electricity generation as a base assumption. The generation variable cost values are those used for the generation dispatch studies of the 2030 Target Scenario.

Details of the different scenarios used for the coverage analysis of the 2030 Target Scenario are included in the final part of this annex.

It should be noted that the hypotheses of installed generation in the other European systems are those corresponding to the ENTSO-E studies of medium-term coverage; the hypotheses derived from the Integrated Energy and Climate Plans have only been considered in the Spanish system. The result of the coverage analyses taking into account the set of integrated plans currently under development could offer different results to the current study depending on the degree to which they agree with the hypotheses considered in the ENTSO-E coverage analyses.

It should be noted that the results are based on the methodology described above, which covers many of the aspects set out in Article 23(5) of Regulation (EU) 2019/943 of 5 June 2019 on the internal market for electricity. These aspects are the considerations of offer zones and the central reference scenario, the contribution of all modelled resources, the market model used, the application of probabilistic calculations, the use of coverage rates, the availability of primary sources and the interconnection capacities between systems.

Demand coverage indicators

Coverage of demand consists of the existence of sufficient resources to satisfy both consumer demand and the operational requirements of the electricity system. As a measure, what are referred to as coverage rates or indicators are used:

Expected energy not served
(EENS) [MWh/year or GWh/year]

EENS is the annual average of the energy not served by the generation system, due to a higher demand value than the available generation and import capacity together with the availability of generation in neighbouring systems. This is an indicator for the forecast of non-supplied energy referred to in Article 23(5)(j) of Regulation (EU) 2019/943 of 5 June 2019 on the internal market for electricity.

In the coverage studies with the described methodology, the expected value of energy not served (EENS) is evaluated as an estimate from a certain number of simulations of possible scenarios. To this end, the EENS is a measure of supply security forecasting, and is mathematically described as such:

$$EENS = \frac{1}{N}\sum_{j \in S} ENS_j$$

where ENS_j is the energy not served in system j ($j \in S$), associated with a loss of load event in the Monte Carlo simulation j_a, and where N is the number of Monte Carlo simulations considered.

<u>Expected pressure loss</u> (LOLE) [h/year]

LOLE is an expected average value of the number of hours per year in which available generation and imports cannot cover the demand of a system. This is an indicator for the forecast of loss of load referred to in Article 23(5)(j) of Regulation (EU) 2019/943 of 5 June 2019 on the internal market for electricity.

$$LOLE = \frac{1}{N}\sum_{j \in S} LLD_j$$

where LLD_j is the duration of loss of load in system j ($j \in S$), associated with a loss of load event in the Monte Carlo j_a simulation, and where N is the number of Monte Carlo simulations considered.

Note that the LLD of the Monte Carlo simulation can only be reported as a whole number of hours due to the time resolution of the simulation. Therefore, it does not reflect the severity of the deficiency or the duration of the loss of load within that hour.

<u>Loss of load probability</u> (LOLP) [%]

LOLP measures the probability in an hour of not meeting all demand with available generation and imports within a defined period of time. This is an indicator for the forecast of loss of load referred to in Article 23(5)(j) of Regulation (EU) 2019/943 of 5 June 2019 on the internal market for electricity.

$$LOLP = \frac{LOLE}{h}$$

where h corresponds to the number of hours in the year under study.

Outcome of the 2030 Horizon Target Scenario and conclusions

The results of the values for the coverage indicators in the analysis of the 2030 Horizon Target Scenario are shown in Table D.12. This table shows the total demands in power plant busbars considered in each climate year, the peak demand value and the values of the coverage indices EENS (expected energy not served), LOLE (loss of load expectation) and LOLP (loss of load probability).

Table D.11. Results of the probabilistic coverage analysis.
2030 Target Scenario. Case study. Spain

	Demand		Coverage indicators		
	Total demand (TWh)	Peak (GW)	EENS (MWh/year)	LOLE (h/year)	LOLP (%)
1982	279	45	0	0	0%
1983	280	49	0	0	0%
1984	262	48	0	0	0%
1985	282	51	0	0	0%
1986	282	47	0	0	0%
1987	280	48	0	0	0%
1988	279	47	0	0	0%
1989	278	46	0	0	0%
1990	280	46	0	0	0%
1991	284	47	0	0	0%
1992	281	47	0	0	0%
1993	282	48	0	0	0%
1994	280	47	0	0	0%
1995	277	46	0	0	0%
1996	278	47	0	0	0%
1997	276	46	0	0	0%
1998	280	45	0	0	0%
1999	281	47	0	0	0%
2000	279	47	0	0	0%
2001	280	48	0	0	0%
2002	277	44	0	0	0%
2003	282	48	0	0	0%
2004	281	46	0	0	0%
2005	284	48	0	0	0%
2006	281	48	0	0	0%
2007	279	47	0	0	0%
2008	280	45	0	0	0%
2009	280	48	230.46	0.3	0%
2010	283	49	0	0	0%
2011	278	47	0	0	0%
2012	282	48	0	0	0%
2013	281	45	0	0	0%
2014	277	45	0	0	0%
2015	280	47	0	0	0%
Average value			**6.8**	**0.007**	**0.00008%**

Source: Red Eléctrica de España

The results obtained from the coverage analysis of the Spanish peninsular system for this 2030 Target Scenario indicate that demand coverage is assured, although situations of energy not served may occur in an average of 0.007 hours per year with an expected annual energy not served of 6.8 MWh/year. The loss of load probability in each hour obtained is 0.00008%.

These values are much lower than the values of coverage indicators used in some European countries for the design of generation needs to cover demand, which are situated at around 3 h/year with energy not served. In the island systems of Spain, a loss of load indicator with a maximum value of 0.2 hours/month is used, as set out in Royal Decree 738/2015.

It can be concluded, therefore, that with the demand and generation assumptions of the Target Scenario 2030, the Spanish electricity system is very reliable in terms of covering the demand for a single node.

Detailed coverage analysis assumptions for the 2030 Target Scenario

Starting hypothesis

The model from which this MAF analysis starts is the 2030 single node target used by ENTSO-E in the studies on medium-term coverage analysis (MAF). This model includes the European systems represented in the figure below:

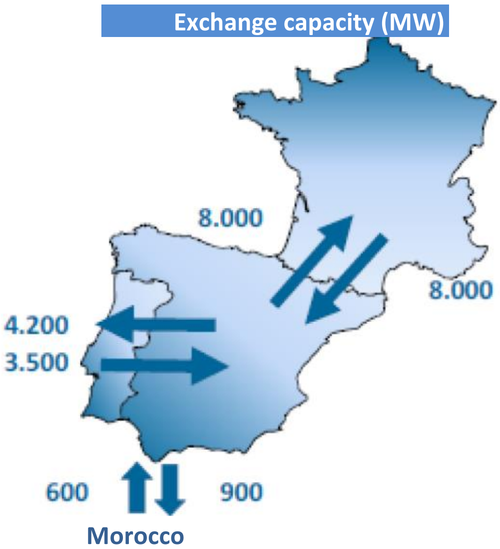
Figure D.8. Diagram of the systems considered for coverage analysis. Source. ENTSO-E

Source: Red Eléctrica de España

Exchange capacity

The interconnection capacity values used in the analyses are those shown in the figure below.

Figure D.9. Exchange capacity 2030 Target Scenario.



Source: Red Eléctrica de España

The contribution of Moroccan generation to the coverage of the Spanish peninsular electricity system is not considered for this coverage analysis.

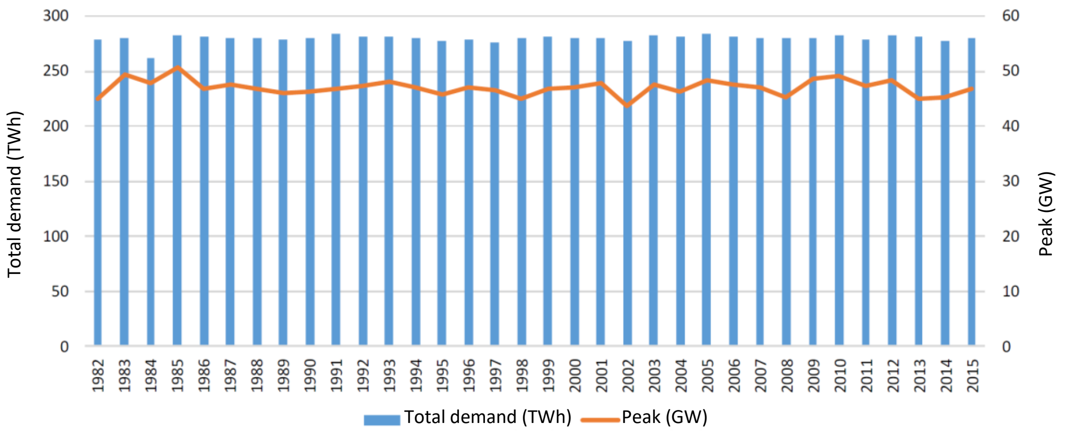
Minimum power-frequency regulation reserves

The minimum power-frequency regulation reserve in the Spanish peninsular electricity system considered is 1,280 MW. This reserve is modelled as a fixed load at all hours of the year, corresponding to the same methodology used to model it in ENTSO-E MAF analyses.

Climate years considered

The following 34 climate years from 1982 to 2015 have been considered. The generation profiles and peak demand used are shown in the following figure.

Figure D.10. Profiles and peak demand in each of the modelled climate years



Source: Red Eléctrica de España

Generation unavailability considered

A value of 5% of the time of unscheduled unavailability in each of the modelled thermal units is considered. In addition to this value, scheduled maintenance at the different nuclear and combined-cycle thermal units is considered. The following table shows the number of hours in which a certain number of nuclear or combined-cycle units have been modelled as simultaneously unavailable due to scheduled unavailability.

Table D.12. Simultaneous scheduled unavailability

	Number of units with simultaneous scheduled unavailability																
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Scheduled maintenance hours in CCGT	0	696	840	840	792	696	792	936	480	648	504	648	504	96	216	0	48
Scheduled maintenance hours in Nuclear	6,096	1,344	1,296	0	-	-	-	-	-	-	-	-	-	-	-	-	-

Source: Red Eléctrica de España

A scheduled and unscheduled unavailability for the interconnections of 6% is considered.

ANNEX E. CONTRIBUTION OF THE PLAN TO THE SUSTAINABLE DEVELOPMENT GOALS OF AGENDA 2030

On 29 June 2018, at the proposal of the High Level Group for Agenda 2030, the Council of Ministers approved the 'Action Plan for the Implementation of Agenda 2030: Towards a Spanish Strategy for Sustainable Development'. This plan highlights Spain's commitment to Agenda 2030 and the need for it to be a reference for all public policies.

The plan also highlights climate change as an additional challenge in meeting other Sustainable Development Goals (SDGs) such as those related to water, underwater life or terrestrial ecosystems (6, 14, 15), as well as the cross-cutting nature of measures to combat it, which allows synergies with all the goals. In this regard, the degree to which the different measures considered in the INECP contribute to the different SDGs has been analysed.

SDG 7 and 13 (affordable and clean energy and climate action) are the central objectives of the INECP, and the following interactions with other SDGs also stand out:

The global and cross-cutting nature of the fight against climate change requires alliances and coordination in all respects, both between the public and private sectors and at local, regional, national and international levels.

The existence of concurrent competences between different levels of administration, the importance of the active involvement of the private sector, and the weight of the European and international context in the field of energy and the climate, are factors that make it necessary to develop cooperation mechanisms that will make it possible to achieve the objectives.

Innovation, both in the development of new technologies and solutions, and in the adequate application of existing ones, has a special preponderance in the INECP, beyond the specific dimension of research, innovation and competitiveness.

In order to meet the objectives of the INECP, the industrial sector is also key. Consequently, several measures aimed at improving competitiveness and reducing emissions from this sector are included.

A significant proportion of the measures to be deployed focuses on the urban sphere, from upgrading to improve the energy efficiency of the residential or service sectors, to the promotion of cleaner and more efficient modes or technologies of transport.

At the same time, reducing emissions and improving efficiency also require greater responsibility on the part of consumers, for whom it needs to be made easier to choose more sustainable alternatives.

On the other hand, the National Plan encourages the development of own consumption and local energy communities, and ultimately greater citizen participation in the energy sector.

The Plan is expected to generate an increase in GDP of between 16.5 and 25.7 billion euros per year and an increase in employment of between 253,000 and 348,000 people per year. The construction, industrial and services sectors stand out in this field, due to investment in the energy upgrading of buildings and new investments linked to the change of model. In addition, some of the measures contain specific criteria for exploiting their job-creation potential or their role in just transition.

The analysis also reveals that the measures favour low-income households and especially vulnerable groups, although specific measures have also been included in the area of consumer protection and the fight against energy poverty. In addition, some measures are aimed at reducing inequalities between territories in terms of access to energy.

Table E.1 below summarises the specific contribution of the various measures envisaged in the plan to the SDGs.

Table E.1. Interactions between the INECP and the SDGs

		INECP Measures 2021-2030	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Decarbonisation	1.1	Development of new facilities for generating electricity using renewables																	
	1.2	Demand management, storage and flexibility																	
	1.3	Adaptation of electricity grids to integrate renewables																	
	1.4	Development of own consumption using renewables and distributed generation																	
	1.5	Incorporation of renewables in the industrial sector																	
	1.6	Framework for the development of renewable thermal energies																	
	1.7	Advanced biofuels in transport																	
	1.8	Promotion of renewable gases																	
	1.9	Plan for the technological upgrading of existing electricity generation projects with renewable energies																	
	1.10	Promotion of bilateral renewable electricity contracts																	
	1.11	Specific programmes for the use of biomass																	
	1.12	Unique projects and strategy for sustainable energy on the islands																	
	1.13	Local energy communities																	
	1.14	Promoting the proactive role of citizens in decarbonisation																	
	1.15	Just Transition Strategy																	
	1.16	Public procurement of renewable energy																	
	1.17	Training professionals in the renewable energy sector																	
	1.18	Revision and simplification of administrative procedures																	
	1.19	Generating knowledge, outreach, awareness and training																	
	1.20	European Emissions Trading System																	
	1.21	Reduction of greenhouse gas emissions in the agricultural and livestock sectors																	
	1.22	Reduction of greenhouse gas emissions in waste management																	
	1.23	Reduction of fluorinated greenhouse gas emissions																	
	1.24	Forest sinks																	
	1.25	Agricultural sinks																	
	1.26	Taxation																	
E Energy efficiency	2.1	Low-emission zones and modal shift measures																	
	2.2	More efficient use of the means of transport																	
	2.3	Renewal of the vehicle fleet																	
	2.4	Promotion of electric vehicles																	
	2.5	Improvements in the technology and management systems of industrial processes																	
	2.6	Energy efficiency in existing buildings in the residential sector																	
	2.7	Renewal of residential equipment																	
	2.8	Energy efficiency in services sector buildings																	
	2.9	Energy efficiency for cooling equipment and large air-conditioning systems in the services sector and public infrastructure																	
	2.10	Energy efficiency in farms, irrigation communities and agricultural machinery																	
	2.11	Promotion of energy services																	
	2.12	Public sector: proactive responsibility and energy-efficient public procurement																	
	2.13	Energy audits and management systems																	
	2.14	Training professionals in the energy efficiency sector																	
	2.15	Communication and information concerning energy efficiency																	
	2.16	Other measures to promote energy efficiency: transition to high-efficiency cogeneration																	
	2.17	Financial measures: National Energy Efficiency Fund																	

		INECP Measures 2021-2030	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Security	3.1	Maintenance of minimum security stocks of petroleum products and gas																	
	3.2	Reducing dependency on petroleum in the islands																	
	3.3	Alternative fuel recharging points																	
	3.4	Promoting regional cooperation																	
	3.5	Extension of contingency plans																	
	3.6	Planning for safe operation of a decarbonised energy system																	
Internal Market	4.1	Increased electricity interconnection with France																	
	4.2	Increased electricity interconnection with Portugal																	
	4.3	Electricity transmission infrastructure other than the ‘Projects of Common Interest’ (PCIs)																	
	4.4	Integration of the electricity market																	
	4.5	Protecting electricity consumers and increasing competition																	
	4.6	Data access																	
	4 7	Integration of the gas market																	
	4.8	Protection of gas consumers																	
	4.9	Improving the competitiveness of the retail gas sector																	
	4.10	Development plan for gas demand management																	
	4.11	Combating energy poverty																	
Research, innovation and competitiveness	5.1	Strategic action on energy and climate																	
	5.2	Implementation of the SET-Plan																	
	5.3	. Network of Excellence in Energy and Climate																	
	5.4	Increasing, coordinating, improving and efficiently using scientific and technological infrastructure and equipment in energy and climate																	
	5.5	Public procurement in green innovation																	
	5.6	Strengthening public venture capital for technology transfer in energy and climate																	
	5.7	New instruments to support research and innovation in energy and climate																	
	5.8	Social innovation for the climate																	
	5.9	Reducing bureaucracy and administrative burdens																	
	5.10	Relaunching the City Foundation for Energy, CIUDEN																	
	5.11	Information system on Science, Technology and Innovation for monitoring financing																	
	5.12	RIC to adapt the Spanish energy system to climate change																	
	5.13	Unique long-term programmes on science and technology that are strategic in the area of energy and climate																	
	5.14	Increasing Spanish participation in European research and innovation funding programmes																	
	5.15	Supporting the participation of Spanish research groups in international energy and climate forums																	
	5.16	Promoting the Innovation Mission initiative																	
	5.17	European innovation financing mechanisms																	
	5.18	International cooperation																	
		Totals	7	0	11	12	7	5	59	28	50	26	31	37	57	1	8	14	55

ANNEX F. MEASURES AND METHODOLOGY TO IMPLEMENT ARTICLE 7 OF THE ENERGY EFFICIENCY DIRECTIVE

F.1. OBJECTIVE

According to the Energy[89] Efficiency Directive (hereinafter EED), the deadline for adopting the laws, regulations and administrative provisions necessary to comply with the EED itself is **25 June 2020**. This Annex aims to advance the information requested by both Annex V of the EED and Annex III of the Governance Regulation, providing a greater level of detail of the policies and measures described in the INECP, as well as the methodology adopted, the implementation of which will make it possible to achieve the energy-saving obligation for the period 2021-2030, in accordance with Article 7 of the EED.

F.2. BACKGROUND

The **energy savings obligation** in Article 7 of the Energy Efficiency Directive provides that Member States shall achieve **cumulative energy end-use savings** at least equivalent to new savings each year from 1 January 2021 to 31 December 2030 of 0.8% of the average annual final energy consumption over the last three years prior to 1 January 2019.

This obligation is a continuation of the one adopted for the period 2014-2020, also in compliance with the said Article 7 of the Directive, with a cumulative final energy target of 15,979 ktoe for the whole period, which is equivalent to 571 ktoe/year of new and additional final energy savings, assuming that a linear distribution of the objective will be applied throughout that period. In order to achieve the final energy savings target for the current period 2014-2020, a combination of the two systems allowed by the Directive has been chosen:

- An energy efficiency obligation scheme in addition to the Energy Efficiency National Fund, in accordance with Article 7a of the EED. Law 18/2014 of 15 October 2014 on the approval of urgent measures for growth, competitiveness and efficiency regulates and creates the system of obligations and the Energy Efficiency National Fund (FNEE), respectively.
- Adoption of alternative policy measures such as, inter alia, taxation, regulation or voluntary agreements, in accordance with Article 7b of the EED.

Law 18/2014 ends on 31 December 2020, so it needs to be extended for the period 2021-2030. This will require an extension by law of the period of obligation until 31 December 2030.

[89] Directive 2012/27/EU of 25 October 2012 on energy efficiency and Directive (EU) 2018/2002 of 11 December 2018 amending Directive 2012/27/EU on energy efficiency.

F.3. CALCULATION OF THE LEVEL OF THE ENERGY-SAVING OBLIGATION 2021-2030

This section provides a description of the calculation of energy savings to be achieved over the whole period from 1 January 2021 to 31 December 2030. The calculation was made in accordance with Article 7(1)(b) of the Energy Efficiency Directive, on the basis of annual final energy consumption (in ktoe) averaged over the most recent three-year period prior to 1 January 2019 and using MITECO statistical data. Details of annual final energy consumption for the years 2016, 2017 and 2018 are shown in the table below:

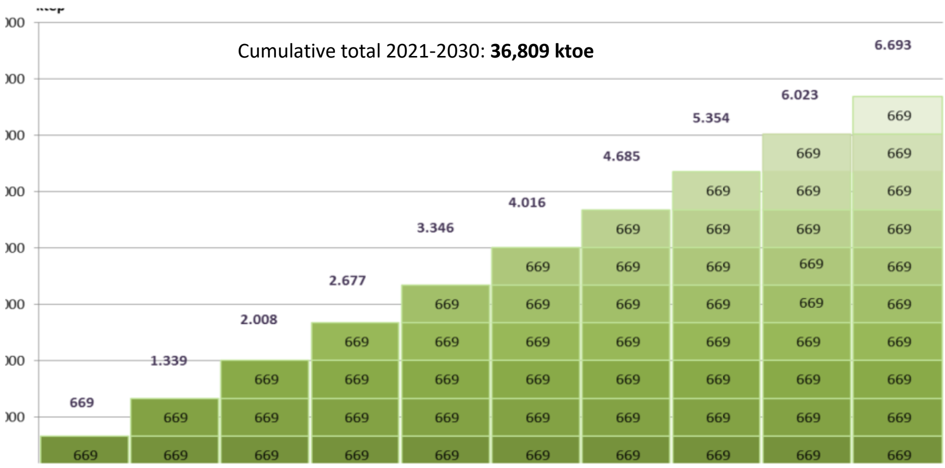
Table F.1. Final energy consumption for 2016, 2017 and 2018 and average (ktoe)

FINAL ANNUAL ENERGY CONSUMPTION (ktoe)		
2016	**2017**	**2018**
82,329	84,269	84,375
AVERAGE		**83,658**

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Based on this annual consumption, the new savings objective for each year is **669 ktoe/year** (equivalent to 83,658 ktoe x 0.08%), bringing the **total accumulated volume of final energy savings for the period 2021-2030 to 36,809 ktoe.** The following figure shows its possible distribution over the period 2021-2030. This distribution could be changed if higher impact measures (both legislative and fiscal) were adopted at the beginning of the period:

Figure F.1. Cumulative end-use energy savings target: 2021-2030



Source: Ministry for Ecological Transition and Demographic Challenge, 2019

F.4. SECTORAL DISTRIBUTION OF THE ENERGY SAVINGS TARGET

Chapter 3.2.1 of the INECP on 'Measures for compliance with the obligation to save energy. The 'sectoral approach' proposes a sectoral breakdown of the cumulative end-use energy savings target for the whole period, which amounts to 36,809 ktoe, proportional to the consumption of the five energy-consuming sectors: transport, industry, residential, services and agriculture and fisheries.

Ten large groups of energy efficiency measures have been designed, which are in turn divided, depending on the instrument used, into sub-measures, some based on **existing** measures in the period 2014-2020 and some **new** measures, so that they can meet such an ambitious cumulative end-use energy savings target (the new cumulative energy savings target for the period 2021-2030 is more than double the cumulative savings target for the period 2014-2020).

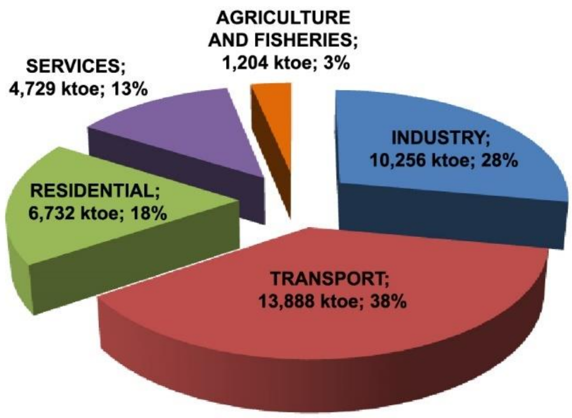
The measures in the transport sector, with four groups of measures identified, will contribute most to the final cumulative energy savings target for the period 2021-2030; it has been assigned a savings target of almost 14 Mtoe, which represents 38% of the cumulative energy savings target for the period. It is followed by the industrial sector, with one measure and a cumulative savings target of 10.2 Mtoe for the period, representing 28%. The residential sector, with two measures, has a savings target of 6.7 Mtoe, representing 18% of the total. The service sector and the agriculture and fisheries sector are those with the lowest contributions: the first, with two measures and a target of 4.7 Mtoe (13%) and the second, one measure and 1 Mtoe (3%) of accumulated savings. The graphic representation of this distribution is shown in the table and figures below.

Table F.2. Energy-efficiency measures for the period 2021-2030 (ktoe)

		Cumulative savings for the period 2021-2030 (ktoe)
TRANSPORT		**13,888.1**
2.1	Low-emission zones and modal shift measures	5,622.9
2.2	More efficient use of the means of transport	2,221.4
2.3	Renewal of the vehicle fleet	2,519.6
2.4	Promotion of electric vehicles	3,524.2
INDUSTRY		**10,256.2**
2.5	Improvements in the technology and management systems of industrial processes	10,256.2
RESIDENTIAL		**6,731.9**
2.6	Energy efficiency in existing buildings in the residential sector	4,755.9
2.7	Renewal of residential equipment	1,976.0
SERVICES		**4,729.2**
2.8	Energy efficiency in services sector buildings	1,378.8
2.9	Energy efficiency for cooling equipment and large air-conditioning systems in the services sector and public infrastructure	3,350,04
AGRICULTURE		**1,203.9**
2.10	Energy efficiency in farms, irrigation communities and agricultural machinery	1,203.9
TOTAL		**36,809.3**

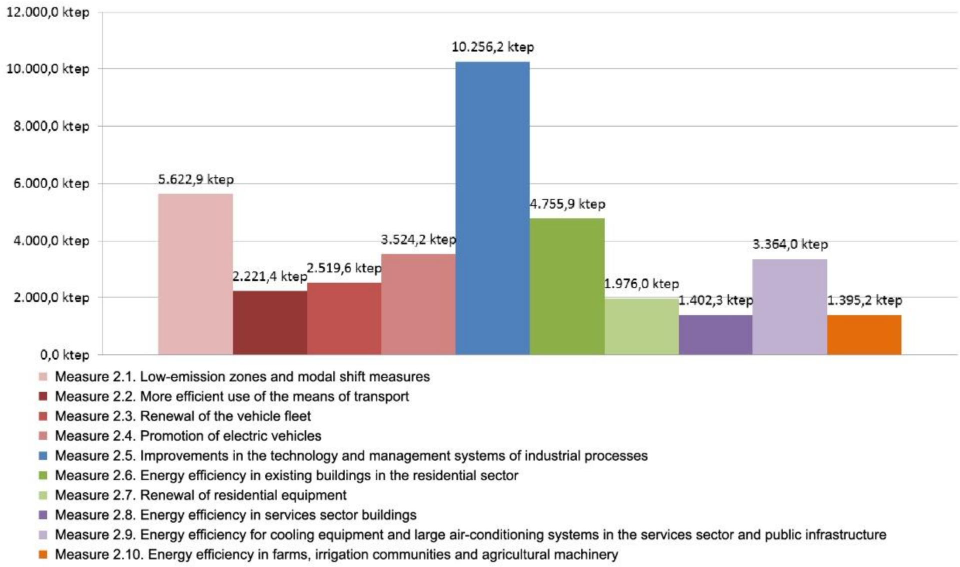
Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Figure F.2. Cumulative end-use energy savings by sector in Spain 2021-2030 (ktoe)



Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Figure F.3. Cumulative end-use energy savings by measure in Spain 2021-2030 (ktoe)



Source: Ministry for Ecological Transition and Demographic Challenge, 2019

F.5. POLICY MEASURES TO FULFIL THE OBLIGATION TO SAVE ENERGY

Article 7(10) of the Energy Efficiency Directive gives Member States two options for achieving the amount of cumulative end-use energy savings: either through an energy efficiency obligation scheme or by adopting alternative policy measures. It is also possible to opt for a combination of both.

A combined system was adopted for the period 2014-2020 and will be maintained for the period 2021-2030, but with adjustments and new measures to achieve the new ambitious end-use energy savings target. The specific proposal for action for the new period is developed below:

F.5.1. ENERGY EFFICIENCY OBLIGATION SCHEME

During the period 2021-2030, the **national energy efficiency obligation scheme** and the **National Energy Efficiency Fund** will be maintained; both were initiated by Royal Decree Law 8/2014 of 4 July 2014, approving urgent measures for growth, competitiveness and efficiency, and subsequently validated by Law 18/2014 of 15 October 2014, approving urgent measures for growth, competitiveness and efficiency. Consequently, this law transposes into Spanish law Article 7a on energy efficiency obligation schemes and Article 20 on the Energy Efficiency National Fund, financing and technical support for the EED. The continuity of this system for the period 2021-2030 **must be approved by law**.

Furthermore, in a new development, the creation of a **system of energy savings certificates** aimed at certain sectors and implementing measures is envisaged. It should be noted that the savings certificate systems were not applied in the period 2014-2020, although they were provided for in the law. The volume of savings for the new period and the investment make necessary a model for promoting energy efficiency that represents a qualitative and quantitative leap forward from the current model.

a) Description of the energy efficiency obligation scheme

For the period 2021-2030, the annual savings target, the percentages of **distribution of the annual savings target among the obligated parties**, as well as the resulting savings quotas or obligations and their **financial equivalence**, will be set annually **by order of MITECO following agreement by the Government's Delegate Commission for Economic Affairs**.

The annual energy savings target to be set shall be shared among the obligated parties in proportion, in the case of electricity and gas traders, to the volume of their domestic final energy sales to final consumers. In the case of wholesale operators of petroleum products and liquefied petroleum gas, in proportion to the volume of their final energy sales at national level for subsequent distribution at retail level and to final consumers, during the second year preceding the annual period of the obligation.

Obligated parties may justify the share of energy savings allocated to them annually by making a financial contribution to the **FNEE** in the amount obtained by multiplying their annual savings obligation by an established financial equivalence.

For this new period, a mechanism based on the presentation of energy saving certificates (ESCs) will also be established. This option will need to be developed by the Government in a regulatory manner, determining which sectors and measures it will apply to.

More details of both the FNEE and the energy saving certificates are given below:

National Energy Efficiency Fund (FNEE)

The FNEE was established by Article 72 of Law 18/2014. It is the system in force during the period 2014-2020 and will also be maintained between 2021-2030.

The FNEE is dedicated to funding support mechanisms for economic and financial aid, technical assistance, training, information or other measures in order to increase energy efficiency in the different energy-consuming sectors, in a way that contributes to achieving the national energy-saving target established by the National Energy Efficiency Obligation Scheme.

Obligated parties must make an annual financial contribution to the FNEE, for the amount resulting from multiplying their annual savings obligation by the financial equivalence to be established. **Given the volume of energy savings and the investment required to meet the objective for the new period, the annual contribution of the obligated parties will be resized.** As in the current period, this contribution shall be paid in four equal quarterly instalments, not later than 31 March, 30 June, 30 September and 31 December of each year.

The financial equivalence will be determined annually by order of MITECO on the basis of the estimated average cost that will make it possible to mobilise the investments needed to carry out the energy-saving and energy efficiency actions designed to achieve the annual energy-savings target in all sectors (transport, industry, etc.). Given the difficulty of mobilising new investment, it is necessary to review the financial equivalence on a regular basis. The supervision and control of the Fund will be the responsibility of a Monitoring and Control Committee attached to MITECO, through the State Secretariat for Energy. The Institute for Energy Diversification and Saving (*Instituto para la Diversificación y Ahorro de la Energía*, IDAE) will be responsible for managing the fund.

The Fund will continue to be endowed with:

- Contributions by parties bound by the national energy efficiency obligation scheme to meet or settle their savings obligations.
- Resources from the Community's structural funds (ERDF).
- Other contributions that are recorded in the General State Budget.
- Any other resource intended to finance actions aimed at implementing end-use energy saving measures.

Energy Saving Certificates (ESCs)

This alternative to the Fund was not developed by the Government in regulations for the period 2014-2020, although Law 18/2014 allows for the establishment of a mechanism for accrediting the achievement of an amount of energy savings equivalent to compliance with the obligation to save under the system of obligations, based on the presentation of Energy Saving Certificates (ESCs), resulting from the implementation of energy efficiency actions defined in a catalogue and meeting the requirements and conditions established. The certificates are required to be subject to a control system that includes physical verification of a statistically significant part of the certified energy efficiency improvement measures.

Article 7a of the Energy Efficiency Directive allows obligated parties to count towards their obligation certified energy savings achieved by **energy service providers or other third parties**, including when obligated parties promote measures through other State-approved bodies or through public authorities that may involve formal partnerships and may be in combination with other sources of finance. Where Member States so permit, they shall ensure that the certification of energy savings follows an approval process that is clear, transparent, and open to all market participants, and that aims to minimise the costs of certification.

b) Cumulative and annual amount of anticipated savings and duration of the period(s) of obligation

The amount of savings foreseen annually and cumulatively attributable to the obligation scheme and therefore to the obligated parties will be set annually **by order of MITECO with the prior agreement of the Government's Delegate Commission for Economic Affairs.**

c) Obligated parties and their responsibilities

In the new period 2021-2030, the obligated parties that will be assigned an annual quota of energy savings will continue to be:

- gas and electricity marketing companies;
- operators of wholesale petroleum products;
- operators of wholesale liquefied petroleum gas.

Although the Directive raises the possibility that the obligated parties may be energy traders or distributors, given that, in Spain, energy distributors do not carry out marketing tasks (unlike in other EU countries) but rather a regulated activity of managing the corresponding network, it has been determined that, in the case of gas and electricity, the energy traders are the obligated parties.

In the case of petroleum products and liquefied petroleum gases, it has also not been considered appropriate to impose the obligations on the system operator, but rather the companies marketing the products for sale to final consumers are the obligated parties. Specifically, taking into account the existing atomisation in the final marketing of these products, wholesale operators of petroleum products and liquefied petroleum gas.

On the basis of the experience gained in managing the obligation scheme for the period 2014-2020, as permitted by the Directive, it is considered appropriate to exclude small enterprises with reduced financial capacity from this obligation. For example, obligated parties with a final sales volume of 60 GWh or less are not obliged to contribute to the FNEE.

d) Target sectors

The sectors addressed will be all energy-consuming sectors, in accordance with the sectoral breakdown indicated in section F.4.: transport, industry, residential, services, and agriculture and fisheries.

e) Eligible actions envisaged under the measure

The action programmes to be developed under the FNEE are those listed in the table below, which indicates whether the measure was implemented in the period 2014-2020 and is existing, or is new:

Table F.3. Action Programs under the FNEE (2021-2030)

NATIONAL ENERGY EFFICIENCY FUND		
No of measure	**SECTOR**	**Existing measure period 2014-2020**
	TRANSPORT	
2.1	**Low-emission zones and modal shift measures**	
	Workplace travel plans (*Planes de transporte al centro de trabajo*, PTT) (co-management with autonomous communities)	EXISTING
	Public transport communication campaign	EXISTING
2.2	**More efficient use of the means of transport**	
	Fleet management systems (co-management with autonomous communities)	EXISTING
	Efficient driving courses for professional drivers (co-management with autonomous communities)	EXISTING
	INDUSTRY	
2.5	**Improvements in the technology and management systems of industrial processes**	
	In SMEs (co-management with autonomous communities)	EXISTING
	In large companies (co-management with autonomous communities)	EXISTING
	RESIDENTIAL	
2.6	**Energy efficiency in existing buildings in the residential sector**	
	Housing sector: Energy upgrade of housing (co-management with autonomous communities)	EXISTING
2.7	**Renewal of residential equipment**	
	Communication campaign for household equipment	EXISTING
	SERVICES	
2.8	**Energy efficiency in services sector buildings**	
	Building for service use: Energy upgrade of service buildings (co-management with autonomous communities)	EXISTING
2.9	**Energy efficiency for cooling equipment and large air-conditioning systems in the services sector and public infrastructure**	
	Plan Renove for storage and freezing compartments (co-management with autonomous communities)	NEW
	Renewal of industrial and service cooling generators (co-management with autonomous communities)	NEW
	AGRICULTURE AND FISHERIES	
2.10	**Energy efficiency in farms, irrigation communities and agricultural machinery**	
	Improvement of energy savings and efficiency in farms (co-management with autonomous communities)	NEW
	Improvement of energy savings and efficiency in irrigation communities (co-management with autonomous communities)	NEW

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

These are non-repayable aid programmes aimed at end users in the industrial, transport, residential, service and agricultural and fisheries sectors. There are also communication campaigns for the transport sector (modal shift measures, with special emphasis on collective public transport) and the residential sector (household equipment).

F.5.2. ALTERNATIVE POLICY MEASURES

Article 7b of the Energy Efficiency Directive allows the savings target to be achieved through alternative measures. During the period 2014-2020, this route was used to develop tax measures, regulations and aid programmes, among others. In the new period 2021-2030, those measures than in the previous period that have proved to be more successful will be maintained and supplemented with new ones.

Table F.4 details the measures planned for the period 2021-2030 in the INECP for the different sectors, putting forward the details requested in Annex III of the Governance Regulation, such as the type of policy measure, a brief description of the measure and the target sectors.

The alternative measures can be grouped according to the implementing public authority into the following types:

1. Voluntary agreements to be made by the IDAE (industry, fleet managers, residential equipment, energy service companies, etc.)
2. Aid programmes with ERDF funds and local authority funds: aimed at activities that are the responsibility of local authorities (Sustainable Urban Mobility, buildings and local infrastructure) and the General State Administration (AGE) (buildings and infrastructure).
3. Aid programmes with the State Budget (*Presupuestos Generales del Estado*, PGE):
    a. MITECO's MOVES aid programme and MINCOTUR's mobility programme.
    b. MITMA State Housing Plan.
    c. Financing of Public Transport through future law.
4. Legislation:
    a. Climate Change and Energy Transition Law that will include various amendments to existing legislation for the elimination of barriers (Horizontal Property Law, Transportation to Work Plans, etc.).
    b. Law on Sustainable Mobility and Financing of Public Transport, as well as Regional Laws and Municipal By-laws related to mobility.

The following table includes a list of alternative measures, indicating whether they have existed in the period 2014-2020 or whether they will be newly implemented in the period 2021-2030.

Table F.4. Alternative policy programmes (2021-2030)

No of measure / ALTERNATIVE POLICY MEASURES / SECTOR	Type of measure	Existing measure period 2014-2020
TRANSPORT		
2.1 Low emission zones and modal shift measures)		
ERDF aid programme 2021-2030 (DUS- Municipalities) for the development of Sustainable Urban Mobility Plans.	Public aid (ERDF)	EXISTING
Drafting of the Law on Sustainable Mobility and Financing of Public Transport, as well as autonomous regional laws and municipal by-laws in the 145 municipalities with populations over 50,000 (52% of the country's population). They will include in particular key measures such as the demarcation of central urban areas with restricted access to the most polluting vehicles with the highest emissions. They will also boost pedestrianisation, traffic restrictions at times of increased pollution, car pooling, promoting the use of bicycles, improving and promoting public transport, etc.	Legislative (autonomous and local)	NEW
Development of the Law on Sustainable Mobility and Financing of Public Transport, with a budget allocation (>€50 million/year).	Legislative (AGE) + PGE	NEW
Draft law on climate change and energy transition: amendment of Article 103 of the Sustainable Economy Law 2/2011 (‘Development of Transport Plans in Companies’), requiring implementation in companies with more than 250 employees (large companies) and the creation within these companies of the role of Transport Coordinator.	Legislative (Climate Change and Energy Transition Law (*Ley de Cambio Climático y Transición Energética*, LCCyTE))	NEW
2.2 More efficient use of the means of transport		
Voluntary agreements for fleet management.	Voluntary agreement	EXISTING
Amendment of the General Regulation on Vehicles (RD 2822/1998): adoption of the regulations to standardise the loads and dimensions of national lorries with those of surrounding countries. An increase in the maximum authorised load to 44 tonnes, with a height of 4.5 m, will enable an increase in the average loads of these vehicles of 10% from 2021, with a consequent reduction in the number of vehicles per kilometre and less consumption per load carried.	Legislative	NEW
2.3 Renewal of the vehicle fleet		
Municipal by-laws on Mobility: application of traffic restriction and parking management measures on public highways by local councils with >50,000 inhabitants, so that the oldest vehicles, which have the highest fuel consumption and pollution emissions, will be penalised.	Legislative (local)	NEW
MINCOTUR Mobility aid programme.	Public aid (PGE)	EXISTING
2.4 Promotion of electric vehicles		
MOVES aid programme (PGE line enabled indefinitely).	ic aid (PGE)	EXISTING
MINCOTUR Mobility aid programme.	ic aid (PGE)	EXISTING
INDUSTRY		
2.5 Improvements in the technology and management systems of industrial processes		
Industry Voluntary Agreements.	Voluntary agreement	EXISTING
RESIDENTIAL		
2.6 Energy efficiency in existing buildings in the residential sector		
Housing Plan aid programme - Ministry of Public Works (now MITMA).	ic aid (PGE)	EXISTING
2.7 Renewal of residential equipment		
Voluntary Agreement Manufacturers and Merchants of Domestic Appliances (communication).	Voluntary agreement	NEW

ALTERNATIVE POLICY MEASURES		
No of measure SECTOR	Type of measure	Existing measure period 2014-2020
SERVICES		
2.8 Energy efficiency in services sector buildings		
2.9 Energy efficiency for cooling equipment and large air-conditioning systems in the services sector and public infrastructure		
Grant programme for the renovation of buildings and infrastructure. ERDF 2021-2030 – AGE	Public aid (ERDF + PGE)	EXISTING
Climate Change and Energy Transition Bill: Extension of Article 5 of Directive 2012/27/EU to all public administrations (renewal of 3% of the surface area of the autonomous communities and municipalities' buildings).	Legislative (Climate Change and Energy Transition Law (*Ley de Cambio Climático y Transición Energética*, LCCyTE))	NEW
Grant programme for the renovation of buildings and infrastructure ERDF – Municipalities	Public aid (ERDF)	EXISTING

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

F.5.3. TAXATION MEASURES

Article 7b of the Energy Efficiency Directive allows the savings target to be achieved through alternative measures. These include taxation, which is dealt with in a separate section, as set out in Annex III to the Governance Regulation. A brief description of the fiscal measures and the sectors addressed is included, as well as an indication of whether it was an existing measure in the period 2014-2020.

Table F.5. Tax measures provided for in the INECP for the period 2021-2030

ALTERNATIVE MEASURES (TAXATION)	
Measure no SECTOR	Existing measure period 2014-2020
TRANSPORT	
2.3 Renewal of the vehicle fleet	
Future green tax reform led by the Ministry of Finance: the Ministry of Finance will analyse possible reforms associated with the automotive sector in order to, among other things, meet the energy saving and efficiency target, as well as decarbonisation.	NEW
2.4 Promotion of electric vehicles	
In the framework of the future green tax reform, the Ministry of Finance will contribute and accelerate the penetration of EVs in Spain.	NEW
RESIDENTIAL	
2.6 Energy efficiency in existing buildings in the residential sector	
In the framework of the future green tax reform, the Ministry of Finance will analyse taxation in the residential sector, in order to internalise the positive externalities that would result from improving the energy efficiency in buildings related to this sector.	NEW
SERVICES	
2.8 Energy efficiency in services sector buildings	
In the framework of the future green tax reform, the Ministry of Finance will analyse taxation in the services sector in order to internalise the positive externalities of improving energy efficiency in buildings related to this sector.	NEW

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

ANNEX G. PARTICIPATORY AND COMMUNICATIVE PROCESS

COMMENTS RECEIVED AND ACTORS INVOLVED IN THE PROCESS OF PUBLIC EXPOSURE OF THE DRAFT PLAN

In accordance with Regulation (EU) 2018/1999[90]of 11 December 2018 on the Governance of the Energy Union project, each Member State is required to submit to the European Commission a draft INECP for the period 2021 to 2030 in accordance with Article 3(1) and Annex I of that Regulation. The deadline for the submission of the first drafts of integrated national energy and climate plans was 31 December 2018.

These Plans, which cover all five dimensions of the Energy Union, are an essential tool for the various Member States to achieve the overall objectives and goals of the Energy Union together. Spain presented its initial draft of the INECP on 22 February 2019. The submission of these drafts constitutes the basis and first step in the iterative process between the Commission and the Member States for the finalisation and subsequent implementation of the integrated national energy and climate plans.

Along with the initial draft of the INECP, MITECO presented two other documents on the strategic framework for energy and climate: The first is the draft Climate Change and Energy[91]Transition Law; the second is the draft Just[92]Transition Strategy. These documents, along with the initial draft of the INECP, were put on public display from 22 February to 1 April 2019. This report provides a summary of the main comments made on that initial draft.

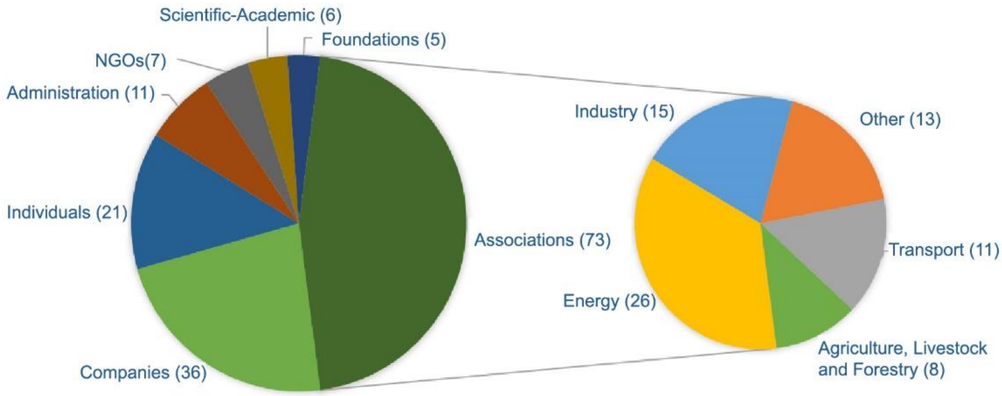
The aim of the public consultation process is to ensure that the whole of Spanish society is informed, participates and expresses its opinions on the aforementioned initial draft, and that these are taken into consideration when drawing up the final Plan.

[90] https://eur-lex.europa.eu/legal-content/ES/TXT/PDF/?uri=CELEX:32018R1999&from=ES

[91] https://www.miteco.gob.es/es/cambio-climatico/participacion-publica/1anteproyectoleyccyte_tcm30- 487336.pdf

[92] https://www.miteco.gob.es/es/cambio-climatico/participacion- publica/5borradorestrategiatransicionjusta_tcm30-487304.pdf[93] Official schools, social platforms, citizens’ forums, etc.

Figure G.1. Classification of agents according to type and associations according to economic sector

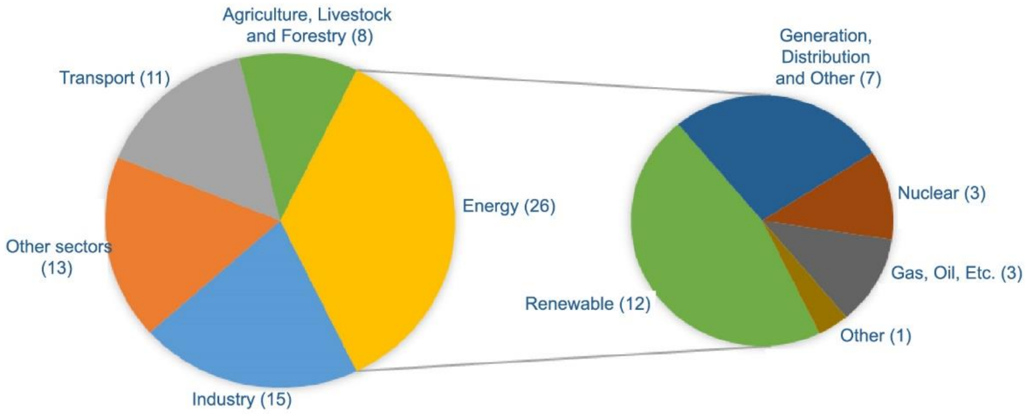


Source: Ministry for Ecological Transition and Demographic Challenge, 2019

A total of 1,175 comments were received from 159 different agents. Most of those who participated in the public consultation belong to: associations (73), followed by companies (36), individuals (21), public administrations (11), NGOs (7), staff from the scientific-academic field (6) and foundations (5) (see figure G.1).

In addition, in the case of associations, stakeholders have been classified according to the economic sector to which they belong: Energy (26), Industry (15), Other[93] (13), Transport (11), and Agriculture, Livestock and Forestry (8). In the energy sector, the greatest participation corresponds to the subsector of renewable energy (12), followed by the subsector of electricity generation, distribution and other (7), nuclear energy (3), gas and petroleum products (3) and other[94] (1) (see Figure G.2).

Figure G.2. Classification of Associations according to Economic Sector and Subsector



Source: Ministry for Ecological Transition and Demographic Challenge, 2019

The observations have been grouped into six classes: for the five dimensions of the INECP and an additional one to include cross-cutting themes throughout the document (see Table G.1).

[93] Official schools, social platforms, citizens' forums, etc.
[94] Others related to generation through waste.

Table G.1. Classification of comments into the various dimensions

DIMENSION	No of thematic blocks
CROSS-CUTTING ISSUES	15
DECARBONISATION	19
ENERGY EFFICIENCY	5
SECURITY OF SUPPLY	2
INTERNAL MARKET	4
INNOVATION, RESEARCH AND COMPETITIVENESS	1

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

Table G.2. Presentation and discussion events on the initial draft of the INECP

Main events to disseminate the initial draft of the INECP				
Date	**Name of event**	**Organiser**	**Place**	**link**
18.12.2018	Discussion seminar: Renewables, climate and Spain's external action	Casa America, Real Instituto Elcano	Madrid	web
21.2.2019	Discussion seminars on the National Energy and Climate Plan	ECODES (Ecology and Development Foundation)	Madrid	news
21.2.2019	Seminar: Development Strategies Integrated Sustainable Urban	European Commission, Ministry of Finance	Madrid	info
26.2.2019	Seminar: Innovation Strategies for Climate Change (ENOMAQ Fair)	Spanish Wine Federation (FEV) and Technological Platform of Wine (PTV)	Zaragoza	news
26.2.2019	Security of supply and the internal market at the INECP (GENERA 2019 Fair)	Madrid Fair Institution (IFEMA)	Madrid	web
27.2.2019	Islas Project: insularity as an opportunity to spearhead decarbonisation (GENERA 2019 Fair)	IFEMA IDAE	Madrid	info
28.2.2019	Impact of the INECP	IFEMA Basque Centre for Climate Change (BC3)	Bilbao	info
1.3.2019	Climate change and energy transition: The INECP (GENERA 2019 Fair)	IFEMA Spanish Office for Climate Change (OECC)	Madrid	info
6.3.2019	Seminar: The agricultural sector facing the environmental and climate challenge	Ministry for Agriculture, Fisheries and Food	Madrid	news
6.3.2019	Revision 2019: Renewable Revolution	Renewable Energy Institute	Tokyo (JPN)	web
6.3.2019	Change the Change (International conference on climate change)	Basque Government	Donostia	web
13.3.2019	Energy and Climate Strategic Framework	Spanish Energy Efficiency Technology Platform (PTE-ee)	Madrid	web
14.3.2019	Seminar on Solar Market Parity Spain	Spanish Photovoltaic Union (UNEF)	Madrid	web
15.3.2019	Seminar: Sustainability and Climate Change	Official College of Architects of the Balearic Islands (COAIB)	Mallorca	news
15.3.2019	Seminar: The role of renewable energy in the transition to a new energy model in the Canary Islands	Institute of Technology and Renewable Energy (ITER)	Santa Cruz de Tenerife	info
15.3.2019	Energy for the Circular Transition	Autonomous University of Barcelona (UAB)	Barcelona	
19.3.2019	Own consumption Seminar	Association of Electrical Energy Companies (AELEC)	Barcelona	news
19.3.2019	2nd Round Table on Financing Energy Efficiency in Spain	Green Building Council España (GBCe).	Madrid	web
19.3.2019	An economic assessment of the INECP	Spanish Association for Energy Economics (*Asociación Española de Economía de la Energía*, AEEE) and Spanish Energy Club	Madrid	info

Main events to disseminate the initial draft of the INECP				
Date	Name of event	Organiser	Place	link
20.3.2019	Project: Energy Poverty and Heat Waves in Urban Areas	Association of Environmental Sciences Biodiversity Foundation	Guadalajara Valencia Melilla Madrid	web
27.3.2019	RES and energy transition Seminar	Catarroja Public FP Centre	Catarroja	info
27.3.2019	CONFEBUS Summit	Bus Transport Confederation (CONFEBUS)	Madrid	info
28.3.2019	DIPAPEL Paper Forum 2019	Aspapel (Spanish Association of Pulp, Paper and Cardboard Manufacturers)	Madrid	info
3.4.2019	WindEurope Conference & Exhibition	WindEurope	Bilbao	web
3.4.2019	Subject: Challenges and opportunities associated with climate change	University Master’s in International Business Management 18-19 ICEX/CECO	Madrid	web
3.4.2019	Meeting of Towns and Cities for Sustainability	CONAMA	Toledo	news
4.4.2019	IIE Seminar: Energy, Agriculture and Rural Affairs	Spanish Institute of Engineering (IIE)	Madrid	info
4.4.2019	Energy efficiency in public buildings	Renewable Energy Foundation Energy Cities	Madrid	web
8.4.2019	International workshop on geothermal energy	Canary Islands Technological Institute (*Instituto Tecnológico de Canarias*, ITC)	Canary Islands	info
9.4.2019	Seminar on Valencian Municipalities towards the energy transition	UPV, ITACA Institute, Valencia Provincial Council and MITECO	Valencia	info
9.4.2019	Training for municipal technicians: Local Adaptation	LIFE SHARA and CENEAM (National Centre for Environmental Education)	Segovia	info
11.4.2019	Driver of new opportunities for employment and regional development	Directorate-General for Innovation, Employment, Industry and Trade of Rioja	Rioja	info
12.4.2019	2019 International Forum on Long-term Energy Scenarios for Clean Energy Transition	IRENA (International Renewable Energy Agency)	Berlin (DEU)	web
17.4.2019	Regional Seminars on Energy and Climate Change	ASELEC (Association of Electrical, Telecommunications and Renewable Energy Installers of Valencia)	Valencia	info
25.4.2019	Round Table: The Integrated Energy and Climate Plan	Master’s in Industrial Economics and Markets UC3M (Universidad Carlos III de Madrid)	Madrid	info
25.4.2019	Smart Meters – Round table on smart meters at the service of consumers	AELEC	Madrid	news
25.4.2019	Regional Consultation in Barcelona	Interreg Med Renewable Energy Community	Barcelona	news
7.5.2019	Seminar: The role of the forest sector in mitigation of and adaptation to climate change	National Training Centre for New Technologies in Rioja	Rioja	info
8.5.2019	Seminar on storage with renewable energy	CIEMAT (Energy, Environment and Technology Research Centre)	Madrid	info
8.5.2019	Pathways to Carbon Neutrality	EERA (European Energy Research Alliance)	Brussels (BEL)	web
9.5.2019	2nd Congress on Nearly Zero Energy Consumption Buildings	AEDIFICAT Foundation, COAAT Mallorca and ABTECIR Association	Mallorca	info
16.5.2019	Scientific-Technical Workshop Adaptation to climate change through FSC certification	MITECO Biodiversity Foundation	Madrid	web
17.5.2019	Distributed energy, sustainable mobility and own consumption	ENERCLUB (Spanish Energy Club)	Oviedo	info
20.5.2019	Webinar: The biomethane sector (case studies)	LIFE (ICAEN)	Online	info

Main events to disseminate the initial draft of the INECP				
Date	**Name of event**	**Organiser**	**Place**	**link**
27.5.2019	Used Vehicle Show	IFEMA	Madrid	web
27.5.2019	Impact assessment of the Spanish integrated National Energy and Climate Plan	University of Oldenburg	Oldenburg (DEU)	info
30.5.2019	Ibero-Brazilian Energy Conference	More events	Lisbon	web
5.6.2019	Technical seminar: Carbon forestry and forest management for climate change mitigation	Official College of Technical Forestry Engineers (COITF), LIFE Forest CO2 Project District Board Retreat	Madrid	web
11.6.2019	I Congress Electrification and Networks: a binomial for the transition	AELEC	Madrid	web
12.6.2019	Waste & Challenges Seminar - Resources for change	Regional Government of the Autonomous Community of Valencia IMEDES Institute	Valencia	web
13.6.2019	Solar+Wind Congress 2019	PVBOX	Madrid	info
13.6.2019	Sun to Liquid	IMDEA (Energy Community of Madrid)	Madrid	info
18.6.2019	EU Sustainable energy week: Islands as lighthouses of Europe's decarbonisation	European Commission	Brussels (BEL)	web
19.6.2019	4th Energy and Sustainable Development Forum	Valencia Chamber of Commerce	Valencia	news
20.6.2019	Energy Round Table and Energy Transition debate: Own consumption	Madrid Business Forum	Madrid	news
24.6.2019	Environmental challenges in the European Union	UNED General Gutierrez Mellado University Institute	Madrid	web
24.6.2019	Impact assessment of the Spanish integrated National Energy and Climate Plan (Bonn Climate Change SB50)	UNFCCC secretariat (UN Climate Change)	Bonn (DEU)	info
25.6.2019	Introduction to the electricity market: energy management in the 2030 time frame	ENERCLUB	Madrid	web
25.6.2019	Multilateral Assessment - Spain	UNFCCC secretariat (UN Climate Change)	Bonn (DEU)	info
27.6.2019	iener'19 II Congress of Energy Engineering	Association of Energy Engineers (AEE)	Madrid	web
28.6.2019	Seminar on actions against climate change in industry	UGT Castile and Leon.	Valladolid	web
4.7.2019	Analysis of the distributional impacts of the Spanish climate and energy policy using a Dynamic-econometric IO model	27th International Input-Output Association Conference	Glasgow (GBR)	info
12.7.2019	INECP Presentation (CIEMAT headquarters)	Energy Efficiency Observatory	Madrid	
17.7.2019	Summer course SU.5.1 The role of renewable energy in energy decarbonisation	University of Cantabria	Suances	info
17.7.2019	Webinar presentation: Distributional Impact assessment of the Spanish integrated Energy and Climate Plan	International Network for Just Transition (RENEWT)	Online	
5.9.2019	Spain's Energy Strategy for 2030	EDF	Madrid	
23.10.2019	INECP: compliance with renewable electricity targets	UNEF – VI Solar Forum	Madrid	web

Main events to disseminate the initial draft of the INECP				
Date	**Name of event**	**Organiser**	**Place**	**link**
24.10.2019	Seminar on Prospects for the Balearic Islands tourism sector. Climate Change	Association for the Advancement of Management (*Asociación para el Progreso de la Dirección*, APD)	Palma	web
4.11.2019	COMPTEM Project	ENERCOOP	Crevillent	info
14.11.2019	Citizen energy in the INECP	Spanish Confederation of Housing Cooperatives (CONCOVI)	Madrid	info
14.11.2019	The role of wind power in the Spanish energy transition	GE Renewable Energy	Madrid	
19.11.2019	CSP Conference 2019: CSP in Spain's Energy Strategy	New Energy Update (Reuters Events)	Madrid	web
19.11.2019	Introduction to the Electricity Market Course: Own consumption and aggregation	ENERCLUB	Madrid	info

Source: Ministry for Ecological Transition and Demographic Challenge, 2019

STRATEGIC ENVIRONMENTAL ASSESSMENT OF THE INECP

The INECP 2021-2030 is subject to the procedure provided for in Chapter I of Law 21/2013 of 9 December 2013 on environmental assessment. This law establishes the need to carry out a Strategic Environmental Assessment, understood as a prevention instrument that allows the integration of environmental aspects in the decision-making process for public plans and programmes. For this purpose, a Strategic Environmental Study has been prepared and, in accordance with one of the main objectives of this Law – **public participation** – consultations are held, the results of which will be taken into account.

In accordance with the aforementioned Law, the environmental body went through the procedure and submitted the initial draft of the INECP and the Initial Strategic Document to the public administrations concerned and interested persons for consultation. The list of entities consulted was available to the public on the MITECO website. Once the responses to the consultations were received, the environmental body prepared the Scope Document of the Strategic Environmental Study, a document that has also been made public on the MITECO website.

Thus, once the **Strategic Environmental Study** has been carried out, it is now submitted for public consultation, accompanied by the **updated version of** the INECP 2021-2030, as well as a non-technical summary of the aforementioned Study, after announcement in the Official State Gazette.

The public consultation will be for at least 45 working days.

ANNEX H. INTERACTIONS WITH OTHER PLANS AND PROGRAMMES

The INECP defines targets for reducing greenhouse gas emissions, renewable energy penetration and energy efficiency. The relevance of the National Plan and its intense environmental and social implications mean that there are numerous planning instruments with which it interacts.

The following is an analysis of the interrelationships between the INECP and the main planning instruments (strategies, plans and programmes) by sector and territory that have been taken into consideration in the strategic environmental study and which is closely linked to the environmental objectives of the National Plan. The planning instruments have been organised by the different environmental aspects:

- Climate change and air quality
- Geology and soils
- Water and inland water systems
- Biodiversity (flora, fauna, habitats), protected natural areas and Natura 2000
- Marine environment
- Cultural heritage and landscape
- Land use, social and economic development
- Energy and Industry
- Transport, mobility and housing
- Waste
- Population, public health and material goods

It should be noted that, although some of the planning instruments are somewhat old or nearing the end of their period of validity, they have been included in the analysis since they constitute the fundamental background and have been marking the objectives of environmental protection in the different sectors.

1. Climate change and air quality

Planning instrument	Objectives or requirements of the planning instrument with which the INECP can interact	Significant interactions of the INECP with the objectives of the planning instrument
National Plan for Adaptation to Climate Change (*Plan Nacional de Adaptación al Cambio Climático*, PNACC) 2006- 2020	The PNACC, adopted in 2006, aims to achieve the integration of climate change adaptation measures based on the best available knowledge into all sectoral and natural resource management policies that are vulnerable to climate change, in order to contribute to sustainable development throughout the 21st century. The Plan is conceived as a continuous and cumulative process of knowledge generation and the creation and strengthening of capacities to apply it. It establishes the reference framework for the coordination between public administrations in the activities of impact assessment, vulnerability and adaptation to climate change in Spain.	The INECP is a planning instrument that responds to the commitments made by Spain in the face of the climate change challenge. Its objectives and measures are in line with the PNACC. The INECP is synergetic with the PNACC, especially in its research, innovation and competitiveness dimension, as it will drive improved knowledge on energy and climate change. It specifically considers, (in the context of the future Spanish Science and Technology Strategy 2021-2027), the possibility of incorporating a Strategic Action on Energy and Climate Change (Measure 5.1) and allocating a volume of funding for RIC in energy and climate.
Spanish Strategy for Climate Change and Clean Energy (EECCYEL) 2007-2012-2020	The Spanish Strategy for climate change and clean energy (EECCYEL) seeks to meet Spain's commitments on climate change and promoting clean energies while improving social welfare, economic growth and environmental protection.	The INECP is a planning instrument that responds to the commitments made by Spain in the face of the climate change challenge. Its objectives and measures are in line with the EECCYEL. The INECP reinforces the promotion of clean energy, since the measures envisaged will allow 42% of the final energy use to be renewable by 2030 and 71% to be used in electricity generation. In addition, it will drive a significant increase in energy efficiency, thus reducing total energy demand. On the other hand, the INECP will contribute to social welfare, as it has health benefits (reduction in the number of premature deaths due to air pollution).
II National Programme for Emission Reduction (*Programa Nacional de Reducción de Emisiones*, PNRE)	The purpose of the PNRE is to promote the measures necessary to move towards compliance with the national emission ceilings established by Directive 2001/81/EC of the European Parliament and of the Council of 23 October 2001 on national emission ceilings for certain atmospheric pollutants: - Sulphur dioxide SO_2: 746 Kt - Nitrogen oxides NOx: 847 Kt - Non-methane volatile organic compounds NMVOCs 662 Kt - Ammonia NH_3: 353 Kt	The INECP is a planning instrument that responds to the commitments made by Spain in the face of the climate change challenge. Its objectives and measures are in line with the PNRE. One of the relevant results presented by the INECP is the penetration of renewable energies and the progressive decrease in electricity production from fossil fuels (decarbonisation dimension), which leads to a reduction in pollutants in the air. In addition, the INECP (energy efficiency dimension) contributes to emission reductions in the non-energy non-ETS sectors (agriculture, livestock farming, forest sinks, waste management, fluorinated gases) and in the non-ETS energy sectors (residential, commercial and institutional, transport and non-emission-dependent industry).

Planning instrument	Objectives or requirements of the planning instrument with which the INECP can interact	Significant interactions of the INECP with the objectives of the planning instrument
National Air Quality Plan 2017-2019 (Plan Aire II)	This Plan was approved on 15 December 2017. One of its objectives is to implement general measures to help reduce emission levels into the atmosphere of the most relevant pollutants with the greatest impact on health and ecosystems, especially in the areas most affected by pollution.	The INECP is in line with Plan AIRE II. Some of the measures in the INECP contribute to an improvement in air quality. Generally speaking, the decarbonisation dimension envisages a major development of renewable energies, together with a progressive decrease in electricity production from fossil fuels, and the energy efficiency dimension entails a reduction in consumption. All this results in a reduction of pollutant emissions into the atmosphere and an improvement in air quality. Some particular measures that stand out are: - Measure 1.22. Reduction of greenhouse gas emissions in waste management - Measure 1.23. Reduction of fluorinated greenhouse gas emissions - Measure 1.24. Forest sinks - Measure 1.25. Agricultural sinks In addition, energy efficiency measures (especially in transport and building) lead to a reduction in pollution and an improvement in air quality in urban and peri-urban areas, especially populated areas. According to the health impact analysis carried out in the INECP, the application of its measures will lead to a decrease of more than 2,000 premature deaths in 2030, with the corresponding significant economic co-benefits in terms of public health.

2. Geology and soils

Planning instrument	Objectives or requirements of the planning instrument with which the INECP can interact	Significant interactions of the INECP with the objectives of the planning instrument
National Plan of Priority Action for hydrological-forestry restoration, erosion control and defence against desertification (PNAP).	It is the general framework for the development of the restoration, conservation and improvement works of the protective plant cover. Among its objectives are the control of erosion, the improvement of the water regime and flow regulation and the maintenance and improvement of the protective function of forests on soil and water resources.	The INECP is in line with the PNAP since it considers among its measures the hydrological-forestry restoration in areas at high risk of erosion. It also contributes to the fight against climate change (by increasing carbon sinks), preventing further desertification in the long term. In this regard, Measure 1.24 Forest sinks stands out: it includes actions such as the creation of wooded areas, forestry work and controlled grazing for the prevention of forest fires, as well as hydrological-forestry restoration in areas with a high risk of erosion, among others.
National Action Programme Against Desertification (PAND)	The drafting and development of the National Action Programme against Desertification (PAND) constitutes the main obligation contracted by our country as a signatory of the United Nations Convention to Combat Desertification (UNCCD). It considers the development of preventive actions, upgrading, research, education and public awareness in the fight against desertification. It pursues the objective of contributing to the sustainable development of the affected areas of the national territory and, in particular, the prevention of land degradation and the recovery of desertified land.	The measures provided for in the INECP are in line with the PAND. Similarly, the PAND measures contribute to increasing CO_2 sinks and benefit the fight against climate change. In this sense, Measure 1.24 on forest sinks stands out: it includes actions such as the creation of wooded forest areas, forestry work and controlled grazing for the prevention of forest fires and hydrological-forestry restoration in areas at high risk of erosion, among others.

3. Water and inland water systems

Planning instrument	Objectives or requirements of the planning instrument with which the INECP can interact	Significant interactions of the INECP with the objectives of the planning instrument
National Hydrological Plan (*Plan Hidrológico Nacional*, PHN)	The current National Hydrological Plan was approved by Law 10/2001 of 5 July 2001 on the National Hydrological Plan, and was subsequently amended by Law 53/2002 of 30 December 2002, Law 62/2003 of 30 December 2003, Royal Decree-Law 2/2004 of 18 June 2004 and Law 11/2005 of 22 June 2005. It is the instrument that integrates the different corresponding demarcation plans in order to obtain a harmonious and coordinated use of water resources. The NHP contains the coordination measures and the solution to possible discrepancies between different districts, uses and developments for supplying populations or for irrigation and the forecast and conditions for water resource transfers. It also contains the delimitation and characterisation of the groundwater bodies shared between two or more districts, including the allocation of resources to each of them.	In the development of the INECP measures, no relevant interactions with the NHP are foreseen. In any case, the location of future hydroelectric developments must comply with the objectives of the NHP.
River basin management plans. Second WFD cycle (2015-2021)	The general objectives of the river basin management plans are to achieve good status and adequate protection of the public water supply and water, to meet water demands, to balance and harmonise regional and sectoral development, to increase the availability of the resource, to protect its quality, to economise its use and to rationalise its uses in harmony with the environment and other natural resources. The incorporation into Spanish law of Directive 2000/60/EC of 23 October 2000, which establishes a Community framework for action in the field of water policy (WFD), has meant that, in addition to the aforementioned objectives, the objective of planning is the good status of the bodies of water in the district (understood as the achievement of environmental objectives in these bodies) and the introduction of the principle of recovery.	River basin management plans may impose limitations on water use (although the INECP provides for a very limited increase in water use). In any case, the protection of the public water supply and the condition of the water bodies must be taken into consideration. Hydroelectric and hydraulic pumping installations can lead to alterations in water bodies (hydromorphology and quality), affecting the achievement of the objectives of the WFD and the hydrological plans. The INECP measures should be aligned with the objectives of these plans. Among the INECP measures that must be taken into account in the development of the River Basin Management Plans are the following: - Measure 1.1. Development of new facilities for generating electricity using renewables - Measure 1.3. Adaptation of electricity grids to integrate renewables - Measure 1.9. Plan for the technological upgrading of existing electricity generation projects with renewable energies On the other hand, climate change has direct effects on water resources, so the measures developed under the INECP to mitigate the impact of climate change will be in line with the objectives of the hydrological plans.

Planning instrument	Objectives or requirements of the planning instrument with which the INECP can interact	Significant interactions of the INECP with the objectives of the planning instrument
Risk management plans for flood	The general objective of the management plans is to ensure that the current flood risk is not increased and, where possible, it is reduced through coordinated action by general government and society. To this end, different programmes of measures are carried out, which should take into account all aspects of risk management, focusing on prevention, protection and preparedness, including flood forecasting and early warning systems, and taking into account the characteristics of the river basin or sub-basin concerned, and the possible effects of climate change.	River restoration measures and measures for hydrological-agroforestry restoration of the basins should be included in the flood risk management plans. The INECP represents an opportunity for the development of these measures since Measure 1.24 Forest sinks includes hydrological-forestry restoration actions and plantations in floodable areas. On the other hand, the measures proposed in the INECP will help to mitigate the effects of climate change in the long term and are therefore measures that support flood risk management plans.
Plan to Promote the Environment for adaptation to climate change in Spain (PIMA-Adapta-AGUA) (2015-2020)	This plan aims to improve knowledge and monitoring of the impacts of global change and climate change on water resources, minimising their risks and increasing the system's resilience to climate change. PIMA Adapta-AGUA's projects and actions are developed along four strategic lines: - Measures for the management and adaptation of river nature reserves (RNF) - Adaptation to extreme events. - Assessment of the impact of climate change on water resources and development of adaptation strategies. - Development of climate change adaptation projects in the public water domain.	In the territorial development of the INECP, no interference is foreseen with the River Nature Reserves, in which the PIMA-Adapta-AGUA Plan contemplates management and adaptation actions. On the other hand, the measures proposed in the INECP will help to mitigate the effects of climate change in the long term and are therefore measures that support flood risk management plans.
National strategy forRiver Restoration 2006	The general objective of the Strategy is to promote the current management of rivers to achieve good ecological status in accordance with the provisions of the Water Framework Directive, integrating the management of river ecosystems into policies for the use and management of the territory, among others.	The development of the INECP measures could affect river systems, so the approach of the National River Conservation Strategy should be taken into consideration. Hydroelectric and hydraulic pumping installations can cause alterations to rivers, affecting the achievement of the WFD objectives. Among the INECP measures that must be taken into account in the development of the abovementioned Strategy are the following: - Measure 1.1. Development of new facilities for generating electricity using renewables - Measure 1.3. Adaptation of electricity grids for the integration of renewables - Measure 1.9. Plan for the technological upgrading of existing electricity generation projects with renewable energies

Planning instrument	Objectives or requirements of the planning instrument with which the INECP can interact	Significant interactions of the INECP with the objectives of the planning instrument
Spanish Strategic Plan for conservation and rational use of wetlands	Developed in compliance with the ‘Ramsar Strategic Plan 1997-2002’, the Plan is the framework instrument that integrates all sectoral policies, as well as seeking to coordinate and control actions in a manner compatible with the conservation of these ecosystems. Its objectives are conservation and rational use, restoration and the necessary integration of the conservation of these ecosystems into the sectoral policies that affect them.	Wetlands are relevant ecosystems for climate change mitigation as a source of CO_2 absorption. The INECP does not provide for the development of actions in wetlands or that may affect them. In any case, the conservation of such habitats, as well as of the aquatic avifauna associated with them, should be taken into account. The INECP will promote additional measures for the conservation and promotion of native biodiversity and aquatic ecosystems, linked to the Spanish Strategic Plan for the Conservation and Wise Use of Wetlands.

4. Biodiversity (flora, fauna, habitats), protected natural areas and Natura 2000 Network

Planning instrument	Objectives or requirements of the planning instrument with which the INECP can interact	Significant interactions of the INECP with the objectives of the planning instrument
Strategic Plan for Natural Heritage and Biodiversity 2011- 2017 (Extended until another strategic plan is approved to replace it)	The Strategic Plan for Natural Heritage and Biodiversity 2011-2017 is the fundamental element for the implementation of Law 42/2007 on Natural Heritage and Biodiversity. Its overall objective is to halt the loss of biodiversity and the degradation of ecosystem services and to address ecosystem restoration. The Plan formulates a concrete vision for the present and future of the conservation of natural heritage and biodiversity in Spain, by defining goals, objectives and actions that promote their conservation, sustainable use and restoration, and establishes a coherent planning model. The conservation of biodiversity; the sustainable use of components of biodiversity; the fair and equitable sharing of benefits arising from the use of genetic resources.	The development of renewable energies provided for in this INECP must be compatible with the criteria and objectives set in relation to natural heritage and biodiversity. Some of the measures provided for in the INECP may have an impact on biodiversity and natural heritage. Undesired effects derived mainly from the development of new electricity generation facilities with renewables, electricity distribution infrastructure and storage systems should be minimised. The INECP will promote additional measures for the conservation and promotion of native biodiversity and ecosystems, linked to the Strategic Plan for Natural Heritage and Biodiversity. On the other hand, the INECP includes measures that are expected to have a very positive effect on biodiversity, soil and the protection of the water cycle. These include: - Measure 1.24. Forest sinks - Measure 1.25. Agricultural sinks
389 **Conservation strategies and endangered species management**	There are currently strategies for 14 species: Imperial Eagle, Brown Teal, Iberian Desman, Ferruginous Macaw, Iberian Lynx, Wolf, Auriculate Navad, Cantabrian Brown Bear, Pyrenean Brown Bear, Balearic Shearwater, Bearded Vulture, Cantabrian Capercaillie, Pyrenean Capercaillie and European Mink. The content includes: the identification of the species or threat being addressed; the geographical scope of application; the description of the existing limiting or threatening factors; the evaluation of the actions carried out; a diagnosis of the conservation status (in the case of species); the aims to be achieved, with quantifiable objectives; the criteria for delimiting critical areas; the criteria for making species requirements compatible with land use and exploitation; the recommended actions for eliminating or mitigating threats; and the frequency of updating.	The development of the INECP measures should not interfere with the territories of species subject to a conservation strategy. In any case, the measures established for the strategies should be considered, taking into account the conservation of both the species and its habitat. The INECP will promote additional measures for the conservation and promotion of native biodiversity and ecosystems, linked to threatened species, especially those with specific conservation strategies.
for Plant**2014-2020**	The strategy responds to Spain's commitment to the Global Strategy for Plant Conservation of the United Nations Convention on Biological Diversity. It is the framework strategy for the coordination of policies and actions in the field of plant conservation. It seeks to promote, through goals, objectives and principles of action, the coordination of policies and actions in the field of plant conservation, as well as to channel the participation of stakeholders.	In the development of the measures provided for in the INECP, pressures and alterations on the plant communities and species of interest must be avoided, in accordance with the Spanish Strategy for Plant Conservation. Some of the measures provided for in the INECP may have an impact on biodiversity and natural heritage. Undesirable effects arising mainly from the development of new electricity generation facilities with renewables, which require considerable land occupation, should be minimised. The INECP will promote additional measures for the conservation and promotion of native biodiversity and ecosystems, especially linked to vegetation.

Planning instrument	Objectives or requirements of the planning instrument with which the INECP can interact	Significant interactions of the INECP with the objectives of the planning instrument
State Strategy for Green Infrastructure and Ecological Connectivity and Restoration (EEIVCRE) (In progress)	Green Infrastructure is a ‘strategically planned network of natural and semi-natural areas and other environmental features, designed and managed to deliver a wide range of ecosystem services. It includes green spaces (or blue spaces in the case of aquatic ecosystems) and other physical elements in terrestrial (natural, rural and urban) and marine areas’. Law 42/2007 establishes that MITECO, with the collaboration of the autonomous communities and other ministries involved, must draw up, within a maximum period of three years, the EEIVCRE which ‘must aim to set the guidelines for the identification and conservation of the elements of the territory that make up the green infrastructure, so that the territorial and sectoral planning carried out by the general government allows and ensures ecological connectivity and the functionality of the ecosystems, the mitigation of and adaptation to the effects of climate change, the defragmentation of strategic areas for connectivity, and the restoration of degraded ecosystems’. MITECO commissioned the *Consejo Superior de Investigaciones Científicas* (Spanish National Research Council) to draw up a scientific and technical basis for the future State Strategy for Green Infrastructure. It is currently being prepared.	The document ‘Scientific and technical basis for the State Strategy for Green Infrastructure and Ecological Connectivity and Restoration’ (which is a scientific and technical document) includes a conceptual framework, a legislative framework and a diagnosis, related to connectivity, which may be of interest when planning the location of actions (mainly those arising from new electricity generation facilities).
Spanish Forestry Plan 2002-2032	In development of Law 42/2007 on Natural Heritage and Biodiversity. It is the overall framework for forest policy, compatible with socio-economic, cultural, political and environmental conditions. It has several objectives, including promoting the protection of the territory in general, and forests in particular, from the action of erosive processes and soil degradation through the restoration of the protective plant cover and complementary actions, and extending the wooded area for protection purposes. At the same time, to increase carbon sequestration in forest biomass to help mitigate climate change.	Various measures of the INECP are in line with and reinforce the Spanish Forestry Plan, in terms of the creation of forested areas, prevention of forest fires, management of conifers or hydrological-forestry restoration in areas with a high risk of erosion, measures which, in turn, contribute to the mitigation of climate change. Furthermore, they enable the rural environment to be revitalised and mitigate the risk of depopulation, also contributing to a just transition. Some measures in this regard are: - Measure 1.5. Incorporation of renewables in the industrial sector - Measure 1.11. Specific programmes for the use of biomass - Measure 1.22. Reduction of greenhouse gas emissions in waste management - Measure 1.24 .Forest sinks
Spanish Forestry Strategy 2015	It is the framework for the management and exploitation of the forests. Among its objectives are to integrate the territory and the forest economy into the environment and the rural economy; to balance the management of the uses of the forest, guaranteeing its sustainability; and to intensify the protection and defence of the forests against the various agents that could cause damage to them.	The INECP’s forest restoration measures are in line with the Spanish Forestry Strategy. However, INECP measures that may affect forestry will be carried out in accordance with the relevant forest resource management plans, and under the assumptions of conservation and protection of the forests.

Planning instrument	Objectives or requirements of the planning instrument with which the INECP can interact	Significant interactions of the INECP with the objectives of the planning instrument
National forestry accounting plan for Spain, including the reference forest level 2021-2025	This Plan accounts for the removals from the national forest estate and proposes a forest reference level (FRL) for the periods 2021-2025 and 2026-2030.	The INECP contributes to the adaptation and building of forest resilience to climate change of forest sinks, which helps to achieve the objectives of the Forest Accounting Plan for Spain, and therefore reinforces its objectives.
Spanish Strategy for the Conservation and Sustainable Use of Genetic Forestry Resources 2006	It is the framework for the support, development and coordination of activities and programmes for forest conservation and genetic improvement, facilitating cooperation and integration of initiatives carried out from different administrations and agencies. The final objective of the Strategy is the conservation and sustainable use of forest genetic resources in Spain, by preserving their capacity for evolution and guaranteeing their use for future generations.	The gas emission reduction measures contemplated in the INECP contribute favourably to the good environmental condition of the forest areas, thus reinforcing their objectives. In addition, the INECP contributes to curbing climate change and its effects (flooding, desertification, deforestation, etc.).
Phenological Monitoring Programme of the Spanish Network of Biosphere Reserves	The Phenological Monitoring Programme of the Spanish Network of Biosphere Reserves is an educational citizen science project focused on students, educators, naturalists, scientists and interested people. It aims to transmit the values of the biosphere reserves and to encourage the study and observation of nature as a basis for knowledge and scientific method. The participation mechanism consists of continuously monitoring common species of fauna and flora in the biosphere reserves, in order to analyse long-term changes (advances or delays) in the dates on which the biological events that characterise the species studied take place: migrations, blooms, reproduction, etc.	The Phenological Monitoring Programme (promoted by the Spanish Network of Biosphere Reserves and the Autonomous Body for National Parks) is a citizen science project that contributes to raising awareness and sensitivity to climate change through the observation of phenological changes in biosphere reserves. The INECP, especially in its Measure 1.19 Generating knowledge, outreach, awareness and training, presents synergies with the Phenological Monitoring Programme, in terms of its dissemination and citizen participation aspects.
Master Plan for National Parks	The Plan establishes the basic guidelines for planning, conservation and coordination of national parks. It includes their strategic objectives in terms of conservation, public use, research, monitoring, training and awareness, as well as objectives for cooperation and collaboration at both national and international levels.	The INECP does not present measures or actions in the National Parks; therefore no interaction with its Master Plan is foreseen.

5. Marine environment

Planning instrument	Objectives or requirements of the planning instrument with which the INECP can interact	Significant interactions of the INECP with the objectives of the planning instrument
Marine Strategy for the North Atlantic Demarcation	It is the main planning instrument created under Directive 2008/56/EC of 17 June 2008 establishing a framework for Community action in the field of marine environmental policy (Marine Strategy Framework Directive) and transposed into Spanish law by Law 41/2010 of 29 December 2010 on the Protection of the Marine Environment, aimed at achieving good environmental status of the marine environment in the **North Atlantic marine demarcation**. The Strategy constitutes the general framework to which the various sectoral policies and administrative actions with an impact on the marine environment must conform, in accordance with the provisions of the relevant sectoral legislation. It includes the assessment of the environmental status of water, the determination of good environmental status, the establishment of environmental objectives, a monitoring programme and a programme of measures to achieve these objectives. It comprises the marine environment between Spain and France in the Bay of Biscay and the northern limit of the waters under the jurisdiction of Spain and Portugal.	The measures provided for in the INECP that are implemented in the marine environment of the North Atlantic Demarcation will be subject to the compatibility report with the Marine Strategies to avoid possible negative environmental impacts. The following measures require special attention: - Measure 1.1. Development of new facilities for generating electricity using renewables, in terms of demonstration projects for technologies under development (offshore wind and marine energy) and future offshore wind farms - Measure 1.3. Adaptation of electricity grids to integrate renewables - Measure 1.12. Unique projects and strategy for sustainable energy on the islands - Measure 4.1. Increased interconnection with France
Marine Strategy for the South Atlantic Demarcation	It is the main planning instrument created under Directive 2008/56/EC of 17 June 2008 establishing a framework for Community action in the field of marine environmental policy (Marine Strategy Framework Directive) and transposed into Spanish law by Law 41/2010 of 29 December 2010 on the Protection of the Marine Environment, aimed at achieving good environmental status of the marine environment in the **South Atlantic marine demarcation**. The Strategy constitutes the general framework to which the various sectoral policies and administrative actions with an impact on the marine environment must conform, in accordance with the provisions of the relevant sectoral legislation. It includes the assessment of the environmental status of water, the determination of good environmental status, the establishment of environmental objectives, a monitoring programme and a programme of measures to achieve these objectives. It comprises the marine environment between the limit of the waters under the jurisdiction of Spain and Portugal in the Gulf of Cadiz and the meridian passing through Cape Spartel.	The measures provided for in the INECP that are implemented in the marine environment of the South Atlantic Demarcation will be subject to the compatibility report with the Marine Strategies to avoid possible negative environmental impacts. The following measures require special attention: - Measure 1.1. Development of new facilities for generating electricity using renewables, in terms of demonstration projects for technologies under development (offshore wind and marine energy) and future offshore wind farms - Measure 1.3. Adaptation of electricity grids to integrate renewables - Measure 1.12. Unique projects and strategy for sustainable energy on the islands

Planning instrument	Objectives or requirements of the planning instrument with which the INECP can interact	Significant interactions of the INECP with the objectives of the planning instrument
Marine strategy for the demarcation of the Strait and Alborán	It is the main planning instrument created under Directive 2008/56/EC of 17 June 2008 establishing a framework for Community action in the field of marine environmental policy (Marine Strategy Framework Directive) and transposed into the Spanish law by Law 41/2010 of 29 December 2010 on the Protection of the Marine Environment, aimed at achieving good environmental status of the marine environment in the **demarcation of the Strait and Alborán marine area**. The Strategy constitutes the general framework to which the various sectoral policies and administrative actions with an impact on the marine environment must conform, in accordance with the provisions of the relevant sectoral legislation. It includes the assessment of the environmental status of water, the determination of good environmental status, the setting of environmental objectives to be achieved, a monitoring programme and a programme of measures to achieve these objectives. It comprises the marine environment between the meridian passing through Cape Spartel and an imaginary line oriented at 128° to the meridian passing through Cape Gata, as well as the marine environment over which Spain exercises sovereignty or jurisdiction in the area of Ceuta, Melilla, the Chafarinas Islands, Perejil Islet, Peñones de Vélez de la Gomera and the Alhucemas and Alborán Islands.	The measures provided for in the INECP that are implemented in the Marine Demarcation of the Strait and Alborán will be subject to the compatibility report with the Marine Strategies to avoid possible negative environmental impacts. The following measures require special attention: - Measure 1.1. Development of new facilities for generating electricity using renewables, in terms of demonstration projects for technologies under development (offshore wind and marine energy) and future offshore wind farms - Measure 1.3. Adaptation of electricity grids to integrate renewables - Measure 1.12. Unique projects and strategy for sustainable energy on the islands
Marine strategy for the Levantine/Balearic demarcation	It is the main planning instrument created under Directive 2008/56/EC of 17 June 2008 establishing a framework for Community action in the field of marine environmental policy (Marine Strategy Framework Directive) and transposed into the Spanish law by Law 41/2010 of 29 December 2010 on the Protection of the Marine Environment, aimed at achieving good environmental status of the marine environment in the **Levantine-Balearic marine district**. The Strategy constitutes the general framework to which the various sectoral policies and administrative actions with an impact on the marine environment must conform, in accordance with the provisions of the relevant sectoral legislation. It includes the assessment of the environmental status of water, the determination of good environmental status, the setting of environmental objectives to be achieved, a monitoring programme and a programme of measures to achieve these objectives. It comprises the marine environment between an imaginary line oriented at 128° to the meridian passing through Cape Gata and the limit of the waters under the jurisdiction of Spain and France in the Gulf of Lion.	The measures provided for in the INECP to be implemented in the marine environment of the Levantine/Balearic demarcation will be subject to the compatibility report with the marine strategies to avoid possible negative environmental impacts. The following measures require special attention: - Measure 1.1. Development of new facilities for generating electricity using renewables, in terms of demonstration projects for technologies under development (offshore wind and marine energy) and future offshore wind farms - Measure 1.3. Adaptation of electricity grids to integrate renewables - Measure 1.12. Unique projects and strategy for sustainable energy on the islands

Planning instrument	Objectives or requirements of the planning instrument with which the INECP can interact	Significant interactions of the INECP with the objectives of the planning instrument
Marine strategy for the Canary Islands demarcation	It is the main planning instrument created under Directive 2008/56/EC of 17 June 2008 establishing a framework for Community action in the field of marine environmental policy (Marine Strategy Framework Directive) and transposed into the Spanish law by Law 41/2010 of 29 December 2010 on the Protection of the Marine Environment, aimed at achieving good environmental status of the marine environment in the **Canary Islands marine demarcation**. The Strategy constitutes the general framework to which the various sectoral policies and administrative actions with an impact on the marine environment must conform, in accordance with the provisions of the relevant sectoral legislation. It includes the assessment of the environmental status of water, the determination of good environmental status, the setting of environmental objectives to be achieved, a monitoring programme and a programme of measures to achieve these objectives. It includes the marine environment around the Canary Islands in which Spain exercises sovereignty or jurisdiction.	The measures provided for in the INECP to be implemented in the marine environment of the Canary Islands demarcation will be subject to the compatibility report with the marine strategies to avoid possible negative environmental impacts. The following measures require special attention: - Measure 1.1. Development of new facilities for generating electricity using renewables, in terms of demonstration projects for technologies under development (offshore wind and marine energy) and future offshore wind farms - Measure 1.3. Adaptation of electricity grids to integrate renewables - Measure 1.12. Unique projects and strategy for sustainable energy on the islands
Strategic Plan for Spanish Aquaculture 2014-2020	In implementation of the Strategy for Sustainable Development of Spanish Aquaculture. It is the framework for action of Spanish aquaculture and its objective is to propose lines of action that will allow the growth and sustainable development of Spanish aquaculture, from its social, environmental and economic perspective.	The Spanish Strategic Plan for Aquaculture determines the suitability of the different areas of the coastal marine environment for the development of aquaculture activity and restricts the activities that may interfere with fish farming. Therefore, the development of the INECP measures must be in line with the zoning provided for in that plan.
State Plan for the Protection of the Seashore against Pollution (Plan Ribera)	The Plan will apply to cases of accidental or deliberate marine pollution, whatever its origin or nature, which affects or may affect the coast. It includes a sensitivity atlas of the Spanish coast and an analysis of its vulnerability and risk, as well as the logistical and management capacities required to deal with a pollution episode of significant size and intensity. The fight against marine pollution on the coast focuses on three aspects: prevention, the organisation of the response, and the coordination of means and personnel between administrations.	There are no plans to introduce marine pollutants into the development of the INECP. The vast majority of marine pollution events affecting the coast have their origin at sea, from ships or oil platforms, which are not covered by the INECP.
Strategy for Adaptation to Climate Change on the Spanish Coast 2016	It has two general objectives: To increase the resilience of the Spanish coast to climate change and climate variability and to integrate adaptation to climate change into the planning and management of the Spanish coast In general, the Strategy seeks to improve the environment of the coast and coastline in the face of the effects of climate change, and sets out a number of sustainability principles. The strategy proposes a system of indicators and indices that provide objective information for the establishment of policies and strategies of action to correct and prevent the effects of climate change on the Spanish coast.	The gas emission reduction measures considered in the INECP contribute to curbing the effects of climate change (rising sea levels, acidification, extreme weather events, etc.). Furthermore, the INECP is perfectly compatible with the principles of sustainability set out in the Strategy, especially with regard to reducing air pollution and greenhouse gas emissions. The measures envisaged in the INECP will make it possible to achieve a 23% reduction in greenhouse gas (GHG) emissions by 2030 compared to 1990.

Planning instrument	Objectives or requirements of the planning instrument with which the INECP can interact	Significant interactions of the INECP with the objectives of the planning instrument
Strategic Environmental Study of the Spanish Coast for the installation of Offshore Wind Farms 2009	The objective of the Strategic Environmental Study is to determine the areas of the public maritime land domain that, for environmental purposes, meet favourable conditions for the installation of marine wind farms (with a power of over 50 MW, subject to the procedure for reserving an area under Royal Decree 1028/2007, which must be updated). To this end, through a geographical representation, it establishes the following zoning: a) Suitable areas: the most suitable areas for the establishment of offshore wind farms because, in principle, their environmental effects are small compared to the advantages they present. b) Exclusion zones: the areas that should be excluded from the process because their potential significant environmental effects, or conflict with other uses of the marine environment, have been identified. c) Suitable areas with environmental conditions: the areas in which the effects or conflicts detected must be analysed in detail during the environmental assessment procedure for each specific project. On the other hand, the Study provides environmental criteria for the design of offshore wind farm projects to be developed in the future.	The INECP provides in Measure 1.1. Development of new facilities for generating electricity using renewable energy, demonstration projects for technologies under development (specifically offshore wind and marine energy) and the deployment of offshore wind farms. In Measure 1.3, Adaptation of electricity grids to integrate renewables, the INECP also provides for the necessary planning of electricity infrastructure in the marine environment associated with the deployment of offshore wind and, to a lesser extent, ocean energy. The Strategic Environmental Study of the Spanish Coast for the installation of Offshore Wind Farms is a reference to be considered for the location of offshore wind farms. In any case, this study and zoning are outdated because of environmental and technical feasibility aspects, and in 2009 offshore wind energy on floating platforms was not considered.

6. Landscape and cultural heritage

Planning instrument	Objectives or requirements of the planning instrument with which the INECP can interact	Significant interactions of the INECP with the objectives of the planning instrument
European Landscape Convention	This Convention aims to protect, manage and plan European landscapes, recognising them as a common resource. Its objectives include promoting the protection, management and planning of these landscapes, and organising European cooperation in this field.	The INECP presents measures that may be in line with the objectives of the European Landscape Convention. Among them is Measure 1.24. Forest sinks, which include improvements to forest systems, pastures and banks. However, there are other measures that can fundamentally change the landscape: - Measure 1.1. Development of new facilities for generating electricity using renewables - Measure 1.6. Framework for the development of renewable thermal energies - Measure 1.11. Specific programmes for the use of biomass - Measure 1.12. Unique projects and strategy for sustainable energy on the islands The actions and measures provided for in the INECP should pay attention to the Convention's provisions on landscape protection, management and planning. Impacts on the landscape should be minimised and environmental integration measures developed.

7. Land use, social and economic development

Planning instrument	Objectives or requirements of the planning instrument with which the INECP can interact	Significant interactions of the INECP with the objectives of the planning instrument
Common Agricultural Policy (CAP) 2015-2020	Europe's agricultural policy aims to support farmers' incomes, while seeking to obtain the high-quality agricultural products that the market demands. On the other hand, it aims to develop this activity while respecting the environment, as in the introduction of renewable energies, more efficient practices or improvements in land-use management. Following the reform of the CAP, a new direction was agreed with the aim of adapting it to the new challenges in terms of: - competitiveness of European agriculture; - equity and diversity of farming systems; - climate change and protection of natural resources; - relations between participants along the food chain. In relation to climate change, the aim is to promote better use of natural resources to combat climate change and preserve biodiversity.	Agriculture is an electricity-intensive sector and the cost of energy is a major element in the pricing of irrigated agricultural products. The INECP promotes own consumption of energy as a measure of competitiveness, since it allows for the reduction and stabilisation of energy costs in the long term. It also aims to reduce energy consumption on farms and irrigation communities through the modernisation of existing facilities, as well as to increase the sink effect of agricultural systems. Some measures in this regard: - Measure 1.4. Development of own consumption using renewables and distributed generation - Measure 1.21. Reduction of greenhouse gas emissions in the agricultural and livestock sectors - Measure 1.25 Agricultural sinks - Measure 2.10. Energy efficiency in farms, irrigation communities and agricultural machinery
Spain's Strategic Plan for the CAP post 2020	The commitments made at international level through the Paris Agreement and Agenda 2030 for Sustainable Development are reflected in the CAP. European agriculture is involved in the agenda for solutions to global challenges, particularly those linked to climate and the environment, but also those related to animal health, nutrition and welfare, quality and sustainability of our food system. Its objectives include the promotion of an intelligent, resilient and diversified agricultural sector that guarantees food security; the intensification of environmental care and climate action, contributing to achieving the EU's climate and environmental objectives; and the strengthening of the socio-economic fabric of rural areas.	Agriculture, through the CAP, can play a very positive role in addressing the climate and environmental challenge, while ensuring food security. Through cross-compliance (a set of legal standards and agricultural practices that farmers must comply with as a requirement to receive direct payments), practices such as efficient soil fertilisation are encouraged, an aspect specifically included in the INECP. Some measures, which contribute to the reduction of GHG emissions and to the environmental integration of agriculture are - Measure 1.4. Development of own consumption using renewables and distributed generation - Measure 1.21. Reduction of greenhouse gas emissions in the agricultural and livestock sectors - Measure 1.25. Agricultural sinks - Measure 2.10. Energy efficiency in farms, irrigation communities and agricultural machinery
National Rural Development Programme 2014- 2020	Its essential objectives are: to promote the integration of agri-food associations, to encourage the creation of producer groups and organisations and to promote the industrial revitalisation of the agri-food sector through cooperation. The promotion and encouragement of the integration of agri-food associations are very important tools to promote their competitiveness, resizing, modernisation and internationalisation.	Various measures of the INECP are in line with and reinforce the National Rural Development Plan. In this respect, measures relating to own consumption (1.4) and the development of local energy communities in rural areas (1.13) that promote access to energy and security of supply are particularly important.

Planning instrument	Objectives or requirements of the planning instrument with which the INECP can interact	Significant interactions of the INECP with the objectives of the planning instrument
Spain's Multi-regional Operational Programme 2014- 2020	It is an instrument that specifies the strategies and overall objectives of intervention by the General State Administration and the autonomous communities, co-financed with the European Regional Development Fund (ERDF) in the areas of smart and sustainable growth in the urban environment. The programme contributes to the improvement and recovery of the competitiveness of the Spanish economy, through the promotion of a more intelligent growth model, supported by research, innovation and ICTs, with special attention to the needs and potential of SMEs. It also promotes a more resource-efficient, greener and more competitive economy (reduction of GHG emissions; improvement of energy efficiency, and increase in the share of renewable energy sources).	The INECP is in line with the objectives of the Multi-Regional Operational Programme towards a more resource efficient, greener and more competitive economy (reduction of GHG emissions, improvement of energy efficiency, increase in the share of renewable energy sources), especially the measures related to the decarbonisation dimensions of energy and energy efficiency.
Spanish Sustainable Development Strategy (SSDS) 2007	The Spanish Sustainable Development Strategy aims at a society that is more coherent in the rational use of its resources, more socially equitable and cohesive, and more territorially balanced. It is focused on seven priority areas: climate change and clean energy; sustainable transport; sustainable production and consumption; public health challenges; natural resource management; social inclusion, demography and migration; and the fight against global poverty.	The INECP identifies challenges and opportunities along its five dimensions: the decarbonisation of the economy, including renewable energies; energy efficiency; energy security; the internal energy market; and research, innovation and competitiveness. It largely reinforces the priority areas of the SSDS, such as climate change, clean energy, transport and public health. It also attaches particular importance to equity and the fight against energy poverty The measures envisaged in the Plan will make it possible to achieve a 21% reduction in greenhouse gas (GHG) emissions by 2030 compared with 1990. The INECP promotes energy efficiency by reducing total energy demand and replacing fossil fuels with other indigenous ones (mainly renewable energies). Finally, the measures of the INECP contribute positively to an improvement in air quality, through the reduction of atmospheric pollutants, with clear benefits for human health.
Sustainable Rural Development Programme (SRDP) 2010-2014	This Programme analyses and diagnoses the situation of rural environment in Spain, defines a rural development strategy, specifies the rural areas that have been defined and proposed for its implementation by the autonomous communities, specifies the types of multisectoral actions that can be implemented, defines the content that the Area Plans must have, determines the framework of cooperation between the public administrations that converge on the rural environment, defines the budget and financing system, and establishes an evaluation and monitoring system.	In the development of the measures carried out under the INECP, the determinations and recommendations contained in the joint Environmental Report of the SRDP will be taken into account. Some of the measures in the INECP make a positive contribution to rural development: - Measure 1.4. Development of own consumption using renewables and distributed generation - Measure 1.21. Reduction of greenhouse gas emissions in the agricultural and livestock sectors - Measure 1.25. Agricultural sinks - Measure 2.10. Energy efficiency in farms, irrigation communities and agricultural machinery

Planning instrument	Objectives or requirements of the planning instrument with which the INECP can interact	Significant interactions of the INECP with the objectives of the planning instrument
Sectoral plan for nature-based tourism and biodiversity 2014–2020	The Plan deepens and consolidates the concept of sectoral integration as a way to advance its conservation and sustainable use. Through one of its goals, it seeks to integrate biodiversity into sectoral policies. Its objectives are: - to develop sustainable nature tourism products; - to promote sustainable products that incorporate the Natura 2000 Network; - to improve consideration of biodiversity in nature-based tourism activities; - to improve knowledge and information on nature-based tourism.	Spain is committed to protecting the natural heritage in a responsible manner, particularly through the protection of its biological diversity, which is one of the highest and most valuable in the European Community. The results of the INECP in terms of GHG emissions have a positive effect on nature and biodiversity, especially on the ecosystems most vulnerable to climate change, such as mountain areas, coastlines or aquatic systems. In relation to tourism, measures to promote own consumption and to encourage renewables (electrical and thermal use) in accommodation and facilities, as well as efficiency measures (in building and transport), reinforce a more sustainable model of nature tourism. On the other hand, the development of the measure of new electricity generation facilities with renewables, which implies an important occupation of territory in the rural area, should minimise its impact on the landscape, biodiversity and natural values of the rural environment. The INECP will promote additional measures for the conservation and promotion of native biodiversity and aquatic ecosystems, linked to the Spanish Strategic Plan for the Conservation and Wise Use of Wetlands. The INECP will promote additional measures for the conservation and promotion of native biodiversity and ecosystems, linked to the Strategic Plan for Natural Heritage and Biodiversity.

Planning instrument	Objectives or requirements of the planning instrument with which the INECP can interact	Significant interactions of the INECP with the objectives of the planning instrument
Action plan for the implementation of the 2030 Agenda . Towards a Spanish Strategy for Sustainable Development	The 2030 Agenda for Sustainable Development was unanimously adopted by the 193 Member States of the United Nations in 2015. The Agenda includes 17 sustainable development objectives (SDAs), 169 targets, 232 indicators, focusing on people, planet, prosperity, peace and partnerships, the means for their implementation and the monitoring and review mechanism at national, regional and global levels. Each Member State must promote the implementation of the Agenda through the specific instruments it considers: national strategies, plans or policies. In line with the Sustainable Development Goals of the UN 2030 Agenda, the action plan is an action-oriented programmatic document, prior to the formulation of a long-term sustainable development strategy. It shares the 17 Sustainable Development Goals set out by the UN, global objectives to eradicate poverty, protect the planet and ensure prosperity for all.	The Plan highlights climate change as an additional challenge in meeting other Sustainable Development Goals (SDGs) such as those related to water, underwater life or terrestrial ecosystems (6, 14, 15), as well as the cross-cutting nature of measures to combat it, which allows synergies with all the goals. In this regard, the INECP has analysed the extent to which the various measures it envisages contribute to the different SDGs (see ANNEX E). The measures of the five dimensions of the INECP are in line with and share some of the objectives of the Action Plan for the implementation of 2030 Agenda, as it moves towards the Sustainable Development Goals (SDGs). The INECP presents very positive synergies with the objectives of the plan. It configures as central objectives of the Plan: - SDG 13. Taking urgent action to combat climate change and its effects - SDG 7. Ensuring access to affordable, safe, sustainable and modern energy for all In addition, the following interactions with other objectives stand out: - SDG 17. Strengthening the means of implementation and revitalising the Global Partnership for Sustainable Development - SDG 9. Building resilient infrastructure, promoting inclusive and sustainable industrialisation and fostering innovation - SDG 11. Making cities and human settlements inclusive, safe, resilient and sustainable - SDG 12. Ensuring sustainable consumption and production patterns - SDG 8. Promoting sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all - SDG 10. Reducing inequality within and between countries
Spanish Strategy for the Circular Economy **(In progress)**	In order to promote the transition to a circular economy model in our country, the Spanish Government is developing the Spanish Circular Economy Strategy, in collaboration with the autonomous communities and the Spanish Federation of Municipalities and Provinces.	The signatories of the Pact for a Circular Economy, signed with the aim of involving the main economic and social agents in Spain in the transition to this economic model, are committed to a series of actions, which are aligned with the INECP. Notably, these include: - Progress in reducing the use of non-renewable natural resources - Promoting guidelines that increase innovation and overall efficiency of production processes These two actions are perfectly aligned with the dimensions of decarbonisation of the economy and energy efficiency addressed in the INECP.

Planning instrument	Objectives or requirements of the planning instrument with which the INECP can interact	Significant interactions of the INECP with the objectives of the planning instrument
Ecological Production Strategy 2018-2020	An instrument to promote the production of quality agri-food products that respect the environment. It has the following objectives: - to promote internal consumption and improve the marketing of organic products; - to contribute to a better sectoral structure of organic production; - to support the growth and consolidation of organic production, with special attention to organic livestock and the industrial sector; - to study the role of organic production in environmental policy and adaptation to climate change.	This strategy has positive synergies with the INECP in that it addresses organic production with the aim of environmental improvement and adaptation to climate change.
Spanish Strategy for Science, Technology and Innovation 2013-2020	It is the framework instrument that establishes the general objectives to be reached during the 2013-2020 period relating to the promotion and development of RDI activities in Spain. The general objectives are: the recognition and promotion of talent and its employability; the promotion of scientific and technical research of excellence; the strengthening of business leadership in RDI; and research oriented towards the challenges of society.	The aspects of the INECP related to knowledge generation, dissemination, awareness-raising and training and the Information System on Science, Technology and Innovation for monitoring financing can contribute to the fulfilment of the Strategy's objectives. The INECP, in the research, innovation and competitiveness dimension, within the framework of the future Spanish Science and Technology Strategy for the period 2021-2027 incorporates a Strategic Action on Energy and Climate Change, and proposes to assign a quantity of finance for RDI in energy and climate.
Natural Roads Programme (since 1993)	The Natural Roads Programme aims to promote, enhance and raise awareness of natural roads and greenways (those built on old railway lines) among the population. It seeks to contribute to the socio-economic development of the rural environment, reusing traditional roads that have fallen into disuse or opening up new paths. Similarly, it seeks to encourage the population to get closer to nature and the rural environment, also responding to the social demand for alternative tourism services.	No interaction with the nature trails programme is foreseen in the development of the INECP.
National Irrigation Plan	It pursues the development of rural areas, integrating productive activity with the conservation of natural resources and respect for the environment, in accordance with the guidelines for structuring the territory to avoid loss of rural population. These include improving the standard of living of farmers, managing agricultural production and markets, improving irrigation water distribution and application infrastructure, and incorporating environmental criteria into land and water management to prevent degradation.	Agriculture is an electricity-intensive sector and the cost of energy is a major element in the pricing of irrigated agricultural products. The INECP promotes own consumption of energy as a measure of competitiveness, since it allows for the reduction and stabilisation of energy costs in the long term. It also aims to reduce energy consumption on farms and irrigation communities through the modernisation of existing facilities. Some measures in this regard: - Measure 1.4. Development of own consumption using renewables and distributed generation - Measure 2.10. Energy efficiency in farms, irrigation communities and agricultural machinery

8. Energy and Industry

Planning instrument	Objectives or requirements of the planning instrument with which the INECP can interact	Significant interactions of the INECP with the objectives of the planning instrument
National Renewable Energy Action Plan in Spain (NREAP) 2011-2020	The National Renewable Energy Action Plan (NREAP) responds to the requirements and methodology of the Renewable Energy Directive and follows the model of national renewable energy action plans adopted by the European Commission. It is also in line with the binding targets set by the Directive: to ensure that renewable sources account for at least 20% of final energy consumption by 2020 and a minimum share of 10% of energy from renewable sources in the transport sector by that year.	The INECP is a planning instrument that responds to the commitments made by Spain in the face of the climate change challenge. Its objectives and measures are in line with the NREAP. One of the main results of the INECP will be a 42% share of renewable energy in energy end-use in the whole economy by 2030. One of the main goals presented by the INECP is to increase energy efficiency, reducing the total demand for energy and promoting the replacement of fossil fuels by other indigenous ones (mainly renewable energies).
National Energy Efficiency Action Plan (NEEAP) 2017-2020	The purpose of NEEAP 2017-2020 is to meet the requirement of Article 24(2) of Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency. The NEEAP establishes the estimated energy consumption, the energy efficiency measures planned and the improvements that the country expects to achieve. The NEEAP presents energy efficiency measures in buildings, industry, transport, agriculture and fisheries. It also promotes high-efficiency cogeneration and district heating and cooling systems in the transformation.	The INECP is a planning instrument that responds to the commitments made by Spain in the face of the climate change challenge. Its objectives and measures are in line with the NEEAP. The measures envisaged in the INECP in the energy efficiency dimension will make it possible to achieve a 39.6% improvement in energy efficiency by 2030.

Planning instrument	Objectives or requirements of the planning instrument with which the INECP can interact	Significant interactions of the INECP with the objectives of the planning instrument
Renewable Energy Plan (REP) 2011-2020.	The REP includes the design of new energy scenarios and the incorporation of objectives in accordance with Directive 2009/28/EC on the promotion of the use of energy from renewable sources, which establishes binding minimum targets. The ultimate objective of the REP is to achieve at least 20% of final energy consumption from renewable sources by 2020 and a minimum 10% share of energy from renewable sources in the transport sector by that year.	The INECP is a planning instrument that responds to the commitments made by Spain in the face of the climate change challenge. Its objectives and measures are consistent with the REP, even more demanding. As a result of the INECP, the presence of renewable energy in energy end-use in the whole economy is 42% in 2030 (from 17% today). In the decarbonisation dimension, the INECP presents specific measures for the promotion of renewable energies. The following are noteworthy: - Measure 1.1. Development of new facilities for generating electricity using renewables - Measure 1.4. Development of own consumption using renewables and distributed generation - Measure 1.5. Incorporation of renewables in the industrial sector - Measure 1.6. Framework for the development of renewable thermal energies - Measure 1.9. Plan for the technological upgrading of existing electricity generation projects with renewable energies - Measure 1.10. Promotion of bilateral renewable electricity contracts The INECP presents energy efficiency measures in the transport sector (Measures 2.1, 2.2, 2.3 and 2.4) which will contribute to the cumulative end-use energy savings target for the period 2021-2030. As a result of the measures adopted in the INECP, 22% of renewables in transport via electrification and biofuels have been achieved, above the 14% required by the European Union for 2030.

Planning instrument	Objectives or requirements of the planning instrument with which the INECP can interact	Significant interactions of the INECP with the objectives of the planning instrument
Plan for the development of the electricity transmission network 2015-2020	Planning is primarily aimed at ensuring the security of electricity supply, while introducing environmental and economic efficiency criteria. The document includes that infrastructure required to guarantee security of supply within the 2015-2020 planning horizon. The following factors were taken into account: - Compliance with the safety and reliability requirements of the electricity network and, consequently, guarantee of supply. - Minimising the global environmental impact. Planning of the electricity transmission network has been subject to a strategic environmental assessment process. - The increase in international connection capacity, as a way of increasing Spain's integration into the single energy market, favouring lower electricity prices. - The integration of renewable energies into the grid, in order to favour the fulfilment of the objectives in this area for 2020. - Attention to demand requirements arising from new industrial activity. - The planning of networks based on an analysis of possible alternatives and costs, which has made it possible to prioritise the urgency of investments, adding the_economic criterion to the previous ones.	The INECP is perfectly aligned with the factors of the Plan, as it contributes to improving supply, increasing international connection capacity, and boosting the development of renewable energies.
Proposals for the Development of the Electricity Transmission Network with a 2026 timeframe.	The proposals are intended to advance the transition of the Spanish energy system in order to meet the objectives in terms of energy efficiency, renewable energy and climate change, as well as to put the Spanish system on the path defined by the European Commission for 2050 and whose intermediate step is to comply with the framework set by the European Union for 2030 in terms of energy and climate change.	The planning of the electricity transmission network for the period 2021-2026 will be guided, among other guiding principles, by the fulfilment of the energy and climate commitments to be specified at national level in the INECP 2021-2030. The integration of renewable generation in the electricity sector, both on the mainland and in non-peninsular territories, makes the reinforcement and growth of the transport and distribution lines in Spanish territory necessary, including mainland connections, non-peninsular systems and interconnections between island systems. The INECP deals with all of these aspects, as well as the development of mechanisms for the management and storage of non-dispatchable electric renewables that will allow the prevention of discharges.

Planning instrument	Objectives or requirements of the planning instrument with which the INECP can interact	Significant interactions of the INECP with the objectives of the planning instrument
General Guidelines on the New Spanish Industrial Policy 2030	The General Guidelines on the new 2030 Spanish industrial policy are framed within the government's Agenda for Change and aligned with the Sustainable Development Goals. The ultimate goal is to achieve a sustainable and inclusive growth model that promotes stable and quality employment; an active industrial policy aimed at transforming our production model with three objectives: - The reindustrialisation of the economy, i.e. the development and strengthening of the various industrial sectors in order to increase their share of GDP and employment. - The necessary transformation of the industrial fabric, in particular small and medium-sized enterprises, to adapt it to a new context, marked by the rapid evolution of digital technologies and growing international competition. - Adaptation to the ecological transition is twofold: on the one hand, taking advantage of the opportunities arising from it, with particular emphasis on moving towards a more circular and decarbonised economic model; and on the other, anticipating and mitigating the impacts it may cause, thus ensuring an orderly and just transition.	The INECP is a planning instrument that responds to the EU's demand in the face of the climate change challenge. It identifies challenges and opportunities along its five dimensions. One of the major goals presented by the INECP is the reduction of total gross GHG emissions in the industry sector (combustion), which reaches 7 $MtCO_2$-eq. The boost to the deployment of renewable energies, distributed generation and energy efficiency promoted by this INECP is characterised by being anchored to the territory, so its implementation will generate significant investment and employment opportunities for the regions and districts of our country. The industrial, economic and employment opportunities identified and promoted in those regions and districts most affected by the energy transition and the decarbonisation of the economy are particularly relevant.
SME 2030 policy strategic framework	The Strategic Framework aims to improve the competitive capacity of small and medium-sized enterprises in the face of the challenges of a global and digitalised economy and to contribute to creating an appropriate climate to support their growth. The proposals are organised through seven levers: Entrepreneurship, Business Management and Talent, Regulatory Framework, Financing, Innovation and Digitalisation, Sustainability, and Internationalisation. These areas are accompanied by fifty lines of action characterised by their horizontality, so that they affect the development of all SMEs as a whole. The actions to be financed must be aimed at improving technology in industrial equipment and processes, or the implementation of energy management systems. The purpose of the aid programme is to encourage and promote actions in the industrial sector that reduce carbon dioxide emissions and final energy consumption by improving energy efficiency, thereby contributing to the achievement of the objectives of reducing energy consumption.	The achievement of the objectives of the INECP 2021-2030 in terms of energy efficiency and generation of energy from renewable sources has a positive impact on the competitiveness of the Spanish economy because: - it improves competitiveness in industry in particular, and in the business fabric in general, thanks to a reduction in energy bills; - it ensures competitive energy costs in the long term and less exposure to the risks of price variability; - the Plan presents an opportunity for the development of a high value-added capital goods and services industry. Measure 2.5. Improvements in the technology and management systems of industrial processes aims to facilitate the penetration of final energy-saving technologies mainly in small and medium enterprises (SMEs). Measure 5. 1. Strategic Action on Energy and Climate and 5.3. Public procurement of Green Innovation to promote innovation from public demand is aligned with the strategies for smart specialisation to improve knowledge exchange between political agents and the interested parties, above all supporting the participation of SMEs.

Planning instrument	Objectives or requirements of the planning instrument with which the INECP can interact	Significant interactions of the INECP with the objectives of the planning instrument
Spanish Strategy for the Development of Energy Use from Forest Biomass	The Strategy is aimed at promoting residual forest biomass for energy purposes, as it considers that the implementation of a sustainable energy model, based on savings, efficiency and diversification of sources, requires a decisive boost to the development of residual forest biomass as renewable energy.	The INECP is a planning instrument that responds to the commitments made by Spain in the face of the climate change challenge. Its objectives and measures are in line with the Spanish Strategy for the Development of Energy Use from Forest Biomass. The INECP presents some measures to promote the use of biomass as an energy source, which contributes to the development of its objectives. The following measures are noteworthy: - Measure 1.5. Incorporation of renewables in the industrial sector - Measure 1.6. Framework for the development of renewable thermal energies - Measure 1.11. Specific programmes for the use of biomass - Measure 1.22. Reduction of greenhouse gas emissions in waste management
National Energy Security Strategy 2015	Spain has a characteristic energy profile: it depends on foreign resources and has a limited level of energy interconnection, but at the same time it has a complete and diversified energy mix. The Energy Security Strategy takes a forward-looking view of the sector, assessing factors such as technological advances in energy generation and distribution, energy interdependence and the influence of changes in power on the availability of resources. Also, the influence of the regulatory framework of the energy market on competition, competitiveness and innovation of companies. It is guided by the ultimate goal of energy security, diversification of energy sources, ensuring the security of transport and supply and promoting energy sustainability. As a fundamental part of the National Security System, Objective 2 of the National Energy Security Strategy establishes the need to 'consider all the energy sources to maintain a balanced mix, which accurately reflects all the specificities of Spain and enables it to reach a certain guarantee of supply, at competitive prices, and within a sustainable model in which clean energies steadily take on greater importance.'	The INECP promotes an intensive reduction of energy dependency, especially with regard to the import of fossil fuels, through the implementation of efficiency measures in the use of energy and the development of indigenous renewable energy sources. In addition, the INECP has developed a dimension, with a package of measures, specifically aimed at energy security. - Measure 3.1. maintenance of minimum security stocks of petroleum products and gas; - Measure 3.2. Reducing dependency on petroleum and carbon in the islands - Measure 3.3. Alternative fuel recharging points - Measure 3.4. Promoting regional cooperation - Measure 3.5. Extension of contingency plans - Measure 3.6. Planning for safe operation of a decarbonised energy system

9. Transport, mobility and housing

Planning instrument	Objectives or requirements of the planning instrument with which the INECP can interact	Significant interactions of the INECP with the objectives of the planning instrument
Long-term strategy for energy upgrading in the building sector in Spain (ERESEE 2014, updated in 2017)	The ERESEE 2014 strategy was the starting point for the promotion of energy upgrading in the building sector in Spain, as well as a roadmap that is still in force and which represents a guide for the different agents involved in the upgrading processes. The 2017 update, which responds to the requirements of Article 4 of Directive 2012/27/EU on Energy Efficiency, includes: an analysis of the evolution of energy consumption in the building sector and the evolution of upgrading in Spain; the monitoring of the measures to promote energy efficiency upgrading implemented; an analysis of the main structural challenges; and a proposal for new measures in the short, medium and long term to promote upgrading and energy efficiency in the building sector.	The INECP includes a series of specific measures to improve energy efficiency in buildings. These measures are consistent with the long-term strategy for energy upgrading in the building sector in Spain, as well as with the Housing Plan, which is the basic tool for promoting urban and rural regeneration and renewal. The INECP measures related to the energy upgrading of buildings are: - Measure 2.6. Energy efficiency in existing buildings in the residential sector - Measure 2.9. Energy efficiency for cooling equipment and large air-conditioning systems in the services sector and public infrastructure
Plan for Infrastructure, Transport and Housing (PITVI) 2012-2024	The PITVI proposes a new strategic planning framework for transport and housing infrastructure in Spain, which marks 'the roadmap' for the new policy in these sectors. The Plan promotes the maintenance of existing infrastructure and guarantees mobility by providing public service obligations (which the State will set in the area of transport), and also seeks the participation of the private sector in investments. One of the objectives of the PITVI is to improve and extend the contribution of the suburban networks to passenger transport in the country's large urban centres. As far as freight transport is concerned, it promotes rail transport in order to improve its efficiency and competitiveness. The PITVI also promotes new technological developments in the field of innovation in transport system management. This is compatible with the development of alternative fuels to diesel traction that are more environmentally efficient and contribute to the reduction of greenhouse gases (GHG). In the area of housing, the PITVI promotes renting and upgrading.	The policies in the INECP to improve energy efficiency in transport and sustainable mobility in cities are aimed at encouraging the modal shift in the mobility of people to those methods that consume less energy; this contributes to improving the efficiency and competitiveness of the sector. The INECP will also promote the improvement of the energy efficiency of the conventional rail system, making it more efficient and competitive, and directing it towards covering the requirement for the daily transport of people and goods, as far as possible. In parallel, it will promote energy efficiency measures in air and maritime transport. With regard to housing, the INECP provides for energy efficiency measures in the residential sector, the promotion of alternative energy and own consumption, which present synergies with the PITVI, especially in relation to the quality and sustainability of building and town planning. The PITVI and INECP are aligned.

Planning instrument	Objectives or requirements of the planning instrument with which the INECP can interact	Significant interactions of the INECP with the objectives of the planning instrument
Spanish Sustainable Mobility Strategy (EEMS)	National reference framework integrating coordination principles and tools to guide and give coherence to sectoral policies facilitating sustainable and low-carbon mobility. Sustainable mobility means ensuring that transport systems respond to economic, social and environmental needs, minimising their negative impacts. The objectives and guidelines of the EEMS are specified in 48 measures structured in five areas: territory, transport planning and its infrastructure; climate change and reduction of energy dependency; air quality and noise; health and safety; and demand management. Among the measures envisaged, special attention is paid to promoting alternative mobility to the private vehicle and the use of the most sustainable modes, pointing out the need to take care of the implications of urban planning in the generation of mobility.	The INECP is a planning instrument that responds to the commitments made by Spain in the face of the climate change challenge. Its objectives and measures are in line with the EEMS. The dimension of decarbonisation of the energy system includes measures to achieve a reduction in emissions. The mobility-transport sector is the second most important sector for reducing emissions in the period 2021-2030. Actions to improve energy efficiency in transport and sustainable mobility in cities are aimed at encouraging the modal shift in mobility of people to those methods that consume less energy. In addition, the INECP has included actions aimed at improving the efficiency of the vehicle fleet through the renewal of fleets and the incorporation of technological advances, as well as actions aimed at the efficient use of means of transport
State Housing Plan 2018- 2021	The objectives of the State Housing Plan include: - to continue to adapt the aid system to current social needs and the limited resources available; - to help mortgage holders meet their mortgage loan obligations; - to strengthen inter-administrative cooperation and coordination; - to improve building quality (conservation, energy efficiency, universal accessibility and environmental sustainability); - to contribute to the increase of the housing stock for rent or on assignment in use; - to facilitate access for young people to decent and adequate housing for rent; - to help prevent the depopulation of small municipalities; - to facilitate the enjoyment of decent and adequate housing for older people and people with disabilities.	The INECP proposes actions in the field of energy upgrading of buildings: the improvement of energy efficiency (thermal envelope) and the improvement of energy efficiency (renovation of thermal heating and DHW installations). There are also measures with actions against energy poverty. - Measure 1.4. Development of own consumption using renewables and distributed generation - Measure 2.7. Renewal of residential equipment - Measure 4.11. Combating energy poverty

Planning instrument	Objectives or requirements of the planning instrument with which the INECP can interact	Significant interactions of the INECP with the objectives of the planning instrument
Strategy for Promoting Alternative Energy Vehicles	It analyses the particularities of each of the alternative technologies to conventional fuels (petrol and diesel) and proposes specific actions structured in 30 measures covering three lines of action: - Industrialisation: the industrialisation of vehicles with alternative energies and the associated supply points is promoted - Market: actions are defined to boost demand in order to achieve a sufficient market. - Infrastructure: encouraging an infrastructure network that allows the mobility needs of users to be met and thus enables the development of an alternative fuel market.	The INECP contains specific measures related to the transport sector in which the modal shift towards low-emission or non-emitting modes of mobility, efficient use of means of transport, renewal of the vehicle fleet and promotion of the electric vehicle are considered, enabling greater penetration of renewable energies in the sector. These measures are detailed in the energy efficiency dimension and there is a specific measure in relation to the strategy: - Measure 2.4. Promotion of electric vehicles On the other hand, the decarbonisation dimension incorporates a measure to support advanced biofuels: - Measure 1.7. Advanced biofuels in transport
National Action Framework for Alternative Energy in Transport	Adopted by the Council of Ministers in 2016, this Framework for Action aims to promote the use of alternative energies in transport from a technology-neutral perspective.	The INECP contains specific measures related to the transport sector in which the modal shift towards low-emission or non-emitting modes of mobility, efficient use of means of transport, renewal of the vehicle fleet and promotion of the electric vehicle are considered, enabling greater penetration of renewable energies in the sector. These measures are detailed in the energy efficiency dimension and there is a specific measure in relation to the strategy: - Measure 2.4. Promotion of electric vehicles On the other hand, the decarbonisation dimension incorporates a measure to support advanced biofuels: - Measure 1.7. Advanced biofuels in transport
ADIF Master Plan to Combat Climate Change (2018-2030)	The Plan, developed by RENFE and ADIF, focuses on reducing emissions and making energy savings by promoting the modal transfer to rail, boosting decarbonisation and energy efficiency in the rail system, and increasing the use of renewable energies, with measures such as green energy purchases. The Plan seeks to promote and take advantage of the environmental benefits that railways have over other modes of transport in terms of atmospheric emissions.	The Plan is limited to the General Interest Railway Network (RFIG), which consumes 98% of the energy of the railway sector in Spain. The Plan shows, in line with the INECP, that the mode of transport that consumes the least energy is rail. The external costs of rail are much lower than those of other modes such as road and air transport (for which the externalities are 3-5 times those of the former). In terms of CO_2 emissions, road emissions are 5 to 7 times those of rail and air transport 7 to 10 times. The objectives of ADIF's Master Plan for Combating Climate Change are modal change, energy efficiency and decarbonisation, all included in the INECP, and the two can therefore be said to be aligned.

Planning instrument	Objectives or requirements of the planning instrument with which the INECP can interact	Significant interactions of the INECP with the objectives of the planning instrument
Air Navigation Plan 2017- 2020	The European Commission's Single European Sky project makes airspace an increasingly global and competitive environment. Its fundamental objective is to eliminate the current fragmentation of air spaces and national systems in order to achieve a homogeneous European space, with interoperable technological systems. In this sense, ENAIRE (national public entity that provides air traffic services) and its strategic plan called '*Plan de Vuelo 2020*', is aimed at modernising and evolving the Spanish air navigation system. The improvement of airspace capacity and efficiency is one of the priorities of this plan.	The INECP interacts positively with the environmental commitments of the Navigation Plan in the sense of reinforcing the reduction of emissions in relation to transport efficiency. The Navigation Plan incorporates as environmental benefits the improvement of route efficiency (more direct route design) and the implementation of green approaches to airports, in order to reduce GHG emissions, shorten flight distances (route improvement) and save fuel. These aspects are aligned with the INECP, in the dimension of energy efficiency in transport.
National Cybersecurity Strategy	This strategy has also strengthened and reinforced public-private collaboration with the various energy operators, a task that has been coordinated by the Cybersecurity Coordination Office (Oficina de Coordinación Cibernética – OCC) of the National Centre for the Protection of Critical Infrastructure and Cybersecurity (Centro Nacional de Protección de Infraestructuras Críticas y Ciberseguridad – CNPIC). Likewise, the revisions of 13 Operator Security Plans (OSP) have been approved, checking their adjustment to the current situation of the threats and challenges to which the critical infrastructures of the energy sector and the nuclear industry are subject, updating the information contained in these plans.	The achievement of the Plan's objectives is subject to the proper functioning of cybersecurity mechanisms, in particular the Plan's energy security and decarbonisation dimensions. The INECP interacts positively with cybersecurity commitments by promoting cybersecurity measures for both energy networks (in particular electricity networks) and data transfer, in particular for consumers.

10. Waste

Planning instrument	Objectives or requirements of the planning instrument with which the INECP can interact	Significant interactions of the INECP with the objectives of the planning instrument
State Waste Prevention Programme 2014-2020	The State Waste Prevention Programme 2014-2020 develops the waste prevention policy, by waste generation reduction, reuse and extension of the useful life of products, reducing the content of harmful substances in materials and products, and reducing the adverse impacts on human health and the environment of the waste generated. For each type of waste, the Plan sets a series of qualitative and quantitative targets focusing on recovery, reuse, recycling, energy recovery and ultimately disposal, as well as the relevant measures to achieve them and monitoring indicators. It also provides for the reduction of biodegradable waste dumping, through recovery, recycling, composting and biomethanisation.	The INECP foresees a reduction of GHG emissions in the waste sector to 1990 levels by 2030. The following measures provided for in the INECP incorporate waste management, to a greater or lesser extent: - Measure 1.8. Promotion of renewable gases - Measure 1.11. Specific programmes for the use of biomass - Measure 1.21. Reduction of greenhouse gas emissions in the agricultural and livestock sectors - Measure 1.22. Reduction of greenhouse gas emissions in waste management - Measure 1.24. Forest sinks
State Framework Plan for Waste Management (PEMAR) 2016-2022	The final objective of the State Framework Plan for Waste Management, like the EU waste policy, is to turn Spain into a resource-efficient society, moving towards a circular economy. In other words, to replace a linear economy based on producing, consuming and throwing away, with a circular economy in which materials containing the waste are returned to the production process again and again for the production of new products or raw materials.	The INECP foresees a reduction of GHG emissions in the waste sector to 1990 levels by 2030. The following measures provided for in the INECP incorporate waste management, to a greater or lesser extent: - Measure 1.8. Promotion of renewable gases - Measure 1.11. Specific programmes for the use of biomass - Measure 1.21. Reduction of greenhouse gas emissions in the agricultural and livestock sectors - Measure 1.22. Reduction of greenhouse gas emissions in waste management - Measure 1.24. Forest sinks
6th General Radioactive Waste Plan (GRWP)	The General Radioactive Waste Plan (GRWP) is the document that includes the strategies and activities to be carried out in Spain in relation to radioactive waste, the dismantling of nuclear facilities and the economic-financial study thereof. It is approved by the Council of Ministers and is regularly reviewed and updated.	The INECP, in the development of measures that may imply the closure and dismantling of nuclear power plants, must comply with the provisions of the Plan.

11. Population, human health and material goods

Planning instrument	Objectives or requirements of the planning instrument with which the INECP can interact	Significant interactions of the INECP with the objectives of the planning instrument
National Civil Protection Strategy	It develops an analysis of the main threats and risks of natural, human and technological origin that can give rise to emergencies and/or disasters in Spain, as well as the strategic lines of action to integrate, prioritise and coordinate the efforts to optimise the resources available for their management.	The INECP is a planning instrument that responds to the commitments made by Spain in the face of the climate change challenge. Its objectives and measures are in line with the National Civil Protection Strategy.
State Civil Protection Plan for Forest Fire Emergencies	The objective of the State Plan is to establish the organisation and procedures for action that will ensure an effective response from the general government in cases of forest fire emergencies in which there is a national interest. It also aims in other cases to provide the necessary support to the Plans of the autonomous communities when these require it. On the other hand, the State Plan facilitates the collaboration of the Plans of the autonomous communities among themselves, establishing the mechanisms that make possible the contribution of means and resources from one to another in a coordinated way.	The INECP is a planning instrument that responds to the commitments made by Spain in the face of the climate change challenge. Its objectives and measures are in accordance with the State Civil Protection Plan for Forest Fire Emergencies. In this regard, Measure 1.24. Forest sinks, includes concrete actions such as a4. Execution of silvicultural work for the prevention of forest fires and a5. Controlled grazing in strategic areas to prevent forest fires
State Plan for Civil Protection against Seismic Risk	The objective of the State Plan is to establish the organisation and procedures for action of those State services and, where appropriate, other public and private entities, which are necessary to ensure an effective response to the different seismic situations that may affect the country.	The INECP does not present measures or actions that directly affect the objectives pursued by the State Plan for Civil Protection against Seismic Risk.
State Plan for Civil Protection against Volcanic Risk	The objective of the State Plan is to establish the organisation and procedures for action that will make it possible to ensure an effective response by the general government in the event of a volcanic risk emergency in which there is a national interest. It also aims in other cases to provide the necessary support to the Civil Protection Plan of the Autonomous Community of the Canary Islands or any other affected community.	The INECP does not present measures or actions that directly affect the objectives pursued by the State Plan for Civil Protection against Volcanic Risk.
State Plan for Civil Protection against the risk of flooding	The objective of the State Plan is to establish the organisation and procedures for action of those State services and, where appropriate, other public and private entities, which are necessary to ensure an effective response to the different types of floods that may affect Spain. The State Plan for Civil Protection against Floods is operationally based on the Special Civil Protection Plans against this risk or, failing that, on the Territorial Plans of the autonomous communities affected.	The INECP is a planning instrument that responds to the commitments made by Spain in the face of the climate change challenge. Its objectives and measures are in line with the State Plan for Civil Protection against the risk of flooding. In this regard, Measure 1.24. Forest sinks, includes concrete actions such as a2. Promoting poplars as replacements for agricultural crops in flood-prone areas and a7. Hydrological-forest restoration in areas at high risk of erosion

Planning instrument	Objectives or requirements of the planning instrument with which the INECP can interact	Significant interactions of the INECP with the objectives of the planning instrument
State Plan for Civil Protection against Radiological Risk	The objective of the State Plan is to establish the organisation and procedures for the performance of the resources and services of the State and, where appropriate, of other public and private entities required to ensure an efficient response by the general government to the different radiological emergency situations affecting the population, in which there is a national interest. It also aims to establish the support mechanisms of the autonomous communities' plans in cases where this is required.	The INECP does not present measures or actions that directly affect the objectives pursued by the State Plan for Civil Protection against Radiological Risk.
State Plan for Civil Protection against Chemical Risk	The purpose of the State Plan is to establish the organisation and procedures for action of those resources and services of the State and, where appropriate, of other public and private entities, which are necessary to ensure the effective response of the general government to the different emergency situations due to accidents with hazardous substances, in which there is a national interest. It also establishes the support mechanisms for the plans of the autonomous communities in the cases that require it.	The INECP does not present measures or actions that directly affect the objectives pursued by the State Plan for Civil Protection against Chemical Risk.

ANNEX I. GLOSSARY

AC - Autonomous Community

ACA - Association of Environmental Sciences (*Asociación de Ciencias Ambientales*)

ACER – Agency for the Cooperation of Energy Regulators

ADIF - Spanish railway infrastructure management company, *Administrador de Infraestructuras Ferroviarias*

AEA - Annual Emission Allocation

AEI - Spanish Research Agency (*Agencia Estatal de Investigación*)

AFA - Access For All

AGE - General State Administration (*Administración General del Estado*)

AIDS - Almost Ideal Demand System

AIE - International Energy Agency

ALINNE - Alliance for Energy Research and Innovation (*Alianza por la Investigación y la Innovación Energéticas*)

and Medium-sized Enterprises (SME)

AQ-SRM - Air Quality-Source Receptor Model

AV - Voluntary Agreement (*Acuerdo Voluntario*)

BATs - Best Available Techniques

BC3 - Basque Centre for Climate Change

BNAE - National Balances of Nitrogen Use in Spanish Agriculture (*Balances Nacionales del Uso del Nitrógeno en la Agricultura Española*)

CAP - Common Agricultural Policy

CASE - Centre for Analysis of Social Exclusion.

CCGT - Combined Cycle Gas Turbine

CCS - Carbon Capture and Sequestration

CDTI - Centre for Technological and Industrial Development (*Centro para el Desarrollo Tecnológico e Industrial*)

CECRE - Control Centre for Renewable Energies (*Centro de Control de Energías Renovables*)

CEF - Connecting Europe Facilities

CESAR - Centre of Economic Scenario Analysis and Research

CGE - Computable General Equilibrium

CH_4 - Methane

CIEMAT - Energy, Environment and Technology Research Centre (*Centro de Investigaciones*

Energéticas, Medioambientales y Tecnológicas)

CIUDEN - City Foundation for Energy (*Fundación Ciudad de la Energía*)

CNMC - Spanish National Commission on Markets and Competition (*Comisión Nacional de Mercados y de la Competencia*)

CO - Carbon Monoxide

CO_2 - Carbon Dioxide

Commercial and Institutional Sectors

COP21 - Conference of the Parties (see UNFCCC, the 21st session was held in Paris)

CORES - The Spanish Corporation for Strategic Reserves of Petroleum Products (*Corporación de Reservas Estratégicas de Productos Petrolíferos*)

CPTI - Public Purchase of Innovative Technology (*Compra Pública de Tecnología Innovadora*)

CRF.- Common Reporting Format

CSIC - Spanish National Research Council (*Centro Superior de Investigaciones Científicas*)

CSP - Concentrated Solar Power

CTE - Technical Building Code (*Código Técnico de la Edificación*)

CYTED - Ibero-American Programme on Science and Technology for Development (*Programa Iberoamericano de Ciencia y Tecnología para el Desarrollo*)

DENIO - Dynamic Econometric National Input-Output (multi-sectoral economic model for analysing socio-economic impacts)

DERIO - Dynamic Econometric Regional Input-Output model

DG. - Distributed Generation

DGPEM - Directorate-General for Energy Policy and Mines (*Dirección General de Política Energética y Minas*)

DHW - Domestic Hot Water

DUSI - Sustainable and Integrated Urban Development (*Desarrollo Urbano Sostenible e Integrado*)

EC - European Commission

ED - Education

EDUSI - Integrated and Sustainable Urban Development Strategies (*Estrategias Integradas de Desarrollo Urbano Sostenible*)

EEA - European Environment Agency

EECTI - Spanish Strategy for Science and Technology and Innovation (*Estrategia Española de Ciencia y Tecnología y de Innovación*) 2013-2020

EEA - European Economic Area

EEC - European Economic Community

EFSI - European Fund for Strategic Investments
EMEP - European Monitoring and Evaluation Programme

ENTSO-E - European Network of Transmission System Operators for Electricity

EPC - Energy Performance Contracts

ERANET - European Research Area Net

ERDF - European Regional Development Fund

ERESEE.- Update of the Long-term strategy for energy upgrading in the building sector in Spain (*Estrategia a Largo Plazo para la Rehabilitación Energética en el Sector de la Edificación en España*)

ERT - Emergency Response Team

ES - Spain

ESD - Effort Sharing Decision.

ESFRI - European Strategy Forum on Research Infrastructures

ETS - Emissions Trading System.

ETSAP - Energy Technology Systems Analysis Programme

EU - European Union

EU-CELAC - Europe-Community of Latin American and Caribbean States

EU-ETS- European Union Emissions Trading System

EUR - euro

EUROSTAT - European Statistical Office

FES CO2 - Carbon Fund for a Sustainable Economy (*Fondo de Carbono para una Economía Sostenible*)

FIDELIO - Fully Interregional Dynamic Econometric Long-term Input-Output

FNEE - National Energy Efficiency Fund (Fondo Nacional de Eficiencia Energética)

FOAK - First Of A Kind

FR - France

GDP - Gross Domestic Product

GFCF - Gross Fixed Capital Formation

GHG – Greenhouse gases

GTS - Technical Management of the System (*Gestión Técnica del Sistema*)

GWP - Global Warming Potential

HBS - Household Budget Survey

HFCs - Hydrofluorocarbons

HFOs - Hydrofluoroolefins

HHI - Herfindahl-Hirschman Index

HORECA - HOtels, REstaurants and CAfés

ICTS - Unique Scientific and Technical Infrastructures (*Infraestructuras Científico Técnicas Singulares*)

IDAE- Institute for Energy Diversification and Saving (*Instituto para la Diversificación y Ahorro de la Energía*)

IEDMT - vehicle registration tax (Impuesto Especial sobre Determinados Medios de Transporte)

IET - Industry, Energy and Tourism

IITRI - IT Research Institute (*Instituto de Investigación Tecnológica*)

INE - Spanish National Statistics Institute

IPCC - Intergovernmental Panel on Climate Change

IRENA - International Renewable Energy Agency

IRPF.- Personal income tax (*Impuesto sobre la Renta de las Personas Físicas*).

ISBN - International Standard Book Number

IVTM - Tax on Mechanical Traction Vehicles (*Impuesto sobre Vehículos de Tracción Mecánica*)

IWG - Implementation Working Group

JRC - Joint Research Centre

JV - Joint Venture

LAIDS - Logarithmic approach to the Near Ideal Demand System

LCS - Living Conditions Survey

LCSP - Public Sector Contracts Law (*Ley de Contratos del Sector Público*)

LED - Light Emitting Diode

LNG - Liquefied Natural Gas

LPG - Liquefied Petroleum Gas

LULUCF - Land Use, Land-Use Change and Forestry

M3E - Modelling of mitigation measures in Spain (*Modelización de medidas para la mitigación en España*)

MaaS - Mobility as a Service

MAPA - Ministry for Agriculture, Fisheries and Food (*Ministerio de Agricultura, Pesca y Alimentación*)

MAC - Marginal Abatement Cost
MCF - Methane Conversion Factor.

MCI - Ministry of Science and Innovation

MERCOP - Measures to restrict oil consumption (*Medidas de Restricción del Consumo de Petróleo*)

MI - Mission Innovation

MIBEL - Iberian Electricity Market (*Mercado Ibérico de la Electricidad*)

MIBGAS - Iberian Gas Market (*Mercado Ibérico del Gas*)

MINCOTUR - Ministry of Industry, Trade and Tourism (*Ministerio de Industria, Comercio y Turismo*)

MINECO - Ministry of Economic Affairs and Digital Transformation (*Ministerio de Asuntos Económicos y Transformación Digital*)

MITECO - Ministry for Ecological Transition and the Demographic Challenge (Ministerio para la Transición Ecológica y el Reto Demográfico)
MITMA - Ministry of Transport, Mobility and Urban Agenda (Ministerio de Transportes, Movilidad y Agenda Urbana)
MOVALT - Alternative Mobility Support Plan
MOVEA - Support Plan for the purchase of electric cars

MOVELE - Electric Mobility Plan (*Plan de Movilidad Eléctrica*)

MOVES - Efficient and Sustainable Mobility Plan (*Plan de Movilidad Eficiente y Sostenible*)

MSW - Municipal solid waste

N_2O.- Nitrous Oxide

NAIRU - Non-Accelerating Inflation Rate of Unemployment

NBP - National Balancing Point (United Kingdom).

NECPs - National Energy and Climate Plans

NGTS-11 - Technical Management of the System Standard Number 11

NH_3 - Ammonia

NMVOCs - Non-Metallic Volatile Organic Compounds

NOx - Nitrogen oxides

NPT - Non-Peninsular Territories

NPV - Net Present Value

NTC - Net Transfer Capacity

O&M - Operation and Maintenance

OCGT - Open Cycle Gas Turbine

OECD - Organisation for Economic Co-operation and Development

OFMSW - Organic Fraction of Municipal Solid Waste.

PA - Public Administration

PACE - Plan of Action in Case of Emergency

PAREER - Grant programme for the energy upgrade of existing buildings (*Programa de Ayudas para la Rehabilitación Energética de Edificios Existentes*)

PCI - Projects of Common Interest

PCP - Pre-commercial Procurement

PEG - *Point d'échange de Gaz Sud/Nord* (South/North of France)

PEICTI - State Plans for Scientific and Technical Research and Innovation (*Planes Estatales de Investigación Científica y Técnica y de Innovación*)

PEMAR - State Framework Plan for Waste Management (*Plan Estatal Marco de Gestión de Residuos*)

PFCs - Perfluorocarbons
PIMA - Plans to Promote the Environment (*Planes de Impulso al Medio Ambiente*)

PITVI - Plan for Infrastructure, Transport and Housing (*Plan de Infraestructuras, Transporte y Vivienda*)

PIVE - Efficient Vehicle Incentive Programme (*Programa de Incentivos al Vehículo Eficiente*)

PMUS - Sustainable Urban Mobility (*Planes de Movilidad Urbana Sostenible*)

PNACC - National Plan of Adaptation to Climate Change (*Plan Nacional de Adaptación al Cambio Climático*)

PNDR - National Rural Development Programme (*Programa Nacional de Desarrollo Rural*)

INECP - Integrated National Energy and Climate Plan (*Plan Nacional Integrado de Energía y Clima*)

PRIMES - Price-Induced Market Equilibrium System

PSV - *Punto di Scambio Virtuale* (Italy): Virtual Exchange Point

PT - Portugal

PTT - Workplace travel plans (*Planes de Transporte al Trabajo*)

PV - Photovoltaic

PV - Photovoltaic Energy

PVB - Virtual Balancing Point

RCI - Residential,

RD - Royal Decree

RDI - Research, Development and Innovation

REE - *Red Eléctrica de España*

RENFE - National Network of Spanish Railways (*Red Nacional de Ferrocarriles Españoles)*

RES - Renewable Energies

RIS3 - Smart Specialisation Strategy

REP - Renewable Energy Plan 2011-2020

RIC - Research, Innovation And Competitiveness

RITE - Regulation of Thermal Installations in Buildings (*Reglamento de Instalaciones Térmicas en los Edificios*)

ROM - Reliability and Operation Model for Renewable Energy Sources

RRE - Effort Sharing Regulation (*Reglamento de Reparto del Esfuerzo*)

SDG - Sustainable Development Goal

ILO - International Labour Organization**WHO -** World Health Organization

SET-Plan - Strategic Energy Technology Plan

SF_6 - sulphur Hexafluoride

SICTI - Information System on Science, Technology and Innovation (*Sistema de Información sobre Ciencia, Tecnología e Innovación*)

SIGEE-AGE - Computer System for Energy Management of the General State Administration Buildings (*Sistema Informático de Gestión Energética de Edificios de la Administración General del Estado*)

SMEs - Small

SNCZI - National System of Flood Zone Mapping (*Sistema Nacional de Cartografía de Zonas Inundables*)

SOx - sulphur oxides
TE - Energy Technologies

TFP - Total Factor Productivity

TIMES - The Integrated MARKAL-EFOM System

TIMES-SINERGIA - Integrated System for the Study of Energy

TPF - Third party financing

TRS - Trading Region South (South of France)

TSO - Transmission System Operator

TTF - Title Transfer Facility (Netherlands)

TUR - Rate of last resort (*Tarifa de Último Recurso*)

TWG - Temporary Working Group

TYNDP - Ten-Year Network Development Plan

UK - United Kingdom

UNFCCC - United Nations Framework Convention on Climate Change
UNIDO - United Nations Industrial Development Organization

VIP - Virtual Interconnection Point

VSL - Value of Statistical Life

WAM - With Additional Measures

WEM - With Existing Measures

WOM - Without Measures

Units of Measurement

€/MWh - Euro per Megawatt hour

GJ - Gigajoules

GW - Gigawatts

GWh - Gigawatt hours

GWh/day - Gigawatt hours per day

GWhe. - Gigawatt-hour equivalent

ktoe. - kilotonne of oil equivalent

kV.**-** Kilovolt.

MtCO_2-eq.- Millions of tonnes of CO_2/equivalent

Mtoe - Millions of tonnes of oil equivalent

MVA - Megavoltage

MW - Megawatts

Nm^3/h - Normal cubic metres per hour/normal cubic metre per hour

PM2.5 - Suspended particles of less than 2.5 microns

TJ - Terajoules

TWh - Terawatt hours

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