



Executive Summary

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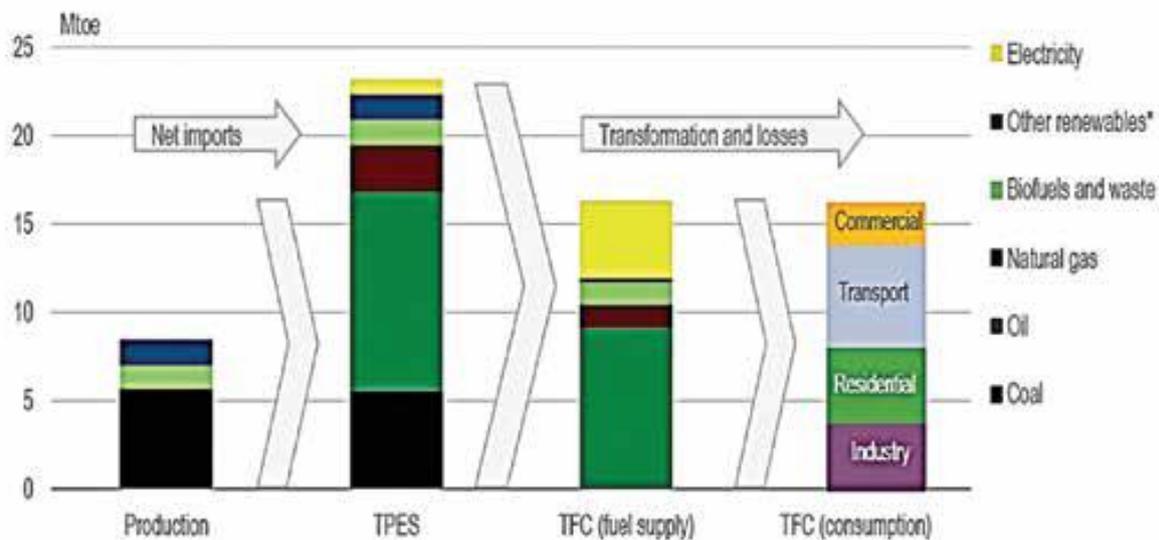
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The scope of this latest report on Greece's energy sector, which IENE aspires to publish annually, is to provide a comprehensive account of the country's energy sector with extensive reference on current and past activities and achievements. The report also includes a mid-term assessment of likely developments.

During last year (2018), substantial progress was achieved on a number of key infrastructure projects but also in energy policy. A number of major institutional interventions were implemented which aimed primarily in enhancing competition at all levels, either by liberalizing further the electricity and gas retail market or by restricting PPC's monopoly access to lignite, through the sale of its lignite units in Megalopolis and Meliti. Taking into account the interesting developments in Greece's energy sector in 2018 - both in terms of institutional changes and in the implementation of specific projects - we should be mildly optimistic for 2019. A summary of Greece's key energy developments in 2018 and prospects for all different energy areas is as follows.

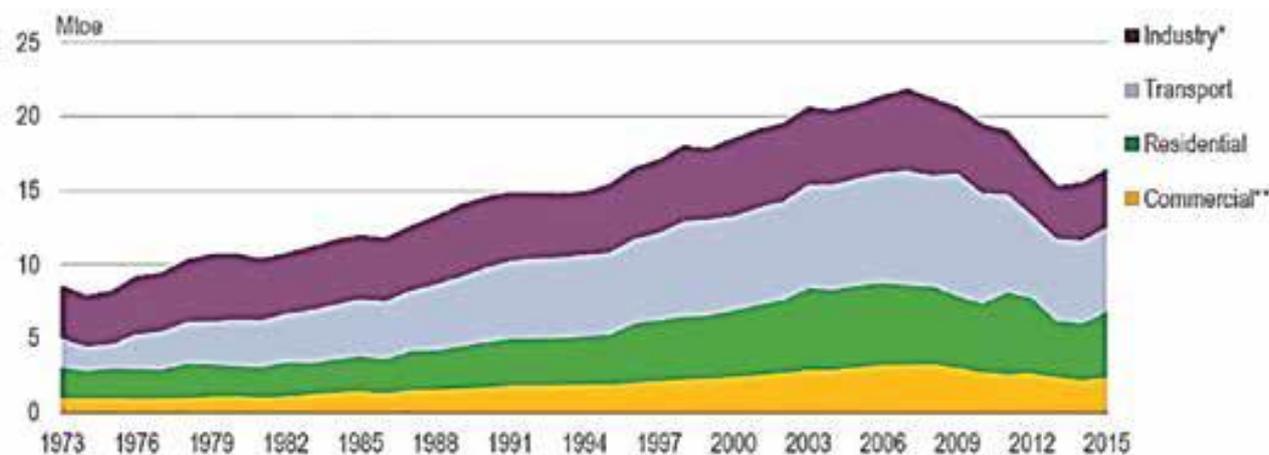
Figure 1: Overview of Energy Production, Total Primary Energy Supply (TPES) and Total Fuel Consumption (TFC), 2015



* Other renewables includes hydro, solar, and wind.

Source: IEA

Figure 2: Total Final Energy Consumption in Greece by Sector, 1973-2015



* Industry includes non-energy use.

** Commercial includes commercial and public services, agriculture, fishing, and forestry.

Source: IEA

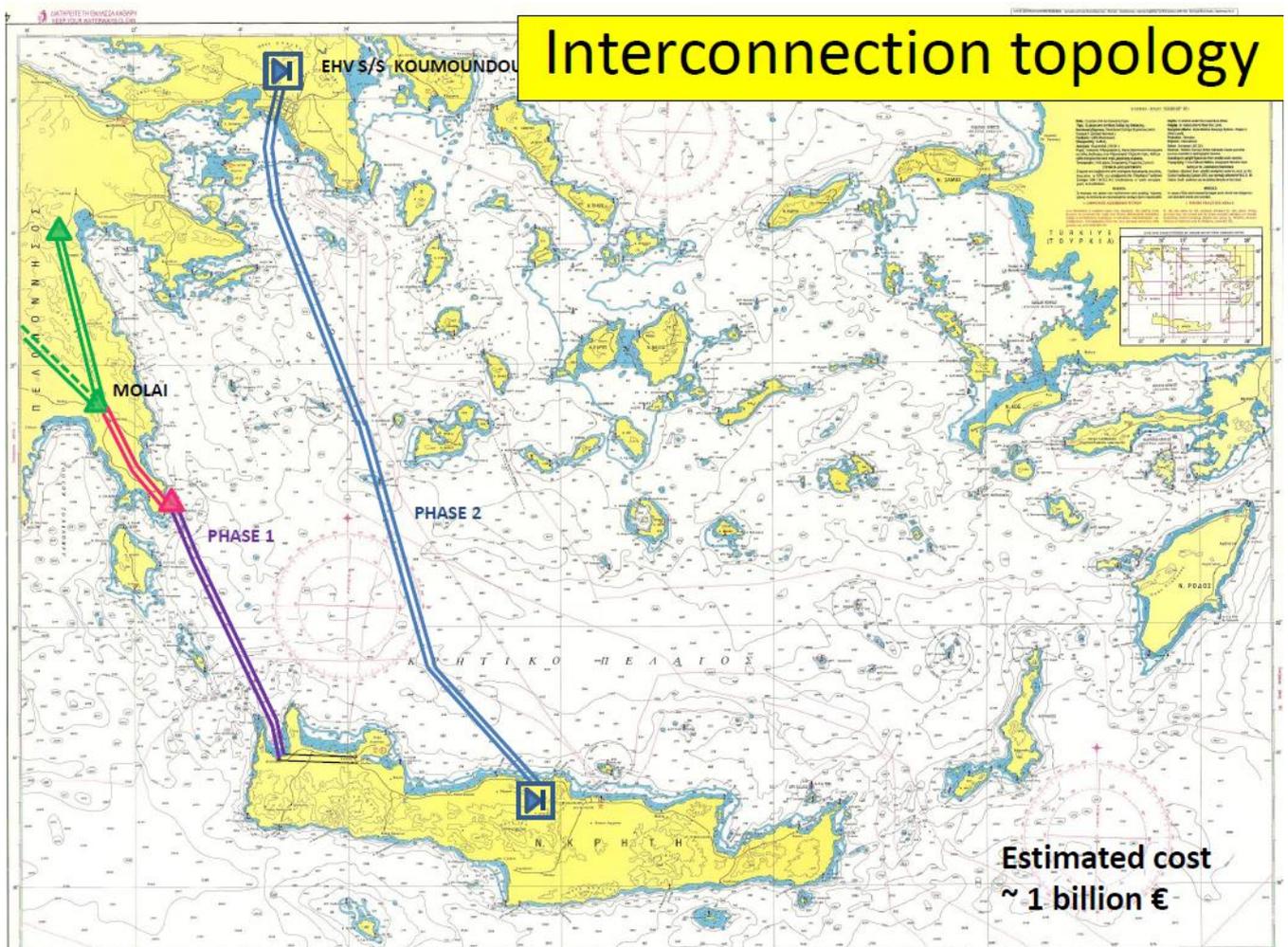
Electricity

A major development this year (2019) concerns the electricity market operation and relates to the abolition of the Mandatory Pool model, currently in force, with the introduction of the Energy Exchange, with substantial preparations having already been made in 2018 by the Energy Ministry, the Regulatory Authority of Energy (RAE), Greece's Electricity Market Operator (LAGIE) and the Greek Exchange. The disinvestment of PPC, which is in full swing through the tender for the sale of its lignite units in Meliti and Megalopolis, will be of critical importance for the further opening of Greece's electricity market. If the tender is successful and credible investors emerge, a major obstacle for PPC will have been removed and the company will be able to concentrate on the development of the RES sector, which is an absolute priority following a decision taken in the context of the company's new strategy. At the same time, it is estimated that with the sale of PPC's lignite units and the simultaneous operation of the new energy market, the continuation of the NOME-type auctions may cease, which will undoubtedly enhance PPC's financial situation.

Developments concerning the country's internal electricity interconnections are considered of major importance. With regard to the electricity interconnection of Crete with the country's mainland interconnected system, the contracts for the implementation of the first phase (i.e. Crete-Peloponnese), known as "small" interconnection, have already been signed and construction is expected to start by the end of this year. For the second phase (i.e. Crete-Attiki), known as "big" interconnection, the case is complex and consultations between Brussels, Athens and Cyprus regarding the construction of the project are expected to be

intense. More specifically, Greece's Independent Power Transmission Operator (IPTO)'s subsidiary company, known as "Ariadne Interconnection", on the strength of a decision taken by the Greek regulator, has lately unfolded plans for the construction of this major electricity interconnection. At the same time, the project's promoter appears to be the "EuroAsia Interconnector" group, which is recognized by the European Commission and has already been backed by PCI funds, is moving ahead independently with its project to connect the electricity systems of Israel, Cyprus and Greece. Some kind of mediation by the EC is highly anticipated over the next few months in order to resolve what appears to be a rather disingenuous situation. Electricity interconnections with the Dodecanese island complex and the North Aegean island group are now planned for 2029 and 2031 respectively.

Map: Electricity Interconnection of Crete with Greece's Mainland Interconnected System



Source: ADMIE

An important advancement in electricity market operation was achieved early last year since from January 1, 2018 Greece's electricity market became fully liberalized. From that date onwards, PPC's monopoly was lifted on all the non-interconnected islands, apart from Crete

and Rhodes, where private electricity suppliers already existed. This facilitates alternative electricity providers to potentially operate on the other 30 small and medium-sized autonomous networks of the Aegean Sea; thus, reducing energy costs.

In 2018, the debate on the new wholesale electricity market was also launched, which is expected to be fully reorganized with the launching of the Energy Exchange in 2019. This year, the Mandatory Pool model will be replaced by four new markets: (a) the Day Ahead market, (b) the Intraday market, (c) the Balancing market and (d) the Forward market. Electricity producers, electricity trading companies, suppliers and energy-intensive industries will be eligible to participate. In terms of electricity suppliers, international experience shows that the Energy Exchange will allow them to reduce their business risk and provide a more secure environment for their long-term business moves, which is anticipated to lead to more competitive tariffs for households and businesses.

Natural Gas

Greece's prospect in becoming a natural gas gate for the Balkan region took a new turn in 2018 with several projects completed or expected to begin in 2019. The upgrading and extension of DESFA's LNG terminal in Revithoussa was completed at the end of November 2018. It is further planned to extend its facilities so that ships of up to 260,000 cubic meters capacity can be docked, i.e. the largest LNG vessels currently in operation. However, the major project concerns the addition of a 95,000-cubic meter third tank, which now brings the total gas capacity of Revithoussa to 220,000 cubic meters.

The FID for the Alexandroupolis FSRU, a project by Gastrade, a subsidiary of the Copelouzos Group, is expected to be taken in early 2019. The FSRU will have a storage capacity of 170,000 cubic meters and will be connected via a pipeline with the country's national gas system in order to establish a fourth gas import point in Greece and an important entry gate to SE Europe. This project is expected to operate in parallel to the Greek-Bulgarian Gas Interconnector (IGB), the construction of which is set to begin in 2019. IGB's entry point will be in Komotini (Greece) and its exit point in Stara Zagora (Bulgaria). Also, the construction of the TAP project is expected to be completed by the end of 2019, with first gas volumes delivered in 2020. At the same time, the active support by the governments of Greece, Italy, the Republic of Cyprus and Israel for the implementation of the submarine pipeline, known as the East Med pipeline project, creates a new dynamic, with the prospect of signing an intergovernmental agreement in the first quarter of 2019.

Following the successful privatization tender for DESFA, conducted by the Hellenic Republic Asset Development Fund, the Independent Gas Transmission Operator, now under a new ownership regime, with a new management team in place, several market players estimate that new gas infrastructure projects will now proceed, such as the Interconnection Greece-FYROM and the reverse flow of the Greek-Turkish gas pipeline that is in operation for over a decade. The promotion of the latter project, in combination with the construction of a bypass pipeline along the Greek-Turkish border in Evros, is of paramount importance for Greece as it will provide a direct link to the Turkish Stream pipeline on Turkish territory. Moreover, a very important project for DESFA will be the transformation of the already existing balancing point and virtual nomination point into a fully fledged gas trading hub, which is expected within 2020, enhancing the role of the Greek Energy Exchange (EnEx).

Also, in the beginning of 2018, the monopoly of Gas Supply Companies (EPAs) of Attiki and Thessaloniki-Thessalia was lifted, as household consumers are now able to switch gas supplier. Practically, the completion of the gas market liberalization also affects the electricity market, as almost all electricity providers have already secured a license from RAE to supply natural gas, while the two EPAs have also extended their operations for the supply of electricity. This means that the option for combined electricity and gas packages is now open as a single energy product. Another important development in Greece's gas sector in 2019 is expected to be the separation of the Public Gas Corporation (DEPA) into two different companies in order to comply with the European Directives related to the unbundling between marketing and ownership and infrastructure management.

Oil and Petroleum Products

The domestic fuel market returned to negative mode in 2018, with sales down by 5%, compared with 2017, according to latest Energy Ministry data. More specifically, the sales of gasoline fell by 5%, while motor fuels, including diesel (which recorded an increase), closed at 1,5% in 2018. Total fuel sales in Greece recorded a significant decline due to a large drop in demand for heating oil, as consumption fell by 17% in 2018, compared to a year ago.

The aforementioned figures illustrate the difficult situation that Greece's fuel market is experiencing for another year, as a result of the continuing economic downturn, with the reduction of consumption, overpricing as well as competition from other markets and fuels that constantly acquire a larger share, both in the transport and heating sectors. This trend is also evident from the significant increase in diesel consumption over the last few years, which has now reached the levels of gasoline.

Regarding the 2018 tender for the sale of 50,1% of Hellenic Petroleum (HELPE), this is now likely to proceed within 2019, based on the interest expressed by Dutch-based Vitol and Swiss-based Glencore, despite the fact that due to the size and complexity of the acquisition, its successful outcome is far from secure. Meanwhile, the prospects for an increase in exports of refined petroleum products by the two large groups (i.e. HELPE and Motoroil), with an overall target of 10,0 million metric tons, are much clearer.

Hydrocarbon Activities

In 2018, a number of important developments in hydrocarbon exploration activities took place in Greece, as several offshore and onshore blocks in Western Greece were at the epicenter of large multinational groups' interest, in partnership with Greek oil companies. Within 2019, the first drillings for hydrocarbons in the new concession areas (e.g. Patraikos, Katakolo) are expected, with the HELPE-Edison consortium planning its first exploration drilling in the Patraikos Gulf region. Regarding Katakolo, Energean Oil & Gas, the only oil producer in Greece, has submitted an Environmental and Social Impact Study, as well as other license applications, in order to proceed to the first production drilling in 2019/2020. The same company is participating in a consortium with Spanish Repsol and is conducting seismic surveys in the Ioannina onshore area and has also started preparations on the onshore area of Aitolokarnania. In addition, Energean Oil & Gas is expected to start producing oil from the new Epsilon oil field, positioned in the west part of its concession in the active Prinos field.

In July 2018, the Total-ExxonMobil-HELPE consortium was awarded two concessions, following an international tender, for the offshore blocks in Southwest and West of Crete in order to explore and exploit hydrocarbons in deep sea formations, with contracts expected to be ratified soon by the Hellenic Parliament. Regarding the offer made by the Repsol-HELPE consortium for the offshore block in the Ionian Sea, the process of evaluating and negotiating the submitted offer is still in progress, but it is not expected to be significantly further delayed.

Law 4001/2011 updated the legal framework and created a new state authority to coordinate and promote hydrocarbon activities, known as the Hellenic Hydrocarbon Resources Management (HHRM), under the supervision of the Energy Ministry. Following the restructuring of the HHRM in 2016, the company has now a leading role in designing and organizing concession rounds, evaluating the submitted offers as well as supervising and coordinating exploration activities.

Renewable Energy Sources (RES)

As far as the RES sector is concerned, the first photovoltaic (PV) and wind farms were licensed in 2018 under the new support scheme, in which electricity from RES is typically sold on the electricity spot market and RES producers receive a premium on top of the market price of their electricity production. In 2019, the installation of new wind farms in licensed areas is planned, both on the mainland and the islands, with the prospect of adding at least 400 MW of new installed capacity. It is worth noting that Greece, despite its huge wind potential, has exploited only a small part of it, since the total installed wind capacity does not currently exceed 3,000 MW. At the same time, it is estimated that in the coming months a draft law will be submitted that will simplify certain procedures both at the licensing stage and in the installation of RES plants; a development that is expected to enhance RES investments as well as a series of competitive tenders (planned by RAE) for licensing new RES installations within 2019.

The experience of recent years shows that the rapidly evolving RES technologies achieve very low and competitive prices with a highly dispersed production that transforms the grid and the market and forcing electricity companies to change their business model. The power grid is gradually being transformed with innovative technologies in order to incorporate the increasing RES penetration with high efficiency, reliability and new services to consumers, while the electricity market is being reorganized and looking for new tools to meet the new challenges for its operation. Electricity evolves as a major energy carrier, expanding its uses by replacing fossil fuels, as it penetrates almost everywhere, such as in the transport sector, heating/cooling, etc., while it is also a pillar for growth. Electric vehicles and hydrogen production for fuel cells in buses and trucks that enter the market very fast will become an extension of the power grid. Today, Greece has a great opportunity to develop RES on a large scale in an attempt to radically change its production model for both electricity and thermal applications.

Energy Efficiency

In terms of energy efficiency, an important support programme, known as “Home Saving” programme, is still running strong and provides incentives for homeowners to improve the energy efficiency of their homes, saving in parallel money and energy. In February 2018, the related Ministerial Decision was signed that defines the terms and conditions for the inclusion of any interested household in the subsidized “Home Saving II” programme, with a total budget of €500 million. So far, 39,793 applications have been approved, resulting in approximately 70% of the funds earmarked. Greece’s Energy Ministry plans to launch a third

consecutive “Home Saving” programme at the beginning of 2019, with a total budget of €200 million, which is expected to improve the energy profile of approximately 20,000 homes.

Equally important is the energy poverty issue in Europe, including Greece, which has been taken into account in the aforementioned long-term energy planning, proposing ways to tackle it. According to 2016 Eurostat’s data, only 1 in 3 Greeks had the economic ability to warm up adequately, ranking Greece in the third lowest position, as higher rates were recorded only in Lithuania (29,3%) and Bulgaria (39,2%), with just 9% of EU residents being unable to provide adequate heating. The energy poverty issue is evident in the countries mostly affected by the economic crisis, since, after Greece, Cyprus (24,3%), Portugal (22,5%) and Italy (16,1%) follow, despite the fact that these are three Mediterranean countries with relatively mild winters. Based on Eurostat data, the economic crisis in Greece has significantly affected the energy poverty issue since 2011, when the percentage of Greeks who could not warm up sufficiently reached 18,6%. Since then, this percentage has been steadily increasing over a three-year period, reaching 26,1% in 2012, 29,5% in 2013 and 32,9% in 2014, while in 2015 it fell slightly to 29,2%, where it stabilized.

Energy Policy

Another positive and very encouraging development in terms of energy policy is the completion of the first stage of the long-term energy planning by the National Committee for Energy and Climate (ESEK), under the guidance of the Energy Ministry, and its recent submission to the European Commission at the end of January 2019, following the incorporation of the comments made during the public consultation. In this sense, the country has acquired a very useful tool for a new energy strategy roadmap, as Greece's energy system is now entering a transition process with main goal the decarbonization in the production and energy use and the transition towards a cleaner environment.

Climate Change

Climate change is not just an environmental issue. It is now closely related to the growth model of a country or a region, as several productive sectors are directly or indirectly affected by climate change and they need to intensify measures to address it.

This is also the case for Greece and a key priority is the incorporation of the climate change issues on its aforementioned long-term energy planning. This essentially concerns the country’s production and use of energy, the General Framework for Spatial Planning and Sustainable Development and the Specific Spatial Planning for RES, among others.

In order to tackle climate change, specific greenhouse gas (GHG) emissions mitigation and adaptation measures have already been implemented at national level under the agreements signed in previous years. Following the 21st United Nations Conference on Climate Change (COP21), 195 countries agreed on a new global, ambitious and legally binding agreement on climate change. Greece ratified the Paris Agreement in October 2016 with Law 4426/2016. Greece's total GHG emissions fell by 33% in 2016, compared to 2005, while in absolute figures they moved at a lower level in comparison with 1990's levels, based on data provided by the National Committee for Energy and Climate (ESEK).

Energy Investments

Greece's energy investments in small- and large-scale projects are expected to become one of the key growth drivers not only in the country's energy sector but also for its economy. At institutional level, the energy market is awaiting the special spatial plan for RES, which is expected to contribute as a growth pivot in order to attract investments with specific terms and conditions and at the same time form the basis for achieving the national energy transition goals and strengthening the RES contribution to the country's energy mix. Currently, there are major investment opportunities in Greece's primary energy sector (e.g. exploration and production of hydrocarbons, RES and energy efficiency), but also in transmission, distribution and infrastructure of gas and electricity. The anticipated energy investments in Greece could well reach €45,5 billion over 2018-2027, taking into account a number of assumptions. A primary assumption being that the country will continue on its economic growth path rather than a recession over the next decade, with an average annual growth rate of 1,5%.

However, there are risks and uncertainties that are part of the economic sphere (i.e. recession, banking crisis, declining demand, etc.), the weak regulatory framework (i.e. incomplete legal and legislative framework, bureaucracy, etc.) and infrastructure, inter alia, which may affect the aforementioned energy investments. The prospects and the objectives for energy investments, which are analysed in the present report, should be considered taking into account the abovementioned limitations. However, since investments are vital to the short- and long-term growth of the Greek economy, the target for optimum exploitation of the high-investment potential offered by the energy sector provides a useful policy tool. The anticipated energy investments, as calculated by IENE, should therefore be considered more as an "investment potential" rather than an absolute figure.