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NATIONAL ENERGY AND CLIMATE PLAN

ATHENS, JANUARY 2019

Contents

Chapter 1	PLAN OVERVIEW AND DRAFTING PROCEDURE.....	6
1.1	Executive summary.....	6
1.1.1	Political, economic, environmental and social context of the plan	6
1.1.2	Overall strategy in relation to the five dimensions of the Energy Union.....	6
1.1.3	Summary table laying down the key objectives, policies and measures of the plan.....	10
1.2	Review of the current state of affairs in terms of policy.....	15
1.2.1	National and Union energy system and policy framework of the national plan	15
1.2.2	Existing energy and climate policies and measures in respect of the five dimensions of the Energy Union.....	15
1.2.3	Energy design challenges in five dimensions	83
1.2.4	Key issues of cross-border interest	91
1.2.5	Administrative structure for the implementation of national energy and climate policies.....	91
1.3	Consultation and involvement of national bodies and actors in the EU and outcomes	94
1.3.1	Participation of the national parliament.....	94
1.3.2	Involving local and regional authorities	94
1.3.3	Consultation of stakeholders, including social partners, and involvement of civil society and the general public	94
1.3.4	Consultation with other Member States.....	96
1.4	Regional cooperation in drawing up the project.....	96
Chapter 2	NATIONAL OBJECTIVES AND EXPECTATIONS	99
2.1	Decarbonisation dimension.....	102
2.2	Energy efficiency dimension.....	108
2.3	Energy security dimension	110
2.4	Dimension of the internal energy market	113
2.5	Research, innovation and competitiveness dimension.....	117

Chapter 3	POLICIES and MEASURES.....	121
3.1.	Decarbonisation dimension.....	121
3.1.1	Greenhouse gas emissions and removals	121
3.1.2	Renewable energy.....	128
3.2	Energy efficiency dimension.....	146
3.2.2	Long-term strategy to renovate the national stock of residential and non-residential buildings, both public and private.....	147
3.2.3	Policies and measures to promote energy services in the public sector.....	148
3.2.4	Other planned policies, measures and programmes to achieve the indicative national energy efficiency target for 2030.....	149
3.2.5	Policies and measures to promote the role of local energy communities.....	151
3.2.6	Measures to exploit the energy efficiency potential of gas and electricity infrastructure.....	151
3.2.7	Regional cooperation in this area, where appropriate	152
3.2.8	Financing measures including support and use of EU funds in this area at national level.....	152
3.2.9	Summary of policy measures	153
3.3	Energy security dimension	162
3.3.1	Policies and measures to achieve the relevant objectives.....	162
3.3.2	Regional cooperation in this area.....	166
3.3.3	Financing of measures in this area at national level, including with EU support and the use of EU funds	166
3.3.4	Summary of policy measures	166
3.4	Internal energy market dimension.....	171
3.4.1	Electricity infrastructure.....	171
3.4.2	Energy transmission infrastructures	172
3.4.3	Market consolidation	174
3.4.4	Energy poverty	176
3.4.5	Summary of policy measures	177

3.5	Research, innovation and competitiveness dimension.....	183
3.5.1	Policies and measures to achieve the relevant objectives.....	184
3.5.2	Cooperation with other Member States in this area	187
3.5.3	Financing of measures in this area at national level, inter alia with EU support and the use of EU funds	188
3.5.4	Summary of policy measures	188
CHAPTER 4	EXISTING SITUATION AND PROVISIONS BASED ON EXISTING POLICIES AND EXISTING MEASURES.....	191
4.1	Devising a scenario of existing policies and measures	191
4.2	Estimated development of the main external factors affecting the energy system and the greenhouse gas emissions.....	192
4.2.1	Greenhouse Gas Emissions and Removals	192
4.2.2	Sectoral changes expected to affect the energy system and the greenhouse gas emissions	192
4.2.3	Global energy trends, international fossil fuel prices, EU ETS carbon price	194
4.2.4	Technology cost developments.....	195
4.3	Decarbonisation dimension.....	196
4.3.1	Greenhouse Gas Emissions and Removals	196
4.3.2	Renewable energy	201
4.4	Energy efficiency dimension.....	212
4.4.1	Current primary and final consumption of energy in the economy and by sector	212
4.4.2	Current capacity for high-efficiency cogeneration and efficient district heating and cooling	218
4.4.3	Forecasts taking into account existing policies, measures for the primary and final consumption of energy for each sector	219
4.4.4	Cost-optimal levels of minimum energy performance requirements resulting from national calculations.....	224
4.5	Energy security dimension	231
4.5.1	Current energy mix, domestic energy sources, dependence from imports	231
4.5.2	Forecasts regarding the developments in respect of existing policies and measures.....	235

4.6	Internal energy market dimension	236
4.6.1	Electricity interconnectivity.....	236
4.6.2	Energy transmission infrastructures	237
4.6.3	Electricity and gas markets, energy prices	239
4.7	Research, innovation and competitiveness dimension.....	247
Chapter 5	IMPACT ASSESSMENT OF PLANNED POLICIES AND MEASURES.....	249
5.1	Impact of planned policies and measures	249
5.1.1	Forecasts for the development of the energy system and the emissions and absorptions of Greenhouse gases	249
5.1.2	Assessment of the interaction and the impact of energy-efficiency/energy-saving policies.....	294
5.1.3	Assessment of interactions between policies and measures and planned policies and measures	296
5.2	Analysis of impact of key national planning policies.....	299
5.3	Overview of investment needs.....	303
5.3.1	Existing investment flows and planned investment assumptions regarding planned policies and measures	303
5.3.2	Risk factors and challenges	307
Chapter 6	Bibliography.....	310

Chapter 1 PLAN OVERVIEW AND DRAFTING PROCEDURE

1.1 Executive summary

1.1.1 Political, economic, environmental and social context of the plan

The set of interventions towards implementing reforms in the energy sector for the creation of competitive energy markets is crucial for ensuring long-term economic prospects, also contributing towards a low-carbon economy.

The increased penetration of renewable energy sources (RES) and the improvement of energy efficiency through a broader policy approach for reducing greenhouse gas emissions, also taking into account such key parameters as energy security and achieving lower costs across the energy sector, are a key objective for Greece.

1.1.2 Overall strategy in relation to the five dimensions of the Energy Union

The primary objective of the Greek energy policy is to ensure the viable and sustainable development of the energy sector from production to end use, also protecting the environment and making a contribution towards addressing climate change. Greece takes an active part in the global effort made to reduce greenhouse gas emissions, most of which is generated by the energy sector.

An additional key objective is to preserve and manage energy resources in a way that ensures the smooth, uninterrupted and reliable coverage of domestic energy needs, as well as access for all consumers (people, businesses and public sector bodies) to affordable and safe energy. The attainment of that objective relates to securing energy resources, by diversifying energy sources and flows, as well as by using domestic energy sources with a view to reducing the energy dependency of Greece, ensuring supply in the domestic market and protecting consumers in case of supply disruption and emergency.

Greece's energy sector is being restructured, with a view to developing and operating competitive and economically viable energy markets, which are supposed to function so as to offer energy products and services to consumers at competitive and transparent prices. Moreover, in a European and global decarbonisation environment, the shift to a low-carbon-intensity energy system will strengthen the competitiveness of the Greek economy, while at the same time allowing new energy technologies to enter the energy market competitively, providing opportunities for innovative investments and activities. This shift aims to transform the energy system, also ensuring sustainable results for the environment and the Greek society.

In addition to that, strengthening Greece's regional role as an energy hub is an additional tool for attaining its aims both in terms of energy and development.

The restructuring and shift of the energy sector, in the context of the commitments and targets that are based on the Paris Agreement, are also inseparably linked to the global Sustainable Development Goals (SDGs).

These sustainable development goals are associated with the necessary shift to new production and consumption standards, the need for sustainable cities, the elimination of poverty, the establishment of flexible infrastructure and the promotion of sustainable industrialisation and innovation. The above aims are the components of a sustainable development model which aims to ensure, in addition to fiscal stability, the restructuring of production, the rational use of resources and, primarily, non-discriminate and unhindered access to basic goods and services for all.

In recent decades, the Greek economy has been based primarily on the services sector, which represents a significant part of the Greek gross domestic product (GDP). Industry represents less than 15 %, and the share of primary agricultural production in the GDP is equally low despite employing 14 % of Greece's workforce. Tourism, the public sector and shipping dominate the services sector. Greece's GDP rose by 0.2 % in 2016 and 1.4 % in 2017 and, following a period of economic recession, further growth, by more than 2 %, is expected in the following years. To date, a significant contribution to that growth has been made by tourism and increased industrial production. There are signs of recovery in the labour market too. Employment rose approximately by 2 % in 2016 compared to the previous year (2015), and the similar rates were recorded in 2017 and 2018. However, based on recent analyses and forecasts, a significant demographic decline is expected in the following decade, which will have a serious impact on all economic sectors.

The structure and dynamics of the Greek economy, employment and demographic developments have a serious impact on the energy sector as they largely determine the level of energy demand.

In recent years, Greece has implemented a large number of reforms in the energy sector, under highly adverse conditions. In addition to the structural reforms already implemented and planned for the energy sector, Greece has developed a holistic sustainable development strategy which aims to increase the contribution of processing and of the primary sector, the volume of exports (which has already been evident in the last two years), productivity and competitiveness. This will be achieved partly by focusing on key areas of innovation and high added value, making good use of Greece's comparative advantages and, most importantly, by investing in its qualified human resources. Greece is supporting and promoting

the effort made to strengthen the role of consumers and the engagement of end users in the energy market, which is capable of creating new jobs and speeding up the development of innovative technologies and applications. A significant impact is expected from the introduction of new institutions, such as that of energy communities, and the technological development of power distribution networks (smart grids and meters). Greece has implemented protection policies for vulnerable customers in the energy sector. More specifically, as a result of the previous years' economic crisis and based on official statistics, 29 % of the Greek households were unable to ensure thermal comfort conditions at home and approximately 40 % of them delayed in paying their energy bills in 2016. However, Greece is implementing targeted policies to address this issue, thus being above the EU average in respect of expenditure indicators for fighting energy poverty.

The energy sector is one of the most important pillars in terms of policy development and implementation in the context of Greece's growth strategy for the next decade.

Breakthroughs are expected to occur in the next decade in the field of power supply in Greece, as the share of RES in energy generation is expected to increase significantly and gradually replace the use of fossil fuels. The policies to be adopted aim at integrating RES in the market in electricity in a competitive manner. However, the anticipated reduction in the mining of lignite and its use for power generation purposes will have a direct and indirect impact on growth and employment in lignite-producing areas and will be felt by the local communities. Therefore, specific transition policies will have to be developed.

Accordingly, in the transport sector, the use of vehicles powered by alternative fuels and electricity, the sharp drop in the unit consumption of energy per type of vehicle, the use of second-generation biofuels, the complete electrification of railway infrastructure and the increase in the share of track-based modes of transport in the overall transport work will, by the end of the next decade, totally transform the technological structure and fuel mix used in the transport sector, thus impacting the national economy as a whole.

Improving energy efficiency in all fields of consumption is the biggest endeavour and challenge for the public policies to be implemented in the next decade. Therefore, it is an absolute and horizontal priority that should cover the entire scope and mix of policies and measures to be adopted. Energy savings achieved through improved energy efficiency have a directly impact on how energy is consumed, on the technologies used and on the coverage of consumer energy needs, also making a substantial contribution towards improving the competitiveness of all industrial activities.

Moreover, savings in the energy sector help increase domestic value added and integrate innovation across the scope of domestic entrepreneurship.

Greece needs to maintain low energy demand, or even reduce it, while trying to achieve economic growth. Consequently, reducing energy intensity and greenhouse gas emission intensity in all sectors (industry, households, tertiary sector, transport and primary sector) is a priority objective.

Reducing energy intensity will also help reduce energy dependence, which is also an important objective. Energy dependency on imports is relatively high (73.6 % in 2016), just like in the rest of the EU, in comparatively small developed economies in particular. Deploying domestic energy sources and improving energy efficiency will make a contribution in this direction.

To implement the energy policy measures and attain the relevant energy and environmental targets, it is necessary to radically transform the energy system over the next decade and, therefore, to implement significant investments in utilising the potential for domestic energy generation, energy networks, energy infrastructure as well as energy consumption and management. The estimated value of the relevant investments that need to be implemented in the next decade, using both private and public funds, exceeds EUR 32 billion, thus having a positive impact on Greece's development path.

Major investments have been planned and scheduled in renewable power generation, in the transformation of the network and the introduction of smart meters in power distribution, in power transmission networks (islands and cross-border interconnectors), in natural gas networks and infrastructures, in hydrocarbon exploration, in the energy upgrading of buildings, in transport infrastructures and in technological research.

The national targets for the next decade are looked into in detail in this national climate and energy plan (NECP) on a mid-term basis, up to 2030, and should serve as a basis for an ambitious long-term strategy aiming to minimise greenhouse gas emissions by 2050, with intermediate milestones for 2040. Therefore, the greenhouse gas emissions dimension is the first and foremost component of the NECP structure.

The national plan also elaborates on the five dimensions of the Energy Union, i.e. decarbonisation (which is broken down into two distinct sections: greenhouse gas emissions and renewable energy sources), energy efficiency, security of energy supply, energy market, and innovation and competitiveness.

In preparing this plan, a significant contribution was made by the technical working groups, which – in cooperation with the measures, policies and models processing group, in accordance with Ministerial Decision No ΔΕΠΕΑ/οικ. 170744 (Government Gazette, Series II, No 304/02.02.2018) – provided assistance both with the collection of the required data and the development and processing of the relevant sections. This procedure represented essentially the initial stage of consultation with technical experts from specific entities playing an institutional role in respect of the topics discussed in the sections concerned, who helped ensure the technical integrity and completeness of this plan. The measures, policies and models processing group drafted this plan under the supervision of the NECP committee.

Finally, it should be stressed that the preparation of the NECP is part of a broader and ongoing framework of consultation with all relevant stakeholders and the civil society, with a view to assessing and incorporating the relevant proposals in each topic and policy priority at the levels of objectives, measures and policies. The final national climate and energy plan for 2030 and the long-term low-carbon strategy are expected to be completed in 2019 and will serve as a basis for preparing regulatory acts and instruments, developing strategic plans and implementing financial instruments and tools.

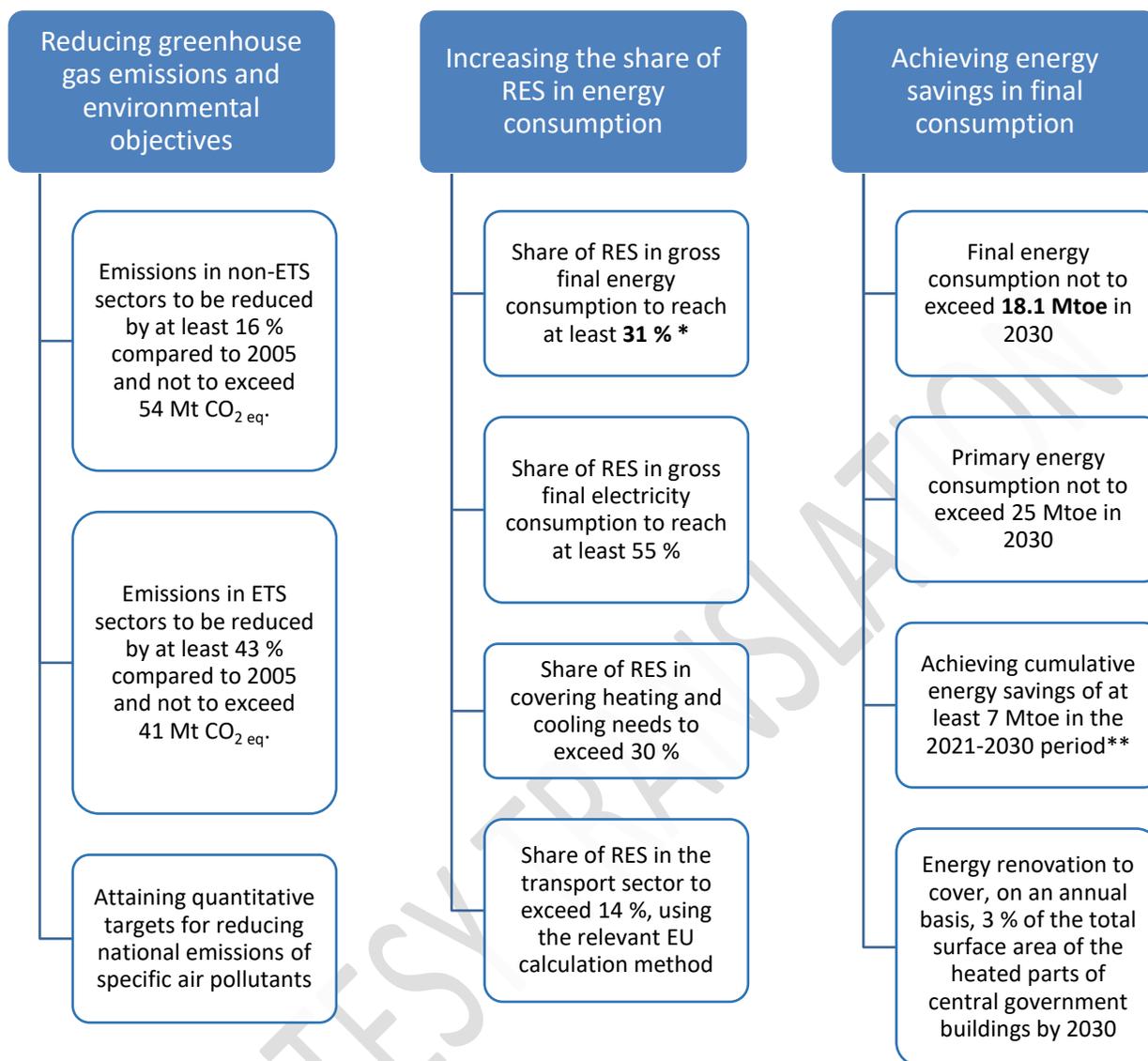
1.1.3 Summary table laying down the key objectives, policies and measures of the plan

Chart 1 below shows the individual quantitative targets in the context of attaining the national energy and environmental objectives for 2030. Please note that account was also taken of the attainment of the corresponding objectives for 2020. Accordingly, Table 1 lists the key policy priorities for each dimension of the national climate and energy plan, which are deemed necessary for attaining these objectives. These policy priorities are the axes for planning and applying/implementing specific measures under each dimension.

All these policy priorities and the specific measures resulting from their implementation are part of an integrated plan for the optimal attainment of the national energy, environmental, socio-economic and development objectives, which requires consistency, horizontal combination and coordination in monitoring the priorities and implementing the measures.

A key requirement for attaining the objectives set out in the context of NECP is to understand that the progress made in each individual sector automatically affects that made in the other sectors, and consequently the impact of the measures that are finally planned and implemented does not relate to or affects just one topic and section of the NECP, but has a bearing on the overall development of the energy system.

COURTESY TRANSLATION



* Without taking into account the contribution of RES in covering cooling needs

** The target will be recalculated based on the ex-post final energy consumption data for the 2016-2018 period

Chart 1: National energy and environmental objectives for the 2021-2030 period in the context of EU policies.

Table 1: Key policy planning priorities.

GHG emissions and removals
PP1: Reduction of emissions from conventional power plants and from the interconnection of autonomous island systems
PP2: Promotion of natural gas as an intermediate fuel for the decarbonisation of the energy system
PP3: Promotion of RES
PP4: Improvement in energy performance of buildings, industry and infrastructures
PP5: Reduction of emissions in the transport sector
PP6: Reduction of fluorinated gas emissions
PP7: Reduction of emissions in the agricultural sector
PP8: Emission reduction measures in the tourism sector
Renewable energy sources
PP1: Promoting RES power generation technologies - Achieving zero operating support for financially competitive ones
PP2: Smooth functioning of the authorisation and physical planning framework
PP3: Promoting dispersed RES systems and strengthening the participation of local communities / consumers
PP4: Inclusion of RES in energy networks
PP5: Statutory obligation for a minimum share of RES in covering the energy needs of buildings
PP6: Strengthening the use of RES systems for covering thermal and cooling needs
PP7: Coupling energy sectors to promote optimal penetration of RES
PP8: Promoting the use of biofuels in transport
PP9: Promoting the use of electricity and other RES fuels in transport
Energy efficiency
PP1: Improvement in energy efficiency of public buildings
PP2: Improvement in energy efficiency of private buildings
PP3: Promoting market mechanisms and energy audits
PP4: Horizontal measures to improve energy efficiency
PP5: Improvement in energy efficiency of industrial sector
PP6: Improvement in energy efficiency of transport sector

PP7: Improvement in energy efficiency of electricity and gas infrastructures
PP8: Promoting measures for modernising water/sewage and irrigation infrastructures
Security of supply
PP1: Increasing the diversification of energy sources and supply from third countries, storage and demand response
PP2: Reducing energy import dependency from third countries
PP3: Readiness of Greece to cope with constrained or interrupted supply of an energy source
PP4: Deployment of domestic energy sources
Energy market
PP1: Strengthening interconnectivity with neighbouring countries for power transmission purposes
PP3: Strengthening competition in the markets of electricity and natural gas
PP4: Protecting consumers and addressing energy poverty
PP2: Promoting gas transmission, distribution and storage infrastructure projects
Research, innovation and competitiveness
PP1: Promoting innovative energy saving technologies
PP2: Promoting innovative decarbonisation technologies
PP3: Digitisation of energy networks - smart networks
PP4: Promoting innovative transport technologies
PP5: Promoting innovative energy storage applications
PP6: Implementing horizontal measures to improve the conditions for research
PP7: Promoting entrepreneurship through research and innovation actions which are part of market functions
PP8: Optimising/adjusting the support framework and schemes for implementing investments intended to strengthen competitiveness
PP9: Strengthening competitiveness by setting up and operating special funds
PP10: Promoting circular economy

1.2 Review of the current state of affairs in terms of policy

1.2.1 National and Union energy system and policy framework of the national plan

The national policy framework within the dimensions of the national energy and climate plan is governed by the respective Union framework for the implementation of which a sufficiently broad regulatory and statutory national framework has been developed. This framework is updated by taking into account its operating results and the developments occurring at national, regional and European levels. In the context of the NECP, the basic key regulatory and statutory framework is set out in the respective sections of the text.

1.2.2 Existing energy and climate policies and measures in respect of the five dimensions of the Energy Union

With a view to attaining Greece's objectives for 2020, a number of measures and policies have been adopted and are being implemented to date. The existing measures and policies on each one of the five dimensions of the plan are presented below.

1.A Dimension 'Decarbonisation' - GHG emissions and removals

A total of 21 policy measures have been implemented to date, with a view to reducing greenhouse gas emissions. These policy measures consist of a mix of policy measures from different categories (technical, regulatory and financial).

The policy measures already implemented with a view to reducing greenhouse gas emissions, as included in the 7th National Communication of Greece in the context of the United Nations Convention on Climate Change, are presented in the following subsections.

Generally, policy measures to improve existing power plants and promote renewable power generation make the most significant contribution towards attaining the objective of reducing greenhouse gas emissions for 2020. Also, policy measures for promoting the use of natural gas in industry, households and the tertiary sector and the implementation of energy efficiency improvement measures also make a significant contribution towards attaining the objective for 2020.

Directives 2010/75/EU and 2015/2193/EU, read in conjunction with the decisions on best available techniques have introduced strict emission ceilings (primarily, but not only, for SO₂, NO_x and PM_{2.5}) for power plants. These ceilings pose significant difficulties in the effort made by existing plants to comply at a reasonable cost, thus constituting an additional constraint. Finally, additional indirect constraints are

introduced by the Framework Directive on Waste (Directive 2008/98/EC), as amended by Directive 2018/851/EU, as well as by the draft Directive on the market in electricity.

The above policy measures, including those implemented in the field of transport and the reclamation of organic waste, play a major role in attaining the objective for 2030.

Decarbonisation measures - GHG emissions and removals

- ***Improvement in energy efficiency of power plants***

The energy efficiency of power plants is improved by gradually withdrawing and replacing less efficient and polluting thermal power plants, as well as by building and operating new thermal power plants in compliance with best available techniques, in conformity to Directive 2010/75/EU (IED) on industrial emissions and Directive 2015/2193/EU (MCPD) on the limitation of emissions of certain pollutants into the air from medium combustion plants. Also, the increased penetration of natural gas in power generation and the interconnection of the power system of the islands with that of mainland Greece are important policy measures which, in turn, contribute towards improving the energy efficiency of the plants.

- ***Encouraging the use of natural gas***

The use of natural gas is encouraged through measures of a political nature, e.g. the liberalisation of the energy market, the adoption of tax incentives, the deduction of interconnection charges, ensuring a competitive price for gas compared to other fuels. Encouraging the use of gas and its penetration in the tertiary and residential sectors is apparent, firstly due to the above incentives and secondly due to additional actions in that direction, e.g. targeted advertising focusing on the economic, energy-related and environmental benefits resulting from its use, as well as the ongoing expansion of gas networks and relevant infrastructure.

The penetration of gas is also apparent in the industrial sector, as achieved through the liberalisation of the energy market, the competitive pricing policy used compared to other conventional fuels, the discount granted in interconnection charges, as well as the direct availability of gas intended to be used extensively as basic fuel and the accessibility of industrial plants to gas as a result of the expansion of networks and infrastructure.

The contribution from the functioning of the emissions trading system (ETS) is also important, as choosing and using natural gas help reduce greenhouse gas emissions to a great extent. Finally, the constraints resulting from the implementation of the applicable authorisation procedure for specific categories of industrial plants has also played an important role.

In conclusion, the most important policy measure in transport consists in encouraging the use of gas in public transport vehicles, waste collection vehicles, as well as other dual-fuel vehicles. There are incentives in place for replacing private vehicles with new gas- and biofuel-fired vehicles or hybrid vehicles.

- ***Promoting RES***

Policy measures to further promote the penetration of RES in power generation are implemented in the context of attaining the target for the share of renewable electricity in gross electricity consumption for 2020, as set by the transposition of Directive 2009/28/EC into the Greek legislation.

Policy measures for further promoting the penetration of RES in transport through the use of biofuels have been launched in the context of attaining the target for the share of renewable energy in transport, as set by the transposition of Directive 2009/28/EC into the Greek legislation.

A detailed description of policy measures for the promotion of RES is provided in the following section.

- ***Implementing energy efficiency improvement measures***

The most important measures to improve energy efficiency and set up CHP plants in the industrial sector were implemented in the context of the 1st national climate change programme through the laws on development, i.e. Law 2244/1993, and the different operational programmes. More specifically, targeted energy savings and RES interventions were funded. These interventions consisted in developing and implementing energy recovery or substitution systems in the production process. Substitution related primarily to liquid fuels being substituted by LPG or NG. As regards RES, funding was granted primarily for autoproduction equipment procurement projects. Funding was also granted for the implementation of bioclimatic interventions and structures and small-scale construction interventions, as well as for the streamlining of equipment, the upgrading of facilities and the installation of new energy-efficient technologies intended to ensure energy savings. Funding was also granted for carrying out energy audits aiming to ensure the energy upgrading of energy-intensive facilities, as well as for providing education and training to the staff of undertakings and organisations.

In addition to that, the national energy efficiency action plans include policy measures for promoting the rational use of energy and energy savings in the residential, tertiary, industrial and transport sectors. These measures aim primarily to improve the energy efficiency of residential buildings and encourage the use of high energy efficiency appliances and efficient heating equipment. These actions are supported by large number of laws, which have contributed towards transposing the relevant Union law into the Greek legislation (Law 3661/2008, Law 4122/2013, Law 3855/2010 and Law 4342/2015).

A detailed description of energy efficiency improvement policy measures is provided in the relevant section.

- ***Implementing measures in road transport***

The main intervention axes and the policy measures implemented in road transport include promoting interventions in the transport network, public transport and all types of vehicles, implementing measures to address air pollution caused by road vehicles in cities, as well as adopting tax measures. They also include introducing biofuels in road transport and promoting the use of natural gas in public transport.

The mitigation of greenhouse gas emissions in transport is also supported by a variety of Union policies adopted through regulations and directives, which have been transposed into the Greek legislation. The key regulations concern reducing CO₂ emissions from new passenger cars and light commercial vehicles, i.e. Regulations (EC) No 510/2011 and (EC) No 510/2011, respectively, and the regulations in force on the environmental and safety requirements of tyres and gear shift indicators. As far as directives are concerned, they relate to the availability of information, the quality of fuels and the deployment of alternative fuels, i.e. Directives 1999/94/EC, 2009/30/EC and 2014/94/EU, respectively.

- ***Reclamation of organic waste and biogas***

A package of policy measures has contributed towards reducing the quantities of biodegradable waste in solid waste treatment facilities. Measures were promoted for collecting bio-waste separately, recycling, recovering energy and using sludge as fertiliser in agriculture.

It should also be stressed that an effort was made to set up biogas collection and combustion plants in landfills operating in cities with a population of more than 100 000. For example, a sewage treatment plant has been set up in Psyttaleia, which provides services to approximately 4 million people living in Attica. Part of the sludge produced there is processed under anaerobic conditions for the production of biogas. Also, the biogas produced covers the energy needs of the waste sewage treatment plants.

A specific authorisation scheme has been adopted for the development of biogas projects, which provides for specific conditions and criteria to be used for the authorisation of heat and power production plants by the use of biogas derived from the anaerobic treatment of biomass. Please note that there are certain biogas-fired power plants in operation already, and a significant number of such plants is currently in a development and/or authorisation phase.

- ***Reduction of fluorinated gas emissions***

To control fluorinated greenhouse gas emissions, including hydrofluorocarbons, the EU has adopted two strategies, as set out both in Directive 2006/40/EC relating to air-conditioning systems used in small motor vehicles and Regulation (EU) No 517/2014 relating to all other key applications using fluorinated gases.

The two emissions reduction strategies described in the abovementioned Regulation are: preventing leakage and controlling the use of fluorinated gases. Measures to prevent leakage and emissions include: leak checks, by-product checks, saving products and equipment at the end of their lifecycle, training and information to users through special labelling and product information.

Corresponding measures to control the use of fluorinated gases include: a ban on new applications, a ban on the use, and a phasing out, of the supply of hydrofluorocarbons.

Conformity checks under these EU Regulations are carried out by the competent authorities in the context of their functions. The competent authorities impose penalties for failures to abide with the law. It should be stressed that the EU and the Member States aim, in the context of the Kigali Amendment to the Montreal Protocol, to phase out the use of hydrofluorocarbons based on specific binding timeframes.

- **Common agricultural policy (CAP) - Green direct payments**

The latest revision of the common agricultural policy (CAP) introduced specific measures for green direct payments, relating to the provision of environmental public goods, by linking sustainable food production, sustainable management of agricultural land and environmentally friendly practices and processes.

Farmers who fail to comply with EU legislation on environmental health, public health and animal health, animal welfare and land management are expected to receive lower direct payments depending on the extent, permanence, seriousness and repeatability of their failures.

The lower agricultural land use intensity rates and the rules adopted for mandatory observance of the cross-compliance system regarding animal waste help reduce greenhouse gases. Moreover, observance of the cross-compliance system helps reduce the use of fertilisers, and therefore N₂O emissions.

- **Rural development programme (RDP) - increase in organic crops**

Organic farming and the reduction in the use of synthetic nitrogen fertilisers leads to a significant drop in N₂O emissions. Based on national statistics, the total area used for organic farming in Greece (fully converted and under conversion to organic farming) was 342 584 ha in 2016. The actions implemented under the RDP for the 2014-2020 period towards adopting organic farming practices and methods are expected to cover 478 318 ha of land, while the aid granted to maintain existing organic farming practices and methods will cover 241 804 ha.

Table 2 shows the contribution of the above measures towards reducing greenhouse gas emissions for the years 2020, 2025 and 2030.

Table 2: Contribution of the measures implemented towards reducing greenhouse gas emissions for the years 2020, 2025 and 2030.

Action for reducing greenhouse gas emissions	Sector	Start year	Effect on mitigation (kt CO ₂ eq)		
			2020	2025	2030
Improving conventional energy generation system	Energy	1996	11.700	8.200	5.500
Encouraging the use of natural gas in residential sector	Energy	1998	304	330	366
Encouraging the use of natural gas in the tertiary sector	Energy	1998	250	350	430
Encouraging the use of natural gas in	Energy	1996	671	861	1.094

Action for reducing greenhouse gas emissions	Sector	Start year	Effect on mitigation (kt CO ₂ eq)		
			2020	2025	2030
industry					
Encouraging the use of natural gas in transport	Transport	1999	17	20	22
Promoting the use of RES in power generation	Energy	1994	15.000	19.000	25.000
Use of biofuels in transport	Transport	2005	650	810	960
Implementing energy efficiency measures in industry (national energy efficiency action plan)	Energy, industry / industrial processes	2008	300	400	500
Implementing energy efficiency measures in the residential and tertiary sectors (national energy efficiency action plan)	Energy	2008	2.930	3500	4000
Measures for road transport	Transport	1983	340	500	600
Reclamation of organic waste	Waste management	2002	800	900	1000
Recovery of biogas	Waste management	2002	500	600	700
Reducing fluorinated gas emissions	Industry / industrial processes	2004	460	1400	2300
Common agricultural policy (CAP) - Green direct payments: Reducing agricultural land use intensity rates and improving animal waste management	Agriculture	2007	430	500	600
Rural development programme (RDP): Increasing organic crops	Agriculture	2007	350	400	450
Common agricultural policy (CAP) - Green direct payments: Reducing the use of fertilisers	Agriculture	2007	125	150	200

Some measures for addressing the issue of fluorinated gases, e.g. a ban on the production of new domestic coolers and freezers primed with fluorinated gases with GWP>150, fire protection equipment which contains fluorinated gases HFC-23, training and certification of technical personnel handling fluorinated gases, installation of leakage detection systems in large cooling, air conditioning and fire protection systems, as well as the use of passenger and specific commercial vehicles which are primed with fluorinated gases without GWP>150, will make a rather limited contribution towards the 2020 and 2030 targets. Although these measures can help reduce greenhouse gas emissions, they are not mentioned specifically in the above table as the assessment of their potential impact cannot be sufficiently substantiated.

Moreover, some measures whose implementation started recently, e.g. the implementation of green logistics, as established by virtue of the joint ministerial decision¹ setting out the operating conditions for the system used to record the environmental performance of undertakings engaged in logistics, have not been assessed currently.

1.B Dimension ‘Decarbonisation’ - Renewable energy

A total of 45 different policy measures have been implemented to attain the three sub-targets for ensuring the highest possible penetration of RES. Table 3 shows the total number of policy measures for each sub-target (including cross-classified measures or measures which can be implemented in several sectors), along with its breakdown into the different categories of policy measures.

Table 3: Classification of existing policy measures under the different sub-targets and categories of measures.

	RES in power generation	RES in heating and cooling	RES in transport
Regulatory	22	8	11
Technical infrastructure	4		1
Financial	3	4	2

¹ Joint Ministerial Decision No. 1023/2018 Union 61,4 54,8 46,7 40,5 39,3

Policy measures to promote RES

- ***Policy measures to promote RES in power generation***

Aid scheme for RES power generation

In early 2016, a new framework was put in place for supporting RES and HECHP plants, which is expected to constitute the most important policy measure for supporting RES plants up until 2030.

As regards the support scheme in particular, Law 4414/2016 introduced a new framework for supporting RES and HECHP plants in early 2016 to ensure:

- ✓ harmonisation with the Guidelines on State aid for environmental protection and energy (2014-2020) (OJ C 200, 28.6.2014);
- ✓ gradual inclusion and engagement of RES and HECHP plants in the market in electricity.

More specifically, Law 4414/2016 envisaged the provision of support to these plants through a sliding feed-in premium (sFiP) scheme, which is calculated on the basis of the difference between the specific market price for the RES/HECHP technology concerned and the reference price.

The reference price was determined by using a typical project per RES technology in respect of construction and operating costs as well as productivity (utilisation rate) for each category based on a reasonable rate of return on funds invested. Any additional capital aid granted under the national development investment programmes will be taken into account by the use of a specific impairment methodology, to prevent excessive operating aid for these projects. It should be stressed that it will be possible for existing RES plants to migrate to the new operating support and market participation scheme voluntarily.

Small plants (wind plants with a capacity of up to 3 MW, other RES plants of up to 500 kW as well as innovative/demonstration RES projects) may be granted operating support in the form of a fixed price, thus ensuring for these projects – which are of local importance and have a distributed power generation footprint – smoother development in the domestic energy system, thus avoiding the imposition of obligations which are disproportionate to their mode of operation and their potential impact on the market in electricity.

Exceptions in respect of market participation obligations were granted only for projects on the non-interconnected islands (NIIs) up until the energy market is fully liberalised on these islands or until they are interconnected with the mainland system. More specifically, as soon as the necessary infrastructures are completed and the daily electricity markets become fully operative, provision has been made for

shifting necessarily to an sFiP scheme and direct participation in the market in electricity on the NII concerned. There are similar provisions in place in case an NII is interconnected with the interconnected system and the interconnected network. Provisions have also been made for the NIIs in respect of matters relating to sliding feed-in premium (sFiP) and feed-in tariff (FiT) contracts.

Finally, the committee responsible for monitoring the support scheme for RES and HECHP plants was set up, as provided for by Article 12 of Law 4414/16, to monitor the support scheme performance and results with due account taken of technological and financial developments which may affect the evolution of weighted power generation costs, also ensuring the necessary conditions for investment security and continuity. Please note that the new support scheme was approved by the EU by virtue of **Decision 7272/16.11.2016**.

In addition to that, a support scheme was put in place on 1 January 2017 in the form of operating support for RES and HECHP plants using a competitive procedure with a view to reducing the cost for consumers, under which only those entities that have passed the procedure successfully will be granted operating support. To ensure optimal planning of the procedure and gain experience in the field concerned, Law 4414/2016 provided for having the Regulatory Authority for Energy (RAE) conduct a trial competitive procedure for photovoltaic plants under two capacity categories with a total capacity of 40 MW, also setting the ceilings for taking part in the competitive procedure.

RAE conducted the trial competitive bidding procedure for photovoltaic plants in December 2016. As regards photovoltaic plants with a capacity of less than 1 MW, bids were submitted for a total of 13 different projects and 9 projects were selected at prices ranging between 94.97 EUR/MWh and 104 EUR/MWh and an average weighted award price of 98.99 EUR/MWh. As regards photovoltaic plants with a capacity of more than 1 MW, bids were submitted for a total of 13 different projects and 7 projects were selected at prices ranging between 79.97 EUR/MWh and 88 EUR/MWh and an average weighted award price of 83.3 EUR/MWh.

A ministerial decision laid down the technologies and/or categories of RES and HECHP power plants which are eligible for an operating support scheme through a competitive bidding procedure, as well as the framework used for designating the competitive procedures as technologically neutral or not, also describing the capacity allocation procedure for participation and setting out other provisions. The above ministerial decision also explained which RES technologies and project categories are exempted from the obligation to take part in competitive bidding procedures and set out the criteria and conditions for said exemption to continue to apply. Please note that the new support scheme was approved by the EU by virtue of **Decision 9102/04.01.2018**.

Finally, a subsequent ministerial decision adopted in 2018 laid down the capacity to be put to tender through competitive bidding procedures for the years 2018, 2019 and 2020, the minimum number of competitive bidding procedures to be conducted each year, the maximum permissible bidding price for each competitive bidding procedure and the fee to be paid for participation in a competitive bidding procedure.

The ministerial decision concerned explained that the following procedures would be conducted in 2018, 2019 and 2020: at least six technology-specific competitive bidding procedures (i.e. three for photovoltaic plants and three for wind plants), at least two joint competitive bidding procedures and at least one area-specific competitive bidding procedure, with a total tendered capacity of ~3 GW.

In this context RAE has already issued calls for the first technology-specific competitive procedures for 2018, which were completed in July 2018 and repeated in December 2018, resulting in the selection of new projects with a total installed capacity of almost 500 MW.

Table 4: Results of competitive bidding procedures for RES projects in 2018.

Conduct of procedure	Capacity put to tender (MW)	Capacity awarded (MW)	Average weighted reference price (EUR/MWh)
Category	Photovoltaic plants: 0-1 MW		
Jul 2018	70	53.48	79.02
Dec 2018	94	61.94	66.66
Year total		115.42	72.39
Category	Photovoltaic plants: 1-20 MW		
Jul 2018	230	53.48	79.02
Category	Wind plants: 3-50 MW		
		MW	RP
Jul 2018	300	170.93	69.53
Dec 2018	229	159.65	58.58
Year total		330.58	64.24
All technologies		499.48	

It follows from the above that competitive procedures can result in lower operating support prices for RES power plants and therefore in lower charges to consumers, especially where the RES technology concerned is commercially mature and the level of competition is high.

As regards the obligations for participation of RES producers included in the new support scheme, plans have already been made for developing the required framework for participation in the market in electricity and for the assumption of balancing obligations, as well as for amending the system and network management codes. Also, the operating aid register is expected to facilitate the monitoring and financial assessment of the implementation of the new support scheme.

Authorisation

The existing framework both for the authorisation and siting of RES plants has made a significant contribution to the current penetration levels. Also, significant improvements have already been implemented in previous years or are currently being planned with a view to ensuring the smooth and effective functioning of this framework for the implementation of RES power plants by 2030.

A summary of the key stages of the authorisation framework for RES power plants is presented in Chart 2.

The key components of the authorisation procedure are: the deadlines for the assessment and/or acceptance of the relevant applications and bids as well as the effective periods of the relevant authorisations, the procedures and criteria used as a basis for the competent authorities and bodies to grant an extension.



Chart 2: Key stages of the authorisation framework for renewable power generation projects.

Please note that the existing framework provides for exemptions from the obligation to obtain a generation authorisation as well as all subsequent authorisations (establishment and operating authorisations) for natural or legal persons engaging in RES or HECHP power generation.

The competent bodies engaged in the authorisation procedure for renewable power generation projects are listed in the table below. They are broken down into those responsible for the issuance and confirmation of the main authorisations and the conclusion of the main contracts and those responsible for issuing an opinion and/or giving approval on the basis of specific inspection procedures carried out on matters falling under their remit.

Table 5: Bodies engaged in the authorisation framework for renewable power generation projects.

Bodies responsible for issuing authorisations or concluding contracts	Bodies responsible for issuing certificates or giving opinions
Regulatory Authority for Energy Operators (ADMIE/DEDDIE) Ministry of Environment and Energy Decentralised Administrations or elected regional authorities DAPEEP (ex LAGIE) Competent Directorate for Town Planning Ministry of Finance (for strategic investments)	CRES Hellenic Civil Aviation Authority Forestry agencies Archaeology agencies Hellenic National Defence General Staff Regional/municipal councils Bodies responsible for protected areas (as appropriate)

Please note that significant improvements were made in previous years towards streamlining the functioning of the authorisation framework for renewable power generation projects and making it more effective. More specifically, Law 3851/2010 provided for the ‘preliminary environmental assessment and evaluation’ and the ‘approval of environmental conditions’ procedures and abolished the obligation to obtain a preliminary environmental assessment and evaluation before a generation authorisation is granted by RAE.

Moreover, Law 4014/2011 abolished the ‘authorisation for an intervention in a forest or forested area’ as an independent administrative act and provided for its conditions to be included in the ‘decision on the approval of environmental conditions’. Therefore, after a generation authorisation is issued, to obtain an establishment authorisation, the party concerned has to request simultaneously the issuance of:

- ✓ a connection offer by the competent operator;
- ✓ a decision on the approval of environmental conditions or standard environmental commitments.

Also, the procedures used and documents submitted at the different stages of the environmental authorisation procedure were standardised, and a relevant electronic environmental register was put in place for the electronic submission and processing of the environmental authorisation procedure.

Based on experience, the environmental authorisation procedure for projects which are exempted from the obligation to obtain a decision on the approval of environmental conditions, for which only standard environmental commitments need to be issued, is completed within less than 12 months on average. As regards other projects, however, there are considerable differences both in terms of technology and in terms of project size and location due to which the length of the environmental authorisation procedure may vary substantially, even taking longer than 3 years to complete.

As regards renewable power generation projects that utilise biomass/biogas in particular, there have been delays in the authorisation procedure lately, also given the increased interest on the part of investors, which are primarily due to the absence of a coordinated policy framework and priorities depending on the raw material and technology used, as well as due to shortcomings, or occasionally due to contradictory provisions, in the institutional framework, which act as roadblocks to the authorisation procedure, at a regional level in particular.

Due to the above reasons, the Ministry of the Environment and Energy set up and staffed a working group in order to prepare a recommendation on revising the institutional framework for power generation through the use of biomass and biogas (Ministerial Decision No ΑΠΕΗΛ/Α/Φ18/οικ.181735/04.08.2016).

Finally, Law 3894/2010 on the acceleration and transparency of the implementation of strategic investments helped speed up renewable power generation projects which met the inclusion criteria. In fact, this legislative framework facilitates the implementation of projects in respect of matters relating to the approval of environmental conditions, town planning rules, the implementation of mandatory expropriation and the granting of the required authorisations. Also, Law 4146/2013 has enhanced and expanded the scope of Law 3894/2010 by simplifying the authorisation procedure in order to make it easier, more streamlined and more attractive to would-be investors and renewable electricity producers.

Siting of RES plants

As regards the siting of RES projects, the specific physical planning and sustainable development framework for renewable energy sources sets out the main directions and the general rules for the siting of RES projects across Greece. This framework contributes towards making known in advance the categories of areas in which the establishment of RES projects is partly or entirely prohibited or which are suitable for this purpose, as well as setting out the establishment conditions, taking into account such criteria as the nature, surroundings, carrying capacity and anthropogenic activities in each area of establishment.

It should be stressed that the existing specific physical planning and sustainable development framework for renewable energy sources (as adopted in 2008) is being revised currently to take into account new technological data in the fields of renewable energy, environmental protection and carrying capacity.

Additional legislative arrangements regarding the siting of RES plants concern the possibility of relocating a RES or HECHP plant and the imposition of sanctions for failure to comply with the law and the conditions laid down in the establishment and operating authorisations, in accordance with the regulatory framework.

Finally, Law 3851/2010 contains provisions on the siting of RES plants and forbids the use of parcels of highly productive agricultural land for carrying out any activity other than farming and power generation by the use of RES plants, including photovoltaic plants, with more stringent provisions applying in Attica. However, Law 4015/2011 have temporarily forbidden the establishment of photovoltaic plants in highly productive agricultural land.

Fees charged to RES plants

The fees applied to RES plants, as charged to renewable electricity +producers, aim either to promote RES through compensatory benefits granted to local communities and identify businessmen who are genuinely interested, or to attain other objectives in the broader energy sector, such as the security of supply.

Following is a list of these fees:

1. The fee in favour of local authorities, in accordance with Law 3468/2006, which is equal to 3 % of the price, net of VAT, at which electricity is sold to the system/network operator or on the NIIIs. Electricity producers using RES systems in buildings or photovoltaic systems and auto-producers in the context of Law 3468/2006 are exempted from payment of that fee.

Joint Ministerial Decision No ΑΠΕΗΛ/α/Ε1/οικ. 23840/23.12.2014 laid down the methodology and the procedure for the distribution of the amounts that correspond to the 1 % fee to beneficiary household consumers. The distribution of the above amounts and payment thereof to beneficiaries for the years 2010 to 2014 have already been completed, and the distribution procedure for the years 2015 to 2017 will be completed in 2018. The total amount distributed for the years 2010 to 2014 stands at EUR 18 310 331.

Where the final distribution table for the amounts paid by RES plants for each municipal or local community was not issued for fear of objections being raised on grounds of questioning the administrative boundaries of these communities, the Ministry of the Environment and Energy is

preparing legislation to redefine the procedure used for looking into objections raised in respect of the administrative boundaries of local and municipal communities in which RES plants are established.

2. The transitional security of supply fee, in accordance with Law 4001/2011, as amended by Law 4203/2013, which is another form of fee charged to renewable electricity producers intended to contribute towards ensuring the security of supply.
3. Holders of generation authorisations for RES or HECHP plants have to pay to LAGIE SA each year, in favour of the special administrative account provided for by Law 2773/1999, an annual fee for retaining the right to hold a generation authorisation, in accordance with Law 4342/2015, which is equal to EUR 1/kW of installed capacity.

This obligation depends on:

- ✓ how long the generation authorisation has been held, by technology;
- ✓ the maturity of the project and the progress made in respect of its implementation;
- ✓ the area in which the project is to be sited.

If the applicable retention fee is not paid within the deadline set, the relevant generation authorisation will expire. The procedure for the determination of the obliged parties and for payment of the retention fee has been completed for two years (2015 and 2016) and is still in progress for the years 2017, 2018 and 2019. The data relating to retention by technology for the years 2015 and 2016 are listed in Tables 7 and 8, respectively.

4. Submission of a letter of guarantee upon acceptance of the final connection offer, which must take place within two months from the date of issuance of the final connection offer at the latest, in accordance with Law 4152/2013. If the final connection offer is not accepted within the deadline set, it will expire automatically. The letter of guarantee will have a duration of at least two years, which will be renewed necessarily before it expires and up until the plant is put in trial operation or, where no trial operation period is provided for, until its connection is activated. The letter of guarantee amount, per unit of requested capacity in MW, will be equal to EUR 42 000 for the first capacity segment of up to 1 MW – said amount being decreased proportionately for a capacity lower than 1 MW – EUR 21 000 for the 1-10 MW segment, EUR 14 000 for the 10-100 MW segment and EUR 7 000 for the segment in excess of 100 MW.

Table 6: Retention fee by technology for 2015.

Technology	Parties obliged to pay the fee for 2015	Parties obliged to pay the fee for 2015 who failed to do so	Capacity of generation authorisations for which a fee should be paid (MW)	Capacity of generation authorisations for which no fee was paid (MW)	Fee amount for 2015 (EUR)	Fee amount not paid for 2015 (EUR)
Total RES and HECHP	832	504	5292.52	2830.05	3,949,663.5	2,733,196.4

Table 7: Retention fee by technology for 2016².

Technology	Number of parties obliged to pay the fee	Capacity of generation authorisations (MW)	Non-activated capacity (MW)	Fee amount for 2016 (EUR)
Total RES and HECHP	370	2,780.48	2,387.05	2,251,825

Special account for RES

The special Account for RES and HECHP was set up by Law 2773/1999 and is the key tool and policy measure for the functioning of the support scheme for renewable power generation, as it uses the reserves to make payments to RES and HECHP energy producers, thus ensuring the sustainability of the support scheme for RES and HECHP power generation. In accordance with Law 4414/2016, the special account for RES and HECHP for the interconnected system and network and the NII is broken down into two sub-accounts:

- I. the sub-account of the market in electricity; and
- II. the sub-account for aid.

The table below shows the categories of income of the two sub-accounts and the corresponding amounts for the 2015-2017 period.

² The publication of payment data by LAGIE regarding the retention fee for 2016 is still pending.

Table 8: Categories of income of the two sub-accounts and the corresponding amounts for the 2015-2017 period.

Category of income (EUR million)	2015	2016	2017
Income from the market in electricity			
DAS settlement value	419.61	367.57	485.61
Imbalance settlement value	15.06	10.74	10.60
Weighted average variable cost of conventional thermal power plants	29.76	35.61	21.96
Charge to load representatives	0.0	31.92	411.46
Aid income			
Special fee for the reduction of gaseous pollutant emissions	1050.57	949.83	888.92
Tendering of remaining emission allowances	175.65	88.63	151.85
Special lignite fee	38.84	29.80	32.77

Chart 3 shows the total and discounted power generation cost by RES technology and the discounted RES aid cost for 2017.

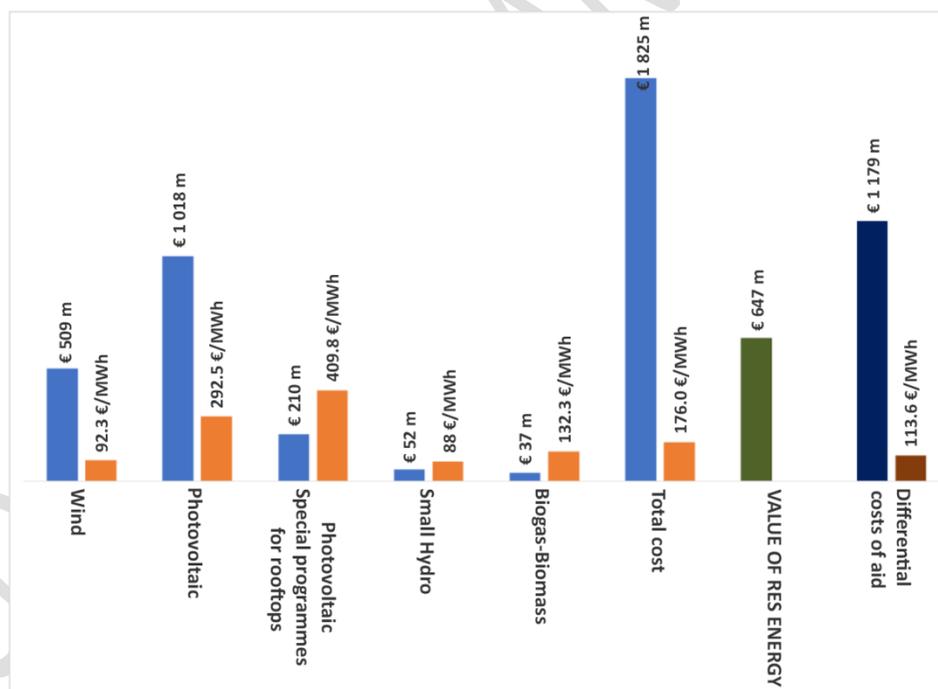


Chart 3: Total and discounted power generation cost by RES technology and the discounted RES aid cost for 2017.

Operating aid register

The operating aid register is a measure intended for the monitoring and economic assessment of the implementation of the support scheme for renewable power generation. It is an electronic platform for RES plants operating under the new support scheme for sliding feed-in premium (sFiP) and feed-in tariff (FiT) contracts.

This register contains necessary administrative and technical information regarding all operating aid contracts, as well as ex-post data on the operating aid amounts received by the owners of these plants on the basis of the relevant quantities of energy generated and fed into the network.

The operating aid register will become fully operative in 2019.

Guarantees of origin

With regard to guarantees of origin, Greece has transposed the Union legislation on the setup and operation of a system for issuing guarantees of origin in accordance with the provisions of Law 3468/2006 and by issuing a specific ministerial decision.

The registers of the guarantees of origin system are kept electronically on an information system, which has been in operation since October 2010. Guarantees of origin are issued for net electricity, as calculated using a specific methodology and certified measurements taken by meters conforming to the specifications laid down by a RAE decision.

Despite the guarantees of origin system being in harmony with the Union legislation, the guarantees of origin issued in Greece are not recognised by other Member States as there is no approved methodology for calculating the energy mix. The reason why they are not recognised is that there is no assurance in the Greek market in electricity that each MWh of RES electricity is used only once in the declaration of origin of electricity which suppliers need to provide to their consumers that they supply. In fact, while guarantees of origin are used to demonstrate the origin of electricity to a group of consumers, said electricity is still shown in the energy mix consumed by other consumers. ***Therefore, there are pending matters that need clarifying in respect of automatic revocation or any possibilities for centralised use of the relevant guarantees of origin for RES producers that are granted operating aid.***

Inclusion of RES plants in power networks

Moreover, the inclusion and operation of RES plants was strengthened significantly by the development projects implemented both regarding power transmission and distribution, whereas the projects already planned under the ten-year development plans of the competent operators are very important too.

The most important projects for the development of the Greek electricity transmission system (ESMIE) which were implemented in recent years as well as those planned for implementation by ADMIE in the following ten years, which will allow for including new RES power plants in the transmission system, are shown in Table 9. The data are based on the ten-year transmission system development plan. Please note that the ten-year development plan is updated and prepared annually by ADMIE and approved by RAE. More specifically, the ten-year development plan makes extensive reference to the penetration of RES plants in the system and provides detailed statistics on the installed capacity and power generated by each plant technology. It also details the possibility for connecting new RES plants in different critical system areas in which there has been increased interest expressed by investors for the setup of RES plants, as well as the system enhancement projects planned by ADMIE in these areas.

It should be stressed that these projects aim to promote the setup of RES plants in congested areas or areas with weak networks or in the context of projects relating to the overall development or expansion of the system and making a contribution in that direction.

Table 9: Development projects for the Greek electricity transmission system.

Area	Project	State of affairs / Year of electrification	Estimated new RES capacity (MW)
PELOPONNESE	Connection of Megalopolis High Voltage Centre (HVC) - Patras HVC - Distomo HVC Transmission Line / Acheloos HVC	2024	2 000 - 2 200 (total in Peloponnese)
	Connection of Megalopolis HVC - Corinth HVC - Koumoundourou HVC	2024	
	Enhancement of Trizinia Loop	2018	115
EVIA	Project 'Connection of Nea Makri - Polypotamos and South	2015	400 + 210

Area	Project	State of affairs / Year of electrification	Estimated new RES capacity (MW)
	Evia High Voltage Network'		
	Upgrading of 150 kV 'Aliveri-Kalamos' connection	Completed in 2013; only Amarynthos terminal is yet to be completed	
	Installation of two 400/150/30 kV autotransformers in Aliveri HVC Development of the 150 kV side of Aliveri HVC and connection thereof with the 150 kV system	2013	340-410
THRACE	Nea Santa HVC and connection thereof with the 400 kV and 150 kV systems	2016	900
	Upgrading of Orestiada-Alexadroupolis Transmission Line	2016	
	400 KV Filippoi HVC - Langadas HVC Transmission Line	2016	
	Upgrading of Nea Santa HVC - Patriarchis Intersection	2019	
INTERCONNECTION OF THE CYCLADES	Phase A (Lavrion-Syros-Tinos-Mykonos)	2018	200-250
	Phase B (Paros-Naxos and Naxos Mykonos links)	2019	
	Phase C (second Lavrion-Syros link)	2020	
	Phase D (West Cyclades)	2024	
INTERCONNECTION OF CRETE	Phases I and II	2020.2023	A new significant capacity margin is expected to be achieved

Area	Project	State of affairs / Year of electrification	Estimated new RES capacity (MW)
			for RES plants, estimated approximately at 1 000 MW in respect of the capacity of the power system.

Specific actions were implemented in recent years with a view to improving the functioning, control and safety of the system, which are expected to facilitate the promotion of RES.

The most important actions include:

- Modernising the infrastructure of ADMIE’s energy control centres.
- Upgrading the market management system at energy control centres.
- Developing systems for predicting the production of RES plants in the context of the Day-Ahead Scheduling (DAS) and of the market operation, as well as in the context of the scheduled operation of the production system.

Finally, plans have been made for amending the system and network management codes as appropriate, to bring them in harmony with Commission Regulation (EU) 2016/631 of 14 April 2016 establishing a network code on requirements for grid connection of generators (requirements for power generators), and therefore of new RES power plants too.

The most important distribution network development projects, both those implemented in recent years and those planned for implementation by DEDDIE in the years to come, relating to the inclusion and functioning of additional RES plants in the distribution network, are described in the table below.

Table 10: Distribution network development.

Projects completed	Projects planned under the 2018-2022 NDP
Grevena Substation - De-paralleling of two existing power transformers (20/25 MVA each)	Reconstruction of a substation in the Edessaios Hydroelectric Power Plant - Decommissioning of the three-winding transformer and installation of two 20/25 MVA transformers, as well as replacement of the existing MV output breakers.
Development of an electronic application providing indicative information to RES power plants about the interconnected network’s current capacity to	Enhancement of the Grevena Substation - Replacement of the two 20/25 MVA power transformers with two 40/50 MVA ones.

Projects completed	Projects planned under the 2018-2022 NDP
take up power from RES and HECHP plants in each geographical area.	Reconstruction of the substation within the Louros Hydroelectric Power Plant - Replacement of the existing 6/7.5 MVA power transformer with a 40/50 MVA one, separation of the MV network between DEDDIE and PPC Renewables, and change of voltage from 15 kV to 20 kV.
Replacement of 8 500 meters installed in photovoltaic plants connected to the LV network with new meters with a telemetering capability.	Enhancing a substation in the Stratos Hydroelectric Power Plant - Enhancing the substation by adding a second 40/50 MVA power transformer and taking up the loads from the nearby HV/MV substations.
	Enhancing the Trikala I Substation - Replacement of two 20/25 MVA power transformers with two 40/50 MVA ones.

Please note that a study was recently submitted by DEDDIE to RAE indicating those HV/MV transformers that are ‘irrevocably congested’ (‘congested’ by taking into account only projects in operation which are connected with them) and making a proposal on the approval and inclusion in the network development plan of the most important projects for enhancing the existing infrastructure, with a view to eliminating congestion in these geographical areas and allowing for the inclusion of new RES plants which are technically feasible to implement. Based on the conclusions of that study and a recommendation from DEDDIE, RAE approved the enhancement of 2 substations (Ioannina I and Arachthos) by adding a new 20/25 MVA power transformer on a trial basis and is now expecting the results of that enhancement to decide whether to carry on with that action.

In addition to that, a specific package of measures has already been implemented with a view to promoting the setup of RES plants on the NIIs, e.g. an estimate of the potential for setting up RES plants, the introduction of the management code, the regulatory framework for the inclusion and management of power plants, the appointment of a working group to look into the possibilities for interconnecting the NIIs with the mainland system, and the planning of three pilot projects on three islands aiming to ensure a high penetration rate for RES plants.

From 2021 to 2030 and in the context of the 4th operating period of the European Emissions Trading Scheme (ETS), Greece has secured a dedicated financing instrument of 25 million allowances (estimated financing of EUR 562.5 million) for interconnection and RES development projects on the NIIs (with an investment co-financing of 60 %).

Net metering and energy communities schemes

Furthermore, an additional set of specific policy measures have also been developed, such as net metering, including virtual net metering, and energy communities, which despite not having gained momentum yet, are significant institutional interventions towards strengthening the role of consumers and developing cooperative schemes for promoting decentralised power generation.

Net metering consists in offsetting the electricity generated by an autoproducer's RES or HECHP plant against that consumed by the autoproducer's facility, which is located in the same area as the RES or HECHP plant or in an adjacent area, on condition that the plant is connected with the network via the supply line to the consuming facility. In a nutshell, this measure provides for an exemption from the fees charged for using the network and system in respect of the portion of the electricity generated which is instantly consumed by the facility itself, as well as the offsetting of the final energy consumed against that fed into the network by the consumer's power generating facility.

The virtual net metering measure provides for offsetting the electricity generated by an autoproducer's RES or HECHP plants against the total electricity consumed by the autoproducer's facilities, on condition that at least one of these facilities is not located in the same area as the RES or HECHP plant or in an adjacent area, or if it is actually located there, it is supplied via a different line.

To date, 1069 net metering systems, with a total installed capacity of almost 17 MW, have been installed. The number and installed capacity of the systems that are in operation are shown in Table 11.

As regards virtual net metering in particular, also given that the scheme has been in place for a short period of time, only 6 systems, with a total installed capacity of 165.66 MW, have been installed on the interconnected system and on the NIIs (Table 12), and there are 25 pending requests corresponding to a capacity of 1.3 MW.

Table 11: Number and installed capacity of net metering systems in operation as of June 2018.

Photovoltaic plants with a net metering system		Interconnected system				NIIs				Total			
		Number		Capacity (MW)		Number		Capacity (MW)		Number		Capacity (MW)	
		LV	MV	LV	MV	LV	MV	LV	MV	LV	MV	LV	MV
In operation	2015	111	0	1.79	0.00	4		0.03	0.00	115	0	1.82	0
	2016	374	4	4.69	0.21	73		0.82	0.00	447	4	5.51	0.21
	2017	226	15	3.10	1.83	132	2	1.543	0.100	358	17	4.64	1.93
	2018	107	4	1.47	0.94	17		0.26	0.00	124	1	1.73	0.94
	Total	818	23	11.05	2.98	226	2	2.650	0.100	1044	22	13.70	3.08
Total		841		14.03		228		2.75		1069		16.78	

Table 12: Number and installed capacity of virtual net metering systems in operation as of June 2018.

Requesting stage		Interconnected system		NIIs				Total			
		Number	Capacity (kW)	Number		Capacity (kW)		Number		Capacity (kW)	
		LV	LV	LV	MV	LV	MV	LV	MV	LV	MV
In operation	2017	4	109.98			0.00	0.00	4	0	109.98	0.00
	2018	2	55.68			0.00	0.00	2	0	55.68	0.00
	Total	6	165.66					6	0	165.66	0

The necessary amendment to the regulatory framework is about to be completed now. Under the amendment, the scope of net metering and virtual net metering will be expanded to include specific provisions on individual technologies, the possibility of installing a storage system for using self-consumed energy internally, the offsetting methodologies per autoproducer category and provisions on settling the electricity that is offset.

As regards energy communities, Law 4513/2018 laid down the framework for the establishment and operation of energy communities, also providing for incentives to be given to ensure their unhindered functioning, as listed in Table 13. The key aim of energy communities is to encourage decentralised power generation by RES projects which attract increased interest at a local level and result in exponential benefits for energy community members.

Table 13: Incentives for the operation of energy communities.

-
- 1. Becoming subject to legal provisions on social cooperative societies (Law 4430/2016) and relevant national or European financing programmes.**

 - 2. Preferential participation in, or exemption from, the competitive bidding procedures provided for by Law 4414/2016 for RES and HECHP plants to be operated by energy communities.**

 - 3. Laying down specific conditions regarding the use of the services of the aggregator of last resort by RES and HECHP plants owned by energy communities.**

 - 4. Laying down specific authorisation conditions for RES, HECHP and hybrid plants owned by energy communities.**

 - 5. Exemption from the obligation to pay the annual fee for retaining the right to hold a power generation authorisation.**

 - 6. Prioritised examination of applications submitted by energy communities for obtaining generation authorisations for RES, HECHP and hybrid plants.**

 - 7. Reducing by 50 % the amount of the letter of guarantee provided for by Law 4152/2013 regarding RES and HECHP plants.**

 - 8. Reduced guarantee amounts required for energy communities to enrol in the registers of participants in the context of DAS and power network management contracts.**

 - 9. Setup of RES, HECHP and hybrid plants by energy communities to cover the energy needs of their members and of vulnerable consumers or people living below the poverty line.**

 - 10. Specific conditions laid down for energy communities which are functioning as operators of electric vehicle charging facilities.**

 - 11. Specific conditions laid down for the authorisation of and participation in energy communities under Law 4001/2011.**
-

Law on development

An additional financing instrument for RES and HECHP power plants is the law on development (Law 4399/2016 (Government Gazette, Series I, No 117/22.06.2016)). The instrument concerned provides for a framework to be used for the establishment of private investment aid schemes for the regional and economic development of Greece. The aid schemes are implemented through a single investment plan for the undertakings concerned, and the eligible expenditure categories under the investment plans include inter alia other investment costs for high efficiency cogeneration of energy from RES and costs for generation of energy from RES to cover heating and cooling needs.

The following types of aid are granted in the context of the investment plans that are subject to the aid schemes under this law:

- Tax deduction
- Grant
- Financial leasing subsidy
- Subsidy for the cost of creating new jobs
- Fixed income tax rate
- Business risk financing through a holding fund

More specifically, aid is granted for the following investment plans:

- Small hydroelectric power plants with an installed capacity of up to 15 MW.
- High-efficiency cogeneration plants from RES.
- Hybrid RES power plants on the NIIs with a guaranteed capacity of up to 5 MW.

A significant contribution was also made by the previous laws on development (Law 2601/1998, Law 3299/2004, Law 3908/11, Law 4146/2013), which were slightly different in respect of the incentives given, the eligible undertakings and the eligible expenditure.

Furthermore, additional programmes have been implemented to finance and subsidise RES and HECHP power plants in the context of the NSRF operational programmes for the 2007-2013 and 2014-2020 periods. These programmes have also helped mobilise the financial sector towards financing RES projects to a satisfactory degree.

- ***Policy measures to promote RES for heating and cooling***

The promotion of RES for heating and cooling has been strengthened significantly by the implementation of specific financial instruments. More specifically, aid was granted under the law on development for investment projects for heating and cooling from RES, and financial aid programmers for RES heating and cooling systems were either completed in the context of the 2007-2013 NSRF operational programmes (savings at home, exemplary demonstration projects for renewable energy sources and/or energy savings in public buildings and demonstration bioclimatic schools) or are being implemented in the context of the 2014-2020 NSRF operational programmes (savings at home II, energy upgrading of public buildings and promotion of RES systems for heating and cooling and for cogeneration of heat and power for own consumption).

Moreover, the holding fund with the name 'Infrastructure Fund' aims to ensure the maximum possible use of financial instruments to also cover the financial gap in the field of promoting RES by 2020.

The programme 'Promotion of RES systems for heating and cooling and for cogeneration of heat and power for own consumption' aims to promote the installation of RES systems for heating and cooling and for cogeneration of heat and power for own consumption with a view to improving energy efficiency. Among other things, this programme provides financing for the installation of RES systems for heating and cooling, i.e. biomass, biogas, geothermal energy, solar thermal and other RES systems, as well as installations for high-efficiency cogeneration of heat and power by the use of RES. Cogeneration facilities are eligible only when they are to be used for autoproduction purposes.

Finally, a biomass-fired plant will be set up in the existing Amyntaion district heating network, as a substitute for the thermal power currently supplied by PPC's Amyntaion thermal power plant. The biomass-fired thermal power plant that is being planned has a total capacity of 30 MW and is expected to cover the thermal needs of the existing Amyntaion district heating network.

In addition to that, there are projects aiming to increase the heating and/or cooling energy generated from RES which either have already been implemented or are being planned under the regional operational programmes. For example, the district heating project of the Municipality Alexandroupolis will use part of the geothermal field of Traianoupolis, as included in the East Macedonia and Thrace operational programme for 2014-2020. The project provides for building an 18 km long rural and urban district heating network with a maximum heat transfer capacity of approximately 10 MWth.

Specific regulatory measures have contributed towards the promotion of RES for heating and cooling, e.g. the provision for mandatory coverage of 60 % of the needs for domestic hot water from solar thermal systems in new buildings and buildings undergoing major renovation.

A significant contribution towards the promotion of RES for heating and cooling (heat pumps, solar thermal systems, geothermal applications) is expected to be made by 2030 owing to the obligation for new buildings to be nearly zero energy buildings as of early 2021 in the case of private buildings and as of 2019 in the case of buildings occupied by public and broader public sector authorities.

Also, regulatory provisions have already been adopted for promoting the use of biomass, geothermal applications and solar thermal systems, which have made a significant contribution towards the existing penetration of RES heating and cooling systems by eliminating specific obstacles.

As regards promoting biomass, ministerial decisions were adopted to regulate matters relating to the functioning of stationary combustion sources used for space and water heating and to adopt specifications for solid biomass fuels intended for non-industrial use.

The method to be used for the retail sale of firewood was also laid down, i.e. by volume, instead of by weight, to ensure better consumer protection. The unit of measurement used is either 'spatial cubic meter stacked' (m³ stacked) or 'spatial cubic meter bulk' (m³ bulk).

As regards using geothermal energy, Law 3175/2003 on the utilisation of geothermal energy, district heating and other provisions created the necessary conditions for the rational use of geothermal energy, and ministerial decisions were adopted laying down the conditions and procedures for the Hellenic State to lease out the right for geothermal energy exploration and management and the overall management of geothermal fields, the designation of and inclusion in a category of geothermal fields, and the authorisations for the installation of space heating/cooling systems for own use by exploiting the heat of geological formations and surface/ground water which are not designated as geothermal fields.

It also lays down the specific conditions and procedure for leasing out the right of exploration and management of low-temperature geothermal fields following a bidding procedure or a call for expressions of interest for the submission of binding investment proposals, depending on the more specific typical size of the field, which are to be conducted by the Secretary-General for Decentralised Administration. Finally, the relevant ministerial decision laid down the more specific conditions of the authorisation for the distribution of thermal energy from the exploitation of low-temperature fields only for agricultural holdings.

The Ministry of the Environment and Energy set up a working group to recommend a draft law on geothermal applications with a view to addressing all problems that prevent this technology from being further promoted.

Finally, the granting of tax exemptions for purchasing RES systems in the past played a pivotal role in the penetration of these RES technologies (mainly solar thermal systems), at a time when overall RES penetration was rather low.

- ***Policy measures to promote RES in transport***

The transposition of Directive 2015/1513/EE by Law 4546/2018 supplemented and formulated an integrated regulatory framework for the use of biofuels in Greece. Now the revised framework contains provisions both on the contribution of '1st generation' and advanced biofuels.

As regards '1st generation' biofuels, a 7 % limit has been established for the energy content of biofuels and bioliquids produced from starch-rich crops, sugars and oil crops (raw materials that are used as food or feed) which can be taken into account in relation to national RES targets. Respectively, biofuels from specific raw materials (such as waste, residues, non-food cellulosic / ligno-cellulosic material, waste cooking oil, animal fat) as well as specific types of fuel (such as renewable vehicle fuels from renewable non-biological sources) are regarded as having twice their energy content in respect of attaining the RES target in transport. These raw materials and fuels are listed in the Annex to the Directive.

A target was also set for 'advanced biofuels' to have a 0.2 % share in the energy content of vehicle fuels. These 'advanced biofuels' are produced from specific raw materials (such as waste, residues, non-food cellulosic / ligno-cellulosic material) which are listed in an annex, as well as raw materials which are not listed in said annex but have been designated as waste, residues, non-food cellulosic / ligno-cellulosic materials and were used in existing facilities before 9 September 2015.

Different legal provisions are included in the context of Law 3054/2002 on the promotion of biofuels. More specifically, a definition is given for biofuels and a provision is laid down to the effect that biofuels are to be placed on the domestic market either unmixed or in mixtures with refined petroleum products on condition that they conform to the technical specifications laid down in decisions of the Supreme Chemical Council. Moreover, mixtures of biofuels and refined petroleum products with a content in excess of the limit set in decisions of the Supreme Chemical Council may be placed on the market on condition that the other specifications of these mixtures are within the limits set in the specifications. The blending of biofuels or bioliquids with the corresponding compatible refined petroleum products should be carried out under the responsibility of the holders of the relevant refining authorisation or a class A marketing authorisation, at their premises. Finally, in accordance with Article 5(a) a biofuel

marketing authorisation is required for the production or importation or marketing of biofuels and bioliquids, which allows the holder to place biofuels and bioliquids on the domestic market, to holders of a refining authorisation or a class A marketing authorisation as well as to end consumers.

The most important policy measure of promoting RES in transport is the obligation to mix diesel with biodiesel and petrol with bioethanol. More specifically, holders of a refining authorisation must blend the diesel sold for transport purposes with not more than 7 % by volume of biodiesel obtained from holders of a biofuel marketing authorisation. Respectively, an obligation was established for blending petrol with bioethanol at ratios of 1 % of the energy content in 2019 and 3.3 % of the energy content in 2020, i.e. 5 % by volume, whereas the ratio concerned can be increased after 2020.

A ministerial decision is adopted every year to call the holders of a biofuel marketing authorisation to take part in the annual allocation. The decision sets the quantity of biodiesel to be allocated based on the quantities of diesel to be brought to the refineries in the following year.

To date there are 17 biodiesel production plants in Greece with a total capacity that is much higher than that required to cover the needs of the domestic market in order to comply with the mandatory biodiesel/diesel blending rate.

A very important measure is the determination of the sustainability criteria for biofuels and bioliquids both with a view to achieving a specific greenhouse gas emissions reduction rate in relation to fossil fuels and ensuring compliance with the requirements regarding the origin of raw materials.

Law 3468/2006, as currently in force, laid down the sustainability criteria for biofuels and bioliquids relating to the achievement of a specific emissions reduction rate in relation to fossil fuels (50 % for old units or 60 % for new units) as well as requirements regarding the origin of raw materials (raw materials must not come from land of increased biodiversity, land with a high carbon stock, etc.). Certification by 'voluntary schemes' is required to verify that the criteria are met.

A number of regulatory provisions were adopted regarding the sustainability criteria, such as the decision laying down the requirements for certification of economic operators and the submission of an annual report on the sustainability characteristics of biofuels and bioliquids³, and the decision on the categories of infringements, the procedure for imposing fines in respect of compliance with the sustainability criteria for biofuels and bioliquids⁴ and the maximum amounts of these fines⁴.

³ Ministerial Decision No ο.κ. 175700/26.04.2016

⁴ Ministerial Decision No ο.κ. 184182/02.08.2016

Another policy measure consists in setting out the specifications for unmixed biodiesel intended for vehicles and heating systems, as well as those for unmixed bioethanol.

Other less effective policy measures were also launched to strengthen the promotion of RES in transport, e.g. issuing technical guidelines, introducing an obligation to post special signs at retail points of sale of biofuels mixed with refined petroleum products, laying down the terms, conditions and technical specifications for the installation of devices supplying unmixed biofuels at fuel and energy stations which are already in operation or in the process of obtaining an authorisation, and developing the data and information management system for detailed monitoring of the production, refinement, importation, exportation and movement of crude oil and of semi-processed and petroleum products.

Policy measures to promote the electric vehicles

Law 4399/2016 transposed into the Greek legislation Directive 2014/94/EU on the deployment of alternative fuels infrastructure, the simplification of the authorisation procedure and other provisions regarding fuel and energy stations. Based on the above Law, a joint ministerial decision was issued to adopt a national policy framework for the deployment of the market in alternative fuel infrastructures for the transport sector.

The integrated framework for the deployment of alternative fuel infrastructures in Greece by 2030 sets out the prospects for the development of electrification, also specifying the number of recharging points for electric vehicles. The operator on the NIs recently approved the deployment of charging stations on the islands, the initial number of which will not exceed seventy.

Law 4233/2014 allowed the installation of public charging stations for electric vehicles in fuel and energy stations, in indoor and outdoor car parks, in car and motorcycle repair shops and in vehicle technical inspection centres. A subsequent ministerial decision laid down the terms, conditions and technical specifications for charging the batteries of electric vehicles.

Finally, different financial incentives were adopted to promote the use of electric vehicles. More specifically, electric cars are exempted from the obligation to pay the annual motor vehicle use tax, the relevant registration fee and the luxury tax. A 50 % exemption from the statutory registration fee is granted for hybrid cars.

The regulatory framework to allow the setup of public charging stations for electric vehicles, also setting out their operating framework and laying down the terms, conditions and technical specifications for charging the batteries of electric vehicles, is about to be completed soon.

2. Dimension ‘Energy efficiency’

A total of 40 different policy measures have been implemented to attain the four different energy efficiency targets, as developed in accordance with Articles 3, 4, 5 and 7 of Directive 2012/27/EU. Table 14 shows the total number of policy measures for each target separately and a breakdown into different categories of policy measures (including cross-classified measures or measures which can be implemented under several energy efficiency targets).

Table 14: Breakdown of existing policy measures into different sub-targets and categories of measures.

	Article 3	Article 7	Article 4	Article 5
Regulatory	14	4	6	7
Technical - infrastructure	9	5	2	1
Financial	17	16	9	6

Policy measures to improve energy efficiency

Horizontal policy measures to improve energy efficiency

The most important horizontal policy measure to improve energy efficiency in Greece consists in the energy efficiency obligation schemes. The legal basis for implementing the measure is offered by Article 9 of Law 4342/2015, which transposed into the national legislation Article 7 of Directive 2012/27/EU on energy efficiency. The rules of procedure⁵ of that measure set out the method used to

⁵ Ministerial Decision No oik. 174063

select the obliged parties, the annual energy target, the role of the officer responsible for the calculation, monitoring, control and verification of the measure, the details on how to measure and verify the savings and all other operating details. The energy efficiency obligation schemes are in the second year of implementation and are responsible for attaining in total 10 % of the overall national target for cumulative end-use energy savings by 2020, i.e. 333 ktoe (100 ktoe in 2017, 133 ktoe in 2018, 67 ktoe in 2019 and 33 ktoe in 2020).

Energy audits are also an important measure for the implementation of energy savings measures. The institutional framework is already in place, while large undertakings are required to carry out an energy audit by the end of 2018. The carrying out of energy audits on SMEs is also encouraged.

Also, targeted financial instruments, such as the law on development, have contributed towards the provision of financial support for investment in energy savings technology.

Other policy measures had a lower contribution towards the attainment of the energy savings targets, e.e. energy efficiency information campaigns in the context of support actions and financing plans, transposition into the national legislation of Directives 2009/125/EC on ecodesign and 2010/30/EU on energy labelling, and the promotion of green public procurement.

Delays were detected in the implementation of specific policy measures, such as the development of a certification scheme for installers of energy-related elements in buildings and building units, the implementation of the programme for the installation of smart meters by 2020 and the setup and activation of the National Energy Efficiency Fund.

Measures were also launched to promote energy services and energy performance contracting, and the necessary institutional framework for the provision of energy services is already in place.

The holding fund with the name 'Infrastructure Fund', as set up in 2017, aims to ensure the maximum possible use of different financial instruments to cover the financial gap, inter alia in the fields of energy savings and promotion of RES. The liquidity of public and private entities will be strengthened through the Infrastructure Fund, for the implementation of projects with favourable funding conditions. The total resources of the Fund amount to EUR 450 million, while the funds of the Operational Programme 'Competitiveness, Entrepreneurship, Innovation' (OP-CEI) in the energy sector amount to EUR 128.7 million.

As regards promoting efficient heating and cooling, a comprehensive assessment identified the potential for promoting more efficient technologies. Furthermore, existing financing programmes or others that are being planned currently have contributed towards increasing the penetration of HECHP plants, expanding district heating networks and promoting efficient RES heating and cooling technologies.

The implementation of the measure 'Installation of gas-fired HECHP systems in hospitals' was launched in 2011 and is still in progress. The measure aims to have gas-fired HECHP systems in hospitals, to improve their energy efficiency.

Also, the programmes 'District heating networks' and 'Florina district heating' were launched in 2009, consisting in the construction of new and the expansion of existing district heating networks. The programme 'District heating networks' was intended for legal persons governed by public law, first and second level local authorities, municipal water supply and sewerage companies, and inter-municipal district heating companies, inviting them to submit proposals for inclusion in and financing under the Operational Programme 'Environment and Sustainable Development' (OP-ESD). Similarly, the programme 'Florina District Heating' was intended exclusively for the Municipal Water Supply and Sewerage Company of Florina. Both programmes aim to promote sustainable regional development by the use of local energy resources and reduce air pollution and emissions of gases contributing to climate change.

A number of measures aiming to promote efficient heating and cooling systems are being planned currently. The programme 'Promotion of efficient district heating systems' aims to promote the installation of integrated district heating systems to improve energy efficiency. The operations that are financed under this programme consist in both the expansion of district heating networks and the construction of a heat generation plant. Aid may also be granted to biomass logistics infrastructures.

The programme 'Completion/expansion of infrastructure to increase power capacity through cogeneration - District heating in the Region of West Macedonia (Florina & Kozani)', as described in the 4th National Energy Efficiency Action Plan (2017), consists in the completion and expansion of infrastructure for recovering waste heat stemming from the power generation process carried out at PPC thermal plants and using it for urban use (space heating and production of hot water) in the cities of Florina and Kozani.

Moreover, the programme 'Promotion of RES systems for heating and cooling and for cogeneration of heat and power for own consumption' aims to promote the installation of RES systems for heating and cooling and for cogeneration of heat and power for own consumption with a view to improving energy efficiency. The measure 'Biomass-fired heat generation units for the district heating network of Amyntaion with a capacity of 30 MW' consists in setting up a biomass-fired plant in the existing Amyntaion district heating network, as a substitute for the heat currently supplied by the PPC thermal power plant in Amyntaion. The biomass-fired heat generation unit that is being planned has a total capacity of 30 MW and will cover the thermal needs of the existing Amyntaion district heating network.

Finally, Law 4549/2018 established a tax incentive by applying a higher cost depreciation rate for related energy efficiency improvement investments.

Policy measures to improve energy efficiency in buildings

Law 3661/2008 laid down minimum energy performance requirements for buildings in addition to those of the pre-existing heat insulation regulations, by transposing into the Greek legislation Directive 2002/91/EC on the energy performance of buildings. After that, the revised Directive 2010/31/EU was transposed by Law 4122/2013, which is still in force currently. The minimum energy performance requirements for buildings, aiming to ensure cost-optimal levels, are laid down in the Regulation on the Energy Performance of Buildings (KENAK)⁶. Finally, the calculation methodology is laid down in detail in the technical guidelines issued by the Technical Chamber of Greece (TOTEES)⁷.

The Regulation on the Energy Performance of Buildings (KENAK) lays down the relevant calculation methodology, the minimum requirements for the energy performance of buildings, the type and content of the necessary energy performance design of buildings and building units, the procedure and frequency for the conduct of energy inspections on buildings and heating and cooling systems, the type and content of the energy efficiency certificate to be issued, the procedure for issuing the certificate, how to control the energy inspection procedure, the competent authorities to carry it out and all other specific matters or necessary details. A total of 1 179 168 energy efficiency certificates were issued for buildings from 2011 to 2017, i.e. 17.73 % for tertiary sector buildings and 82.27 % for residential buildings.

⁶ Joint Ministerial Decision No 5825/09.04.2010, as recently amended by Joint Ministerial Decision No 178581/30.06.2017

⁷ Ministerial Decision No oik. 182365/17.11.017

Moreover, under the Regulation on the Energy Performance of Buildings (KENAK), all new buildings must conform to the minimum energy performance requirements and to be classified at least under category B. The same applies to buildings undergoing major renovation to the extent that this is technically, functionally and financially feasible, whereas any isolated interventions made in existing buildings must conform to the minimum energy performance requirements.

In accordance with Article 9 of Law 4122/2013, all new buildings must be nearly zero-energy buildings by 1 January 2021. However, this obligation should be complied with by 1 January 2019 in respect of new buildings occupied by public and broader public sector authorities. The national plan for increasing the number of nearly zero-energy buildings, which has already been completed, is expected to help ensure compliance with the above-mentioned requirements.

Article 25 of Law 4067/2012 provides for an incentive to be given by increasing the building ratio by 5 % for new buildings classified under energy category A+ under the KENAK, which entail minimum energy consumption owing to the use of energy savings systems, HECHP units and RES systems. This incentive is increased to 10 % for minimum energy consumption buildings which also have exceptional environmental performance. Similar incentives are given under Article 20 of Law 4178/2013, which provides for offsetting the fine for illegal buildings against energy upgrading works.

Improving the energy efficiency of dwellings has been supported considerably by the programme 'Savings at home', as financed by the 2007-2013 NSRF. The programme, with a total budget of EUR 548 million, was implemented from 2011 to 2015. Under the programme, support was given to energy savings interventions in residential buildings by financing 15 % to 70 % of the total expenditure, also granting an interest-free loan for the balance. The programme was intended for dwellings with a low energy classification (below energy efficiency class D), setting a specific energy target, as well as those with an objective value of not more than 2 100 EUR/m². The level of financing was dependent upon the owner's income profile, and the loan could have a term of more than six years. The energy savings ensured by the interventions were to be evidenced by having energy certificates issued before and after the implementation of the interventions, and the financial transactions were to be carried out through financial institutions participating in the programme. A total of 51 659 dwellings were included in the programme by July 2017, with a total cost of EUR 529 million. The dwellings that were renovated had a total floor area of 5.2 million m², and a total of 893 GWh of primary energy savings were achieved.

The programme 'Savings at home II', which is financed by the 2014-2020 NSRF and has a total public funding budget of EUR 292 million, was launched in February 2017. The programme is still being implemented and subsidises the energy upgrading of dwellings through the upgrading of the heating, cooling and hot water systems and of the heat insulation capacity of the building envelope. Subsidy rates range between 0 % to 60 % depending on the applicant's income profile, and there is also an interest-free loan granted under this version of the programme. The total eligible expenditure stands at EUR 25 000, the energy target is adjusted to the applicant's income profile, and the project implementation procedure is supported by an electronic platform.

An additional programme for the energy upgrading of dwellings was implemented under the 2007-2013 NSRF, which supported the replacement of conventional diesel boilers with new gas-fired ones. Applications were accepted under the programme⁸ until April 2015. The programme had a total budget of EUR 15 million and provided for subsidising up to 60 % of the project expenditure.

Article 7 of Law 4342/2015 provides that the heads of regions and mayors are responsible for having an energy efficiency plan prepared for buildings within their jurisdiction, setting out specific energy savings and energy efficiency improvement targets and actions every two years. It also provides for putting in place an energy management system and implementing, insofar as it is economically feasible, the energy efficiency plans using, inter alia, specific financing tools and instruments, as well as energy service providers through the conclusion of energy performance contracts. Finally, the above buildings, which are included in energy efficiency plans or energy management systems, should take priority in establishing financial incentives and programmes for improving the energy efficiency of public buildings.

The 'energy officer' post is introduced⁹ in the public and broader public sector, also setting out the tasks entrusted to energy officers and the competent public bodies' responsibility to implement the measure concerned. The energy officer is responsible for one or several buildings used by each body, depending on the operating needs at hand, for all its employees, as well as for the useful floor area and volume of its buildings. Please note that the tasks of energy officers are supported by a custom-designed electronic platform for the energy management of public buildings.

⁸ Adopted by Ministerial Decision No Φ.14/02/19398/2927/14.11.2014

⁹ Joint Ministerial Decision No Δ6/B/14826/17.06.2008

By the end of 2018, the covenant of mayors had been voluntarily endorsed by 156 municipalities, stating their support for a shared vision for 2050 on speeding up the decarbonisation of their respective territories, strengthening their ability to adapt to climate change and providing their citizens with access to safe, sustainable and affordable energy. More specifically, 117 of them have also submitted relevant sustainable energy (and climate) action plans for the attainment of targets by 2020, 12 have submitted plans for the attainment of targets by 2030, and 17 have also included specific adaptation targets.

A significant number of energy upgrading operations for public buildings have been implemented under the two 'Savings' programmes. The subject matter of the programme 'Savings' included actions and proven best practices aiming to reduce energy consumption in the urban environment, with emphasis placed firstly on buildings (public buildings used by first level local authorities) and on the upgrading of public spaces, and secondly on municipal and private transport and on energy-intensive municipal facilities, by implementing technical interventions and awareness and mobilisation actions for citizens, local authorities, companies and organisations. Under the programme 'Savings II', as a follow-up to the programme 'Savings', financing was granted for the implementation of energy savings interventions in existing municipal buildings and infrastructures used by first level local authorities, including open building infrastructures. The programmes were financed by the 2007-2013 NSRF. Out of the available budget of EUR 38.43 million, EUR 18.5 million was eventually spent on the completion of 73 projects, which are expected to ensure annual primary energy savings of 3.4 ktoe and final energy savings of 2.5 ktoe. Approximately EUR 270 million has been budgeted under the 2014-2020 NSRF for energy savings actions in public buildings, and an additional EUR 129 million will be made available in the form of loans through the Infrastructure Fund.

As regards tertiary sector buildings, the programme 'Improving the energy efficiency of SMEs' is being planned, aiming to support micro, small and medium-sized enterprises in order to improve their energy efficiency.

Finally, energy performance contracting is an additional tool for promoting energy savings interventions in buildings, both in the public and tertiary sectors, as the required regulatory framework is already in place.

Policy measures to improve energy efficiency in transport

A number of energy savings measures have been planned and implemented in the transport sector. Some of them have been completed and a number of them are still being implemented.

The measure 'Reform of public transport systems', which was launched in 2008, aimed to encourage more people to use public transport for their transport needs. It consisted in facilitating the work of public transport operators in order to increase passenger demand for track-based and road modes of transport, with a view to achieving a higher percentage of people using public transport from 26.6 % in 2008 to 35 % in 2016. The expansion of the suburban railway from Kiato to Patras is being implemented, and there are plans being prepared for a future expansion thereof to also cover other areas in Attica, e.g. Lavrion and Rafina. In this context, the electrification of the Athens - Thessaloniki - Eidomeni railway is about to be completed. The measure 'Infrastructure projects in the transport sector', as launched in 2006, aimed to improve travel times for passenger cars and public transport, thus enhancing the transport quality and safety and energy savings. Also, the construction of appropriate infrastructures has strengthened alternative forms of mobility (walking, cycling, etc.), and the increased use of track-based modes of transport has helped reduce the use of passenger cars and save energy. Actions implemented in the context of the above measure consisted in expanding the Athens metro, expanding the suburban railway in the broader area of Athens and developing cycling and traffic-calmed networks in municipalities, and so on.

The development of sustainable urban mobility plans is yet another measure to help improve energy efficiency in the transport sector. The implementation of the measure started in 2011 and is still in place primarily in large cities like Athens and Thessaloniki, as well as in other urban centres in Greece. Some of the actions included in this measure are car sharing, encouraging walking and cycling, developing mobility plans for large companies, schools, sights, hospitals, venues, etc. Mobility plans include actions intended to prevent several people travelling to the same destination at a given time from using different passenger cars (e.g. offering free public transport tickets to commuters or using or company buses, improving accessibility at transfer stations, promoting car pooling). Relevant actions were also implemented under the above-mentioned programme 'Savings', and the preparation of sustainable urban mobility plans was also financed by the Green Fund.

The measure 'Promoting cost-effective, eco and safe driving' was launched in 2008 and is still in progress. Eco driving is a new form of driving that combines simple driving methods and maintenance rules. This helps achieve 5 % to 20 % fuel savings and reduce pollutant emissions, noise and accidents. The measure is implemented by the Centre for Renewable Energy Sources and Saving (CRES). To date, CRES has implemented such actions as information campaigns, training for professional drivers, inclusion of eco driving in the training process used to obtain a driver's licence and training seminars for passenger car drivers. The implementation of the training programmes encouraging economical and eco driving for vehicle drivers at a municipal level was also supported by the above-mentioned programme 'Savings'.

The measure 'Incentives to replace private cars and promote energy efficient vehicles (biofuel, hybrid)' was implemented by the Ministry of Infrastructure, Transport and Networks from 2009 to 2012. The measure consisted in giving economic and tax incentives for replacing old energy-intensive private vehicles with brand new state-of-the-art vehicles and promoting energy-efficient vehicles. The measure was implemented by giving tax and economic incentives through Legislative Act No 16.9.2009/2 setting out measures to address air pollution. The implementation of the act ended on 3 November 2009, after 140 000 vehicles were withdrawn. However, the passenger car withdrawal measure was reintroduced by virtue of a decision¹⁰ on the replacement of vehicles using outdated technology.

The implementation of the measure 'Eco-labelling – energy label for passenger cars' started in 2002¹¹, under Directive 1999/94/EC.

The implementation of the measure 'Quota obligation for energy-efficient vehicles in public agencies or organisations' started in 2012, aiming to encourage the use of vehicles with higher energy efficiency and lower emissions in public agencies and organisations.

The measure 'Linking vehicle taxation with energy efficiency and CO₂ emissions', as implemented in 2010, aimed to encourage the use of vehicles with lower fuel consumption and pollutant emissions levels by directly linking the annual motor vehicle use tax with each vehicle's emissions level, carbon dioxide emissions in particular. The amount of tax is calculated by multiplying each vehicle's CO₂ emissions (gr/km) by the amount set for each level.

¹⁰ Ministerial Decision No ΔΕΦΚ 5006718ΕΞ2001/11.02.2011 on incentives for replacing vehicles using outdated technology.

¹¹ Ministerial Decision No 90364/31.01.2002

The measure 'Replacing old light commercial vehicles in the public and private sectors', as implemented in 2010, consisted in replacing old EURO III light commercial vehicles used in the public and private sectors with new EURO V vehicles. A similar measure, i.e. 'Replacing old passenger cars in the private sector', was implemented simultaneously. The measure aimed to replace old EURO III passenger vehicles used in the private sector with new EURO V vehicles.

The measure 'Electrification of vehicles and recharging stations for electric vehicles' has been under implementation since 2014. The measure aims to encourage the purchase and use of electric vehicles (private cars, bicycles and heavy duty vehicles) and the simultaneous setup of (RES and/or conventional) recharging stations for vehicles. The measure consists in applying lower taxation and giving incentives through grants for purchasing electric vehicles of all types to individual drivers and public bodies operating fleets of vehicles. Combined with the purchase of vehicles, this measure will also include a grant for setting up public and private recharging stations for vehicles, supplied primarily with renewable and/or conventional energy sources.

Finally, the national system for mandatory periodic technical inspection of vehicles at Vehicle Technical Inspection Centres (KTEOs) was introduced in the 1980s. Also a decision¹² was adopted under Directive 2014/45/EC for periodic technical inspection of motor vehicles and their trailers. Correct and regular vehicle maintenance is associated with reduced fuel consumption and pollutant emissions. All vehicles must be tested for flue gas emissions every year and then obtain a flue gas control card either from the vehicle inspection centres or certified car repair shops.

Policy measures to improve energy efficiency in industry

A number of the horizontal policy measures contribute towards promoting energy savings technologies in the industrial sector. However, the measures implemented in this sector recently, are supported primarily by State subsidisation and/or loans granted under favourable conditions and are usually included in broader programmes for investment in innovation and the modernisation of Greek enterprises. More specifically, the programme 'Relocation of enterprises to industrial/business areas and business parks' aimed to strengthen competitiveness by creating economies of scale for the businesses to relocate there. The programme aimed to ensure sustainable management of environmental resources and natural beauty, strengthen extrovert business activity, strengthen entrepreneurship support schemes and encourage the modernisation of business accommodation, reduce the intensity of energy

¹² Joint Ministerial Decision No οικ. 49372/3352/04.08.2017

consumption for bodies with high operating costs and create the conditions for strengthening business activity and employment.

The programme 'Innovative entrepreneurship, logistics, food and drink' consisted in strengthening investment intended to encourage innovation and/or enhance the competitiveness of undertakings in respect of products and services for which they have a comparative advantage, investment in innovation by technologically advanced undertakings in the primary and secondary sectors, investment by undertakings engaging in the processing of foodstuffs, in particular organic foodstuffs with a designation of origin and those that are typical local products, as well as business plans in logistics. Micro, small and medium-sized enterprises were targeted for participation in the programme, and eligible actions included purchasing and installing new/state-of-the-art machinery and other equipment and systems which were environmentally friendly and had low energy consumption levels.

The programme 'Green business' aimed to create the conditions for including an environmental dimension in the functioning of businesses, with a view to implementing interventions in the production chain process. More specifically, the programme aimed specifically to reduce the energy and, above all, the environmental footprint of processing undertakings, encourage the development and marketing of 'green' products and services, enhance the environmental and social profile of businesses and mitigate the lack of social acceptance for processing activities.

The programme 'Support to improve energy efficiency in processing undertakings' aimed to improve the energy efficiency of processing undertakings, reduce their energy costs and thus increase their competitiveness, as well as mitigate the impact of climate change caused by the irrational use of energy.

Finally, the programme 'Energy efficiency improvement in SMEs' is being planned currently and is co-financed by the European Regional Development Fund (ERDF) and the Operational Programme 'Competitiveness, Entrepreneurship, Innovation (OP-CEI) 2014-2020. The total budget of the action stands at EUR 64.06 million and the total public expenditure stands at EUR 32.3 million. The programme aims to support micro, small and medium-sized enterprises, to help them improve their energy efficiency.

Other policy measures to improve energy efficiency

Energy efficiency improvement measures in electricity and gas infrastructure are already underway and planned by the respective transmission system and distribution network operators as part of the development plans they are preparing. For example, power distribution infrastructures are being developed to allow for significant technical capabilities in the fields of demand management, improved load and consumption forecast and reduced losses. The most important project is the setup of a telemetering infrastructure by DEDDIE.

Finally, the financing programme 'Implementing energy efficiency improvement actions for road lighting systems operated by local authorities' consists in procuring and installing more energy-efficient equipment for the road lighting systems operated by first and second level local authorities. Respectively, the financing programme 'Implementing energy efficiency improvement actions for pump station installations operated by local authorities' consists in procuring and installing more energy-efficient equipment for the pump stations operated by first and second level local authorities.

3. Dimension 'Energy security'

A total of 42 different policy measures have been implemented, aiming to attain the individual sub-targets regarding the security of supply.

Table 15 shows the total number of policy measures for each sub-target separately, along with a breakdown thereof into different categories of policy measures.

Table 15: Breakdown of existing policy measures into different sub-targets and categories of measures.

	Increasing the diversification of energy sources and supply from third countries, storage and demand response	Reducing energy import dependency from third countries, including by deploying domestic energy sources	Readiness of Greece to cope with constrained or interrupted supply of an energy source
Regulatory	6	3	16
Technical - infrastructure	12	2	2
Other		Policy measures to promote RES	

Policy measures regarding the security of supply

Policy measures for increasing the diversification of energy sources and supply from third countries, storage and demand response

Diversification of energy sources in the field of electricity is achieved by interconnecting the individual power networks of different countries. Close cooperation was established between power network operators in the broader area as early as in 1991, and as a result, ENTSO-E was established in 2009, whereupon the ten-year development plan for European networks and the six regional development plans were issued. The Greek system functions in parallel with the European system through transmission lines, mainly five 400 kV circuits, interconnecting with the Albanian, Bulgarian, FYROM and Turkish systems. The Greek system is also asynchronously connected with Italy (via a submerged DC connector).

Under conditions of increased penetration of variable RES, storage is necessary to avoid extensive RES generation cuts. As regards the NIIs in particular, the required regulatory framework has been completed and a number of generation authorisations have been granted for hybrid power plants and solar thermal plants with storage. The margins for the penetration of RES, including hybrid power plants, are approved by RAE following a recommendation from DEDDIE, while competitive procedures need to be conducted for the setup of new hybrid power plants. Finally, RAE is expected to issue calls to tenders for ‘smart islands’ in accordance with the provisions of Law 4495/2017, to ensure RES penetration levels in excess of 60 %.

The power interruptibility measure has made a substantial contribution towards the security of supply by having interruptible consumers authorise the system operator to impose, in exchange for payment of a price, a temporary restriction on their active power up to an agreed ceiling, following a warning.

In the field of natural gas, the projects planned for the development, enhancement and interconnection of the national gas system (ESFA) have helped use different energy sources. The Trans Adriatic Pipeline (TAP) has been under construction since 2016. The TAP will have an 878 km long path and serve as an continuation of the much larger TANA/O/TANAP pipeline (1 850 km), which crosses Azerbaijan, Georgia and Turkey. The initial carrying capacity of TAP is 10 bcm of gas per year. However, its capacity may even exceed 20 bcm by the addition of two further compressor stations.

As regards gas storage, holders of power generation authorisations must, under the conditions laid down in their authorisations and with a view to responding to gas supply crises, ensure the uninterrupted operation of their plants on natural gas for not less than five days in case of an unscheduled interruption in the supply of gas, in the event of an ESFA emergency in particular. Some electricity producers have opted for fulfilling the above specific condition by maintaining an LNG reserve in a storage facility. However, despite the ongoing upgrade B of the Revythousa Terminal (construction of a third container), using this infrastructure for electricity producers to fulfil their above-mentioned obligation is considered to be technically impossible unless infrastructure is set up for long-term gas storage (e.g. underground container).

The measure 'Interruptible gas consumers' has made a substantial contribution towards the security of supply by allowing the demand for natural gas to be interrupted at specific levels in crisis situations.

Finally, the measure 'Interruptible gas consumers' is a potentially effective demand response tool. More specifically, this measure allows suppliers and large gas customers to conclude a gas demand management agreement, to address crisis situations. Under a contract concluded by and between the ESFA operator and individual suppliers, the amounts paid by each supplier for proven demand management after an alert level crisis is declared and for as long as the crisis remains at the level of alert/emergency may be recovered, in whole or in part, up to a maximum amount to be determined by a RAE decision.

As regards petroleum products, the regulation for keeping emergency stocks has helped ensure the security of supply of oil and/or petroleum products in Greece by laying down the terms on which emergency stocks are monitored and controlled as well as other relevant details, such as the certification of emergency stock warehouses, the conditions for physical access to and availability of these stocks, the transfer of stock-keeping obligations and the determination of the fee to be paid for that purpose and of the required calculation methods.

Policy measures for reducing energy import dependency from third countries

A key policy measure for reducing energy import dependency from third countries consists in having interconnections in place between the NIIs and the mainland system. The interconnection of the independent systems on the islands aims to strengthen the reliability of supply to the interconnected islands at an interconnected system level, to use other domestic energy sources as a substitute for imported oil and to utilise RES on the islands in a more cost-effective manner.

The work of interconnecting the islands with the power transmission system is being implemented by ADMIE in different phases:

- Phase A (completed in 2018): Connection of Syros with Lavrion and with the islands of Paros, Mykonos and Tinos. Upon completion of phase A, the units of local power plants will be put in cold reserve. Existing MV interconnections are used to supply electricity to the islands of Ios, Sikinos, Folegandros via Paros and Koufonisi, Schinoussa, Iraklia via Naxos.
- Phases B and C (to be completed in 2019 and 2020, respectively): They consist in setting up additional HV connections via submerged cables, to ensure the required reliability of supply.

As regards the interconnection of Crete, ADMIE has finalised the relevant interconnection plan, to be implemented in two phases as follows:

- Phase I: AC 150 kV interconnection, with a nominal capacity of 2x200 MVA, from Crete to Peloponnese. The main tender for phase I has been completed, and the project is expected to be completed in the first half of 2020.
- Phase II: DC interconnection, with a nominal capacity of 2x500 MW, from Crete to Attica. The project is expected to be completed in 2022.

The committee set up to look into the cost-effectiveness of the electrification method used for the NIIs, under Commission Decision 2014/536/EC, also plays an important role. The Committee has looked into and evaluated alternatives for the electrification of the NIIs per group of islands.

Policy measures for the preparedness of Greece and of the bodies involved to cope with constrained or interrupted supply of an energy source

With regard to policy measures to address risks in the field of electricity, in accordance with Article 95(4) of Law 4001/2011, ADMIE has to prepare a dedicated study on the adequacy of capacity and sufficient reserve capacity margins, taking into consideration the ten-year ESMIE development plan approved each time and Greece's long-term energy planning.

The study on adequate capacity aims to detect any future risks relating to the power generation system's ability to properly respond to anticipated power demand developments in the mid term (i.e. in 5-10 years). The study also allows for identifying the need for new installed generation capacity, with a view to responding safely to demand in the period concerned.

Adequate flexibility has also been looked into in recent years, as the increased penetration of variable RES (mainly wind and photovoltaic plants) increases both the volatility and uncertainty of residual load (load less output from variable RES) and the flexibility needs of the system. The main categories of flexibility sources are dispatchable generating units, storage, interconnections and demand response. Furthermore, variable RES power plants themselves are partially controlled (e.g. several wind farms are already capable of reducing the amount of power they generate if so ordered by the operator, as the case often is on the NIIs), and cuts of part of variable RES power plants' own generation (if still relatively low on an annual basis) is also an important source of flexibility. Also, given that the development of interconnections constitutes essentially an extension of the system (e.g. interconnection of islands), flexibility needs are reduced as the volatility and uncertainty both of the load and of the overall generation of variable RES power plants are mitigated.

To maintain the reliability of the electrical system and to meet the demand for electricity without cuts, it is necessary to take measures to ensure the installation and operation of sufficient power generation capacity (and adequate flexibility). Just like in other Member States, given that the objective of ensuring adequate capacity cannot be attained sufficiently by the operation of the markets in electricity, mechanisms have been adopted to strengthen market participants and ensure adequate system capacity. For example, the imbalance settlement scheme, the transitional flexibility compensation scheme, the variable cost recovery scheme, etc. have been adopted in recent years.

Similar to what is happening in other Member States, Greece recently notified to the Commission a new mechanism to ensure sufficient power generation capacity (long-term capacity compensation scheme).

Also, the Greek power transmission system management code provides for the implementation, primarily by ADMIE, of specific measures that consist in preventive action to address infrastructure situations based on the n-1 security criterion and to address problem situations (Chart 1).

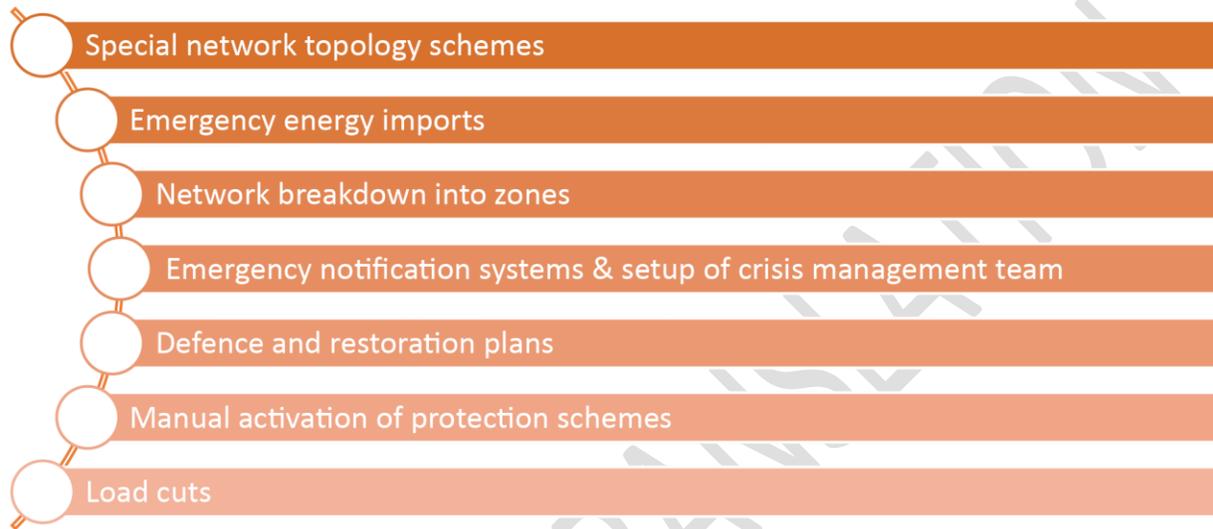


Figure 1: Measures to address risks in the field of electricity.

DEDDIE, in its capacity as operator on the NIIs, has to prepare an emergency plan laying down the required actions and necessary ex-ante and ex-post measures to be taken early enough in each power plant and on each island. Also, system recovery following a complete shutoff is organised by the load dispatch centres for Crete and Rhodes in cooperation with conventional PPC power plants, based on existing plans aiming to ensure the quickest and most cost-effective possible restoration of power supply. On the other NIIs, system recovery following a complete shutoff is carried out by independent/local power plants within just a few minutes, owing to the flexible units available therein. Finally, in emergency situations, the network operator may apply load cuts either manually or automatically in accordance with the network management code.

As regards natural gas, the risk assessment study prepared by RAE aims to ensure the fullest possible identification and assessment of the risks affecting the security of gas supply, running, inter alia, scenarios of exceptionally high gas supply and demand disruption, such as failures of the main transmission/storage infrastructures or LNG terminals, and disruption of supplies from third countries. Similar to the national risk assessment study, RAE has to prepare a regional risk assessment study,

aiming to ensure the fullest possible identification and assessment of the risks affecting the security of gas supply within the set of risks under consideration, i.e. risks with a regional dimension, also looking into conditions – scenarios – which could have an impact at a regional level. The preventive action plan prepared by RAE aims to set out appropriate measures to mitigate or eliminate the risks that may affect the security of gas supply in Greece, as identified by the risk assessment. An important measure consists in strengthening the use of an alternative fuel (in accordance with the conditions laid down in their authorisation, some electricity producers operating gas-fired plants are required to ensure the uninterrupted operation of their plants using diesel as an alternative fuel). Finally, the emergency plan (as prepared by DESFA and approved by RAE) contains the measures taken to eliminate or mitigate the impact of any natural gas supply disruption.

The setup of the emergency measures coordination committee (ESMEA) aims to coordinate national agencies towards addressing the impact of a major ESFA accident. The crisis management group, which is part of ESMEA, is entrusted with the task of assessing the recommendations made by DESFA's crisis management unit and ADMIE, as well as making decisions on the implementation of alarm level 3 measures, except where the situation is caused by a major ESFA accident, and the implementation of measures to support the supply of gas in neighbouring countries.

As regards petroleum products, a committee for the management of major disruptions in the supply of oil and/or petroleum products has been set up to prepare and recommend an emergency measures plan with a view to addressing serious disruptions in the supply of oil and/or petroleum products, as well as to make recommendations on matters relating to the regulation on keeping emergency stocks and its implementation. The committee works together with the European Union and the International Energy Agency in making available stocks of oil and petroleum products to address major disruptions of supply and controls authorisation holders to ensure the conditions for successfully implementing the emergency measures plan. The emergency measures plan intended for addressing major disruptions in the supply of oil and/or petroleum products sets out, inter alia, the criteria for identifying disruptions of supply, the setup and staffing of coordination committees and bodies, the procedures and all necessary measures for the management of emergency stocks in case of major disruption of supply at international and/or local levels.

Policy measures for the development of domestic energy sources

The increase in the penetration of RES contributes towards the deployment of domestic energy sources and enhanced security of supply. A detailed description of both the current state of affairs and policy measures was provided in a previous section.

Also, the hydrocarbon extraction is a key policy measure for the development of domestic sources. The similarities between a number of geological formations in the South Ionian Sea and in sea areas in Southeast and West Crete and the Zohr field in Egypt, the Calypso and Onisiforos fields in Cyprus or the Aphrodite field in Cyprus or the Leviathan field in Israel have attracted a lot of interest for hydrocarbon exploration in Greece. The exploration to be carried out in the following five years in the onshore and offshore areas ceded will allow for assessing what proportion of imports can be replaced by domestic production.

The institutional framework for hydrocarbon extraction is already in place, and the first offshore and onshore blocks have already been ceded. The first international round of concessions was carried out in 1996 for 6 areas, finally ceding 4 areas in West Greece (NW Peloponnese and Aitolokarnania to Triton; Ioannina and W Gulf of Patras to Enterprise Oil). However, seismic surveys did not yield positive results and the drilling did not reach the depth provided for in the initial agreements owing to various reasons. As a result, exploitation in these areas did not proceed.

Extensive geophysical exploration was carried out in 2012 by the Norwegian company PGS in a sea area along the entire Ionian Sea and in the South of Crete. An international open public call for expressions of interest was also issued for three areas (Ioannina, Gulf of Patras and Katakolo), and as a result three concession contracts were signed in 2014.

A second call to tenders was also issued for ceding hydrocarbon exploration and exploitation rights in 20 sea areas in West Greece and in the South of Crete, along with an international call to tenders for ceding hydrocarbon exploration and exploitation rights in the onshore areas of 'Arta and Preveza', 'Aitolokarnania' and 'Northwest Peloponnese'.

Finally, there are also requests for the concession of new offshore areas in progress in the context of the international call to tenders issued in 2018, where ExxonMobil and Total expressed an interest in the 2 offshore areas in the West and Northwest of Crete and Hellenic Petroleum (ELPE) and Repsol expressed an interest in the offshore area of West Greece. Table 16 shows the current state of affairs in respect of hydrocarbon extraction.

Table 16: Current state of affairs in respect of hydrocarbon exploration and exploitation.

Area	State of affairs
Concessions of offshore blocks	
Prinos	Continued production of crude oil by Energean Oil & Gas. Development of satellite reserves and expansion of facilities.
Katakolo	After the field was announced to be commercially exploitable in November 2016, Energean Oil & Gas entered the exploitation phase.
Block 2	The JV Total (50 %) - ELPE (25 %) - Edison (25 %) entered the initial exploration phase in March 2018.
Block 10	ELPE (100 %). The relevant file has been submitted to the Hellenic Court of Audit, before being ratified by the Hellenic Parliament.
SW of Crete	JV Total (40 %) - Exxon Mobil (40 %) - ELPE (20 %) The relevant file has been submitted to the Hellenic Court of Audit, before being ratified by the Hellenic Parliament.
W of Crete	JV Total (40 %) - Exxon Mobil (40 %) - ELPE (20 %) The relevant file has been submitted to the Hellenic Court of Audit, before being ratified by the Hellenic Parliament.
Ionian Sea	JV Repsol (50 %) - ELPE (50 %) was selected from among the applicants. The procedure for the completion of the lease agreement is underway.
Block 1	Offer submitted by ELPE.
Sea of Thrace	JV Calfrac (75 %) - ELPE (25 %). Work on hold.
Gulf of Patras	JV ELPE (50 %) - Edison (50 %) carried out reprocessing and acquisition of seismic data. It entered exploration phase B in April 2018, including exploratory drilling. The agreement was ratified by the Hellenic Parliament in 2014.

Concession of onshore blocks	
Ioannina	After a 2-year extension of the first phase for Energean Oil & Gas (100 %), Repsol joined as operator (JV Repsol [60 %] - Energean Oil & Gas [40 %]).
NW Peloponnese	ELPE (100 %) as operator. It entered the initial exploration phase in March 2018.
Arta and Preveza	ELPE (100 %) as operator. It entered the initial exploration phase in March 2018.
Aitolokarnania	Repsol (60 %) as operator in JV with Energean Oil & Gas (40 %). It entered the initial exploration phase in March 2018.

4. Dimension 'Internal energy market'

In the last 49 years, different policy measures have contributed towards the attainment of different sub-targets with regard to the energy market operation/dimension. Table 17 shows a classification of policy measures for each sub-target separately, along with a breakdown thereof into different categories of policy measures.

Table 17: Breakdown of existing policy measures into different sub-targets and categories of measures.

	Electricity interconnectivity and energy transmission infrastructure: Regional cooperation, financing	Consolidation of the energy market	Addressing energy poverty
Regulatory	1	17	4
Technical - infrastructure	21		1
Financial			5

The policy measures implemented in recent years aim to increase the number of market participants, strengthen competitiveness and ensure better electricity tariffs, create a sufficient number of products, provide top-level services and develop a framework that strengthens liquidity and the supervision of individual markets, also making sure that guarantees are provided by participants for smooth market functioning.

The Greek electricity system has functioned simultaneously and in parallel with the interconnected European system since October 2004, under overall coordination by ENTSO-E (European Network of Transmission System Operators for Electricity). The Greek system functions in parallel with the European system through transmission lines, mainly 400 kV, interconnecting with the Albanian, Bulgarian, FYROM and Turkish systems. The Greek system is also asynchronously connected with Italy (via a submerged DC connector).

The ENTSO-E regional committee (Regional Group Continental Europe – RGCE) evaluated the test results from the parallel operation of the Turkish and European systems in September 2013, to find out that the Turkish and European systems could be connected permanently. Therefore, an agreement was signed by and between the ENTSO-E system operators and the Turkey system operator in April 2015.

Apart from strengthening existing interconnectors and developing new ones, Greece is considering measures to ensure the reliable functioning of existing interconnectors, in peak demand periods in particular, with a view to cutting down on electricity costs for Greece and increasing the capacity available for meeting demand.

Strengthening electricity interconnectivity, regional cooperation

Bulgaria

Provision has been made for a second interconnection, via a Greece-Bulgaria 400 kV transmission line from the Nea Santa HVC to Maritsa East. The project is included in ENTSO-E's ten-year development plan and has been designated by the EU as a project of common interest (PCI).

Cyprus

It was designated by the EU as a PCI and included in the Israel-Cyprus-Greece interconnection. The plan envisages an interconnection via submerged DC connectors.

Albania

An effort started recently and in cooperation with Albania to consider the upgrading of the Greece-Albania 150 kV interconnection by operating the Mourtos-Bistricka transmission line, which is practically under no use currently. Given the significant works that are being carried out for enhancing the southern Albanian transmission system at the 220 kV and 110 kV levels in areas where plans are being made for new power plants, it is now possible to make better use of the above interconnecting transmission line.

FYROM

Finally, as regards the upgrading of the Greece-FYROM interconnection in the context of ENTSO-E's ten-year development plan for European networks in 2018, surveys were completed recently for looking into the need to enhance the European transmission system by 2040. These studies identified the need to enhance power transmission capacity between the Greek system and that of FYROM under the scenarios considered. The solution proposed was to upgrade the existing Meliti-Bitola 400 kV interconnecting transmission line. The project will be included in ENTSO-E's ten-year development plan for European networks as a project 'under consideration', following agreement with the FYROM system operator. Joint surveys will also be conducted to look into its feasibility.

Strengthening natural gas interconnectivity, regional cooperation

Trans Adriatic Pipeline (TAP)

TAP is part of the Southern Gas Corridor and will be used to transfer gas from the Shah Deniz II field in Azerbaijan to South Italy via Greece, Albania and the Adriatic Sea. Provision has been made for linking it to the Interconnector Greece-Bulgaria (IGB) and the Ionian Adriatic Pipeline (IAP), which is currently being planned, to supply gas to West Balkan countries. The pipeline has a total length of 878 km, with

550 km on Greek territory. The Greek section of the pipeline will be connected with Turkey at Kipoi and with Albania at Ieropigi.

TAP was financed by EIB, with a loan of EUR 1.5 billion. The construction of the Greek section started in June 2016 and is within schedule, or even ahead of schedule in certain parts.

TAP is strategically important for the area's energy security as it is capable of supplying gas to the developing energy markets in SE Europe through vertical interconnectors. TAP will strengthen the energy security of Greece, with plans for supplying 1 bcm of gas per year to Greece. Essentially, however, it is a project that will strengthen Greece's geopolitical position, will give added value thanks to its multiple interconnectivity options and may serve as a gas transit 'vehicle' even from sources other than the Shah Deniz II field.

East Med

The EastMed gas pipeline is a PCI currently being planned, to connect Europe with natural gas fields in the East Mediterranean Sea. The project is being pursued through a four-party collaboration between Greece, Cyprus, Italy and Israel, and plans are being made for signing a four-party cross-border agreement in 2018 for further promoting the project. When implemented, the EastMed will put an end to the energy isolation of Cyprus, as well as Crete. A 'corridor' for natural gas from new sources is being created for the EU in the form of an upstream pipeline. The pipeline will also help diversify the EU's energy sources. The pipeline will follow both a submerged and onshore route, directly from the Cypriot and Israeli gas fields in the East Mediterranean Sea, via Cyprus, Crete and the Peloponnese, to mainland Greece. From there, it will follow an onshore route up until it is connected to the IGI Poseidon pipeline (Greece-Italy). The design of the pipeline is underway. In accordance with its design, it will have a total length of 1 870 km and a capacity of 10 bcm/y, which may be increased to 20 bcm/y owing to inputs from the Levantine Basin gas fields, which contain natural gas both from Cyprus and Israel. The project construction phase is expected to start in 2020. The project will be completed at the end of 2025, when it will be possible to start using it commercially/operationally. The project is included in the list of PCIs, and so far financing of EUR 36.5 million has been granted by the EU through the CEF programme. The total investment cost of the project is estimated at EUR 5.2 billion for the connection with mainland Greece and EUR 6.2 billion for the connection with Italy (IGI Poseidon).

Turkey-Greece-Italy Interconnection (ITGI)

The ITGI project was designed for the transmission of natural gas from the Caspian Sea region or other sources of gas in that region. It comprises three different sections: (i) the 296 km long Interconnector Turkey-Greece (ITG), which has been in operation since 2007; (ii) the new 570 km long pipeline from Komotini to the Northwest coast of Thesprotia; (iii) a compressor near the coast of Thesprotia; and (iv) the 216 km long submerged Poseidon pipeline from Thesprotia to Italy. The submerged pipeline will be constructed by IGI Poseidon, i.e. a JV between French-Italian Edison (50 %) and DEPA (50 %). Poseidon pipeline was designated as a PCI in 2017. Based on the initial plans, DESFA will construct the onshore pipeline as part of the Greek national gas system.

Interconnector Greece-Bulgaria (IGB)

The 182 km long IGB (PCI) will connect Komotini and Stara Zagora and will have a transmission capacity of 3 bcm per year, which may be increased to 5.5 bcm. The IGB project is deemed to be very important for strengthening the security of supply in SE Europe, as it links the Greece-Bulgaria boundary thus allowing for gas to be imported from several sources. The final investment decision on the IGB was made in December 2015 and construction is due to start in 2018. The design, construction and operation of the IGB has been undertaken by JV ICGB AD, whose shareholders (IGI POSEIDON SA [which belongs to DEPA and Edison by 50/50] and Bulgarian Energy Holdings [owned by the Bulgarian State]) signed the final investment decision (FID) in Sofia on 10 December 2015. The total implementation cost is estimated at EUR 240 million.

Vertical Greece-FYROM interconnection

A MoU was signed in Skopje on 14 October 2016 by and between DESFA and Macedonian Energy Resources Skopje (MER) for a vertical connection with the Greek national network. It should be stressed that the project is included in our energy strategy for setting up vertical interconnecting pipelines to transmit natural gas to Balkan countries via the Greek national system. This gas interconnector will stretch from the area of Nea Mesimvria, Thessaloniki to the city of Negotino, where it is to be connected to the FYROM transmission network. It will have a total length of 120 km and an annual transmission capacity of 2 or 3 bcm of natural gas.

Ionian Adriatic Pipeline (IAP)

In the context of the Energy Community, a ministerial declaration was signed (by Albania, Croatia, Montenegro) in September 2007 in the context of the Zagreb summit, announcing the construction of the Ionian Adriatic gas pipeline (IAP). The bi-directional pipeline will have a capacity of 5 bcm/y and a length of 515 km, will run along the east coast of the Adriatic Sea and will be connected to the Trans Adriatic Pipeline (TAP) in Fier, Albania and reach Split, Croatia via Montenegro and Bosnia and Herzegovina. A MoC was signed in Tirana on 23 May 2013 by and between Albania, Bosnia and Herzegovina, Montenegro and Croatia for the implementation and interconnection of TAP and IAP. A MoU was also signed in August 2016 by and between Albania, Bosnia and Herzegovina, Croatia, Montenegro and the State hydrocarbon company of Azerbaijan (Socar), which was important for the development of the project.

Development of energy transmission and distribution infrastructure

As regards the development of power transmission infrastructure, the projects planned for implementation and already implemented in the context of the national power transmission system constitute the most important policy measure. More specifically, ADMIE, in the context of the ten-year system development plan, identifies the major transmission infrastructures that need to be constructed or upgraded in the next ten years. Also, apart from new system projects, ADMIE also describes in that plan the improvements to the structure of the existing substations and the enhancement of the existing transmission network of transmission lines with a view to strengthening the functionality and reliability of system installations. Moreover, a very important part of the plan for the extension of the electricity system is the interconnection of most NIIIs with the mainland system.

Similarly, DEDDIE has developed a five-year network development plan, identifying the most important works for the development and enhancement of its network with a view to meeting the demand for electricity and covering the connection needs of consumers and RES producers, also seeing to it that the quality of the energy supplied is upgraded and the cost-effectiveness and safety of the distribution network are streamlined.

In recent years, DEDDIE has implemented a number of strategic projects, with the long-term goal of ensuring its digital transformation by 2021. All these projects are expected to bring about radical technological changes in terms of network management, so that DEDDIE is able to respond to its upgraded role as market operator. These projects aim to modernise the remote control of all networks in Greece, implement new customer service systems across Greece, optimise the use of electricity systems

on the NIIs, modernise technical systems (network mapping, consumption measurement) and reorganise key operations (development programming, logistics).

Finally, DEDDIE, as operator on the NIIs, uses the action plan for the implementation of infrastructure on the NIIs (RAE Decision No 389/2015) to promote different infrastructure projects intended to ensure the smooth implementation of the management code for the NIIs, e.g. installation of an information system by the end of 2020, of measurement infrastructures by the end of 2019, and of the central energy control centre and the local energy control centre of Rhodes by the end of 2020.

As regards natural gas DESFA operates and develops the national gas system (ESFA), comprising the national gas transmission system and the LNG terminal on the island Revythousa.

The construction of a third LNG storage container was completed recently, thus making a substantial contribution towards increasing the gasification capacity of the Revythousa LNG Terminal. The third container will have a capacity of 95 000 m³ of LNG and will increase the terminal's total storage capacity to 225 000 m³ of LNG, from the current level of 130 000 m³ of LNG. Also, the gasification capacity will be increased to 1 400 m³ of LNG per hour, from the pre-construction level of 1 000 m³.

Gas distribution networks are developed by three new distribution companies: EDA Attikis (Attica), EDA THESS (Thessaloniki, Thessaly) and DEDA (other parts of Greece, with an existing network in Continental Greece, Central Macedonia, Corinth and Thrace).

Measures for the integration of the energy market to those of neighbouring countries

The reorganisation of the Greek electricity market is the most important measure as part the consolidation of the electricity market at European level and the coupling of the neighbouring markets. In order to move from the current state of the electricity market to a single European market with the aim of integrating the single European electricity market and achieving the Target Model, the wholesale **electricity markets (Day-Ahead Market, Intraday Market and Balancing Market) and the Energy Financial Market**, have been established. The **Hellenic Energy Exchange S.A.**, which was established in 2018, will take over the operation of the Day-Ahead Market, the Intraday Market and the Energy Financial Market and ADMIE will take over the operation of the Balancing Market.

In order to integrate the Greek electricity market with neighbouring markets, measures have been taken in recent years to preserve the smooth functioning of the existing and new forms of the electricity market (Target Model) and the sustainability of its Participants.

In particular, with regard to the existing electricity market, the definition of the Administratively Defined Maximum Reserve Price for the provision of the Primary Control service and the Secondary Control Range (from the current price of EUR 10/MWh to EUR 50/MWh) is expected to lead to a rise in the revenues of flexible power plants.

As a measure aiming at the smooth functioning of the new Markets and the protection of their Participants, a **Clearing House** has been established, which will be able to undertake the clearing of the transactions carried out on the Day-Ahead Market and the Intraday Market.

In addition, steps have been taken to enhance the participation of flexible production plants (including energy storage plants and demand response systems) for the smooth operation of the Intraday and the Balancing Market and the promotion of the penetration of variable RES (especially wind and photovoltaic) plants.

In addition, once the Intraday Market will have grown and acquired sufficient liquidity, obligations for balancing the new RES and CHP plants will apply, while measures have been taken to establish and operate the Local Intraday Auctions, Continuous Trading Sessions and Regional Intraday Auctions which are expected to give more flexibility to RES involvement by ensuring access to markets at regional/European level, ensuring adequate liquidity at intraday level to correct failures in RES forecasting. The new RES plants that are expected to be connected to the electricity grid must now participate in the Electricity Market either independently or through Aggregators, reducing the need for additional flexibility in the Balancing Market.

However, besides taking measures for the smooth operation of the Intraday and Balancing Market and enhancing the penetration of variable RES, to maintain the reliability of the electrical system and to meet the demand for electricity without cuts, it is necessary to take measures to ensure the installation and operation of sufficient power generation capacity. In particular, if the target of ensuring sufficient power is not achieved through the operation of electricity markets, it is proposed to adopt or extend mechanisms that will strengthen Market Participants and ensure that the system is adequate. Indicatively, in recent years, in the framework of operation of the existing electricity market, the Imbalance Settlement Scheme, the Transitional Flexibility Compensation Scheme, the Variable Cost Recovery Scheme, etc. have been adopted.

As part of the Imbalance Settlement Scheme, any extraordinary transactions made to ensure the physical equilibrium of the System on Dispatch Day are cleared due to speculative fluctuations in demand or generation. Correspondingly, with the Variable Cost Recovery Scheme, electricity generators are compensated if they are operating their plants at a lower cost than their variable cost compared to the case where the particular plant is included at the request of the Operator and without its operation having been scheduled at the time of setting up the Day-Ahead Scheduling and when, at the time of setting up the DAS, it is included in a specific charging level purely for meeting reserve requirements.

With the Transitional Flexibility Compensation Scheme, producers are compensated for their availability in providing the flexibility service, i.e. the possibility of a power plant to follow the Operator's Dispatch Instructions and to increase or decrease its allocated power for a specified period by carrying out a rapid cycle, so as to follow the load.

Recently, the Greek State has notified the European Commission of a new mechanism for ensuring sufficient power generation capacity (***Long-term Capacity Compensation Scheme***).

The Capacity Compensation Scheme will contribute to both the reliability of the electrical system and the security of supply as well as to the protection of consumers. The implementation of this scheme is expected to be launched at the same time as the electricity market harmonisation phase with the Target Model specifications. Moreover, within the framework of the operation of the new Electricity Purchases, in order to strengthen both the system's flexibility and power adequacy, Demand Response Aggregators have been established and expected to start operating, that will contribute to increasing the flexibility of the power generation units.

Consumer protection and increased competition in the electricity market are also a key priority. For this reason, measures have been adopted in recent years, such as the setting of a ceiling on the price offered by the units available (EUR 300/MWh for thermal units), while the objective of boosting competition has been the introduction of a minimum level of supply from producers, which is equal to the variable cost of each unit, so that producers pay at least the cost of their fuel and any misconduct be prevented.

Moreover, competition in the wholesale electricity market was reinforced by the methodology for calculating the variable cost of hydroelectric units, while it was decided in 2018 to separate and contribute two lignite branches of PPC S.A. to two new companies in order to allow private producers to have access to lignite generation.

Accordingly, the system of auctioning electricity forward products with physical delivery through DAS and with a regulated starting price to Eligible Electricity Suppliers (NOME auctions) is a particularly important measure to strengthen competition in the retail electricity market. The objective of this mechanism is to initially reduce by 25 % PPC S.A.'s retail and wholesale market share, while the final decrease should be more than 50 % by the year 2020.

With a view to strengthening competition and enhancing liquidity in the natural gas market, following a relevant decision of the Competition Commission, a mechanism for the auctioning of natural gas quantities by DEPA S.A. was established. More specifically, in 2012, it was foreseen to establish a programme for the allocation of gas quantities through electronic auctions to the market on an annual basis equal to 10 % of the quantity supplied the previous year. Moreover, DEPA S.A. has committed since 2016 to a gradual increase in the total quantity to be disposed of as a percentage of DEPA sales of the previous year, with a specific implementation plan (16 % in 2017, 17 % in 2018, 18 % in 2019 and 20 % in 2020).

Furthermore, the National Natural Gas Transmission System has a fully functional Balancing Platform and a Virtual Trading Point since 1 July 2018. Through the Balancing Platform, the Operator will now be able to buy and sell the quantities of gas needed to balance the National Transmission System through auctions. The daily reference values for the purchase and sale of gas are now based on transactions between users and the Operator at the Balancing Platform. At the same time, the activation of the Virtual Trading Point allows for the first time traders whose object does not involve handling natural gas to operate in the Greek market, as it is now possible to carry out transactions of gas quantities, without the prior commitment of capacity at physical points of entry/exit, as has been the case to date. The launch of the above is the first and the most decisive step for the development of a functional wholesale gas market, according to the requirements of the Gas Target Model, as well as the achievement of DESFA's strategic goal of creating a Greek regional gas hub. The next step is the operation of a Trading Platform, where anonymous transactions will take place between gas market participants, which will determine the gas purchase and sale limit values.

In addition to the above important step towards market integration is the signing of an Interconnection Agreement between DESFA and the operator of the upstream Bulgarian gas system, Bulgartransgaz, for the Kulata (BG)/Sidirokastro (GR) Interconnection Point, which has enabled third parties to access the point in both directions since 1 July 2016, laying the foundations for the development of cross-border trade in the region of South-Eastern Europe. The second version of the agreement, which incorporated the provisions of the other European Network Codes, entered into force on 1 June 2017.

Regarding the strengthening of competition in the oil products market, regulatory provisions have been launched, such as the reduction of the minimum required share capital and the volume of minimum required storage space to facilitate the entry of new entrants into the oil products wholesale market. In the same direction, in the case of bottled LPG trading, the requirement of the minimum number of refillable bottles for new entrants in the industry was reduced. Finally, common terms and conditions were established for the granting of marketing authorisations to all companies operating in the Greek oil products market, in order to motivate oil companies to operate in the island country.

Finally, it is worth noting that Greece is a net exporter of oil products, thanks to its strong refining capacity and despite the low crude oil production.

Addressing energy poverty and consumer protection

The Social Household Tariff, which was introduced to protect vulnerable consumer groups with the purpose of providing discounts to the electricity consumed by beneficiaries, is one of the most important policy measures to combat energy poverty. A similar provision is also made, through the Solidarity Services Tariff, to legal entities of public law of a privileged nature, religious-charitable institutions and specially certified private non-profit bodies that provide social care services.

In 2017, EUR 10 million was earmarked as one-off special aid to support low-income consumers who have been disconnected from the electricity grid due to overdue debts, in order to meet their energy needs. The automatic transition of vulnerable household customers into the Universal Service regime was also introduced, without any interruption of their electricity supply in case the supplier terminates the Supply Agreement or the previous supplier submits to the respective operator an order to deactivate the supply due to overdue debts or non-compliance by the client with the terms of settlement of due debts.

From the year 2012 until today, the granting of a heating allowance to certain categories of consumers of domestic heating oil has been instituted because of the increase in the final price of this particular product.

In addition, energy efficiency improvement programmes have already been launched at national level to combat energy poverty, and their contribution has been significant. To this end, the 'Saving at home' programme involves the implementation of interventions to improve the energy performance of residences that are proved to have low energy performance and belong to low-income owners who cannot fund on their own the energy upgrade of their residence.

Under the energy efficiency obligation scheme, energy companies participating in this scheme can meet the energy-saving target by implementing technical and/or behavioural measures in vulnerable households by increasing energy-saving units by a factor of 1.4. Moreover, in the context of providing incentives for the efficient operation of the Energy Communities, it provides for the installation of RES and CHP and Hybrid Plants by energy communities in order to meet the energy needs of their members and vulnerable consumers or citizens living below the poverty line within the Region where the seat of the energy community is located by applying virtual energy offsetting.

Additional measures include the elaboration of the Energy Poverty Action Plan, which comprises specific actions related to the improvement of energy efficiency in energy-poor households and other social policy or energy pricing measures, and the functioning of the Energy Poverty Observatory.

Finally, the relevant provisions of the Management Code of the Hellenic Electricity Distribution Network (Government Gazette, Series II, No 78/20.01.2017) and the subsequent RAE Decisions that followed (Electricity Theft Manual, Government Gazette, Series II, No 1871/30.05.2017 and setting of the Administratively Defined Price, Government Gazette, Series II, No 1947/07.06.2017) updated the regulatory framework for dealing with the phenomenon of electricity theft, which was very widespread in the previous years. Consistent consumers are being affected by the electricity theft phenomenon, with the increased cost of electricity being passed on to the wholesale market due to electricity theft (rise of non-technical losses). Based on the new framework, the amounts collected by the offenders are now used to offset the loss suffered by consumers from the phenomenon by crediting a portion of them in the ETMEAR, Public Utilities, System and Network User Charges bills, as well as for enhancing the special reserve for the development of measures to address electricity theft.

5. Dimension of research, innovation and competitiveness

- **Policy measures to promote research and innovation**

The European Strategic Energy Technology Plan (SET Plan) is the pillar of EU energy and climate policy in research and innovation, contributing to the structuring of European and national research programmes and making significant investments in low- carbon technologies.

European technology priorities, grouped according to the main objective of the Energy Union under the SET, are:

- Gaining the first place in the world in renewable energy.
- Providing an intelligent consumer-focused energy system.
- Developing and strengthening energy-efficient systems.
- Diversifying and enhancing energy options for sustainable transport.
- Guiding the ambition of carbon capture, use and storage.
- Enhancing safety in the use of nuclear energy.

At the national level, the Energy Innovation Platform is the core of the consultation on the specialisation of energy research and innovation (R&I) issues/priorities. Through this process, the objectives of the Smart Specialisation Strategy (RIS3 or S3) are earmarked and priorities are set at national and regional level by developing and combining the benefits of R&I with business needs to address emerging opportunities and market developments in a coherent manner.

This **innovation platform** brings together representatives from the industry, research centres, universities, technology institutions, financial institutions, co-competent ministries and regions. A small Advisory Group has also been set up to elaborate recommendations to the relevant platform, made up of experts with significant activity in the sector, both from the production and the research field.

Following the smart specialisation options, the most important policy measures implemented in the country are:

I. The Single State Aid Action 'Research - Create - Innovate'. The main objective of this action is to link R&I with entrepreneurship and strengthen the competitiveness, productivity and openness of enterprises towards international markets, with a view to transitioning to quality innovative entrepreneurship and increasing domestic added value.

The more specific interventions of the action are:

- Research and development by small and medium-sized enterprises which supports broad-based industrial research, innovation promotion and business networking.
- Business partnerships with research organisations where collaboration on R&I projects between businesses and research institutions is promoted.
- Exploiting research results produced from previous research projects.

II. The Multiannual Investment Plan to support research infrastructures, which aims at strengthening strategic infrastructure.

III. The Hellenic Foundation for Research and Innovation, which aims to promote free research and innovation through PhD scholarships.

IV. The operations 'Development of Innovative Business Areas in the areas of the National Smart Specialisation Strategy' and 'Specialised Skills Centre Networks' aim to support integrated programmes for the creation and support of innovative cooperative clusters of enterprises and research entities.

V. The Equity Fund (Equifund), which is an investment platform with a multiplier effect on the economy and society, helping to find financing through equity investments in companies.

VI. The operation 'Exploitation of research results and innovation produced by research institutions', which aims to fund clusters (e.g. universities, technological educational institutes, research bodies) to exploit research results.

VII. The operation 'Promoting Start-ups (Spin-off/Spin-out)' to strengthen the establishment and development of knowledge-intensive start-ups from universities, technological educational institutes, research centres, enterprises and independent researchers for trading/commercialising mature research results and innovative ideas. Finally, Greece's participation in energy programmes funded under Horizon 2020 systematically promotes research and innovation, aiming at smart, sustainable and integrated development, as well as effectively addressing various major social challenges.

- **Policy measures to promote competitiveness**

Additional policy measures are being launched to promote competitiveness in the fields of energy production and consumption. More specifically, Development Law 4399/2016 on the 'Institutional framework for establishing Private Investment Aid schemes for the country's regional and economic development - Establishing the Development Council and other provisions' is an important tool for investment in industrial plants and small and medium-sized enterprises, including the energy sector, through the granting of different aid schemes (tax exemption, grants, subsidies for the cost of created jobs, stabilisation of the income tax rate and venture capital financing through venture capital funds).

The promotion of strategic investments through Law 3894/2010 provides the international and Greek investment community with a stable and transparent investment framework consisting of rules, procedures and administrative structures for implementing large public and private projects. This law aims at developing investment plans that generate long-term positive wide-ranging results of significant intensity in the national economy while helping to overcome major problems such as bureaucracy, complexity of the legal framework and opacity, that discourage investors and significantly delay the implementation of major projects. Moreover, legislative provisions to simplify the licensing process have been put in place to make the process easier, smoother and more attractive.

The company 'New Economy Development Fund (TANEO) S.A.' aims to acquire minority shares in venture capital funds, venture capital companies and corresponding venture capital schemes established specifically for this purpose. These investment schemes should be managed by private sector entities with private-economic criteria and invest exclusively in small and medium-sized enterprises in Greece.

Finally, the Hellenic Fund for Entrepreneurship and Development (ETEAN S.A.) is a link in the financial cycle of financing between the small and medium-sized enterprises and the banks, taking over the part of the business risk of small and medium-sized enterprises that is not taken over by banks.

Financial intermediation for small and medium-sized enterprises is being substantially promoted through the provision, in addition to guarantee, of other modern financial products, such as the creation of special purpose funds that provide low-cost financing.

The above policy tools, despite the fact that they mobilise all investment efforts, mobilise significant investments both in the field of energy production and infrastructure and in increasing energy efficiency by contributing to increased competitiveness in the manufacturing and tertiary sectors.

1.2.3 Energy design challenges in five dimensions

1.A Decarbonisation dimension - Emissions and removals of greenhouse gases

The most important challenge for the majority of policy measures is to effectively address the complexity of different components (technical, administrative, managerial, institutional, social) that need to be tackled in order to properly implement the specific policy measures.

The lack of the necessary infrastructure is a major challenge for the implementation of measures and policies at several levels, such as for the promotion of natural gas in the transport sector.

With regard to the reduction of emissions of fluorinated gases and in addition to the existing control and sanction mechanisms, controls must be intensified and coordinated. In the case of policy measures relating to the agricultural sector, the main challenge lies in the fact that it is necessary to inform and integrate a large number of producers of agricultural products, since Greece is marked by the existence of a large number of small and medium-sized producers.

Finally, the lack of control and certification procedures represents an obstacle to the proper implementation of policy measures to reduce fluorinated gas emissions.

1.B Decarbonisation dimension - Renewable Energy Sources

In the case of renewable energy policy measures for electricity generation, the complexity, delays and volatility of the existing institutional framework are the main challenges for the licensing of RES units for electricity generation. The development of an integrated framework with regard to the siting of RES facilities applicable across the territory with clear rules, criteria and constraints is critical to the higher RES penetration in electricity generation. At the same time, the overall reorganisation of the licensing framework, taking into account the new operational aid scheme and the requirements of the new directive, is imperative, and a number of provisions can be adapted to the reorganised licensing framework.

The effective coordination and cooperation between the institutional actors involved and the development of an efficient monitoring mechanism for all operational parameters are considered prerequisites for the existing support scheme.

In general, a substantial improvement in the control and enforcement monitoring mechanism is required for a multitude of policy measures, and in some cases the need to complete the necessary regulatory framework needs to be addressed.

In the case of tendering procedures, the development of specific and joint tendering procedures, as well as area-specific ones, including the establishment of a time-stable framework for their implementation, has already been launched. At the same time, concerning the special RES account, the main challenge involves the increased requirements for the methodology for monitoring its sustainability and addressing the various liquidity problems.

In the case of the energy offsetting measure, the challenge is the gradual expansion of the scheme and the adoption of a mechanism to monitor the effects on regulated charges. In addition, in specific policy measures, technical support, as in the case of energy communities, is critical.

With regard to the transmission system development measures, management complexity and time delays due to external factors are the main challenges to their implementation, and the saturation phenomena need to be addressed, allowing for the installation of new RES power in areas with high potential. In general, dynamic planning is required, incorporating the various regulatory technical challenges and external parameters.

Concerning the NIIs, the Management Code should take into account the new requirements for RES plants that affect even their operational/financial plan and require the completion of all the required implementation tools.

In the case of existing financial mechanisms, priority is given to simplify procedures and select the most cost-effective applications. Moreover, a major obstacle is the lack of a monitoring procedure to check their implementation.

The incomplete regulatory framework and the absence of an enforcement monitoring mechanism are the main problems related to the promotion of RES in nearly zero-emitting buildings, while the need for training and adaptation to the technical requirements of the stakeholders is also critical. Incomplete information and technical difficulties in the implementation and development of relevant networks are the main challenges with respect to geothermal energy. Finally, the high initial installation cost for some of the RES systems is a deterrent to their greater penetration regardless of the expected benefit over their entire life cycle.

Emission problems (microparticles) due to open-free combustion environments and the lack of certification of the raw material used are the main obstacles to the further promotion of biomass for space heating, and corrective action and regulatory tools are needed to reduce the negative environmental impact of the implementation of the measure.

With regard to policy measures to promote RES in transport, the high initial cost of electric vehicles and natural gas is the most important problem, which has also undermined the sustainability of the required charging and supply infrastructure. The main objective should be to promote the use of Greek raw materials and to support domestic biodiesel producers. However, further exploitation of biodiesel should be compatible with the policy on the promotion of advanced biofuels and the reduction of conventional biofuels in line with the requirements of the new Directive.

Important challenges include providing consumers with information on the benefits of biofuels, completing the regulatory framework, certifying sustainability criteria by voluntary schemes, and more effectively analysing and processing the statistical data collected by the IT system, taking into account the reporting requirements of the new Directive.

Finally, the development of the required infrastructure is an important parameter to further promote electrification.

COURTESY TRANSLATION

Challenges to the electricity system due to high RES penetration

Increasing the penetration of variable RES (mainly wind and photovoltaic plants) increases the volatility and uncertainty of the residual load (load less output from variable RES) and the flexibility needs of the system. The main categories of flexibility sources are dispatchable generating units, storage, interconnections and demand response. It is worth noting that the current level of RES penetration (with the gradual introduction of 5 GW of wind and photovoltaic plants into the interconnected system over the previous years) has been achieved without new storage facilities.

In order to achieve high levels of variable RES penetration, as set out in the National Energy and Climate Plan, in an economically rational way (sufficiently low cuts in their production), there is generally a **need for energy storage**. Pumped storage has been for several decades the most widespread international method for large-scale storage of electricity. Today, international developments are rapid in terms of other forms of storage, either for large or for small installations, especially for batteries of different kinds. There is also interest in electricity-to-gas (e.g. hydrogen) storage applications, in the context of which the interconnection of electricity and gas networks is also investigated. Moreover, given the international interconnections of the Greek continental system, the investigation of the needs for storage and coverage at a regional level may also prove efficient.

It is also worth noting that, apart from storage requirements, the transformation of the electricity system to achieve 50 % RES penetration also creates other technical challenges. For example, it is very likely that these penetration rates at energy level per year will produce even higher rates of 'instantaneous' penetration of power plants with electronic power converters, a technology used, for example, in wind farms and photovoltaics, and is totally different from the rotating generators of other plants (e.g. lignite, natural gas and hydroelectric plants). This in turn brings about significant changes for which the electricity industry, including the electricity grid operators, have been preparing internationally.

2. Energy efficiency dimension

In the case of policy measures relating to infrastructure development, technical complexity and the definition of both technical specifications and the implementation mechanism are the main problems leading to significant delays.

It is also highlighted that there is a need to develop effective mechanisms for measuring, controlling and monitoring the implemented policy measures, which must be accompanied by the development of the necessary tools and formats. The need to educate, develop certification systems and smoothly adapt the market to technical requirements are considered essential prerequisites for the effective design and implementation of policy measures.

Several policy measures require the adaptation of the regulatory framework, while in the case of public procurement, including public buildings, complexity is an indisputable challenge that needs to be addressed.

With regard to existing funding mechanisms, the key challenges include the choice of cost-effective applications, the simplification of existing procedures, the lack of incentives to implement efficient measures and technologies and the difficulty of financing projects through energy efficiency agreements.

In addition, a transition to the next phase of implementation for specific policy measures should be undertaken. For example, in the case of enforcement regimes, the transition from behavioural to technical measures and the further expansion of the existing scheme through the possibility of exchanging certified energy-saving units are the main challenges.

The legislative framework for multi-property buildings, the individual properties of which are leased or used by the owners themselves, require appropriate modifications. In particular, in order to promote the improvement of the energy performance of these buildings, particular emphasis should be placed on eliminating the barriers related to the separation of incentives between tenants and owners and ensuring that heat comfort needs are met in the most energy-efficient way among all users of these buildings.

In addition, with regard to the energy upgrading of public and private buildings, ensuring economic efficiency and technical and operational feasibility for different uses and categories of buildings requires relevant changes to the legislative framework. Finally, the design of policy measures should in any case be holistic in order to avoid possible incompatibilities between the policy measures already in place and the new measures being planned.

3. Energy security dimension

The integration of variable RES (mainly wind and photovoltaic plants) increases the flexibility needs of the system. High-energy penetrations make it necessary to store energy for sufficient energy absorption of RES units, depending on the level of interconnection of the system and the conditions of neighbouring systems. In addition, storage also contributes to the system's power sufficiency. In order for RES to become the main source of energy in the continental power system (and the island systems that remain autonomous), a radical transformation of the system is needed to maintain and strengthen security of supply.

Another key challenge for the coming period is the reduction of the country's energy dependence, along with the promotion of the decarbonisation of the energy system, including the gradual reduction of domestic lignite fuel production, making it imperative to exploit the high domestic RES potential.

The development of domestic hydrocarbon mining by maximising direct public economic benefits at national and local level and in a safe and compatible way with the natural and man-made environment is another major challenge in the coming period.

With regard to infrastructure policy measures concerning international and domestic interconnections, the most important challenges concern management complexity, time delays due to external factors and availability of resources, meaning that dynamic planning with the potential to incorporate the different regulatory and technical challenges and external parameters is required.

In the case of demand response measures, changes need to be made in their implementation process, completion of the electricity market reform, development of the necessary infrastructure and monitoring systems (e.g. smart meters) and selection of appropriate economic incentives to ensure the involvement of final consumers to whom they are addressed.

Finally, in the case of the use of back-up fuels and in particular for the maintenance of a seasonal gas reserve as a means of enhancing security of supply, the use of floating tanks has capacity constraints and also requires the use of the Revythousa facility (or another gasification facility); as a result, this policy measure requires the development of appropriate infrastructure.

4. Internal energy market dimension

With regard to infrastructure policy measures relating to international and domestic interconnections and development projects, the most important challenges involve management complexity, time delays due to external factors and the availability of resources, requiring dynamic design with the possibility to incorporate the various regulatory-technical challenges and external parameters.

The completion of the necessary regulatory framework and the development of the necessary technological infrastructures and systems are considered crucial conditions for the smooth operation of the new electricity markets and the achievement of the objectives of the integrated energy market. To achieve this, the strategic transformation projects of DEDDIE should be completed. Concerning the above, it is pointed out that they are high added value projects for both the consumer and the market as a whole. These projects are marked by the need for particularly significant investment and increased risk. It is therefore necessary to ensure adequate funding and the development of an incentive mechanism for the implementation of such projects through regulatory decisions such as providing additional return on capital costs.

With regard to measures to strengthen both the wholesale and retail energy markets of all energy products, it is necessary to develop a mechanism to assess the achievement of the desired degree of competition and the benefits for end consumers. Failure to achieve this goal requires the design and implementation of new policy measures with the ultimate goal of protecting end consumers.

Finally, regarding the fight against energy poverty, the key challenges involve the possible simplification of procedures for the participation of beneficiaries in the existing policy measures and amendments exclusively targeted to the participation of energy-vulnerable households.

The Energy Poverty Response Action Plan requires the evaluation of the existing policy measures for their extension, the development and implementation of a methodology for selecting the most effective measures in terms of cost-effectiveness and the avoidance of use of the projected benefits for reasons other than to fight against energy poverty. Moreover, a challenge is to develop effective mechanisms to control and monitor the policy measures in place, including the process of verifying beneficiaries.

Finally, it is necessary to make provision for financing mechanisms aimed at the energy upgrading of energy-vulnerable households residential buildings and for incentives under both the Enforcement Regimes and the Energy Communities.

5. Dimension of research, innovation and competitiveness

The more specific technological challenges in the research, innovation and competitiveness dimension are supported by a series of measures and correspond to the energy planning objectives, which are the following:

Use of new RES technologies to meet the needs for generation, transmission, distribution and storage of electricity by:

- Continuously increasing the competitiveness of production of renewable energy technologies.
- Increasing the efficiency and flexibility of conventional fuel plants as a consequence of the new role they play in the electricity market, as well as the continuous increase in greenhouse gas emission allowance prices.
- Increasing the overall flexibility needs of the electricity system, and energy storage.
- Optimally integrating RES technologies into distribution networks in direct connection with consumption, as well as integrating Information and Communication technologies. Use of new RES technologies to meet heat and cooling needs by:
 - Increasing the competitiveness of heat pumps as well as all low-enthalpy technologies in general.
 - Optimally integrating RES technologies for heating and cooling purposes in the building sector, in particular to the extent that new buildings will be almost zero-energy consumption in the new decade.
 - Ensuring further penetration of solar energy technologies in all uses.
 - Using biomass efficiently.
 - In order to meet the objectives of increasing energy efficiency, challenges in the field of research, innovation and competitiveness must be addressed by:
 - Reducing the cost of construction and upgrade of existing buildings to nearly zero-energy consumption buildings.
 - Adopting new technologies and methods of increasing energy efficiency in the tertiary sector and the public and wider public sector.
 - Reducing network losses and optimising their operation.

Concerning the transport sector, the respective challenges in the field of research, innovation and competitiveness concern:

- The reduction of the cost of low energy storage and electrification technologies.

- The development of smart electrification infrastructures.
- The production of second generation biofuels.
- The reduction of the cost of all alternative fuels that can be used in transport.

Finally, with regard to the reduction of at least 40 % of greenhouse gas emissions, the challenges in the field of research, innovation and competitiveness, other than those already mentioned for RES and energy efficiency, are as follows:

- Maturation and integration of low-emission technologies in the industry, especially in iron and steel.
- Capture and storage of carbon dioxide produced by electricity generation using conventional fuel.
- Application of advanced techniques in rural economy, forests, etc.

1.2.4 Key issues of cross-border interest

Key issues of cross-border interest in the fields of energy and climate focus on the transfer of know-how on policies and measures, on the recognition and planning of the implementation of new cross-border energy infrastructures or on enhancing infrastructure in place, on cooperation to implement innovative and pilot energy projects, on the functioning of energy markets, on cooperation between information systems, and on cooperation as part of financing programmes.

Their implementation often takes place in the context of transnational agreements and transnational memoranda of cooperation/understanding. These transnational partnerships and agreements are designed and finalised in close cooperation and synergy with the Ministry of Foreign Affairs.

1.2.5 Administrative structure for the implementation of national energy and climate policies

- The Ministry of Environment and Energy is responsible for environmental and energy policy. The ministry is responsible for energy policy making, and for renewable energy and energy efficiency policy making. It is also responsible, among other things, for waste policy and forest policy making, for monitoring / making an inventory of greenhouse gas emissions and for the coordination of all relevant actions and adaptation to climate change. The ministry oversees a total of 48 institutions, including public-sector energy companies.
- The Ministry of Finance is responsible for taxation, including energy taxation and other tax-related matters, and oversees the Hellenic Competition Commission (HCC) and other agencies.

- The Ministry of Infrastructure and Transport is responsible for the strategic planning and implementation of the country's infrastructure projects, the planning and implementation of national policy and the creation of an appropriate institutional framework at European and international level to develop high-quality transport services in conditions of healthy competition.
- The Ministry of Rural Development and Food is responsible for agricultural policy, interventions in rural development and the rural economy of Greece. The interventions are aimed both at producing sufficient, quality and safe products, at ensuring a satisfactory level of agricultural income and reasonable prices for consumers and, on the other hand, at providing public goods, ensuring the sustainable use of natural resources and protecting the environment.
- The Ministry of Maritime Affairs and Fisheries is responsible for shipping, port policy and maritime investment, fisheries and island policy, mainly focusing on the coordination and mobilisation of public and private players in the development of the islands.
- Ministry of Economy and Development The Ministry of Economy and Development is responsible for the elaboration of the country's development strategy aimed at ensuring financial stability, implementing reforms for growth and employment, and lastly, modernising the public sector through the effective coordination of the implemented policies.
- The Regulatory Authority for Energy (RAE) is an independent authority with financial and administrative independence on all energy markets. It has acquired direct powers over time, including the right of consensus for the Code of Operation of the National Gas and Electricity Network, the Code of Authorisations and the Code of Operation of the Gas and Electricity Distribution Network. The Regulatory Authority for Energy also approves methodologies and details for the implementation of operating codes and is responsible for licensing, market control and oversight.
- The Centre for Renewable Energy Sources and Saving (CRESS) is the Greek national entity for the promotion of renewable energy sources, energy efficiency and energy saving. CRESS was founded in September 1987, is a private entity of private law and has financial and administrative autonomy. It is supervised by the Ministry of Environment and Energy. Its main objective is to promote renewable energy sources, energy efficiency and energy saving applications at national and international level, as well as to support all activities (technological, research, advisory, investment) in the above fields.

- The Hellenic Competition Commission (HCC) is an independent authority that oversees the smooth functioning of competition in the Greek market. It may conduct market power or market abuse investigations and act as an advisory body of the government. The Hellenic Competition Commission is supervised by the Ministry of Finance, but is financially and functionally independent.
- The Hellenic Energy Exchange S.A. (HEEx SA) manages the Energy Markets and the Energy Financial Markets in accordance with the provisions of Law 4512/2018 and its delegated acts. It is responsible for ensuring an even playing field and transparency on the wholesale electricity market. At the same time, it is expected to lead to the merging of the Greek market with regional European markets.
- The Renewable Energy Sources and Guarantees of Origin manages the Renewable Energy Sources (RES) and the High Efficiency Combined Heat and Power Plants of the National Interconnected System (Transmission System and Distribution Network of the Mainland and Interconnected Islands) and the Guarantees Origin of electricity produced from RES and CHP.
- The Hellenic Hydrocarbon Resources Management (HHRM) manages the rights of the Greek State regarding the exploration and exploitation of hydrocarbons across the Greek territory.
- The Independent Power Transmission Operator (ADMIE) S.A. is responsible for the control, maintenance and development of the Greek electricity transmission system in order to ensure that the country is supplied with electricity in a sufficient, safe, efficient and reliable manner and for the operation of the market electricity related to non Day-Ahead Scheduling (DAS) transactions in accordance with the principles of transparency, equality and free competition.
- The Hellenic Electricity Distribution Network Operator (HEDNO) was established after the spin-off of the Distribution segment of PPC S.A. in compliance with EU Directive 2009/72/EC and is responsible for the operation, maintenance and development of the electricity distribution network in Greece and for ensuring transparent and non-discriminatory access for consumers.
- The National Natural Gas System Operator (DESFA) is responsible for the operation, management, exploitation and development of the National Natural Gas System and its interconnections, in a technically sound and economically efficient way, in order to best serve its Users.

1.3 Consultation and involvement of national bodies and actors in the EU and outcomes

1.3.1 Participation of the national parliament

Three consultations have already taken place in the National Parliament on the National Energy and Climate Plan. In the first (27 February 2018), a presentation was made about the Governance Regulation and the country's obligations in the field of energy and the environment and the proposed mechanism for drawing up the plan. In the second (29 March 2018), a detailed presentation was made about the quantitative objectives per policy axis as well as additional energy, environmental, social and economic objectives of the project, as well as the organisational structure of the project implementation mechanism. Finally, in the third one (23 January 2019), the integrated text of the National Energy and Climate Plan was presented to the Parliament, with reference to the 2030 energy and climate policy objectives, the description of the measures and policies envisaged to achieve the relevant energy and climate objectives, as well as the amount of investment required to achieve these objectives.

1.3.2 Involving local and regional authorities

On 18 June 2018, a workshop was held with the local government bodies at the level of regions and municipalities, attended by 86 representatives of municipal and regional bodies. At the same time, a questionnaire was sent together with the invitation to the workshop, which included questions about the regional dimension of the energy and climate plan, obstacles and challenges for its implementation.

1.3.3 Consultation of stakeholders, including social partners, and involvement of civil society and the general public

- I. On 2 April 2018, a workshop was held with institutional and market stakeholders and NGOs, focusing on 'Goals and Challenges of National Energy Planning'. The purpose of the workshop was to present measures and policies that could contribute to the achievement of energy, environmental and socially related objectives that will contribute to the economic development of Greece and to the protection of Greek consumers with the core objective of adopting a sustainable national energy development model.

The event was attended by 114 participants, including 33 representatives of associations, 10 university institutes / research centres, 27 representatives of companies and NGOs, 35 representatives of energy and environmental stakeholders, 5 representatives of the press and 4 other natural persons.

In the framework of the workshop, a questionnaire was sent to the participants asking for proposals regarding the objectives, measures and policies that should be related to the issues of national energy planning for the period up to 2030. The aim of the consultation was to provide a complete inventory of the proposals regarding the objectives and measures that should be put in place and implemented accordingly in the Greek territory in the framework of the National Energy Planning.

II. A press conference was held on 20 November 2018, presenting the quantified objectives of the project, with a broad participation of representatives of the printed and electronic press, and the Energy and Climate Plan¹⁴.

III. A Workshop on 'Research, Innovation and Competitiveness in the Energy and Decarbonisation Field' was held on Thursday, 29 November 2018.

The aim of the workshop was to submit proposals within the framework of the consultation on national priorities and policies for a decade in the areas of Research, Innovation and Competitiveness in the field of Energy in order to keep pace with the cutting-edge technologies and at the same time to combine financial opportunities and capacities, and also to update the institutional requirements.

The total number of participants amounted to 171, including 30 company representatives, 20 representatives of university companies, 16 R&D organisations, 16 representatives from public and private bodies, 30 CRES partners and 59 other natural persons.

IV. The Energy and Climate Plan was posted on a consultation website for regulatory texts for a period of 24 days, from 13 November 2018 to 7 December 2018¹⁵. 868 comments were received, including 19 from associations of stakeholders, 10 from civil society organisations, 7 from companies active in the energy sector, 6 from universities / research centres and 826 from natural persons.

After evaluating the comments of both the consultation and the workshops, the final text of the Plan was drafted.

¹⁴ [http://www.ypeka.gr/Default.aspx?tabid=389&sni\[524\]=5976&language=el-GR](http://www.ypeka.gr/Default.aspx?tabid=389&sni[524]=5976&language=el-GR)

¹⁵ <http://www.opengov.gr/minenv/?p=9704> and, respectively, at the link of the Ministry of Environment and Energy [http://www.ypeka.gr/Default.aspx?tabid=389&sni\[524\]=5960&language=el-GR](http://www.ypeka.gr/Default.aspx?tabid=389&sni[524]=5960&language=el-GR)

1.3.4 Consultation with other Member States

Targeted contacts and consultations are planned on the basis of the specific priorities and objectives per subject matter, as outlined in this energy and climate plan.

1.4 Regional cooperation in drawing up the project

During the process of drafting the National Energy and Climate Plan, active/existing and ongoing regional cooperation on energy and climate issues has been taken into account in order to assess any synergies and specific actions that may contribute to the achievement of the national energy, environmental and other objectives of the National Energy and Climate Plan.

In this context, the following information is reported:

Greece-Cyprus-Jordan

Memorandum of Understanding between the Ministry of Environment and Energy of the Republic of Cyprus, the Ministry of Energy, Trade, Industry and Tourism of the Republic of Cyprus and the Ministry of Energy and Mineral Resources of the Hashemite Kingdom of Jordan in the field of Cooperation on Renewable Energy Sources, Nicosia, 16 January 2018.

The purpose of the cooperation on the basis of the signed Memorandum of Understanding is the exchange of information and know-how, policy-making, education and actions for Renewable Energy Sources, Energy Efficiency, Innovation-Research and Exchange of knowledge, best practices and pilot projects in buildings, with a particular emphasis on the integration of near zero energy buildings and on the integration of renewable energy sources.

Greece-Cyprus-Israel-Italy

Memorandum of Understanding between the Government of the State of Israel, the Government of the Republic of Cyprus, the Government of the Hellenic Republic and the Government of the Italian Republic concerning the cooperation on the natural gas pipeline 'EastMed pipeline', Nicosia, 5 December 2017.

The purpose of this Memorandum is to confirm the parties' intent to cooperate in the development and implementation of the EastMed Pipeline project as a viable and strategic choice for natural gas-producing countries, as it will ensure a direct and long-term export route to Greece, Italy and other European markets, and will enhance EU security of supply while promoting competition between natural gas suppliers.

Greece-Cyprus-Israel

Joint Declaration of Greece-Cyprus-Israel in the framework of the Fourth Summit which took place in Nicosia on 8 May 2018 concerning agricultural policy, energy and industry. Emphasis was placed on the completion of Inter-Governmental Cooperation for the East Med pipeline.

Greece-Cyprus-Egypt

Joint Declaration of Greece-Cyprus-Egypt, at the 6th Summit which took place in Elounda, Crete, on 10 October 2018, on the diversification of energy sources, security of supply, extraction and exploitation of hydrocarbons and the promotion of renewable energy sources.

Greece-Germany

Under the TARES (2013-)/SRSS project, cooperation on renewables and energy efficiency in Greece with regard to policy and measures has been intensified and steps have been taken to develop new initiatives in the above-mentioned sectors as well as in the sector of power systems.

In addition, cooperation aims at promoting new innovative technologies and exchanging knowledge and experience on relevant issues. Cooperation also extends to R&D in the above-mentioned areas to promote ideas for innovative and pilot projects.

Greece-Italy

Joint Declaration of Greece-Italy in the framework of the Conference of the Ministers for the Environment and Energy of the Hellenic Republic and Economic Development of the Republic of Italy, held in Corfu on 14 September 2017.

Central and South Eastern Europe Energy Connectivity - CESEC

Memorandum of Understanding on a Joint approach to address the natural gas diversification and security of supply challenges in the CESEC Initiative countries, signed on 10 July 2015 in Dubrovnik, Croatia.

Memorandum of Understanding complementing the CESEC Initiative for Central and Southeast Europe with the Joint approach on electricity market, energy efficiency and renewable development, signed on 28 September 2017 in Bucharest.

Especially with regard to renewable energy sources, the cost-competitive renewable energy potential and the added value of RES for the development of a cost-effective, low-carbon energy system and job creation in the CESEC Initiative countries are recognised. In this context, please note the importance of stable and effective conditions for the cost-effective development of renewable energy sources, including the impact of capital costs, and the need for further integration of RES into the market, system and network.

Emphasis is also placed on the development of long-term strategies and plans, such as national energy and climate plans to explore options for further cooperation in their preparation and definition.

Other cooperation measures

- Participation in CA-EED, CA-EPBD and CA-RES groups on RES and energy efficiency.
- Participation in ENTSO-e meetings on energy infrastructure market and development issues.
- Participation/cooperation of CRES (technical adviser of the State) in the EnR programme.

Specific partnerships on Research, Innovation and Competitiveness issues

GSRT's transnational partnerships are an integral part of its overall activity in preparing and strengthening research policies that cover a wide range of bilateral, trilateral and multilateral actions.

In the context of long-term cooperation and ongoing bilateral R&T cooperation agreements with other countries, the GSRT is launching joint calls for R&T projects. The calls announced involve the submission of proposals for the implementation of bilateral R&T cooperation projects in the energy sector. The proposals submitted involve areas of mutual interest in the energy sector, that have been developed through consultations with the competent bodies of the partner countries and are compatible with the strategic areas of Research, Technological Development and Innovation (RTDI) and the thematic priorities set out in the National Strategy for Smart Specialisation (RIS3) 2014-2020.

In particular, to date, the calls announced involve proposals for the implementation of bilateral R&T cooperation projects between:

Greece-China (with indicative Public Expenditure on the participation of Greece: 10 million EUR)

Greece-Germany (with indicative Public Expenditure on the participation of Greece: 9 million EUR)

Greece-Israel (with indicative Public Expenditure on the participation of Greece: 9 million EUR)

Greece-Russia (indicative Public Expenditure on the participation of Greece: 9 million EUR).

Chapter 2 NATIONAL OBJECTIVES AND EXPECTATIONS

The National Energy and Climate Plan (NECP) briefly presents the existing structure of the energy sector, the policies implemented so far, the evolution scenario of the energy system for the achievement of the national energy, climate and associated environmental targets for the year 2030, as well as the proposed policies and measures for their implementation.

In particular, the energy and climate objectives set out in this plan, as well as the presentation of the respective policies and measures to achieve them, reflect both the magnitude of the opportunities, benefits and advantages of the national economy, the energy system and civil society, in general, as well as the challenges and cuts that need to be made.

The main objective of the National Energy Planning and the development of the National Energy and Climate Plan is to design and plan the social, environmental and cost-effective policies and measures that will help to achieve the medium- and long-term national energy and climate goals, will contribute to the economic development of the country and will also respond to the challenge of reducing energy costs and, in general, of protecting end users from the high prices of energy products and services.

In this context, the main goals set out in the preparation of the national energy planning and the preparation of the energy and climate plan are:

- to achieve specific national targets for reducing greenhouse gas emissions, to increase the participation of Renewable Energy Sources in domestic energy consumption and to achieve energy savings in final energy consumption;
- to enhance security of energy supply;
- to strengthen the competitiveness of the Greek economy;
- to protect consumers and, at the same time, to strengthen their role in the energy system;
- to set up and operate a competitive domestic energy market;
- to increase the domestic added value in the energy sector and to create new jobs.

In particular, as part of the national energy planning, key quantitative policy targets are set for the period up to the year 2030, stemming from national priorities as well as from the climate and energy objectives developed and agreed at EU level. They also comprise 'intermediate' targets in the framework of key international and European projects and long-term strategies to reduce greenhouse gas emissions by 2050. These national targets for the year 2030 arise both from specific quantitative commitments undertaken by Member States (i.e. targets for non-ETS sectors and for the reduction of national emissions of certain air pollutants as compared to 2005), and taking into account the characteristics and specificities of the national energy system, the domestic potential for developing technologies and applications, the potential for adaptation as well as the socio-economic characteristics. This process results in the adaptation of national targets to the corresponding central European ones (i.e. the targets for sectors that are part of the Emissions Trading Schemes, RES, energy saving), which are finally proposed under this national plan.

It should be noted that this plan is part of the central European climate change policy with specific climate targets by 2050 and the need to develop a long-term strategy by 2050. The analysis made with the present/proposed energy and climate plan focuses on measures and policies by the year 2030.

In addition, it should be stressed that improving energy efficiency is a key horizontal priority, as it leads to multiple benefits such as reducing greenhouse gas emissions, reducing energy costs, improving comfort conditions in buildings, increasing added value and employment and improving the competitiveness of businesses.

The key objectives are also applicable in the period until 2020, where national binding or indicative targets have already been set in the framework of Union and national law.

Specifically for the year 2020, the following targets are set:

- i. a target of a 4 % reduction in non-ETS greenhouse gas emissions compared to 2005. This national target is expected to be achieved through existing policy measures, as, under the current national plan, it is estimated that in 2020 it will achieve non-ETS greenhouse gas emission reductions at 27 % compared to 2005.

ii. a national indicative key target set for Final Energy Consumption (FEC) of no more than 18.4 Mtoe by 2020. This target is expected to be achieved in the context of energy planning as the FEC in 2020 is anticipated not to exceed 17.3 Mtoe. However, the individual targets related to achieving cumulative energy savings of 3 333 ktoe in the period 2014-2020 and the target of renovating the central public administration buildings are subject to significant deviations and it is expected that there will be a delay in meeting them by 2020. Based on the above, it is clear that the framework of existing measures and policies needs to be strengthened, enriched and that the effectiveness of these measures in achieving the specific quantitative targets that are even more demanding by the year 2030, needs to be increased.

iii. target of RES penetration into gross final energy consumption for the year 2020, which at national level is set at 18 % according to the provisions of Directive 2009/28/EC. In the context of Law 3851/2010, this target was increased to 20 % in 2010. In addition, three sub-national indicative sub-targets for the promotion of RES in gross electricity consumption, heating and cooling and transport, amounting to 40 %, 20 % and 10 % respectively by 2020, were set out in the same law. The key target for the share of energy from RES in gross final energy consumption was 15.23 % in 2016, remaining relatively stable over the period 2013-2016, which indicates that, while it is possible to achieve the national target by 2020, efforts should be intensified in terms of implementing measures and their political and energy results. Similarly, at sub-target level for RES, there are variations and deviations, indicating in which areas more emphasis should be placed in the coming period to ultimately achieve the key target for 2020. A particularly important evidence that shows the success and effectiveness of recent sectoral policies and RES measures is that, in the context of energy planning, the key objective of RES participation in gross final energy consumption is achieved, as the estimated relative share is expected to reach at least 18 % by 2020.

While achieving these national, climatic and related environmental targets in the context of European policies and commitments is a priority of National Energy Planning in the development of the NECP, other national targets are developed at the same time on the basis of the policy axes already mentioned, taking into account the individual potential, the technical specificities and the qualitative characteristics of the Greek energy system in the fields of production, distribution and consumption of energy. These national qualitative targets are presented as Targets for the Development and Evolution of the Energy System. Achieving them requires the development and implementation of specific and complementary policies and measures, and the monitoring of their achievement is deemed to include the adoption of relevant quantitative targets, where possible.

These qualitative objectives are divided into four main categories, which are the following:

- 1. Targets related to the development and operation of an energy system**
- 2. Targets of protecting and strengthening the role of consumers**
- 3. Targets to change fuel consumption and consumption patterns in final consumption areas**
- 4. Targets related to the competitiveness of national economy**

It should be noted that to achieve all these energy planning targets and priorities, a necessary horizontal condition is to mobilise significant investment funds from both the private and the public sectors, which will need to maintain and strengthen their role in an increasingly efficient way, especially in energy networks. A key condition is also the combined use of specialised financial mechanisms that will allow for the optimal economic and timely implementation of the planned measures and policies at the level of specific projects and interventions.

The implementation of these investments is obviously directly related to the creation of the appropriate framework for the development and implementation of the investment projects and thus to the individual regulatory, licensing and financial framework.

2.1 Decarbonisation dimension

A. Emissions and removals of Greenhouse Gases

For non-ETS sectors, a target to reduce greenhouse gas emissions by at least 16 % compared to the respective emission levels for 2005, is set. In line with the baseline scenario of energy policy and the evolution of the energy system, which provides for the continuation and implementation of new measures and policies (Target and Policy Achievement Scenario), this objective is achieved with a reduction rate of 31 %.

The sectors covered by the Emissions Trading Scheme (ETS) are subject to the overall European GHG reduction target of 43 % compared to the corresponding 2005 emission levels. According to the Target and Policy Achievement Scenario of the energy system presented in this plan, the emission reduction for the sectors covered by the ETS is 63 %.

In addition, the NECP integrates and adopts the quantitative targets set in the context of the implementation of Directive 2016/2284/EC on the reduction of national emissions of certain air pollutants for the period 2020-2029 and for the year 2030 compared to 2005 (as shown in Table 18), which also requires the development, establishment and implementation of National Air Pollution Control Programmes, as well as the monitoring and reporting of the emission levels for relevant pollutants [sulfur dioxide (SO₂), nitrogen oxides (NO_x), volatile organic compounds other than methane (NMVOC), ammonia (NH₃) and fine particulate matter (PM_{2.5})] and other pollutants (CO, heavy metals, POPs, BC).

It should be noted that these emissions are not simulated or further analysed within the framework of the NECP, as their evolution is an obligation of other national emission inventories and of the National Programme for the Control of Air Pollution, which is being developed in 2019, further analysing the impact of the NECP on the achievement of the targets set for Greece under Directive 2016/2284/EC.

Table 18: Quantitative targets for the reduction of national emissions of certain air pollutants for the period 2020-2029 and for the year 2030 compared to 2005.

Air pollutants	Percentage of emission reductions compared to 2005	
	Period 2020-2029	2030
Sulphur dioxide (SO ₂)	74%	88%
Nitrogen oxides (NO _x)	31%	55%
Non-methane volatile organic compounds (NMVOCs)	54%	62%
Ammonia (NH ₃)	7%	10%
Fine particulate matter (PM _{2.5})	35%	50%

With regard to climate change adaptation, Greece has already developed and adopted by means of Law 4414/2016 1 the National Strategy for Adaptation to Climate Change 2, which sets out the general objectives, guiding principles and means of implementation of a modern, effective and developmental adaptation strategy within the framework set by the United Nations Convention on Climate Change, European Directives and international experience.

The National Strategy for Adaptation to Climate Change is a strategic document aimed at providing guidelines and as such, does not analyse in depth the necessary sectoral policies but includes indicative actions and adjustment measures for 15 sectoral policies: Agriculture-Livestock, Forest Ecosystems, Biodiversity-Ecosystems, Aquaculture, Fisheries, Water Resources, Coastal Belts, Tourism, Energy, Infrastructure-Transport, Health, Structured Environment, Extractive Industries, Cultural Heritage, Insurance Sector, without prioritising measures and actions.

These issues will be the essence of the Regional Plans for Adaptation to Climate Change, which specify the guidelines of the National Strategy for Adaptation to Climate Change by defining the immediate adaptation priorities at regional/local level. That is, the Regional Plans for Adaptation to Climate Change will precisely define, based on the climatic conditions and vulnerability of each region, the policy areas and priority geographic units for taking measures, and will also specify these measures, as well as the financial instruments for the implementation of the measures, operators, stakeholders, etc. The Greek regions are currently in the process of elaborating their own Regional Plans for Adaptation to Climate Change (with different degrees of maturity per Region).

B. Renewable Energy Sources

The target a **RES contribution to gross final energy consumption** is to achieve a RES share of **at least 30 %**. According to the Target and Policy Achievement Scenario of the energy system presented in this plan, this goal is achieved with a contribution share of **31 %**, considering that the share of the use of heat pumps to meet cooling needs in a highly energy efficient manner is not accounted for¹⁶ as RES contribution. If this share is finally accounted for, also in line with the RES Directive referring to a RES contribution to heating and cooling, **the share is 32 %¹⁷ and has been defined as a national target for the year 2030.**

Additional targets are that the RES contribution share in gross final electricity consumption reaches at least 55 %, the RES share for heating and cooling needs exceeds 30 % and the RES share in the transport sector exceeds 14 % in line with the relevant EU calculation methodology.

¹⁶ In the relevant EU methodology, whose adoption is pending.

¹⁷ Under the relevant Governance Regulation, the national target is set at 31 % and by applying a specific methodology for RES contribution to cooling, taking into account heat pumps, this may amount to 32 %.

At the same time, for the promotion of RES and the increase of their contribution in final consumption, another target is the **electrification and coupling of final consumption sectors**.

In particular, a considerable penetration of electric vehicles is expected, contributing to various dimensions of the NECP, while for rail transport, full electrification will be achieved much earlier and by 2020 at the latest. The aim is to achieve this penetration in the most cost-effective way for the national economy, while at the same time the appropriate infrastructure and the necessary regulatory framework must be developed in a timely manner as these are prerequisites for the electrification of the transport sector. A further aim is to combine the consumption sectors in the greatest and most efficient extent, placing emphasis on maximising the use of RES. The electrification of different uses in final consumption is an essential component in achieving this aim. A typical example is heat pumps which, together with the future greater use of energy storage systems and self-generation schemes, will make a decisive contribution in this direction. A similar example is the **possibility of injecting either hydrogen or methane produced from RES in the natural gas network**. In this direction, the sustainability and efficiency of such a scheme will be considered initially and, if deemed positive, appropriate measures and policies will be promoted.

Relevant quantitative targets are to achieve a share of electric passenger cars of up to 10 % by the year 2030 and that the contribution share of heat pumps to the heating and cooling needs of the building sector exceeds 25 % by 2030.

Moreover, a target is set for the promotion of decentralised RES systems, through schemes, self-generation, energy offsetting and energy communities. In particular, it is envisaged to operate such power generation systems using RES with an installed capacity of 1GW by 2020.

Regarding the evolution of RES contribution shares in final consumption, the tables below present the forecast evolution of these shares at specific time points.

Table 19: Evolution of RES shares by target and sector by 2030.

Evolution of RES shares	2020	2022	2025	2027	2030
RES share in gross final consumption of energy [%]	18.0%	19.9%	22.9%	26.2%	31.0%
RES share in final consumption for heating and cooling [%]	24.5%	25.9%	28.4%	30.1%	32.3%
RES share in Gross Electricity Consumption [%]	29.1%	34.6 %	41.2%	48.7%	56.4%
RES share in Final Consumption for Transport [%]	6.0%	6.7%	8.7%	11.2%	20.0%

Table 20: Progress towards achieving the RES target per sector by 2030.

Progress of the RES energy share in achieving the target of 2030.	2022	2025	2027	2030
in Gross Final Energy Consumption	14%	37%	63%	100%
in Final Consumption for Heating and Cooling	18%	50%	72%	100%
in Gross Electricity Consumption	20%	44%	72%	100%
in final consumption for transport	5%	19%	37%	100%

In particular, while the evolution of RES shares in electricity generation and heating is relatively linear, the share of RES in transport is projected to be more pronounced gradually after 2025, especially towards the end of the next decade and during the years 2028-2030, when it is expected, in economic terms, that electric vehicles will optimally penetrate the market, with RES representing the dominant share of the electricity mix, as compared to all other fuels, and that advanced biofuels will be used for the same reasons. The lagging behind of the penetration of RES in the transport sector has also a slight impact on the progress of the RES target, which is 37 % in 2025 and 63 % in 2027.

This is considered to be the best possible evolution at the level of the national economy, as the scheduling of new RES projects in the power generation sector as well as to meet the heating needs of RES systems will not lead to non-optimal financial investments and will protect the national energy system and available funding programmes from frontloaded locking into actions and measures that will be more efficient if implemented more smoothly during the period under review.

In the field of RES electricity generation, the main applications for the next period that will contribute to the achievement of the targets are wind farms and photovoltaic parks, which are considered to be the most mature and competitive, and are subject to market and cost-effectiveness rules in terms of their impact on aid issues. The following tables show the evolution of these figures for RES technologies in power generation.

Table 21: Evolution of installed capacity of RES units for power generation.

Electricity generation - Installed capacity [GW]	2020	2022	2025	2027	2030
Biomass & Biogas	0.07	0.09	0.12	0.23	0.32
H/E	3.42	3.66	3.72	3.83	3.86
Wind farms	2.83	3.19	4.04	5.16	6.62
P/V	3.54	4.38	5.33	5.81	6.76
Solar thermal plants	0.00	0.00	0.07	0.07	0.07
Geothermal	0.00	0.00	0.00	0.03	0.08
Total	9.87	11.33	13.29	15.14	17.71

Table 22: Evolution of electricity generation from RES units.

Electricity generation [GWh]	2020	2022	2025	2027	2030
Biomass & Biogas	269	383	518	1122	1736
H/E	5152	5789	5983	6207	6269
Wind farms	6575	7450	9491	12094	15508
P/V	5655	6916	8319	9020	10342
CSP	0	0	257	258	260
Geothermal	0	0	0	252	631
Total	17651	20537	24568	28953	34746

Regarding the penetration and participation of RES to meet thermal needs in final consumption, it is expected that there will be a significant increase in the role of heat pumps, especially in the tertiary sector, increased participation of thermal solar systems and geothermal energy as well as a steady contribution of biomass. It is also envisaged that for the first time there will be a small RES contribution of district heating networks.

Table 23: RES contribution to meet thermal needs in final consumption.

RES for heating (ktoe)	2020	2022	2025	2027	2030
Bioenergy	884	909	1010	1068	1129
Solar	210	217	231	248	276
Ambient heat, Geothermal	407	499	592	659	764
Total	1501	1625	1833	1975	2168

Lastly, in the transport sector, as described above, it is expected that there will be a significant contribution from electric vehicles and biofuels, especially from the advanced ones in the last period of 2020-2030, at the end of the following decade.

Table 24: RES contribution in the transport sector.

Transport sector (ktoe)	2020	2022	2025	2027	2030
Biofuels	212	229	266	315	472
Electricity	30	26	57	75	162
Total	242	256	323	391	634

2.2 Energy efficiency dimension

Within the energy efficiency dimension, the objective is to achieve energy savings in final energy consumption of at least 32.5 % compared to the projected evolution of final energy consumption by 2030, as estimated in 2007 in the European energy policies and, therefore, that final energy consumption does not exceed 18.1 Mtoe in 2030. According to the scenario of additional policies and measures / scenario of achieving the objectives of the energy system presented, this target is achieved at an energy saving rate of 32.6 %. Concerning energy savings, the target of final energy consumption of 18.1 Mtoe corresponds to primary energy consumption of up to 24.7 Mtoe in 2030.

Another objective pertains to the cumulative amount of energy savings to be achieved over the period 2021-2030 in accordance with Article 7 of Directive 2012/27/EU on energy saving obligations. According to the available final energy consumption figures, at least 7-7.3 Mtoe of cumulative energy savings should be achieved over the period 2021-2030, but the target will be re-calculated on the basis of the final energy consumption figures for the years 2016-2018.

In addition, the target of an annual energy renovation of the total area of the thermal zone of the buildings of the central public administration is equal to 5 400 square meters, representing 3 % of the total area, as shown in the table below.

Table 25: Buildings of central public administration.

No	Operator Name	Surface area of building	POSTAL CODE / TOWN
1	Hellenic Parliament	24.000	
2	Presidency of the Republic	1.538	10028 / ATHENS
3	Presidency of the Republic	856	10028 / ATHENS
4	Ministry of Shipping and Island Policy	1.007	18510 / PIRAEUS
5	Ministry of Shipping and Island Policy	2.034	18510 / PIRAEUS
6	Ministry of Shipping and Island Policy	535	18510 / PIRAEUS
7	Ministry of Shipping and Island Policy	5.951	18233 / AG. IOANNIS RENTIS
8	Ministry of Shipping and Island Policy	4.855	18510 / PIRAEUS
9	Ministry of Digital Policy	655	ATHENS
10	Ministry of Foreign Affairs	11.237	10671 / ATHENS
11	Ministry of Foreign Affairs	7.031	10671 / ATHENS
12	Ministry of Foreign Affairs	8.268	10671 / ATHENS
13	Ministry of Foreign Affairs	2.848	10671 / ATHENS
14	Ministry of Foreign Affairs	3.008	10671 / ATHENS
15	Ministry of Foreign Affairs	3.776	10671 / ATHENS
16	Ministry of Foreign Affairs	3.014	10671 / ATHENS
17	Ministry of Foreign Affairs	7.415	10671 / ATHENS
18	Ministry of Transport and Infrastructure	12.419	10191 / ATHENS
19	Ministry of Transport and Infrastructure	620	11472 / ATHENS
20	Ministry of Health	12.600	ATHENS
21	Ministry of Economy & Development	16.800	ATHENS
22	Ministry of Interior (Macedonia-Thrace)	11.236	THESSALONIKI
23	Ministry of Justice	973	11636 / ATHENS
24	Ministry of National Defence	9.500	15561 / ATHENS
25	Ministry of National Defence	10.208	15561 / ATHENS
26	Ministry of National Defence	2.058	15561 / ATHENS

No	Operator Name	Surface area of building	POSTAL CODE / TOWN
27	Ministry of National Defence	11.580	15561 / ATHENS
28	Ministry of National Defence	1.900	15561 / ATHENS
	TOTAL	177.922	

The necessity to renovate the existing building stock is indisputable, as this will result in significant energy savings and cost savings for citizens, while the comfort, safety and health conditions in the use of these buildings will be upgraded.

To this end, it is necessary to **establish a central quantitative target for the renovation and replacement of residential buildings** with new nearly zero-energy consumption buildings, which could in aggregate amount to 10 % of all homes by 2030. **The target set is that at least 40 000 homes be upgraded or replaced by new energy-efficient ones on a yearly basis.** This target will contribute significantly to the radical upgrading of the aging building stock, and will also give a significant boost to the construction sector through high added value technologies.

At the same time, for this dimension as well as other dimensions of the NECP, the aim is also **to extend the use of natural gas to final consumption.** In particular, natural gas is expected to be the intermediate fuel for switching to a low greenhouse gas emissions model in all final consumption sectors, and may also lead to both the improvement of energy efficiency and lower energy costs compared to other conventional technologies. The aim is to achieve greater gas contribution in all final consumption sectors and, in fact, that its extended use replaces part of the current consumption of petroleum products in these sectors. The development of the necessary transmission and distribution infrastructure to enable natural gas access to higher end users rates in the building sector and the further increase in its use in industry and transport are priorities for the coming period. The quantitative target for this priority is to increase the direct use of natural gas in the final consumption sectors by at least 50 % compared to 2016.

2.3 Energy security dimension

Optimal utilisation and use of domestic energy sources: Recognising the potential and optimally utilising the domestic energy sources in economic terms is a key objective and pursuit for the development of the national energy system. In particular, the utilisation of RES potential for both power generation and direct disposal and use in final consumption, as well as exploration for the extraction and exploitation of domestic hydrocarbon deposits are energy policy axes for the coming period.

Reducing the energy dependency rate: Reducing the energy dependency rate is another important target for the evolution of the national energy system. Besides, high energy dependency is an issue that concerns the whole of the European Union, with the highest rates appearing in small, developed economies such as Greece. Greece's high energy dependency is due to the particularly high use of oil products and, to a lesser degree, natural gas, which together account for more than 65 % of gross domestic energy consumption and are almost entirely imported mainly from countries outside the European Economic Area. Within the framework of the NECP, the objective is to initially achieve the containment of the energy dependency rate and ultimately to reduce it progressively, ensuring the proper functioning and security of supply of the national energy system. In quantitative terms, this objective is to reduce energy dependency from the high average rates observed in recent years and the initial aim is to contain and stabilise its rate to 70 % and then to less than 70 % by 2030, despite the decline in the use of lignite and the recovery of the Greek economy. Moreover, in the period after 2030, the objective is to further and more rapidly reduce the energy dependency rate, taking into account the new possibilities of using domestic energy sources.

Interconnection of autonomous island electrical systems: In Greece, there are currently 29 autonomous island electric systems (32 until the recent implementation of the 1st Interconnection Phase of the Cyclades in 2018), whose operation requires increased financial resources, which does not allow the smooth and optimal power supply of consumers from these systems fully and under all circumstances. The target set is that, by the end of the next decade, almost all of these autonomous systems will be interconnected with the interconnected system, thereby achieving savings in the national economy, reducing energy dependency, providing the same high quality electricity and services to citizens, complying with the requirements of environmental legislation, and further utilising the potential of domestic renewable energy sources available in these island systems. Even if the interconnection of some small and remote electrical systems is not technically and cost-effective, innovative energy applications will be implemented in these systems in the context of developing 'smart' islands. This objective is expressed in quantity terms in the interconnection or upgrading of all autonomous electrical systems by the year 2030.

Island interconnections and RES penetration in autonomous island systems

New island interconnections are being promoted in the country, which today operate as stand-alone electrical systems based mainly on oil-fired power plants. After the recent completion of the first phase of the interconnection of the Cyclades, the electrical systems of Paros (including the islands of Naxos, Antiparos, Ios, Sikinos, Folegandros, etc.), Syros and Mykonos were also interconnected. The majority of the Aegean islands **will also be interconnected in the period 2020-2030, starting with the interconnection of Crete.**

Island interconnections will allow for more reliable fuelling with a more efficient blend of fuel and thus avoiding SGI charges for more expensive fuel-efficient imported petroleum, which is estimated to result in annual savings of SGI charges of EUR 400-450 million at the time of completion of the interconnection programme. Reducing the use of oil on the islands to be interconnected by 2030 will also contribute to a 3 % reduction in energy dependency, as in this way not more than 900 thousand tons of oil will be consumed annually at the end of the decade to generate electricity for the islands. Similarly, there are significant benefits in terms of reducing greenhouse gas emissions. In addition, after the interconnection, it will be possible to exploit the island's RES potential in a more cost-efficient way, to provide the same quality of electricity and services to the citizens of the country as well as to comply with the requirements of environmental legislation.

The aim is that, by the end of the next decade, almost all of these autonomous systems will have been connected to the interconnected system

For islands that are not expected to be interconnected, a significant reduction in oil use for power generation is also being promoted, **with the installation of modern RES units combined with storage technologies**. In this direction, the installation of **hybrid RES plants** is promoted either through private projects or through pilot projects such as CRES's project for the **conversion** of Ai Stratis into a 'green island' and the **Hellenic Electricity Distribution Network Operator's project for 'smart island' (Kastelorizo, Astipalea, Symi)**, whereas a **hybrid RES plant on the island of Ikaria and a hybrid RES plant on the island of Tilos have already been put into operation**. Moreover, Greece participates actively in the new EU initiative '**Clean Energy for EU Islands**' along with 13 other Member States.

2.4 Dimension of the internal energy market

Electricity interconnectivity

Increasing cross-border transmission capacity is necessary for the following reasons:

- contributes significantly to the security of supply;
- is a key factor in the integration of national electricity markets (according to the Barcelona criterion, the minimum electricity import capacity should be at least equal to 10 % of the installed capacity in each country);
- will allow for the desired high RES penetration in Europe.

For the year 2017, the average total electricity import capacity was 1 565 MW, representing an average of 9.3 % for the year 2017, while it is estimated that the 10 % target will be reached by 2020. The Greek government is promoting projects to increase the capacity of electricity interconnections to and from the North, both by constructing new transmission lines and strengthening the existing ones. These projects are also accompanied by Transmission Systems enhancement projects in the wider Balkan region, with the ultimate objective of increasing the interconnection capacity of the zone and meeting the target for 2030 (**15 % interconnectivity**).

Energy transmission infrastructures

Greece aims to make the country an energy hub for both the electricity market and the gas market. In this way, Greece is promoting projects, which will be implemented in the next decade, to strengthen the country's electricity interconnection with its neighbouring countries and, at the same time, to connect virtually all non-interconnected islands with the continental system, contributing significantly to the integration of the electricity market. With regard to the gas market, future projects that will contribute to enhancing the security of supply and the technical adequacy of the NNGS are described in detail in Chapter 4 hereof.

In addition to the strategic projects for the transmission of electricity and natural gas, DEDDIE is promoting projects to streamline the remote control of the networks throughout Greece, the implementation of new customer service systems all over Greece, the optimisation of the management of the electrical systems of the non-interconnected islands etc., while Network Operators-Natural Gas Distributors aim to develop and expand the natural gas distribution networks in the Greek territory in order to provide cheap energy to all citizens.

- I. **Raising the country's profile as a regional energy hub:** The empowerment and exploitation of the geopolitical role of Greece is a national objective. Consequently, the completion of existing interconnections and the design of new international interconnections with pipelines from third countries is considered imperative. In addition, these actions will also contribute to the diversification of energy sources and supply routes from third countries.

More specifically, with regard to the electricity market in the next decade, the following interconnection projects are being implemented/promoted:

- Second Greece – Bulgaria interconnection
- Greece – Cyprus – Israel interconnection
- Upgrade of a 150 kV interconnection between Greece and Albania
- Upgrade of Greece – FYROM interconnection

Greece is also promoting several transboundary-international gas transport projects, enhancing the diversification of energy sources in the country and other European countries, and in conjunction with the promotion of natural gas storage systems, enhances their energy efficiency in cases of natural gas shortages.

- II. **Digitisation of the energy system:** The digitisation of the energy system is a prerequisite for the development of well-functioning and competitive domestic energy markets and for the optimal implementation and use of all technological applications and market mechanisms that can be developed within the energy markets. Emphasis will be given through operators' development programmes to plan and implement the relevant infrastructure projects, information systems, control centres and metering devices that will allow the complete transition of the current energy system to a fully digitised one, compatible with all the stipulated regulatory provisions on the operation of energy markets.

Market integration and competitive energy markets

The objective of Greece is to integrate the electricity and gas markets with those of the other EU Member States. Greece, in addition to the above-mentioned electricity and natural gas transmission projects, which reinforce the country's interconnectivity, is promoting measures for the reorganisation of the domestic electricity and gas markets (Target Model), focusing on ensuring harmonisation with the European Directives and Regulations on electricity and gas markets.

The completion of the restructuring of the electricity and gas markets is expected to lead to more competitive prices for the specific energy products, while it will be possible to provide services of a different type to the participants who will be able to meet the energy needs of consumers in the most efficient way. Meanwhile, improving competitiveness in energy markets will lead to economic growth.

The country's objective is also to increase demand-side participation in the electricity market and to promote the deployment of storage systems that will enable electricity and gas prices to be restricted, and will strengthen the penetration of RES into the system and the power adequacy of the electricity system.

It is noted that Greece, through the Long-term Power Compensation Mechanisms and the Application of Interruptible Load Mechanisms, aims to encourage the participation of demand in the electricity market in order to limit the cost of energy and enhance the system's power adequacy. At the same time, Greece, by setting a pricing framework, aims to promote the installation of electricity storage systems both in the autonomous systems of the NIIs and in the interconnected system of Greece. The installation of storage systems in the NIIs seeks to increase the penetration of RES in these systems (in addition to the existing 20 %) and to strengthen the system's power to meet demand, while the installation of the storage system in the Interconnected System, in addition to reducing the cost of energy and enhancing power adequacy, aims to strengthen RES penetration and provide flexibility and ancillary services to the System.

In particular, Greece is promoting the installation of RES storage systems in 4 autonomous island systems, applying pilot modes of operation and management to achieve RES penetration exceeding 60 %, while RES penetration of more than 85 % is sought in one of them.

Moreover, through the interconnection of the majority of NIIs with the System, ADMIE aims at:

- increasing the reliability of supply of the interconnected islands at interconnected system level (Note: Even for large non-interconnected systems, the internationally recommended reliability indicators may be twice worse). It is noted that reliability is related to adequacy (possibility of supplying the loads taking into account predictable and unpredictable interruptions), on one hand, and to the security of the system (ability to withstand disturbances such as short circuits or loss of components), on the other;

- substituting oil with other energy sources (in line with the development of the energy mix in the Continental System), resulting in lower generation costs and lower energy dependency (to the extent that the Continental System mix consists mainly of domestic sources);
- realising the RES potential of the islands in a more cost-effective way.

In line with the electricity market, Greece also aims to integrate the natural gas market and strengthen the participation of both the storage and demand response systems of the gas market, while promoting, through the construction of new cross-border natural gas transport projects, the reorganisation of the gas market, the strengthening of the gas transmission network with new storage tanks and the implementation of market participation policies for large customers in the gas market through demand restraint orders, thus reducing energy costs and increasing power and energy efficiency in Greece.

Addressing energy poverty: Addressing the phenomenon of energy poverty is imperative because it has been gradually intensified over the last few years. The worsening of this phenomenon is mainly due to the economic downturn and its impact on the citizens. Indicatively, about 29 % of the total population appears unable to warm up their homes, while in the case of the economically vulnerable population, the figure was 50 % in 2016. Targeted policy measures will be launched with a view to eliminating the energy poverty of energy-vulnerable households, meeting the anticipated comfort conditions and avoiding the resulting health problems. An environmental objective for all citizens, both vulnerable and not, is to reduce air pollution, especially in urban centres. The quantitative objective is to reduce by at least 50 % the relevant energy poverty footprint by 2025, to reduce it by 75% compared to 2016 and to bring it to levels well below the EU average, by 2030.

Promoting energy community schemes: The contribution of energy communities is twofold, since they will contribute both to the realisation of renewable energy and energy saving investments and to the more active participation of the local community and ultimately to the strengthening of the role of citizens in energy activities. Energy communities achieving a minimum number of projects is considered crucial for shaping and assessing the required implementation framework. In this context, the aim is also that energy communities develop innovative energy offsetting schemes, both in the energy generation and consumption sector, thus supporting decentralised energy generation and management. Finally, the design of specific financial instruments will help achieve this. A quantitative target set is to implement participation projects on RES with capacity exceeding 500 MW by the year 2030, as well as to mobilise cumulative representation bodies with the participation of energy communities and citizens.

2.5 Research, innovation and competitiveness dimension

The Greek Research and Innovation System is one of the strong components of the Greek economy with further potential to contribute to solving many problems and to the general development of the country's economy.

The GSRT, which is actively involved in the development and implementation of the country's development programming for the period 2014-2020 and is responsible for Thematic Objective 1 'Strengthening Research, Technological Development and Innovation', is the body that has undertaken setting up a Multi-Annual Research Infrastructure Financing Plan, that will be highlighting the country's long-term investment priorities in large-scale Research Infrastructures, in line with RIS3 priorities, as well as the regional impact of these investments. It is also responsible for the establishment of the Operational Programme in the field of Research, Technological Development and Innovation, which is the main financial instrument for RTDI activities in the period 2014-2020.

Thus, the existing national priorities in the field of energy R&I are those that have emerged from the Research and Innovation Strategies for Smart Specialisation (RIS3)¹⁸ for the programming period 2014-2020, and in particular by consulting the Innovation Platform for Energy set up for this purpose by the GSRT, as well as from the suggestions of the respective Advisory Group to the Platform.

The proposals on ENERGY and the ENVIRONMENT made by the relevant Scientific Council of the GSRT concerning Research and Innovation Strategies for Smart Specialisation (RIS3 2014-2020), concern the following:

A. TARGETED RESEARCH

1. Efficient use of energy in buildings, at an estimated cost of EUR 60 million
2. Reduction of CO2 emissions at an estimated cost of EUR 40 million
3. Renewable Energy Sources, at an estimated cost of EUR 80 million
4. Smart Grids - Future Electricity Networks at an estimated cost of EUR 60 million

¹⁸ <http://s3platform.jrc.ec.europa.eu/s3-guide>

B. NON-TARGETED RESEARCH

1. Hydrogen and fuel cells at an estimated cost of EUR 20 million
2. Carbon capture and storage technologies at an estimated cost of EUR 5 million
3. New Gas Storage Technologies in the form of CNG or LNG at an estimated cost of EUR 5 million
4. New exploration and detection technologies for oil and gas deposits at an estimated cost of EUR 5 million

In terms of competitiveness, the indicators put forward for the achievement of the targets are:

Improving the energy and greenhouse gas emissions intensity: A key objective through this indicator is to achieve the gradual decoupling of economic growth with energy consumption and greenhouse gas emissions. Improving energy intensity and emissions intensity through the adoption of targeted measures will ensure that this will be the result of the energy efficiency improvement measures to be implemented and will contribute to both reducing energy costs and enhancing the competitiveness of the various economic sectors. This ensures that the positive development of the economic environment and of the various structural factors will not hinder the progress of the overall energy policy goals and the transition to a low-carbon economy. The penetration of RES in all areas of final energy consumption, rational energy management, as well as the use of more energy-efficient devices and processes are the key tools to achieve this goal.

Reducing energy costs: Reducing energy costs is a key policy priority to make energy products more accessible to all consumers. Measures and policies in the context of this target will take into account the purchasing power of consumers and their **special** groups, as well as any specificities related to local characteristics, such as those of remote areas. Maintaining an average cost of energy products below the European consumer average is also the relative quantitative objective of this energy planning priority. The aim of energy planning is also to adopt measures and policies for specific economic sectors and activities with a high energy footprint and export orientation to significantly improve their competitiveness.

Development plans for the areas that will be affected most by the transition to a low-carbon economy:

The challenges faced by lignite-dependent areas for the transition to a low-carbon economy can be tackled with tailored solutions to support structural transformation and accelerate the process of economic diversification and technological transition. The aim is to elaborate a sustainable development strategy plan, focusing on the sectors with dynamic prospects in terms of output, employment and income indicators. In this case, local satellite companies of every scale will be mobilised so that every region or local society can reap the benefits of switching to clean energy, new jobs be created and investment in new technologies be promoted.

Increasing the domestic added value of the energy sector: Recognising and ultimately promoting innovative applications and services in the energy sector with high domestic added value is a priority target for the next period, as it contributes positively to the gross domestic product and enhances the sustainability of the energy sector. In addition, this objective also achieves the expansion of direct and indirect jobs due to the activities of the energy sector. The exploitation of specialised scientific and technical human resources is a central priority and goal of energy planning, and also aims to create and maintain over 50 000 jobs by implementing RES and energy-saving measures and policies. The development of domestic hydrocarbons by maximising direct public economic benefits at national and local level and in a safe and compatible way with the natural and man-made environment is also expected to contribute significantly to this goal.

Promoting circular economy: Circular economy will be a catalyst for the productive reconstruction of the country, with a clear regional dimension. The contribution of circular economy to achieving climate change mitigation objectives is considered to be particularly important, since it has been estimated that switching to a circular pattern can lead to a significant reduction of greenhouse gas emissions through recycling and reuse of materials, better product design according to their use and introduction of new 'circular' business models, especially in the transport and building sectors. The 'circular' production model is considered to be easily adaptable to the Greek economy due to the variety of opportunities and possibilities for resource utilisation but also to the changes in the economy as a whole, but also more specifically in the field of waste management. The National Circular Economy Strategy, adopted by the Central Economic Policy Council on 17 April 2018¹⁹, aims precisely at accelerating circular economy actions and unlocking growth potential, including a series of actions on financial instruments, planning and establishing regulatory frameworks and regulations, removing bureaucratic obstacles, linking small

¹⁹ http://www.opengov.gr/minenv/wp-content/uploads/2018/05/kykliki_oikonomia.pdf

and medium-sized entrepreneurship and the social economy to technological innovation and improving governance networking and accelerating applications.

COURTESY TRANSLATION

Chapter 3 POLICIES and MEASURES

3.1. Decarbonisation dimension

The definition of policy measures to reduce both greenhouse gas emissions and pollutant emissions in the framework of the National Emissions Ceilings (NEC) Directive 2016/2284 in the period 2021-2030 aims to cover eight different policy priorities presented in Figure 2.

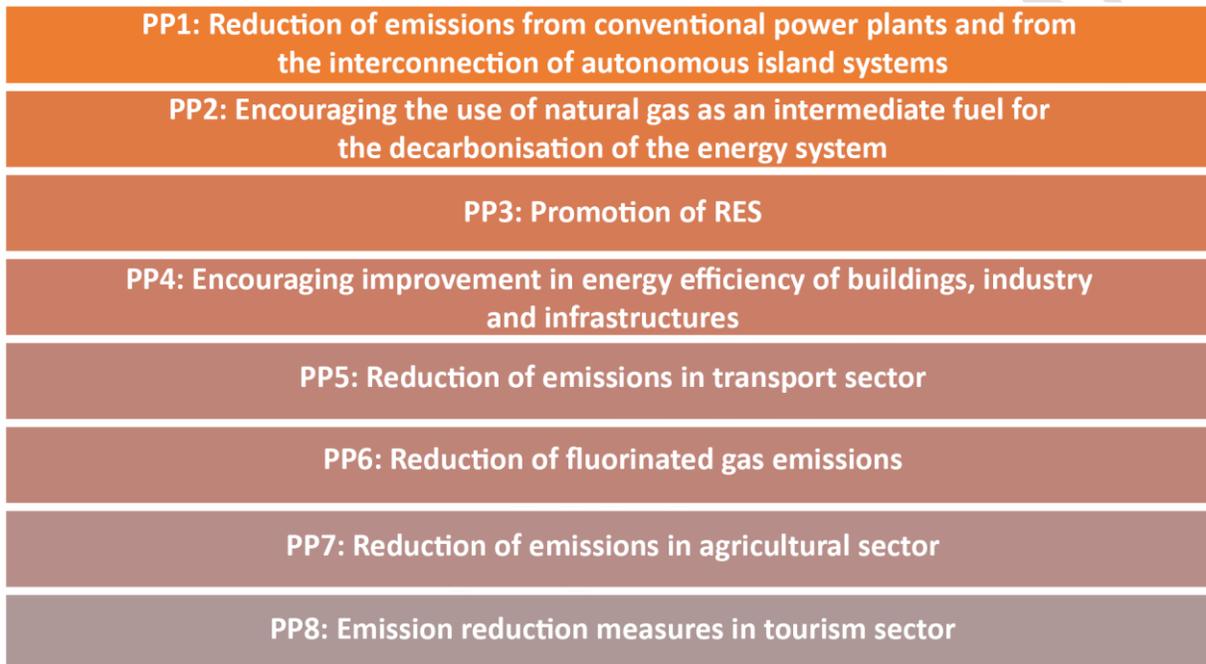


Figure 2: Policy priorities for policy measures to reduce greenhouse gas emissions over the period 2021-2030.

The policy measures that have been specified in the above policy priorities are analysed separately in the following sections.

3.1.1 Greenhouse gas emissions and removals

3.1.1.1 *Policies and measures aimed at attaining the target*

Launching initiatives to reduce emissions from conventional power plants and generally improve their efficiency will contribute to reducing greenhouse gas emissions in the coming period. The most important policy measures under these initiatives concern both the gradual withdrawal or upgrade of thermal power plants and the construction and operation of new thermal plants with greater energy efficiency. Similarly, additional emission reductions are expected from the interconnection of islands

with the mainland system, where the operation of local, highly polluting power plants will gradually cease.

Given that natural gas, although a fossil fuel, has lower greenhouse gas emissions than conventional fuels, the substitution of oil or lignite with natural gas is an intermediate policy step forward in reducing greenhouse gas emissions. The main priority is promoting natural gas for electricity production in specific final consumption sectors through various existing and designed policy measures, such as the building, the industrial and the transport sector.

Promoting RES is a top policy priority to move towards the decarbonisation of the economy. All measures for the penetration of RES in electricity generation, in heating and in transport contribute to this objective. In addition, reduction of the quantities of biodegradable waste in solid waste treatment facilities, not only for electricity and thermal energy generation (e.g. biogas production) but also for complementary actions such as the separate collection for bio-waste, recycling and the use of sludge as a fertiliser in agriculture. The above measures, which have already been launched in the framework of the National and Regional Waste Management Plan, will be intensified in the period 2021-2030, as National Planning is being evaluated/revised under the new package of Directives on waste and the implementation of the National Circular Economy Action Plan.

The implementation of energy efficiency improvement measures, which have been included in the policy priorities for improving energy efficiency in the building sector and in industry, including electricity and gas infrastructure, also contribute to reducing greenhouse gas emissions. Furthermore, the generation of heat from CHP units and the promotion of district heating to meet the heating needs of buildings due to reduced consumption of oil products may lead to a reduction in greenhouse gas emissions.

Transport is a major contributor to greenhouse gas emissions and, therefore, calls for interventions that will make a substantial contribution to the greening of the sector. To this end, policy measures in the transport sector contribute to promoting RES and improving energy efficiency. Examples include the promotion of electrification in road and rail transport and the power supply of ships during berthing through the development of the necessary infrastructure. Other examples of measures are the development of public transport, the promotion of alternative fuels including the use of biomethane, the elaboration of sustainable urban mobility plans and the strengthening of the public sector's exemplary role. Moreover, the promotion of biofuels and the use of electricity will contribute to reducing emissions in the transport sector. Finally, spatial and urban planning contribute to reducing greenhouse gas emissions through the promotion of coherent urban forms and the ways in which cities and their

functions are organised (e.g. in a way that contributes to the reduction not only of the needs for travel by means of passenger vehicles but also of the carbon footprint).

A combination of policy measures will be implemented to reduce fluorinated gases not only through preventing leakages and emissions but also through controlling the use of fluorinated gases. Discontinuation of the production of new private household refrigerating and freezing equipment which operates with the use of fluorinated gases with a GWP over 150, production of fire protection equipment which contains fluorinated gases HFC-23, training and certification of technical staff that deals with fluorinated gases, installation of leakage detection systems in large cooling, air-conditioning and fire protection systems, as well as use of vehicles that use fluorinated gases with a GWP below 150 are indicative measures.

The revised Common Agricultural Policy (CAP) introduces specific measures in the context of Green Direct Aid by promoting sustainable food production, sustainable farm management and environmentally and climate-friendly practices and methods. The measures that will be implemented aim at preventing desertification, improving water management, reducing the intensity of natural resources, optimising the use of agricultural land, reducing the use of fertilisers and improving animal waste management. The promotion and increase of organic farming is also a key priority of the next Rural Development Programme, contributing to the reduction of greenhouse gas emissions.

In addition, the Rural Development Programme will promote a more intensified implementation of the forestry measure, which will also increase the absorption from the LULUCF sector. Currently, the contribution of the measure to the country's overall emissions/absorption balance cannot be estimated, but it is noted that significant impacts on overall emissions/removals are not expected in any case, as the contribution of the LULUCF sector is extremely small in relation to the total carbon footprint of Greece, while the zero-balance rule under Regulation 2018/841, is complied with.

Finally, emphasis will be placed on the tourism sector, given the ever increasing tourist flows and the expansion of the tourist season, thus increasing and diversifying energy needs. In this context, the extension of RES to hotels, tourist accommodation and catering facilities will be supported by using and developing a set of systems and applications. Also, the development of specifications for the installation of energy-saving systems in tourist areas will be explored, possibly for new installations (e.g. bioclimatic buildings, materials and building techniques). Finally, targeted information and awareness-raising programmes for both tourists and Greek professionals active in the tourism and catering industry will be launched to contribute to additional reductions in greenhouse gas emissions.

3.1.1.2 *Financing measures including support and use of EU funds in this area at national level*

As mentioned above, a significant part of the funding for the implementation of the proposed measures, especially in the areas of waste, rural development and forestry, comes from European Union resources and involves infrastructures and programmes that are either implemented within the current (2014-2020) programming period, or will be planned for the coming (2021-2027) programming period through the corresponding NSRF and Rural Development Programme.

Particular reference is also made to the financing of development actions in the areas of Greece whose economy is strongly dependent on coal mining for electricity generation. Already, for the period 2018-2020, Greece will auction part of its revenues from greenhouse gas emission allowances of at least EUR 60 million to finance low carbon and environmental footprint development projects in the Florina and Kozani Regional Units and in the Municipality of Megalopolis to support the fair transition of these areas through the creation of a 'Special Account for the Fair Transition of Lignite Areas'. The development operations to be financed on an annual basis for revenue sharing from auctioning allowances shall be generated through an open public consultation on the basis of the following axes:

- Development of clean forms of energy, funded by projects implemented by energy communities with the participation of natural persons, and/or local authorities and/or legal persons governed by private/public law, aiming at the promotion of Renewable Energy Sources and the reduction of energy poverty. This axis could include, among others, biomass/biogas projects, with the participation of local livestock cooperatives and generally self-generation projects with the possibility of utilising the existing energy infrastructure (e.g. transport networks).
- Energy savings: Improving the energy performance of public/private buildings in compliance with the minimum energy performance requirements of buildings and tackling energy poverty. Prioritising the promotion of energy communities with the participation of local authorities as eligible entities.
- Support for the primary sector: Promoting energy crops, namely locally produced biomass for the supply of alternative district heating systems, and enhancing local crops with high added value (e.g. saffron, rose, oregano, tea), new innovative livestock activities, and promoting the export activities of existing cooperatives and their integrated development. Geothermal field utilisation projects could also be included in this axis to support greenhouse crops and greenhouse parks, as well as circular economy operations with the treatment of sewage sludge and the disposal of products as soil improvers, land reclamation and/or irrigation projects, etc.

- Interventions in the field of circular economy/exploitation of secondary materials: Treatment of sewage sludge and disposal of products as soil improvers, use of ash, etc. with emphasis on the respective actions/projects/priorities of the National Circular Economy Plan.
- Industrial heritage: Utilising lignite stations to promote the industrial heritage of the lignite areas of Greece.
- Implementing integrated action programmes in the field at work (e.g. new forms of energy, agri-food industry, tourism, subsidising new jobs in companies dealing with systems or techniques for managing and saving energy, or energy upgrading, etc.) as well as training programmes in the above areas.
- Implementing entrepreneurship and innovation support programmes in various sectors and especially in those mentioned above.
- Providing technical support to potential beneficiaries for the maturation of projects/actions for public projects.

The Fair Transition Support Initiative will continue over the period 2021-2030 through the use of a potential surplus of auctioning revenues, while the possibility of using Special Account funds to co-finance actions whose main funding comes from other sources, is already being considered. It is also aimed that 'Fair Transition' be supported through other financial instruments from the period 2021-2027.

3.1.1.3 Summary of policy measures

Table 26 summarises the policy measures foreseen for reducing greenhouse gas emissions as detailed in the following sections.

Table 26: Planned policy measures to reduce greenhouse gas emissions.

Numbering	Name of policy measure	Objective	Sector affected	Estimated impact (1: Very Low to 5: Very high)	Category of measure	State of implementation
M1.1	Reduction of emissions from conventional power plants and from the interconnection of autonomous island systems	Reduction of non-EU ETS greenhouse gas emissions	Electricity generation	5	Regulatory, technical measure	Under implementation, Update-Reform
M1.2	Promotion of natural gas as an intermediate fuel for the decarbonisation of the energy system	Reduction of non-EU ETS greenhouse gas emissions	Electricity generation All sectors of final energy consumption	5	Regulatory, technical, economic measure	Under implementation, Update-Reform
M1.3	Promotion of RES	Reduction of non-EU ETS greenhouse gas emissions	Electricity generation Heating-Cooling Transport sector	5	Regulatory, technical, economic measure	Under implementation, Update-Reform
M1.4	Improvement in energy performance of buildings, industry and infrastructures	Reduction of non-EU ETS greenhouse gas emissions	All sectors of final energy consumption	5	Regulatory, technical, economic measure	Under implementation, Update-Reform

Numbering	Name of policy measure	Objective	Sector affected	Estimated impact (1: Very Low to 5: Very high)	Category of measure	State of implementation
M1.5	Reduction of emissions in the transport sector	Reduction of non-EU ETS greenhouse gas emissions	Transport sector	4	Regulatory, economic measure	Under implementation, Update-Reform
M1.6	Reduction of fluorinated gas emissions	Reduction of non-EU ETS greenhouse gas emissions	Industrial processes Cooling, air-conditioning, fire protection systems	2	Regulatory measure	Under implementation, Update-Reform
M1.7	Reduction of emissions in the agricultural sector	Reduction of non-EU ETS greenhouse gas emissions	Agricultural sector	3	Regulatory, economic measure	Under implementation, Update-Reform
M1.8	Emission reduction measures in the tourism sector	Reduction of non-EU ETS greenhouse gas emissions	Tertiary sector- Tourism	2	Regulatory measure and information and awareness-raising measure	Envisaged

3.1.2 Renewable energy

The definition of policy measures for the promotion of RES in the period 2021-2030 aims to cover eight different policy priorities, which are presented in Figure 3.

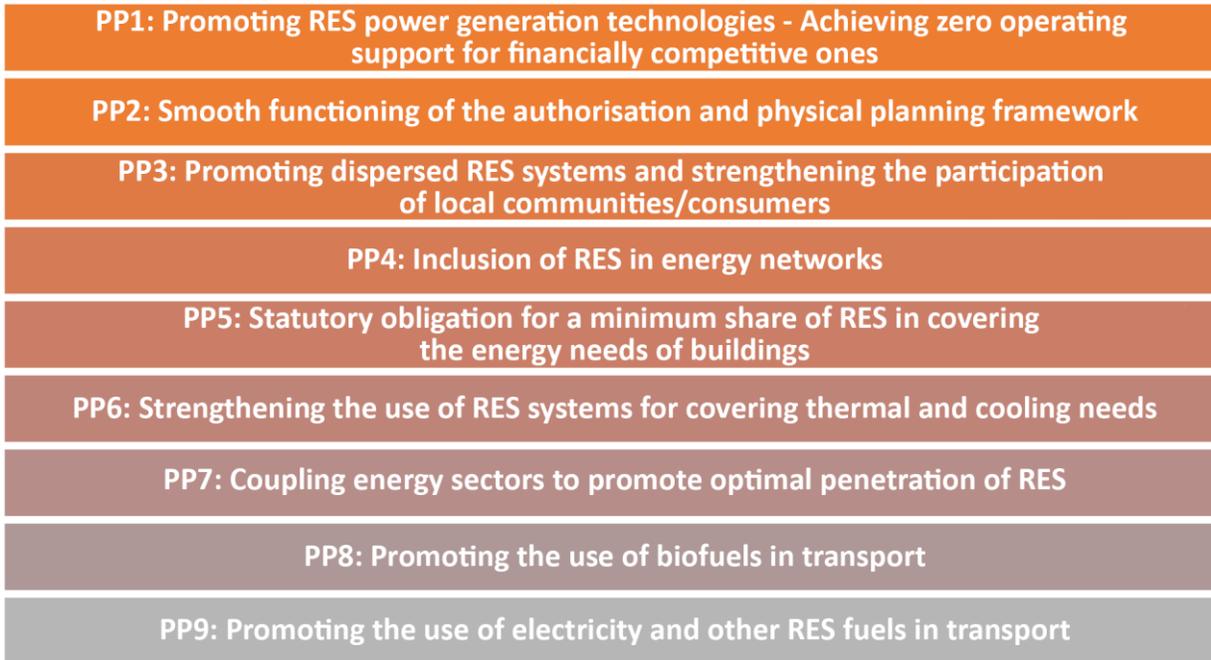


Figure 3: Policy priorities of policy measures for the promotion of RES in the period 2021-2030.

The policy measures that have been specified in the above policy priorities are analysed separately in the following sections.

3.1.2.1 Policies and measures to achieve the national contribution to the EU-wide target of 2030

The promotion of RES technologies for the production of electricity with minimal operational support is a key priority for the next period, as this will reduce the charges imposed on consumers for the development and operation of RES plants. More specifically, operating aid for the most economically competitive renewable energy technologies such as photovoltaic and wind power plants is expected to be continually decreasing and ultimately eliminated over the medium term, as plants using these technologies will be fully competitive on the electricity market.

A key mechanism for achieving this central objective of minimising operational aid is the competitive bidding process. The framework of competitive bidding processes is expected to be extended and supported in the coming years taking into account, each time, the specificities of the Greek energy system and the parameters of the licencing framework, increasing investor interest and ensuring fair competition between the interested parties. The achievement of full competitiveness of the operation of competitive tendering procedures in terms of the electricity market is expected to be speeded up for these projects, including through their extended implementation, and, therefore, projects will be developed regardless of the conduct of competitive procedures without there now being a requirement for operating aid for these plants, while they will participate in the electricity market having the same obligations as those of the other participants therein.

However, the Sliding Feed-In Premium will continue to be the key tool for supporting RES technologies for electricity generation as a whole whereas, at the same time, particular provision will still be made for installations with low installed capacity to which fixed price operating aid will be applied. In this context, a specific mechanism and monitoring procedure is already being developed in order to adjust the reference price of each technology and category of RES plants for projects that have not yet been put into operation, to developments in the financing, development and operating cost of such plants.

Innovative and pilot RES projects will continue to be eligible for financial support through operating and investment aid on condition that they have been proven to lead to an increase of the domestic added value and that they contribute to meeting local and/or special energy needs.

Operation of RES plants without the need for operational support

The continued rapid decline in the weighted cost of electricity for more commercially mature and competitive RES technologies, i.e. photovoltaic and wind projects, is expected to continue and be intensified over the following period. The achievement of full competitiveness of the operation of competitive tendering procedures in terms of the electricity market is expected to be speeded up for these projects, including through their extended implementation, and, therefore, projects will be developed regardless of the conduct of competitive procedures **without there now being a requirement for operating aid** for these plants, while they will participate **in the electricity market having the same obligations** as those of the other participants therein.

A key axis for the further development of RES power plants is their obligation to participate in the electricity market and to meet the relevant obligations arising therefrom. The obligation to participate in the electricity market of renewable energy units above certain limits is a key policy measure, entirely complementary and related to competitive procedures and contracts for differential increment and it reflects the business and commercial maturity with which new plants producing electricity from RES should now be treated.

New cumulative representation mechanisms are already being developed under these obligations, whereas operation according to the new electricity market model will increase not only the opportunities but also the obligations for the participation of these plants. The aim is to gradually increase this obligation for the new RES projects provided, of course, that their equal participation is ensured and that they are not disproportionately burdened. In this context, **direct participation** of RES plants in the electricity market without their obtaining any kind of aid or guaranteed contract will be provided for clearly.

Ensuring the sustainability of the RES aid scheme has now been achieved through the orderly and transparent functioning of the Special RES Account; therefore, over the following period, this mechanism will continue to operate in the best way as regards the structuring of available input mechanisms.

The development of environmental markets with the use of Guarantees of Origin for energy from RES is scheduled for the following period and is expected to function as a complementary market mechanism which will further contribute to the orderly operation of the Special Account.

In the forthcoming period, special emphasis will be placed on updating, simplifying and operating more efficiently both the licensing and the spatial planning framework for RES. The main objective of this process is the licensing and ultimately the development and construction of the required RES units to meet the national target. In any case, the development of new projects requires to balance and take account of business, environmental and social parameters in a fair and transparent manner and this is also the main objective to be taken into account in the reform of the licensing and spatial planning framework.

In particular, in the case of the licensing framework, emphasis will be placed not only on shortcomings and conflicting provisions of the institutional framework but also on other matters which include the existence of time limits for the assessment and/or acceptance of relevant applications and bids, the temporal validity of permits, the foreseen exemptions from permit requirements, the standardisation of procedures and documents, the implementation of the electronic environmental registry where environmental impact studies can be submitted electronically and handled, and where all relevant

procedures for the development of a coordinated policy framework and of priorities according to the source material and to the biomass/biogas technology for electricity generation can be monitored.

In addition, with regard to the spatial planning framework, the category of areas in which the installation of RES projects is partly or entirely excluded or which are suitable for such installation will be made known in advance and in a clear and transparent manner, whereas the conditions for installation will be determined taking into account criteria such as the physiognomy, environmental protection, carrying capacity and human activities of each area of installation. The specific requirements arising for the development of a specific regulatory (licencing and support scheme's framework) and spatial planning framework for marine wind farms, are also highlighted. Respectively, both centralised and decentralised storage units require the development of a comprehensive regulatory and normative framework for their operation in the energy markets and their integration into electricity grids.

The multidimensional contribution of the scattered RES production is indisputable, therefore it is imperative to maintain and expand the self-generation and energy offsetting schemes already in place. However, it is necessary to monitor and update their regulatory framework whenever it is necessary to take account of technological developments and to ensure the proper functioning of the electricity grids and the economic efficiency of the energy system.

In this context, the shape of energy communities is seen as an indispensable tool for strengthening the role of local communities and consumers, and therefore the operation of these schemes will be supported and reinforced by specific tools. In particular, the design and implementation of specialised financing mechanisms which aim at providing financial support for the development of RES energy projects by energy communities, are expected to be completed shortly. Finally, as part of the reform of the electricity market regulatory framework, the necessary adjustments will also be launched to allow the participation of decentralised energy schemes by energy communities.

Energy infrastructure plays a key role in the high penetration of RES units for electricity generation and therefore the design and development of new projects by the Operators will incorporate the projections of penetration of new RES units and will plan the necessary adjustments and actions to ensure that it will be implemented as seamlessly and efficiently as possible for the operation of the energy system. In this context, the technically and economically optimal enhancement and expansion of energy infrastructure in both the transmission system and the distribution network to tackle the saturation phenomena hampering the further development of RES units in specific areas will also be, for the next period, a key measure for the optimal integration of RES into energy networks. In addition, the development of new financing models to speed up development of the specific infrastructures will be routed whereas

management complexity and time lags due to exogenous factors will be limited through more effective planning and transparent consultation processes. In the above context, the Energy Network Operators will examine the planned interventions and identify the costs involved in both the required infrastructure and the balancing needs for the operation of these units.

In the context of the new interconnections of the autonomous systems of non-interconnected islands (NIs) to the mainland system, utilisation of the existing local RES capacity will be optimised, nevertheless taking into account technical, economic and social parameters. Moreover, the development of storage units, both centralised and decentralised, as well as demand management schemes, is expected to contribute to the achievement of this goal of optimal integration of RES into electricity networks. In this context, the necessary regulations/acts are already being promoted so that these tools can be optimally used.

The development and optimisation of the licencing framework including drawing up the technical specifications and is considered as being a prerequisite for implementing projects relating to construction of RES district heating networks, injection of biogas into the natural gas network and further exploitation of available geothermal fields. It is noted that due to the fact that these measures also contribute to the achievement of the energy efficiency improvement targets, it is necessary to implement them in order to maximise the synergies of the two sectors of interest.

The potential for further RES penetration in buildings remains high and requires the adoption of specific policy measures for its efficient use. A key tool will be to implement a regulatory framework for minimum RES participation in meeting the energy needs of the building sector. In this context, the projections for nearly-zero energy buildings will contribute to the further penetration of RES applications in the building sector, taking into account technical and economic sustainability criteria, contributing to the achievement of the objectives set in the context of improving energy efficiency.

The above provisions of the regulatory framework will be incorporated into the New Regulation on Energy Efficiency of Buildings, while special emphasis will be placed on the exemplary role which public buildings must play through the determination of limits for minimum participation of RES taking into account primarily, in addition to the economic sustainability and energy benefit criteria, the static shielding cost.

In addition, efforts will be made to maximise synergies with both the policy on maintaining the self-generation and energy offsetting scheme and other public and private policy measures in the field of energy efficiency.

The use of RES systems for heating and cooling (mainly heat pumps and solar thermal systems) will be enhanced by combining different policy measures. Moreover, the financial instruments available in the context of the new programming period and of the respective Operational Programmes will be designed in order for them to contribute to the promotion of the economically optimal RES systems per category of final consumer taking into account at the same time contribution to the achievement of the respective objective. In addition to the financial instruments, a scheme of special tax incentives for the installation of RES systems for heating and cooling in the domestic and tertiary sector is also envisaged.

In addition, synergies with the energy efficiency obligation schemes, which are a policy measure in the field of energy efficiency improvement, contributing to the promotion of RES systems through energy suppliers, will be maximised. The promotion of RES systems can be implemented either through the achievement of a mandatory RES penetration target or through the premium for energy savings achieved in the case where RES systems are installed.

The development of a scheme to support thermal energy produced by RES mainly in district heating networks including biomethane injection into the natural gas network, an action contemplated in the National Plan for the Circular Economy, will be expanded and evaluated in the next period so that, subject to positive documentation of the technical and economic feasibility of this special support scheme, its establishment and development be launched.

To further promote bioenergy, specialised support programmes will be designed both for the development of efficient supply chains for residual biomass/biodegradable matter and for the support and implementation of optimal environmental and energy-efficient bioenergy applications.

Reconciliation of energy sectors to enhance optimal RES penetration is also a priority as it contributes to the utilisation of excess electricity produced from RES to meet the demand for heating and cooling and freight load in transport.

This objective can be achieved through the development and implementation of an integrated demand response framework, the construction of demand storage and response units, the digitisation of the energy sector, the efficient operation of energy markets and pilot actions to promote smart cities.

Maximising synergies with energy efficiency is of crucial importance, mainly due to the need to deploy the smart electricity metering plan by 2030 to support policy measures in this policy priority. Respectively, the possibility of injecting either hydrogen or methane produced from RES in the natural gas network will also be examined. In this direction, the sustainability and efficiency of such a scheme will be considered initially and, if deemed positive, appropriate measures and policies will be promoted.

The most basic and most effective policy measure to promote the use of biofuels in transport is to continue and strengthen the existing regulatory framework for the obligation to blend biofuels and use biofuels individually. More specifically, the obligation to blend diesel with biodiesel and gasoline with bioethanol will continue whereas both the new enhanced blending obligations and the potential extension of the measure to other transport sectors will be gradually examined. Moreover, the need for developing specific market mechanisms to support the use of biofuels in specific sectors will be explored. Finally, domestic production of advanced biofuels will be supported, where applicable, through the development of a support scheme and/or specific financing tools placing emphasis on the production of biofuels with the highest domestic added value.

The promotion of electrification is a key policy objective, which shall be contingent upon completion of the relevant regulatory framework as well as planning for the development of the necessary energy infrastructures for recharging electric vehicles. Furthermore, in order to promote this use, the effectiveness and general utility of the national economy with regard to the development of an integrated framework for financial support for the use of electric vehicles, such as the introduction of efficient tax incentives and/or tax exemptions, should be considered. In this context, integrated interventions will be planned in the next few years at a regulatory level to launch all the conditions for the healthy and sustainable deployment of electrification in Greece. Emphasis will be placed on categories of heavy-duty vehicles (e.g. taxis, buses, courier-rental companies, etc.) and, therefore, of a potentially large energy and environmental benefit.

Finally, the design of pilot actions for the generation and utilisation of RES gaseous fuels in the transport sector will contribute both to reducing the implementation cost and to improving the technical feasibility of the specific fuels providing, at a later stage, the opportunity for their wider use.

RES and competitiveness

Total new investments to electricity produced by RES for the next decade are expected to deliver a **return on domestic value added over € 11bn during their operation**. Similarly, there are many benefits to creating direct and indirect jobs from the development and operation of these projects, as it is estimated that more than **30 thousand new full-time jobs** will be created and maintained for the next 25 years.

3.1.2.2 Specific measures for regional cooperation, as well as the estimated surplus energy production from renewable sources

Cooperation with neighbouring Member States is contemplated, so that RES and CHP power plants located in countries within the European Economic Area can take part in the tendering procedures, provided that there is an active cross-border energy trade with them. It is aimed that, in the context of a reciprocity pact with these candidate countries, to set the terms and conditions and other relevant issues that will allow the bidirectional participation of candidate RES and CHP projects in specific tendering procedures that will take place in Greece and in the other Member States in the immediate period ahead. The power generated by these projects that may be selected in the context of these specific tendering procedures will result from the application of a specific methodology already described and defined in a regulatory act.

At present, no provision is made concerning the use of other cooperation mechanisms either for surplus electricity generation from renewable energy sources to be transferred to other Member States, or for deficit electricity in order to achieve the national contribution and the pathways presented in relation to the contribution of RES to the gross final energy consumption.

At the level of regional cooperation regarding the promotion of RES in all sectors and the development of market measures and mechanisms, under the TARES project (2013-), there is cooperation with the respective Ministry of the German Government, while at the same time, it is contemplated to implement specific pilot and/or exemplary RES projects for electricity generation as part of this cooperation.

Moreover, as mentioned in the initial section on regional cooperation in planning, the country's participation through its representatives in CA-RES contributes significantly to the cooperation of Greece with the other Member States.

3.1.2.3 Specific measures relating to financial support, including the support and use of EU funds

The basic financial instruments include:

- Domestic and international financial resources
- Special Account for RES with specific sources of financial revenues for the operational support of electricity produced by RES
- National operational programmes under the new programming period
- New investment law
- Resources from national and European research programmes, as well as resources for the implementation of innovative and pilot applications in the framework of international collaborations

3.1.2.4 Evaluation of support for electricity from renewable energy sources to be carried out by Member States

The proper functioning of the Special Account for RES is largely related to ensuring the sustainability of the RES support scheme. This has now been achieved through successive legislation that has taken place in recent years, to ensure both sufficient and steady inflows of financial resources, and to rationalise the inclusion of specific revenue categories in it.

The transparent operation of the Special Account for RES is also ensured by the monthly recording of the detailed and segregated by category and/or technology financial inflows and outflows required for the operation performed by the Competent Body (DAPEEP SA) and which is posted in the form of a monthly bulletin in a specific online link that is publicly accessible.

As part of the monitoring of the operation of the special account, forecasts of future inflows and outflows are made for at least the following calendar year in order to establish whether there is need to take measures for its optimal operation and financial liquidity. It should be noted that, with specific legislation (Law 4533/2018), a special security reserve of EUR 70 million (70 000 000) is now foreseen, which should be taken into account in the planning of the course of financial inflows and outflows of the special account, respectively.

This way, in the next period, this mechanism will continue to operate in the optimal way with regard to the structure of the available inflow mechanisms, ensuring in any case the necessary support of RES electricity for the respective plants in operation.

3.1.2.5 Specific measures for setting up one or more contact points, simplifying administrative procedures, providing information and training and facilitating the conclusion of electricity purchase agreements

As already mentioned, a key priority for the next period is the updating, simplification and efficiency of both the licensing and the spatial planning framework for RES. In this context, new relevant information tools and databases will be deployed and developed to allow optimal provision of relevant information to interested parties. The aim is to implement the licensing framework for the production of electricity by RES, to achieve specific timetables for the evaluation and issuance of licensing acts, as well as to codify the relevant legislation so that uniform and complete information is provided both to the licensing authorities and to interested parties. In this context, in addition to updating the overall licensing framework, which will take into account the new requirements and possibilities for the operation of these projects, the establishment of one or more central contact points will be promoted, aimed at facilitating both licensing and eventually the development and manufacture of the required RES units to achieve the national target.

At the level of scattered generation of RES systems, as already described in the previous section, there are self-generation, energy offsetting and virtual energy offsetting schemes, with specific technical characteristics, criteria and administrative requirements for inclusion of users. These schemes also incorporate a specific methodology for the clearing of electricity generated by decentralised RES electricity generation systems. The updating of the regulatory framework for these schemes is already underway to take account of technological developments (e.g. the potential for the use of electricity storage systems), and in the future the aim is for these schemes to be modified and adapted accordingly, so that the smooth operation of the electricity grids and the economic efficiency of the energy system are achieved, while ensuring that consumers can choose to install and use these systems, without facing disproportionate technical or financial obstacles.

The development of a specific institutional framework for the promotion of energy communities, which has already been completed and is in place, as detailed in point 1.2.2 hereof, is seen as a necessary tool for strengthening the role of local communities and consumers and, therefore, the operation of these schemes will be supported and strengthened by specific financing tools as well as by the use of licensing and operational incentives (e.g. with regard to participation limits in tendering procedures and possibilities for representation on the electricity market). It is also important to involve energy communities in energy offsetting schemes (especially virtual energy offsetting), maximising the benefits that will arise at the level of local economy.

3.1.2.6 Assessment of the need to build new RES district heating and cooling infrastructure

The recognised technical and economic potential of RES for the development of district heating applications can be found in certain areas of the Greek territory and mainly concerns the exploitation of low enthalpy geothermal fields as well as residual solid biomass. In this context, specific feasibility studies have already been developed for the development of district heating networks, which in most cases take into account the use of these infrastructures to meet local needs in the domestic, tertiary and rural areas.

Interest in such infrastructure is mainly found in Northern Greece and/or in semi-mountainous/mountainous areas, as well as in certain islands in the northern Aegean where there is both local RES potential for district heating and inter-seasonal thermal needs at local level. Just as important is also the interest in using the existing district heating infrastructure, replacing lignite as a fuel and utilising locally available RES and specifically biomass.

The development of such infrastructure, provided that the investment is economical in terms of the number of users, the volume of thermal energy consumed and the length of the network under development, will bring significant benefits in terms of local added value and the protection of final consumers with respect to energy costs.

The objective is, also through the use of financial instruments providing support from national co-financed projects, to develop RES district heating networks using solid biomass and geothermal energy of 30-40 MW_{th} during the next period.

3.1.2.7 *Specific measures to promote the use of energy from biomass*

The use of biomass for energy generation in Greece is limited in relation to the availability of residual biomass. The following measures are proposed for its promotion:

Priority in the use of waste (agri-livestock units and industries, urban): To promote the use of energy from biomass, with a focus on new technologies, it is necessary to take into account the availability of biomass in Greece in terms of the availability of agricultural/forestry residues and waste from the industries concerned, as well as the biodegradable fraction of urban waste and sewage, in relation to the principles of the Circular Economy and the relevant legislation on waste, so as not to distort the competitive markets of biomass (food, feed, materials). Priority should be given to avoiding or reducing waste (agricultural/forestry, livestock, urban), waste recycling and use for heat/power generation, as well as advanced biofuels for transport. Bioenergy support systems, which would run counter to waste treatment targets and would lead to inefficient use of recyclable waste, should be avoided.

Supply chain organisation and land planning of sites for temporary storage of agricultural/forest residual biomass: The organisation of the supply chain from the collection of residual raw materials in the primary sector, its processing and conversion into the secondary sector, the heat and power distribution networks to engineers, supervisors, technicians, plant maintainers, requires supportive measures because it involves high costs that may inhibit the sustainability of future investments in the production of bioenergy and biofuels. These measures should also include support for the development of infrastructure for the temporary storage, pretreatment and storage of residual biomass within private premises/plots and/or central collection points (biomass management centres), which will help to address the inappropriate practice of open burning sites observed in the countryside. Managing centres may be either private or public (e.g. municipal or regional) and their existence will generally make it easier to access biomass and exploit it through the activities of the circular economy.

Maintenance of the sustainability certification scheme for biofuels, bioliquids and solid fuels to ensure that only sustainable biofuels, bioliquids and solid fuels are used in the Greek territory.

Sustainable forest management: Rational logging of forests, update of forest management studies kept in the country's Forestry Offices and planning of a sustainable cycle of periodic logging operations with specific requirements and conditions. Enhancing the role of energy communities and cooperatives in cleaning up forests to protect them against fires in accordance with specific technical specifications and utilising the woody biomass removed for energy purposes.

Strengthening the primary sector through the promotion of energy crops of woody biomass or coppice plantations: In addition to the utilisation of agri-livestock waste and agricultural/forest residues, the

primary sector could also contribute to the production of biomass from the cultivation of short-rotation forest species and other perennial plants (e.g. reed). These energy crops will provide additional jobs in the region, and will also increase the availability of biomass to minimise the need for imported biomass. Relevant support measures are to support such investments through a specific reference to financing programmes (NSRF, Rural Development, etc) Simplification of the process of implementing such crops either by natural or legal persons. Land planning in regions throughout Greece where it will be possible to cultivate such crops (degraded soils, nitrified soils, quarries after mining etc.) so that their development will not compete with other markets (food, feed, materials).

Creation and enhancement of the domestic bioethanol market, by enhancing conventional bioethanol (i.e. bioethanol derived from the processing of agricultural food items such as corn, wheat, beet, etc. according to the applicable sustainability criteria), and above all provision of support to the advanced production of bioethanol from the use of residual forms of biomass and waste as well as non-food crops. Relevant support measures concern a provision for minimum bioethanol blending targets with conventional transport gasoline, and also a provision to introduce cellular (advanced) bioethanol with specific low blending rates.

Development of the biomethane market, both for its injection into the natural gas network and its use as a transport fuel, so as not to limit the country to gas imports alone. In order to achieve this goal, a specific licensing process should be instituted in order to allow for the earliest possible implementation of bio-methane production projects in the country, with the aim of achieving the greatest possible substitution of natural gas from domestically produced and renewable biomethane.

3.1.2.8 Summary of policy measures

Table 27 summarises the policy measures planned for the promotion of RES as detailed in the following sections.

Table 27: Planned policy measures to promote RES.

Numbering	Name of policy measure	Objective	Sector affected	Estimated impact (1: Very Low to 5: Very high)	Category of measure	State of implementation
M1.1	Competitive procedures for commercially mature RES technologies.	Increase in electricity generation from RES	Electricity generation	5	Regulatory, economic measure	Under implementation
M1.2	Obligations to participate in the market and gradual increase of obligations by type of RES plant and contract model.	Increase in electricity generation from RES	Electricity generation	5	Regulatory measure	Adopted, Update-Reform
M1.3	Continuation of support scheme with dynamic adjustment of operating aid for new installations of individual RES technologies.	Increase in electricity generation from RES	Electricity generation	5	Regulatory measure	Adopted
M1.4	Support to innovative pilot projects with high domestic added value.	Increase in electricity generation from RES	Electricity generation	2	Economic measure	Envisaged
M1.5	Guaranteed liquidity of operating aid mechanism for RES plants with optimal structure of inflow mechanisms.	Increase in electricity generation from RES	Electricity generation	4	Regulatory, economic measure	Under implementation
M1.6	Use of guarantees of origin.	Increase in electricity generation from RES Increase of RES for heating-cooling Increase of RES in transport	Electricity generation Heating-Cooling Transport sector	1 1 1	Regulatory, economic measure	Adopted, Update-Reform

Numbering	Name of policy measure	Objective	Sector affected	Estimated impact (1: Very Low to 5: Very high)	Category of measure	State of implementation
M2.1	Update, simplification and optimisation of the operation of the licencing framework.	Increase in electricity generation from RES	Electricity generation	5	Regulatory measure	Under implementation, Update-Reform
M2.2	Update, simplification and optimisation of the operation of the spatial planning framework.	Increase in electricity generation from RES	Electricity generation	5	Regulatory measure	Under implementation, Update-Reform
M2.3	Licencing and spatial planning framework for marine wind farms	Increase in electricity generation from RES	Electricity generation	2	Regulatory measure	Envisaged
M2.4	Regulatory and normative framework for storage facilities	Increase in electricity generation from RES	Electricity generation	2	Regulatory measure	Envisaged
M3.1	Maintenance of self-generation and energy offsetting scheme, with control and update of the regulatory framework for its operation where necessary.	Increase in electricity generation from RES Increase of RES for heating-cooling	Electricity generation Heating-Cooling	2 1	Regulatory measure	Under implementation, Update-Reform
M3.2	Support for the development of RES energy projects by energy communities also through the use of specialised financing tools.	Increase in electricity generation from RES Increase of RES for heating-cooling	Electricity generation Heating-Cooling	3 2	Regulatory measure	Envisaged
M3.3	Reform of the regulatory framework for the electricity market as regards opportunities	Increase in electricity	Electricity generation	1 1	Regulatory measure	Envisaged

Numbering	Name of policy measure	Objective	Sector affected	Estimated impact (1: Very Low to 5: Very high)	Category of measure	State of implementation
	for the participation of decentralised energy schemes.	generation from RES Increase of RES for heating-cooling	Heating-Cooling			
M4.1	Aid for energy infrastructures to deal with saturation effects (transmission and distribution) and development of new financing models for rapid development of such infrastructures. Provision for optimal utilisation of RES capacity in the context of new interconnections.	Increase in electricity generation from RES	Electricity generation	3	Technical measure	Under implementation, Update-Reform
M4.2	Development of demand management schemes.	Increase in electricity generation from RES	Electricity generation	2	Regulatory measure	Adopted
M4.3	Development and optimisation of licencing framework and of technical specifications for RES district heating networks, injection of biogas into the natural gas network and exploitation of geothermal fields (correlation with measures of section EA).	Increase in electricity generation from RES Increase of RES for heating-cooling	Electricity generation Heating-Cooling	1 2	Regulatory measure	Adopted, Update-Reform
M5.1	New Regulation on the Energy Performance of Buildings (correlation with measure M2.1 and with measures of section EA).	Increase in electricity generation from RES Increase of RES for heating-cooling	Electricity generation Heating-Cooling	1 2	Regulatory measure	Envisaged
M5.2	Public buildings (correlation with measure M2.1 and with measures of section EA).	Increase in electricity generation from	Electricity generation Heating-Cooling	1 2	Regulatory measure	Under implementation, Update-Reform

Numbering	Name of policy measure	Objective	Sector affected	Estimated impact (1: Very Low to 5: Very high)	Category of measure	State of implementation
		RES Increase of RES for heating-cooling				
M6.1	Financing tools in the context of the new programming period.	Increase of RES for heating-cooling	Heating-Cooling	3	Economic measure	Envisaged
M6.2	Application of obligations to energy suppliers.	Increase of RES for heating-cooling	Heating-Cooling	2	Regulatory measure	Envisaged
M6.3	Use of tax incentives in the residential and tertiary sector.	Increase of RES for heating-cooling	Heating-Cooling	3	Fiscal measure	Envisaged
M6.4	Development of support scheme for thermal energy from RES and, in particular, biomethane in the natural gas network.	Increase of RES for heating-cooling	Heating-Cooling	2	Regulatory, economic measure	Envisaged
M6.5	Development of supply chains for residual biomass/biodegradable matter and support for the development and implementation of optimal environmental and energy-efficient bioenergy applications.	Increase of RES for heating-cooling	Heating-Cooling	2	Regulatory, technical measure	Envisaged
M7.1	Utilisation of electricity generation from RES for heating/cooling and transport as well as for the operation of storage systems.	Increase in electricity generation from RES Increase in RES for heating-cooling Increase in RES in transport	Electricity generation Heating-Cooling Transport sector	2 1 1	Regulatory, economic measure	Envisaged
M7.2	Pilot actions / Smart cities.	Increase in electricity generation from RES	Electricity generation Heating-Cooling Transport sector	2 1 1	Economic measure	Envisaged

Numbering	Name of policy measure	Objective	Sector affected	Estimated impact (1: Very Low to 5: Very high)	Category of measure	State of implementation
		Increase of RES for heating-cooling Increase of RES in transport				
M8.1	Regulatory framework for obligations to blend biofuels and to use biofuels singly.	Increase of RES in transport	Transport sector	5	Regulatory measure	Under implementation, Update-Reform
M8.2	Support scheme for biofuels and specific financing tools for the production of advanced biofuels.	Increase of RES in transport	Transport sector	2	Economic measure	Envisaged
M8.3	Regulatory framework for the use of biofuels in specific sectors and development of specific market mechanisms.	Increase of RES in transport	Transport sector	3	Regulatory, economic measure	Envisaged
M9.1	Completion of the necessary energy infrastructures for recharging electric vehicles.	Increase of RES in transport	Transport sector	3	Regulatory measure	Adopted, Update-Reform
M9.2	Development of financial support framework for the use of electric vehicles.	Increase of RES in transport	Transport sector	2	Regulatory, economic measure	Envisaged
M9.3	Pilot actions for the use of RES gaseous fuels in the transport sector.	Increase of RES in transport	Transport sector	1	Regulatory, Technical measure	Envisaged

3.2 Energy efficiency dimension

The definition of policy measures for the improvement of energy efficiency in the period 2021- 2030 aims to cover eight different policy priorities, which are presented in Figure 4.



Figure 4: Policy priorities to promote energy efficiency over the period 2021-2030.

The policy measures that have been specified in the above policy priorities are analysed separately in the following sections.

3.2.1 *Energy efficiency obligation schemes and alternative policy measures*

The objective under Article 7 of Directive 2012/27/EU will be achieved by combining the energy efficiency obligation scheme and implementing alternative policy measures.

The energy efficiency obligation scheme applicable to energy providers will continue to be implemented and its operation through a new regulatory framework will adjust the energy savings target of the parties involved and improve both the operation and the efficiency of the scheme. At the same time, further extension of the existing scheme through the operation of a white certificate mechanism will be explored.

The contribution of alternative policy measures to the achievement of this target will be significantly greater, and the process for their specification is under way. However, it should be noted that alternative policy measures will include several of the policy measures outlined in the following sections.

3.2.2 Long-term strategy to renovate the national stock of residential and non-residential buildings, both public and private

A specific policy package will be launched to mobilise the required investments in the context of the long-term strategy for the renovation of the building stock. In particular, the financing programmes for the renovation of both residential and tertiary buildings under the new programming period will continue to be implemented by revising and improving the existing financing model. In the case of public buildings, the financing model, based on a full subsidy for energy upgrading actions, will be re-examined, while in the case of other tertiary sector buildings the aim will be to achieve optimum cost-effectiveness and to ensure equal access for interested parties. Meanwhile, alternative funding mechanisms, such as Energy Efficiency Agreements, will be adopted.

In the new programming period, successful financing programmes for improving the energy performance of residential buildings will continue and their operating framework will be appropriately modified to support socially and energy-vulnerable households in a more effective way. Moreover, appropriate regulatory modifications will be introduced to deal with the phenomenon of split of incentives between tenants and owners and ensure that thermal comfort needs of all users of multiple-owner buildings are met in the most energy-efficient way.

The upgrade of the role of energy managers for public buildings through the modification of the relevant legislative framework which governs their role and responsibilities is expected to also contribute significantly. The continued improvement of the energy performance of public buildings will also be enhanced through the implementation of the Action Plans for Sustainable Energy and the Action Plans for the Energy Performance of Buildings that must be drawn up under the responsibility of the Regions and Municipalities with the support of targeted financing programmes. The contribution from the implementation of Energy Management Systems will be oriented to this direction. In any case, the main priority for public buildings will be the promotion of technically feasible and optimal measures and programmes in terms of social costs and results.

Moreover, the adoption of new regulatory measures (also in the context of the revision of Directive 2010/31/EU with Directive 2018/844/EU) will aim both at shaping the appropriate framework and at creating incentives to maximise the number of buildings which would exceed the minimum energy efficiency requirements.

Successful and efficient policy measures, such as replacing old oil boilers with new, more efficient heating systems in existing buildings, and the mandatory installation of solar thermal systems in new and radically renovated buildings, will continue. Finally, the new regulatory framework, coupled with tax, financial and urban planning incentives, is expected to increase the pace of energy upgrading of private buildings.

Building stock renovation

Improving the energy performance of the country's building stock is a key priority of the National Energy Planning. Continuing the successful financing programmes and adapting them to improve their financial efficiency and make a more effective contribution to the protection of vulnerable social groups in the population.

A 10 % energy upgrade of Greek residences during the 2021-2030 period and the overall improvement of the energy performance of the building stock is expected to lead to a 10 billion euro increase in domestic added value and to create and maintain over 25 thousand new full-time jobs.

3.2.3 Policies and measures to promote energy services in the public sector

Improving the energy performance of public buildings through energy performance contracts and in general through joint ventures between the private and the public sector. Therefore, an immediate priority is to adjust the relevant framework of the supporting financing programmes and of the supporting structures dealing with the technical and administrative difficulties found will be scheduled, with a view to further develop energy services in public buildings. Finally, the construction of a series of major energy-saving public buildings through energy efficiency contracts will be the starting point for the further development of this type of project.

Moreover, the further development of energy services should contribute to achieving sustainable solutions for the purpose of improving the energy performance of private buildings. The regulatory framework will be completed and improved taking into account the experience to-date, whereas the necessary framework for easier access to capital under favourable terms for stakeholders will be developed.

3.2.4 Other planned policies, measures and programmes to achieve the indicative national energy efficiency target for 2030

Implementing concrete measures to improve energy efficiency in infrastructure is expected to bring about significant results. Indicatively, in the new programming period, priority is given to projects to promote CHP and expand gas distribution networks, including autonomous CNG networks. Existing mechanisms to support energy efficiency improvement measures, such as the energy upgrade programme for street lighting in local authorities, will continue and further financing tools will be promoted to modernise water and irrigation infrastructure (network replacement, remote control/remote command systems, replacement of pumps with new, more energy efficient ones, etc.) that are also expected to have a significant impact on energy savings and at the same time on the cost of providing water services. This priority includes a measure under preparation to improve the energy efficiency of pumping stations.

In the context of a holistic approach, the design and implementation of policy measures in the building, transport and network sectors is taking place with a view to promoting innovative smart city models. In this context, both buildings and vehicles, as independent units, will be capable of communicating and interacting through supporting structures based on the use of advanced ICT (Information and Communications Technology) technologies. Smart meters and smart networks will form a key part of these designs, allowing the monitoring and management of the large amounts of information that will be necessary for their harmonious operation. Completion of the programme for the development of smart meters will assist significantly in the rational use of energy by final consumers. Furthermore, combined with the new regulatory framework of the demand response mechanism, better electricity balancing and peak load management are expected to be achieved.

The role and form of Energy Performance Certificates will be upgraded through their conversion into individual road maps for the energy upgrade of buildings or building units. New schemes for the certification of installers will also be introduced, which will ensure both the correct implementation of energy savings interventions and the utilisation of the maximum potential of technologies.

The energy saving potential related to the correct implementation of the European legislative framework for eco-design and energy labelling of products could be best harnessed through systematic controls of their implementation. Information actions on energy efficiency will also contribute to the awareness-raising and, ultimately, to the encouragement of final consumers to adopt more rational practices of energy use.

Additional horizontal actions contributing to the implementation of energy upgrades in the building sector are both the development of a common and open database and the establishment of a legislative framework for the setting up of innovative technology procurement groups. The aim of the database will be to better identify the relevant savings potential of the projects under preparation and to make easier the benchmarking between similar buildings through the available energy features of listed buildings and ex-post data of energy-saving projects to reduce the risk of corresponding investments. Accordingly, the setting up of innovative technological supply groups will lead to lower costs of design and implementation of energy saving measures.

Green procurement is expected to play a key role in the new period through the inclusion of criteria for the promotion of energy-efficient technologies and services, demonstrating, at the same time, the exemplary role of the public sector.

In the transport sector, various policy measures will be combined. First, the integration of the necessary infrastructure for the promotion of alternative fuels in transport is a priority, and a review of the existing institutional framework for the development of an alternative fuel infrastructure market and the introduction of tax incentives for all types of alternative fuels will be launched. Moreover, the implementation of infrastructure projects in the field of road and rail transport combined with the drawing-up of plans for the shifting of commercial transport operations is expected to bring about significant improvement of energy efficiency in the sector. The role of Sustainable Urban Mobility Plans will also be crucial in improving energy efficiency in the transport sector, by covering all modes of transport, including public transport and active modes of transport such as walking and cycling. Furthermore, the obligation to allocate energy efficient vehicles to public services and organisations will be respected, while upgrading of public transport with new technology vehicles will be achieved as far as this is economically, technically and resource efficient. Finally, the highly successful replacement programme for passenger cars and light trucks with new energy-efficiency ones, will be repeated through a broader funding scheme, in order to replace public and freight vehicles.

In the industrial sector, the existing programmes concerning the provision of financial incentives to improve the energy efficiency of industries and manufacturing enterprises will continue under the new programming period, and in addition, the measure for the relocation of industrial plants to industrial-business zones will be strengthened. New policy measures will support actions at the level of industrial-business zones leading to better energy management and increased savings, such as central heat production and distribution systems.

The existing framework for mandatory energy audits on large enterprises will facilitate the promotion of appropriate audits on SMEs and households. Furthermore, incentives will be established for the application of the energy saving measures proposed in the energy audits not only to obligated large enterprises but also to SMEs and households. Finally, new measures will be developed to support the implementation of energy management systems in SMEs in order to continuously improve their energy efficiency.

3.2.5 Policies and measures to promote the role of local energy communities

The most active involvement of the stakeholders at local and regional level will be initially carried out by drawing up both the Sustainable Energy Action Plans and the Energy Efficiency Plans of Buildings under the responsibility of the Regions and Municipalities and then by implementing the proposed interventions with the support of targeted financial programmes under the regional operational programmes for the new programming period.

Moreover, their contribution to specific policy measures, such as the promotion of energy services in the public sector with specific demonstration projects, the facilitation of obligated parties under the enforcement regime by collecting candidate energy savings projects and developing Sustainable Urban Mobility and Transport Shift Plans, may be catalytic.

3.2.6 Measures to exploit the energy efficiency potential of gas and electricity infrastructure

Specific measures to improve the energy efficiency of electricity and gas infrastructures will be implemented by managers under development programmes with a view to improve energy efficiency in load transmission, distribution and management and in the interoperability of networks, as well as in energy generation facilities including energy microgeneration facilities.

3.2.7 Regional cooperation in this area, where appropriate

At the level of regional cooperation in terms of promoting energy efficiency in all sectors and developing measures and policies, there is cooperation with the corresponding German government ministry as part of the TARES+ project (2016-).

Moreover, as mentioned in subchapter 1.4 on regional cooperation in planning, the country's participation through its representatives in CA-EED and CA-EPBD contributes significantly to the cooperation of Greece with the other Member States.

3.2.8 Financing measures including support and use of EU funds in this area at national level

The main funding measure concerns the implementation of energy efficiency improvement interventions through operational programmes, whether national or regional, under the new programming period. Particular emphasis will be placed on the energy upgrading of the building stock through energy efficiency contracts and, more generally, through public-private partnerships.

The establishment of the Energy Efficiency Fund will significantly enhance the implementation of energy efficiency improvement measures in all energy consumption areas. More specifically, the Energy Efficiency Fund, with a budget of EUR 450m, is expected to facilitate the access of stakeholders to funding, to contribute improvement of the indicator for the cost of output of the programmes implemented and to utilise the unexploited potential for energy savings in specific sectors more effectively.

At the same time, the tax relief measure will continue, through the doubling of the fixed asset depreciation rate of the investment in energy savings by legal persons, whereas respective tax relief policy measures will also be examined with regard to other sectors, taking into account the estimated overall effects on the Greek economy.

Finally, the implementation of a completely new measure, which will introduce tendering procedures for the achievement of energy savings, will improve the economic efficiency of the technologies applied and to reduce the risk of implementation of measures by third parties through the grouping of small individual projects.

3.2.9 Summary of policy measures

Table 28 summarises the policy measures envisaged to achieve the individual energy efficiency objectives, which are analysed in the following sections.

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Table 28: Policy measures envisaged to improve energy efficiency.

Numbering	Name of policy measure	Objective	Sector affected	Estimated impact (1: Very Low to 5: Very high)	Category of measure	State of implementation
M1.1	Promotion of EPCs (Energy Performance Contracts) through targeted financing programmes.	Objective of Article 3 Objective of Article 7 Objective of Article 4 Objective of Article 5	Tertiary sector- Public buildings	1 3 2 2	Economic measure	Under implementation, Update-Reform
M1.2	Financing programmes for the renovation of public buildings under the new programming period.	Objective of Article 3 Objective of Article 7 Objective of Article 4 Objective of Article 5	Tertiary sector- Public buildings	1 2 2 2	Economic measure	Envisaged
M1.3	Funding of upgrades to public buildings on the basis of the Action Plans for Sustainable Energy and of the Action Plans for the Energy Performance of Buildings of Municipalities and Regions.	Objective of Article 3 Objective of Article 7 Objective of Article 4 Objective of Article 5	Tertiary sector- Public buildings	1 3 1 2	Economic measure	Adopted, Update- Reform
M1.4	Improvement of regulatory framework and strengthening of the role of energy managers for public buildings.	Objective of Article 3 Objective of Article 7 Objective of Article 4 Objective of Article 5	Tertiary sector- Public buildings	1 3 1 2	Regulatory measure	Under implementation, Update-Reform
M1.5	Promotion of energy management systems in public buildings.	Objective of Article 3 Objective of Article 7 Objective of Article 4 Objective of Article 5	Tertiary sector- Public buildings	1 2 1 3	Regulatory, economic measure	Adopted, Update- Reform
M1.6	Regulatory measures for the promotion of nearly zero-energy buildings (nZEB).	Objective of Article 3 Objective of Article 4 Objective of Article 5	Tertiary sector- Public buildings	2 2 3	Regulatory measure	Envisaged
M1.7	Regulatory, tax and financial incentives for the promotion of	Objective of Article 3 Objective of Article 7	Tertiary sector- Public buildings	1 2	Regulatory, economic	Envisaged

Numbering	Name of policy measure	Objective	Sector affected	Estimated impact (1: Very Low to 5: Very high)	Category of measure	State of implementation
	buildings which go beyond the minimum energy requirements (nZEB).	Objective of Article 4 Objective of Article 5		2 1	measure	
M2.1	Financing programmes for the renovation of residential buildings under the new programming period.	Objective of Article 3 Objective of Article 7 Objective of Article 4	Residential sector	3 3 3	Economic measure	Under implementation
M2.2	Financing programmes for the renovation of tertiary sector buildings (other than public buildings) under the new programming period.	Objective of Article 3 Objective of Article 7 Objective of Article 4	Tertiary sector- Buildings other than public sector buildings	1 2 2	Economic measure	Envisaged
M2.3	Promotion of Energy Performance Contracts (EPCs) in the private sector through targeted financing programmes.	Objective of Article 3 Objective of Article 7 Objective of Article 4	Tertiary sector- Buildings other than public sector buildings	1 3 1	Economic measure	Envisaged
M2.4	Use of tax and urban planning incentives for implementing energy savings interventions in residential buildings and tertiary sector buildings (other than public buildings).	Objective of Article 3 Objective of Article 7 Objective of Article 4	Residential sector Tertiary sector- Buildings other than public buildings	1 1 2	Regulatory, economic measure	Under implementation, Update-Reform
M2.5	Regulatory measures for the promotion of nearly zero-energy buildings (nZEB).	Objective of Article 3 Objective of Article 4	Residential sector Tertiary sector- Buildings other than public buildings	2 3	Regulatory measure	Envisaged
M2.6	Regulatory, tax and financial incentives for the promotion of buildings which go beyond the	Objective of Article 3 Objective of Article 7 Objective of Article 4	Residential sector Tertiary sector- Buildings other	1 2 2	Regulatory, economic measure	Envisaged

Numbering	Name of policy measure	Objective	Sector affected	Estimated impact (1: Very Low to 5: Very high)	Category of measure	State of implementation
	minimum energy requirements (nZEB).		than public buildings			
M2.7	Mandatory installation of solar thermal systems in new buildings and in buildings undergoing major renovation.	Objective of Article 3 Objective of Article 7 Objective of Article 4	Residential sector Tertiary sector- Buildings other than public buildings	2 2 2	Regulatory measure	Under implementation
M2.8	Replacement of old oil-fired boilers with new more efficient heating systems in buildings.	Objective of Article 3 Objective of Article 7 Objective of Article 4	Residential sector Tertiary sector- Buildings other than public buildings	1 1 2	Economic measure	Under implementation
M2.9	Dealing with the phenomenon of split motivation between tenants and owners and ensuring that thermal comfort needs of users of multiple-owner buildings are met.	Objective of Article 3 Objective of Article 7 Objective of Article 4	Residential sector Tertiary sector- Buildings other than public buildings	1 1 2	Regulatory measure	Envisaged
M3.1	Strengthening of the role and improvement of the regulatory framework of energy efficiency obligation schemes.	Objective of Article 3 Objective of Article 7 Objective of Article 4 Objective of Article 5	All sectors of final consumption	2 5 2 1	Regulatory measure	Under implementation, Update-Reform
M3.2	Implementation of tendering procedures for achieving energy savings.	Objective of Article 3 Objective of Article 7 Objective of Article 4	All sectors of final consumption	2 2 2	Economic measure	Envisaged
M3.3	Design of framework for setting up innovative technological supply groups.	Objective of Article 3 Objective of Article 7 Objective of Article 4	All sectors of final consumption	1 1 2	Regulatory measure	Envisaged
M3.4	Promotion of energy audits in	Objective of Article 3	Industrial, tertiary	1	Economic	Envisaged

Numbering	Name of policy measure	Objective	Sector affected	Estimated impact (1: Very Low to 5: Very high)	Category of measure	State of implementation
	SMEs and in households.	Objective of Article 7 Objective of Article 4	and residential sector	1 1	measure	
M3.5	Financing programmes for implementation of the recommendations of energy audits to obligated or non-obligated parties.	Objective of Article 3 Objective of Article 7 Objective of Article 4	Industrial and tertiary sector	2 2 1	Economic measure	Envisaged
M3.6	Promotion of energy management systems in SMEs.	Objective of Article 3 Objective of Article 7 Objective of Article 4	Industrial and tertiary sector	1 1 1	Economic measure	Envisaged
M4.1	Establishment of the National Energy Efficiency Fund.	Objective of Article 3 Objective of Article 7 Objective of Article 4 Objective of Article 5	All sectors of final consumption	4 4 3 3	Regulatory, economic measure	Envisaged
M4.2	Scheme for the certification of installers of energy components of buildings which affect their energy behaviour.	Objective of Article 3 Objective of Article 4	All sectors of final consumption	1 1	Regulatory measure	Envisaged
M4.3	Strengthening the role of Energy Performance Certificates (EPCs) through their modification and upgrade.	Objective of Article 3 Objective of Article 7 Objective of Article 4 Objective of Article 5	Tertiary and residential sector	1 2 2 2	Regulatory measure	Under implementation, Update-Reform
M4.4	Completion of programme for the installation of individual smart meters.	Objective of Article 3 Objective of Article 7	Tertiary and residential sector	2 3	Technical measure	Under implementation, Update-Reform
M4.5	Development of the regulatory framework for demand response.	Objective of Article 3 Objective of Article 7	All sectors of final consumption	1 1	Regulatory measure	Envisaged

Numbering	Name of policy measure	Objective	Sector affected	Estimated impact (1: Very Low to 5: Very high)	Category of measure	State of implementation
M4.6	Financing programmes for the energy upgrading of street lighting.	Objective of Article 3 Objective of Article 7	Tertiary sector	1 1	Economic measure	Under implementation
M4.7	Financial and tax aid for investment in energy-saving technologies.	Objective of Article 3 Objective of Article 7	All sectors of final consumption	1 1	Economic measure	Under implementation, Update-Reform
M4.8	Implementation of information actions on energy efficiency.	Objective of Article 3 Objective of Article 7	All sectors of final consumption	1 1	Information-awareness raising measure	Under implementation
M4.9	Promotion of energy-efficient products through the implementation of energy labelling and of the eco-design directive.	Objective of Article 3	All sectors of final consumption	1	Regulatory measure and information / awareness-raising measure	Under implementation
M4.10	Promotion of green public contracts.	Objective of Article 3 Objective of Article 5	Public sector	1 1	Regulatory, economic measure	Adopted, Update-Reform
M4.11	Strengthening multi-level governance for energy efficiency.	Objective of Article 3	All sectors of final consumption	1	Regulatory measure	Envisaged
M4.12	Financing programmes for promoting high-efficiency cogeneration from RES and district heating/cooling under the new programming period.	Objective of Article 3 Objective of Article 7 Objective of Article 4 Objective of Article 5	All sectors of final consumption	2 1 1 1	Economic measure	Envisaged
M4.13	Extension of natural gas distribution networks including autonomous CNG networks.	Objective of Article 3 Objective of Article 4 Objective of Article 5	All sectors of final consumption	1 1 1	Technical, economic measure	Under implementation
M4.14	Promotion of innovative smart	Objective of Article 3	All sectors of final	1	Technical	Envisaged

Numbering	Name of policy measure	Objective	Sector affected	Estimated impact (1: Very Low to 5: Very high)	Category of measure	State of implementation
	city models through the use of state-of-the-art technologies.	Objective of Article 7	consumption	1	measure	
M4.15	Creation of database for energy characteristics of buildings and energy upgrading actions	Objective of Article 3 Objective of Article 7 Objective of Article 4 Objective of Article 5	All sectors of final consumption	2 1 2 1	Information-awareness raising measure	Envisaged
M5.1	Financing programmes for improvement of the energy efficiency of industries and manufacturing enterprises under the new programming period.	Objective of Article 3 Objective of Article 7	Industrial sector	1 1	Economic measure	Envisaged
M5.2	Promotion of the relocation of industrial plants to industrial-business zones.	Objective of Article 3 Objective of Article 7	Industrial sector	1 1	Economic measure	Envisaged
M5.3	Promotion of central generation and heat distribution systems at the level of industrial-business zones	Objective of Article 3 Objective of Article 7	Industrial sector	1 1	Technical, economic measure	Envisaged
M6.1	Compulsory quotas of vehicles with greater energy efficiency in the fleets of the public services and of public bodies.	Objective of Article 3	Transport sector	2	Regulatory measure	Adopted, Update-Reform
M6.2	Promotion of the use and improvement of the energy efficiency of the urban public transport system.	Objective of Article 3 Objective of Article 7	Transport sector	2 2	Technical, economic measure	Under implementation, Update-Reform
M6.3	Implementation of the infrastructure projects which are currently in progress in the (road	Objective of Article 3 Objective of Article 7	Transport sector	2 2	Technical measure	Under implementation

Numbering	Name of policy measure	Objective	Sector affected	Estimated impact (1: Very Low to 5: Very high)	Category of measure	State of implementation
	and railway) transport sector.					
M6.4	Elaboration of sustainable urban mobility plans.	Objective of Article 3 Objective of Article 7	Transport sector	1 1	Regulatory measure	Envisaged
M6.5	Elaboration of plans and implementation of infrastructures for transferring transport activities of commercial transport.	Objective of Article 3 Objective of Article 7	Transport sector	1 1	Regulatory measure	Envisaged
M6.6	Use of tax incentives to promote alternative fuels in transport (biofuels, hybrid fuels, electric fuels, natural gas, LPG).	Objective of Article 3 Objective of Article 7	Transport sector	2 2	Economic measure	Under implementation, Update-Reform
M6.7	Completion of the institutional support framework for the development of infrastructures with a view to promoting alternative fuels in transport (recharging stations for electric vehicles, natural gas, etc.) and for the costing of fuels.	Objective of Article 3	Transport sector	3	Regulatory, technical measure	Adopted, Update-Reform
M6.8	Implementation of programme for the replacement of passenger vehicles and light trucks with new high energy efficiency ones.	Objective of Article 3 Objective of Article 7	Transport sector	3 1	Economic measure	Envisaged
M7.1	Promotion of measures for improving energy efficiency in electricity infrastructures.	Objective of Article 3	Electricity infrastructures	1	Regulatory, technical measure	Under implementation, Update-Reform
M7.2	Promotion of measures for improving energy efficiency in	Objective of Article 3	Gas infrastructures	1	Regulatory, technical	Under implementation,

Numbering	Name of policy measure	Objective	Sector affected	Estimated impact (1: Very Low to 5: Very high)	Category of measure	State of implementation
	natural gas infrastructures.				measure	Update-Reform
M8.1	Promotion of measures for modernising water/sewage and irrigation infrastructures with a view to achieving simultaneous savings in water and energy.	Objective of Article 3 Objective of Article 7	Water infrastructures	1 1	Technical, economic measure	Under implementation, Update-Reform

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3.3 Energy security dimension

The definition of policy measures for security of supply over the period 2021-2030 aims to cover four different policy priorities, which are presented in Figure 5.

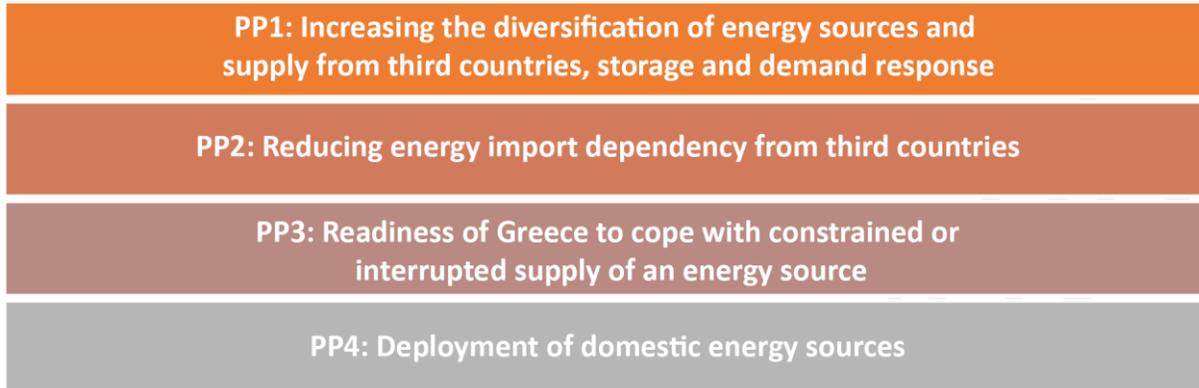


Figure 5: Policy Priorities for Security of Supply in the period 2021-2030.

The policy measures that have been specified in the above policy priorities are analysed separately in the following sections.

3.3.1 Policies and measures to achieve the relevant objectives

3.3.1.1 *Policies and measures to increase the diversification of energy sources and supplier third countries, and promote storage and demand*

The projected increase in capacity between the National Electricity Transmission System and neighbouring systems will contribute to increasing the diversification of energy sources and supplier countries. In this context, it is envisaged to strengthen existing ones (for example, the upgrade of the 150 kV Greece-Albania interconnection and the 400 kV Greece-FYROM interconnection) and to built new interconnections (2nd interconnection between Greece and Bulgaria and interconnection of Greece-Cyprus-Israel). It is noted that the increase in capacity depends on the overall configuration of the Transmission System in the wider Balkan region. It is estimated that, as a whole, in the region of South-Eastern Europe, as determined by ENTSO-E, transport lines with a total length of 13 800 km will be built or upgraded.

In the years to come, measures to reform the domestic electricity market and strengthen competition will promote measures to increase demand-side participation of consumers, in general, in the electricity market. The development of the demand response framework offers another important source of power

system adequacy, while a relevant provision has been incorporated into the long-term power-efficiency mechanism under construction.

Moreover, the storage of electricity is more closely related to the absorption of surplus RES energy, since the penetration of variable RES (mainly wind and photovoltaic power plants) is increasing. Provision is made for the utilisation and development of various forms of storage, also depending on the costs and the development of the relevant technologies (pumped storage, batteries, conversion into gas, etc.)

In the case of natural gas, it is expected that new interconnections be developed and the existing interconnections with neighbouring systems be reinforced, and to develop new natural gas pipelines of regional interest and with strong transmission capacity towards third countries, which strengthen Greece's role as an energy hub. More specifically, development projects of the National Natural Gas System (NNGS) have been designed and launched under the Ten Years Development Plan of the Hellenic Gas Transmission System Operator for the period 2017-2026.

According to the Natural Gas Market Roadmap, the most important projects of national and international interest concerning pipelines and gas storage units are:

- completion and operation of the TAP pipeline
- operation of the Revythousa facility after the 2nd upgrade (increase of LNG storage space)
- implementation of the gas interconnector Greece-Bulgaria (IGB)
- implementation of the FSRU of Alexandroupoli (installation of a floating LNG storage and gasification plant in the Thracian Sea)
- design of the interconnector Turkey-Greece-Italy (ITGI)
- preparation works for the design of the East Med pipeline
- exploring the fitness of the underground gas storage space in South Kavala in terms of security of supply
- promoting the interconnection of Greece-FYROM.

Finally, as in the case of electricity, it is envisaged to support natural gas demand management measures, such as the measures for first- and second-tier interruptible customers.

3.3.1.2 Policies and measures for reducing energy dependence on imports from third countries

In the decade 2021-2030, it is expected that the NIIIs will be interconnected with the continental electricity system, resulting in a further reduction in the need for import of oil from third countries for electricity generation purposes.

In particular, new interconnections of Greece's islands, which now operate as autonomous electrical systems, based mainly on oil power plants, are being promoted.

After the recent completion of the first phase of the interconnection of the Cyclades, the electrical systems of Paros (including the islands of Naxos, Antiparos, Ios, Sikinos, Folegandros, etc.), Syros and Mykonos were also interconnected. The majority of the Aegean islands will also be interconnected in the period 2020-2030, starting with the interconnection of Crete, which will have been completed at the beginning of the next decade. The aim is that by the end of the next decade almost all of these autonomous systems will have been connected to the interconnected system

The interconnections that have already been launched, as they are integrated into a 10-year Development Programme of ADMIE, approved by RAE, include:

- the interconnection of the Cyclades (Phases A, B, C), which is being implemented (the 1st Phase was completed in 2018)
- the interconnection of Crete (Phases I and II).

In addition, the Economy Scrutiny Committee's findings so far suggest that interconnection leads to a more cost-effective electrification of the NIIs. According to these findings, it is appropriate to interconnect:

- the electrical systems in the Cyclades area whose electrical interconnection with the National Interconnected System in Phases A, B, had not been provided for, and
- the Dodecanese,
- the Aegean islands (Skyros, Limnos, Lesvos, Chios).

Particularly for islands that are not expected to be interconnected, a significant reduction in oil use for power generation is also being promoted, with the installation of modern RES units combined with storage technologies. In this direction, the installation of hybrid RES plants is promoted either through private projects or through pilot projects such as the CRES's project for the conversion of Ai Stratis into a 'green island' and the Hellenic Electricity Distribution Network Operator's project for 'smart islands' (Kastelorizo, Astypalea, Syros), and two hybrid RES plants have been put into operation on the island of Tilos (with battery) and on the island of Ikaria (with pumped storage). Moreover, Greece participates actively in the new EU initiative 'Clean Energy for EU Islands'.

Replacing imported fuel from RES in both the transport and the heating and cooling sector will also reduce energy dependence on third countries, since RES, with the exception of biofuels, are a domestic source, to the extent that they are not of EU origin.

In general, the projected growth of domestic energy sources in all sectors, as well as the projected increase in energy efficiency, will reduce energy dependence.

3.3.1.3 Policies and measures for the preparedness and response stakeholders of the limitation or shut-off energy source

With regard to the preparedness of the country and the actors involved in addressing the containment or interruption of the supply of energy sources, it is generally envisaged to maintain and strengthen the current relevant policy measures, such as the Preventive Action Plan for natural gas, solidarity mechanisms, the Regulation for the storage of oil products emergency stocks, etc., and to elaborate a Risk Management Plan in the electricity sector covering various circumstances (e.g. extreme weather, malicious attacks, lack of fuel) on the basis of the relevant EU Regulation. In addition, a new mechanism to ensure sufficient capacity for electricity production (Long-Term Power Adequacy Compensation), which has been notified to the European Commission, is planned to be established in the coming period.

3.3.1.4 Policies and measures for the development of domestic energy sources

Promoting domestic hydrocarbon mining is a key priority. Land areas and mainly marine areas in which Greece has rights of exploration and exploitation of hydrocarbons are extensive and largely unexplored with regard to the existence of exploitable hydrocarbon deposits whereas the existence of indications and of geological analogues with oil areas in neighbouring countries creates justified expectations of large deposits. Attempts for the exploration and optimal use of domestic hydrocarbons will continue in the decade 2021-2030, their central focus being environmental protection. The aim is to exploit the new hydrocarbon reserves that will be realised by maximising direct public economic benefits at national and local level and in a safe and compatible way with the natural and man-made environment.

Optimum use of the domestic lignite resources is expected to continue contributing significantly to securing supply and to containing energy dependence, even though its use in electricity generation will progressively decrease, but with a parallel increase in the penetration of domestic RES resources.

Finally, apart from other advantages, the increase in the penetration of RES contributes to deployment of the domestic energy sources and to increase in the security of supply. The priorities and policy measures for increasing the penetration of RES were developed in detail in the corresponding section.

3.3.2 Regional cooperation in this area

Within the framework of international links, regional cooperations have already been launched with the following countries:

Albania	Cyprus
Bulgaria	FYROM
Israel	Turkey
Italy	

3.3.3 Financing of measures in this area at national level, including with EU support and the use of EU funds

The basic financial instruments include:

- Domestic resources
- Operational programmes under the new programming period
- Projects of Common Interest (PCIs)
- A specific financial instrument under the 4th EU-ETS period.

3.3.4 Summary of policy measures

Table 29 summarises the policy measures envisaged to achieve the individual energy security objectives, which are analysed in the following sections.

Table 29: Planned policy measures on energy security.

Numbering	Name of policy measure	Objective	Sector affected	Estimated impact (1: Very Low to 5: Very high)	Category of measure	State of implementation
M1.1	New interconnections with neighbouring electricity transmission systems and upgrade of existing ones.	Increase of diversification, storage and demand response Preparedness to deal with limitation or interruption of supply Development of domestic energy sources	Electricity	3 3 2	Technical measure	Under implementation, Update-Reform
M1.2	Arrangements for promoting electricity demand response. Relevant provision in the capacity adequacy mechanism which is under development.	Increase of diversification, storage and demand response Reduction in energy dependency	Electricity	5 3	Regulatory measure	Envisaged
M1.3	New interconnections with neighbouring natural gas transmission systems and upgrade of existing ones.	Increase of diversification, storage and demand response Preparedness to deal with limitation or interruption of supply	Natural gas	3 2	Technical measure	Under implementation, Update-Reform
M1.4	Strengthening of natural gas demand management measures.	Increase of diversification, storage and demand response Preparedness to deal with limitation or interruption of supply	Natural gas	5 3	Regulatory measure	Adopted, Update-Reform
M1.5	Storage and LNG projects.	Increase of diversification, storage and demand response Preparedness to deal with	Natural gas	5 4	Technical measure	Under implementation, Update-Reform

Numbering	Name of policy measure	Objective	Sector affected	Estimated impact (1: Very Low to 5: Very high)	Category of measure	State of implementation
		limitation or interruption of supply				
M2.1	Interconnections of non-interconnected islands for the reduction of electricity generation from imported fuels and utilisation of local RES capacity in the most cost effective manner.	Reduction in energy dependency Development of domestic energy sources	Electricity	4 4	Technical measure	Under implementation
M2.2	Substitution of imported fuels from RES in transport.	Reduction in energy dependency Development of domestic energy sources	RES Petroleum products	3 5	Regulatory, economic measure	Under implementation
M2.3	Substitution of imported fuels from RES in heating/cooling.	Reduction in energy dependency Development of domestic energy sources	RES Petroleum products	4 5	Regulatory, economic measure	Under implementation
M3.1	Continuation of rolling capacity adequacy study by the Independent Power Transmission Operator, implementation of foreseen measures and introduction of long-term capacity assurance mechanism.	Increase of diversification, storage and demand response Preparedness to deal with limitation or interruption of supply	Electricity	3 5	Regulatory measure	Under implementation
M3.2	Continuation of risk assessments on the supply of natural gas (including regional studies).	Preparedness to deal with limitation or interruption of supply	Natural gas	4	Regulatory measure	Under implementation
M3.3	Development of Risk	Preparedness to deal with	Electricity	4	Regulatory	Under

Numbering	Name of policy measure	Objective	Sector affected	Estimated impact (1: Very Low to 5: Very high)	Category of measure	State of implementation
	Preparedness Plan in the electricity sector	limitation or interruption of supply			measure	implementation
M3.4	Maintenance and update of Preventive Action Plan and of Emergency Plan for the supply of natural gas and implementation of planned measures, including solidarity mechanisms.	Preparedness to deal with limitation or interruption of supply	Natural gas	4	Regulatory measure	Under implementation, Update-Reform
M3.5	Maintenance and update of Emergency Action Plans for the supply of electricity to non-interconnected islands and implementation of planned measures.	Preparedness to deal with limitation or interruption of supply	Electricity	4	Regulatory measure	Under implementation, Update-Reform
M3.6	Maintenance of committee for management of serious oil and/or oil product supply disruption.	Preparedness to deal with limitation or interruption of supply	Petroleum products	4	Regulatory measure	Under implementation
M3.7	Maintenance and update of measures of the National Electricity Transmission System (emergency imports of electricity, load shedding schemes, Defence Plan, Restoration Plan, etc.).	Preparedness to deal with limitation or interruption of supply	Electricity	4	Regulatory measure	Under implementation, Update-Reform
M3.8	Maintenance and update of the regulation on the maintenance of emergency oil stocks.	Preparedness to deal with limitation or interruption of supply	Petroleum products	4	Regulatory measure	Under implementation, Update-Reform
M4.1	Increase in the penetration of	Reduction in energy	RES	4	Regulatory,	Under

Numbering	Name of policy measure	Objective	Sector affected	Estimated impact (1: Very Low to 5: Very high)	Category of measure	State of implementation
	RES with a view to meeting energy targets.	dependency Development of domestic energy sources		5	economic measure	implementation
M4.2	Optimal use of domestic lignite deposits.	Reduction in energy dependency Development of domestic energy sources	Electricity	4 4	Regulatory, technical measure	Under implementation
M4.3	Optimal use of domestic hydrocarbon extractions.	Reduction in energy dependency Development of domestic energy sources	Oil products Natural gas	1 4	Regulatory measure	Envisaged

COURTESY TRANSLATION

3.4 Internal energy market dimension

The policy measures adopted with regard to the reorganisation of the domestic electricity and gas market, the strengthening of interconnection with neighbouring electricity markets and the strengthening of competition in the domestic market contributed to the reduction of energy costs and hence to the strengthening of competitiveness of the Greek economy and to avoid burdening and/or alleviating electricity and gas consumers. To further reduce energy costs over the period 2021-2030, it is planned both to maintain and improve the most effective existing policy measures and to implement new measures that will decisively contribute to the achievement of the individual sub-targets. These policy measures aim to meet the following policy priorities for the period 2021-2030 (Figure 6).



Figure 6: Policy priorities for reforming the energy market between 2021 and 2030.

The policy measures that have been specified in the above policy priorities are analysed separately in the following sections.

3.4.1 Electricity infrastructure

3.4.1.1 *Policies and measures to achieve the interconnectivity target set out in point 2.4.1*

Existing electricity interconnections with neighbouring countries have made it possible, by increasing imports, to reduce the cost of electricity to relieve domestic consumers and boost business competitiveness. In the future, interconnections will make a significant contribution to the convergence of prices on the European electricity market, as well as to the harmonious increase in the penetration of variable RES plants.

Measures to continue building new interconnectors and strengthen the existing ones is a key priority, while promoting policies that will encourage the construction of new power plants. Examples include completion of the new interconnecting line between Greece and Bulgaria (Maritsa - Nea Santa) and upgrade of the existing interconnecting lines between Greece and Albania and between Greece and

FYROM. In addition, the possibility of interconnection of Greece to Cyprus and, through Cyprus, to Israel, is promoted. Finally, it is proposed to investigate the possibility of improving the reliability of existing interconnections.

At the same time, the reliable electrification of all consumers in Greece with the lowest possible cost and the lowest possible environmental burden is a matter of key concern. The interconnection of the majority of Greek non-interconnected islands with the mainland electrical system, besides reducing the cost the electricity generation cost and, therefore, restricting the regulated charges imposed on the electricity bills of all customers through the public utilities, will help limit pollutants emitted and reduce energy dependence on other countries due to the limited use of oil products.

3.4.1.2 Regional cooperation in this area

Within the framework of international links, regional cooperations have already been launched with the following countries:



3.4.1.3 Financing of measures in this area at national level, including with EU support and the use of EU funds

The basic financial instruments include:

- Domestic resources
- Projects of Common Interest (PCIs)

3.4.2 Energy transmission infrastructures

3.4.2.1 Policies and measures to achieve key infrastructure objectives

The promotion of natural gas in the Greek territory is a key priority as it will help reduce energy costs for consumers, while the implementation of cross-border gas transport and storage projects will significantly enhance the country's energy role in the region of South-Eastern Europe as an energy hub requiring the reinforcement of gas distribution, transportation and storage projects. In order to achieve this goal, the

completion of the gas transport and storage projects under implementation or planning as well as the expansion of the distribution network in the Greek territory will be initiated by significantly enhancing the consumers and businesses active in the areas where it expands by reducing their energy costs.

In the design phase, there are many energy infrastructure projects of direct interest to Greece, such as:

- The East Med pipeline.
- The Turkey-Greece-Italy Interconnection (ITGI)
- The Interconnector Greece-Bulgaria (IGB)
- The vertical Greece-FYROM interconnection
- The Ionian-Adriatic pipeline (IAP).

Moreover, the Development Plan of the National Natural Gas System (NNGS), drawn up by DESFA for the period 2017-2026, sets out the following NNGS development projects:

- Compression station at Kipi.
- The Metering/Regulation station at Komotini.
- The Compression station at Abelia.
- Upgrading of the Compression Station at N. Mesimvria.
- The Metering/Regulation station at N. Mesimvria for the connection of the NNGS with TAP.
- The Nea Mesimvria-Idomeni/Gevgeli pipeline and Metering/Regulation station.

3.4.2.2 *Regional cooperation in this area*

Within the framework of international links, regional cooperations have already been launched with the following countries:

Albania	Cyprus
Bulgaria	FYROM
Israel	Turkey
Italy	Adriatic countries

3.4.2.3 Financing of measures in this area at national level, including with EU support and the use of EU funds

The basic financial instruments include:

- Domestic resources
- Projects of Common Interest (PCIs)

3.4.3 Market consolidation

3.4.3.1 Policies and measures to achieve the objectives set out in point 2.4.3

The reduction in energy costs is expected to result from the strengthening of competition both in the electricity sector and in the supply of electricity and gas.

For example, in the period 2021-2030, a package of measures will be investigated for strengthening competition in the wholesale electricity market, as a continuation of the already planned measures for eliminating duties and taxes which are currently imposed on competitive power plants and which limit their competitiveness in the wholesale market, as well as adoption of mechanisms, where necessary, which will ensure the sustainability of power plants and the capacity adequacy of the mainland system. At the same time, when electricity markets get off the ground in the context of market reorganisation under the European target model, the existing NOME mechanism will be gradually replaced by the energy market for financial products in order to achieve smooth transition to the new market framework and in order not to slow down the process of strengthening competition.

Additional policy measures will be implemented to strengthen competition and reduce energy costs, such as the launch of the four markets envisaged in the Target Model and the coupling of the Greek electricity market with neighbouring markets.

In the context of measures to reform the domestic electricity market and strengthen competition, measures will be promoted to increase demand-side participation of consumers, in general, in the electricity market, thereby enabling consumers to influence electricity prices. Completion of the regulatory framework for demand response is necessary in order to achieve this objective.

At the same time, and in line with the Gas Market Roadmap 2017-2022, similar measures will be adopted in the gas sector such as the maintenance of gas releases and the implementation of policy measures for the reform of the retail and wholesale natural gas markets in a form commensurate with the structure and operation of the reformed electricity market.

In addition, according to the 2017-2022 Natural Gas Market Roadmap, in addition to increasing the use of natural gas in heating uses (mainly residential and commercial) through the expansion of the existing distribution network, the construction of a new distribution network in new geographic areas and the development of CNG infrastructures, it is planned to design and implement important infrastructure projects of national and international interest with a view to strengthening and expanding of natural gas systems in the Southeastern Europe and Eastern Mediterranean region.

3.4.3.2 Measures to increase the flexibility of the energy system

Greece is promoting measures to enhance the flexibility of the energy system by involving market demand and providing incentives for the deployment of storage systems. Indicatively, incentives are provided through the introduction of a long-term capacity adequacy mechanism where electricity consumers can participate, and incentives are also provided for the construction of new storage systems.

At the same time, the possibility of establishing Aggregators and Energy Communities has been institutionalised, enabling electricity consumers to operate in the electricity market, either as consumers or as producers, and through dynamic electricity tariffs to restrict both the electricity costs of the System and the consumers involved in these bodies.

Demand participation in the electricity market will be made possible and strengthened through the installation of 'smart' meters for all electricity consumers, a project expected to be completed in the next decade. This will enable customers to remotely send orders to consumers to change their load curve, to reduce electricity prices and to participate in ensuring the power adequacy of the electricity system.

3.4.3.3 Measures to ensure the inclusive participation of renewable energy, demand response and storage

As mentioned above, the Greek State has already taken measures to promote the participation of demand in the electricity market, both through the institutionalisation of Aggregators, as well as through the institutionalisation and participation of consumers in Energy Communities, while the provision of additional incentives is planned through their institutionalisation and participation in the Long-term Power Adequacy Mechanism.

Law 4414/2016 also stipulated that all new power plants would be obliged, above a power limit, to participate in the electricity market by submitting an appropriate priced supply-forecast either on their own or through the Aggregators. If they submit an incorrect provision, RES plants will be charged with the corresponding charges-fines.

3.4.3.4 Policies and measures to protect consumers and improve competition

Consumer policy measures will include, among other things, adoption of a regulatory framework for the protection of electricity consumers from high electricity market prices on the wholesale market.

Moreover, strengthening the necessary control mechanisms to ensure the transparent and lawful operation of the oil market and to safeguard consumer protection is a priority. At the same time, in order to enhance the penetration of alternative fuels and electrification, aid for stations is planned so that they are modernised and so that they supply consumers with the whole set of alternative fuels.

3.4.4 Energy poverty

3.4.4.1 Policies and measures to achieve the objectives set out in point 2.4.4

With regard to combating the phenomenon of energy poverty, the improvement of the existing measures of the social tariff and the status of the Universal Service will be launched to only involve energy-vulnerable households.

At the same time, consideration will be given to the possibility of introducing the 'energy card' as a support measure for vulnerable electricity consumers, which will replace the other support measures for the consumption of energy goods and which will enable consumers to select themselves the way in which they will have their energy needs met.

Targeted financing programmes will be designed to improve the energy efficiency of residential buildings of households that are vulnerable with regard to energy. In addition, incentives will be explored for both to energy suppliers under the energy efficiency obligation scheme and to energy communities so that they contribute more actively to the energy upgrade of the specific buildings.

3.4.5 Summary of policy measures

Table 30 summarises the policy measures envisaged to achieve individual objectives as part of the internal energy market dimension, which are analysed in the following sections.

COURTESY TRANSLATION

Table 30: Planned policy measures for the internal energy market.

Numbering	Name of policy measure	Objective	Sector affected	Estimated impact (1: Very Low to 5: Very high)	Category of measure	State of implementation
M1.1	Reinforcement of electricity interconnections with neighbouring countries.	Electricity interconnectivity Energy transmission infrastructures Energy market integration Adequacy of electrical system Flexibility of energy system Consumer protection Improvement of competition Energy poverty	Electricity	5 5 4 3 3 3 3	Technical measure	Under implementation, Update-Reform
M1.2	Development of interconnections of non-interconnected islands to the mainland system.	Electricity interconnectivity Energy transmission infrastructures Energy market integration Adequacy of electrical system Flexibility of energy system Consumer protection	Electricity	5 5 3 3 2 3	Technical measure	Under implementation, Update-Reform

Numbering	Name of policy measure	Objective	Sector affected	Estimated impact (1: Very Low to 5: Very high)	Category of measure	State of implementation
M2.1	Aid for international natural gas transmission projects.	Electricity interconnectivity Energy transmission infrastructures Energy market integration Adequacy of electrical system Flexibility of energy system Consumer protection Improvement of competition Energy poverty	Electricity Natural gas	5 5 4 4 3 3 3 2	Technical measure	Under implementation, Update-Reform
M2.2	Aid for natural gas storage projects.	Electricity interconnectivity Energy transmission infrastructures Energy market integration Adequacy of electrical system Flexibility of energy system Consumer protection Improvement of competition	Electricity Natural gas	2 2 2 4 4 3 2	Technical measure	Under implementation, Update-Reform

Numbering	Name of policy measure	Objective	Sector affected	Estimated impact (1: Very Low to 5: Very high)	Category of measure	State of implementation
M2.3	Aid for projects for the extension of the distribution network.	Electricity interconnectivity Energy transmission infrastructures Adequacy of electrical system Flexibility of energy system Consumer protection Energy poverty	Electricity Natural gas	5 4 3 2 2 3	Technical measure	Under implementation, Update-Reform
M3.1	Elimination of duties and taxes on competitive energy sources (production of lignite, natural gas, etc.).	Consumer protection Improvement of competition Energy market integration Energy poverty	Electricity	4 4 4 3	Regulatory measure	Under implementation, Update-Reform
M3.2	De-escalation of the NOME mechanism until the full implementation of the market for forward products.	Consumer protection Improvement of competition	Electricity	3 3	Regulatory measure	Envisaged
M3.3	Adoption of long-term capacity adequacy mechanism.	Adequacy of electrical system Consumer protection	Electricity	5	Regulatory measure	Envisaged
M3.4	Continuation of the implementation of reforms for reshuffling the electricity market and for implementing the 4 markets under the Target Model.	Energy market integration Consumer protection Improvement of competition	Electricity	4 3 4	Regulatory measure	Adopted
M3.5	Continuation of the adoption of	Energy market	Electricity	5	Regulatory	Adopted, Update-

Numbering	Name of policy measure	Objective	Sector affected	Estimated impact (1: Very Low to 5: Very high)	Category of measure	State of implementation
	measures for coupling the electricity market with the markets of the neighbouring countries.	integration Consumer protection Improvement of competition		4 4	measure	Reform
M3.6	Adoption of measures for the strengthening of demand response and for the participation of demand in the wholesale electricity market.	Consumer protection Improvement of competition	Electricity	3 3	Regulatory, technical measure	Adopted, Update- Reform
M3.7	Maintenance of mechanism for disposal of natural gas quantities through electronic auctions (gas release).	Consumer protection Improvement of competition	Electricity Natural gas	3 4	Regulatory measure	Under implementation
M3.8	Continuation of measures/policies for reforming the retail and wholesale natural gas market.	Consumer protection Improvement of competition	Electricity Natural gas	3 4	Regulatory measure	Under implementation, Update-Reform
M4.1	Maintenance of social tariff scheme.	Energy poverty Consumer protection	Residential sector	4 1	Economic measure	Under implementation
M4.2	Adoption of measures for protecting consumers from high electricity wholesale market prices (e.g. imposition of a price cap).	Consumer protection	All sectors of final energy consumption	3	Regulatory measure	Under implementation, Update-Reform
M4.3	Provision for the automatic transition of vulnerable domestic customers into the universal service scheme.	Energy poverty	Residential sector	4	Regulatory measure	Under implementation
M4.4	Exploration of the introduction of	Energy poverty	Residential sector	4	Economic	Envisaged

Numbering	Name of policy measure	Objective	Sector affected	Estimated impact (1: Very Low to 5: Very high)	Category of measure	State of implementation
	the 'energy card'.				measure	
M4.5	Energy upgrade of residential buildings of households that are vulnerable in terms of energy and promotion of the installation of RES plants with a view to meeting their energy needs (net metering).	Energy poverty	Residential sector	4	Economic measure	Envisaged
M4.6	Provision of incentives to existing mechanisms (e.g. energy efficiency obligation schemes and energy communities).	Energy poverty	Residential sector	4	Economic measure	Under implementation, Update-Reform
M5.1	Strengthening of the necessary control mechanisms to ensure transparency in the oil market.	Consumer protection Improvement of competition	All sectors of final energy consumption	4 2	Regulatory measure	Under implementation, Update-Reform

3.5 Research, innovation and competitiveness dimension

The definition of policy measures to promote Research, Innovation and Competitiveness in the period 2021-2030 aims to cover eight different policy priorities, which are presented in Figure 7. The first five are aimed at promoting research and innovation on the main axes of the European Energy Policy from a technological point of view; the sixth is aimed at providing horizontal support to synergies between all stakeholders and the development of monitoring structures, the seventh at promoting entrepreneurship through its mechanisms market and the last three at improving competitiveness.

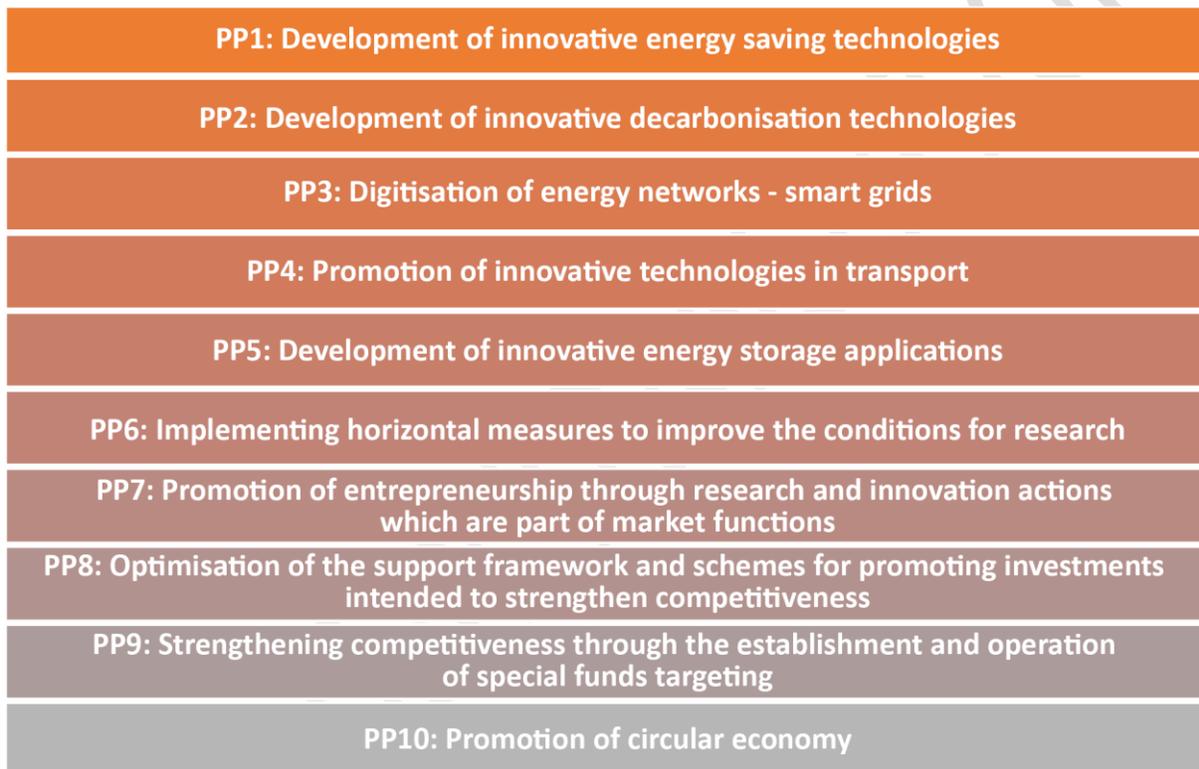


Figure 7: Policy Priorities of policy measures to promote Research, Innovation and Competitiveness in the period 2021-2030.

The policy measures that have been specified in the above policy priorities are analysed separately in the following sections.

3.5.1 Policies and measures to achieve the relevant objectives

3.5.1.1 *Policies and measures to promote research and innovation*

Policy measures to promote research and innovation are strongly related to the technologies promoted within the framework of the Energy Union.

More specifically, the need to achieve energy efficiency improvement targets in all areas of final energy consumption poses significant challenges by making it imperative to strengthen research into new materials and innovative technological applications in heating and cooling systems, with emphasis on improved reliability and automated operation. At the same time, it facilitates the maturation and integration of innovative energy-saving technologies that contribute significantly to improving energy efficiency. Compliance with the minimum requirements for nearly zero-energy buildings will lead to the reinforcement of new research activities and innovative technology solutions in related sectors, such as insulation materials, efficient heat pumps, energy efficient lighting technologies, RES and energy storage technologies, etc. Similar research and innovation actions will also be strengthened in the tertiary sector, and the resulting reduction in final energy consumption will make a significant contribution to improving their competitiveness. In the industrial sector, the use of innovative waste heat recovery technologies, the development of advanced small and large CHP plants, the promotion of energy efficiency improvement technologies and the development of new processes and techniques in the production process in energy-intensive industries, and RES deployment, will be supported.

Achieving the goal of reducing greenhouse gas emissions in all sectors of economic activity is expected to lead both to the full and market-based integration of mature technologies in the energy market and to the gradual penetration of less competitive technologies. This particular transition to a new production and demand model presents important technological challenges, requiring the development of know-how and the promotion of innovative technologies. Therefore, provision has been made to further promote advanced RES technologies (e.g. photovoltaic plants, concentrated thermal solar plants/solar thermal power plants, offshore wind energy, ocean energy, geothermics, solar energy for heating and cooling) and bioenergy (including all technologies for the creation of value chains - through utilisation of the locally available biomass/rural residues/waste) in the coming period. In addition, support will be provided for the development of technological applications with a view to improving the credibility, the automated operation and the monitoring of the environmental performance of these technologies. At the same time, the penetration, with incorporation of smart diagnostic systems, of both hydrogen technologies and of technologies for carbon capture, storage and/or use in energy intensive industries and in other polluting installations, will be encouraged. Finally, innovative applications will contribute to

mitigating the environmental impact of businesses and the impact of climate change on the urban environment as well as promoting the circular economy, with emphasis on recovery of materials and reuse and recovery of energy.

The challenges of digitising energy networks and developing smart grids are a key priority of research and innovation in the coming period. Targeted research initiatives will be strengthened to promote smart telemetering, safe and effective handling of the data collected and more efficient operation of the energy distribution and transmission networks. More specifically, support will be provided for the development and implementation of solutions with regard to specific needs, such as increase of observability and controllability of the energy system, improvement of the load forecast accuracy, management of the load curve in the context of demand response, increase in the flexibility of all energy generation plants, provision of balancing services by RES plants, improvement of the flexibilities of the new and upgraded thermal power stations, optimal incorporation of different RES technologies at a regional and local level, etc. Moreover, support will also be provided for the creation of digital applications for the implementation of secure electricity transactions, or other environmental parameters (such as avoidance of greenhouse gas emissions), between final consumers and small-scale producers.

The development of innovative processes for making more efficient use of fossil fuels is a key priority in the design of measures to promote research and innovation in transport. In addition, innovative actions relating to electric vehicles and to the strategies for their recharging will be supported and emphasis will be placed on the fact that the electricity consumed should come from RES. Respective actions for the development of innovative technologies will also be designed for biofuels. Finally, actions for planning efficient LNG storage facilities for the refuelling of ships and for the development of applications for optimising energy consumption in port facilities will be supported.

Energy storage is also an important research and innovation field. Innovative local or small-scale storage applications will involve the storage of either electrical or thermal energy. Therefore, measures will be taken to strengthen the development of new or improved storage technologies with higher efficiency, availability, durability, security and at the lowest cost. In addition, support will be provided for electrochemical energy storage technologies, which relate primarily to RES applications for utilisation in non-interconnected electricity networks or in remote points in the electricity network. At the same time, research actions to be promoted in the scientific fields relating to smart networks and electromobility (electric vehicles) will contribute positively not only to the transport sector but also to the energy storage sector.

Promoting research and innovation in the energy sector requires the active involvement of all market players. The strategic choices made by the enterprises in the sector (power transmission and distribution), the policies pursued by public bodies and authorities, as well as the tools for financing the actions implemented by the enterprises will be driven by synergies to the greatest possible extent.

Horizontal support policies include:

- Establishment of a monitoring and control mechanism to maximise synergies between energy, research and competitiveness policies and support it with the necessary resources.
- Regulatory measures for the easier and more efficient implementation of research or pilot projects by all market players, with the ultimate goal of benefiting final consumers.
- Measures to promote partnerships between all stakeholders by supporting advisory and networking actions among stakeholders to facilitate the transfer of know-how and the maximisation of synergies.

3.5.1.2 Policies and measures to promote competitiveness

Promoting entrepreneurship through research and innovation actions that are integrated into the market is also a priority which contributes directly to the competitiveness component. To this end, it is planned to set up and operate special funds to promote research and innovation in SMEs and to ensure the conditions for successful investment, exploitation of patent rights, licensing, etc.

Support will also be given to the creation of innovative clusters of companies and research entities to promote healthy entrepreneurship. Finally, support will be provided for the establishment of knowledge-intensive start-ups for the commercial exploitation and commercialisation of mature research results and innovative ideas, as well as for the development of entrepreneurship support structures, such as incubators, technology parks, co-working spaces, etc.

Enhancing competitiveness calls for improving the existing regulatory framework for the implementation of investments in industrial plants and in SMEs, including the energy sector, in order to create a stable and transparent framework of rules, procedure and administrative structures with a view to completing smoothly large public and private projects. In addition, in order to achieve higher leverage of private capital, the effectiveness of the existing private investment aid schemes will be assessed in order to continue implementing the most efficient among them and/or to attempt to implement new ones.

The role of special target funds, such as the 'Fair Transition Fund', will also be important in facilitating the provision of concessional financing to SMEs and to undertaking part of the business risk which is not undertaken by financing institutions, while providing the necessary guarantees.

The contribution of the circular economy to improving competitiveness is considered to be particularly important and it is therefore necessary to promote concrete actions reflected in the National Circular Economy Strategy, adopted by the Central Economic Policy Council on 17 April 2018.

The actions of the National Strategy include indicatively the implementation of the national waste prevention programme, the reduction of food waste, the adjustment of the framework for construction of public and private projects, the facilitation of the processing and use of secondary raw materials, the development of criteria for the eco-design of products, the promotion of the use of waste as secondary fuel in industry, the creation of an institutional regulatory framework which will facilitate the production of biomethane from organic waste and its injection into the natural gas network or its use as transport fuel, and the management, utilisation and re-use of waste.

3.5.2 Cooperation with other Member States in this area

Cooperation with other countries in the area of research and innovation is shaped by the transnational collaborations of the GSRT, which are an integral part of its overall activity in making and strengthening research policies. These collaborations cover a wide range of bilateral, tripartite and multilateral actions as a result of the country's international policy and the joint will of the governments involved. The forms of multilateral cooperation vary from cooperation at ministerial level (e.g. BSEC, Organization of the Black Sea Economic Cooperation) or collaborations, initially decided at ministerial level and implemented by researchers/scientists (e.g. ERANETS).

3.5.3 Financing of measures in this area at national level, inter alia with EU support and the use of EU funds

The basic financial instruments include:

- Domestic resources
- Operational programmes under the new programming period
- Specific operational funds with public and private capital
- National, European, transnational and international programmes to support research actions and the implementation of innovative and pilot applications

3.5.4 Summary of policy measures

Table 31 summarises the policy measures envisaged to achieve individual objectives as part of the research, innovation and competitiveness dimension, which are analysed in the following sections.

COURTESY TRANSLATION

Table 31: Contemplated policy measures to promote Research, Innovation and Competitiveness.

Numbering	Name of policy measure	Objective	Sector affected	Estimated impact (1: Very Low to 5: Very high)	Category of measure	State of implementation
M1.1	Development of innovative energy-saving technologies	Promotion of research and innovation	Energy efficiency, RES Consumer-focused smart energy system	5	Economic measure	Under implementation, Update-Reform
M1.2	Development of innovative decarbonisation technologies	Promotion of research and innovation Development of low-carbon technologies	RES Carbon capture, use and storage	5 4	Economic measure	Under implementation, Update-Reform
M1.3	Digitisation of energy networks - smart networks	Promotion of research and innovation	Consumer-focused smart energy system	5	Economic measure	Under implementation, Update-Reform
M1.4	Promotion of innovative technologies in transport	Promotion of research and innovation Development of low-carbon technologies	Sustainable transport	4 4	Economic measure	Under implementation, Update-Reform
M1.5	Development of innovative energy storage applications	Promotion of research and innovation	Sustainable transport Consumer-focused smart energy system	4	Economic measure	Under implementation, Update-Reform
M1.6	Implementation of horizontal measures for improving the conditions for conducting research	Promotion of research and innovation	All NECP subject fields	5	Regulatory measure	Envisaged
M1.7	Promotion of entrepreneurship through research and innovation actions which are embedded in the market functions	Improvement of competitiveness	All NECP subject fields	4	Economic measure	Under implementation, Update-Reform

Numbering	Name of policy measure	Objective	Sector affected	Estimated impact (1: Very Low to 5: Very high)	Category of measure	State of implementation
M1.8	Optimisation of framework and aid schemes for promoting investments with a view to strengthening competitiveness	Improvement of competitiveness	All NECP subject fields	3	Economic measure	Under implementation, Update-Reform
M1.9	Strengthening competitiveness through the establishment and operation of Special Target Funds	Improvement of competitiveness	All NECP subject fields	4	Economic measure	Envisaged
M1.10	Promotion of circular economy	Improvement of competitiveness	All NECP subject fields	3	Regulatory, economic measure	Under implementation, Update-Reform

COURTESY TRANSLATIONS

CHAPTER 4 EXISTING SITUATION AND PROVISIONS BASED ON EXISTING POLICIES AND EXISTING MEASURES

4.1 Devising a scenario of existing policies and measures

A scenario of existing policies and measures has been devised for the analysis of the evolution of the energy system and the impacts and interactions of existing energy policies and measures.

Devising and studying this scenario is intended to evaluate the implementation of measures already in place and/or implemented under national and European energy and climate policy.

The key challenges addressed and considered in the scenario of existing policies and measures concern security of supply, greenhouse gas emission reductions, low carbon technology penetration, and energy efficiency in all end-use sectors.

Taking into account the specific challenges, this scenario meets the national targets under the European 2020 policy, achieving the following rates:

1. The share of RES in gross final energy consumption for the year 2020 is estimated at 18 %, meeting the national target for 2020.
2. Final energy consumption for the year 2020 is estimated to be significantly lower than the 2007 forecast. In particular, final energy consumption amounts to 18.2 Mtoe in 2020, i.e. 32 % lower than the corresponding 2007 forecast.
3. The reduction in non-ETS greenhouse gas emissions is estimated at 27 % in 2020 (46.7 MtCO_{2eq}) compared to 2005 (64.5 MtCO_{2eq}), presenting a 4 % drop in the target set (61.9 MtCO_{2eq}) in 2020 compared to 2005.

The assumptions made for the individual parameters affecting the evolution of the energy system, which limit or enhance the development of individual energy figures, are summarised in the forecasts for the evolution of the following figures for the period 2018-2040:

- i. economic activity by industry
- ii. population and number of households
- iii. international fuel prices
- iv. prices of greenhouse gas emission allowances

- v. evolution of the investment cost of energy technologies
- vi. potential of RES technologies
- vii. development of electricity and natural gas infrastructure

The evolution of demand for useful energy in the final consumption sectors (buildings, transport, etc.) is driven by both the evolution of economic activity per industry and the evolution of population, households, household size, production capacity of individual industrial sectors and other macroeconomic and demographic parameters.

The reference year shall be 2016 as it is the most recent year for which there is a complete official national energy balance.

4.2 Estimated development of the main external factors affecting the energy system and the greenhouse gas emissions

4.2.1 Greenhouse Gas Emissions and Removals

Any assumptions relating to the country's aggregates and population figures have been taken into consideration by the Ministry of Finance and are summarised in the following table.

Table 32: Macroeconomic and demographic projections.

	2015	2020	2025	2030	2035	2040
Population (millions)	10.858	10.594	10.285	9.979	9.705	9.456
GDP [millions € ₂₀₁₆]	176920	191554	210054	229652	251078	270482

4.2.2 Sectoral changes expected to affect the energy system and the greenhouse gas emissions

Accordingly, projections relating to the development of the individual sectoral aggregates have been taken into consideration by the Ministry of Finance and are summarised in the following table.

Table 33: Sectoral macroeconomic projections.

	2015	2020	2025	2030	2035	2040
Agricultural sector [millions € ₂₀₁₆]	6919	7049	7527	8652	9228	10190
Construction sector [millions € ₂₀₁₆]	3092	4354	4770	5195	5678	6097
Services Sector [millions € ₂₀₁₆]	115547	121751	133114	144907	158239	169837
Energy Sector [millions € ₂₀₁₆]	3063	3525	4274	4824	5603	6036
Industry [millions € ₂₀₁₆]	14946	17085	18306	20014	21881	23572

Assumptions concerning household and transport work development are summarised in the following table.

Table 34: Projections for household and transport work development.

	2015	2020	2025	2030	2035	2040
Number of households [millions]	4.081	4.039	3.977	3.915	3.864	3.821
Household size [residents/household]	2.66	2.62	2.59	2.55	2.51	2.47
Passenger transport work						
Public road transport [million pkm]	22822	18333	19157	19981	20899	21700
Private vehicles [million pkm]	87128	92903	99904	107241	115222	122585
Two-wheel vehicles [million pkm]	5941	5878	5789	5699	5625	5562
Track-based modes [pkm]	1263	1313	1295	1276	1261	1249
Commercial transport work						
Trucks [ec tonne-kilometres]	19764	23791	20414	29231	32474	36094
Track-based modes [ec tonne-kilometres]	294	587	515	616	650	685

4.2.3 Global energy trends, international fossil fuel prices, EU ETS carbon price

The common assumptions taken by the European Commission regarding the development of international fuel prices and of EU ETS allowances are summarised in the following table.

Table 35: Projections for the development of international fuel prices and emission allowances.

	2016	2020	2025	2030	2035	2040
International fuel prices, assessment of price trends based on common EU assumptions						
Crude oil [€ ₂₀₁₆ /GJ]	6.80	11.90	15.73	17.33	18.08	19.14
Natural Gas (Lower Calorific Value) [€ ₂₀₁₆ /GJ]	4.66	7.59	9.64	10.49	11.20	11.58
Hard coal [€ ₂₀₁₆ /GJ]	2.16	2.85	3.16	3.79	4.01	4.18
Value of emission allowances [€ ₂₀₁₆ /tonne CO _{2,eq}]	7.76 ²⁰	15.52	23.28	34.66	43.45	51.73

²⁰ Value for year 2015

4.2.4 Technology cost developments

For the technology cost development of electrical generation technologies, there has been used data from the investment cost structure aiming at the development of such modules within Greek territory, as well as cost development projections on the basis of international and European studies. In the context of the analysis of these studies, it was initially considered appropriate to maintain the development cost for a set of electricity generation technologies from RES at the same current levels and gently scale it down after 2030, whereas for the technologies which show potential for further development cost reduction, there was a forecast for the development of this cost until 2040. It becomes evident, following the results presented in the sections below, that this cost assessment affects both the type of the new power generation modules being installed as well as the electricity generation mix.

In terms of technology, a sharp reduction in the development costs of the photovoltaic parks and, at a smaller but equally significant rate, of wind farms, is suggested, while an improvement in the nominal capacity of the systems is envisaged for both of these technologies. It is noted, however, that, compared to photovoltaic parks on land, photovoltaics generally demonstrate a remarkable penetration in the construction sector, with comparatively higher costs and a reduced rate of utilisation.

The following table shows the relevant assumptions regarding the development of the development costs.

Table 36: Forecasts for the development of the typical cost for electricity generation unit development from RES.

Development cost (€/kW)	2016	2020	2025	2030	2035	2040
RES Technologies for electricity generation						
Wind farm	1.250	1.161	997	860	774	731
Solar panels - park	1.000	737	631	559	515	490
Solar panels – roofs	1.400	1.132	981	864	783	734
Solar thermal park with storage	4.700	4.100	3.860	3.370	2.880	2.390
Geothermal	4.400	4.400	4.400	3.400	2.400	2.000
Hydroelectric - small	1.950	1.900	1.900	1.900	1.900	1.900
Biomass - large	2.700	2.700	2.700	2.700	2.700	2.700
Biomass - medium	3.500	3.500	3.500	3.500	3.500	3.500
Biogas	4.350	4.350	4.350	4.350	4.350	4.350

4.3 Decarbonisation dimension

4.3.1 Greenhouse Gas Emissions and Removals

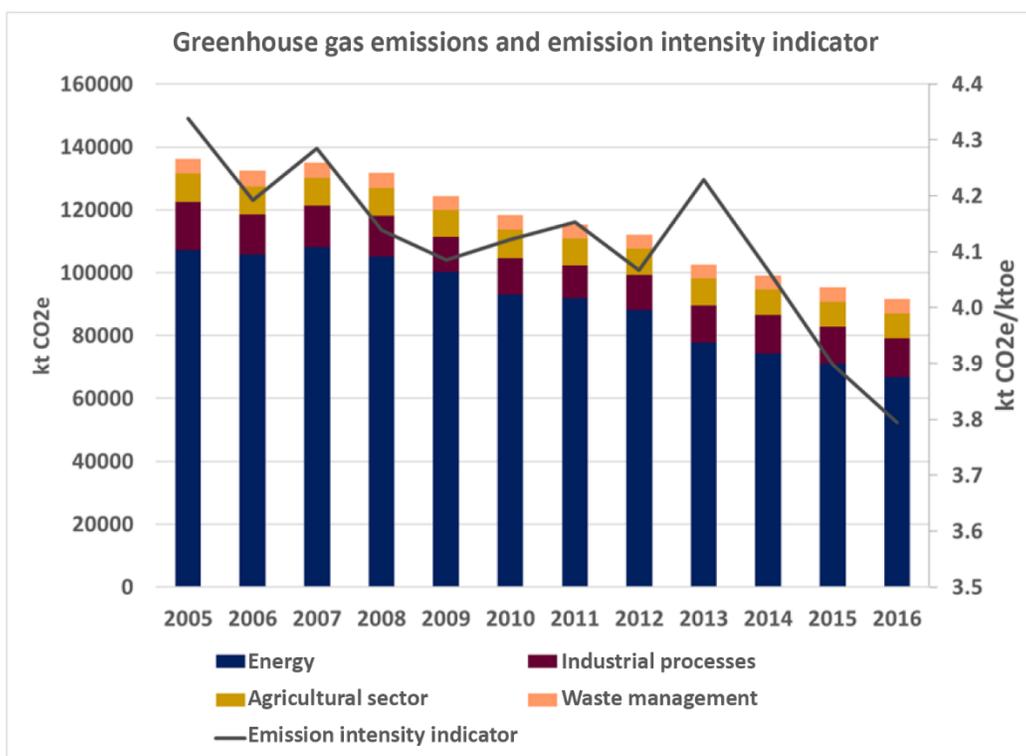
4.3.1.1 *Trends in current GHG emissions and removals in the EU ETS, Effort Sharing Regulation and LULUCF sectors and different energy sectors*

Specifically, greenhouse gas emission reduction measures as well as adaptation measures at national level under the agreements concluded over the past years have been initiated in order to address climate change. In the context of the processes of the 21st Conference of the Parties (COP-21) to the United Nations Framework Convention on Climate Change (UNFCCC), held in Paris in 2015, 195 countries have agreed on a new global, sufficiently ambitious and legally binding agreement on a response towards the global threat of climate change.

Greece ratified the Paris Agreement in October 2016 by Law 4426/2016. The total greenhouse gas emissions experienced a decline of 33 % in 2016 in comparison with 2005²¹, while in absolute figures they were found to be at a lower level than those of 1990.

High reliance of the energy sector on lignite and petroleum products, as evidenced by the data already presented, results in high values of the greenhouse gas intensity indicator compared to other member states. However, the greenhouse gas intensity indicator decreased during the period 2005-2016 (decline of 12.5 %) mainly because of high RES penetration in the final consumption and energy efficiency improvement measures (Graph 4).

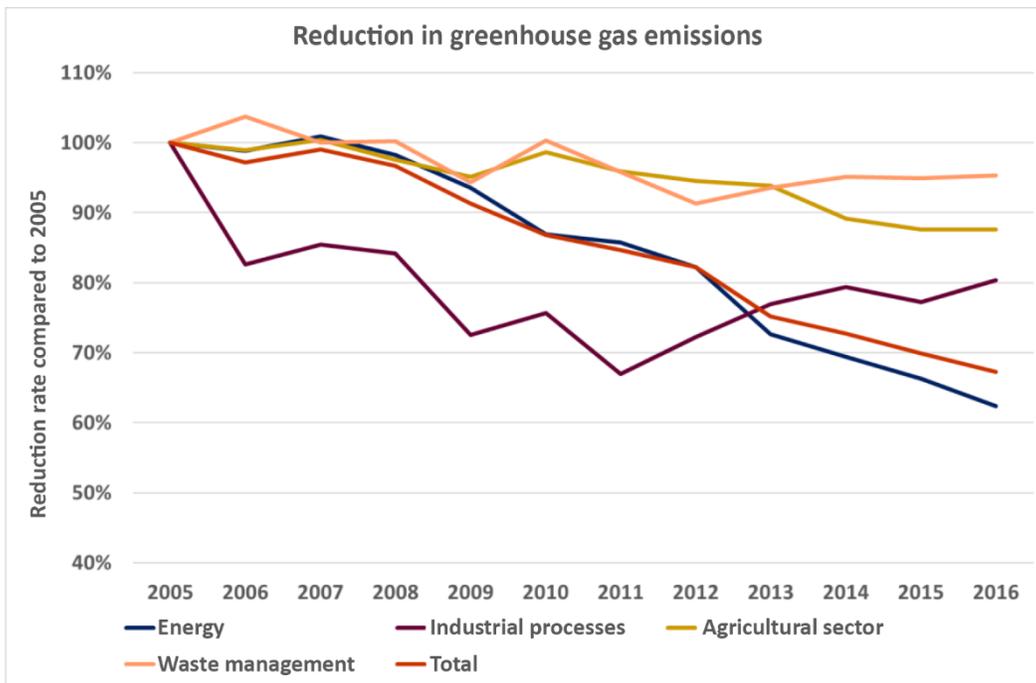
²¹ The depiction of values in the present section shall be made specifically for the period 2005-2016 in order to establish correlation with the objectives in the context of relevant policies. In the remaining sections of the chapter concerning energy system characteristics, the data presentation shall be made over a period of a decade.



Graph 4: Development of greenhouse gas emissions per contribution sector and emission intensity indicator.

The contribution of the energy sector in the overall greenhouse gas emissions is the highest when compared to emission produced by other business areas. In particular, fossil fuel combustion for the electricity generation and heat constitutes the most important factor which contributes to the development of the existing situation.

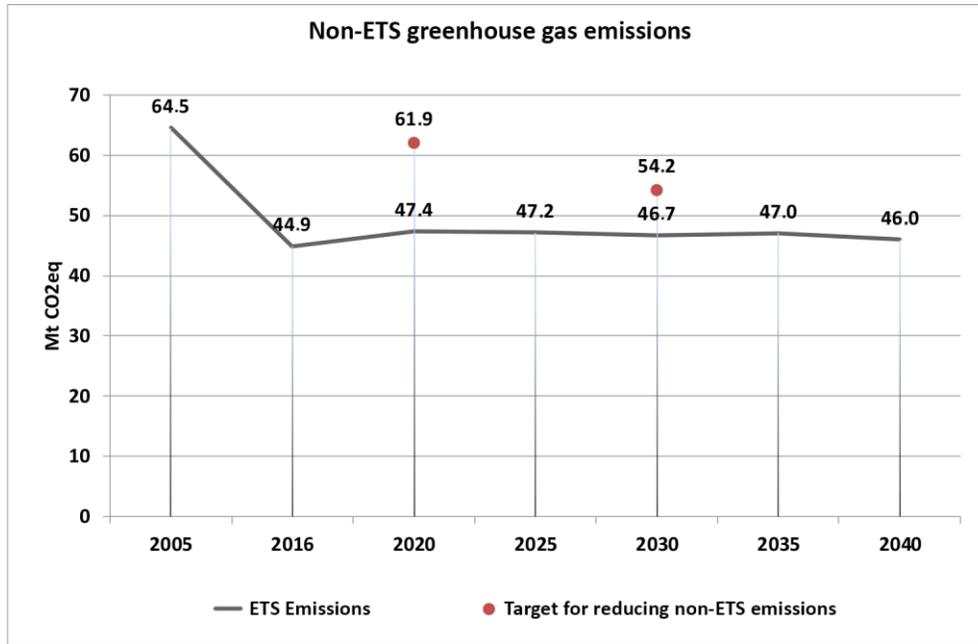
Graph 5 shows the development of the reduction rate with respect to the year 2005 in the total greenhouse gas emissions as well as the sub-sector contribution. More specifically, the reduction of emissions in the energy sector has been particularly significant (reduction of 38 % for 2016 with respect to the year 2005) and was higher than the corresponding percentage reduction achieved in the totality of the emissions for all sectors. Greenhouse gas emissions in other sectors were moderately reduced (agricultural sector, industrial processes and waste management).



Graph 5: Development of reduction rate in greenhouse gas emissions compared to 2005 (excluding LULUCF emissions).

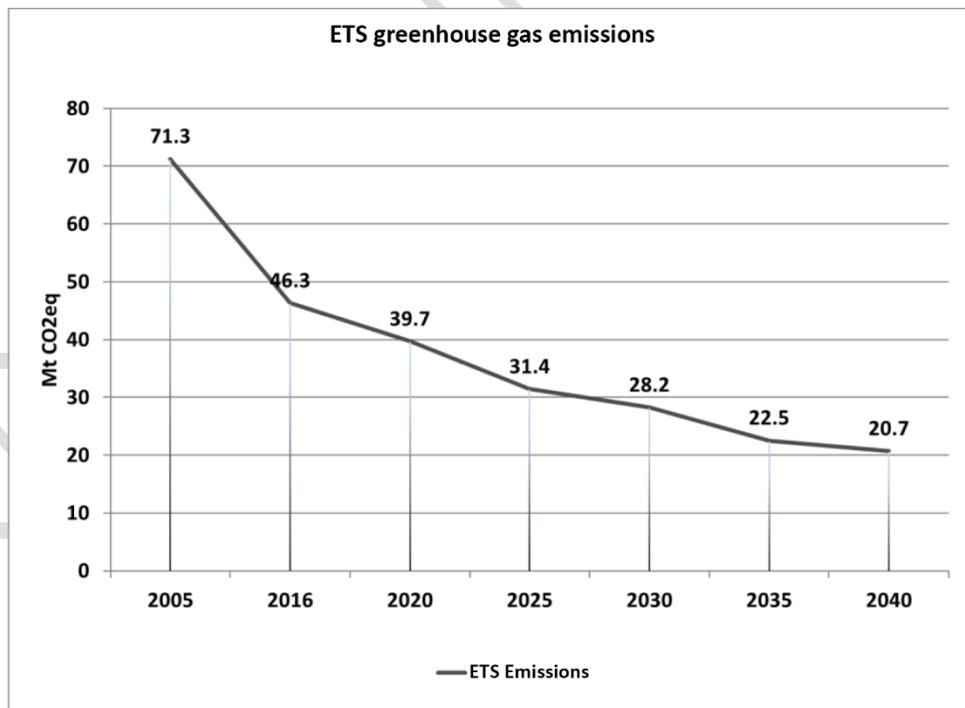
4.3.1.2 Forecasts for sectoral developments regarding existing national and EU policies and measures at least until 2040 (including 2030)

Establishing and implementing the policies and measures described in the section outlining existing measures, it is assessed that the objective of reducing greenhouse gas emissions outside the EU ETS is achieved as it is expected to decrease to 47, 4 MtCO_{2eq} in 2020 and 46, 7 MtCO_{2eq} 2030, as shown in Graph 6.



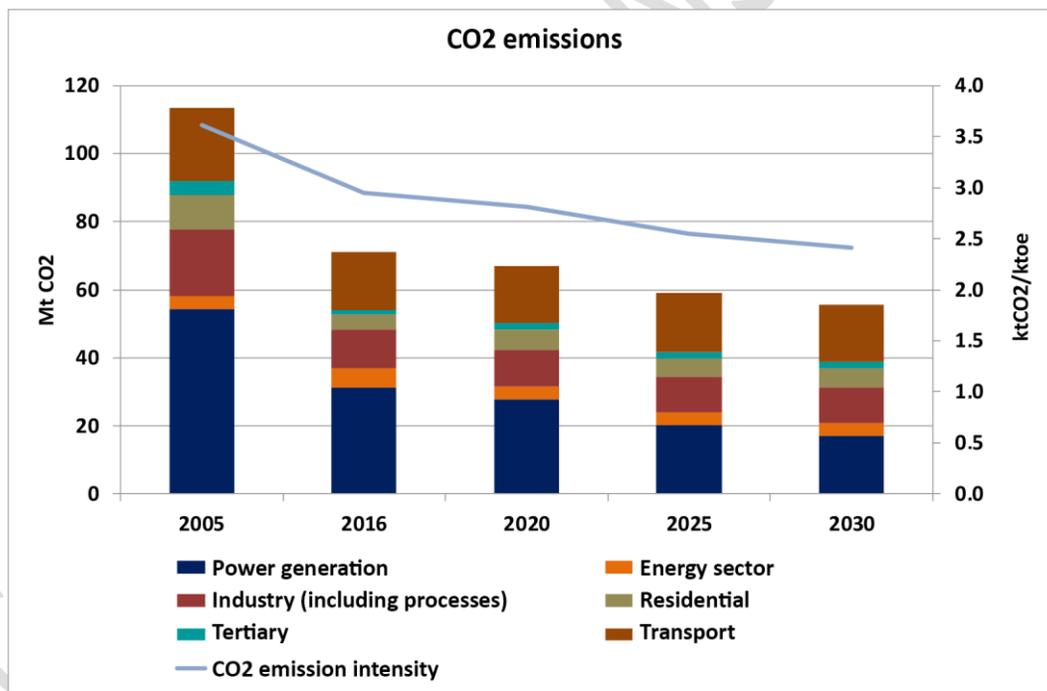
Graph 6: Development of greenhouse gas emissions outside the EU ETS until 2040 taking into consideration the existing policies and measures scenario.

Accordingly, in the sectors within the ETS, a reduction of 60 % and a reduction in 2030 ETS emissions in respect of the year 2005 are finally achieved.



Graph 7: Development of greenhouse gas emissions included in the ETS until 2040 taking into consideration the existing policies and measures scenario.

With regards to CO₂ emissions, sectors related to the generation and use of energy in Greece, concerning the electricity generation, the rest of the energy sector (e.g. petroleum refineries), the industry, including industrial processes, transport and other end-use sectors of fuels, namely the residential, tertiary and the agricultural sector, are examined. In particular, in relation to 2016, a CO₂ emissions reduction has been observed both in 2020 and 2030 in the fields of electricity generation, the rest of the energy sector and the industry, while the CO₂ emissions of the residential and tertiary sectors show an increase, and the CO₂ emissions from transport remain at the same levels as in 2016. However, the total emissions for 2020 are estimated at the level of 67 Mt of CO₂ and for 2030 at the level of 56 Mt CO₂, compared to 71 Mt CO₂ for 2016, with the maximum contribution to that reduction being achieved by the electricity generation sector (45 % reduction in 2030 compared to 2016) (Chart 8). This reduction is achieved by selecting cleaner forms of energy in all sectors and in particular in the field of electricity generation, where high CO₂ emissions technologies, (i.e. lignite and petroleum stations) are replaced by RES for electricity generation. In parallel, the intensity of the CO₂ emissions for those sectors shows a significant decrease of 33 % in 2030 compared to 2005.



Graph 8: Development of CO₂ emissions until 2040 taking into consideration the existing policies and measures scenario.

4.3.2 Renewable energy

4.3.2.1 Current share of energy from renewable sources in gross final consumption of energy and in individual sectors (heating and cooling, electricity and transport,

The contribution of RES in the consumption of energy in the territory of Greece shows a significant increase in the period 2006-2016, since the total contribution for 2016 as a share in gross final consumption of energy is 15.2 %, more than doubling the relative share corresponding to RES in 2006 (Chart 9).

With the exception of the transport sector, where the share of RES involved extreme variations and a slight absolute increase by 2016, the contribution of RES in the gross consumption of electricity and in the final consumption of energy for heating during the period 2006-2016 showed a significant increase with an average annual growth rate close to 10 %.

It is worth recalling that the variations observed at intervals in the share of RES concerning final consumption of energy for heating, are exclusively due to the use of solid biomass, the use of which has fluctuated over the last few years, after significant increases observed at the beginning of the current decade and culminated in the year 2012.

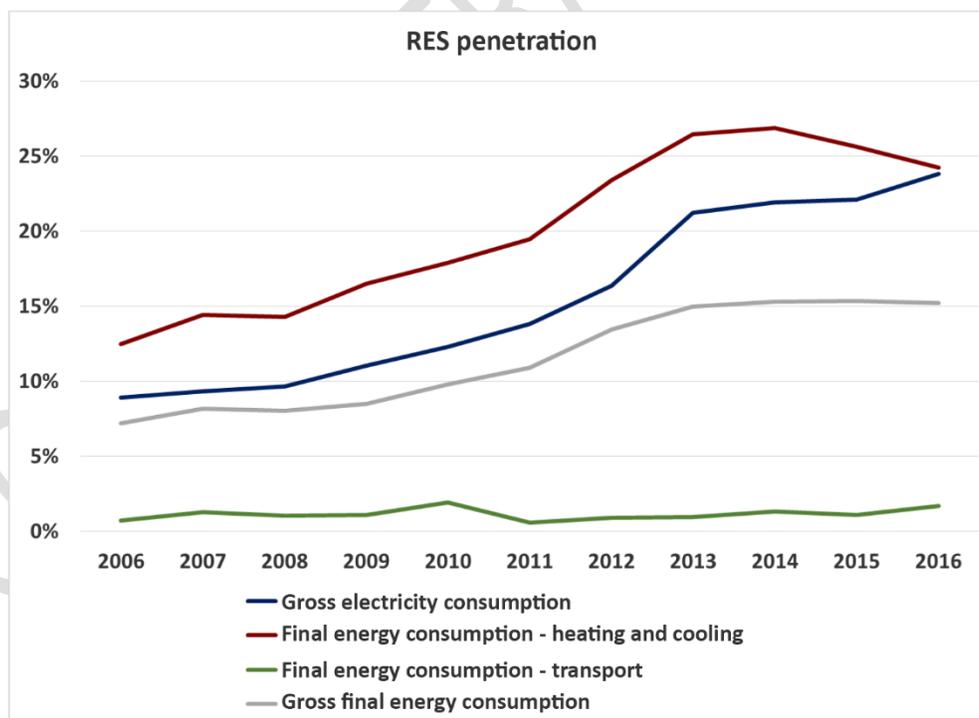
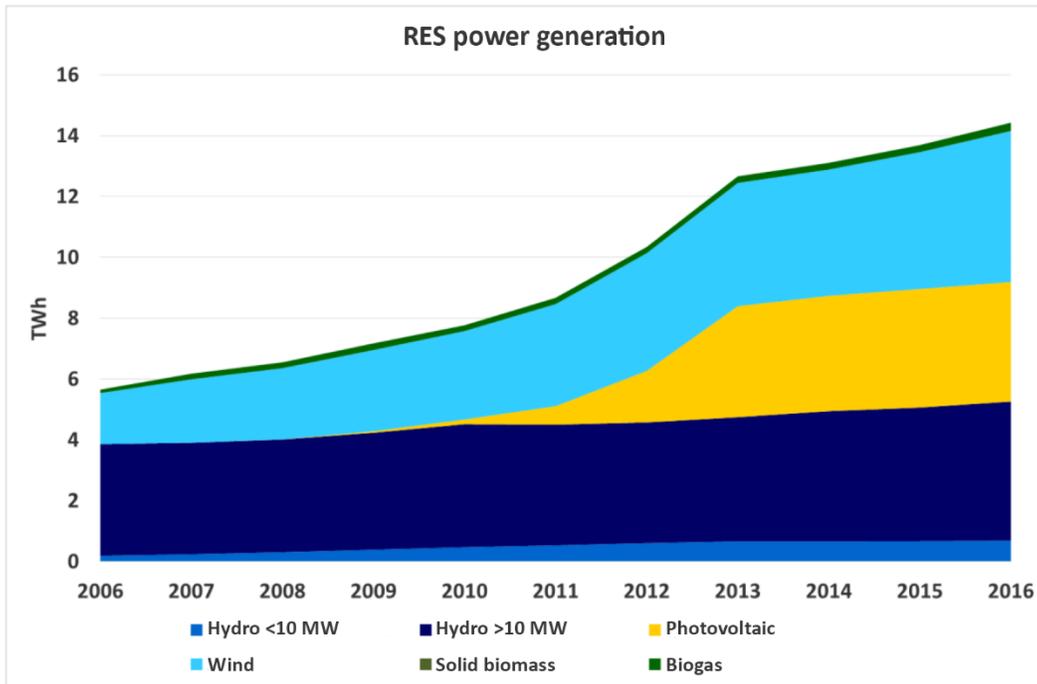


Chart 9: Total and specific RES shares in the domestic energy system on the basis of EU methodology.

The share of RES to the gross consumption of electricity in 2016 reached 23, 8 % by producing a tremendous growth compared to 2006, when the corresponding share was 9 %. It is noted that in the interests of comparability in terms of the share of RES, normalized production is taken into consideration regarding RES power plants with yearly strong seasonal and calendar power variations (i.e. wind power and hydro). Namely, historical data is taken into account regarding electricity generation per unit of installed capacity concerning RES technologies in the territory of Greece.

In absolute terms, RES power generation in the territory of Greece has already reached more than 25 % share in gross final consumption of electricity yearly, rendering its contribution to securing electricity requirements within Greece essential. In particular with regard to the electricity generation from RES with characteristics of non-controlled generation, i.e. electricity generation from photovoltaic and wind power stations, the percentage of this share is already more than 15 % in gross final consumption of electricity and is significantly higher than the corresponding market share at the level of the European Union.

It is also important to note that due to increased electricity generation from RES at the level of distribution network, the following phenomenon is already observed: in particular during the summer months the hours with the highest electricity demand at system level (8-10pm) are different from the hours with the highest total demand (2-3pm). In essence, the dispersed electricity generation from RES achieves to reduce the peak of the system's load in absolute figures. However, since this dispersed generation is primarily stochastic and variable, needs are created for flexible generation and management of electricity, because fluctuations may occur in the system's electricity demand curve requiring immediate cover of the demand as it is finally formed.



Graph 10: RES electricity generation in the period 2006-2016.

The RES share increase in electricity generation is mainly due to the installation of a large number of wind and photovoltaic parks observed especially after 2010, which was the combined result of the aid scheme applied to such investments, which was particularly attractive in financial terms, extremely in some specific categories of photovoltaic projects, as well as the rapid decrease of the installation cost especially for the photovoltaic stations.

The electricity generation from RES is now close to 15 TWh per year (Chart 10), and that from wind energy has already exceeded 5.5 TWh in 2017 in the Greek territory.

Electricity generation from wind parks corresponds to more than 35 % of total electricity generation from RES in the Greek territory, followed by electricity generation from large hydroelectric projects (refers to the hydroelectric plants which have installed capacity of more than 10 MW), followed by that from photovoltaic panels whose share is close to 27 %. The electricity generation from other RES technologies and other categories of projects in total is on average around 5 % of the overall RES electricity generation. The installed capacity of respectively RES stations (Chart 11) has increased significantly in recent years with significant growth of the solar power over the period 2011-2013 and at a steady increase in the wind power stations throughout the period this.

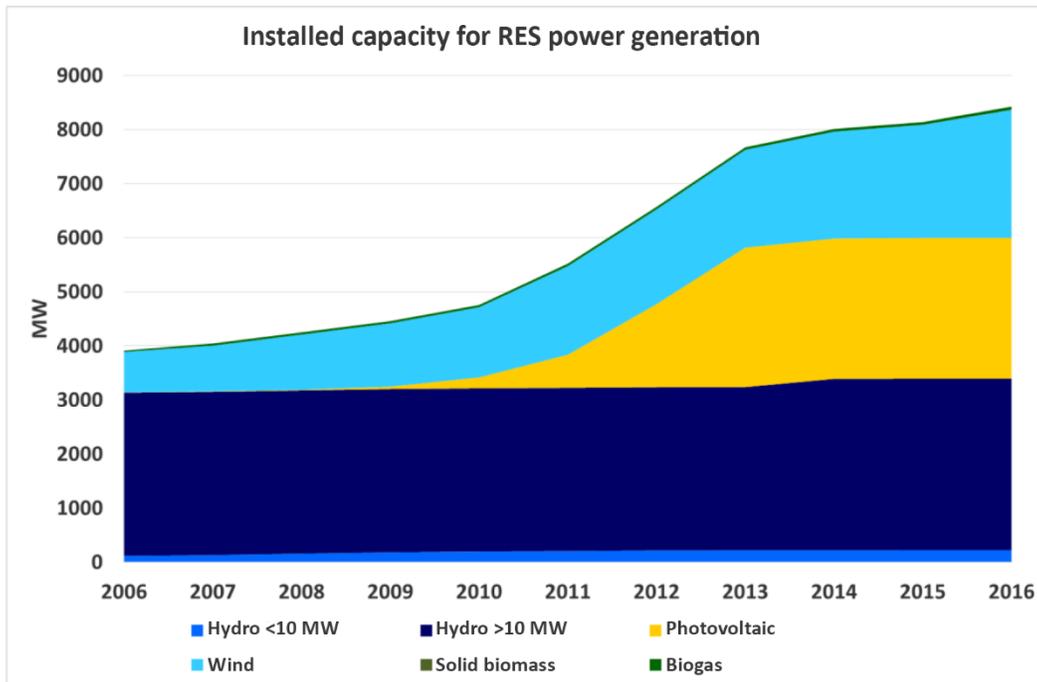


Chart 11: Installed capacity for RES electricity generation in the period 2006-2016.

Specifically, it should be noted that the development of wind power stations in Greece showed stable and sufficient figures of new annual installed capacity following 2006, with an average annual growth rate power for the period 2006-2016 standing at 12 %. With regard to the wind power stations, the last two years combined, 2016-2017, have been the years with the highest absolute growth of installed capacity, as more than 500 MW of new wind power stations were commissioned, while during 2018 the wind power stations appear to have greater installed capacity between RES technologies with more than 2750 MW, followed by photovoltaic stations of total installed capacity, regardless of system type and use, standing at 2650 MW.

Unlike the wind power and photovoltaic stations, the remaining RES technologies did not show considerable growth rates of capacity after the year 2010 and by the year 2014, with the total installed capacity of small hydroelectric power plants, biomass and biogas plants now rising to 307 MW. It should, however, be noted that even for these technologies in the period 2015-2018 a significant relative increase of their installed capacity is recorded, at approximately 15 %, indicating that there is a further potential for the development of RES technologies for electricity generation beyond wind power and photovoltaic plants. It should be noted that the installed capacity of large hydroelectric power stations includes the capacity of pumped storage stations, amounting to 699 MW. It is noted that for the calculation of RES electricity generation, the figures set out do not take into account the electricity generation produced by pumping.

The particularly positive and increasing growth rates of the total RES technologies for electricity generation from the year 2015 shall be attributed to a large extent to the new operating support scheme, which radically redefined the operating and support framework to the newly commissioned RES power plants (detailed description included in the relevant section of chapter 3). Over time, the RES support system of electricity generation in question, constituted the dominant factor in the development of new RES projects, in addition to the large hydropower plants, while its adoption followed the European and national goals set per period as regards their involvement in the gross final consumption of electricity.

It is noted that, regarding both the new wind power and the new photovoltaic stations, the differential costs of operating aid are less than € 25/MWh (approximately 20 % of the average cost of the RES operating units) paving the way to a brand new period in relation to the operation of these stations which, in turn, will be taking place with the smallest possible financial support at the expense of society and gradually without any support at all, within highly competitive market conditions.

In addition to the electricity generation sector, the RES contribution to covering the needs for heating at the level of final consumption of energy increased significantly during the period 2006-2016 rising to 24.2 % in 2016. The RES contribution in final consumption of energy for heating recorded the highest absolute value in the year 2012 with 1492 ktoe while the highest relevant share amounted to 26.8 % as reported in the year 2014. Overall, this share has now been stabilised at around 25 %, thus substantially surpassing even the respective national indicative goal for 2020 set at 20 %.

In accordance with the figures shown in Chart 12, which refer to the period 2010-2016 as there is no previous official energy data for the contribution of heat pumps, solid biomass is the main RES form to cover heating needs, yet fluctuating strongly as regards its utilisation during the period considered (maximum share of RES energy produced for heating 79 % in 2012 and a minimum of 66 % in 2016). In addition, the utilisation of solid biomass is predominantly focused on domestic combustion, while the use of solid biomass has been extended in urban centres over the last five years resulting to negative environmental effects (smog effect and high concentrations of suspended microparticles) due to the use of inappropriate raw material and open combustion heaters.

Thermal solar systems have consistently gained an important place among RES applications in the attempts to cover final consumption of energy for heating, since they maintain a dominant position being the technology which meets the needs of domestic hot water, while they show relatively modest rates of increase in their contribution (relative increase of around 9 % over the period 2010-2016 regarding electricity generation). Thermal solar systems are a technology of particularly high added value and with a high market penetration in Greece, which is one of the first countries worldwide as regards the installed surface of thermal solar systems per inhabitant, with total installed area estimated to amount to more than 4,5 million square metres of solar panels.

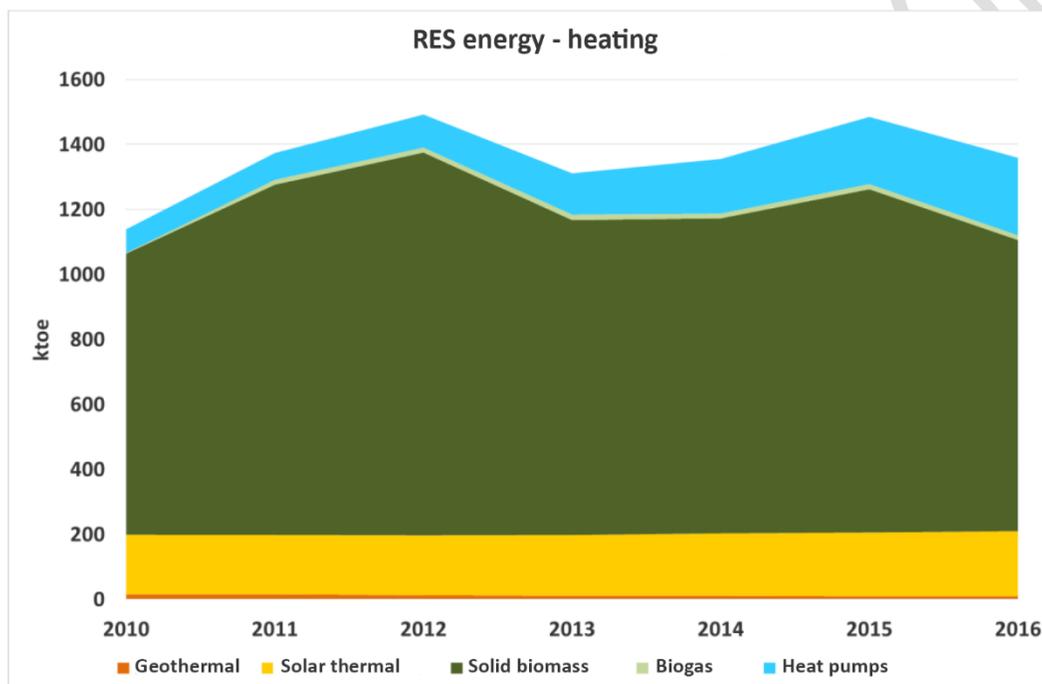


Chart 12: RES thermal energy generation in the period 2010-2016.

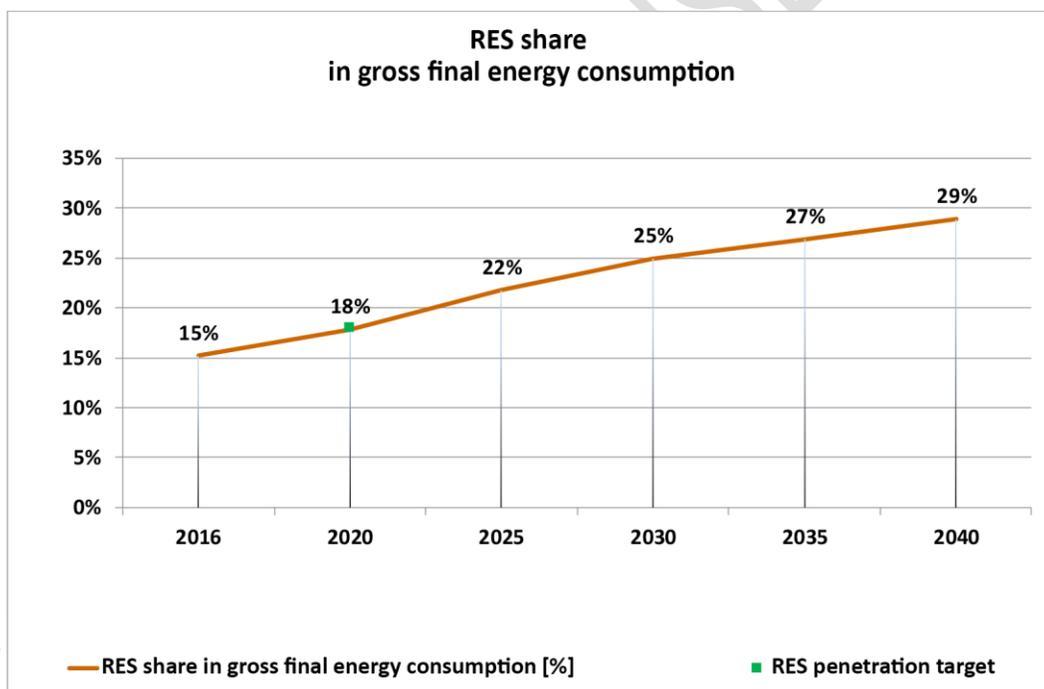
The increase of the share of heat pumps for heating is also impressive, since there was a significant growth rate in the same period (increase 229 % compared to 2010) by making heat pumps the RES technology with the next largest contribution to the final consumption of energy for heating purposes, after solid biomass. It is noted that the heat pumps with a high energy efficiency rate are taken into account as RES with energy contribution as it results from the part of the demand for energy they cover from the heat of the environment.

The contribution of geothermal energy to the coverage of the consumption of energy for heating remains constantly at low levels, with a greater contribution to the tertiary and the agricultural sector.

With regard to the contribution of RES to the consumption of energy in the field of road and rail transport, it ranges in relatively low levels, as in 2016 it was 1.7 % mainly due to the contribution of biodiesel. The contribution of electricity in final consumption of energy of the transport sector remains particularly low, while the contribution of bioethanol can be expected to lead to higher penetration rates until 2020, where it is assessed that participation of RES in final consumption of energy in the transport sector, in accordance with Directive 2009/28/EC, will exceed 5 %.

4.3.2.2 *Indicative forecast of developments in respect of existing policies for 2030 (with a view to 2040)*

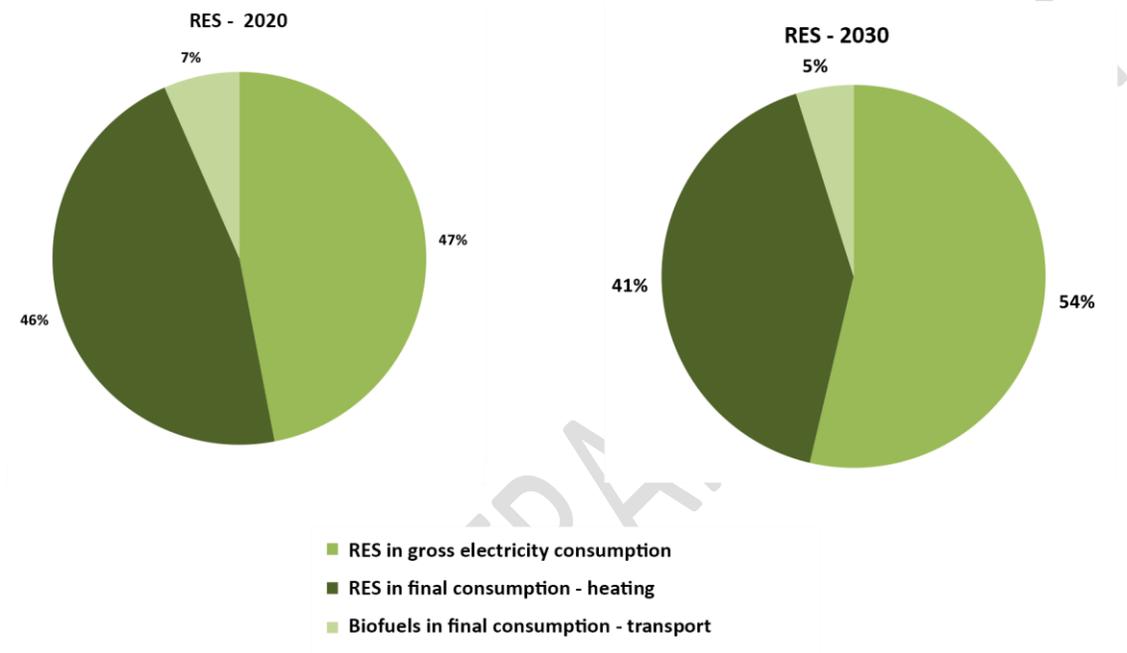
Graph 13 shows the development of RES penetration until 2040, reaching the objective set for the RES share in gross domestic consumption of energy for 2020, with its share reaching 18 %.



Graph 13: Development of market penetration of RES in gross final consumption of energy until 2040 for the scenario of existing policies and measures.

The share of all RES in gross final consumption of energy is formed by three components, the contribution of RES to the gross final consumption of electricity, the contribution of RES to the final consumption for heating and cooling, and finally, the contribution of biofuels to the final consumption for transport. It is noted that for the contribution of RES to heating and cooling, the bioenergy,

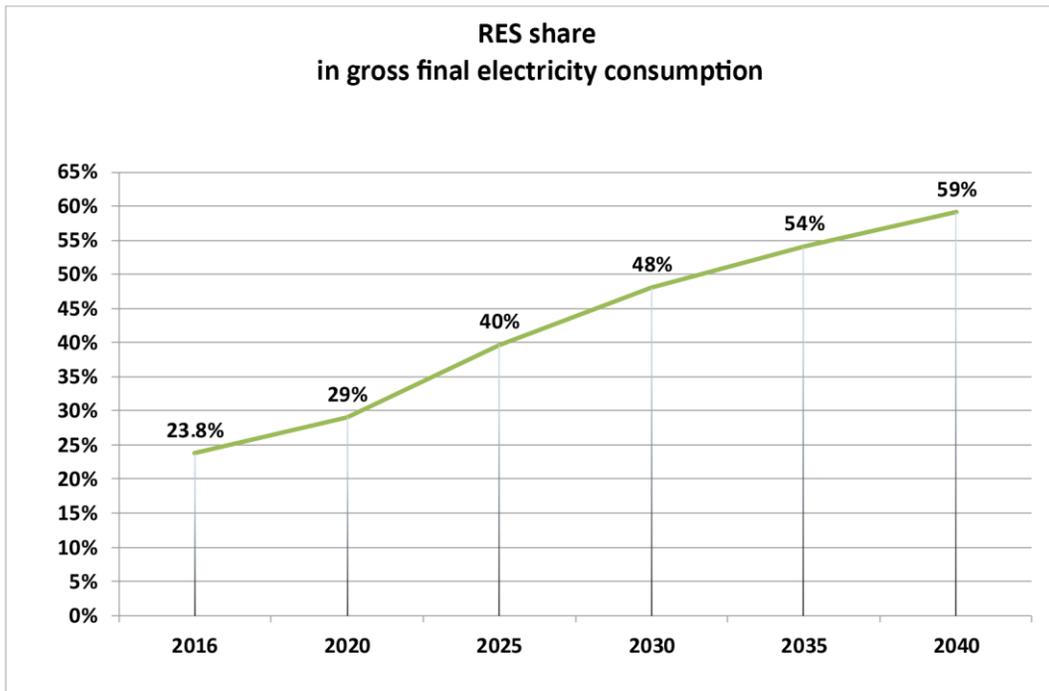
geothermal energy, thermal solar panels, and the ambient heat used for the operation of heat pumps²² are taken into account. Electricity from RES consumed by the various heating technologies, including heat pumps, is not included as it is already included in the RES contribution to the gross final consumption of electricity. Graph 14 presented the shares of these three components for 2020 and 2030 in the total of RES in gross final consumption of energy, and RES for electricity have the biggest share, i.e. 47 % in 2020 and 54 % in 2030.



Graph 14: RES share per sector in total RES penetration in gross final consumption of energy in 2020 and 2030 in scenario of existing policies and measures.

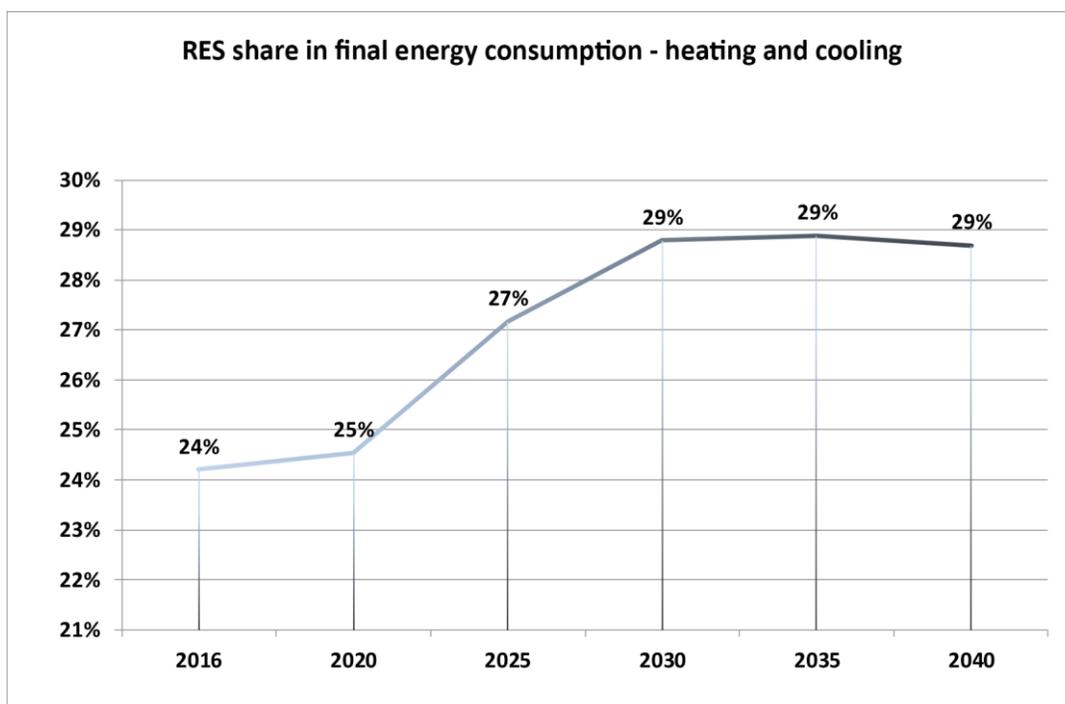
²² Refers to their operation for covering heating needs. It is noted that while these systems are used, no methodology has been issued by the EU for the counting of their share as contribution of RES, in accordance with the provisions of the Renewable Energy Directive which makes reference to the contribution of RES to heating and cooling. In particular for Greece, with the specific domestic climatic conditions and requirements in cooling, the application of the relevant methodology is of significant importance, because specific policies and measures can be taken in this framework, and the counting of this contribution is deemed necessary if specific technical criteria are fulfilled, and there should be no further delays.

In particular, Graph 15 shows the development of the RES penetration in gross final consumption of electricity, which amounts to 48 % for 2030 with the utilisation of all commercially mature technologies. It is noted that in 2016, this indicator was 24 %. The RES contribution to the gross final consumption of electricity is doubled in 2030 in comparison to 2016, with an average annual growth of approximately 2 percentage points.



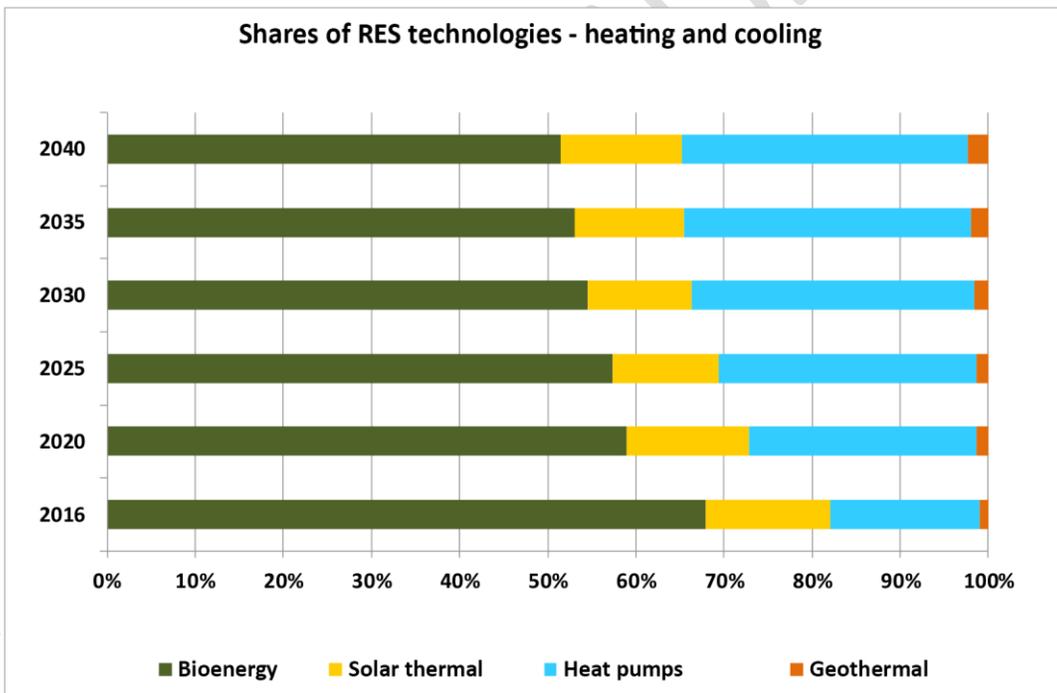
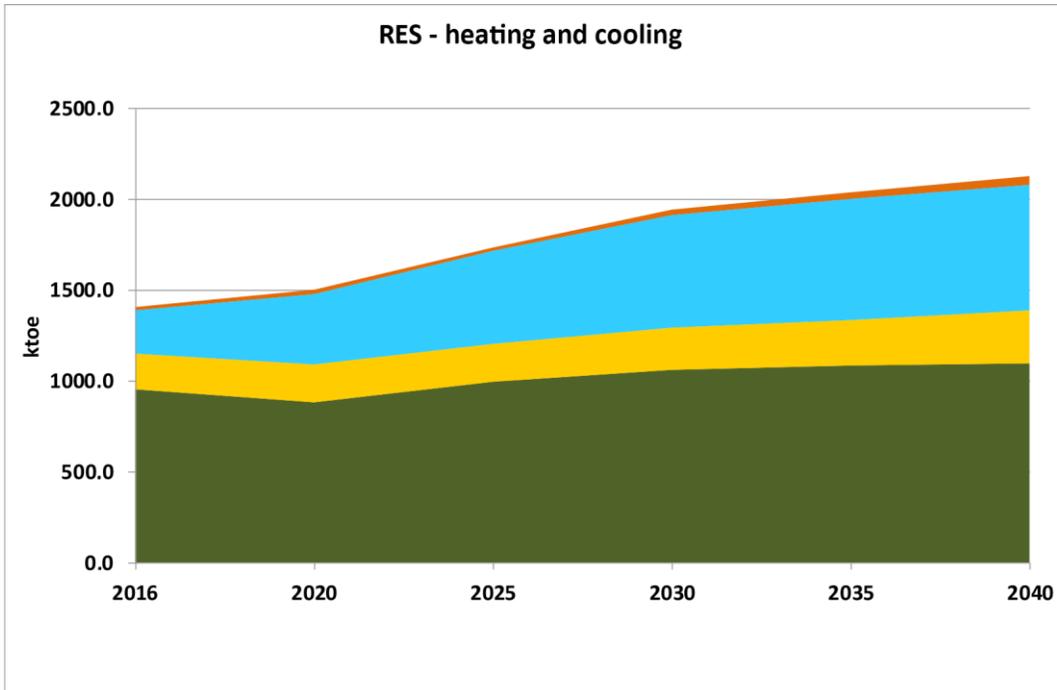
Graph 15: Development of market penetration of RES in gross final Consumption of Electricity until 2040 for the existing policies and measures scenario.

The development of RES penetration in the final consumption for heating and cooling is shown in Graph 16, where this percentage shows a moderate increase in comparison to 2016 and amounts to 25 % in 2020 and 29 % in 2030 with an average increase of almost 0.3 % per year.



Graph 16: Development of market penetration of RES in the final consumption of energy for heating and cooling until 2040 for the scenario of existing policies and measures.

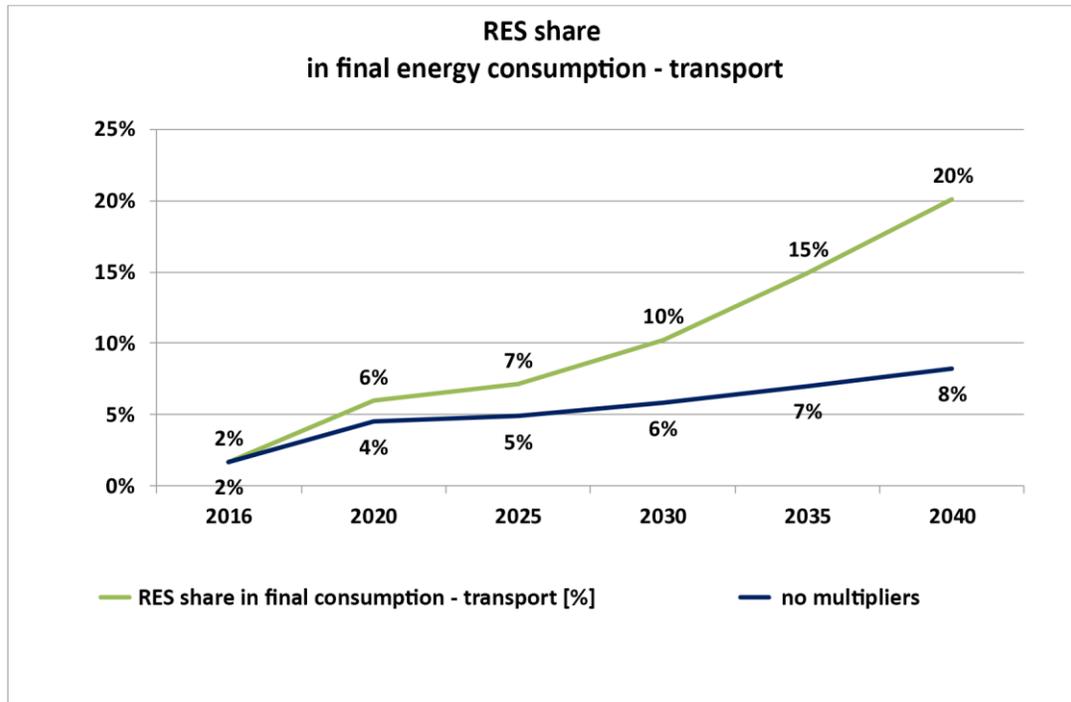
As shown in Graph 17, the use of bioenergy (primary solid biomass) for heating, shows a slight decrease in the next period until 2020, which is generally corresponding to the variations observed in its use during the recent years. In particular, the economic downturn of the previous years, in conjunction with the promotion of the use of solid biomass in urban areas have led to a historically high level of consumption of solid biomass, and in particular domestic firewood for heating. Thermal solar systems will continue to have a significant share in heating, mainly for domestic hot water in the building sector, but their share in total final consumption is not expected to differentiate significantly until 2030 (Graph 17). The use of heat pumps for heating purposes is expected to play a key role in the RES penetration in the final consumption by 2030, with their share in the contribution of RES to heating increasing from 17 % in 2016 to 26 % in 2020 and 32 % in 2030.



Graph 17: Development of RES shares for heating and cooling in the final consumption of energy until 2040 for the scenario of existing policies and measures.

Finally, the transport sector is characterised by significant increase of the RES share, mainly due to the penetration of biofuels and the considerable contribution of electricity, which is generated from RES to a great extent. Thus, according also to Graph 18, RES penetration will be 10 % in the final consumption of

energy for transport by 2030. It is noted that according to the revision of Directive 2009/28/EC on the promotion of RES, the calculation of RES share in transport shall include specific multipliers for the contribution of advanced biofuels and electricity from RES, so that the RES share appears greater than the actual, which amounts to the level of 6 %.



Graph 18: Development of market penetration of RES in the final consumption of energy for transport until 2040 for the scenario of existing policies and measures²³.

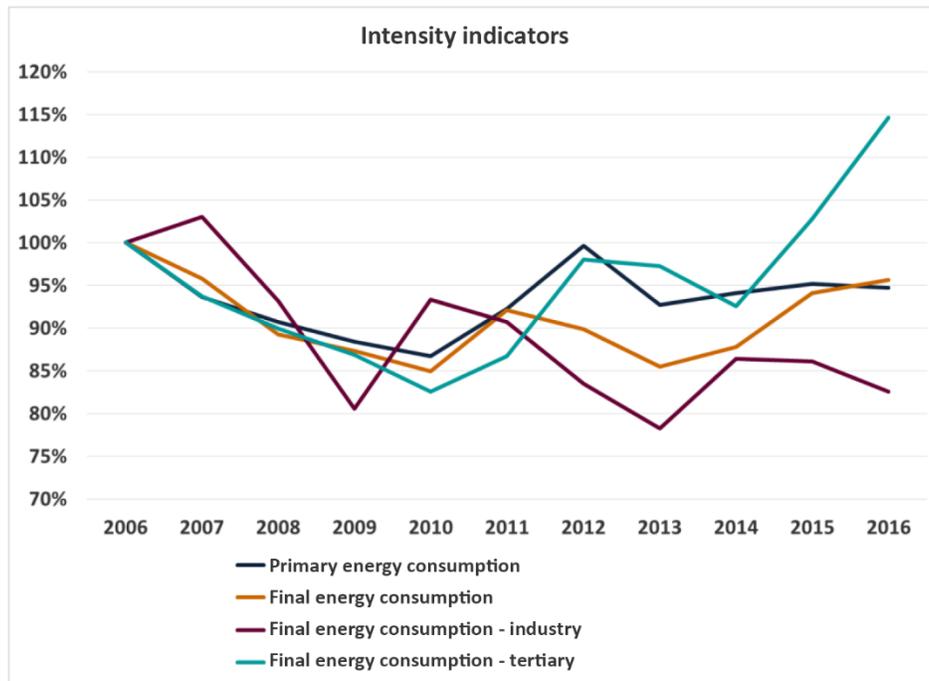
4.4 Energy efficiency dimension

4.4.1 Current primary and final consumption of energy in the economy and by sector

The reduction of final consumption of energy during the period 2006-2016 may be attributed to a number of factors, including the implementation of energy efficiency improvement measures. This effect is established by the development of consumption intensity indicators, which are depicted in Graph 19.

²³ The RES share in transport has been calculated as provided for in the revision of Directive 2009/28/EC on the promotion of RES, and includes specific multipliers for the contribution of advanced biofuels and electricity from RES.

More specifically, the primary consumption of energy, final consumption of energy and final consumption of energy in the industrial sector indicators have been respectively improved at 5 %, 4 % and 17 % for 2016 as compared to 2006 demonstrating the contribution of the policy measures applied. By contrast, the final consumption of energy intensity indicator for the tertiary sector has deteriorated.

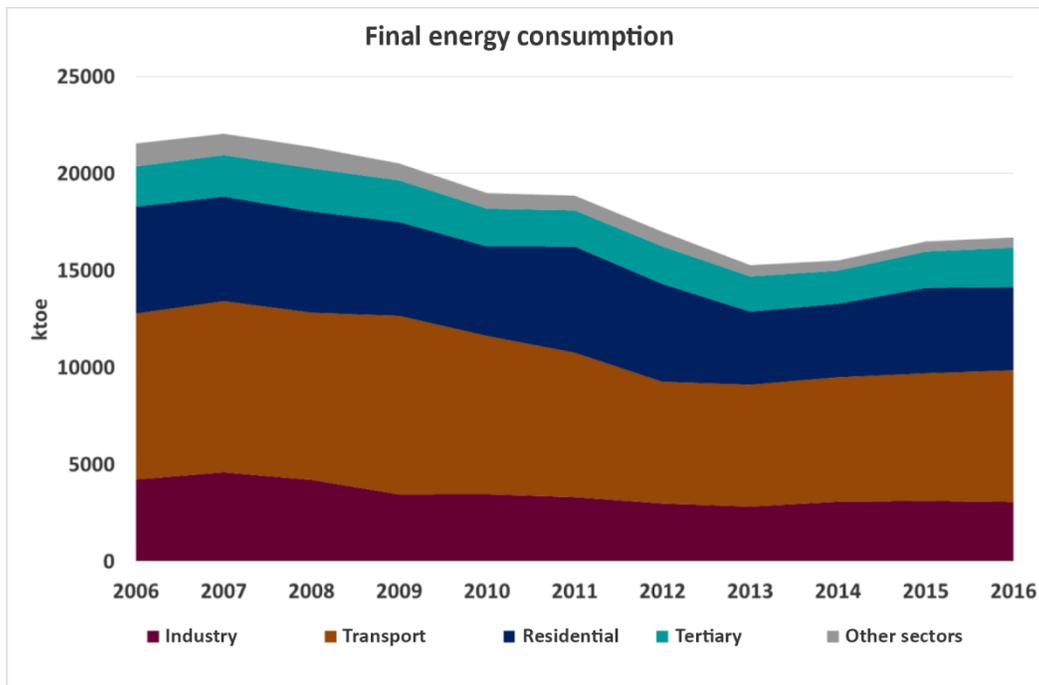


Graph 19: Development of primary and final consumption of energy intensity indicators during the period 2006-2016.

Reduction of final consumption of energy recorded for all end-use sectors during the period 2006-2016. The smallest reduction was detected in the tertiary sector (reduction of 2 %), while the reduction in other sectors ranged between 21 % - 27 % (Graph 20).

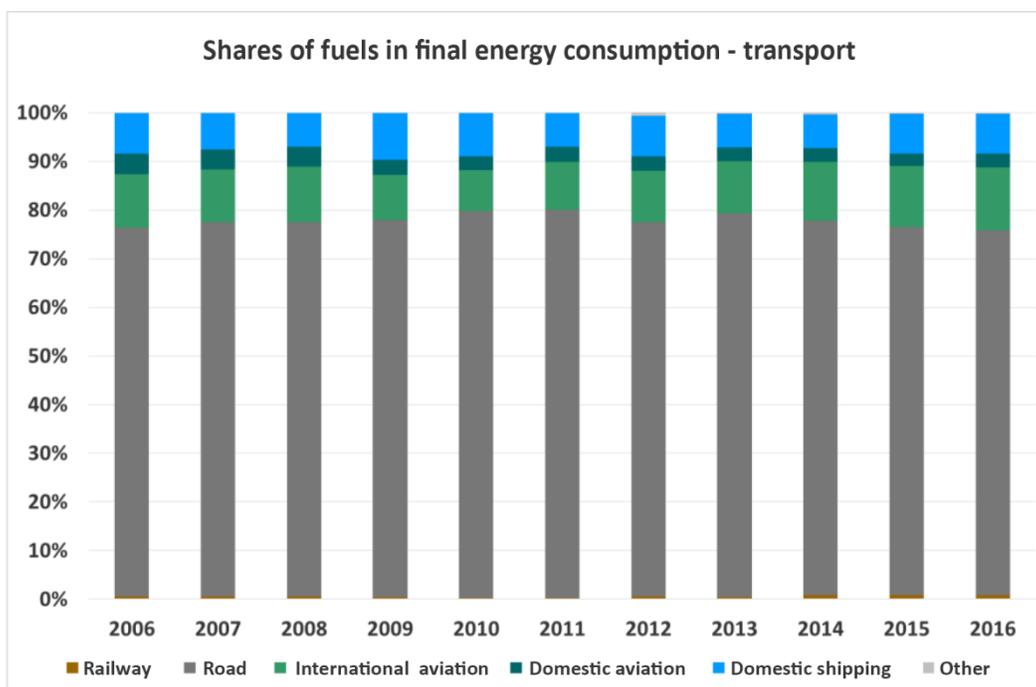
However, during the period 2013-2016 almost all end-use sectors showed an increase of the final consumption of energy. The biggest increase was found in the residential and tertiary sector (increase of 14 % and 12 % respectively), while the increase in the industrial sector and in the transport sector was 8 %.

For 2016, the transport sector has the largest contribution as a share to the final consumption of energy (41 %), while the participation of both the residential and the industrial sector (shares of 26 % and 18 % respectively) are also significant. Finally, the contribution of the tertiary sector is lower (12 %).



Graph 20: Development of final consumption of energy by sector of end-use for the period 2006-2016.

Road transport amounts to 75 % of the total consumption of energy in the transport sector, maintaining its share relatively unchanged compared to other types of transport during the period 2006-2016 (Graph 21). In addition, during this period the road transport showed a decrease of around 21 %, while showing a slight increasing trend during the period 2013-2016 (of 3 %). The shares of other types of transport are significantly lower, while the international aviation shows the highest contribution of the specific types of transport (13 %). Rail transport is the only type of transport which showed an increase of 16 % in the period 2006-2016 but with very low percentage of participation in the total of the sector (0.8 %).



Graph 21: Development of the contribution of different types of transport in the final consumption of energy in the sector for the period 2006-2016.

Graph 22 shows the contribution of the different types of fuels to the final consumption of energy during the period 2006-2016 in the industry, transport, in the residential and the tertiary sector.

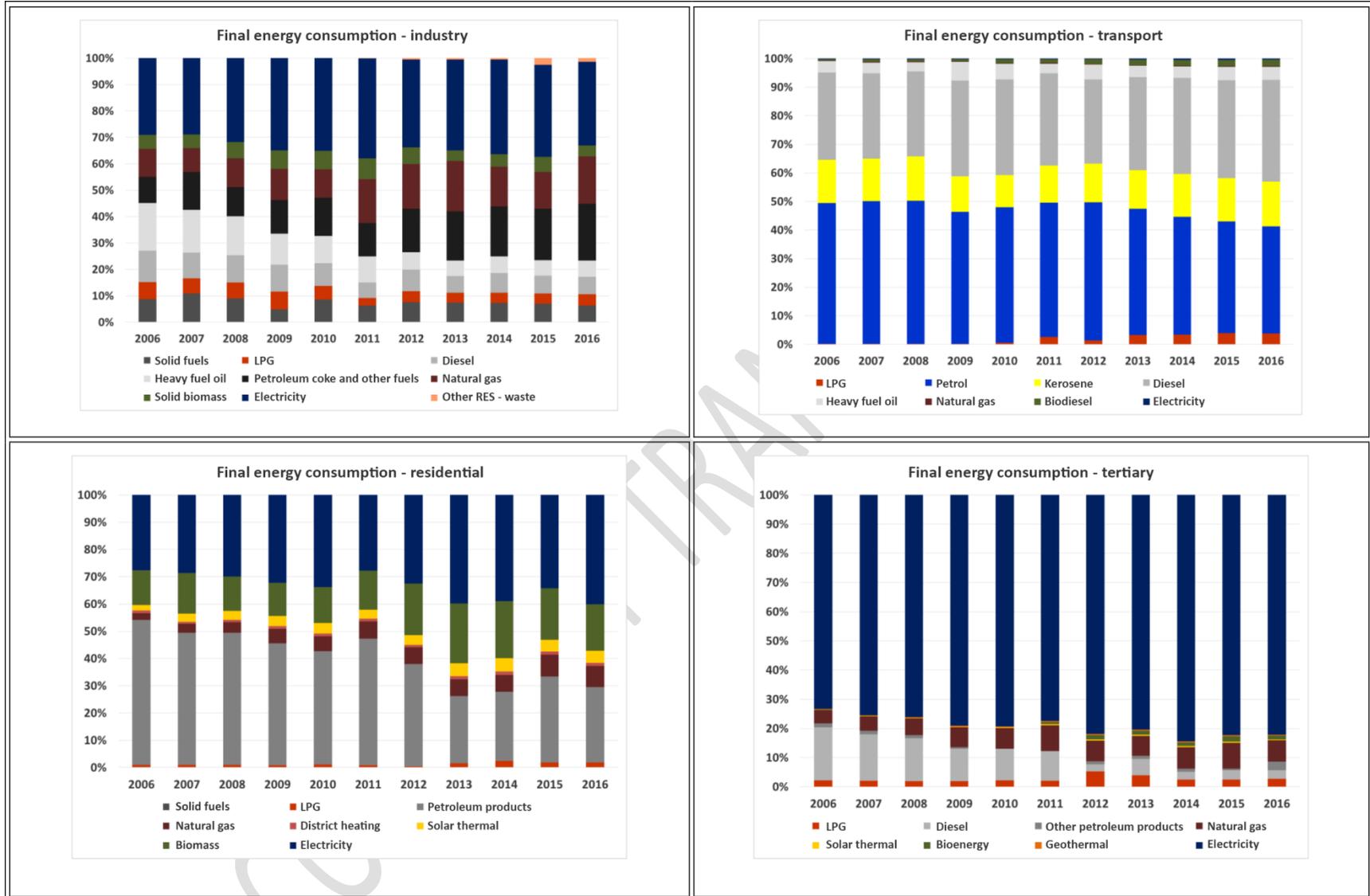
In the industrial sector, petroleum products retain the main share in the final consumption of energy, while the contribution of both electricity and natural gas is also significant. Natural gas has increased its participation in the period 2006-2016 at 24 %. Although the contribution of electricity has decreased in absolute figures, it has increased as a percentage of the total final consumption of energy. The participation of petroleum products decreased significantly over the period 2006-2016. However, the use of petroleum coke increased to 59 % in 2016 compared to 2006.

In the transport sector the penetration of alternative fuels (natural gas, electricity and biodiesel) is quite low, so these specific types of fuel represent only 3 % of the total final consumption of energy in the sector concerned in 2016. However, these types of fuel are characterised by a quite dynamic tendency after showing an increase over the period 2006-2016 (an increase of 32 % of natural gas, 51 % of electricity and 233 % of biodiesel). The petroleum products continue to be the main source of power in the transport sector, although there was a decrease of participation of 22 % during the period 2006-2016. However, LPG has significantly decreased and gasoline was significantly substituted by road diesel during the period 2013-2016, due the regulatory changes that have been applied in the transport sector.

In the residential sector, electricity, heating oil and biomass retain the highest shares in the final consumption of energy. The use of heating oil was significantly limited (decrease of 59 % during the period 2006-2016), while the penetration of natural gas and electricity increased (increase of 139 % and 13 % respectively). However, after the historically low percentages of consumption of heating oil in the residential sector in 2013, there is a relative increase in its consumption until 2016 (28 % increase over the period 2013-2016).

Finally, in the tertiary sector, electricity is the main type of fuel (82 % in 2016). In addition, the use of electricity increased both in total over the period 2006-2016, and in part during the period 2013-2016 (increase of 10 % and 14 % respectively).

COURTESY TRANSLATION



Graph 22: Development of the contribution of different types of fuel in the final consumption of energy for the period 2006-2016.

4.4.2 Current capacity for high-efficiency cogeneration and efficient district heating and cooling

The current capacity (technical and economic) for high-efficiency cogeneration and efficient district heating and cooling is reflected in the Comprehensive Implementation Capacity Assessment study for the high-efficiency cogeneration and efficient district heating and cooling of the Ministry of Environment and Energy.

Through this study, for the first time at national level there is an approximation of the possibility to meet the needs of heating and cooling in an energy-efficient manner. This approximation includes an assessment of the demand for heating and cooling in all economic activity sectors, the potential of high efficiency cogeneration, efficient district heating and the recovery of waste heat from industrial plants to meet this demand in a cost-effective way.

In order to determine the economic potential, the financial sustainability indicators are calculated through the economic analysis of energy-efficient generation and transportation systems of the thermal energy to substitute existing conventional generation systems for space heating and domestic hot water production. Geographically, the entire Greek territory is covered at municipal level, and the climatic conditions, the economic feasibility and the technical implementation capacity of the technologies under examination are taken into account.

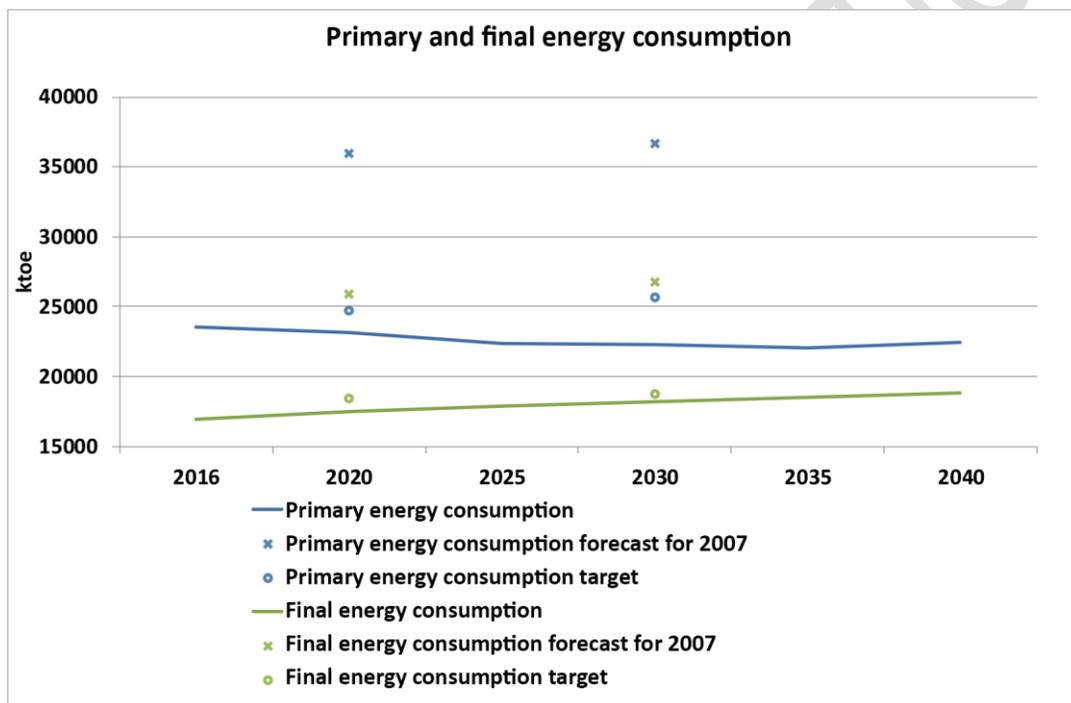
The technical capacity is determined based on the possible positions of disposal of waste heat (Thermal Power Stations, CHP Units, big Industries, or Industrial Areas), of the areas which have usable capacity of biomass and the areas adjacent to the natural gas transmission system.

In parallel, a cost-benefit analysis is also carried out at the level of society, taking into account the external costs and benefits resulting from the penetration of technologies of the scenarios under examination. In the cases where there is no economic potential, the amount of the funding gap remaining to have financially viable investments in these technologies is examined.

The study develops a set of scenarios in relation to the heat demand which is met by district heating and always a different technology or source of heat is use. Each scenario is evaluated against the baseline scenario, which relates to the current situation of heating and cooling generation by use of conventional technologies.

4.4.3 Forecasts taking into account existing policies, measures for the primary and final consumption of energy for each sector

In accordance with the estimates resulting from the scenario of existing policies and measures, the overall primary consumption of energy shows a moderate decrease until 2040, while, specifically for the years 2020 and 2030, it is achieved to have lower consumption compared to the respective targets, as shown in Graph 23. In parallel, a moderate increase of the final consumption of energy and its relative stabilisation is observed over the period from 2020 to 2030. As shown in Graph 23, in 2020 it is estimated that the final consumption of energy will be 5 % lower than the respective objective, while for 2030 the final consumption of energy will be 3 % lower than the respective objective.

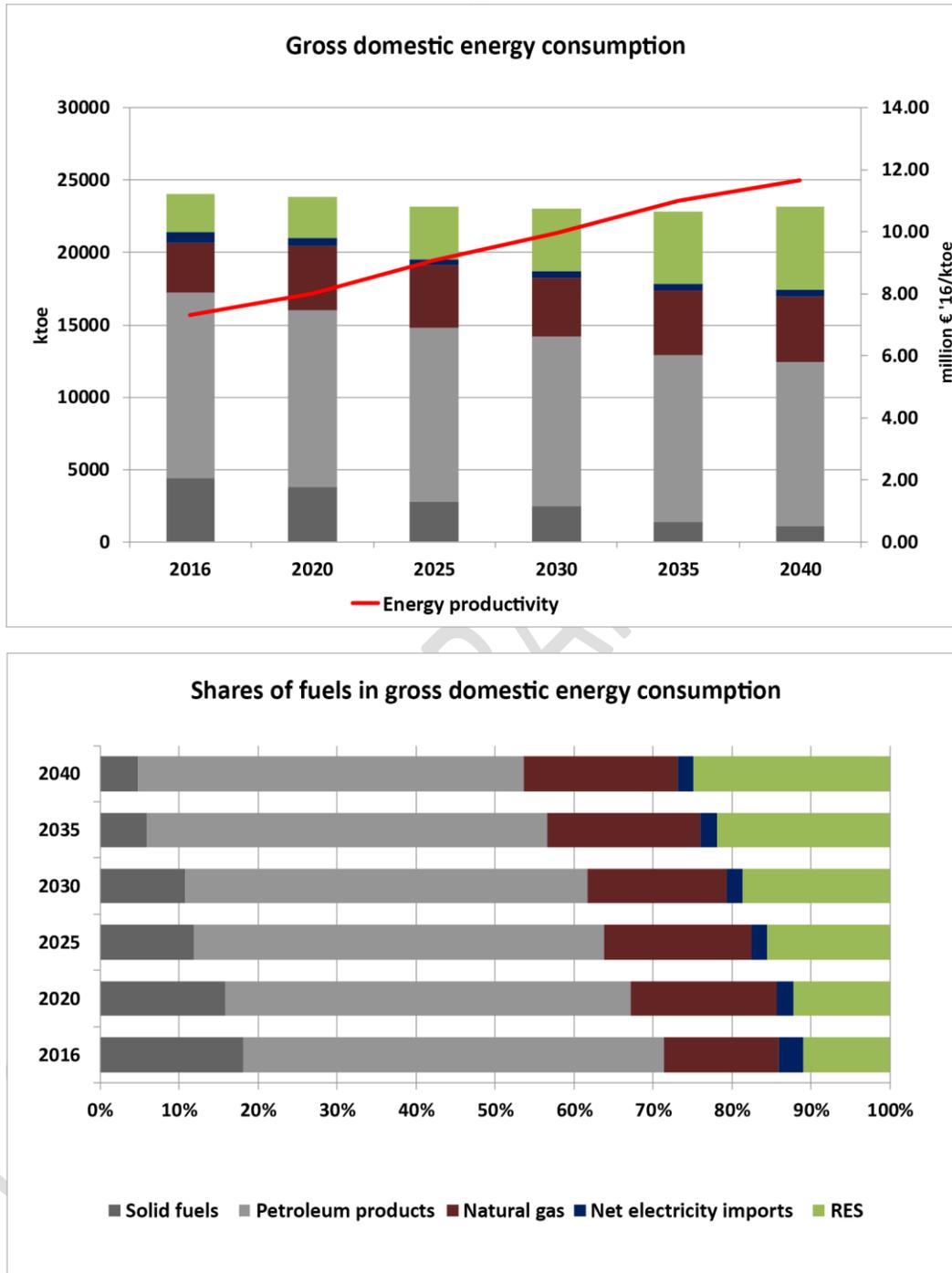


Graph 23: Development of primary and final consumption of energy until 2040 for the scenario of existing policies and measures.

In the energy system in total, taking into account the provisions of the scenario of existing policies and measures, the gross domestic consumption of energy shows a moderate decrease of 5 % in 2030 compared to 2016, which results in a significant improvement of the cost-efficiency of the energy sector, as shown by the development of the energy productivity indicator (Graph 24).

In particular, energy productivity shows an increase of 36 % in 2030 compared to 2016. In parallel, the domestic energy mix presents considerable changes, in particular from the increased penetration of RES. In particular, RES are increased by 63 % in 2030 compared to 2016, with their share being 19 % in 2030

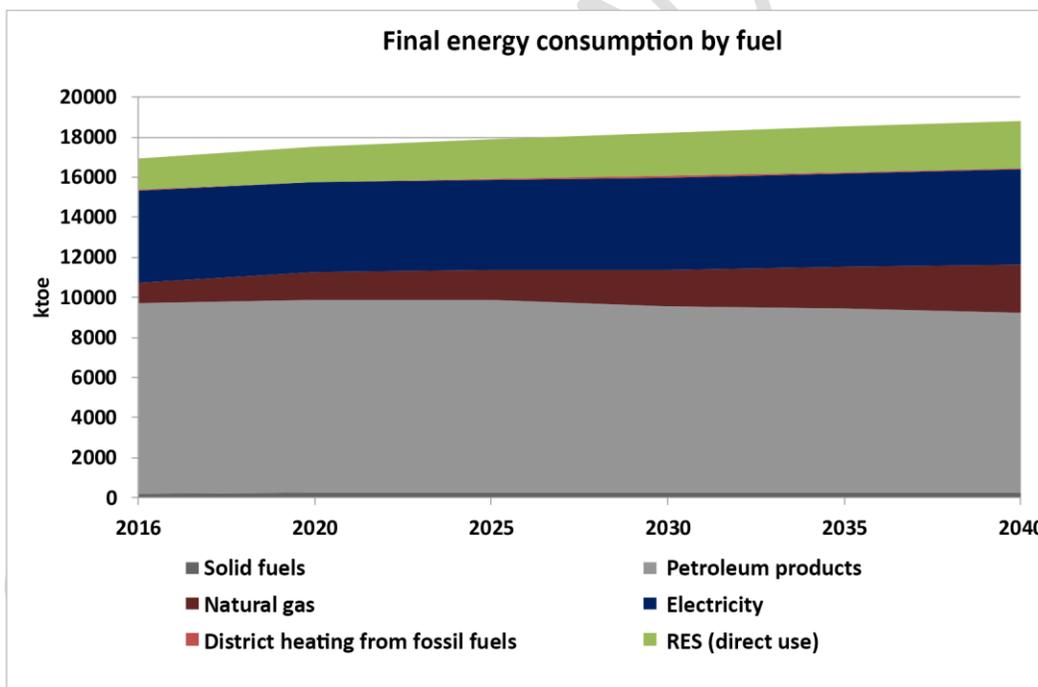
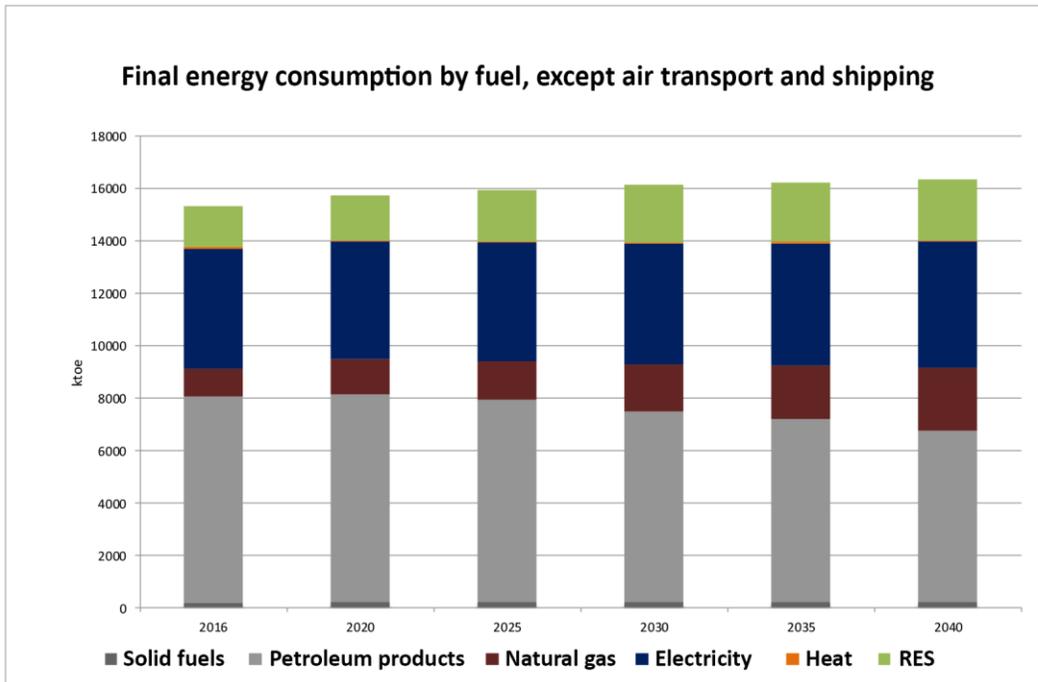
compared to 11 % in 2016, while the share of the solid fuels and oil products is reduced to 62 % in 2030, compared to 71 % in 2016 (Graph 24).



Graph 24: Development of fuels shares in the gross domestic consumption until 2040 for the scenario of existing policies and measures.

The final consumption of energy has a modest overall increase of 7.6 % in 2030, compared to 2016, which, in absolute terms, results in final consumption of energy of 17.5 Mtoe in 2020 and 18.2 Mtoe in 2030. However, the application of existing policies and measures in the fields of final consumption, especially in the building sector, as well as of the overall technological improvements at the level of energy efficiency of appliances, vehicles and the relevant energy consuming equipment in the end-use sectors, leads to the energy saving target being reached at the level of 32 % for both 2020 and 2030, compared to the development assessment for the final consumption for 2030 as reflected in 2007 (Graph 25).

COURTESY TRANSLATION



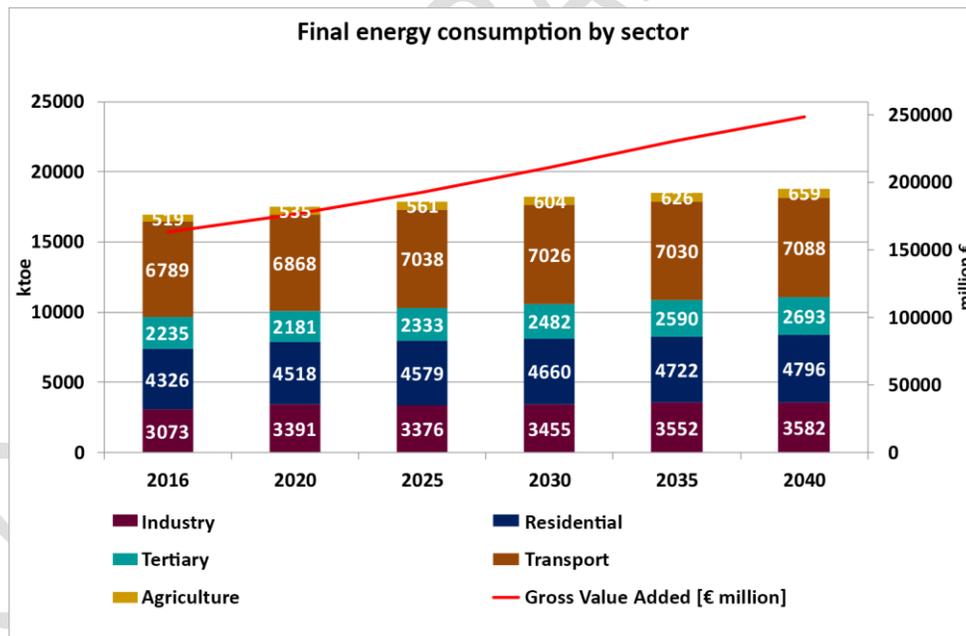
Graph 25: Development of the shares of the final consumption of energy fuels until 2040 (excluding aviation and navigation, b. total FEC).

It is worth noting that the energy saving target is achieved despite the fact that in the calculation of final consumption the ambient energy used from heat pumps is now included and considered as RES, whose amount was not taken into account in the relevant energy balances until 2016. It is noted that the total

final consumption of energy includes the consumption of the sub-sectors of transport related to aviation (national and international) and domestic navigation. For those sub-sectors, in the context of this text, there is no provision for the adoption of measures and policies to improve their energy efficiency and therefore, although they influence the final consumption of energy, they have a negative effect on the quantitative and qualitative capture of the efficiency of energy policy measures.

The graph below show the development of energy consumption in end-use sectors until 2030, taking into account assumptions regarding the development of demand in each end-use sector, based on the existing policies and measures (Graph 26).

Examining this development, it is found that final energy consumption will increase continuously until 2030, as also indicated by the development of economic figures, the available income of households and the added value of economic sectors, which determines the development of demand to the maximum extent. However, precisely due to the implementation of existing energy-saving measures and policies, and in view of the elasticity of demand, the growth rate of final energy consumption in relation to the year 2020 shall be limited significantly and be significantly lower than the added value growth rate, as shown in Graph 26.



Graph 26: Development of final energy consumption per sector in 2040 for the scenario of existing policies and measures.

More specifically, in the transport sector, which is traditionally related to the largest portion of final energy consumption, and despite the slight increase between 2016 and 2020, as a result of the gradual exit from the economic crisis, final energy consumption is maintained at 7.1 Mtoe in the period 2020-2030.

The building sector in 2030 shows a moderate increase in energy consumption in the household sector (by 8%) and higher increase in the tertiary sector (by 11%).

In the residential sector, gas and electricity still hold the largest market shares in final consumption, with a total rate of 62 % in total final consumption in the residential sector in 2030, while the share of natural gas is increased in relation to the current levels, and the increase of the respective shares of heat pumps and geothermal systems is much more moderate.

In the tertiary sector the increase of the total demand foreseen, is expected to be covered mainly by heat pumps and natural gas, whereas a decrease in oil consumption is also expected.

The transport sector as a whole presents only minor variations compared to 2016, in accordance with the scenario of existing policies and measures. Although a significant penetration of biofuels is foreseen for the period until 2030, the use of oil products remains essentially stable until 2030, with their share slightly declining and remaining almost at 95 % in 2030. Accordingly, the electricity is more apparent in the mix of transportation with a minor share of around 1 % in 2030.

In the industry during the period 2016-2030, and in accordance with the scenario of existing policies and measures, there is a small increase of final consumption of energy, mainly due to the expected development of economic aggregates and the added value of the economy sectors. In particular there is an overall increase in consumption of energy by 12 % in 2030 in comparison to 2016, with small variations in the individual shares of energy products.

4.4.4 Cost-optimal levels of minimum energy performance requirements resulting from national calculations

The result of the cost-optimal calculations is to determine the minimum energy performance requirements for buildings and their comparison with national requirements established by Regulation on the Energy Performance of Buildings (KENAK). The minimum requirements of KENAK have three main axes: a) the overall design of the building (e.g. location, orientation, surrounding area), b) the building envelope i.e. the thermal characteristics of the components of the envelope and c) the technical systems regulating the indoor heating comfort.

In accordance with the 2nd report on the determination of cost-optimal minimum energy performance requirements (July 2018), the results of the cost-optimal study are produced from the application of the macroeconomic perspective, i.e. taking into account the costs and benefits of the investment in energy efficiency to the community, which differentiate, inter alia, according to the construction time.

The grouping of the buildings into two categories was selected: the existing ones (i.e. whose building permits were issued before KENAK 2017 entered into force) and the new ones (whose building permits were issued after KENAK 2017 entered into force).

For existing buildings subject to major renovation, the minimum envelope thermal insulation requirements have not been amended, since they were determined by KENAK 2010, while for new buildings stricter requirements of energy performance were provided, in relation to the existing buildings, which improve the thermal insulation of the envelope. Both categories of buildings must follow the same minimum requirements for technical systems.

KENAK describes the methodology for calculating the consumption of energy of the buildings in order to assess the energy performance of those, under which the energy performance certificate is issued (EPC), which is used as a national comparison method for the energy consumption in buildings.

For the calculation of the energy performance of buildings the Greek territory is divided into 4 climate zones (A, B, C and D – the order of the letters goes from the warmest to the coldest) on the basis of the heating degree-days.

The results of the cost-optimal calculations in the sense of minimum energy performance requirements have been compared with the statistics for the consumption of energy of residential and tertiary buildings per climate zone and energy efficiency class, of the electronic Record of the Building-Inspection Service (according to the EPCs), after the Energy Inspection Divisions of the Ministry of Environment and Energy processed them and performed a sensitivity analysis.

A sensitivity analysis of the information (degree of confidence: 95 %) resulted in the following ranges of values of primary energy consumption in energy categories B to A+ (Table below). All values follow a normal distribution.

Table 37: Range of values of the amounts of energy consumed in energy categories B to A+

Energy category	Amounts of primary energy consumed by residential buildings per climate zone (kWh/m ² a)			
	A	B	C	D
A+	11 - 25	14 - 35	10 - 44	17 - 36
A	18 - 56	21 - 55	26 - 74	54 - 88
B+	32 - 81	31 - 99	45 - 125	37 - 128
B	45 - 112	56 - 126	72 - 172	63 - 184
Energy category	Amounts of energy consumed by tertiary sector buildings per climate zone (kWh/m ² a)			
	A	B	C	D
A+	12 - 77	14 - 91	52 - 69	30
A	65 - 185	41 - 114	68 - 119	82
B+	98 - 218	60 - 196	99 - 218	105 - 156
B	133 - 266	115 - 245	120 - 280	149 - 218

For the cost-optimal study various combinations of measures on the improvement of energy characteristics of the building envelope, the integration of the efficient technical building systems and the use of renewable energy on site, such as the installation of solar panels, the production of domestic hot water and heating by solar support as well as the installation of heating/cooling systems using heat pumps were used. It is noted that for new buildings that are designed according to the specifications of KENAK, there is an obligation to integrate at least one passive solar system such as: direct solar gain (southern exposures), mass wall, Trombe wall, solar area (greenhouse).

It is also important to indicate that there is potential for further energy saving, by means of passive systems, and by applying the principles of bioclimatic design.

According to the report on the determination of cost-optimal levels of minimum energy performance requirements, the best energy related interventions that can be made in a typical building together with a cost-benefit analysis, contribute to the following significant energy saving.

Table 38: Average consumption and primary energy saving and for the standard “individual house”

INDIVIDUAL HOUSE						
Period	Climate zone	Average primary energy consumption according to the EPC (kWh/m ² .a)	Primary energy consumption according to cost optimal (kWh/m ² .a)	Difference (%) (1) - (2)	Average primary energy consumption with 40 % saving (kWh/m ² .a) (1) x 60 %	Average primary energy consumption with 60 % saving (kWh/m ² .a) (1) x 40 %
		(1)	(2)	(3)	(4)	(5)
1955-1980	A	546.7	184.7	66.2 %	328.0	218.7
	B	623.6	190.3	69.5 %	374.2	249.4
	C	971.6	187.5	80.7 %	583.0	388.6
	D	1108.8	203.8	81.6 %	665.3	443.5
1980-2000	A	321.4	128.0	60.2 %	192.8	128.6
	B	363.0	177.3	51.2 %	217.8	145.2
	C	545.8	246.2	54.9 %	327.5	218.3
	D	619.7	229.6	62.9 %	371.8	247.9
2000-2010	A	251.8	128.0	49.2 %	151.1	100.7
	B	282.4	120.9	57.2 %	169.4	113.0
	C	422.2	122.9	70.9 %	253.3	168.9
	D	476.0	257.0	46.0 %	285.6	190.4
2010-2017	A	139.7	73.4	47.5 %	83.8	55.9
	B	153.5	81.6	46.8 %	92.1	61.4
	C	250.0	129.1	48.4 %	150.0	100.0
	D	281.7	151.0	46.4 %	169.0	112.7

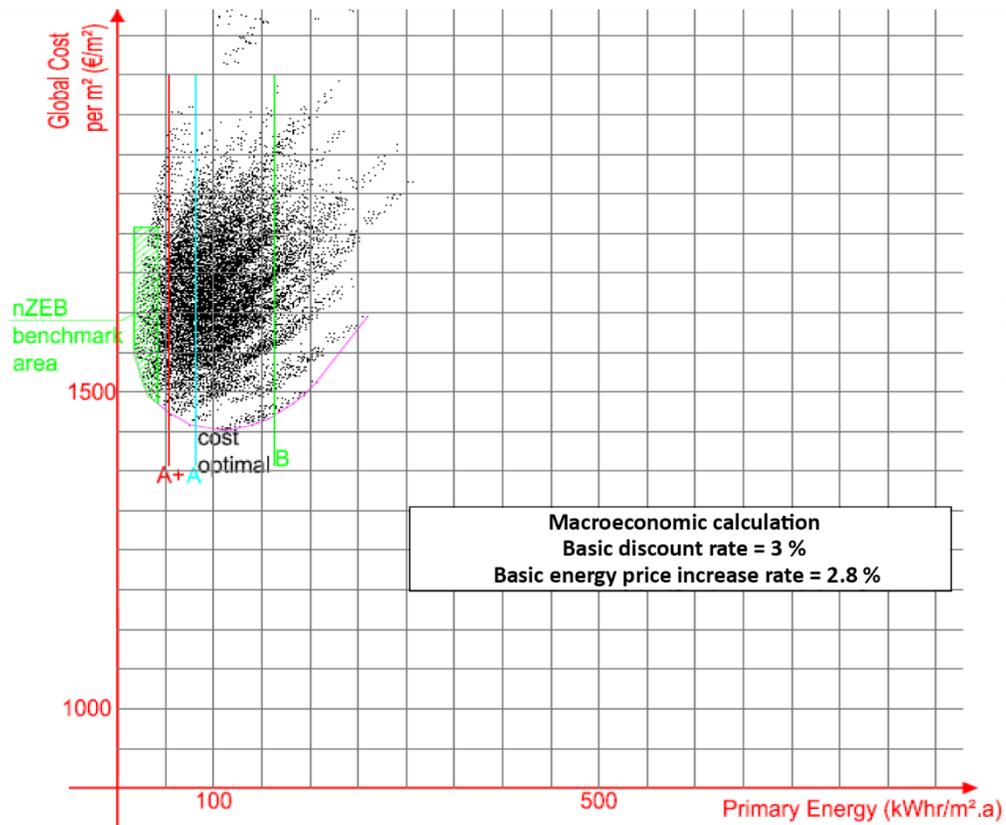
Table 39: Average consumption and primary energy savings for the standard “3-storeyed building”

3 STOREYED BUILDING IN CONTACT WITH NON HEATED SPACE						
Period	Climate Zone	Average primary energy consumption according to the EPC (kWh/m2.a)	Primary energy consumption according to cost optimal (kWh/m2.a)	Difference (%) (1) - (2)	Average primary energy consumption with 40 % saving (kWh/m2.a) (1) x 60 %	Average primary energy consumption with 60 % saving (kWh/m2.a) (1) x 40 %
	(1)	(2)	(3)	(4)	(5)	(1)
1955-1980	A	295.1	82.4	72.1 %	177.1	118.0
	B	342.0	100.0	70.8 %	205.2	136.8
	C	542.5	122.3	77.5 %	325.5	217.0
	D	608.6	137.2	77.5 %	365.2	243.4
1980-2000	A	182.9	86.9	52.5 %	109.7	73.2
	B	203.6	100.8	50.5 %	122.2	81.4
	C	295.8	124.9	57.8 %	177.5	118.3
	D	310.1	140.2	54.8 %	186.1	124.0
2000-2010	A	149.9	94.2	37.2 %	89.9	60.0
	B	165.9	93.4	43.7 %	99.5	66.4
	C	241.7	142.3	41.1 %	145.0	96.7
	D	274.0	162.2	40.8 %	164.4	109.6
2010-2017	A	89.9	77.1	14.2 %	53.9	36.0
	B	101.9	88.0	13.6 %	61.1	40.8
	C	167.8	121.0	27.9 %	100.7	67.1
	D	181.6	159.3	12.3 %	109.0	72.6

Table 40: Average consumption and primary energy savings for the standard “multi-storeyed office building”

MULTI-STOREYED OFFICE BUILDING						
Period	Climate zone	Average primary energy consumption according to the EPC (kWh/m2.a)	Primary energy consumption according to cost-optimal (kWh/m2.a)	Difference (%) (1) - (2)	Average primary energy consumption with 40 % saving (kWh/m2.a) (1) x 60 %	Average primary energy consumption with 60 % saving (kWh/m2.a) (1) x 40 %
		(1)	(2)	(3)	(4)	(5)
1955-1980	A	446.6	101.8	77.2 %	268.0	178.6
	B	484.7	111.8	76.9 %	290.8	193.9
	C	530.5	120.4	77.3 %	318.3	212.2
	D	575.0	127.5	77.8 %	345.0	230.0
1980-2000	A	363.8	96.5	73.5 %	218.3	145.5
	B	393.3	104.6	73.4 %	236.0	157.3
	C	423.8	115.1	72.8 %	254.3	169.5
	D	452.8	121.4	73.2 %	271.7	181.1
2000-2010	A	361.3	137.6	61.9 %	216.8	144.5
	B	381.2	149.5	60.8 %	228.7	152.5
	C	414.8	167.6	59.6 %	248.9	165.9
	D	442.9	178.1	59.8 %	265.7	177.2
2010-2017	A	277.4	131.0	52.8 %	166.4	111.0
	B	285.7	140.7	50.8 %	171.4	114.3
	C	285.3	152.5	46.5 %	171.2	114.1
	D	290.9	159.2	45.3 %	174.5	116.4

Below there is an indicative graph for a set of scenarios:



Graph 27: NZEB zone delimitation in the scenarios cloud for the new standard building, of climate zone C (Graph shows the total costs in relation to the primary energy consumption)

Starting from 2021 all new or fully renovated existing buildings should satisfy the minimum requirements for nearly zero energy buildings (NZEB), which will lead to further improvement of the energy efficiency of the building sector.

Analysing the scenarios under examination for the delimited NZEB areas from the clouds of executed scenarios of the cost-optimal study, and taking into account the provision for the participation of RES in the building sector, in order for a building to qualify as a Nearly Zero Energy Building it must:

- a) be classified at least in the energy efficiency class A, if it is a new building,
- b) be classified at least in the energy efficiency class B+, if it is an existing building.

In the above categories, the numeric indicator of the consumption of primary energy is the one resulting from the application of KENAK.

The cost-optimal levels of minimum energy performance requirements, shall be reviewed in 2020.

4.5 Energy security dimension

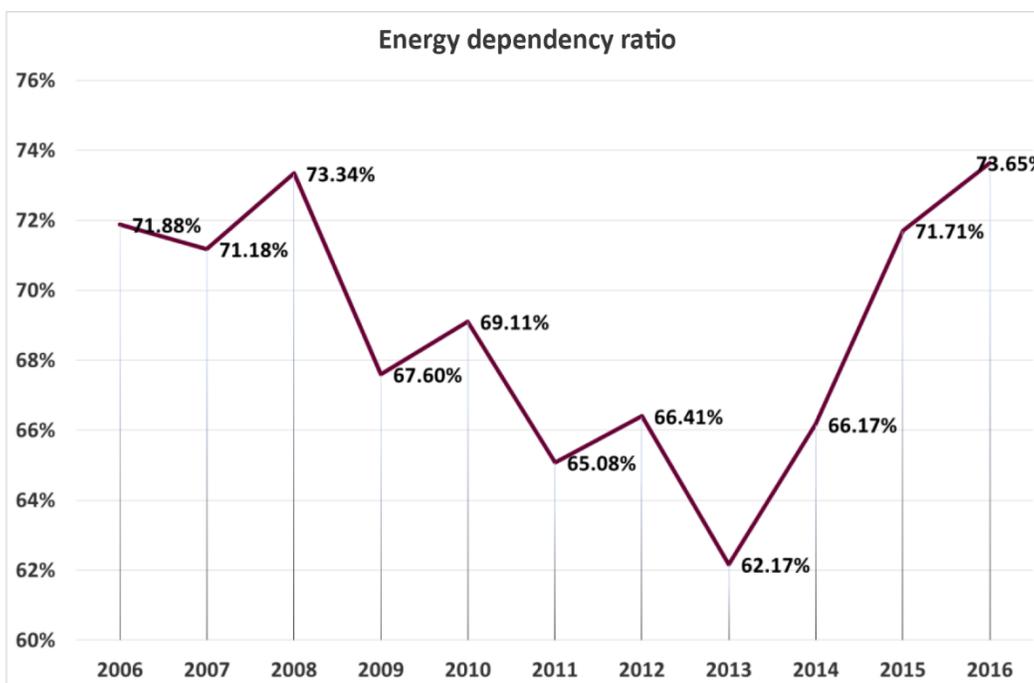
4.5.1 Current energy mix, domestic energy sources, dependence from imports

The energy system at EU level is characterised by high energy dependency and therefore, its decrease is a key objective under the Energy Union. Respectively, at the Member States level, the monitoring of the energy dependency indicator, especially if it results from imports from third countries outside the EU, is essential as it is directly related to energy supply security.

The energy dependency of Greece is high mainly due to the import of almost all primary oil and gas consumption, representing the biggest share of gross domestic consumption of energy. The energy dependency indicator²⁴ has been historically close to 70 %. With 73.6 % for 2016, the country has a higher indicator than the corresponding one at EU level (54 %) or at Eurozone level (61.9 %). The average indicator between the 19 Eurozone Member States is 65.1 % and Greece, together with Portugal is in order No 12 and 13.

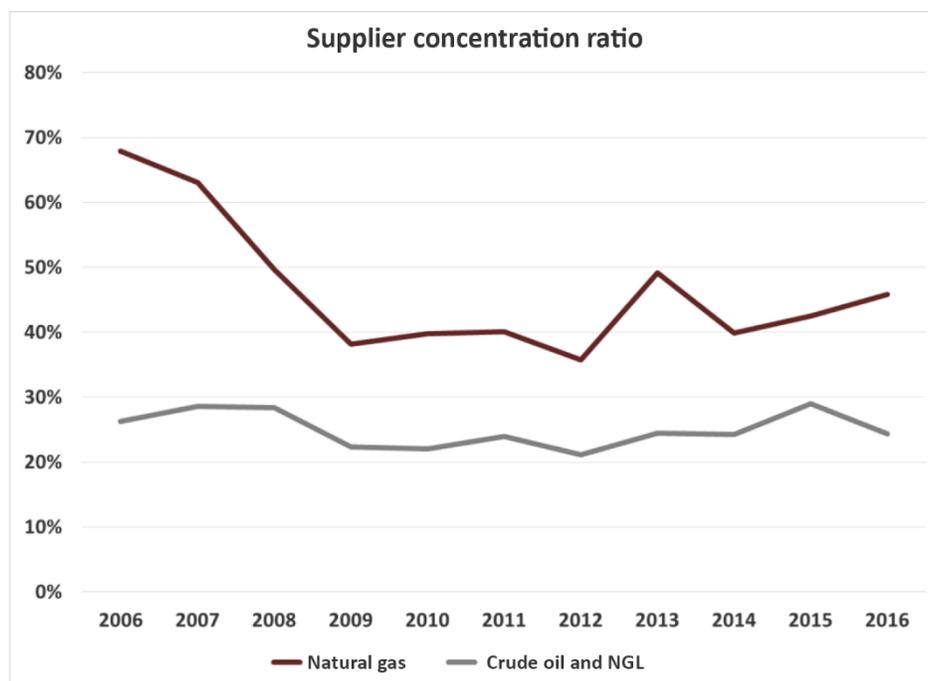
The development of the energy dependency indicator for the period 2006-2016 is reflected in Graph 28. The increase of the indicator in the last few years is directly related to the corresponding sharp reduction in the use of domestic lignite in electricity generation. In addition, the reduction in the relevant indicator in the previous years is also related to the economic downturn.

²⁴ Percentage of imports in the gross domestic consumption of energy (including fuels for international navigation). It is noted that imports of uranium are not counted by Eurostat and the electricity generated from nuclear power is considered as domestic source.



Graph 28: Energy dependency indicator for the period 2006-2016.

The need to diversify energy sources in view of the increasing role of natural gas in the energy sector has led to the development of strategies for the security of supply in gas both in short and medium term. The participation in international projects of gas pipelines to reinforce the medium term security of supply of gas, contributes to achieving the objective of making the country an energy hub in South-Eastern Europe. In addition, measures have been implemented for the extension of existing infrastructures in order to increase the storage capacity of Liquefied Natural Gas. As a result, over the period 2006-2016 the Supplier Concentration Index (SCI) for natural gas has significantly decreased, as shown in Graph 29. However, the value of this indicator remains relatively high even in 2016 (45.8 %), due to the fact that Russia is the main supplier of natural gas to Greece, covering at least 60 % of imports, and consequently, the main supplier of domestic consumption.

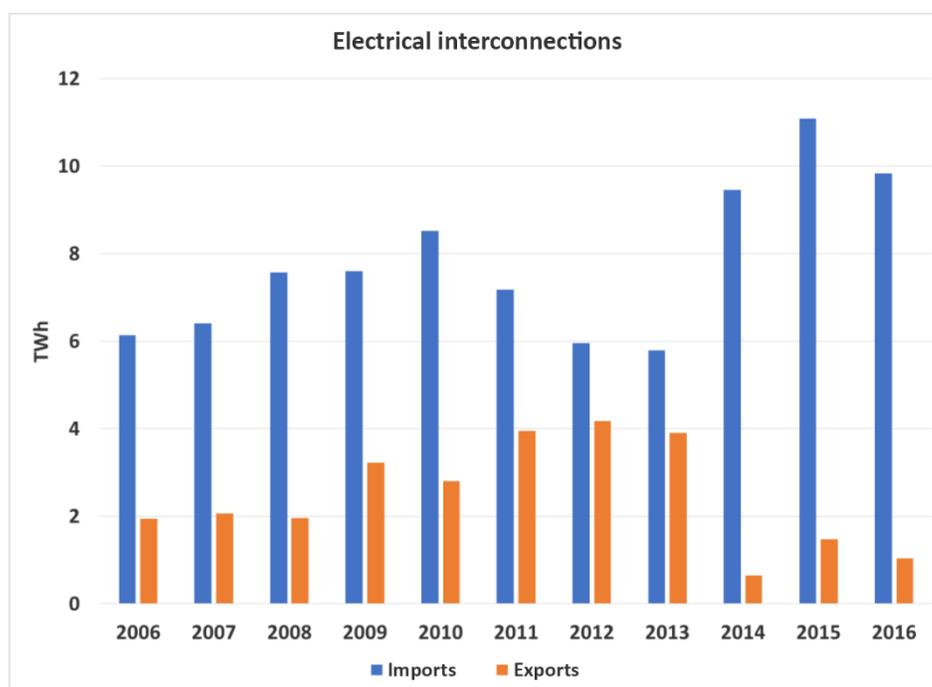


Graph 29: Development of Suppliers Concentration Indicator during the period 2006-2016.

The potential to utilize domestic energy sources is quite high, mainly because of the prospects to utilize all available forms of RES, but also the domestic lignite reserves and possibly the hydrocarbons.

An additional feature of the Greek energy sector is the fact that the import-export balance has been positive over time. Since October 2004 the Greek interconnected electricity transmission system operates at the same time and in parallel to the European interconnected system. The Greek system functions in parallel with the European system through transmission lines, mainly extra- high voltage (400 kV), interconnecting with the Albanian, Bulgarian, FYROM and Turkish systems. The Greek system is also asynchronously connected with Italy (via a submerged DC connector).

The development of imports and exports of electricity is shown in Graph 30, where both the strong variation in the net balance of electricity interconnections and its significance in absolute figures on an annual basis are established. In particular, even though during the recent years (2014-2016) there has been a net increase in imports, in 2017, according to the official data so far, the net imports amounted to approximately 6.2 TWh (12 % of total demand), i.e. the quantities of net imports returned to those of the period 2006-2013.



Graph 30: Development of imports and exports of electricity over the period 2006-2016.

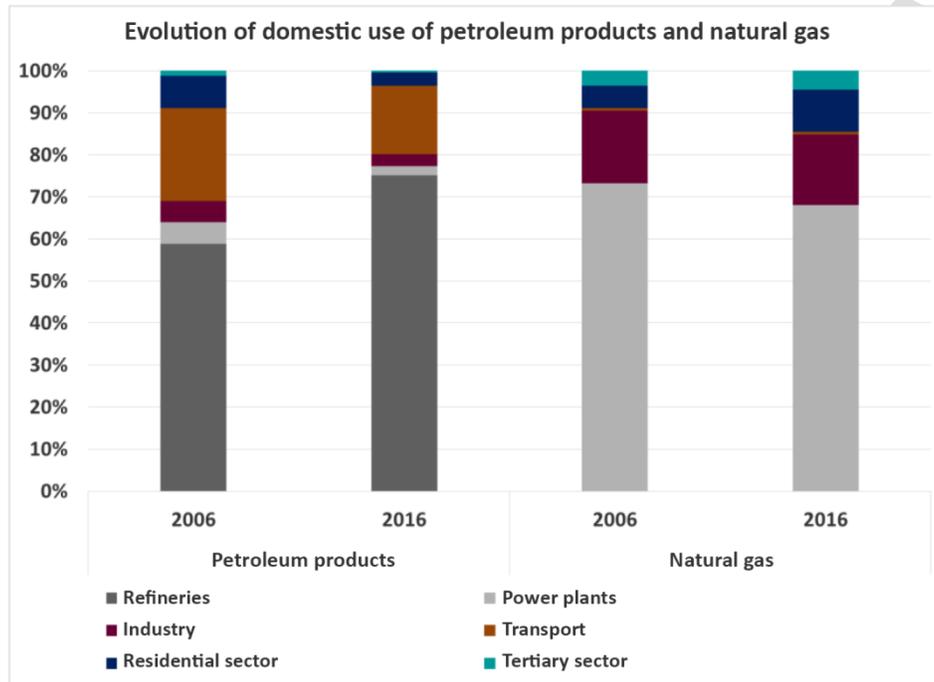
The existing domestic production of crude oil is negligible (0.16 million tonnes-increase of 71 % compared to 2006), while the country is fully dependent on imports of crude oil (crude oil net imports amount to 28.2 million tonnes). It is noteworthy that, despite the low production of crude oil, Greece is export-oriented on petroleum products, thanks to the strong refining capacity. However, it is noted that the interest for the exploration and the search for hydrocarbons has revived in recent years leading to the expression of interest for exploration and exploitation of terrestrial and marine areas. Any discoveries of reserves of not less than 500 million (equivalent) barrels may lead to significant commercial reclassifications and investments contributing to the economic growth of the domestic economy, and increasing the domestic added value.

Finally, the domestic production of natural gas is negligible (0.009 bcm), while net imports increased by 23 % in 2016 compared to 2006. In addition, the interest for the exploration and search for natural gas has revived in recent years, in particular following the discoveries of related reserves in the South-Eastern Mediterranean.

Graph 31 shows the development of sectoral use of petroleum products and natural gas for 2006 and 2016.

More specifically, breaking down the use of petroleum products, their use in the refineries has been reinforced, while it decreased in the other uses (power plants, industry, transport, residential sector and tertiary sector). However, natural gas use, when breaking down the use beyond the electricity generation sector, has increased, with the greater increase being detected in the residential sector.

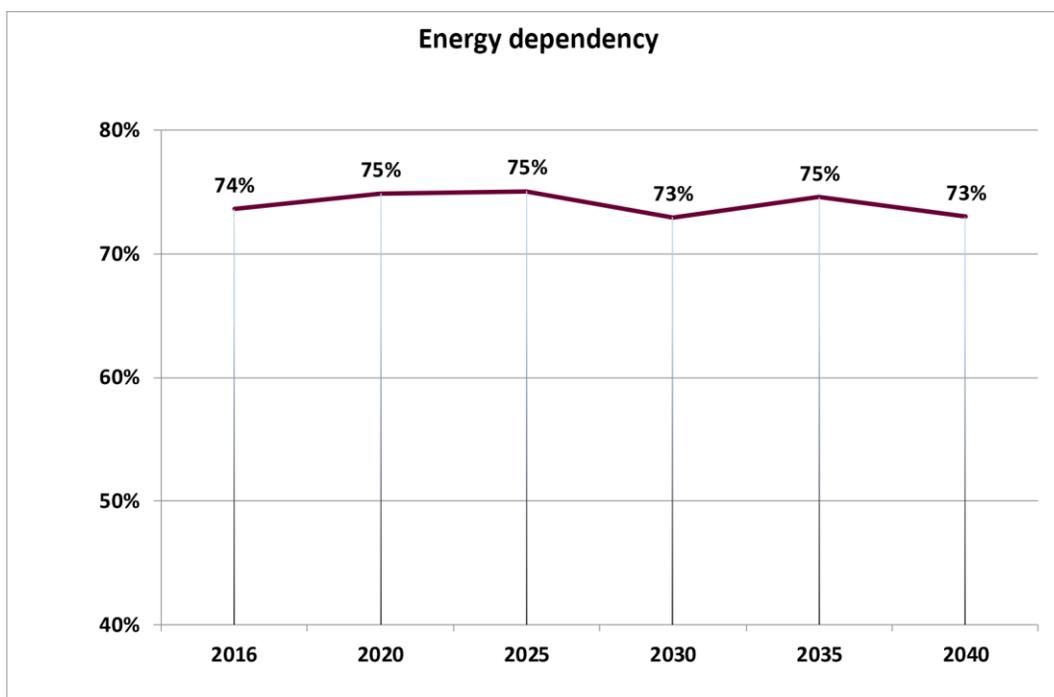
It is noted that in absolute figures both the use of petroleum products and natural gas presents a significant increase during the period 2006-2016.



Graph 31: Development of domestic use of petroleum products and natural gas over the period 2006-2016.

4.5.2 Forecasts regarding the developments in respect of existing policies and measures

As regards the energy dependency of the country on fuel imports, in accordance with the scenario of existing policies and measures, it is estimated that a moderate variation will be observed, with small differentiations throughout the period under consideration (Graph 32).



Graph 32: Development of energy dependency by 2030.

4.6 Internal energy market dimension

4.6.1 Electricity interconnectivity

4.6.1.1 Current level of interconnectivity and main interconnection lines

Greece is connected in terms of electricity to five neighbouring countries, Albania, FYROM, Bulgaria and Turkey through five single AC lines of 400 kV and with Italy through a DC submarine cable (of 400 kV). Additionally, there is a 150 kV AC connection with Albania.

Table 41: NTC: Net Transfer Capacity

Neighbouring Country	NTC to	NTC from
Albania	250	250
Bulgaria	400	700
FYROM	350	450
Turkey	216	166
Italy	500	500

The Independent Power Transmission Operator calculates periodically the total NTC (Net Transfer Capacity) from the Northern boundaries of the country, and the transfer capacity of the DC interconnection with Italy is generally stable and amounts to 500 MW, except in case of failures.

In 2017 the average total capacity in imports was 1565 MW. This size of import capacity meets in general the objective of 10 % of the total installed capacity set for 2020 for each Member State (9.3 % on average for 2017). It is noted that the increase in capacity to and from the North is also supported by projects which reinforce the Transmission Systems in the wider region of the Balkans.

4.6.2 Energy transmission infrastructures

4.6.2.1 *Main characteristics of the existing electricity and gas transmission infrastructure*

The Independent Power Transmission Operator is the owner and the operator of the Greek transmission system of the mainland comprising 11,508 kilometres of transmission lines and 343 substations. The electricity transmission system consists of three double circuit lines of 400kV which run across the territory from North to South and additional single lines of 400 kV which run across the territory from East to West. The biggest part of electricity generation in the country takes place in Northern Greece close to the lignite mines, while approximately 65 % of total consumption comes from the central and Southern Greece.

In Greece, in addition to the interconnected mainland system, there are 29 autonomous island systems of the Non-Interconnected Islands (NIIs), and the operation of the NII systems is the responsibility of the Hellenic Electricity Distribution Network Operator (DEDDIE). An ambitious part of the expansion plan of the System is the interconnection of the majority of the Aegean islands with the mainland system. These interconnections are considered to be a key priority as they would facilitate the penetration of RES in NIIs and will have a positive effect in the cost of electricity generation, since now, in these isolated island systems the demand is heavily based on electricity generation by internal combustion engines and oil consumption.

The National Gas Transmission System transfers gas from the Greek-Bulgarian (upstream managed by BULGARTRANGAZ Manager) and the Greek-Turkish (upstream managed by BOTAS) borders to consumers located in mainland Greece.

It consists of:

- The central gas pipeline and branches thereof,
- the border metering stations at Sidirokastro, Serres and Kipi, Evros,

- the compression station in Nea Mesimvria, Thessaloniki,
- the natural gas metering and regulating stations,
- the load control and distribution centres,
- the Operation and Maintenance Centres of the Sidirokastro Border Metering Station in Eastern Greece, Northern Greece, Central Greece and Southern Greece, and
- the Remote Control and Communications System.

The main transmission pipeline, of overall length of 512 km and design pressure of 70 barg, extends from the Greek-Bulgarian borders (Promahonas) to Attica.

Natural gas transmission branches of 952 km start from the central transmission pipeline to supply natural gas to the regions of Eastern Macedonia, Thrace, Thessaloniki, Plati, Volos, Trikala, Inofita, Antikira, Aliveri, Corinth, Megalopoli, Thisvi and Attica.

Throughout the central pipeline and the branches there are:

- Valve stations for the partial isolation of the National Gas Transmission System in cases of emergency or scheduled maintenance,
- Scraper trap stations to send and receive cleaning devices (scrapers) or devices for the internal inspection of the pipeline,
- Downward corrosion protection system of the pipeline and optical fibre cable to meet the needs of the system operational control, communications and remote control.

4.6.2.2 Forecasts on requirements for the extension of the network

In addition to the development of the electricity transmission system by means of installing new transmission lines and reinforcing the existing ones, as for example

- the second interconnection between Greece – Bulgaria
- the interconnection among Greece – Cyprus – Israel
- the improvement of the interconnection of 150 kV between Greece – Albania
- the improvement of interconnection between Greece – FYROM
- the interconnection of the country to Cyprus and through Cyprus to Israel,

the strengthening of the transmission system within the country is also promoted, e.g. projects in the Peloponnese, in order to eliminate the relevant saturation and to interconnect the majority of the NIIs.

The prospect of interconnecting the autonomous electricity systems of the islands with the national interconnected electricity system, where feasible and appropriate from a technical-financial point of view, was a consistent practice of the PPC from the early 1960s, in order to reduce as far as possible, or to prevent the operation of petrol power plants supplying the islands. Until recently, all Ionian islands have been linked to the High Voltage system, and in respect of the Aegean islands only Andros is connected with High Voltage, while many islands close to the coast have been connected with Medium-Voltage (Sporades islands, Thasos, Samothrace, Kithira, etc.).

As regards the interconnection of the Cyclades islands, their interconnection with each other and with the mainland system is expected to be implemented through underwater cable connections. On the basis of the above, the Independent Power Transmission Operator implements the project of interconnection of Cyclades islands in 3 stages, of which stage A was concluded in 2018 and stage C of the project is expected to be completed in 2020.

Respectively as regards the interconnection of Crete the Independent Power Transmission Operator finalised the interconnection plan of Crete, which shall also be carried out in two stages with stage A being completed in 2020 stage B in 2023.

Moreover, as noted above, the Committee set up by executives of RAE, Independent Power Transmission Operator, DEDDIE S.A. and DESFA S.A., with a view to examine the cost-efficiency of the power supply method for Non-Interconnected Islands (NIIs), in the framework of applying also the Decision 2014/536/EC of the European Commission, proposes with its first conclusion as cost-efficient the interconnection of the NIIs Sifnos, Milos-Kimolos and Thyra, and following, the interconnection of the rest NIIs (Kithnos, Serifos, Anafi, Amorgos, Donousa and Astipalaia, of the Dodecanese Islands). As a result, and following the studies conducted by the Independent Power Transmission Operator, in the last ten-year transmission system development plan submitted to RAE (2019-2028), there is a provision for High Voltage Connection of the islands Serifos, Milos, Thira and Folegandros (which is already supplied by the ESMIE through Medium Voltage interconnection with Paros).

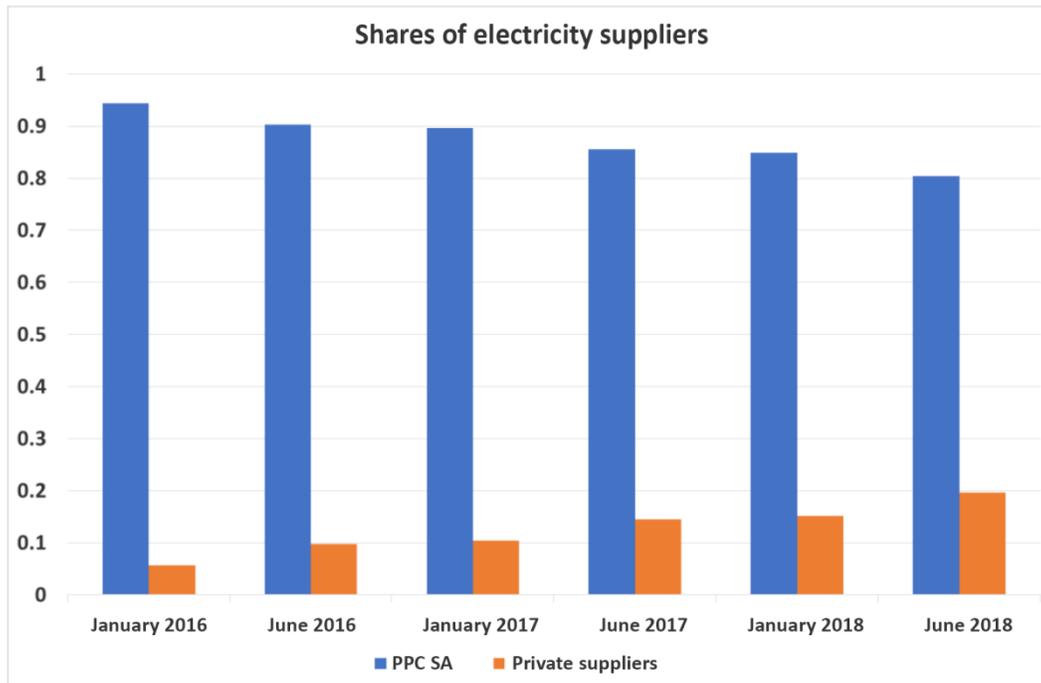
There are similar results in the Conclusion of the Committee for the Dodecanese Islands (November 2017), while the North-East Aegean Islands are under examination.

4.6.3 Electricity and gas markets, energy prices

4.6.3.1 *Current situation of the electricity and gas markets, including energy prices*

The Greek electricity market consists of sub-mechanisms and markets such as the market of natural transmission rights assignment for Electricity in the interconnections, the auctions of electricity forward

products, the compensation mechanism for flexible capacity, the short-term (day ahead) wholesale market (daily energy planning), the imbalance settlement and the retail electricity market. In the retail electricity market 19 suppliers are currently active, and the share of PPC SA is decreasing (close to 80 %) and the share of private suppliers vary for each of them from 0 % to 4.45 % in June 2018 (Graph 33).



Graph 33: Development of shares of electricity supply companies.

In order to move from the current situation of the electricity market to an integrated European market, the development of the Target Model has already been initiated. The application of the Target Model achieves the optimisation of the use of the capacity of the transmission system, by means of coordinated practices of the transmission system operators, the reliable prices and liquidity in the allocation of the capacity of interconnections for the day-ahead market, the effective functioning of the futures markets and the design of effective intraday markets for the allocation of the capacity of interconnections.

Part of the plan for the extension of the electricity system is the interconnection of most NIIs with the mainland system. These interconnections are considered to be a key priority as they would facilitate the penetration of RES in NIIs and will have a positive effect in the cost of electricity generation and the local environmental footprint, since now, in these isolated island systems the demand is heavily based on electricity generation from petrol as a fuel. The electrical systems of Paros (including the system of Naxos, Antiparos, Ios, Sikinos, Folegandros and others), Siros and Mykonos have already been

interconnected with High Voltage, while Crete and the remaining Cyclades Islands are expected to be interconnected in the next years.

With regard to the natural gas market, since 2015, thanks to the successive amendments of Law 4001/2011 (in particular with the laws, 4336/2015, 4337/2015 and 4414/2016), the complete reorganisation of the retail sale and distribution of natural gas in Greece has started, with a sequence of steps until 2018, in accordance with the standards of the liberalised market.

In particular, the legal, operational and financial separation of the natural gas distribution and supply enterprises was established and the monopoly of the EPAs (Gas Supply Companies), both in distributing and in supplying natural gas was terminated, so that all consumers, including domestic consumers, have the right to choose their supplier since 1.1.2018.

In particular, from 1 January 2017, the three existing monopoly regional distribution and supply companies (EPA Attikis, EPA Thessaloniki and EPA Thessalia) have concluded the legal and operational separation of the distribution and the supply of natural gas, and at the moment three new distribution companies have been established: EDA Attikis (Attica), EDA THESS (Thessaloniki, Thessaly) and DEDA (other parts of Greece, with an existing network in Continental Greece, Central Macedonia, Corinth, Thrace). Each of the three newly founded distribution companies (EDA) has now a distribution licence and a licence to exploit the distribution network in the assignment regions, while the existing distribution network is still owned by DEPA. However, any future new and/or extended distribution network shall belong to investors/new distribution companies. DEDA, together with the other two EDAs, are currently the Gas Distribution System Operators in Greece.

The final step towards the full liberalisation of the natural gas retail market took place on 1 January 2018, since when all customers of natural gas in Greece have the option to choose their gas supplier freely.

In addition, the provisions of the most recent (4th) review of the NNGS Management Code constitute a first step towards the creation of a wholesale gas market, contributing to the improvement of the conditions of the market while third parties have been given the possibility to access the natural gas distribution networks.

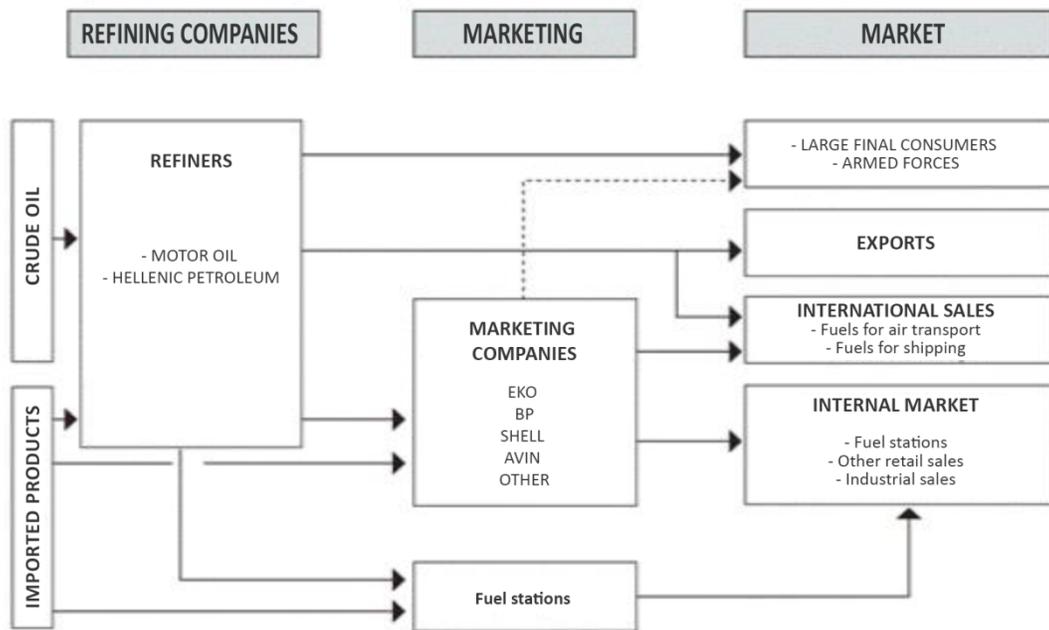
The main milestones in the process of amending the system of third-party access to the NNGS with a view to implement the EU Network Codes are the following:

- Conclusion of an Interconnection Agreement between DESFA and the operator of the upstream Bulgarian gas system, Bulgartransgaz, for the Kulata (BG)/Sidirokastro (GR) Interconnection Point, enabling third parties to access the point in both directions since 1 July 2016, and laying the foundations for the development of cross-border trade in the region of South-Eastern Europe.
- Entry into force of the 3rd revision of the NNGS Management Code, which introduced critical changes throughout the system of third-party access to the NNGS, from both a regulatory and an operational point of view.

Entry into force (since 01.07.2018) of the 4th revision of the NNGS Management Code, according to which the operation of the Balancing Platform was established, on which the administrator will, on the basis of market mechanisms procure and sale the quantity of natural gas required to balance the NNGTS load in the form of Short Term Standardised Products; the creation of a Virtual Trading Point was also established in which NNGS users will have access without being obliged to reserve a capacity in it, replacing the Virtual Nomination Point in which only the NNGS users who had reserved a capacity in it could participate; the last remaining issues regarding the implementation of the EU Code on Capacity Allocation at Interconnection Points were lifted, by adding to the NNGS Management code the necessary supplementary provisions; and the implementation of the capacity disposal procedure was also established, pursuant to the provisions of the recent Commission Regulation on Capacity Allocation (EU 2017/459) at the entry point “Kipoi”, which is an entry point from a third country (Turkey).

In addition, however, to the integration of third party access to the Greek system in accordance with the provisions of the EU Codes, there was also a number of changes in relation to the commitments of the Public Gas Corporation (DEPA) before the Competition Commission. As regards the disposal of quantities of gas through electronic auctions and with the purpose to strengthen the liquidity in the Greek market of natural gas, following a proposal from RAE, the quantities of natural gas are now delivered to the Virtual Nomination Point, and DEPA, since 2016, has committed to a gradual increase of the total quantities to be disposed, expressed as a percentage of DEPA sales of the previous year as follows: sixteen percent (16 %) in 2017, seventeen percent (17 %) in 2018, eighteen percent (18 %) in 2019 and twenty percent (20 %) in 2020. Furthermore, the procedure of auctions has been amended, as any action will be carried out in two phases. In the first phase, both suppliers and eligible customers have the right to participate, while in the second phase of each auction where the quantity of gas above ten percent (10 %) is auctioned, only gas suppliers have the right to participate. Since the beginning of 2015, all the quantities are disposed only through the Virtual Nomination Point, eliminating the requirement for a supply contract between DEPA and the supplier or the eligible customer.

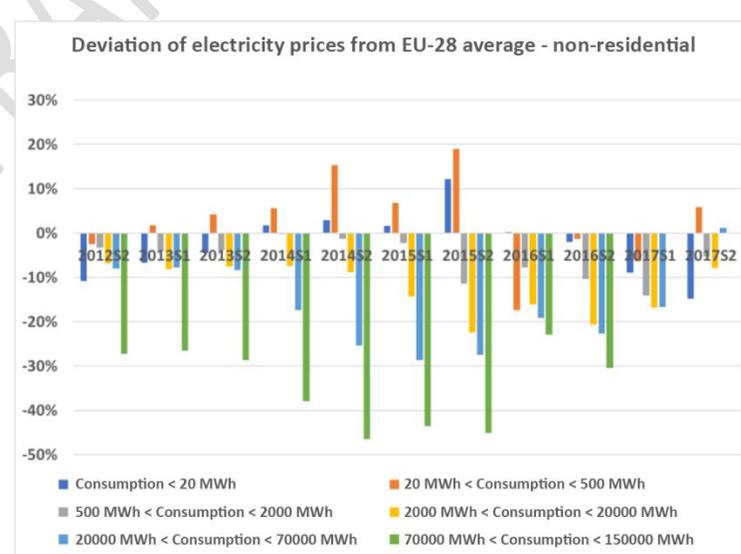
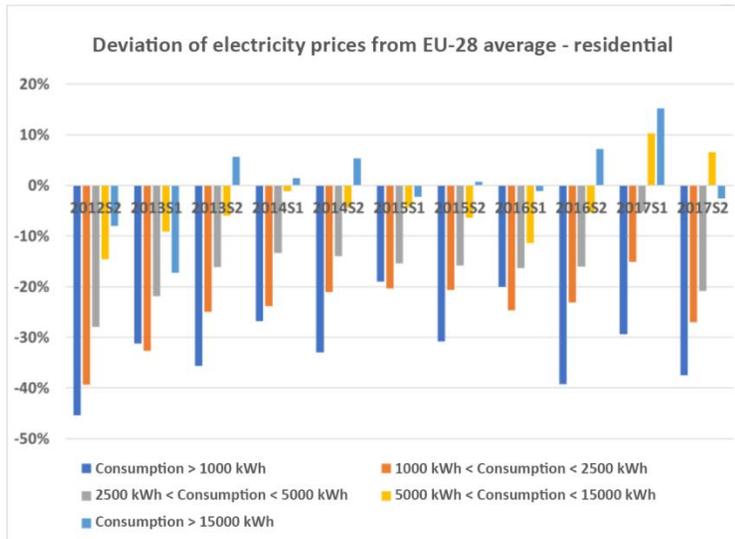
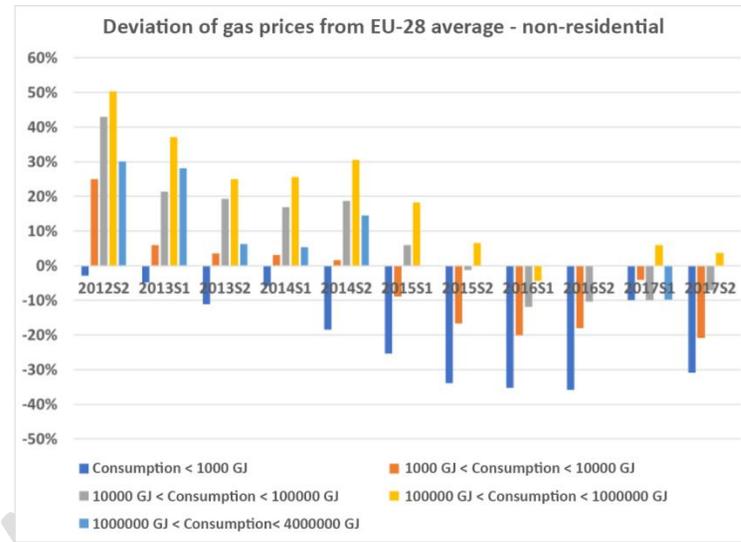
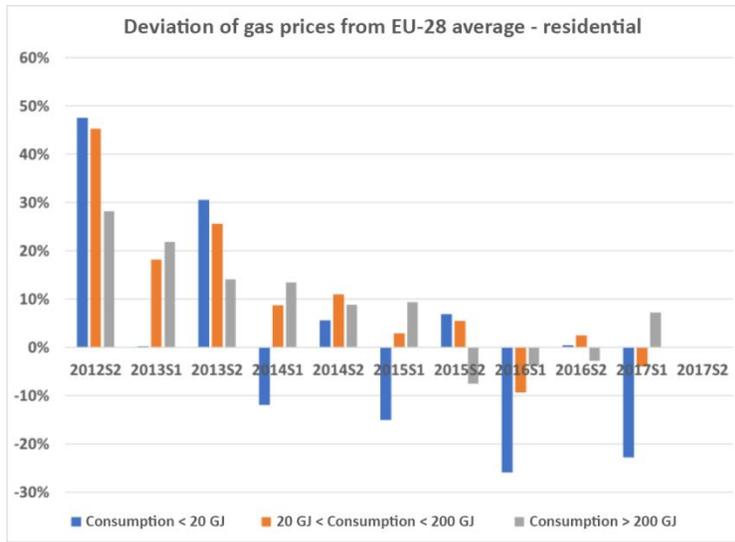
Petroleum products are traded in the relevant market, which is characterised by very high levels of competition. The Greek petroleum products market is structured in three levels: refining, wholesale trade (trade) and the retail trade (Graph 34).



Graph 34: Structure of the Greek petroleum products market.

Indicatively, it is noted that according to updated information that there are 2 active refiners with 4 refineries, 21 companies with category A trading licence, 18 companies with category B1 trading licence (tax-free shipping fuels) and 4 companies with category B2 trading licence (tax-free aviation fuels).

Graph 35 shows the deviations of the electricity and natural gas prices from different categories of consumption for the period 2012-2017 compared to the average price of the 28 Member States. In the case of natural gas, there is a gradual reduction in prices for all consumers after 2015, leading to prices lower than the corresponding mean prices as a result of the measures taken for the liberation of the natural gas wholesale and retail markets. Electricity prices were significantly lower than the corresponding mean prices for all consumers in 2012, and despite an increasing trend, they remained at lower levels for almost the totality of the different consumption categories in consumption at the end of 2017.

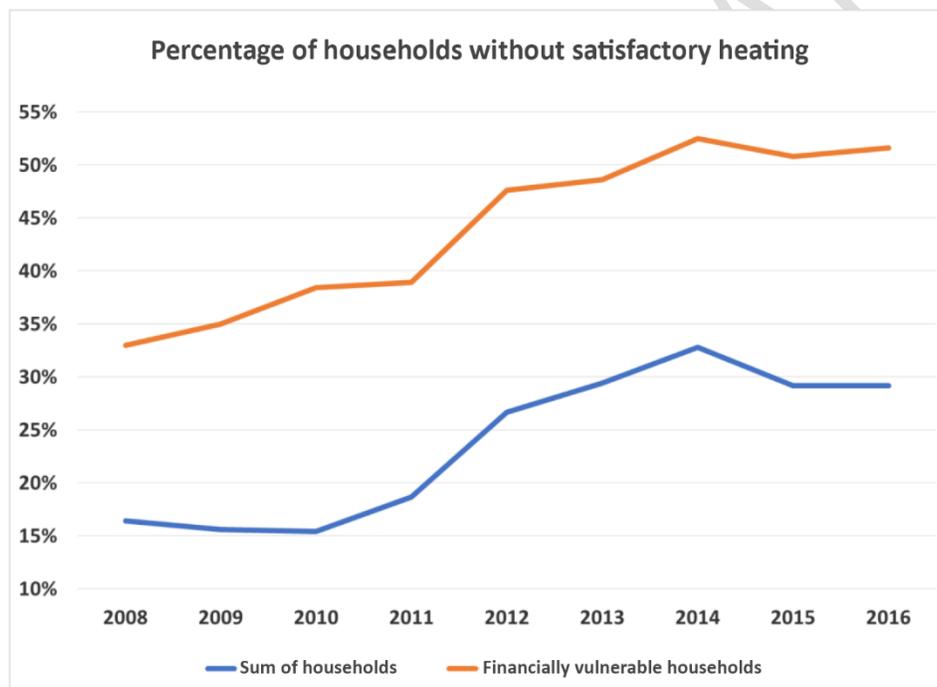


Graph 35: Deviation of electricity and natural gas prices from the mean price of the Member States of the EU 28.

The energy poverty phenomenon has increased in recent years mostly due the impact of the economic downturn. This conclusion can be derived from the indicator for the failure of households to achieve satisfactory levels of indoor heating comfort, which is determined by the Hellenic Statistical Authority as part of sample Income and Living Conditions Study (SILC), that it carries out.

Graph 36 shows the deterioration of this indicator since 2011, while it has a tendency to stay stable over the period 2014-2016.

Approximately 30 % of the all Greek households appears not capable to heat its residence in a satisfactory way, and in the case of the economically vulnerable households²⁵, the corresponding percentage is 50 %. It is noted that for 2015 Greece had the 4th highest position among Member States in this indicator, indicating the size of energy poverty in Greek households.

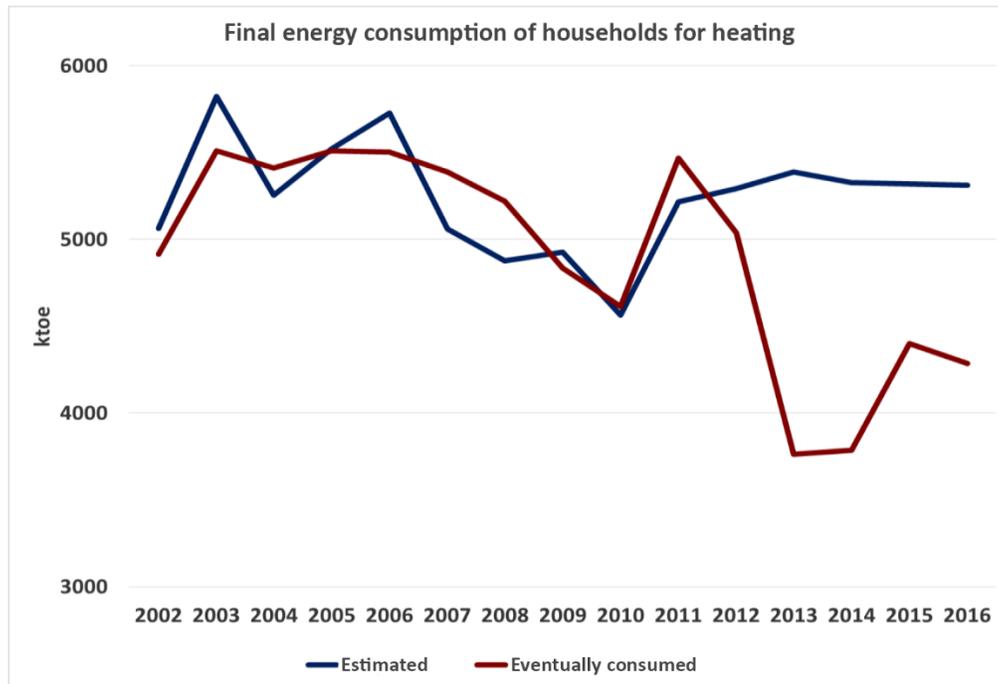


Graph 36: Development of the indicator for the failure to achieve satisfactory heating.

Essentially the households, due to the economic downturn, have not been able to cover the conditions of indoor heating comfort, leading to declaring failure to achieve satisfactory heating levels.

²⁵ Households with income less than or equal to the poverty threshold.

This conclusion is reinforced by Graph 37 where in the context of a standard statistical correlation, a deviation appears between the final consumption of energy by households and the estimated final consumption on the basis of the final consumption heating degree-days at the level of the territory.



Graph 37: Comparison of final consumption of energy and estimation of consumption on the basis of the statistical correlation methodology.

Despite the fact that there is no common definition for energy poverty, at neither European nor national level, various methodological approaches have been developed for the determination of energy vulnerable households. CRES, in the framework of the Energy Poverty Observatory, uses as an indicator to quantify the phenomenon of energy poverty the percentage of households which are unable to cover 80 % of their minimum energy needs. This indicator must be assessed in addition to the indicator reflecting the percentage of households which spend more than 10 % of their income for the purchase of energy products. The analysis of the results for the performance indicators for 2011 leads to the conclusion that the percentage of energy vulnerable households amounts to 40 % of all households, which is also confirmed by other research studies that have been carried out. In parallel, the results of the application of the indicators under examination, showed also the significant variation between the regions of the Greek territory, as the percentage of vulnerable households varies between 25 % and 67 % at regional level.

4.7 Research, innovation and competitiveness dimension

The implementation of the energy policy objectives in the next decade, requires the activation of a large part of the economic operators related directly or indirectly to the production and consumption of energy. The specific objectives relating to the development of research and innovation in the sector lead to an increase in the economy competitiveness, to the change of the production model (towards the integration of innovation in entrepreneurship), as well as to the maximisation of domestic added value.

The key challenges for the development of R&I in the energy sector are those observed for the whole economy and are:

- The small size. Greece is one of the countries with limited research activity. In recent years, however, there is significant progress, which, despite the crisis, sets up a potential for further development. The Research Expenditure as a percentage of GDP which is the main indicator for comparisons, for the first time in 2016 exceeded 1 % compared to 0.67 % in 2011. The technological transition and the expected investments in the field of energy in the next decade, strengthen the integration potential for new knowledge and innovative technologies, despite the small size and the low level of industry development in the country.
- The weak participation of the Production Sector in Research. Regarding the Research expenditure of Enterprises as a GDP percentage, Greece is very low with a percentage of 0.42 % in 2016. The small activity of the enterprises in R&I reduces the added value arising from the of new technologies. Such a phenomenon is very visible in the field of energy as even the major public and private enterprises are not dynamic in investing in research and development.
- The high quality and productivity of research potential. The level and the productivity of the research potential as illustrated by the indicators “publications” and “references” put Greece in very good positions in relation to its size and the financing of the R&I. Despite the slight decrease observed due to the crisis and the migration of many researchers abroad, Greece appears quite high in publications, in particular in references with growth rates higher than the average of the EU and of the OECD.

However, the satisfactory performance on the indicators related to the publications and the references must be associated with a corresponding improvement in applied research and exploitation of research results, as illustrated by indicators such as for example the number of patents.

The high competitiveness of research potential. Another positive attribute, associated with the preceding, is the high competitiveness, established by the success in competitive EU programmes. On the intensity indicators such as the number of participants per 1000 researchers, Greece occupies the 3rd place, in absorbing funds per 1000 researchers occupies the 5th place etc.

In addition, the possibility to utilise the high-quality research results for the creation of innovative technologies that can be economically exploited and developed by companies operating in the area may be reflected in part by the interest shown by companies and individuals to safeguard the application rights through **patent applications**. Thus, over the decade 2007-2017, national patent applications on Climate Change Mitigation Technologies amounted to **548**, a major proportion of which (68 % concerns the production and transfer of energy. In addition, it appears that applications for patents relate to RES at a great extent (**344** out of 372), i.e. fall within the general sector of the development of low-carbon footprint – technologies which, as it will be also shown below, attract the highest funding.

In addition, the standard, in this country, practical separation of public policies applied for research and innovation, energy, as well as for competitiveness and growth, take away the opportunity of synergies in order to optimise their outcome. The need for constant monitoring and re-engineering of the tools used, the synergies and the creation of innovative financing policies in response to specific problems is necessary.

Finally, it is necessary to develop the necessary regulatory framework, which will lead to a more effective use and implementation of the results generated by the completed research and pilot projects.

Chapter 5 IMPACT ASSESSMENT OF PLANNED POLICIES AND MEASURES

5.1 Impact of planned policies and measures

5.1.1 Forecasts for the development of the energy system and the emissions and absorptions of Greenhouse gases

5.1.1.1 Formulation of a scenario of additional policies and measures

For the design and establishment of additional policies in the field of energy a scenario of energy policy with additional measures beyond those already applied or in place has been formed (scenario of additional policies and measures – APM).

The formulation and design of the scenario of additional measures and policies aims to evaluate parameters affecting the energy system and establish additional national policies, which would fulfil at the same time both the challenges faced by the energy sector in Greece and the obligations arising from the harmonisation of the national framework with the EU Energy and Climate Policy.

As it happens with the scenario of existing policies and measures, the key challenges addressed and considered in the scenario of additional policies and measures concern security of supply, greenhouse gas emission reductions, low carbon technology penetration in the electricity generation and the final consumption, and energy efficiency in all end-use sectors.

Taking into account the specific challenges, the scenario of additional policies and measures meets the national targets under the EU policy,:

- (i) The share of RES in gross final energy consumption for the year 2030 is estimated at 31 %.**
- (ii) Final energy consumption for the year 2030 is estimated to be significantly lower than the 2007 forecast and the reduction achieved amounts to 33 % compared to the respective forecasts.**
- (iii) The reduction in non-ETS greenhouse gas emissions is estimated at 31 % in 2030 compared to 2005, the set objective being at 16 %.**

Most of the key assumptions made for the individual parameters that affect the development of the energy system are identical to those of the scenario of existing policies and measures. However, the development of the costs of RES technologies is differentiated, while, in addition, it is accepted that the electricity infrastructure development plan is extended to include the interconnection of Southern Cyclades Islands, the Dodecanese Islands and the North Aegean Islands.

In addition, the scenario of additional policies and measures, incorporates a set of new policies and measures as described in detail in Chapter 3 per subject, which shall be taken into account in the resolution process to capture the development of the energy system from the simulation model.

It is noted that these objectives, as well as the application of the relevant measures and policies, are taken into account until 2030 and for the period 2030-2040 neither new objectives nor new measures and policies are taken into account. For the above reasons the development of the system for the period 2030-2040 simulates the corresponding development of a scenario of existing policies and indicates the need for new measures and policies, as well as the adoption of relevant energy and environmental objectives which will be reflected in detail in the long-term national energy planning until 2050.

Table 42: Electricity infrastructure development plan for each scenario.

Internal Interconnections	Year of interconnection	Scenario
Interconnection of Cyclades		
Stage A-C: Includes the electricity systems of Siros, Paros (including also Naxos, Antiparos, Koufonisi, Schinoussa, Iraklia, Ios, Sikinos, Folegandros) and Mykonos (including also Dilos and Rinia)	2018-2020	Scenario of EPM and Scenario of APM
Stage D: Other Cyclades Islands (Western and Southern)	2024: Interconnection 2025: full year of operation	Scenario of EPM
Interconnection Of Crete		
Stage I: 150kV, 2x200 MVA	2020: Interconnection	Scenario of EPM and Scenario of APM
	2021: full year of operation	

Stage II: ESMIE undertakes all the load of Crete	2022: Interconnection 2023: full year of operation	Scenario of EPM and Scenario of APM
Interconnection of Dodecanese Islands	2029	Scenario of EPM
Interconnection of North Aegean	2031	Scenario of EPM
International Interconnections		
2nd Interconnection with Bulgaria, 600 MW	2023	Scenario of EPM and Scenario of APM

5.1.1.2 Main characteristics of the energy system in 2030

The future landscape of the energy system as shown in the **scenario of additional policies and measures** is summarised in the development of energy quantities, as presented below. The results presented below make clear that the development of the energy system varies significantly from the scenario of existing policies and the relevant energy and environmental objectives for 2030 are mainly achieved through changes in the mix of electricity generation but also through large variations in fuel consumption in the final consumption sectors.

Table 43: Concise energy balance and indicators based on the results of the scenario of additional policies and measures

Concise Energy Balance [ktoe]	2016	2020	2025	2030	2035	2040
Primary Energy Generation	6762	6475	6068	8052	7872	8630
Solid fuels	3973	3561	2234	2109	1030	896
Oil	218	281	408	536	536	536
Natural Gas	10	21	48	64	64	64
RES	2562	2613	3379	5343	6242	7134
Net import	19046	19326	18816	17142	17472	17315
Solid fuels	397	230	229	231	234	223
Oil	14331	13882	13307	12178	11925	11623
Natural Gas	3480	4400	4491	3934	4582	4501
Electricity	756	533	447	357	298	446

Concise Energy Balance [ktoe]	2016	2020	2025	2030	2035	2040
Bioenergy	135	281	342	442	434	521
Seagoing Shipping	1719	1922	2063	2175	2292	2416
Oil	1719	1922	2063	2175	2292	2416
Gross Domestic Consumption	24142	23879	22822	23020	23052	23529
Solid fuels	4370	3790	2463	2340	1264	1120
Oil	12830	12241	11653	10540	10169	9743
Natural Gas	3490	4421	4539	3998	4646	4565
Electricity	756	533	447	357	298	446
RES	2637	2894	3720	5785	6676	7655
Energy industry consumption	1961	1434	1454	1611	1608	1606
Oil	1802	1245	1255	1256	1256	1257
Electricity	145	163	164	176	165	167
Bioenergy	0	26	36	179	186	182
Net Electricity Generation	4156	4426	4468	4778	4990	5033
Solid fuels	1273	1129	792	776	447	394
Oil	463	303	250	132	131	130
Natural Gas	1137	1476	1313	882	1119	989
RES	1285	1518	2112	2988	3292	3520
Network Losses and Self-Consumption of Electricity	443	575	501	434	427	395
Non-energy uses	593	765	765	765	765	765
Final consumption of energy	16941	17494	17822	18043	18195	18477
by sector						
Industry	3073	3391	3372	3447	3536	3608
Residential	4326	4518	4549	4595	4615	4693
Tertiary	2235	2181	2314	2441	2539	2634
Transport	6789	6868	7026	6957	6884	6887
Agriculture	519	535	561	603	622	655
by fuel						
Solid fuels	199	230	231	233	236	226
Oil	9495	9661	9234	8436	8076	7649
Natural Gas	1048	1346	1750	2025	2243	2487
Electricity	4597	4497	4463	4671	4840	5031
District heating from fossil fuels	51	47	45	38	38	33
RES (direct use)	1552	1713	2099	2640	2761	3051

Indicators	2016	2020	2025	2030	2035	2040
Total emissions of greenhouse gases (Mt CO_{2eq})	91.2	87.1	76.3	70.6	65.4	62.1
ETS Emissions	46.3	39.7	29.7	26.1	21.4	20.0
Emissions other than ETS	44.9	47.4	46.6	44.5	44.0	42.1
Emissions of CO₂ per sector (Mt CO₂)	71.1	67.0	56.7	51.2	45.7	43.4
Electricity generation	31.3	27.9	18.5	14.7	9.9	8.1
Energy Sector	5.6	3.6	3.8	3.8	3.8	3.7
Industry (including the processes)	11.3	10.9	10.2	10.4	10.6	11.2
Residential	4.7	5.8	5.4	4.9	4.9	4.6
Tertiary	1.1	1.9	1.8	1.7	1.6	1.6
Transport	17.1	17.0	17.0	15.7	14.9	14.2
Total greenhouse gas emission intensity (kt CO_{2eq}/ktoe)	3.8	3.6	3.3	3.1	2.8	2.6
RES share in gross final energy consumption [%]	15.2 %	18 %	23 %	31 %	33 %	35 %
RES share in final consumption for heating and cooling [%]	24.2 %	25 %	28 %	32 %	33 %	34 %
RES share in Gross Electricity Consumption [%]	23.8 %	29 %	41 %	56 %	61 %	63 %
RES share in final consumption - transport [%]	1.7 %	6 %	9 %	20 %	29 %	40 %
Energy Dependency [%]	74 %	75 %	76 %	68 %	69 %	67 %
Energy productivity [millions € '16/ktoe]	7.31	8.02	9.20	9.98	10.89	11.50
Primary consumption of energy per inhabitant [toe/resident]	2.18	2.18	2.14	2.23	2.30	2.41

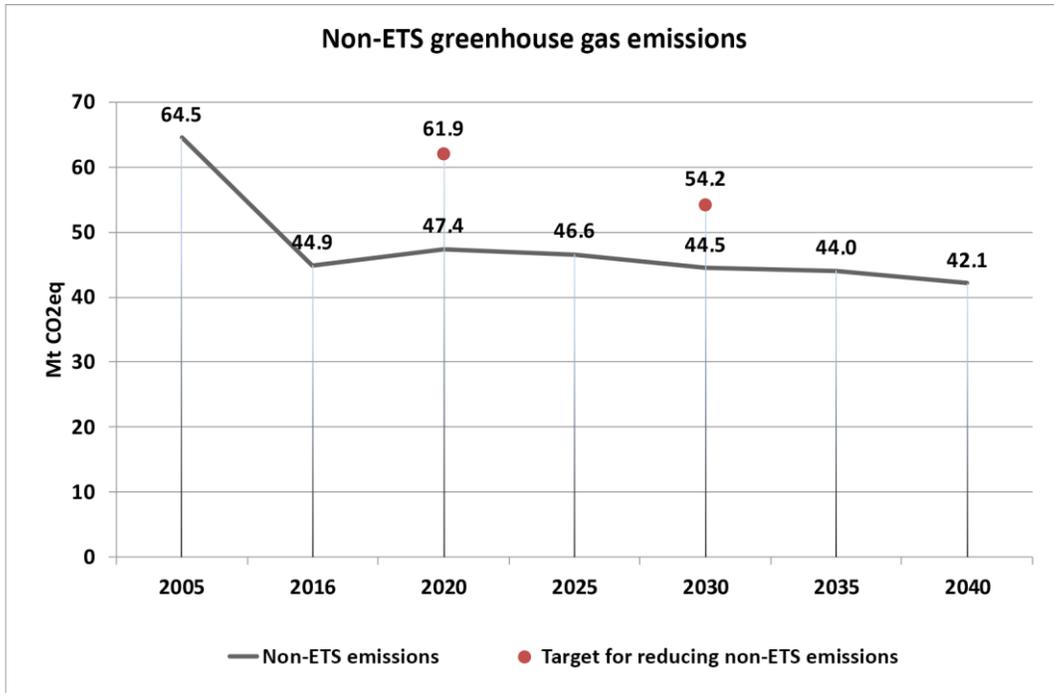
The scenario of additional policies and measures, as simulated for the period 2030-2040 takes into account the continuation of the policies and measures that will be implemented during the period until 2030 and does not examine new policies or obligations or even objectives in the period 2030-2040, therefore, it is a scenario of existing policies for this final period and is an indicative capture of a reference development. It is noted, however, that for the continuity of energy models, it incorporates a relevant progress at the level of technological development and costs of low carbon technologies in this period.

From the results presented below it is clear that the national energy and climate objectives for 2030 are further strengthened, both overall and in particular until 2040, achieving greater market penetration of RES, further improvement of energy efficiency and high values of reduced greenhouse gases emissions. However it is also clear that the rates achieved in the final period with regard to the participation of the RES and the reduction of emissions, is much lower than those that were achieved during the period from 2020 to 2030. In this way the reported scenario for the achievement of energy targets for 2030 achieves to show that the achievement of long-term energy and environmental goals requires the continuous adaptation and establishment of new relative targets for the period after 2030, as well as the taking-up of new energy and environmental policies and measures in order to continue and ultimately to achieve an even higher RES participation in the energy mix, further improvement of energy efficiency and further reduction of the greenhouse gas emissions.

In the context of the long-term energy planning by 2050 which will be prepared in the next period, it is recognised by the analysis of these results that it is necessary to adopt additional energy and environmental objectives for the period after 2030, which will be able to achieve the objectives to be set, and which will ultimately impose the new measures and policies for the period 2030-2050.

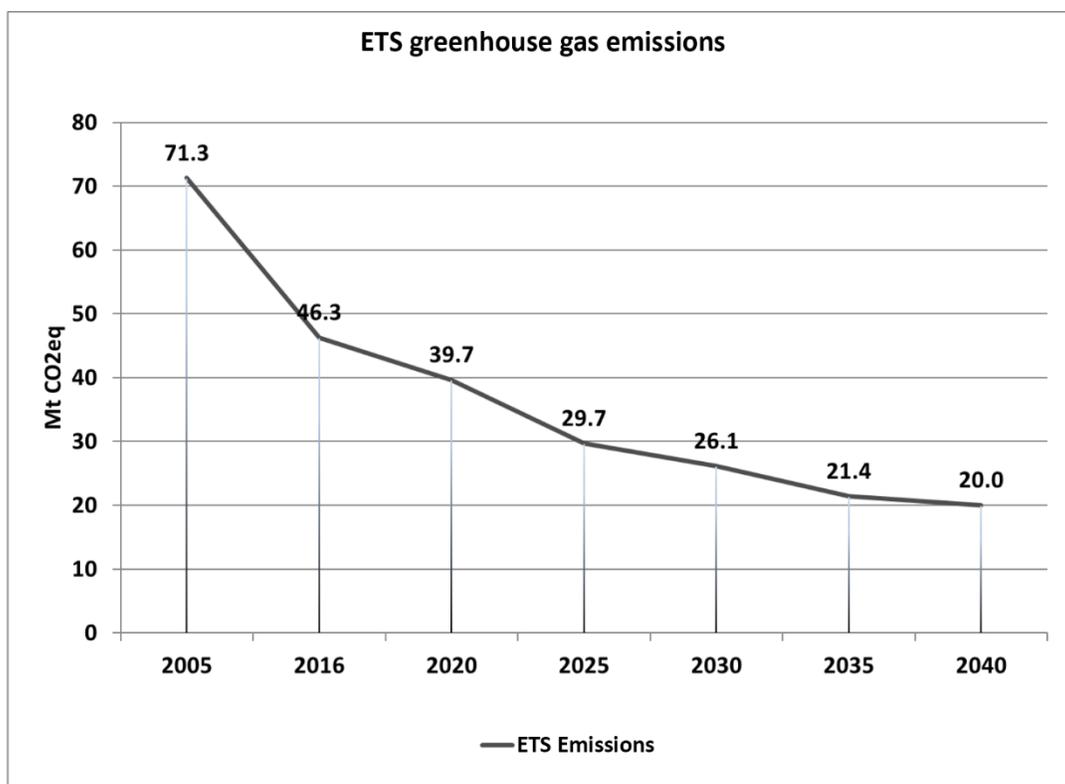
The presentation of the development of energy figures in this chapter is made for the period 2016-2040, however, taking into account the specific national objectives by 2030 and the fact that the measures designed are adapted for the period from 2020 to 2030, the presentation, the analysis and evaluation of the results of the development of the energy system are made for the period until 2030.

In particular, for 2030, the reduction target for greenhouse gases emissions other than the EPC is achieved at a significantly higher level in relation to the mandatory EU reduction target for Greece (16 % reduction in 2030 compared to 2005, i.e. 54.2 MtCO_{2eq}), as they are expected to decrease to 44.5 MtCO_{2eq} in 2030, as shown in Chart 38.



Graph 38: Development of greenhouse gas emissions outside the EU ETS until 2040 taking into consideration the additional policies and measures scenario.

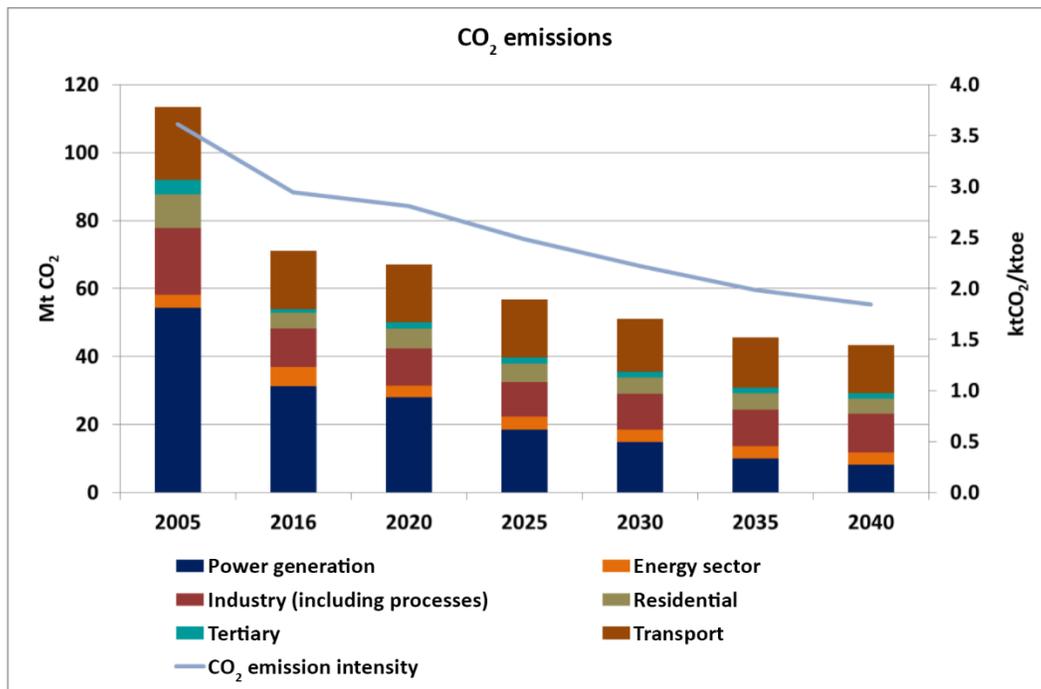
Accordingly, in the sectors within the ETS, there is an even greater reduction of emissions compared to the target set for 2030. In particular, when the target for ETS emissions reduction is 43 % for 2030 compared to 2005, a decrease of 63 % is finally achieved and the emissions are reduced in absolute figures to 26.1 Mt CO₂eq as shown also in Graph 39.



Graph 39: Development of greenhouse gas emissions included in the ETS until 2040 taking into consideration the additional policies and measures scenario²⁶.

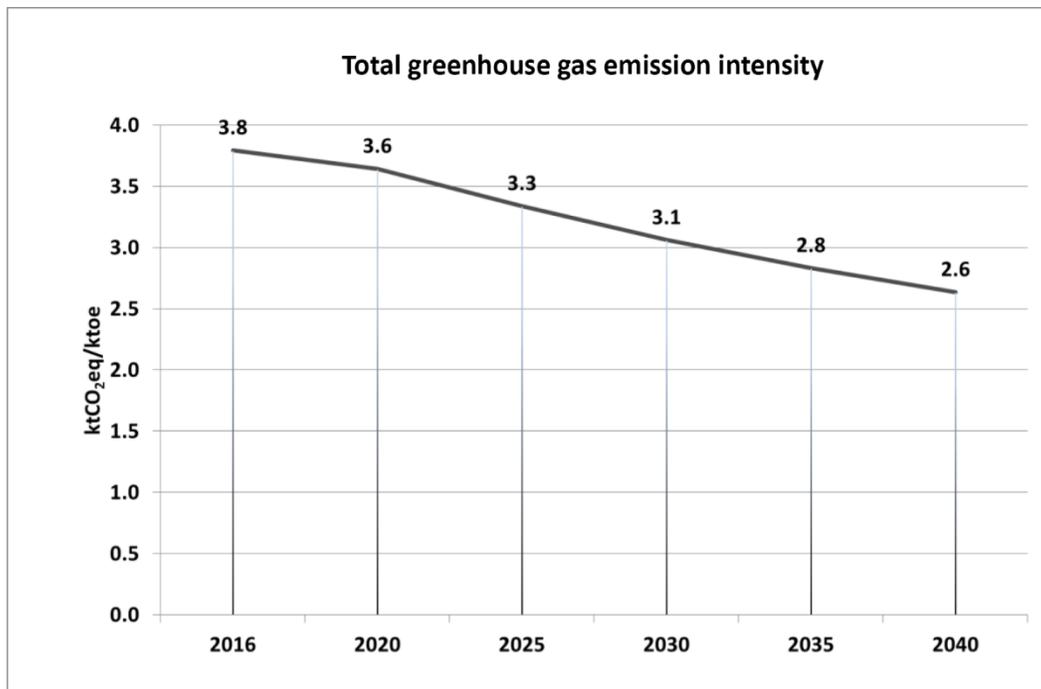
In particular for CO₂ emissions in Greece in 2030, compared to 2016, there is a reduction in the sectors of electricity generation, the rest of the energy sector (e.g. refineries), industry, including industrial processes, and transport. However, for the same period there is an increase in CO₂ emissions in the end-use sectors, i.e. the residential, tertiary and agricultural sector. However, the total CO₂ emissions for 2030 are estimated at the levels of 51 Mt of CO₂ compared to the for 71 Mt CO₂ in 2016, with the highest decrease being observed in the electricity generation sector (53 % decrease in 2030 compared to 2016) (Chart 40). As in the case of existing policies and measures, the total reduction of emissions is achieved by the choice of cleaner forms of energy in all sectors and in particular in the sector of electricity generation, where, as described also below, a percentage of more than 22 % of high technology CO₂ emissions (i.e. lignite and petroleum plants) is replaced by electricity generation from RES in 2030. In parallel, the intensity of the CO₂ emissions for those sectors shows a significant decrease of 38 % in 2030 compared to 2005.

²⁶ Does not include emissions from the aviation sector.



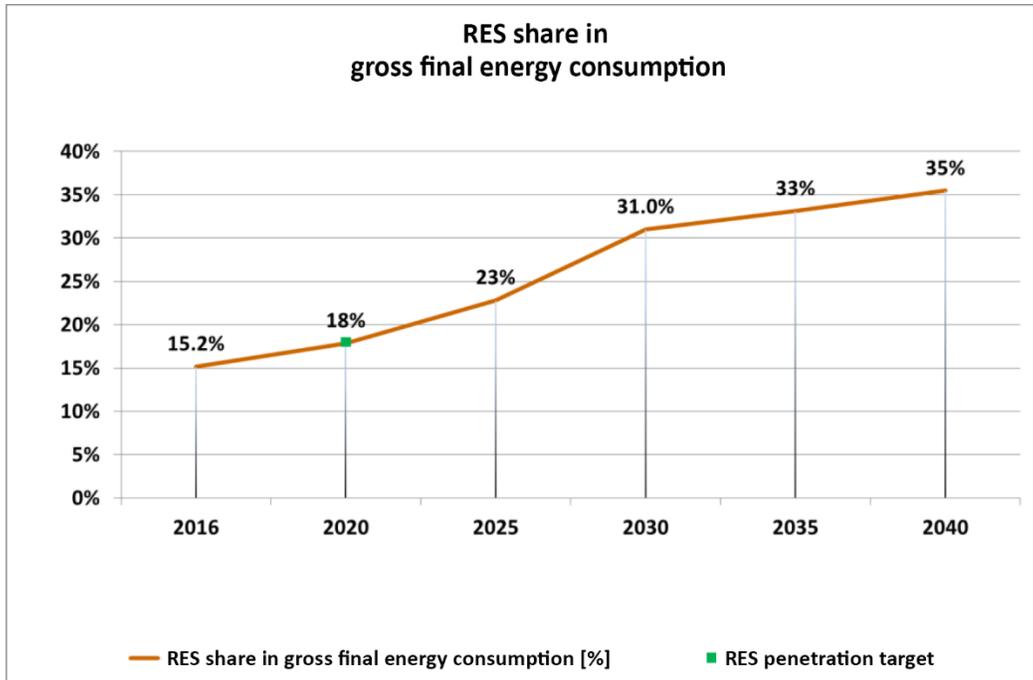
Graph 40: Development of CO₂ emissions until 2040 taking into consideration the additional policies and measures scenario.

Accordingly, the total greenhouse gas emissions intensity shows a significant decrease of around 19 % in 2030 compared to 2016, highlighting the achievement of a future energy mix of lower greenhouse gas emissions (Graph 41).



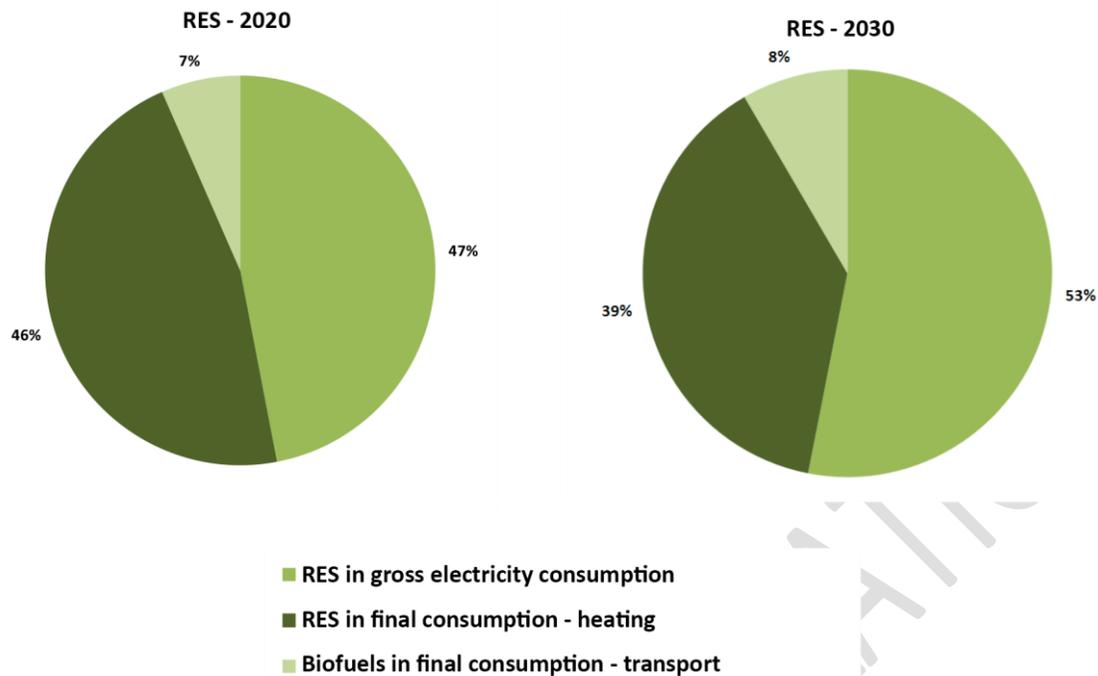
Graph 41: Development of total greenhouse gas intensity until 2040 taking into consideration the additional policies and measures scenario.

Graph 42 shows the development of RES penetration until 2040, achieving both the target set for the RES share in gross domestic consumption of energy as the share is estimated at 18 % for the year 2020, and the target set for 2030, as the corresponding RES share in gross domestic consumption is expected to be 31 %.



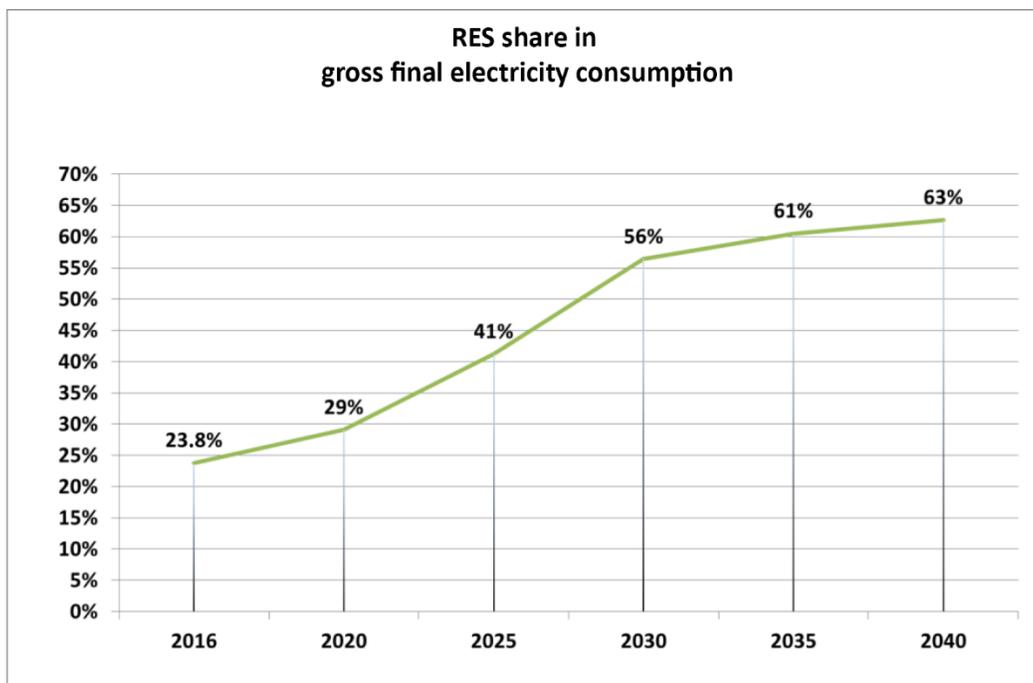
Graph 42: Development of market penetration of RES in gross final consumption of energy until 2040 for the scenario of additional policies and measures.

Graph 43 presents the shares of the three components that form the total contribution of RES in gross final consumption of energy (i.e. the contribution of RES to gross final consumption of electricity, the contribution of the RES final consumption to heating and cooling and finally, the contribution of the final consumption of biofuels for transport) for 2020 and 2030 in total RES in gross final consumption of energy, with the RES in electricity presenting the highest percentage, i.e. 47 % in 2020 and 53 % in 2030.



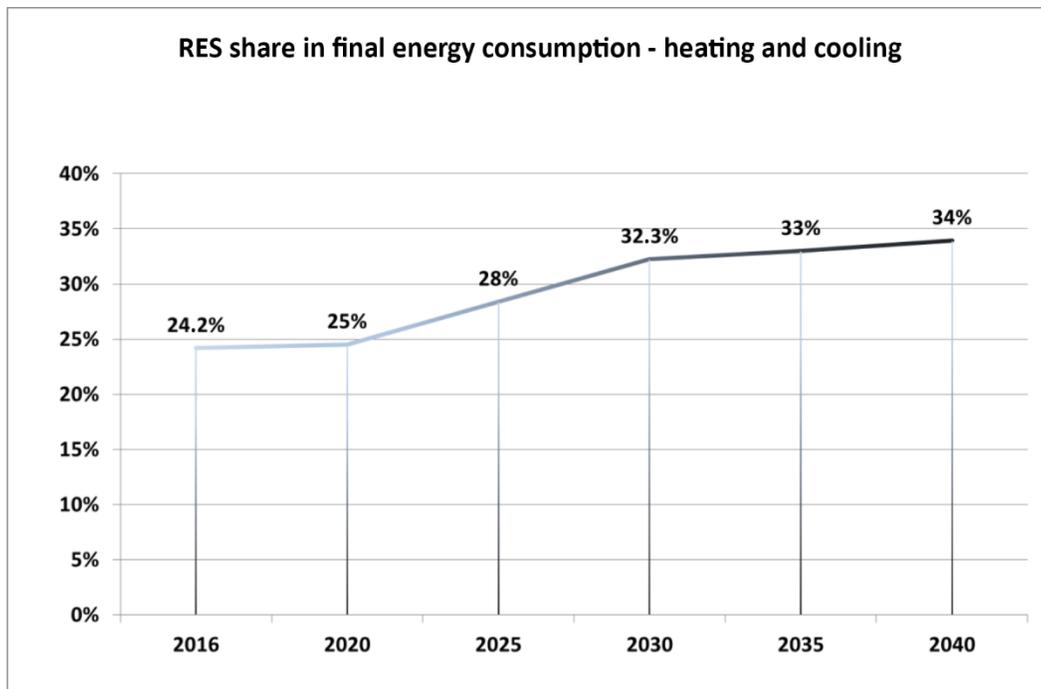
Graph 43: RES share per sector in total RES penetration in gross final consumption of energy in 2020 and 2030 in scenario of additional policies and measures.

In particular, Graph 44 shows the development of the RES penetration in gross final consumption of electricity, which amounts to 56 % for 2030 with the utilisation of all commercially mature technologies, while this percentage was 24 % in 2016. The participation of RES in gross final consumption of electricity almost doubled in 2030, compared to 2020, with an average annual growth of around 2.7 percentage points, indicating the fundamental change and shift of the national electricity generation towards RES. As described also below, while in 2016 58 % of the total disposal of electricity in the country (i.e. net electricity generation and import-export balance) derived from fossil fuels, in 2030 is foreseen that the same percentage will be covered by RES (Graph 44).



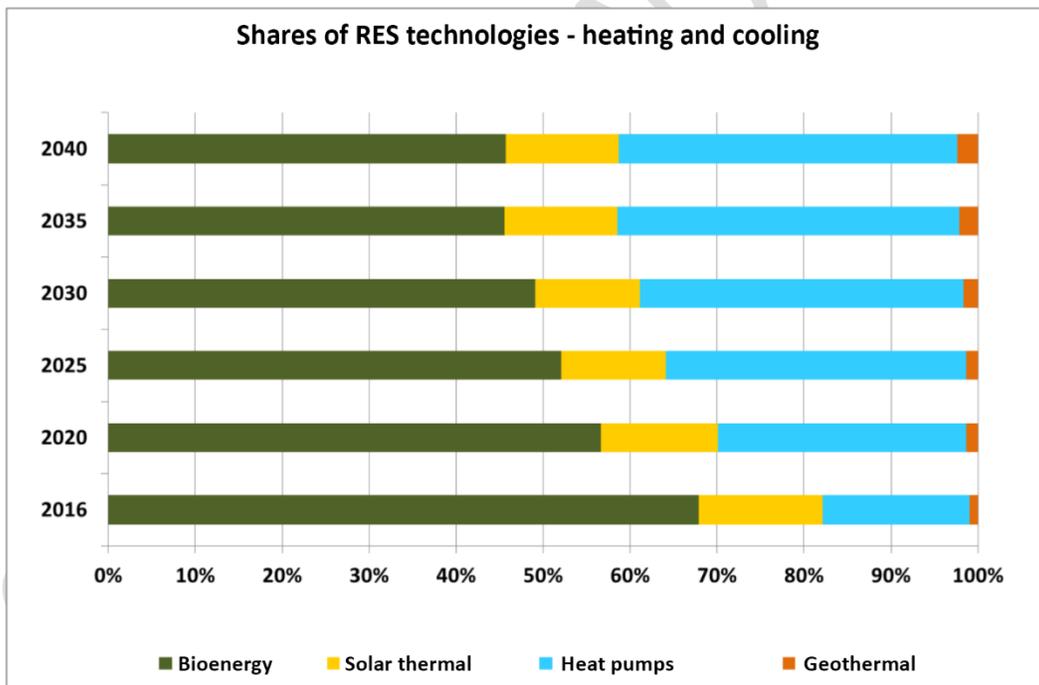
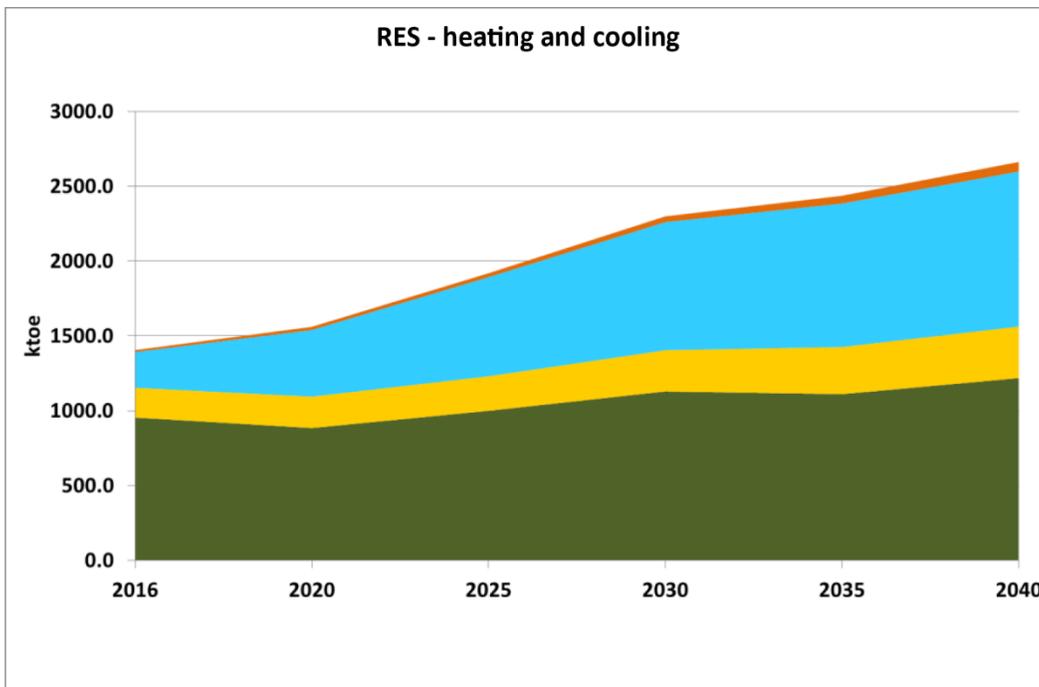
Graph 44: Development of market penetration of RES in gross final consumption of electricity until 2040 for the scenario of additional policies and measures.

The development of the RES penetration in the final consumption for heating and cooling in the scenario of additional policies and measures is presented in Graph 45, where that percentage is increased significantly compared to 2016 and amounts to approximately 32 % in 2030 with an average increase of almost 0.6 % per year, which is mainly due to the significantly increased market penetration of heat pumps for covering the needs for heating and cooling in the tertiary and the residential sector, the maintenance of the use of biomass at high levels, the increased use of thermal solar systems in the residential sector, as well as the use of RES (biomass, geothermal systems) in district heating networks.



Graph 45: Development of market penetration of RES in the final consumption of energy for heating and cooling until 2040 for the scenario of additional policies and measures.

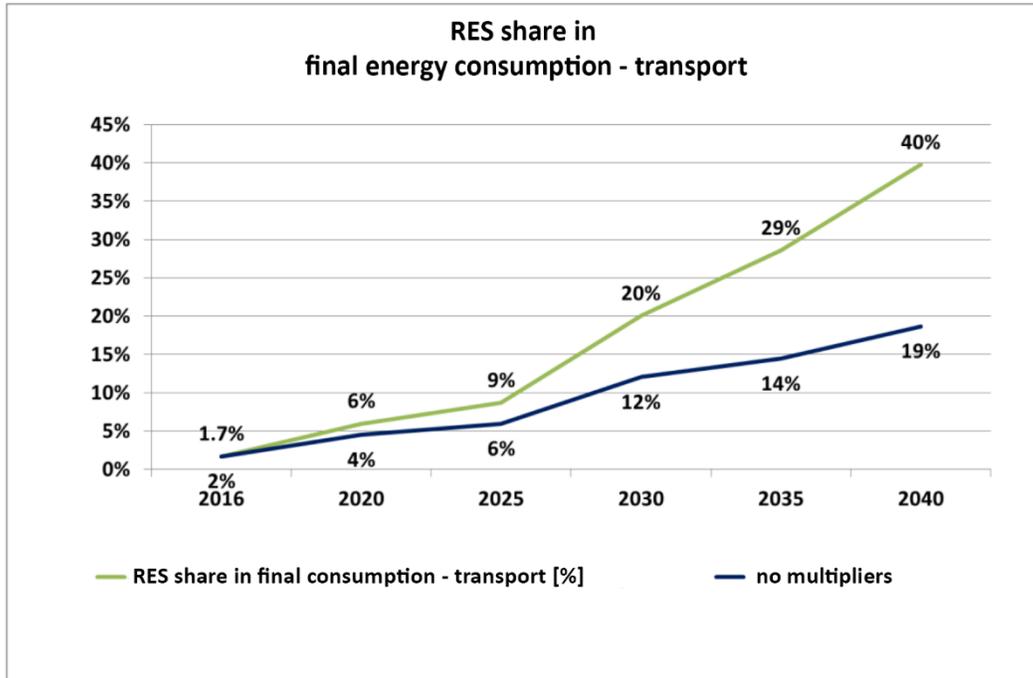
As shown in Graph 46, the use of bioenergy (primary solid biomass) will continue to grow, but with a moderate rate until 2030, mainly due to the reduction of its use in the urban centres on environmental grounds. Thermal solar systems will continue to have a significant share, mainly for domestic hot water heating in the building sector, increasing significantly in absolute figures, but their share in total final consumption is not expected to be significantly differentiated by 2030. The use of heat pumps for heating purposes is expected, also in the scenario of additional policies and measures, to play the most decisive role in RES penetration in the final consumption by 2030 with their market share in the contribution of RES for heating purposes amounting to 41 % in 2030.



Graph 46: Development of RES shares for heating and cooling in the final consumption of energy until 2040.

Finally, the transport sector is characterised by fast increase of the RES share, mainly due to the penetration of biofuels and the considerable contribution of electricity, which is generated from RES to a great extent, as analysed in the following paragraphs. Thus, in line with the Graph 47 RES penetration in

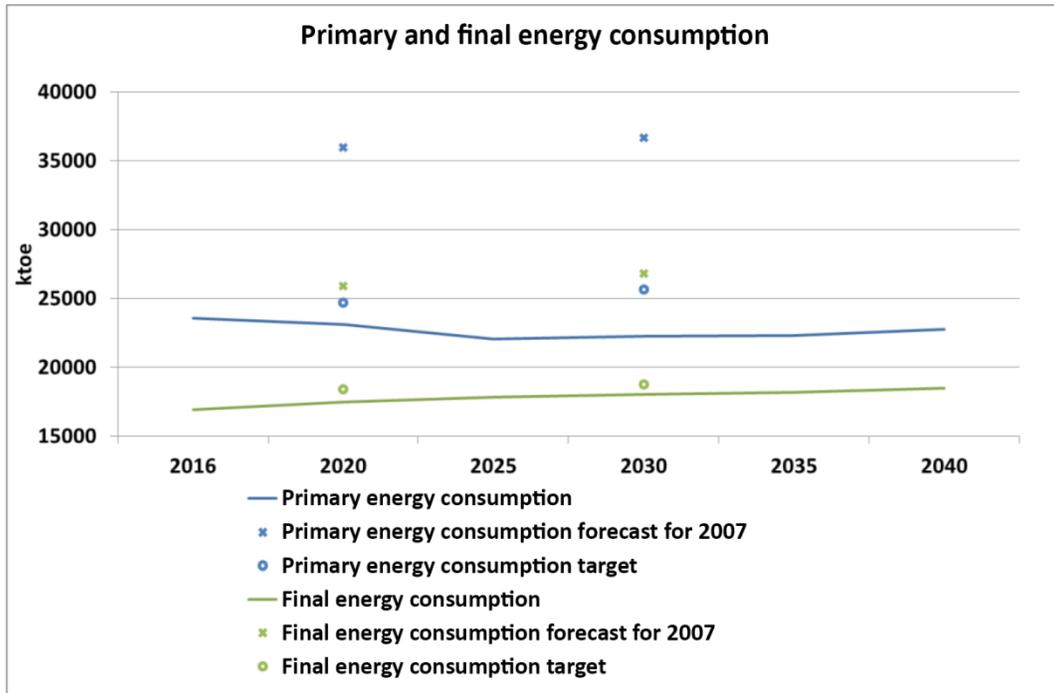
the final consumption of energy for transport will be 20 % 2030, as calculated according to the Revision of Directive 2009/28/EC for the promotion of RES, with the actual share (without multipliers) being at the level of 12 %.



Graph 47: Development of market penetration of RES in the final consumption of energy for transport until 2040 for the scenario of additional policies and measures²⁷.

As regards the overall primary consumption of energy shows a moderate decrease until 2030, while, specifically for the years 2020 and 2030, it is achieved to have lower consumption compared to the respective targets, as shown in Graph 48. In parallel, a moderate increase of the final consumption of energy and its relative stabilisation is observed over the period from 2020 to 2030. As shown in Graph 48, in 2020 it is estimated that the final consumption of energy will be 5 % lower than the respective objective, while for 2030 the reduction of the final consumption of energy is more than 30 % that was predicted in 2007 and reaches 33 %. In addition, as in the case of existing policies and measures, the improvement of the energy efficiency of the system is evident through the penetration of RES, mainly in the electricity generation, which is reflected in the reduction of the difference between the primary and the final consumption of energy.

²⁷ The RES share in transport has been calculated as provided for in the revision of Directive 2009/28/EC on the promotion of RES, and includes specific multipliers for the contribution of advanced biofuels and electricity from RES.

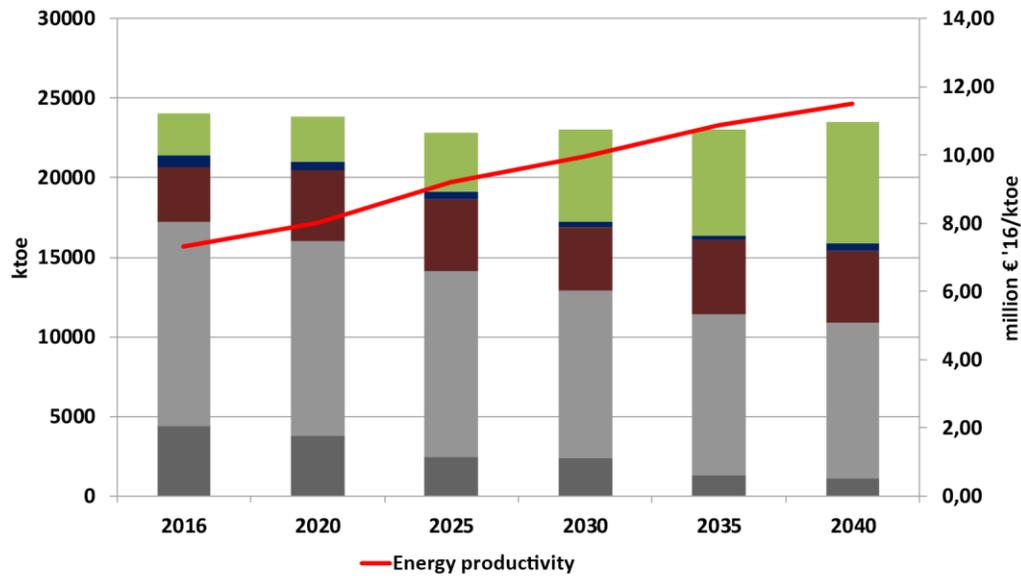


Graph 48: Development of primary and final consumption of energy until 2040.

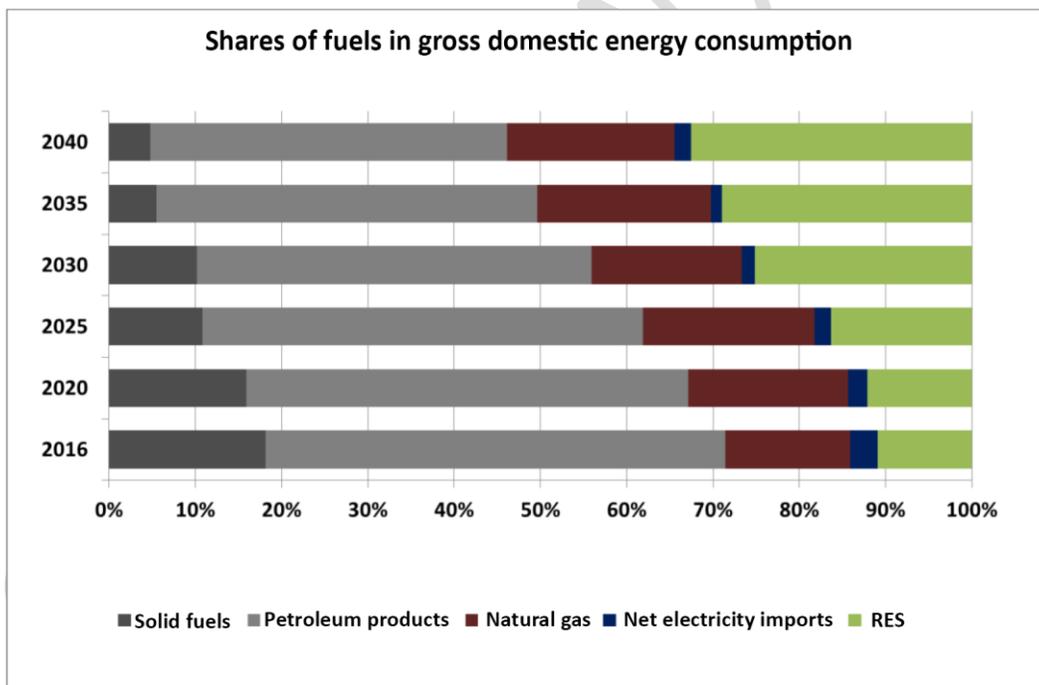
In the energy system in total, gross domestic consumption of energy shows a relative stability, which results in a significant improvement of the cost-efficiency of the energy sector, as shown by the development of the energy productivity indicator (Graph 49).

In particular, energy productivity shows an increase of 42 % in 2030 compared to 2016. At the same time, the higher market penetration of RES is evident, as it is essentially tripled compared to 2016, while the share of solid fuels and petroleum products is significantly limited (Graph 49).

Gross domestic energy consumption



Shares of fuels in gross domestic energy consumption



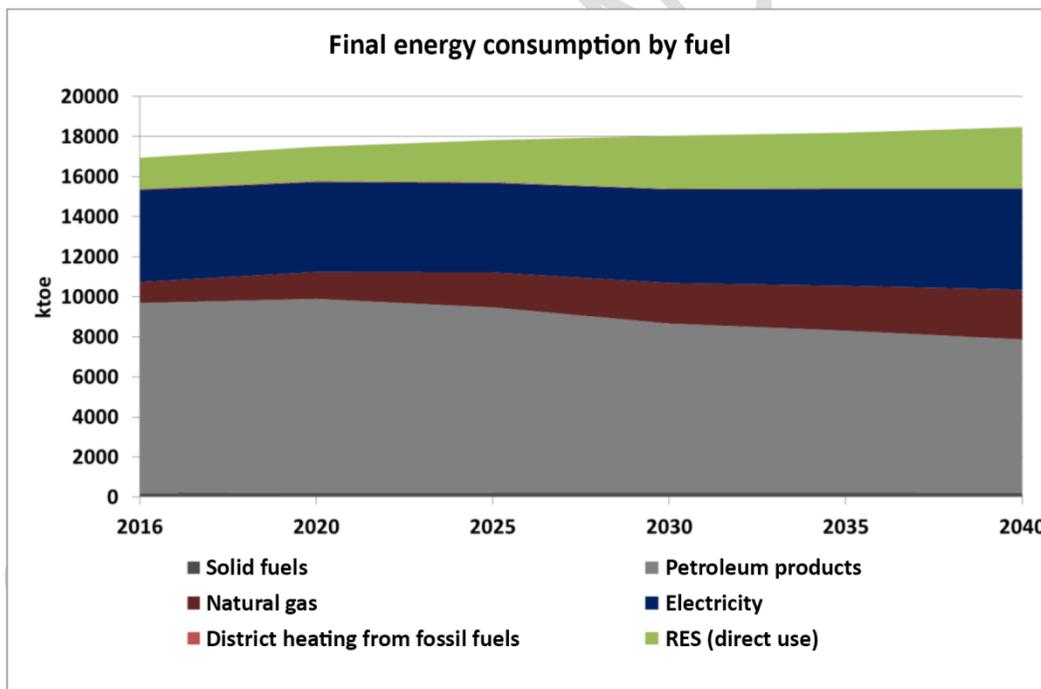
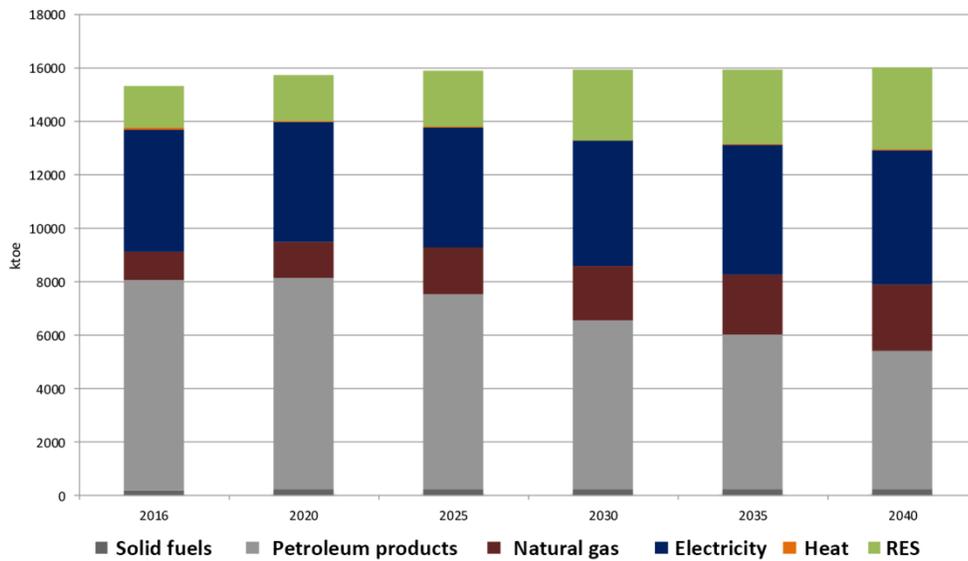
Graph 49: Development of fuels shares in the gross domestic consumption until 2040 for the scenario of additional policies and measures.

The final consumption of energy has a modest overall increase by 7 % in 2030 compared to 2016. The major part of this increase refers to the period 2018-2020, while the reduced rate of increase of the final consumption of energy during the years 2021-2029 leads to the achievement of the energy saving target

equal to 33 % for 2030, compared to the estimation of the final consumption for 2030 as reflected in the year 2007, with the forecast for final consumption of energy being equal to 18 Mtoe (Graph 50).

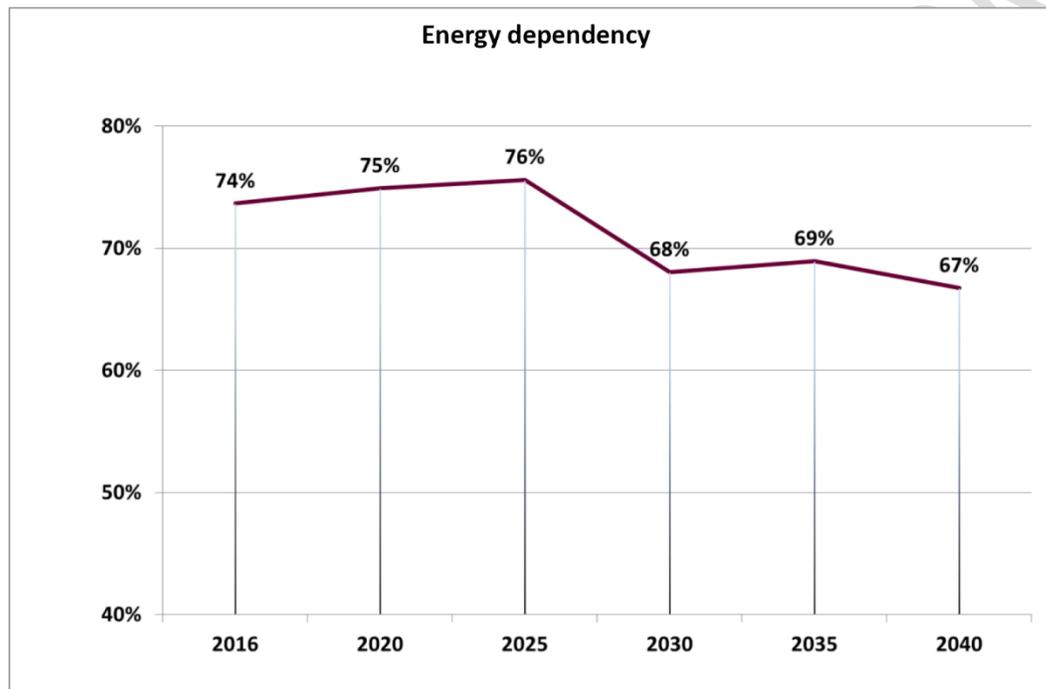
COURTESY TRANSLATION

Final energy consumption by fuel, except air transport and shipping



Graph 50: Development of the shares of the final consumption of energy fuels until 2040 (excluding aviation and navigation, b. total FEC).

In parallel, the direct use of RES in the final consumption of energy is more than doubled (i.e. thermal solar, geothermal, heat pumps, bioenergy) in 2030 compared to 2016, with a slight decrease in the direct use of oil products and a significant rise of the direct use of natural gas. The district heating from fossil fuels remains stable and its share in the total is very low, amounting to 0.2 % in 2030 (Graph 50). The total final consumption of energy includes also the consumption of the sub-sectors of transport related to aviation (national and international) and domestic shipping in respect of which there is no provision for the adoption of measures and policies to improve their energy efficiency.



Graph 51: Development of energy dependency by 2040.

With regard to the energy dependency of the country from fuel imports, there is a moderate variance of the specific indicator, achieving a percentage of reduction in 2030 of 7 percentage points compared to 2020, and 6 percentage points compared to 2016 (Graph 51). This result is mainly due to the high RES penetration in the national energy mix, which over-compensates the big reduction in the use of domestic lignite in electricity generation.

5.1.1.3 Evolution of electricity generation

The evolution of electricity generation until 2030 consists of high market penetration of RES and the withdrawal of lignite and petroleum plants, scheduled, on the one hand, due to high emissions of gaseous pollutants and the age of such plants and, on the other hand, in view of the upcoming interconnections of the islands with the interconnected system during the period considered. The essential characteristics of the electricity generation system until 2040, in line with the scenario of additional policies and measures, are presented in the table below.

Table 44: The essential characteristics of the electricity generation system until 2040, in line with the scenario of additional policies and measures.

Electricity generation	2016	2020	2025	2030	2035	2040
Installed Capacity [GW]						
Solid Fuels - Lignite	3.9	3.4	3.5	2.7	1.5	1.3
Oil	1.7	1.8	1.0	0.5	0.1	0.1
Natural Gas	5.2	5.2	5.2	5.4	4.9	4.6
Bioenergy	0.1	0.1	0.1	0.3	0.3	0.4
H/E	3.4	3.4	3.7	3.9	3.9	4.0
Wind farms	2.4	2.8	4.0	6.6	7.3	7.4
PV	2.6	3.5	5.3	6.8	7.4	8.0
Solar thermal plants	0.0	0.0	0.1	0.1	0.1	0.1
Geothermal	0.0	0.0	0.0	0.1	0.2	0.3
Total	19.3	20.3	23.5	27.8	27.6	28.0
New power of storage systems	0.0	0.0	0.0	0.7	0.7	0.7
Net Electricity Generation [GWh]						
Solid Fuels - Lignite	14800	13128	9213	9026	5197	4588
Oil	5381	3529	2913	1536	1525	1509
Natural Gas	13218	17163	15265	10255	13017	11503
Bioenergy	253	269	518	1736	2023	2361
H/E	5603	5152	5983	6269	6361	6453
Wind farms	5146	6575	9491	15508	17302	18055
PV	3930	5655	8319	10342	11039	11827
Solar thermal plants	0	0	257	260	264	267
Geothermal	0	0	0	631	1301	1971
Total	48339	51471	51959	55563	58029	58533
Net import [GWh]	8796	6200	5196	4156	3460	5191
CO₂ emissions from Electricity Generation [Mt CO₂]	31	28	18	15	10	8

The high penetration of RES is due to the expected further reduction in the costs of RES technologies for electricity generation, in particular solar parks and wind power stations, as well as the expected increase in the generation costs of conventional plants, due to the increase in emission allowance costs²⁸. These two parameters make RES particularly competitive with conventional plants for the period following 2020. Moreover, the objective of RES penetration in gross final energy consumption is achieved in the most cost-effective manner for national economy, through the significant increase of the contribution of wind power stations and solar parks in electricity generation. This is because these technologies will entail a very low weighted average cost of electricity generation, directly competitive market-wide with conventional thermal power plants in the short term.

It is noted that part of the petroleum plants on the islands which will be interconnected will continue to exist, mostly on cold standby. However, their operation will be considerably limited as, on the one hand, the electric charge of islands will be mainly covered by the interconnected system and, on the other hand, the implementation of the IED and MCPD Directives will be decisive in determining the maximum number of hours of operation.

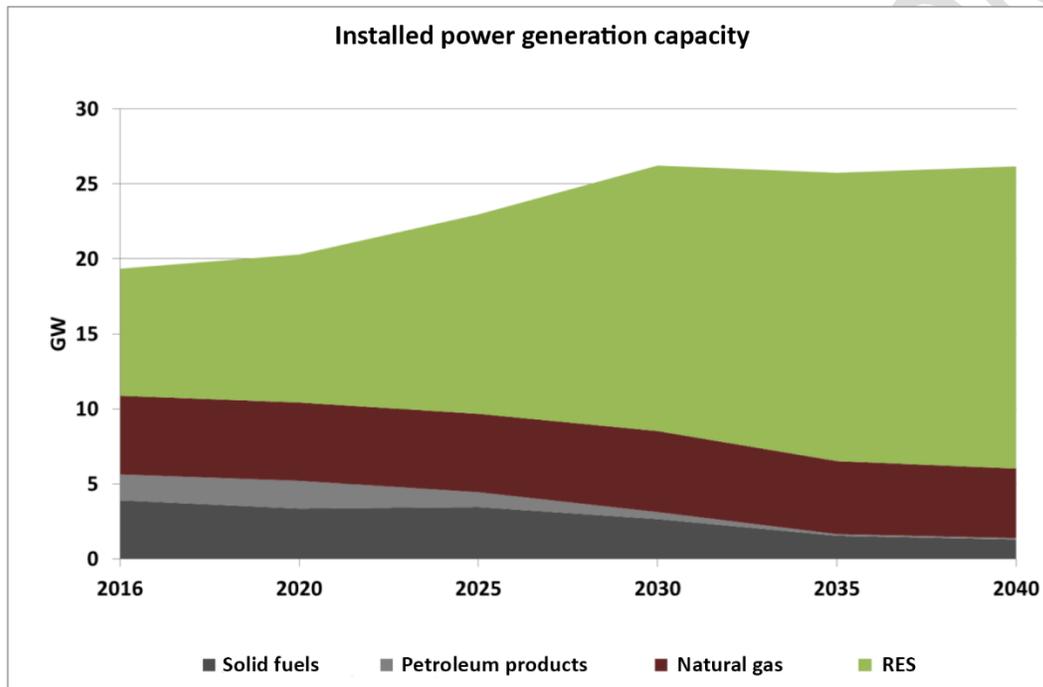
In particular, the total installed capacity for electricity generation will be increased by 44 %, mainly due to the significant penetration of variable RES plants, as variable RES have a lower utilisation rate in relation to conventional thermal power plants. The installed capacity of lignite plants and petroleum plants is expected to decrease by 1.3 GW individually in 2030 in relation to the year 2016, while the total installed capacity of RES shall increase by 9.2 GW in the same period, with more than 90 % of the increase occurring in wind farms and solar parks (Graph 52). It is noted that, specifically for photovoltaics, the broadening of their use has also been integrated at distribution network level, especially in urban and semi-urban areas, through energy offsetting schemes and projects by energy communities.

With regard to the shares and amounts of installed capacity of both thermal power generation plants and RES technologies, it is noted that they have been determined in the context of energy simulation, taking into account specific assumptions regarding the reduced cost of electricity generation by such plants and they should be considered indicative and possible, but not binding. Specifically regarding RES, and taking into account the context of competitive tendering procedures and the development of cost reduction in electricity generation, therefore, the possibility of developing such procedures outside the

²⁸ It is noted that this analysis has taken into account only one scenario regarding the evolution of emission allowance prices, on the basis of prices proposed by the European Commission, as indicated in the relevant section of the Annex.

support system, the final distribution of the power of such projects on a technological level may be differentiated by 2030.

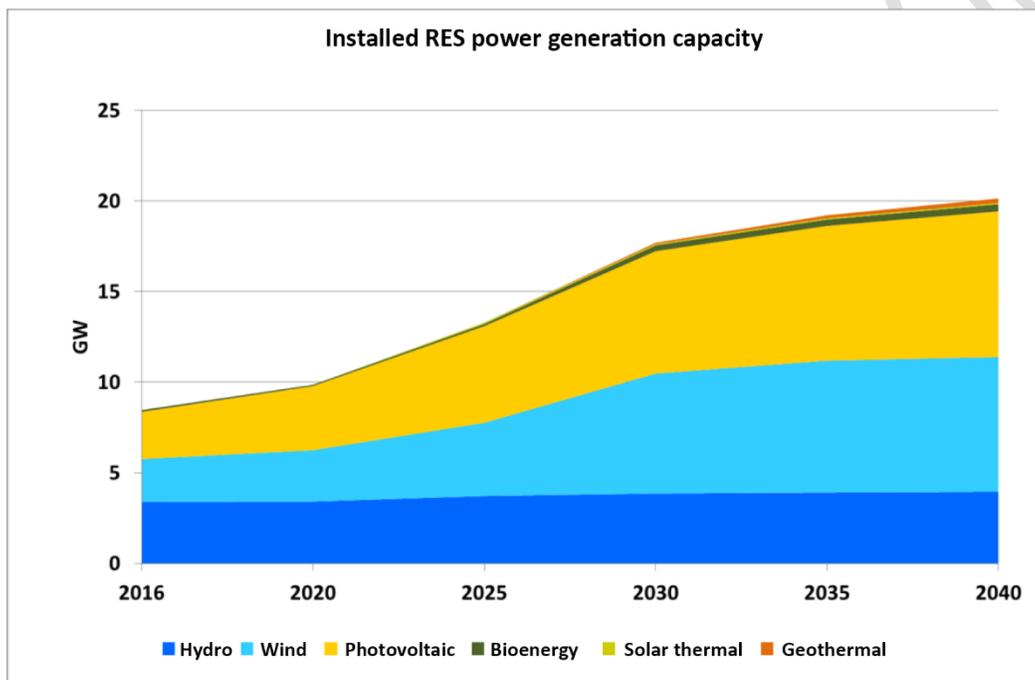
Therefore, more than anything, the requirement for electricity generation from RES must be treated as an objective and rely on the competition between RES technologies, to assess which power will finally contribute to this objective. Accordingly, as regards thermal power plants, this approach must also not be binding and the operating margin for plants, whether new or not, or withdrawal of plants must be determined depending on the needs of the liberalised and competitive electricity market.



Graph 52: Evolution of installed capacity of electricity generation plants until 2040.

More specifically, regarding the contribution of RES to electricity generation, variable RES (wind power stations and solar parks) shall increase for the year 2020 to 6.4 GW, and to 13.4 GW for 2030. It is estimated that 700 MW of cumulative new power from wind power stations and solar parks will have to be installed on average every year. The installed capacity of H/E power stations is increasing by about 450 MW and by 260 MW for bioenergy in relation to 2016, while it is estimated that the penetration of solar thermal power stations and geothermics will be low (Graph 53).

In order to achieve high levels of variable RES penetration in the most economically efficient manner (sufficiently low cuts in their production), there is a need for energy storage (pumped storage hydropower, batteries, conversion into gas, etc.). Based on previous studies on the costs related to the mainland electricity generation system (such as the 2018 Ten-year Development Plan of ENTSO-E), the TIMES model considers that new storage systems are integrated in the years following 2025 (in addition to the existing hydroelectric power stations of Sfikia and Thisavros, which have a pumping capacity), the cost of which is estimated at around EUR 0.5 billion. The total power transferred to storage systems for 2030 is estimated at about 1.5 TWh, with losses around 30 % over their cycle of use.



Graph 53: Evolution of installed capacity of electricity generating RES until 2040.

The provision for this new installed power from wind farms and solar parks, as shown in annual figures, reflects the size of the challenge to achieve the national objective regarding the participation of RES in the gross final consumption of electricity, but also as a whole. More specifically, although the required technical and financial potential is available, annual growth rates must be achieved for these technologies cumulatively over ten years, rates which have never been achieved in our country in the past, with the exception of the period 2011-2013, when they were achieved with a non-economically sound and, ultimately, non-sustainable, manner.

For the above reasons, it is necessary, in addition to achieving a reduction of the weighted cost of electricity generation from these technologies so that no operating support is required, to provide all necessary regulatory, technical and coordinating tools so that said growth may be achieved under

transparent, continuous and unambiguous terms for all stakeholders and for the local communities where such new RES projects are carried out.

It is noted that in order to achieve the above figures in new installed power generated from wind farms and solar parks, and the highest possible utilisation rate, it is necessary to also examine gradually new opportunities at the level of technology applications (e.g. storage), as well as new categories of projects (e.g. marine wind farms), provided that it is deemed that the reduction in the cost of such applications and projects is sufficient so that the total new cost of electricity generation by such applications and projects remains at a low level and is directly competitive under electricity market rules. In this context, the relevant regulatory and operational framework for these projects should be developed.

At the same time, to include all these projects in the energy networks, it is important to examine the need to expand the networks for the distribution and transmission of electricity, as well as the timely scheduling of the expansions which will be deemed necessary from a technical and financial point of view. In any case, all these projects are expected to operate with full obligations for participation in the electricity market.

The simulation of the evolution of the energy system until 2030 also provides for the significant development of new PV projects at distribution network level, especially at low network voltage, as it is expected that more than 500 MW of such systems will be installed across the Greek territory, especially through the energy offsetting scheme, thereby further utilising gradually the possibilities provided for the use of these systems on a technological and regulatory level.

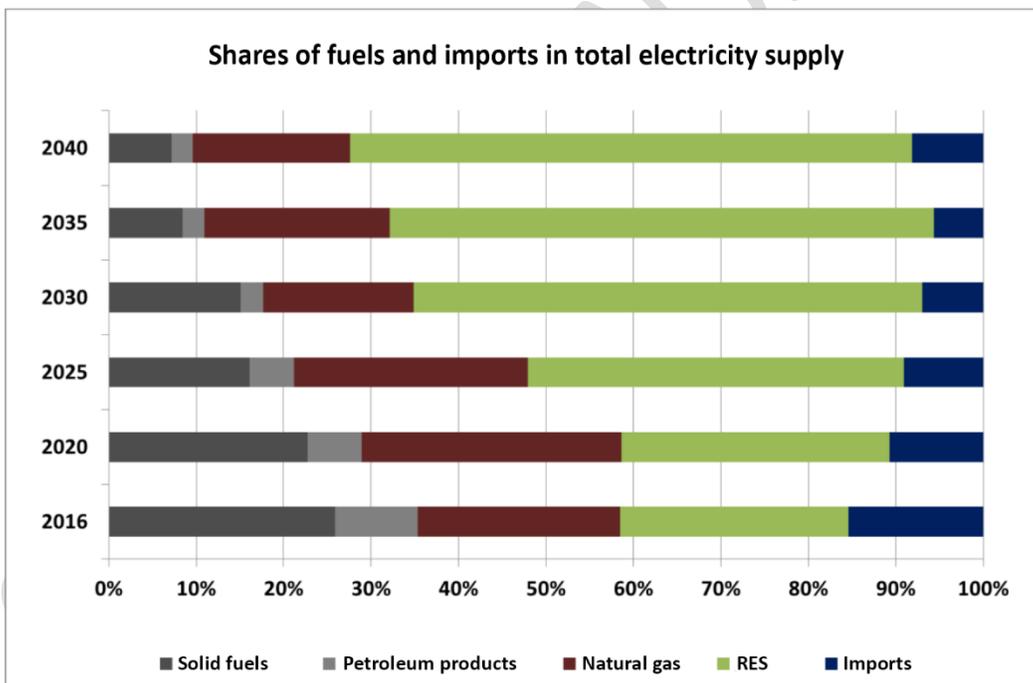
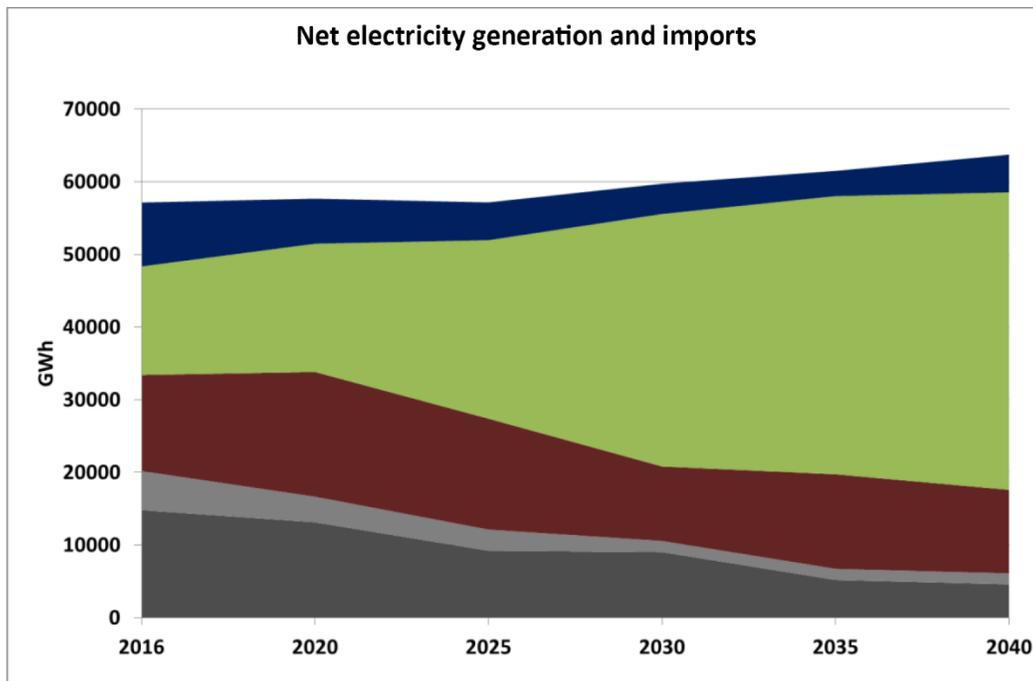
A specific reference should also be made to the new RES power expected to be installed by plants with fully distributed electricity generation features (i.e. stations exploiting geothermal fields, biomass and biogas), which are expected to quadruple their current installed capacity by 2030. These plants are necessary for the proper functioning of the domestic electric system, also taking into account the expected large figures of electricity generation from variable RES, so that they may also function as compensation charges when necessary. The development of this category of electricity generation from RES is an additional challenge to the development of the energy system, because it requires optimal coordination at local level both at the stage of licensing and construction, and at the stage of the operation of such plants, and these specific plants have the highest domestic added value among RES technologies during the time of their operation.

The challenges for the development of small hydroelectric projects are equally significant, as the installed power of such projects is expected to be more than double over the next decade and until 2030, thus contributing greatly to the significant contribution of RES to gross electricity consumption. Specially regarding projects subject to multiannual licensing procedures, the existence of a clear, continuous framework is necessary for this category of projects to achieve such participation figures.

As shown in Graph 54, the total net electricity generation, including imports in the country, increases in relation to that in 2016 by 5 % until 2030 and is gradually based on 'cleaner' sources (the share of imports is reduced to 7 % of the total electricity for distribution). In particular, while approximately 31 % of electricity generation is currently undertaken by power stations using lignite as fuel, lignite-based power generation will account for 16 % of power generation in 2030.

Accordingly, the share of petroleum products in electricity generation shall be reduced substantially, i.e. by 71 %, by 2030, mainly due to the withdrawal of petroleum plants currently installed on non-interconnected islands, following their interconnection with the mainland system. However, in 2030, there will still be little generation from petroleum products (around 3 %), mostly involving electricity generation in refineries.

The involvement of natural gas in electricity generation by 2030 also appears reduced, by 22 % in relation to 2016, its share in total electricity generation decreasing from 27 % in 2016 to 18 % in 2030.



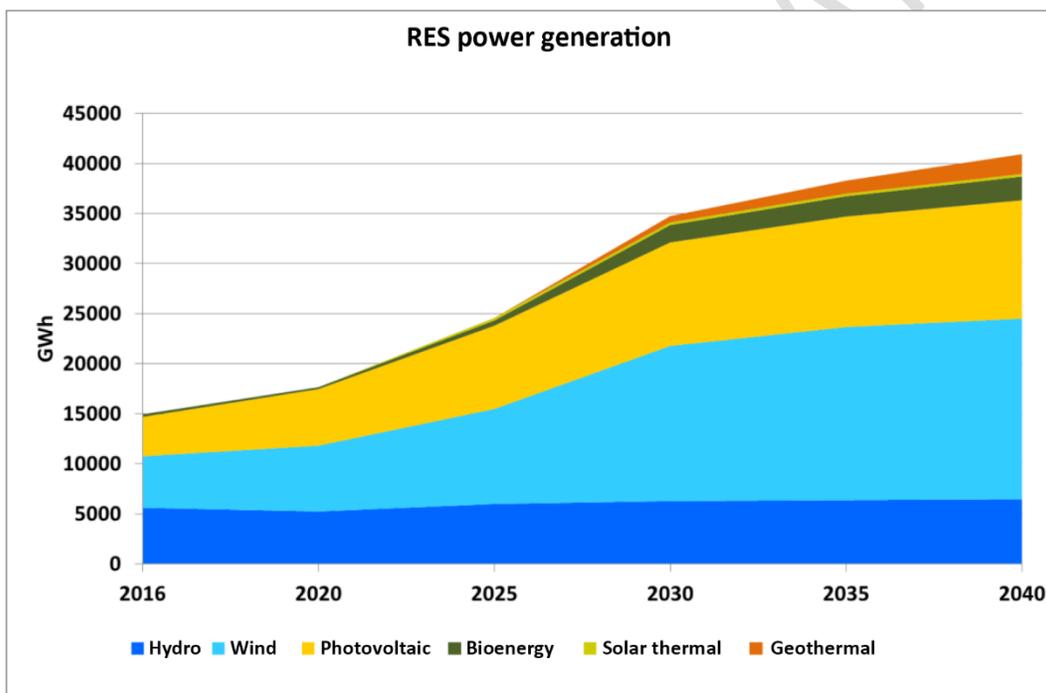
Graph 54: Evolution of net electricity generation and imports until 2040.

Regarding RES in particular, as shown in Graph 55, electricity generation by wind farms will triple in 2030 in relation to 2016, and electricity generation by solar parks will increase by 163 % in 2030 in relation to 2016.

The increase of electricity generation by H/E power stations is 12 % in 2030 in relation to 2016, and has been calculated taking into account the average domestic hydraulicity based on historical data per geographical water resource.

The increase of bioenergy (biomass, biogas and bioliquids) in electricity generation is also expected to be significant, as their share in total net electricity generation is expected to multiply by seven in 2030.

Although solar thermal power plants and geothermics had no contribution in 2016, they will feature among the RES technologies contributing to electricity generation in 2030.

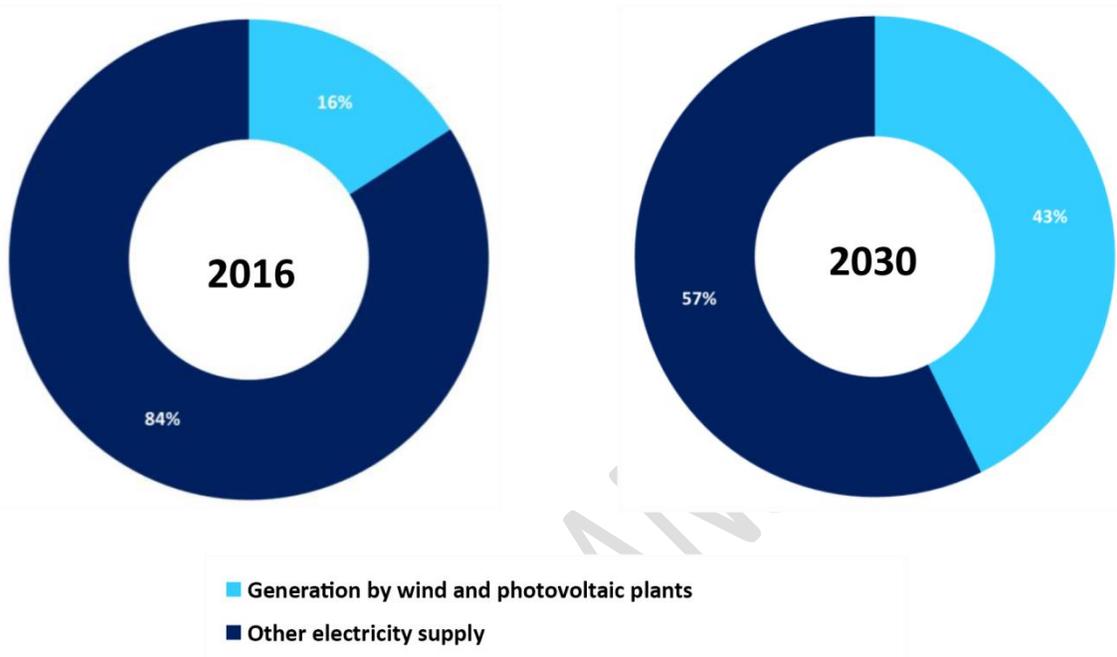


Graph 55: Evolution of electricity generation from RES until 2040.

However, solar thermal power plants and geothermal plants are expected to have a small contribution of 0.5 % and 1.1 % respectively in the total domestic electricity generation, but with particularly significant advantages for the operation of the energy system. Additionally, their contribution as a share should be added to that of the plants using bioenergy, increasing the total share of these technologies to 5 % of the total domestic electricity generation and to 8 % of electricity generation from RES.

In 2030, all fully distributed RES plants together, including hydroelectric plants, will represent a 16 % share in total domestic electricity generation and a 26 % share in electricity generation from RES.

Graph 56 indicates the share of electricity generation from variable RES (wind power stations and solar parks) in the total electricity distribution, which shall increase from 16 % in 2016 to 43 % in 2030.



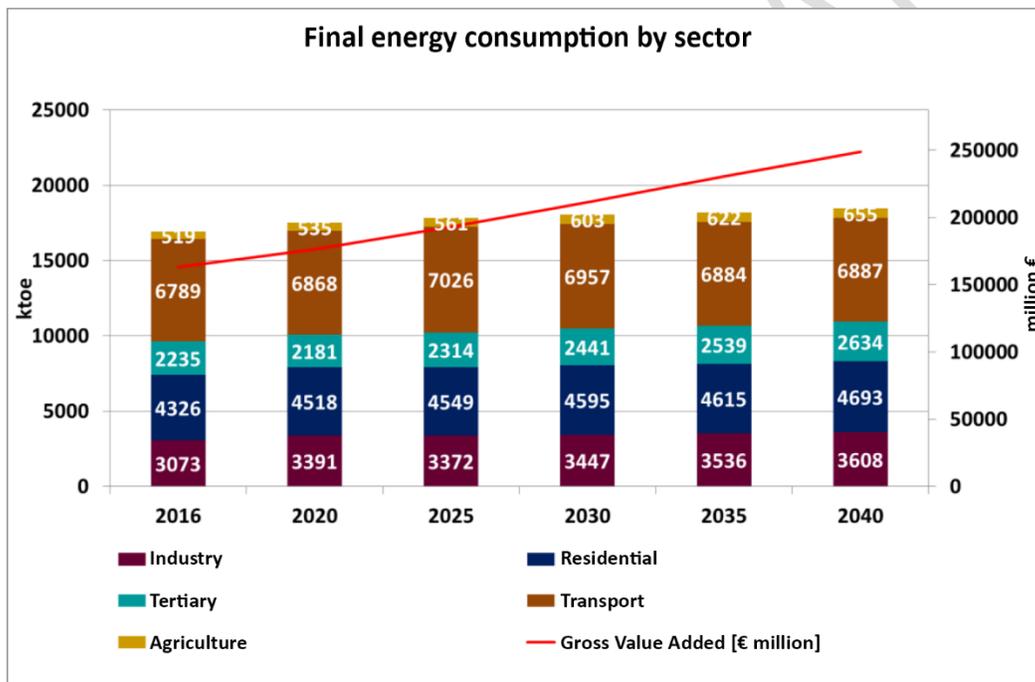
Graph 56: Time illustrations of the share of electricity generation by wind farms and solar parks in total electricity distribution.

The development of transmission networks shall include the interconnection of the Cyclades and Crete with the mainland system until 2025 and of the Dodecanese until 2030, as well as strengthening the transmission system, aiming to optimise the use of the potential of RES in the south Aegean and the Dodecanese, to make use of local geothermal and solar thermal fields, to meet the demand for energy from cleaner sources as compared to energy from petroleum plants on the islands, and to prepare the system for higher RES penetration. The scenario involving additional measures and policies takes for granted that the necessary measures have been taken to prevent the saturation of networks, which may result from the integration of new and increasing variable RES stations.

5.1.1.4 Development of energy consumption in end-use sectors

The graphs below show the development of energy consumption in end-use sectors until 2040, taking into account assumptions regarding the development of demand in each end-use sector (Graph 57).

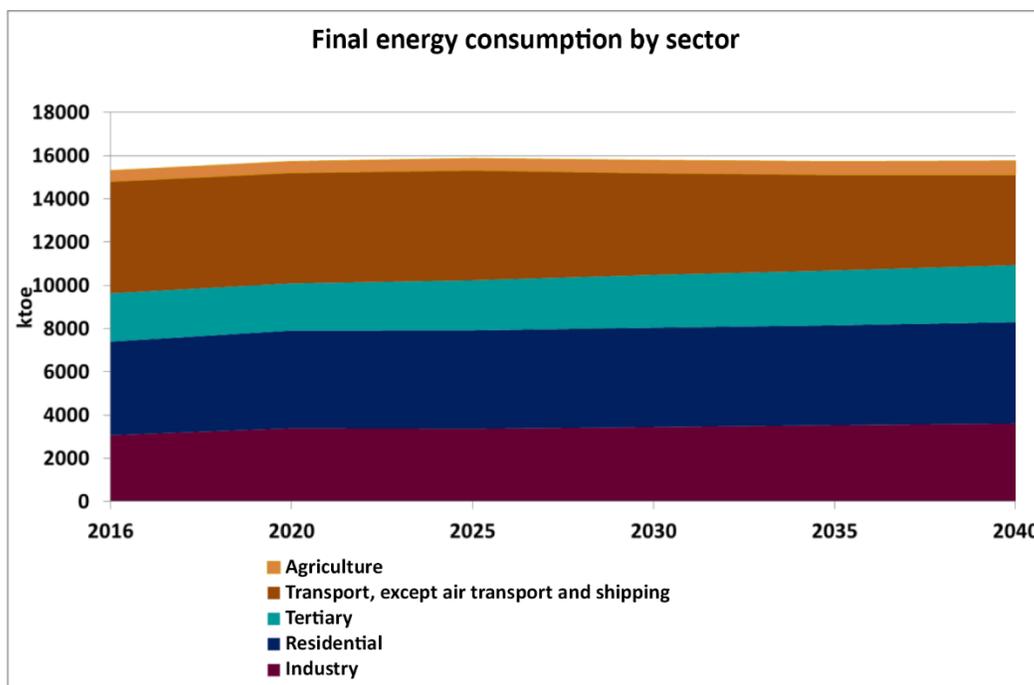
Examining this development, it is found that final energy consumption will increase continuously until 2030, as also indicated by the development of economic figures, the available income of households and the added value of economic sectors, which determines the development of demand to the maximum extent. However, precisely due to the implementation of energy-saving measures and policies, and in view of the elasticity of demand, the growth rate of final energy consumption in relation to the year 2020 shall be limited significantly and be significantly lower than the added value growth rate, as shown in Graph 57.



Graph 57: Development of final energy consumption by sector by 2030.

More specifically, in the transport sector, which is historically linked to the largest portion of final energy consumption, and despite the slight increase between 2016 and 2020, as a result of the gradual exit from the economic crisis, final energy consumption is maintained at 7 Mtoe in the period 2020-2030 and starts decreasing gradually after 2025. Through the gradual replacement of the non-energy-efficient fleet of vehicles, as well as the upgrading of public transport vehicles, the above-mentioned energy consumption appears reduced by 0.5 Mtoe as compared to the average consumption of the decade 2006-2016 and by approximately 2 Mtoe as compared to the historical high of 2009. It is worth noting

that maintaining final energy consumption at the same levels has also absorbed the increase in consumption in the sub-sectors of air transport and maritime shipping, which is related to the increase of transport in the respective sub-sectors (Graph 58).



Graph 58: Development of final energy consumption by sector until 2040, with the exception of energy consumption in the sub-sectors of air transport and maritime shipping.

The contribution of the household sector in total final consumption in 2016 shall be 26 %, but it is reduced to 25 % in 2030. This leads us to the conclusion that, despite the increase observed in the total final consumption of energy, energy-saving measures manage to restrain the increasing trend in this sector. In absolute figures, the average consumption in the period 2016-2030 shows a decrease compared to the corresponding consumption in the period 2006-2016 from 4.7 Mtoe to 4.5 Mtoe, and the difference is even stronger in comparison to the historically maximum consumption of 5.5 Mtoe in 2006.

5.1.1.5 Development of energy consumption in the building sector

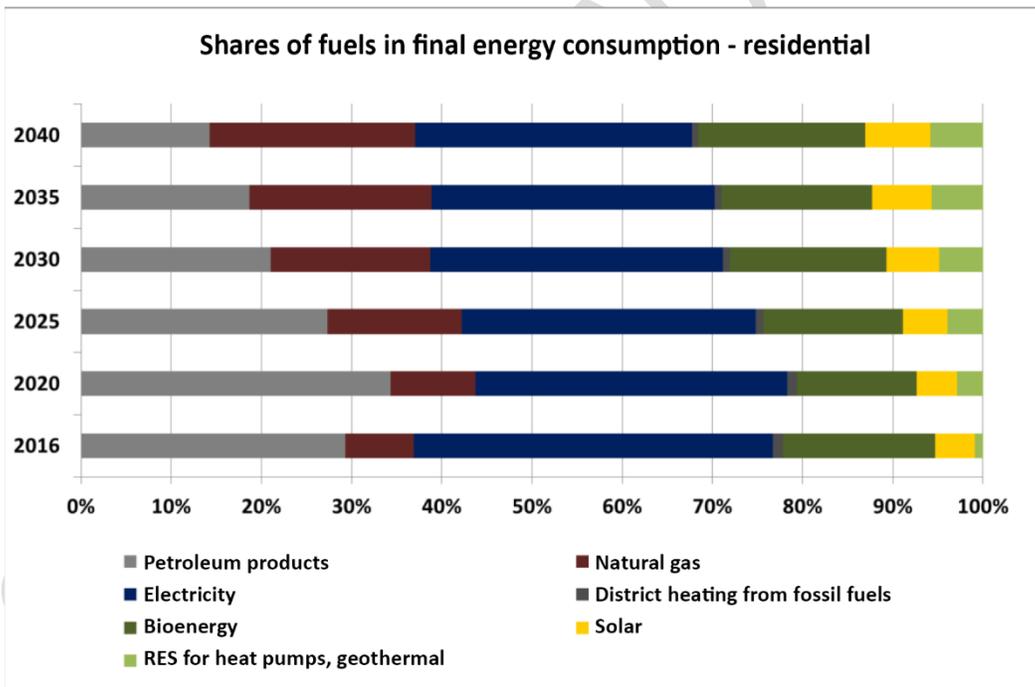
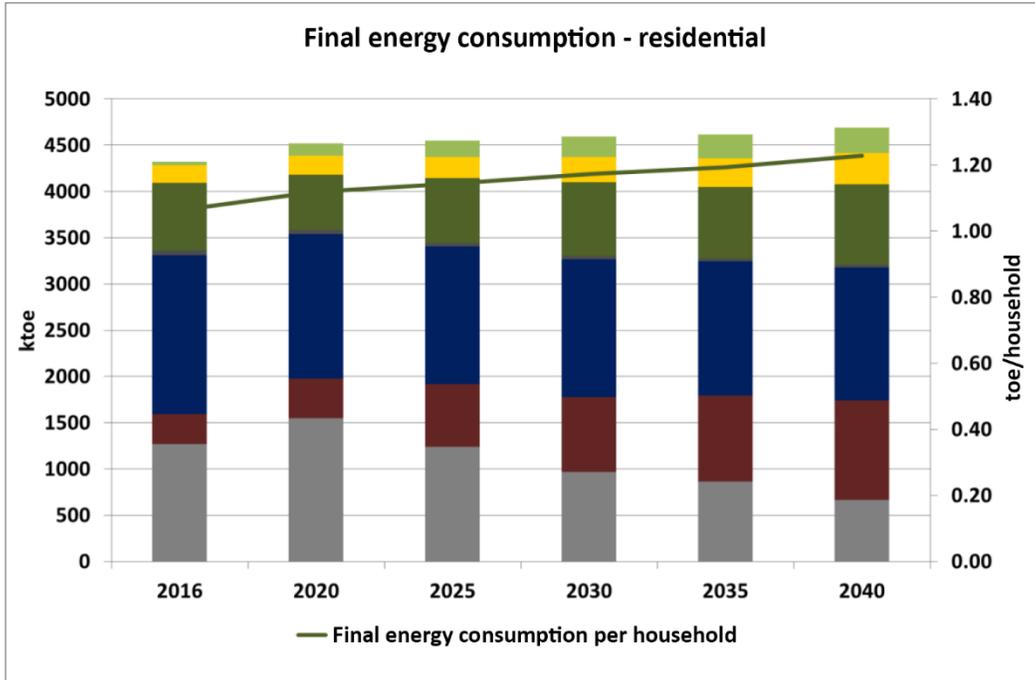
The building sector in 2030 shows a moderate increase in energy consumption as compared to that of the household sector (Graph 59) and higher growth as compared to that of the tertiary sector (Graph 60) in 2016.

In the household sector, gas and electricity still hold the largest market shares in final consumption, with a total rate of 53 % in total final consumption in the household sector in 2030. The highest increase is observed in the use of natural gas, with its market share in total consumption increasing from 8 % in 2016 to 18 % in 2030, replacing part of oil consumption for heating, the share of which is reduced from 29 % in 2016 to 21 % in 2030.

Table 45: Final energy consumption in the household sector until 2040, based on the additional policies and measures scenario.

Residential sector	2016	2020	2025	2030	2035	2040
Final Energy Consumption	4326	4517	4549	4595	4615	4693
Consumption by fuel						
Oil	1266	1551	1242	968	862	668
Natural Gas	329	424	677	810	933	1071
Electricity	1719	1562	1484	1490	1446	1439
District heating from fossil fuel	51	47	38	36	34	33
Bioenergy	728	599	703	800	771	870
Solar	192	204	225	269	308	337
RES for heat pumps, Geothermal	39	129	179	222	261	275
CO₂ emissions from the Household sector [Mt CO₂]	4.7	5.8	5.4	4.9	4.9	4.6
Final energy consumption per household [toe/household]	1.06	1.12	1.14	1.17	1.19	1.23

What is more, the use of thermal solar systems increases by 40 % in 2030 compared to 2016, while the decrease by 13 % in 2030 compared to 2016 is also observed in the consumption of electricity, mainly due to the decrease in the use of non-efficient electrical heating systems of individual households, which has intensified over the years of the economic crisis. This is understood more easily considering the fact that the average electricity consumption rate during the period 2000-2012 was 29 % and increased to 40 % in the period 2013-2016. Heat pumps (considered as ambient heat, not taking into account electricity consumption) and geothermics represent a 5 % share in 2030 compared to 1 % in 2016, whereas the use of bioenergy still represents 17 % of the final energy consumption in 2030 (800 ktoe), because of the limitations to the penetration of this technology in urban centres.



Graph 59: Development of final energy consumption in the household sector until 2040

According to the available historical data, it is noted that the final energy consumption in the household sector is strongly linked to heating degree days. This correlation appears to be lost from the year 2012 onwards, mainly due to the economic crisis. It is observed that, in the first years of the economic crisis, maintaining heating comfort was a priority for Greek households; however, the lasting crisis period made it impossible for them to continue covering their needs sufficiently.

Therefore, during the period of exiting the economic crisis and until 2030, an increase in final energy consumption in the household sector should be expected, reaching the levels of the previous decade. However, the slight 6 % increase in final consumption as estimated for the period 2016-2030 is due primarily to targeted energy-saving measures implemented during that period. This conclusion is reinforced by the fact that the average final energy consumption in the period 2016-2030 appears reduced by 16.5 % compared to the corresponding average consumption in the period 2002-2012.

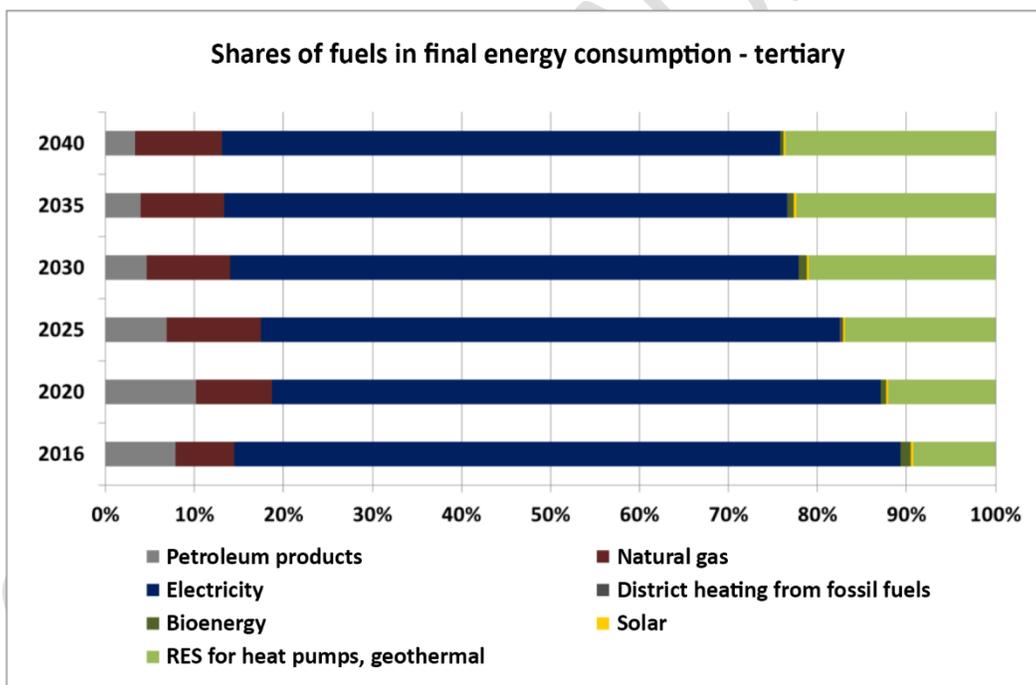
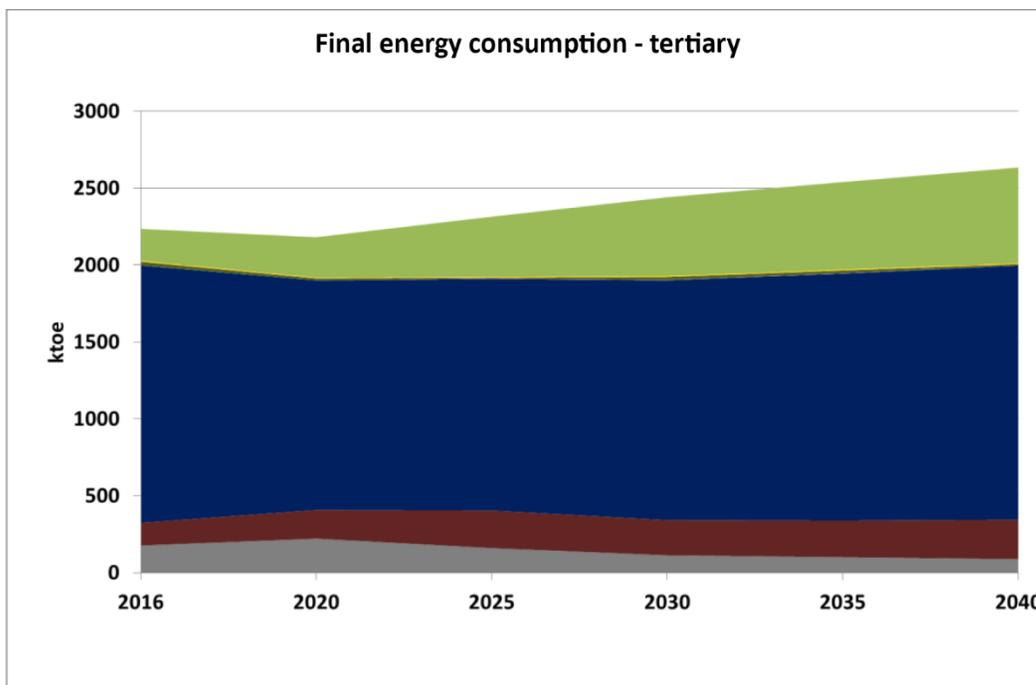
The tertiary sector is dominated by the penetration of heat pumps with a participation rate of 21 % in 2030 compared to 9 % in 2016 (only ambient heat is taken into account for the calculation of the share, without considering electricity consumption). Heat pumps are able to meet both heating and cooling needs; therefore, they are introduced mainly to replace old boiler/cooler systems as well as old, low-performing air conditioners.

Table 46: Final energy consumption in the tertiary sector until 2040, based on the additional policies and measures scenario.

Tertiary sector	2016	2020	2025	2030	2035	2040
Final Energy Consumption	2235	2181	2314	2441	2539	2634
Consumption by fuel						
Oil	176	221	150	113	100	88
Natural Gas	148	186	244	229	238	257
Electricity	1672	1492	1505	1558	1605	1651
District heating from fossil fuel	0	0	7	3	4	0
Bioenergy	25	13	12	20	16	10
Solar	7	5	6	6	7	7
RES for heat pumps, Geothermal	206	263	391	512	568	621
CO₂ emissions from the Tertiary sector [Mt CO₂]	0.5	1.1	1.1	0.9	0.9	0.9
Energy Productivity in the Tertiary Sector [million € '16/ktoe]	50.74	69.89	74.17	77.81	83.11	88.42

The penetration of heat pumps, where part of their consumption relates to electricity and the rest to ambient energy (RES), the progressive replacement of old lighting systems to new, high energy efficiency ones, including the energy upgrade of street lighting, but also the use of more energy-efficient devices, lead to a reduced share of electricity in total energy, more specifically, by 11 percentage points, from 75 % in 2030 to 64 % in 2016. Finally, the increase in the consumption of natural gas by 90 ktoe in the period 2016-2030, also contributes to the reduction of the final consumption of energy from oil by 76 ktoe in the same period. As a result, oil represents only 5 % of total consumption, compared to an average of 17 % over the period 2000-2013.

COURTESY TRANSLATION



Graph 60: Development of final energy consumption in the tertiary sector until 2040.

Targeted energy-saving measures should bring building stock renovation rates back to the levels of the decade 2000-2010, placing the country's overall building stock renovation rate above the European annual 1 % average. In particular, in the housing sector, it is expected that by 2030 10 % of the total number of dwellings in the country, i.e. 40 000 homes per year, will be upgraded in terms of energy

efficiency (in part or in full). Such energy upgrades also include the dwellings of vulnerable households through targeted actions, thus addressing energy poverty and aiming to achieve the relevant national objective set. As regards public buildings, it is expected that at least the target for upgrading and renovating in terms of energy efficiency 3 % of the total surface area of the buildings used by the central government every year until 2030, will be met.

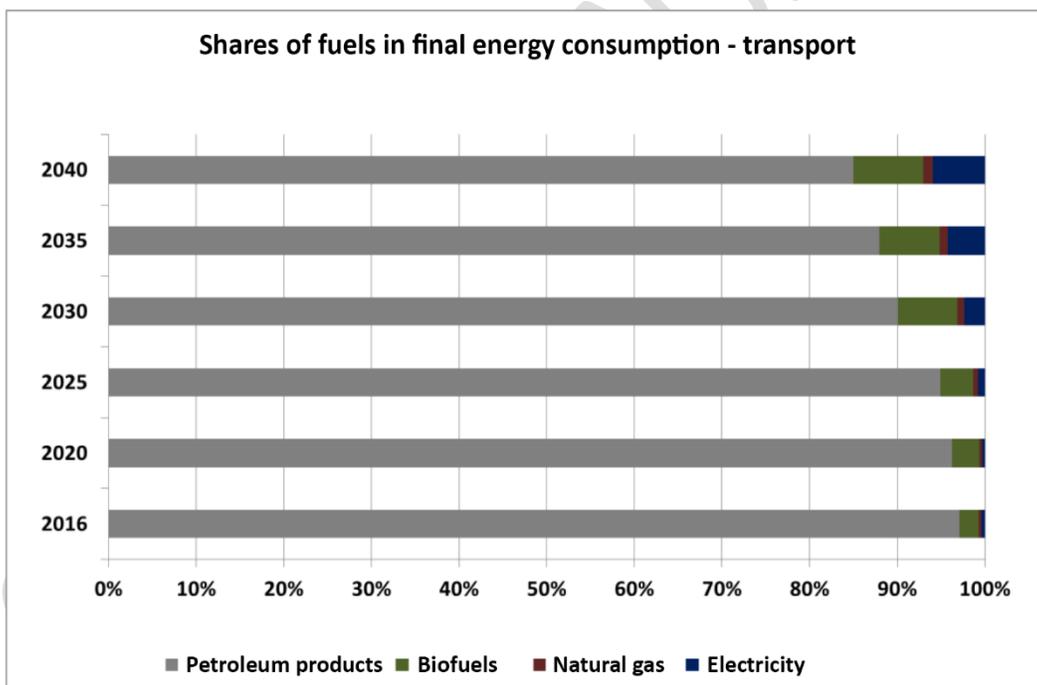
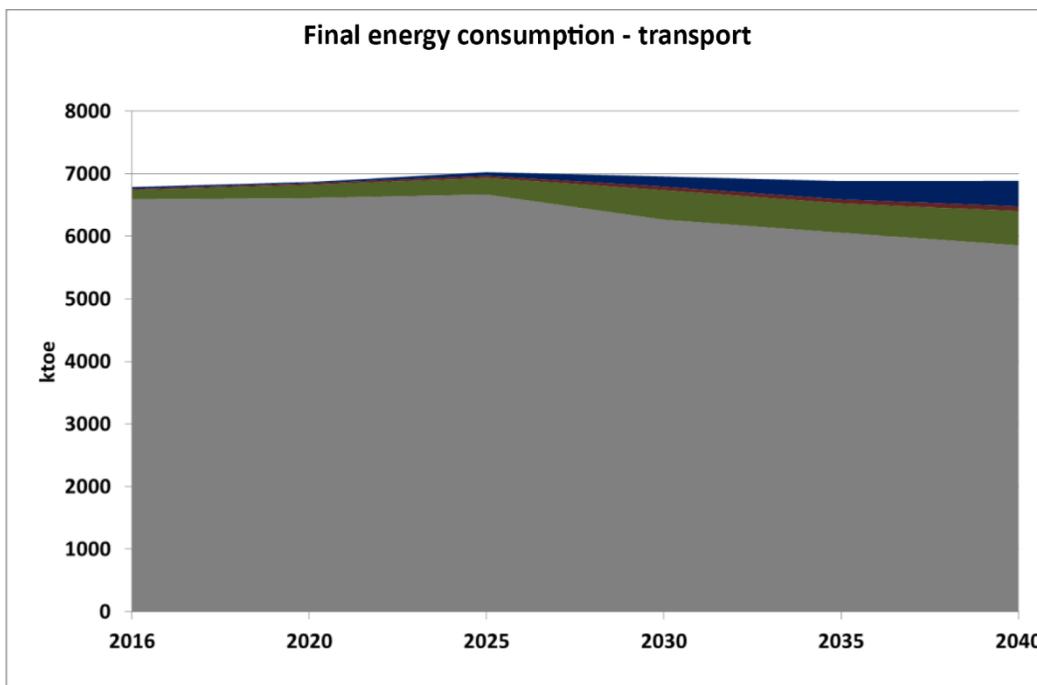
5.1.1.6 Development of energy consumption in the transport sector

In the transport sector, a relatively large market penetration of biofuels and electricity, as well as a corresponding decrease in petroleum products, is observed (Graph 61). However, the decrease in the use of petroleum products in the transport sector is low in absolute figures compared to that of 2016, as it appears around 5 % in 2030, its share decreasing to 90 % in 2030 compared to 97 % in 2016. The use of biofuels increases significantly, as their share triples and their percentage in total consumption increases to 7 % in 2030, as opposed to only 2 % in 2016. Electricity has a 2 % share in total energy consumption in 2030, i.e. 162 ktoe in 2030 as opposed to 28 ktoe in 2016, in absolute figures. Please note that the development of the participation of biofuels in the energy mix of the transport sector to represent such a high share shall be subject to the participation of advanced biofuels and the enhancement of their mixing rates into diesel and petrol.

Table 47: Final energy consumption in the transport sector until 2040, based on the additional policies and measures scenario.

Transport sector	2016	2020	2025	2030	2035	2040
Final Energy Consumption	6789	6868	7026	6957	6884	6887
Consumption by fuel						
Oil	6592	6602	6668	6266	6057	5856
Bioenergy	149	212	266	472	470	547
Natural Gas	19	24	35	57	65	77
Electricity	28	30	57	162	292	407
CO₂ emissions from the Transport sector [Mt CO₂]	17.1	17.0	17.0	15.7	14.9	14.2

It is a challenge to develop appropriate infrastructure, supply chains and production plants in order to strengthen the domestic production of such fuels, thereby contributing to the increase of domestic added value and to the decrease of the country's energy dependency.



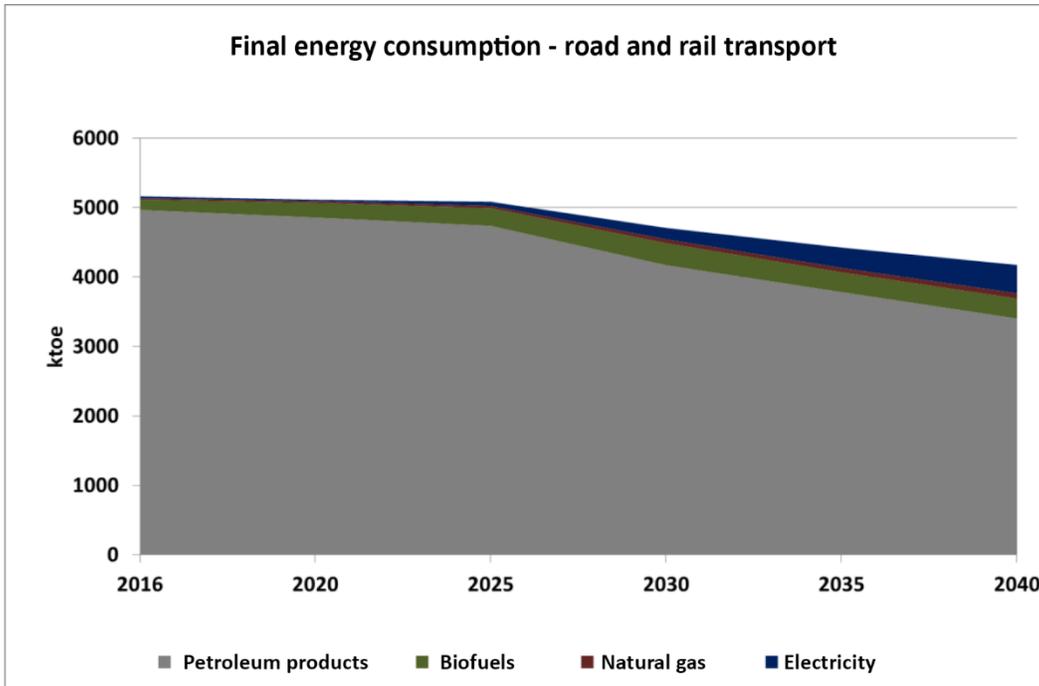
Graph 61: Development of final energy consumption in the transport sector until 2040.

However, if air transport and domestic maritime shipping consumption is exempted from the transport sector, the share of petroleum products appears more significant, as it decreases from 96 % in 2016 to 86 % in 2030. This is due to the significant penetration of electrification and biofuels in these sub-sectors of the transport sector, their aggregate share increasing to 10 % in 2030 from 3 % in 2016. Specifically regarding electrification in road transport, the results show a **10 % participation of passenger vehicles operating with electricity in the entire fleet of passenger vehicles in circulation in 2030**. The gradual renewal of the existing fleet of passenger vehicles, with new, more energy-efficient transport units, such as electric vehicles and more efficient internal combustion vehicles, will lead to a decline in the final energy consumption of passenger vehicles, amounting to 9 %, 293 ktoe in absolute figures for the period 2016-2030. For example, the electrification of road passenger transport leads to a significant improvement in energy efficiency per transport unit, unit consumption decreasing to 24 ktoe/kpkm in 2030 compared to 32 ktoe/kpkm in 2016. Furthermore, the full electrification of track-based modes will lead to a decline in final energy consumption in the sub-sector by 26 %.

More specifically, the electrification of transport will be mainly achieved through railways, whereas in the sub-sectors of passenger vehicles and buses, the share of electricity is expected to increase to 5 % and 3 % respectively in 2030.

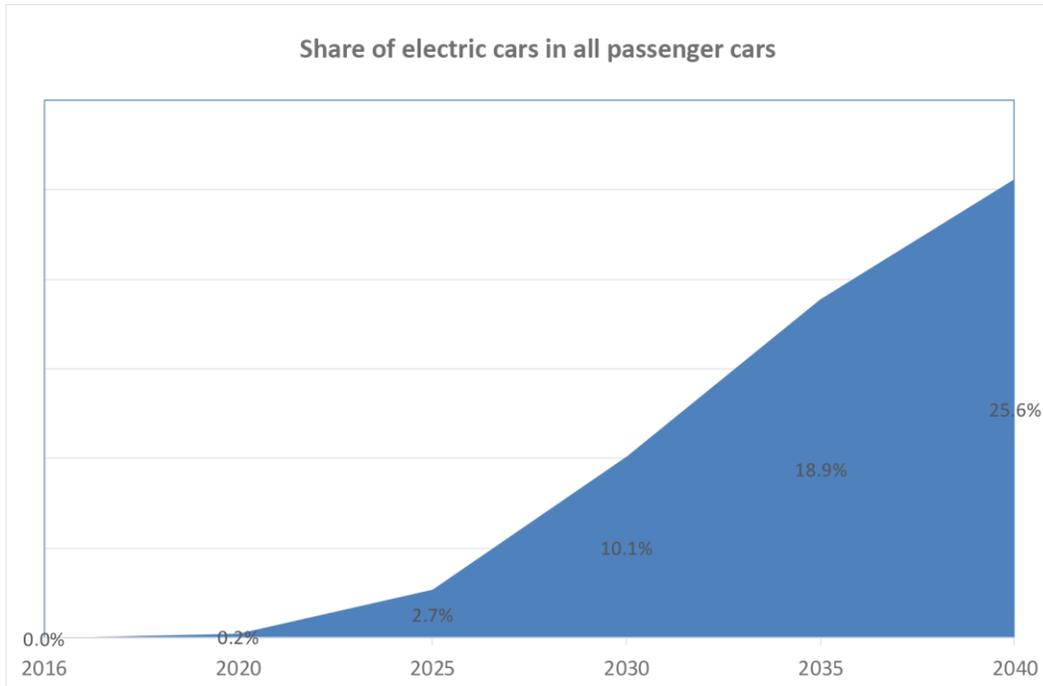
The change from petroleum fuels to electricity, mainly in track-based modes, is integrated in the general framework of policies in the transport sector, where, in conjunction with urban mobility actions and the enhancement of the role of urban track-based modes and railways, which are expected to undertake some of the transport load of passenger and commercial vehicles, will achieve the maximum possible energy savings and the improvement of energy efficiency per transport unit. In addition, a further penetration of natural gas is foreseen, mostly through new registrations in the transport sector, especially in the category of buses and heavy vehicles, thus ensuring both environmental and energy benefits.

Accordingly, biofuels are expected to replace a large share of oil consumption over the period 2016-2030, thus transforming their participation share in the passenger vehicles sub-sector from 1 % to 7 %.

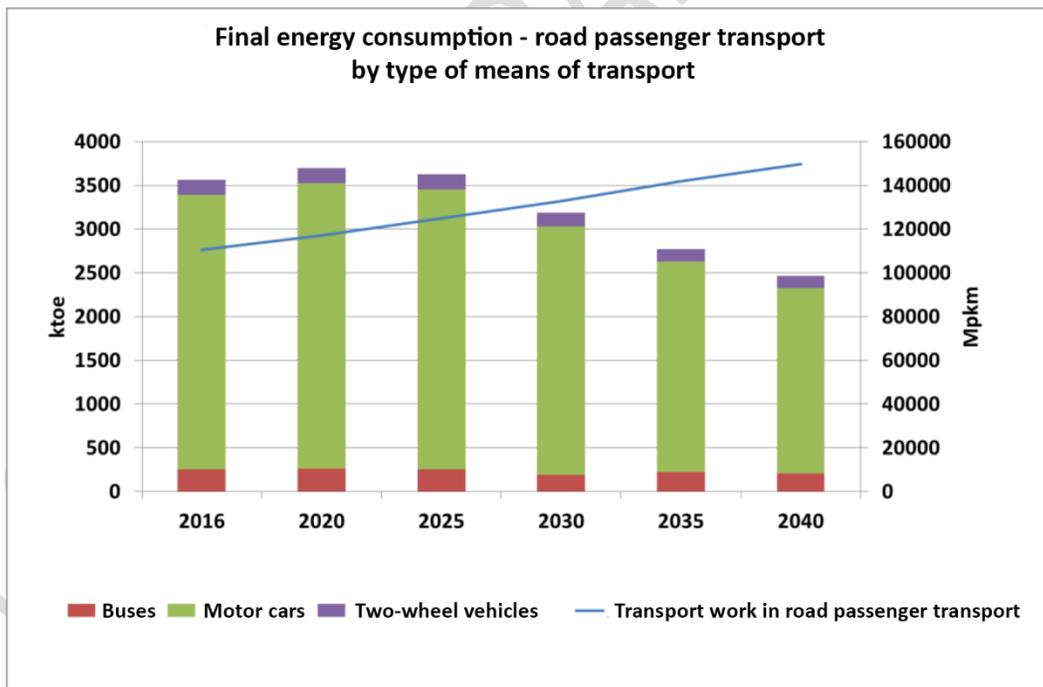


Graph 62: Development of final energy consumption in road and rail transport until 2040.

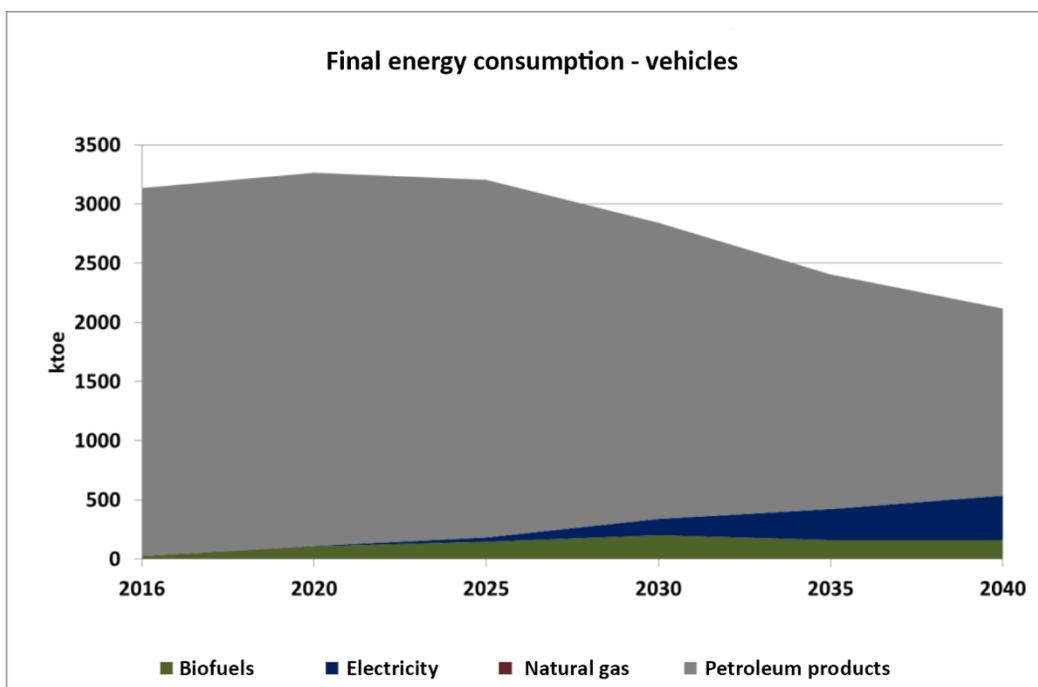
It is noted that further analysis on and assessment of technological developments and the optimal fuel mix to be achieved by 2030 are already being carried out in the transport sector, and the quantitative and qualitative figures regarding energy consumption in this sector will be updated based on the results of the most specialised analysis.



Graph 63: Development of the share of electric cars out of all passenger cars until 2040.



Graph 64: Development of final energy consumption for road passenger transport by type of means of transport until 2040.



Graph 65: Development of final energy consumption of cars by type of fuel until 2040.

5.1.1.7 Development of energy consumption in industry

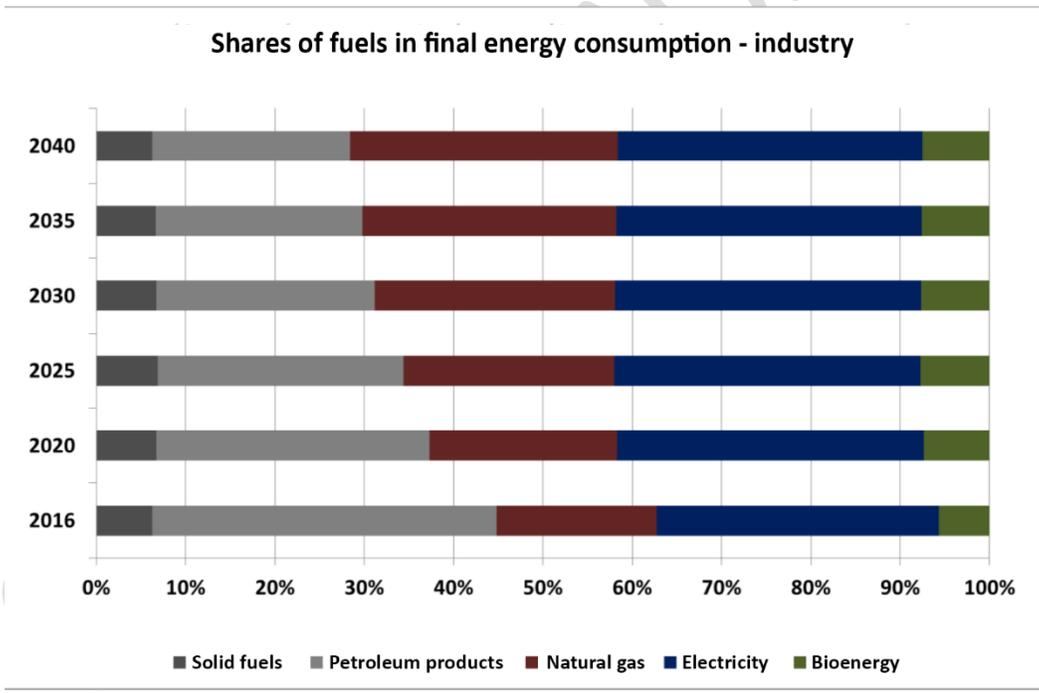
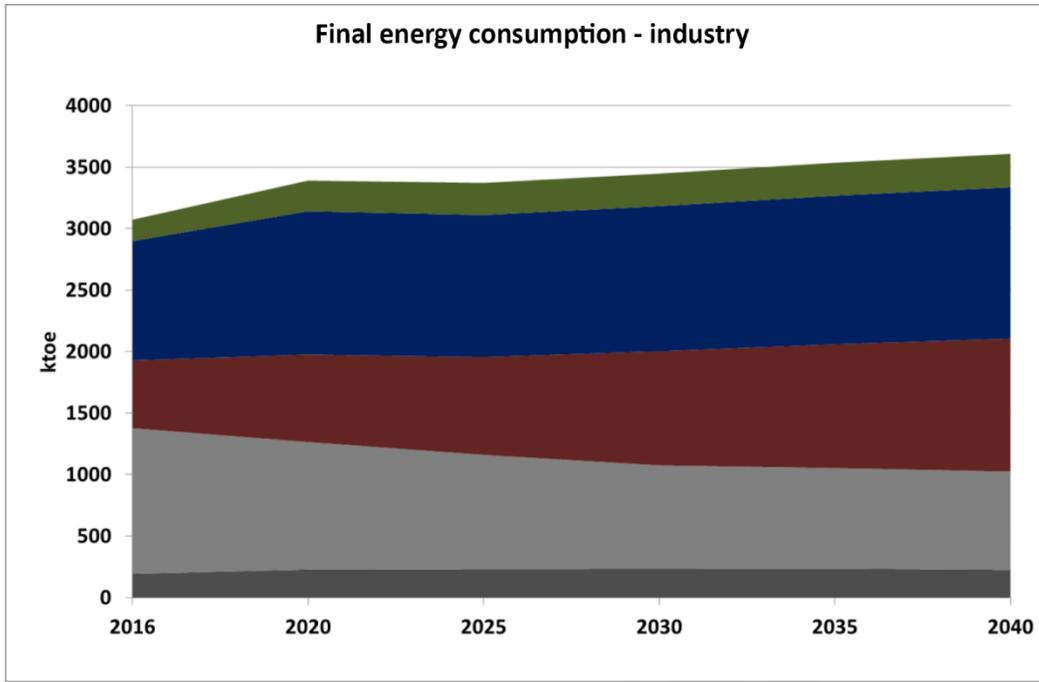
In industry, a small increase in final energy consumption is observed over the period 2016-2030, mainly due to the expected development of economic figures and the added value of economic sectors. In particular, there is an overall increase in energy consumption by 12 % in 2030 compared to that in 2016. As a result of this increase, final energy consumption in 2030 is at 90 % of the average final energy consumption over the period 2000-2016.

Table 48: Final energy consumption in the industrial sector until 2040, based on the additional policies and measures scenario.

Industry	2016	2020	2025	2030	2035	2040
Final Energy Consumption	3073	3391	3372	3447	3536	3608
Consumption by fuel						
Solid fuel	194	229	231	233	236	226
Oil	1184	1036	930	842	817	799
Natural Gas	551	712	794	928	1007	1082
Electricity	970	1165	1156	1180	1208	1230
Bioenergy	174	249	261	264	268	271
CO₂ emissions from Industry [Mt CO₂]	11.3	10.9	10.2	10.4	10.6	11.2
Energy Productivity in Industry [million € '16/ktoe]	5.87	4.80	5.18	5.54	5.91	6.24

As regards the shares of individual energy products, a 68 % increase is observed in the final consumption of natural gas in 2030 compared to that in 2016, followed by a 52 % increase in the consumption of bioenergy over the same period. On the contrary, the consumption of petroleum products in the period 2016-2030 is reduced in absolute figures by 342 ktoe, while their share in total final energy consumption is also reduced from 39 % in 2016 to 24 % in 2030. As the consumption of petroleum products drops, they are replaced by natural gas and electricity. In particular, in 2030, the share of natural gas and electricity in final energy consumption amounts to 27 % and 34 % respectively, compared to 18 % and 32 % respectively in the year 2016.

COURTESY TRANSLATION



Graph 66: Development of final energy consumption in the industry sector until 2040.

5.1.2 Assessment of the interaction and the impact of energy-efficiency/energy-saving policies

Based on a Bottom up approach, considering the demand in energy generation, it is easily understood that planning aiming to the improvement of energy efficiency as regards final demand and energy generation and distribution, may help to achieve the national and, by extension, the European objectives on energy and the climate in the most cost-effective manner.

The improvement of energy efficiency in this plan is considered a horizontal priority, and the related measures complement the other basic aspects of the planning.

Regarding decarbonisation, as it is concluded based on the existing measures and policies (Chapter 1) and the new ones (Chapter 3), measures for the improvement of energy efficiency play an important role in achieving a reduction in greenhouse gas emissions. As for renewable energy sources, measures for the improvement of energy efficiency are of primary importance for meeting the targets associated with the use of RES in cooling and heating and in transport. As regards security of supply, it is clear that the improvement in energy efficiency and the resulting decrease in demand leads to reduced energy dependency of the country, while measures based on demand response are already in force both for electricity and natural gas. With regard to the aspect of the internal energy market, in the context of the measure for the Development of Energy Transport-Distribution, actions will be implemented for infrastructure managers to improve the energy efficiency of infrastructure, aiming to improve energy efficiency in transport, distribution, load management and the interoperability of networks. In addition, the measures for the improvement of energy efficiency in vulnerable households are essential for dealing with the phenomenon of energy poverty.

The recognition of the value of energy efficiency as a good practice functioning in a complementary and horizontal manner as regards the promotion of the energy and social objectives of the country is undeniable and demonstrated by both the good practices implemented so far and the way that this aspect is handled in the planning.

Good practices that have been followed to date aiming to the horizontal promotion of energy efficiency:

Use of resources in the operation of the European Emissions Trading Scheme (ETS): Part of the resources of the financing tool from the European Emissions Trading Scheme (ETS) is used to promote energy efficiency measures and policies by means of improving the conditions of financing such actions.

Synergies between RES and minimum energy performance requirements for buildings: All new and fully renovated buildings must meet with RES 60 % of their needs for domestic hot water.

Implementation of low discount rates: To determine the minimum energy performance requirements for buildings and review the related regulation, the country has set the main discount rate at 3 %, taking into account the social aspect of the cost-benefit analysis, recognising the multiple non-energy benefits of energy efficiency measures.

Implementation and dissemination of stricter energy efficiency policies: The country has successfully implemented energy efficiency schemes, by requiring that not only electricity and natural gas providers implement energy efficiency measures, which is the most common practice among Member States, but also providers of petroleum products.

Approaches in the context of the national plan for energy and the climate, for the horizontal promotion of energy efficiency:

Ambitious energy efficiency targets: (a) Objective to achieve energy savings in final energy consumption, at 33 % compared to the forecast on final energy consumption by the end of 2030. (b) Energy upgrade of 10 % of the building stock by 2030.

Macroeconomic effects of energy efficiency technologies: In the context of the national plan for energy and the climate and with a view to maximising the non-energy benefits of energy efficiency measures, the impact of key energy efficiency technologies in the sector of employment, on the increase in domestic added value, on revenue and the health of the citizens of the country, was assessed and taken into account.

Optimisation of synergies between RES and energy efficiency: Aiming to the optimal planning of energy efficiency policies, RES policies for heating and cooling, and RES policies in transport, through the study and analysis of a portfolio, the appropriate and optimum combinations of policies were determined, to achieve all related sub-objectives set in the context of the planning, whilst minimising the costs and the risk of the implementation of said objectives.

5.1.3 Assessment of interactions between policies and measures and planned policies and measures

The two scenarios in question feature significant differences in the development of the energy system, especially as regards their structure and the participation of fuels and technologies, as well as attaining the relevant energy and climate objectives for 2030 (Table 49).

Table 49: Differences among key energy figures between the scenario of existing policies and measures and the scenario of additional policies and measures.

Energy figure / Electricity indicator	Scenario of existing policies and measures	Scenario of additional policies and measures
Total emissions of greenhouse gases	75 Mt CO _{2eq}	70,6 Mt CO _{2eq}
Percentage of emission reductions in non-ETS sectors compared to 2005	28%	31%
Percentage of emission reductions in ETS sectors compared to 2005 (excluding the air transport sector)	60%	63%
Participation of RES in Gross Final Energy Consumption	25%	31%
Participation of RES in Gross Final Consumption of Electricity	48%	56%
Participation of RES in heating and cooling	29%	32%
Participation of RES in transport in accordance with the revision of the Directive	10%	20%
Participation of RES in transport, no multipliers of Directive	6%	12%
Savings in final energy consumption compared to the forecast of	32%	33%
Final energy consumption	18,2 Mtoe	18 Mtoe
Final electricity consumption	53,4 TWh	54,3 TWh

Energy figure / Electricity indicator	Scenario of existing policies and measures	Scenario of additional policies and measures
Contribution of RES in domestic electricity generation	54,8%	62,5%
Total installed capacity of Wind Farms and Solar Plants	11,4 GW	13,4 GW
Total installed capacity of RES for electricity generation	15,3 GW	17,7 GW
Net electricity generation from fossil fuels	24,2 TWh	20,8 TWh
Interconnection of autonomous island electrical systems (% of electric	60%	90%
Percentage of houses which will have undergone energy refurbishment or will	2,5%	10%
Energy dependency indicator	73%	68%
Increase in direct use of natural gas in end-use sectors	73%	93%
Share of electric private vehicles	5%	10%
Participation of heat pumps in the heating and cooling needs of	19%	25%

With regard to the participation of the RES in the energy system, the scenario of additional policies and measures achieves a higher RES share in the energy system, both overall and in individual sectors. This significantly higher participation of RES is the result of specific new policy measures or the enhancement of the efficiency and implementation of existing ones, aiming to achieve the specific objectives which are binding in terms of the energy simulation of the energy system.

More specifically, the optimal operation of the electricity market framework and the enhancement of energy infrastructures aiming to a larger and unobstructed installation and operation of significantly larger RES stations, as well as the continuity and the strengthening of the scheme of competitive procedures and of operating support to small plants, contribute to a higher penetration of RES for electricity generation. In this respect, the efficiency of the updated, streamlined and optimised spatial and licensing framework which will allow for the aforementioned optimal development, is also essential.

Additionally, using targeted financial programmes and tax incentives will allow for a higher penetration of RES systems to cover thermal needs. These policy measures, in conjunction with imposing obligations on electricity suppliers, will contribute to maximising synergies with the energy efficiency improvement measures planned for achieving the objective set out in Article 7. Finally, support to auto-generation and energy offsetting schemes, and the promotion of RES projects by energy communities, will lead to further exploitation of RES both for the generation of electricity as well as for heating and cooling.

RES penetration in the field of transport doubles in the scenario of additional policies, mainly due to the expansion of the regulatory framework on obligations related to the mixing of biofuels and using biofuel by itself, and support to the production of sophisticated biofuels. Furthermore, the increased use of vehicles running on electricity due to the installation of the necessary energy infrastructure for charging and the development of a framework for financial support, will contribute to achieving this specific sub-objective, leading to higher electricity demand.

The higher penetration of RES in the scenario of additional policies will significantly improve the energy dependency of the energy sector, despite the lower electricity generation by lignite stations, also reducing electricity imports. Promoting measures to enhance the participation of demand and consumers in general in the electricity market, and using the domestic mining of hydrocarbons in the best way will contribute to a lesser extent to the improvement of the energy dependency indicator.

The interconnection of the autonomous electricity systems on non-interconnected islands with the mainland electricity network will contribute to the improvement of energy dependency through the withdrawal of electricity generating petroleum plants and, at the same time, it will facilitate the integration of the domestic electricity market, leading to lower electricity generation costs, and the further penetration of electricity generating RES stations.

Particular emphasis will be placed on measures for the energy upgrading and renewal of the building stock in the additional policies scenario. The planned measures are diverse and most of them have particularly little contribution to the energy savings achieved in relation to policy measures, which have been integrated in the existing policies scenario, such as the energy upgrade of public buildings, the promotion of energy-saving interventions to exceed minimum energy requirements (nZEB) and the implementation of several horizontal measures. However, the fact that the difference in final energy consumption between the two scenarios considered is not particularly big in no way cancels the significant contribution of the measures for the improvement of energy efficiency in the additional policies scenario.

In particular, it is noted that, if ambient energy used by heat pumps and is considered as a RES, is not taken into account for the calculation of final energy consumption (according to the practice of calculating the relevant balances until 2016), the achieved energy savings are quite increased. In addition, although the actions for addressing the phenomenon of energy poverty with targeted actions result in the improvement of the energy efficiency of these households, they help to increase the consumption of final energy compared to the previous situation, in order to cover the minimum levels of indoor heating comfort and deal with the problem of energy poverty.

The direct use of natural gas in final consumption sectors will be considerably enhanced in the additional policies scenario through a combination of policy measures relating to both natural gas transmission and distribution networks including international interconnections, and financial support for the installation of natural gas boilers. It is noted that the increased use of natural gas will contribute to a number of objectives such as the improvement of energy efficiency and the differentiation of energy sources.

Finally, the losses of the electricity system are reduced considerably in the additional policies scenario as a result of the policy measures aiming to improve energy efficiency in the corresponding infrastructure.

5.2 Analysis of impact of key national planning policies

The quantification of the impact under the draft of the national plan on energy and the climate focuses on the impact of the increase of the participation of renewable energy sources on energy consumption and on the measures and policies for the improvement of energy efficiency.

The macroeconomic impact of a detailed list of clean energy technologies, RES and energy savings was calculated by means of the input-output method. The input-output tables give a full picture of the flow of products and services in the examined economy for a given year, thus reflecting the relationship between producers and consumers, as well as the interdependencies among businesses. The resulting mathematical formulas permit to examine the impact of a change on one or more economic activities across the economy.

The three different matrices found in a standard entry-exit table are the following:

- table of intermediate consumption
- table of final demand
- primary input matrix

The most recent available input-output table for the Greek economy, which pertains to the year 2010 and includes 65 economic sectors, was used for the analysis. Additionally, the results relate to the gross macroeconomic effects related to the net energy technologies in question and the analysis takes into account the following macroeconomic effects:

Investment effects linked with the construction and implementation of various technologies, including the installation of the relevant equipment and materials. This type of macroeconomic effect is provisional and created prior to the investment (feasibility study, planning, etc.) and the implementation phases.

Effects of the operation and maintenance of the technologies considered. Operating costs also include fuels and electricity used for the operation of the technology considered. This type of macroeconomic effect is permanent and lasts throughout the course of the intervention.

Increased consumption results from the implementation of energy efficiency measures in households following the repayment period. More specifically, this relates to additional available funds for household expenses equal to the economic benefit of energy savings. This creates additional demand for products and services, resulting in permanent macroeconomic effects in the period considered.

The analysis does not take into account any effects from the reduction in the activity of traditional/conventional energy economy sectors (e.g. electricity generation, marketing of fuels, etc.), due to reduced energy needs resulting from the energy-saving measures or the replacement of electricity generation by fossil fuels.

In addition to the macroeconomic effects of clean energy, its impact on public health was also calculated. Air pollution is a serious cause of death and disease around the world. Health effects include an increase in hospitalisations and an increased risk of premature death. In the context of this analysis, the reduction of emissions is quantified by measure, comparing its performance (based on the resulting emissions) with a situation where the measure is not implemented (base-case scenario).

Disability-Adjusted Life Years (DALY) have been used widely since the 1990s to assess the international and/or regional burden from diseases. Given the effects of atmospheric pollutants on human health, the DALY measurement is also used as an indicator for the quantification of the health impact of environmental pollution associated with the burden from diseases. Therefore, in this analysis, the quantification of the benefit from the implementation of the analysed clean energy technologies uses DALY.

In accordance with the World Health Organisation (WHO), a DALY can be considered as a lost 'healthy life' year. The DALY is calculated as the sum of the Years of Life Lost (YLL), due to premature mortality in the population and the Years Lived with Disability (YLD) for people who have a specific health condition.

Following the calculation of the effects based on the above methodology, the clean energy, RES and energy-saving technologies have been assessed independently with regard to their impact on a series of key socioeconomic and environmental indicators, which correspond to a sub-set of the Sustainable Development Goals of the United Nations.

Table 50: Criteria for the multi-criteria analysis on RES and energy efficiency.

Evaluation criteria	Objective	Units	RES	Energy efficiency
Increase in domestic added value	Max	$\frac{\text{M€}}{\text{M€ of investment}}$	✓	✓
Reduction of health effects	Max	$\frac{\text{DALY avoided}}{\text{M€ of investment}}$	✓	✓
Reduction in greenhouse gases	Max	$\frac{\text{ktn of CO}_2 \text{ equivalent avoided}}{\text{M€ of investment}}$	✓	✓
Differential weighted energy costs	Min	$\frac{\text{€}}{\text{MWh generated}}$	✓	-
Economic efficiency	Min	$\frac{\text{€}}{\text{MWh saved}}$	-	✓
Market maturity	Max	Qualitative	✓	-
Technical facility	Min	Qualitative	-	✓

This assessment was based on a broadly recognised method of multi-criteria analysis, PROMETHEE II. This method involves power relations and has been developed to support decision-making to deal with classification problems, using bilateral comparisons (pairs) between alternative actions for each criterion, thus achieving a final classification of all actions. In this analysis, RES technologies are the alternative, whereas socioeconomic and environmental indicators represent the different assessment criteria. The assessment criteria were chosen based on the formulation of a consistent set of criteria, namely a repetitive, adequate, non-redundant set.

To determine the weight of each criterion, a number of experts were recruited and were asked to classify the selected criteria in the context of the promotion and implementation of RES and energy efficiency technologies, until 2030. The weight of each criterion ultimately used in the multi-criteria analysis was determined by implementing the SIMOS method on the results of the questionnaires. The SIMOS method is a technique to indirectly identify the weight of criteria, allowing each deciding individual to rank the different criteria of a consistent set of criteria, by means of a set of cards.

Based on the implementation of the SIMOS method for determining the weight of the criteria and of the PROMETHEE II method for the multi-criteria analysis of alternative technologies, the technologies under examination were classified into three categories based on their significance, depending on their final performance as regards the above criteria. Thereafter, the results were used to determine the best portfolios of RES and energy efficiency policies, using the portfolio theory.

Regarding energy efficiency in particular, through the combination of the examined technologies, with an emphasis on the 'major' ones, taking into account the classification resulting from the multi-criteria analysis, a number of representative policies for achieving the energy efficiency targets, the share of RES for heating and cooling needs, as well as a sub-objective related to the share of RES in transport, were designed. Policy setting has included, apart from technologies, the financial mechanism for the implementation of the policies, by introducing in the analysis a wide range of financial arrangements including, inter alia, third-party financing, lending schemes, grants, etc. Finally, the problem of selecting the best policy portfolios which fully achieve the aforementioned energy efficiency and RES objectives for the years 2021-2030 was resolved based on the following criteria: (a) increase of the leverage of private capital / minimisation of any financial capital to be paid by the state, and (b) minimisation of the risk associated with the successful implementation of the actions.

Additionally, as regards RES policies for electricity, the problem of selecting appropriate portfolios of RES technologies which fully achieve the objective of RES penetration in energy production was also dealt with, based on the following criteria: (a) minimisation of the differential weighted cost of energy, and (b) maximisation of the Gross Added Value of the implementation of selected measures.

On the basis of the results of these analyses, and in accordance with the scenario for achieving the objectives, total new investments in the field of electricity generation from RES is expected to result in benefits in domestic added value exceeding EUR 11 billion throughout the operation of such systems. Similarly, there are many benefits to creating direct and indirect jobs due to the development and operation of these projects, as it is estimated that more than 30 thousand new full-time jobs will be created and maintained in the next 25 years. The impact on the income of involved employees is also particularly significant, as the implementation of related policies and measures will bring about an increase of EUR 4.5 billion. With regard to the effect on public health, the expected benefit is quantified at 8 500 DALY.

The key priority of planning with regard to the improvement of the energy efficiency of the building stock in the country is to generate significant macro-economic benefits for the country. The energy upgrade of 10 % of Greek homes in the decade 2021-2030 as well as the improvement of the energy efficiency of the building stock as a whole, are expected to lead to an increase of more than EUR 10 billion in domestic added value and to the creation and maintenance of more than 25 thousand full-time jobs. The increase in the income of involved employees is expected to reach approximately EUR 4 billion, and the expected benefits for public health are expected to exceed 17 000 DALY.

5.3 Overview of investment needs

5.3.1 Existing investment flows and planned investment assumptions regarding planned policies and measures

Achieving medium-term and long-term national energy objectives through policy measures in key energy and climate fields as detailed above, will result in significant investments in the development of the country by means of enhancing competitiveness in the economy and in employment.

The provision for expected investments in the period 2020-2030, in the basic planning axes of the NECP, is shown in the table below. These investments are expected to contribute significantly both to national economy and to the protection of consumers from price fluctuations in energy products, through the reinforcement of competition in energy markets.

Table 51: Estimation of investments in key areas of the National Energy Planning.

Sector	Total estimated investments (€ million) for the period 2020-2030
1. Electricity generation from RES	8.500
2. Electrical system infrastructure	5.500
3. New conventional electricity generation plants and upgrading of existing	1.900
4. Works for the development of an electricity distribution network – Digitisation	3.300
5. Cross-border natural gas pipelines	2.200
6. Natural gas networks and storage	2.000
7. Research and Innovation	800
8. Energy efficiency	9.000
9. Investments in the Refinery sector	1.500
TOTAL	34.700

A key tool to support these investments, at least in certain categories of investment measures, will be the new programming period 2021-2027, on the basis of which appropriate financing programmes must be ranked, also taking into account the analysis of available resources.

The essential characteristics of the new Programming Period 2021-2027 are the following:

- i. The existence of necessary appropriate conditions (replacing the ex ante conditionalities of the current period), some of which relate to the energy sector. The fulfilment of the necessary appropriate conditions shall be monitored throughout the programming period and any delays in said fulfilment may create difficulties in the financing of the corresponding projects.

ii. The increase in the significance of reimbursable aids (given by means of financing tools) and the tendency to reduce grants. The increased use of financing tools will result in an increase in available resources for implementing certain categories of energy projects, thanks to the leverage and recycling of resources. Furthermore, it is made possible to combine resources from Funds with other resources in order to facilitate the financing of the projects.

In this context, and according to the proposal of the European Commission on the Multiannual Financial Framework, EUR 19 138 million in constant 2018 prices, or EUR 21 582 million in current prices, are allocated to Greece for the period 2021-2027. These funds are provided by the European Social Fund, the European Regional Development Fund (ERDF), the Cohesion Fund and the European Territorial Cooperation.

Regarding the ERDF in particular, according to the above proposal, available funds correspond to EUR 10 222 million in constant 2018 prices or EUR 11 528 million in current prices.

The proposal for a regulation concerning the ERDF and the Cohesion Fund stipulates that, for countries with a gross national income lower than 75 % of the EU average, at least 30 % of ERDF resources must be used for Policy Objective 2, pertaining to energy, the climate and the environment.

Therefore, it is expected that EUR 3 066.6 million in constant 2018 prices, or EUR 3 458.4 million in current prices, will be available for that Policy Objective.

The rates of co-financing by category of regions, as suggested in the Common Provisions Regulation, are as follows:

- 70 % for the least-developed
- 55 % for transition regions
- 40% for the more developed

Please note that all Greek regions fall into the first category, except for Attica and the South Aegean, which are classified as transition regions.

Taking into account the major proportion of co-financing (70 %), the public funds available for Policy Objective 2 can be estimated. These resources amount to EUR 4 380.9 million in constant 2018 prices or EUR 4 90.6 million in current prices.

Because of the non-binding timetable for the completion of the negotiation on the regulatory framework, the negotiation on the partnership agreement, and the submission and approval of the programmes, the approval of the programmes of Cohesion Policy 2021-2027 is expected after the first half of 2021. Taking into account the adjustment period of the national institutional and organisational framework, the programmes are expected to be activated in the first half of 2022.

The amount of funding available for the implementation of projects in the Energy Sector will be announced following the adoption of the Operational Programmes in the first half of 2021 and will depend on the maturity of the projects, their compatibility with eligibility rules and their timely preparation, submission and integration.

As already mentioned, the actions/projects to be financed in the Energy Sector are primarily integrated in Policy Objective 2. The specific objectives supported by the ERDF under that Policy Objective are as follows:

- I. promoting energy efficiency measures
- II. promoting renewable energy sources
- III. developing smart energy systems, networks and equipment for storage at local level
- IV. promoting the adaptation to climate change, the prevention of risk, and resilience to disasters
- V. promoting sustainable water management
- VI. promoting the transition to a circular economy
- VII. strengthening biodiversity and green infrastructure in the urban environment, and reducing pollution.

Restrictions in eligibility result from Article 6 of the ERDF draft regulation, as well as the intervention areas suggested in the Common Provisions Regulation draft with regard to Funds. In particular, the ERDF shall not support 'investment related to production, processing, distribution, storage or combustion of fossil fuels, with the exception of investment related to clean vehicles as defined in Article 4 of Directive 2009/33/EC of the European Parliament and of the Council'.

The intervention areas indicated in the Common Provisions Regulation draft and pertaining to a low-carbon economy are the following:

- Energy efficiency and demonstration projects in SMEs and supporting measures
- Energy efficiency renovation of existing housing stock, demonstration projects and supporting measures
- Energy efficiency renovation of public infrastructure, demonstration projects and supporting measures
- Support to enterprises specialised in providing services which contribute to a low carbon emissions economy and to resilience to climate change
- Renewable energy: wind
- Renewable energy: solar
- Renewable energy: biomass
- Renewable energy: marine (wave, tidal)
- Other renewable energy sources (including geothermal energy)
- Smart Energy Distribution Systems at medium and low voltage levels (including smart grids and ICT systems), and relevant storage systems
- High efficiency co-generation, district heating and district cooling.

5.3.2 Risk factors and challenges

Based on the structure of the above chapters, beginning with policy objectives, policy guidelines have been set out, complemented by a series of policy measures which may be classified as regulatory and technical. Focusing on technical measures, those usually pertain to the implementation of a technological intervention, which is inevitably accompanied by the mobilisation of investment costs, regardless of who takes up this burden. Therefore, for each policy measure, different combinations may apply regarding the undertaking of the financial burden of the investment for the implementation of the same technology.

The selection of the most suitable financial mechanism and instrument, as well as the distribution of the financial burden of each policy measure is a matter directly and closely linked to the success of the implementation of said measure. Therefore, the key planning principles with regard to the taking up the financial burden of the various stakeholders is a process still not placed in the centre of energy planning.

The key principles of energy planning include the optimisation of the relation between the cost and the results of policy measures, while defending the interests of all stakeholders and keeping the risk of implementation failure at the lowest possible levels. Therefore, policy measures are being planned and will be implemented for a more efficient management of the structural funds and the national objectives, aiming to the maximum mobilisation of private funds, both from investors and benefitting citizens or businesses, as appropriate. However, in order to achieve that objective, a series of financing mechanisms and instruments will be used, with the ultimate goal of creating appropriate conditions to attract investment, combining different sources of financing, and optimising the efficiency of state funds.

In particular, the efficiency of state funds will be optimised by reducing grants and, instead, granting preferential loans which will allow for the recycling of capital (reimbursable aid), through special funds.

Similarly, conditions to attract investments will be created, first, through an appropriate regulatory framework and, secondly, through reasonable rules governing the implementation of each measure. The mechanisms to be considered for enhancing this framework shall include security for first losses from loans, an increase in scale, especially for small projects, by means of aggregation, the standardisation of processes and methodologies to reduce the risk of the parties involved in the case of projects which are hard to manage, the establishment of decentralised or central structures for technical support, the removal of legislative and regulatory obstacles, compliance with transparent and non-discriminatory procedures, which may or may not be competitive, and the implementation of tax incentives.

Specific reference is made to the field of energy efficiency, which will focus on ventures based on the implementation of projects through energy performance contracting (EPC), public private partnerships (PPP) and market-centred mechanisms. This category of measures includes the existing energy performance obligation scheme, which is expected to continue with an enhanced role until 2030, the competitive procedures of energy-saving plants, as well as the market of white (energy efficiency) certificates. What is more, alternative payment schemes for projects between various stakeholders will be investigated, such as payment by means of bills or taxes, any regulatory obstacles will be removed, and the granting of tax incentives to facilitate further energy upgrade actions will be considered. Such schemes are expected to help deal with phenomena such as the sharing of the benefit between owners and tenants, which is a serious obstacle to the energy upgrade of the existing building stock. Finally, specific schemes will be considered in order to tackle energy poverty, either through existing policy measures or through new ones, supported by state subsidies.

Accordingly, infrastructure projects will continue to be supported with co-financing from structural funds, whereas, as mentioned above, the main instruments for electricity generating RES stations will include the operating aid scheme and the extended use of competitive procedures, so that the expected private investments may have an increasingly smaller impact on financial support and that the new projects achieve, also depending on market evolution, positive results as regards the reduction of energy costs for consumers.

However, emphasis will be placed on support from investment funds, so that access to financing may be achieved under more competitive terms and that the number of investment plans with access to such financial conditions increases.

With regard to RES in the areas of heating, cooling and transport, a more efficient use of the programmes of the new financial period 2021-2027 will be attempted, in conjunction with holistic interventions, especially in energy efficiency matters, whereas the objective for strengthening domestic sophisticated fuels production is to plan special actions which will focus on everything, from the development of appropriate supply chains to production.

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