

HAEE

WWW.HAEE.GR

HELLENIC
ASSOCIATION *for*
ENERGY ECONOMICS

Greek Energy Market

Report 2020



Advancing the Energy Transition

Powered by:



NATIONAL BANK
OF GREECE

| Greek Energy Market Report |

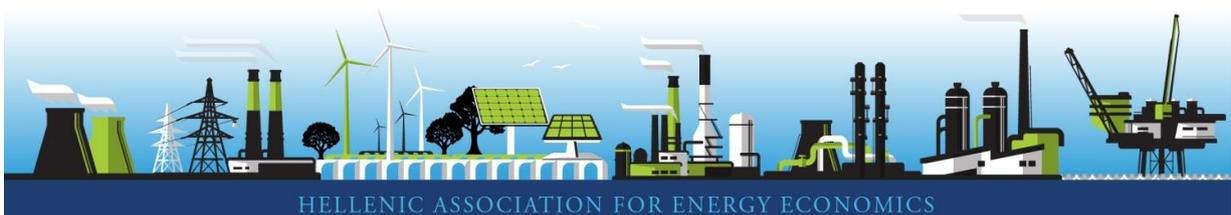
2020



| Greek Energy Market Report |

HAEE 2020

Disclaimer: "The contents of this report are the authors' sole responsibility. They do not necessarily represent the views of the Hellenic Association for Energy Economics or any of its Members."



Hellenic Association for Energy Economics



Hellenic Association for Energy Economics (HAEE) brings together all those who study, debate and promote the knowledge of energy, environment and economy in our country. HAEE is the Greek affiliate of the International Association for Energy Economics (IAEE), which is a non-profit research and professional organization acting as an interdisciplinary forum for the exchange of ideas and experiences among energy experts.

HAEE was founded in 2015 in Greece, and has a global orientation welcoming the participation of researchers and practitioners from around the world interested in energy, environmental and economic related subjects. It acts as an independent consulting body for national and international organizations to whom it provides a broad contribution on issues related to energy, economics, policymaking and theory.

Through meetings and joint initiatives HAEE also provides a means of professional communication and exchange within its members and the authorities defining the Greek energy policy. HAEE organizes meetings amongst experts and specialists interested in networking - organizes conferences and seminars on both national and international levels - promotes training initiatives in the energy and economic sector - provides researches, studies and other services for its members.

HAEE promotes the understanding of energy, environment and economy related topics within universities and encourages the participation in the Association's activities of young students who are invited to seminars and conferences and can make use of the IAEE library for their academic works. HAEE is financially supported by member dues, contributions for research activities carried out for companies and bodies involved in the energy field, and by the sale of conference proceedings as well as conference fees and other initiatives.

National Bank of Greece



NATIONAL BANK
OF GREECE

With its 179-year participation in the country's economic and social life, NBG is one of the most significant Greek financial organizations, as it plays a key role in efforts to support the Greek economy and enable the economic transformation of the country.

The Bank's broad customer base, respected brand name, strong market share in deposits and enhanced capital adequacy ratios that provide the liquidity needed to finance Greek businesses, reflect the long-standing relationship of trust it enjoys with its clientele.

NBG has long been the leading Greek bank in financing the energy sector and has established a strong footprint across all segments of the industry, with investments of €3 billion in corporate customers, €1 billion in renewable energy sources of total capacity (either in operation or under construction) amounting to about 1.45 GW and over €100 million in private-public sector partnerships. Being committed to the backing of all major projects that aim to foster economic growth, NBG provides tangible support to the country's aspiration to evolve into a key energy hub for Europe, with obvious benefits for the domestic economy.

Foreword



Assoc. Prof. Dr. Spiros Papaefthimiou
Chairman HAAE

The coronavirus (Covid-19) pandemic has caused an unprecedented global economic and social crisis, significantly affecting all aspects of life. The energy sector is also severely affected by this crisis, which has slowed transport, trade and economic activity across the globe. The whole range of consequences is yet to be revealed and is difficult to predict, however it is already clear that demand for energy resources has dropped, prices have plummeted and production has been declining. The implications of the pandemic for energy systems are still evolving but clean energy transition(s) must be at the center of economic recovery and stimulus plans. Renewables, energy efficiency and energy storage, smart grids, cross-sectoral integration, hydrogen, sustainable agriculture will be some of the cornerstones of the upcoming era. The decline in CO2 emissions needs to continue, while The Clean Energy Package and the New Green Deal should not slip away from the list of national policymakers' and regulators' priorities.

With the newly released "Greek Energy Market Report 2020" the Hellenic Association for Energy Economics presents an analysis and detailed review of the Greek Energy market based on the most recent data and valuable insights. In this regard, HAAE's annual report manages to identify the relative strengths and weaknesses of the Greek energy market during a time of great change. The goal is to provide a full picture to international or domestic companies, market participants, regulators and policy makers. Progress is assessed through a series of variables including the country's goals for 2030 and 2050, regulatory frameworks, energy security, sustainability, liberalization and through the use of detailed statistics.

On behalf of HAAE, I wish to express my sincere gratitude to our partner, National Bank of Greece, for its significant support and contribution towards the completion of this report. Namely, I would like to thank the CEO of NBG, Mr. Pavlos Mylonas, for endorsing the production of this report, Mr. Vassilis Karamouzis, with whom the idea was born, and of course Ms Argyro Banila and Mr. Harry Vovos for an excellent collaboration.

Foreword



Prof. Dr. Kostas Andriosopoulos
Project Coordinator

The COVID-19 pandemic has created at the beginning of 2020 the biggest crisis in generations, sending shock waves through health systems, economies, and energy systems around the world. Those developments put additional pressure for faster and more efficient implementation of the European Green Deal Investment Plan. This framework is anticipated to mobilize EU funding and create an enabling background to facilitate and stimulate the public and private investments needed for the transition to a climate-neutral, green, competitive, and circular economy. In light of this crisis, the need for a sustainable, green recovery has become even more pressing, but also the need to provide support to the most vulnerable regions. This is why the European Commission wants to reinforce the Just Transition Fund as part of its crisis response mechanism.

Nowadays, the Greek government has shown determination towards this direction, throughout a series of new measures and innovative legislations assisting the ongoing Energy Transition. This willingness is reflected in the revised and ambitious National Energy and Climate Plan that provides exact targets and strict deadlines. Until the end of 2030, the Plan projects new investments related to the Energy sector, which are estimated at around 40 billion euros, reflecting its very promising growth potential and significant contribution to the Greek economy. Special attention is paid towards Decarbonization, Renewable Energy Sources, Digitalization, Eco-mobility, and of course Energy Efficiency. Finally, the state's planned privatization of major energy assets, such as the two companies of the Public Gas Corporation, DEPA Infrastructure and DEPA Commercial respectively, the Hellenic Electricity Distribution Network Operator (HEDNO), and Hellenic Petroleum among others, are additional steps towards the further liberalization of the Greek energy market.

This 2nd version of the "Greek Energy Market Report" is based on the successful initial edition of 2019. The challenge of this year's edition was to adopt and include the severe impact of the pandemic on all aspects of our analysis, hence particular interest is paid in this direction. Besides, another novelty is that the Report includes insightful highlights and a short overview on each of the chapters under examination. Precisely, the chapters focus on the Country Profile in terms of basic economic and energy-related indicators, the Energy Transition and the projections of the National Energy and Climate Plan, the Hellenic Energy Exchange that is anticipated to officially operate under the Target Model in September 2020. Moreover, the Report reviews all the developments and statistics derived from the Electricity and Natural Gas markets, the increased penetration of Renewable Energy Sources, the importance of Oil & Refining for Greece, the recent developments in terms of Energy Efficiency and the projected Investments towards the Energy market. Above all, I hope that the "Greek Energy Market Report 2020" will act as a tool supporting the dialogue among market participants and policymakers in order to assist sustainable economic growth and increase social welfare.

Foreword



Mr. Paul Mylonas
CEO, National Bank of Greece

It is a pleasure to introduce for a second consecutive year the “Greek Energy Market Report”, an important sponsorship of National Bank of Greece (NBG). Via this publication we continue to support the country’s energy transformation.

The economic repercussions of Covid-19 are leaving a clear footprint on the global energy market. According to the International Energy Agency, energy demand in 2020 is expected to contract by 6 per cent - the largest drop in 70 years in percentage terms and the largest ever in absolute terms. Moreover, energy investment globally could fall by one-fifth this year, with many governments and private investors adopting a “wait-and-see” strategy.

In contrast to the times, Greece appears determined not to stray from its path to achieve the ambitious National Plan for Energy and the Climate – that is, to ensure that two-thirds of Greek electricity production come from renewable sources by 2028. Persisting with bold reforms, Greece is cutting project approval times and is streamlining spatial planning processes. In fact, investments in renewable energy sources, electricity interconnections and energy pipelines of the range of €10-12bn are projected to materialize over the next three years, which in turn could evolve into a vital recovery factor for the Greek economy in the post-covid era. Moreover, further momentum could be added through the implementation of the Recovery Plan for Europe, as key guidelines of the Green Deal is expected to be at the heart of this blueprint.

NBG considers itself a leader in Energy initiatives in Greece. With a total energy portfolio exceeding €2.5bn in utilized credit limits, NBG has a large and diverse portfolio across energy projects of the primary and the secondary market, supporting large as well as SME clients, both local as well as international. Moreover, NBG has channeled more than 1/3 of its funding towards renewable energy projects. Such involvement spans across traditional technologies covering Wind, Solar and Hydroelectric power, but we are also expanding towards innovative technologies such Hybrid (Solar, PV and storage), FSRU and CCGT. Having a clear corporate vision to preserve its leading ranking in Energy investments in Greece, NBG is committed to diversify and broaden further its Energy portfolio. We believe this publication plays an important role in informing the public about the specifics of the Greek energy sector and we remain available to actively explore cooperation opportunities in support of your organic expansion in the Energy sector.

Coordinator

Dr. Kostas Andriosopoulos holds the position of full Professor in Finance and Energy Economics at ESCP Business School, where he is the Executive Director of the Energy Management Centre. Dr Andriosopoulos is currently the Vice Chairman at the Public Gas Corporation of Greece (DEPA) and the Chairman of the Energy Committee of the American-Hellenic Chamber of Commerce. Kostas holds a PhD in Finance (Cass Business School, City University London), where he has been the recipient of the prestigious Alexander S. Onassis Public Benefit Foundation's scholarship. He also holds an MBA and MSc in Finance (Northeastern University, Boston, USA), and a bachelor's degree in Production Engineering and Management (Technical University of Crete, Greece). Kostas is the Founder and former Chairman of the Hellenic Association for Energy Economics.

Lead Researcher

Filippos Ioannidis is a PhD candidate at the Department of Economics at Aristotle University of Thessaloniki, Greece. Filippos holds an MSc in Banking and Finance from the School of Economics, Business Administration and Legal Studies (International Hellenic University, Thessaloniki, Greece) and an MSc in Economics from School of Economics and Management (Lund University, Lund, Sweden). He obtained his bachelor's degree in Economics from the Department of Economics (University of Macedonia, Thessaloniki, Greece). Currently, he is a research associate of HAEE.

Research Team

Konstantinos Ioannidis is an electrical engineer holding an MSc in Electrical and Computing Engineering from Democritus University of Thrace (DUTH). He was also awarded an MSc with distinction in Wind Energy Systems from the University of Strathclyde, Glasgow, UK. His expertise lies in the Energy Sector and specifically in the Renewable Energy Sources, and he is a research associate and energy advisor of the Hellenic Association for Energy Economics on Renewable energy topics.

Christos Zisakis is a research associate and energy consultant for the Hellenic Association of Energy Economics (HAEE). Christos holds a MEng in Mechanical Engineering, with a major in Energy Engineering, from the National Technical University of Athens (NTUA), Greece, the country's oldest technical university. He has been awarded an MSc with distinction in Energy Management from ESCP Business School following his studies in London, UK and Paris, France. Before joining the HAEE team, Christos has held positions in the energy industry in Greece and the United Kingdom.

Leonidas Ourgantzidis is an economist working as a research assistant for the Hellenic Association for Energy Economics. He holds an MSc in Economics with distinction from the University of Nottingham (UoN) and a BSc in Economics with honors from the University of Macedonia (UoM). His academic interests focus on the efficacy of environmental policies and the energy efficiency challenges.

Contributors

The authors are grateful to **Konstantinos Dimitrainas** (Sector Head/ Large Corporate Banking Division - NBG), and **Eleftherios Soumpasis** (Relationship Manager/ Large Corporate Banking Division - NBG) for their significant contribution towards the completion of the "Greek Energy Market Report - 2020".

Executive Summary

Aligned with the initial version of 2019, the second edition of the “Greek Energy Market Report 2020” reviews all the developments related to the Greek energy sector, by providing the most recent available data. Special focus is placed on the externalities occurred due to the outbreak of the COVID-19 crisis. Moreover, a concrete analysis is provided for different sectors affecting the road towards the Energy Transition. In order to achieve that, the report provides both global and European energy trends and then assesses the role of Greece in terms of following or not those patterns.

Moreover, the report identifies all energy aspects that Greece is lagging behind, hampering the accomplishment of the country’s energy and climate targets. At the same time, it functions as a useful tool for those who want to have a solid view of the Greek energy market. Aiming to capture all the topics mentioned above, the Report consists of nine distinct chapters, covering the majority of the energy sector:

- Chapter 1 covers the **Country Profile** of Greece by analyzing and providing the key demographic, macroeconomic and energy statistics, accompanied by a careful examination of the pandemic effect on the Greek energy market.
- Chapter 2 provides an illustrative summary of the National Plan for Energy and Climate by pointing out the country’s energy related targets towards the **Energy Transition**.
- A robust examination of the formation and role of the newly established **Hellenic Energy Exchange** is provided in Chapter 3.
- The next chapter, focuses on the **Electricity** sector, highlighting various issues related to generation, capacities, prices, imports, exports and the important market of Eco mobility.
- Chapter 5 is dedicated to **Natural Gas** and explores all the developments that occurred in the market followed by the recent liberalization. Again, all the characteristics affecting supply, demand and import prices are carefully investigated in parallel with the projected plans for expansion of the market through new grid construction and use of LNG & CNG technologies.
- Chapter 6 focuses on the significant penetration of **Renewable Energy Sources** in Greece, by providing unique data, geographical and market analysis, and an update in regard to the recent regulatory framework.
- Chapter 7 covers **the Oil and Refining** market, which continues to play a crucial role for the country, and the recovery of the Greek economy.
- The concept of **Energy Efficiency** is extensively analyzed in Chapter 8, highlighting the progress of Greece towards achieving all its energy related goals in various sectors, such as transportation, industry and households.
- Finally, by linking global and European energy **Investment** trends with the current developments in Greece, Chapter 9 outlines the existing framework in terms of all the ongoing and future energy investments, covering all aspects of the sector.

Data sources are robust and reliable since figures come from freely accessible databases such as, World Bank, OECD, Eurostat, IEA and Bloomberg, while statistics and data considering the Greek energy market were carefully collected from domestic sources such as, EnEx, ADMIE, DESFA, RAE and Elstat.

In summary, Greece is implementing comprehensive energy sector reforms to foster competitive energy markets, create opportunities for investors, support the transformation of the energy system and provide sustainable outcomes for the environment and Greek society. The ample availability of renewable energy potential combined with the ongoing large-scale infrastructure projects show that Greece will be an important player in the formulation of the European Union (EU) energy mix and will provide significant investment opportunities in all energy industries. Besides, located at the crossroads between East and West Greece is anticipated to play a key role in the South Balkans and East Mediterranean, as well.

Greece has currently the opportunity to leverage its economic recovery to accelerate emission reductions through energy efficiency and increased shares of Natural Gas and Renewable Energy Sources (RES) in the energy mix. A key part of this process is the development of a strong and coherent National Energy and Climate Plan for 2030 and beyond, as well as incorporating climate objectives into integrated energy planning. The country has seen an impressive increase in the share of Renewables in electricity generation, even over-achieving the targets set for solar PV. Better exploitation of its Renewable energy potential could result in a more balanced energy mix and contribute to increasing energy security.

In recent years, the Greek energy system is characterized by the decreasing consumption of conventional fuels based in large part on lignite which was strategically chosen for electricity production after the oil crisis of the 70s. Another basic characteristic of Greece is that the country is highly dependent on imports, which include Crude Oil, Oil Products and Natural Gas. In that context, over the last decade we observe an increasing penetration of Natural Gas into final consumption, although it still represents a small share of total consumption in Greece and falls short from the European average. On the other hand, following the introduction of the CO₂ tax, Natural Gas represents a significant share in electricity production, as percentage which is steadily growing over the years.

Furthermore, the energy sector in Greece has a higher contribution to gross value added and employment than in most EU countries and is poised to grow significantly in the coming years, driven by a number of significant factors. First and foremost, the required optimization of the energy mix, which consists the reduction of fossil-fuel generated electricity and increased contribution from RES. This shift will be driven both by the revised EU policy of 35% renewable energy sources by 2030, and by the preference for cheaper and cleaner energy sources, such as Natural Gas.

Next, the outbreak of the COVID-19 delayed the state's planned privatization of major energy assets, such as the Natural Gas distributor (DEPA), the Hellenic Electricity Distribution Network Operator (HEDNO) and the Hellenic Petroleum. National authorities seek to further liberalize the Electricity and Natural Gas markets and to separate the production and supply from transmission networks. The country aims to explore the potential to become a European gateway for Natural Gas, Electricity and Oil resources through mega-infrastructure projects such as, the TAP, IGB, EastMed gas pipelines, EuroAsia Interconnector or gas and oil exploration and production.

Another important aspect of the upcoming energy investments is directed towards energy efficiency and cost reduction driven by such technologies as smart metering, smartgrid and energy efficient buildings. Finally, major infrastructure development initiatives such as the interconnection of the Greek islands with the main electricity grid and the establishment of the Hellenic Energy Exchange in accordance with the electricity Target Model support the development of the Single Energy market in Europe.

Above all, Greece should continue pursuing the implementation of ambitious energy related policies, drawing on the evaluation of outcomes from past and current measures and on the lessons learned by other countries.

Contents

"Everything that an investor needs to know about the Greek Energy Market" 

1. Country Profile



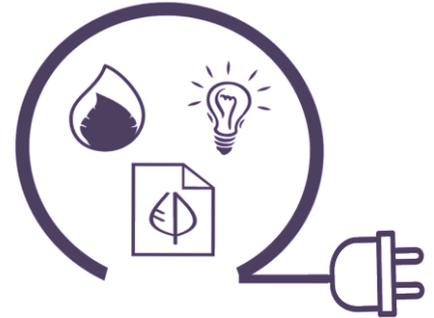
| 9 |

2. Energy Transition



| 23 |

3. Energy Exchange



| 47 |

4. Electricity



| 65 |

5. Natural Gas



| 89 |

6. Renewable Energy Sources



| 105 |

7. Oil & Refining



| 121 |

8. Energy Efficiency



| 141 |

9. Investments

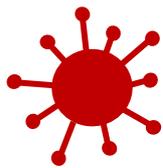


| 153 |

1. Country Profile



**Impact of
COVID-19**



Highlights



The **Greek economy** is forecasted to decrease by **10%** in **2020** and return to a **5.1%** growth in 2021

Greece's Economic Sentiment Indicator **dropped** by more than **20%** as an aftermath of the pandemic



Greek 10-year **bond yield dropped below 1%** for first time in February 2020 and remained in low levels during the COVID-19 crisis

The unemployment rate **fell to 15.5%** in the first quarter of 2020 but is expected to sharply **increase** as a consequence of a hampered touristic period



A single-hit scenario projects a Greek **debt to GDP** ratio of **188%** for 2020 and a double-hit scenario a ratio of **195%**

Energy market represented **3.7% of Greece GDP** for 2018



Gross energy consumption in Greece is projected to **drop by 11%** in 2020 due to COVID-19 impact



The increased penetration of **RES** continue in Greece representing **48%** of primary energy production for 2019 compared to the **40%** achieved in the previous year

Due to the lockdown effect, a significant annual drop of more than **20%** is anticipated for 2020 in terms of **total CO2 emissions**



Overview

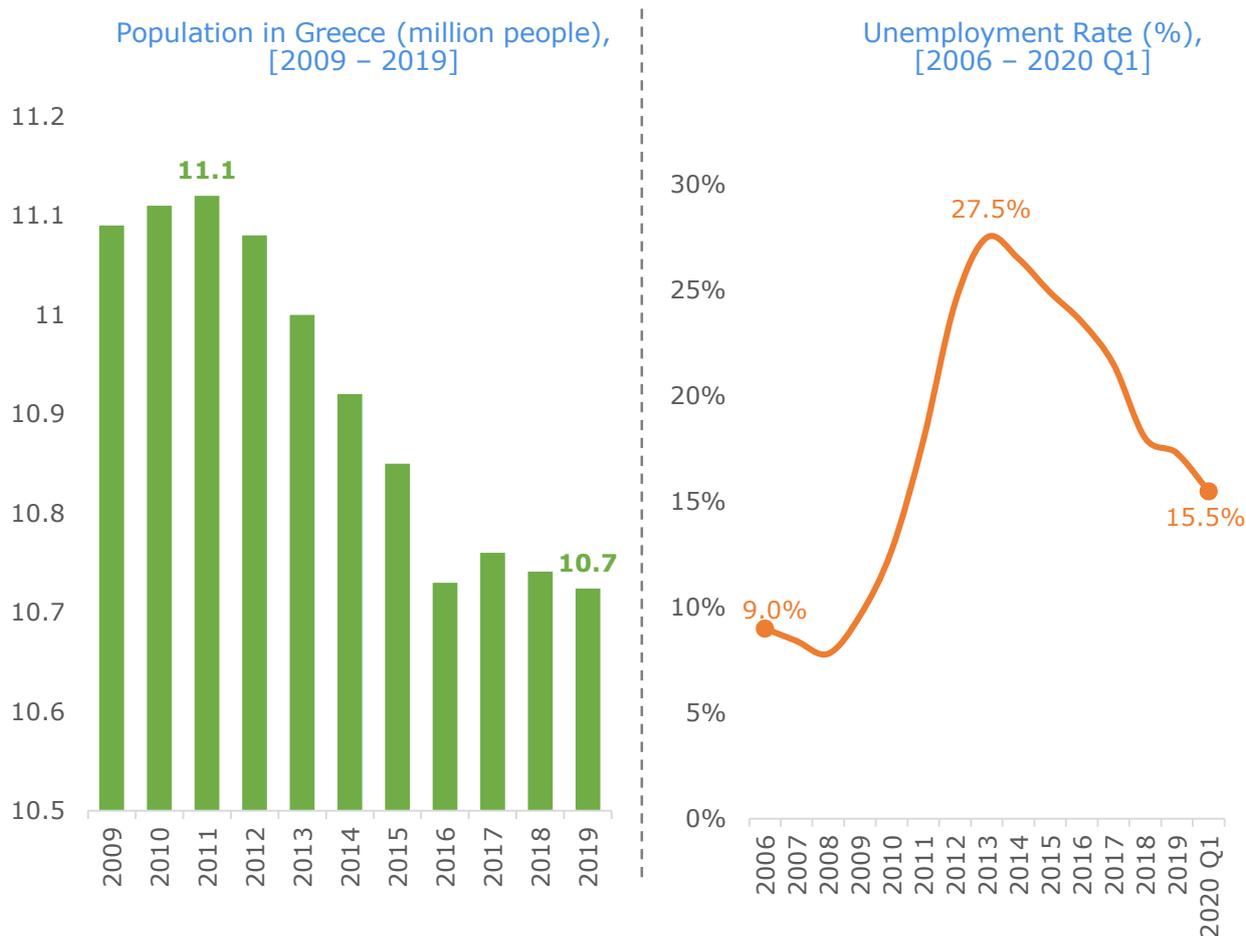
Greece has earned praises for tackling the Covid-19 threat to public health but now faces a challenge in containing the impact on the country's fragile economy. Even in the best-case scenario, the recession is likely to rival the worst years of the recent debt crisis. The biggest blow is expected in the tourism sector, which is the lifeblood of the Greek economy. The arrival of visitors from key destinations is the most important issue troubling national authorities. The total amount that could be a direct loss from the negative effect on tourism is projected to be 10 billion euros.

The crisis is also expected to trigger a big drop in domestic demand, which is another vital element of the economy. Private consumption accounts for around 70% of the Greek GDP. In March 2020, an estimated 2 million workers, just over half of Greece's entire workforce, received financial support. Household spending fell by 10% at the peak of the crisis in 2011, but there are fears of a bigger drop this year due to the unprecedented lockdown in the whole economy. A slowdown in investments is also likely, just as the government was targeting an increase of 13.4% in investment spending during 2020. The IMF predicts Greece will suffer the biggest recession of all European economies, with GDP contracting by 10% before a rebound of 5.1% in 2021. The European Commission also believes Greece's dependency on hospitality and its many small enterprises will lead to the economy taking a big hit. Brussels expects the Greek economy to contract by 9.7%, a drop that is way bigger compared to all the other European Union countries. Again, a strong rebound of 7.9 is expected in 2021.

The IMF expects Greek unemployment to rise by five points this year, reaching 22.3%. This translates into 1.1 million unemployed during a time when Greece had been hoping to see the jobless figure drop below 700,000 this year. The threat to jobs was evident in March 2020 employment figures, when 41,903 people lost their jobs, compared to 2019 when this amount represented total jobs creation. The government has adopted a range of mitigating fiscal measures to provide businesses and workers with temporary help. The Finance Ministry believes these interventions could limit the recession around 8%. Whichever way this plays out, the COVID-19 crisis will impact Greece's economy. The contraction will likely be larger than in many of Greece's eurozone peers. In that context, the Greek economy will have to find a way to bounce back from this new setback.

Considering the case of the Greek energy market, gross energy consumption is anticipated to decrease by almost 11% in 2020 due to the COVID-19 outbreak, however a quick rebound is expected to take place over 2021. Aiming to depict the impact of this drop, the following analysis illustrates prior projections of the evolution of various energy variables before and after the COVID-19 crisis. In overall, consumption decline during 2020 is attributed to the drop of the general demand for Natural Gas, Oil and Coal. Current estimations project that after two years, the energy market will return to prior projections and be aligned with the targets of the National Plan for Energy and Climate.

Increased unemployment rate following the COVID-19 crisis is a crucial issue that needs to be tackled

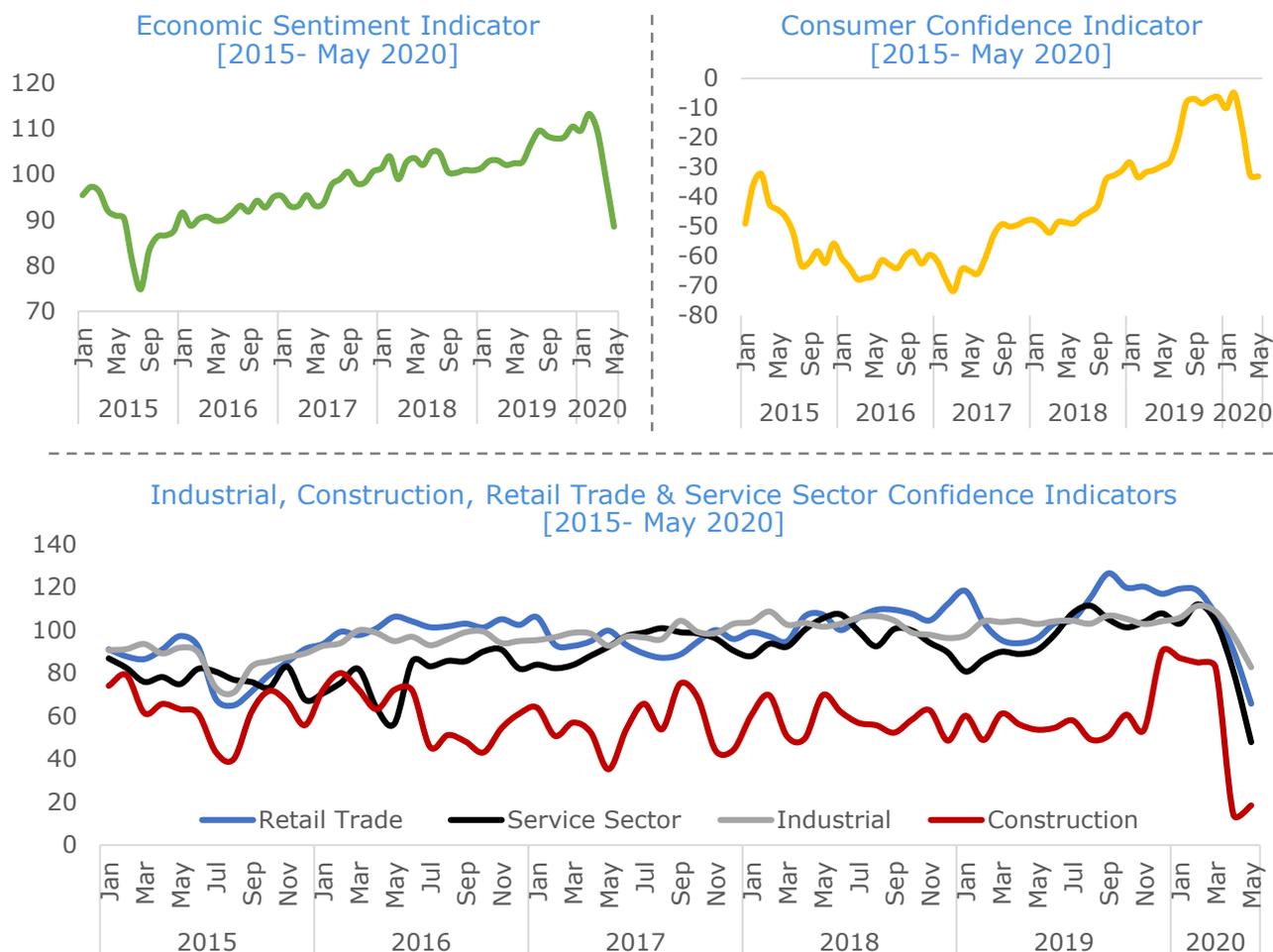


Source: Eurostat, Elstat, HAEE's analysis

Highlights

- Greece's population numbered 10.724.868 million people in 2019. The population's decline can be linked to the severe economic crisis and the brain drain that followed.
- An estimated 500.000 people moved abroad during the financial crisis, during which the Greek economy shrunk by a quarter and unemployment skyrocketed to 28%.
- Even though unemployment decreased to 15.5% during the first quarter of 2020, following the COVID-19 is anticipated to sharply increase during Q2 and Q3 of 2020 .
- Youth unemployment rate in Greece continues to be the highest in the developed countries, since it reached 32.4% in March 2020.
- The successful management of the coronavirus crisis by the Greek authorities during spring 2020, gives confidence for a quick drop of unemployment rate in 2021.

The analysis of various economic indicators depict the catastrophic effect of COVID-19 in terms of business confidence

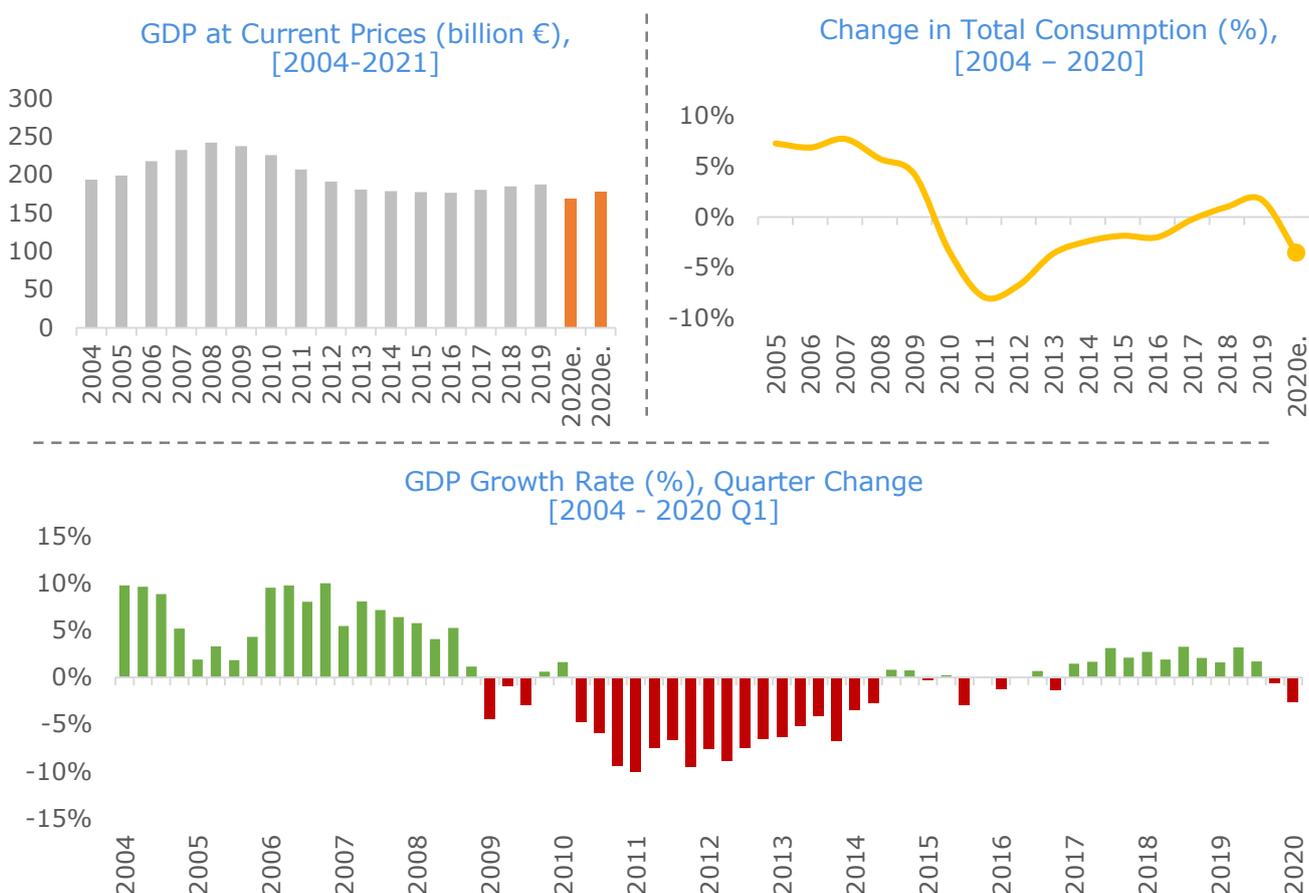


Highlights

Source: IOBE, HAEE's analysis

- Following a path of a steady upsurge, Economic Sentiment Indicator reached its maximum value in February 2020 and then collapsed to 2015 levels.
- In overall, Economic Sentiment Index in Greece sharply dropped as a result of the strict lockdown measures with the subsequent effects in all sectors.
- The same downward trend holds for the Consumer Confidence Indicator which is anticipated to return to prior levels by the end of 2020.
- Considering the Confidence Indicators of Retail Trade, Services, Industry and Construction we observe a sudden drop during the first months of 2020.
- Based on autumn 2019 figures, the Construction Confidence Indicator is anticipated to quickly recover which is apparent by a small shift in May 2020.

Based on IMF's scenario, real GDP in Greece is forecasted to decrease by 10% in 2020 and return to a 5.1% growth in 2021

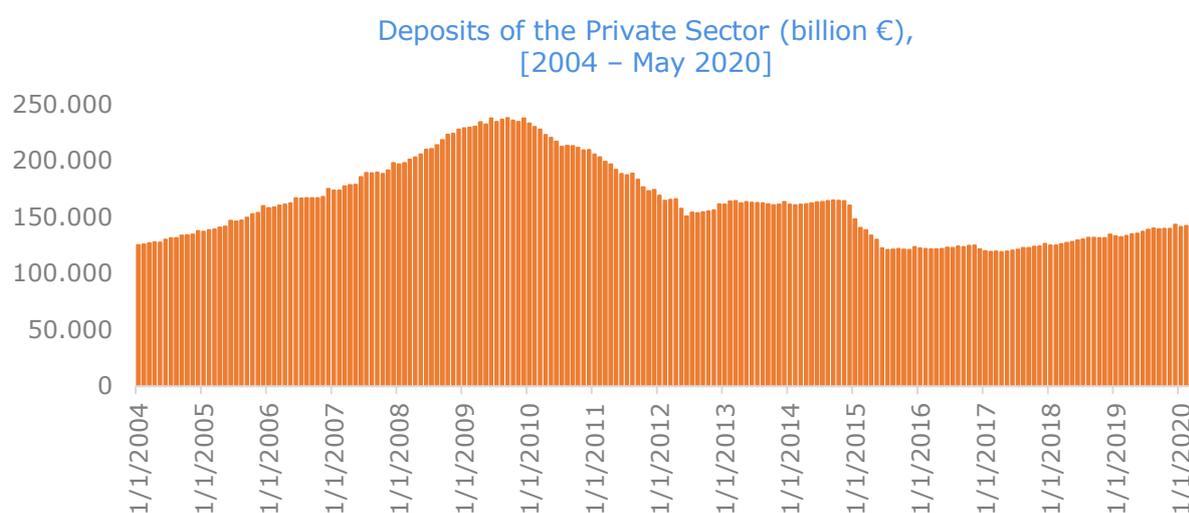
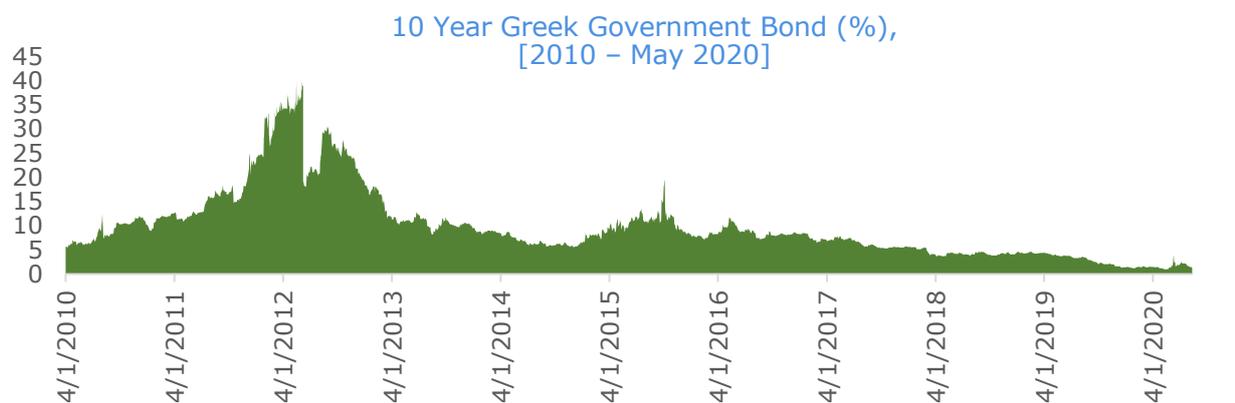


Source: Elstat, HAEE's analysis

Highlights

- Over the previous decade, the Greek economy suffered the longest recession of any advanced capitalist economy to date.
- Prior to COVID-19 crisis, the Greek economy was estimated to grow by 2.2% in 2020 and around 2% in 2021.
- For 2019, the GDP of Greece stood at 187 billion euros, however, estimations for 2020 project a drop to €168 bil. followed by an increase to €177 bil. in 2021.
- During the last quarter of 2019 and first quarter of 2020, the Greek economy suffered significant contraction after 11 quarters of achieving positive growth rates.
- Total consumption reached positive values for 2018 (1%) and 2019 (1.72%), however a sharp drop to -3.52% is anticipated for 2020.

Greece's 10-year government bond yield dropped below 1% in February of 2020, and remained at low levels during the COVID-19 crisis

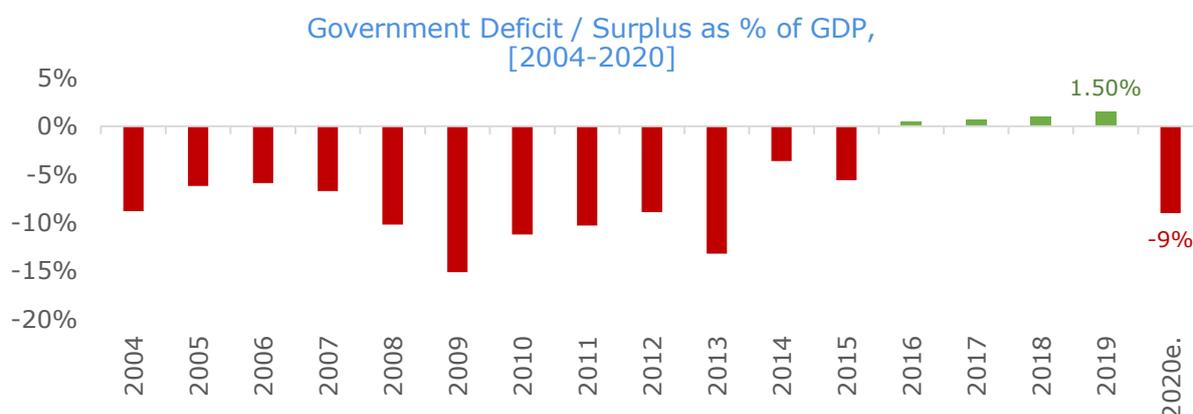
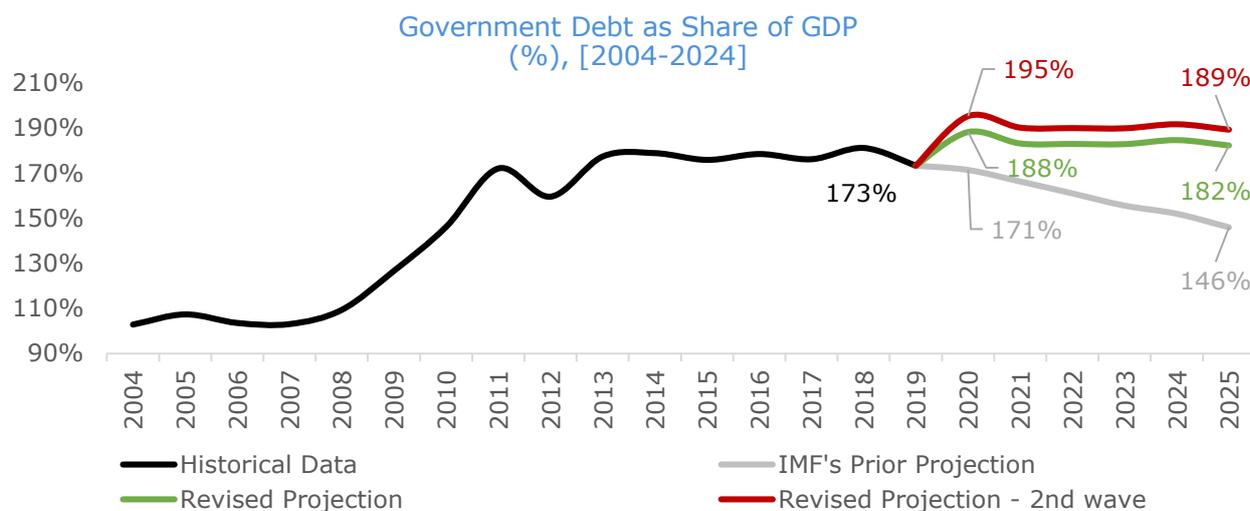


Source: Bloomberg, Bank of Greece

Highlights

- Supported by an improving economy and credit ratings upgrades, Greek debt has been one of the euro zone bond market's top performers in 2019.
- In January 2020, Fitch upgraded Greece's credit rating to 'BB' from 'BB-', due to the achievement of GDP growth and budget discipline.
- The trajectory was for further upgrades and a first investment-grade rating was about to follow, possibly by the end of 2021.
- The continuous increase in bank deposits and the improvement in liquidity allowed the elimination of capital controls as from the 1st of September 2019.
- However, the negative impact due to the Coronavirus put additional pressure on the fragile Greek economy that is mainly affected by the hard-hit sector of Tourism.

Unlike the positive outcome for public health, the Greek economy will emerge shaken from the COVID-19 crisis



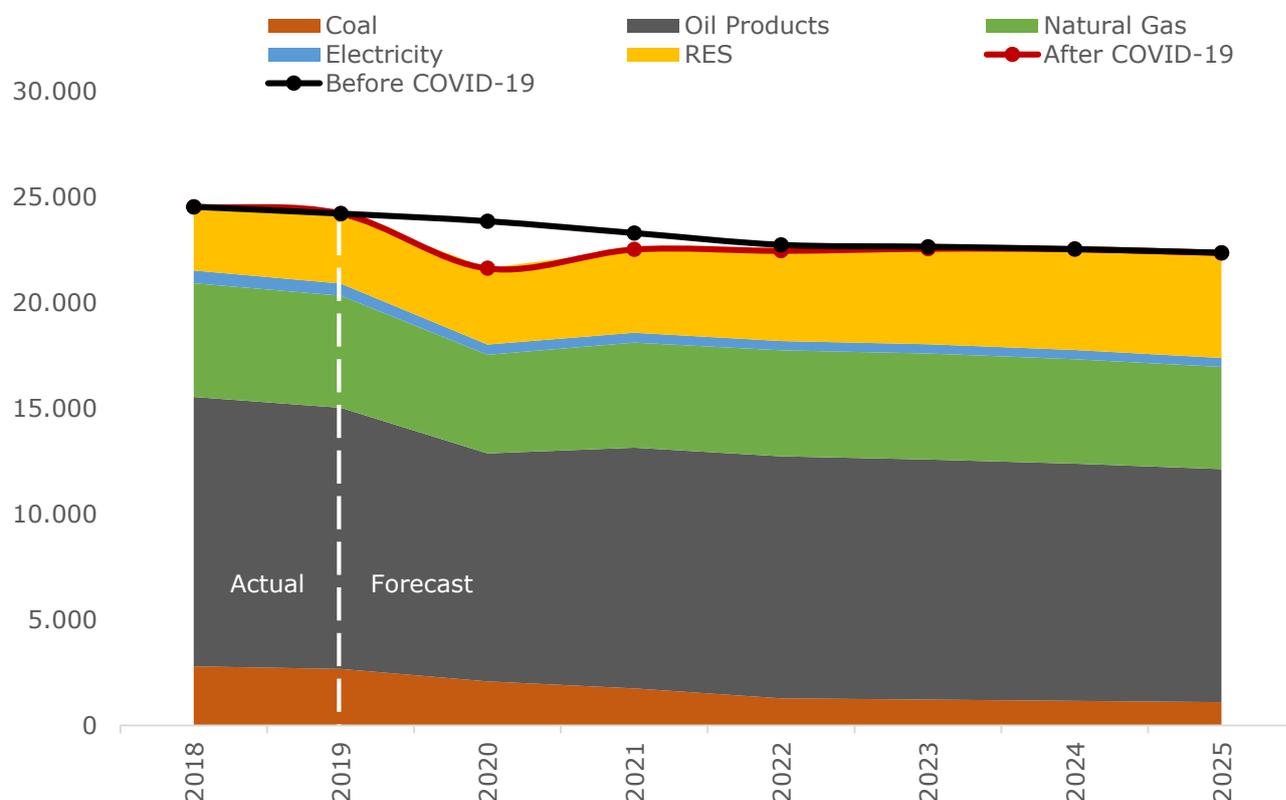
Highlights

Source: Eurostat, HAEE's analysis

- Greece continues to hold the Eurozone's highest ratio of public debt compared to its GDP, reaching 173% in 2019, followed by Italy at 132.2%.
- Greece recorded a Government Budget surplus equal to 1.5% of the country's Gross Domestic Product in 2019.
- However, even in the best case scenario, the recession is likely to rival the worst years of the recent debt crisis.
- The OECD warned that among the advanced and emerging economies, Greece was rated as the most vulnerable from the imposed shutdown.
- The prevailed optimism about the dropping projection of debt to GDP at 146% in 2025, quickly disappeared since revised estimations fluctuate around 185%.

Due to the COVID-19 outbreak, gross energy consumption in Greece is anticipated to decrease by almost 11% in 2020

Evolution of Gross Energy Consumption in Greece (ktoe), [2018-2025]



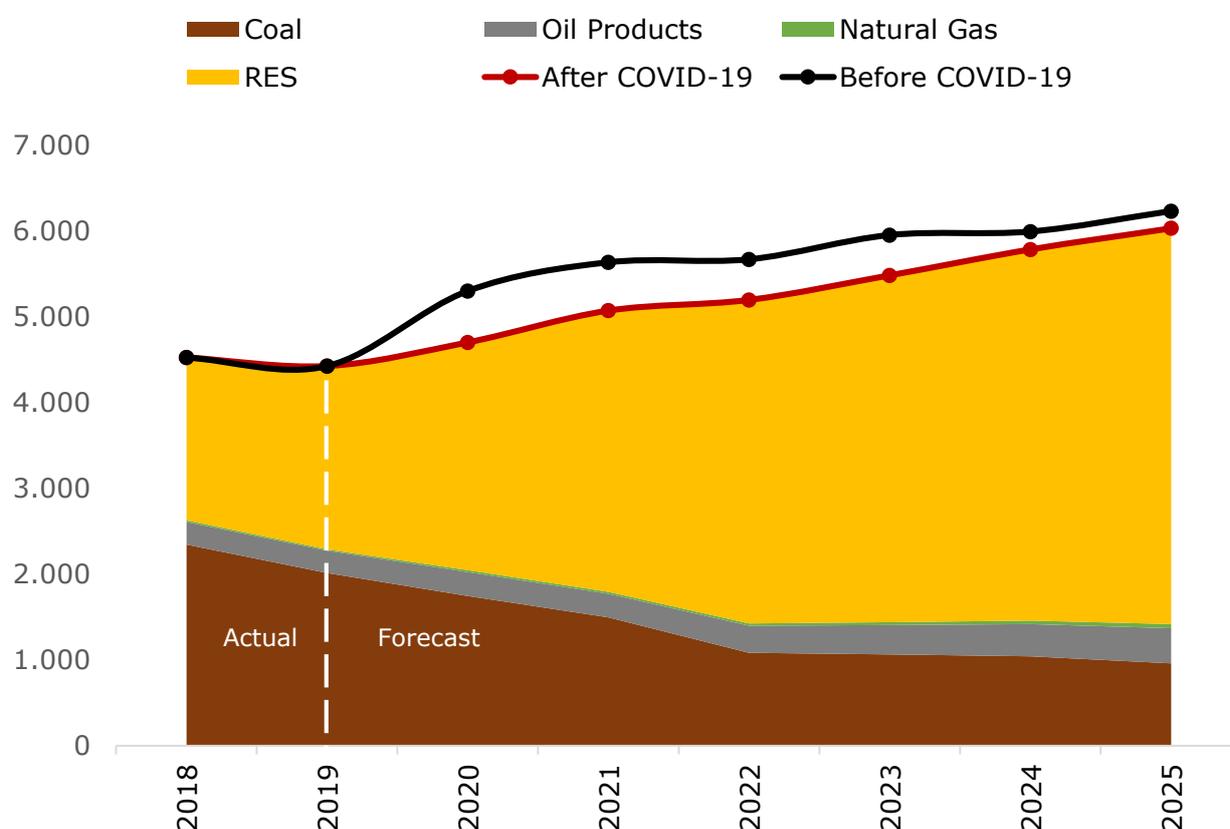
Source: HAEE's analysis

Highlights

- The sharp decline during 2020 is attributed to the drop of the overall demand mainly for natural gas, oil and coal.
- By 2022, energy consumption will return to prior projections, that is anticipated to follow a downward trend due to improvements achieved in energy efficiency.
- RES share is not strictly affected from the pandemic and continue to gradually increase their penetration into the system.
- Coal consumption will drop to historical levels after the recent government's decision to phase-out all lignite units by 2023.
- In the long run, the gap between the two projections will gradually decrease, reaching at almost identical levels by 2022.

Primary energy production in Greece is anticipated to follow an upward trend mainly driven by the increased penetration of RES

Evolution of Primary Energy Production in Greece (ktoe), [2018-2025]

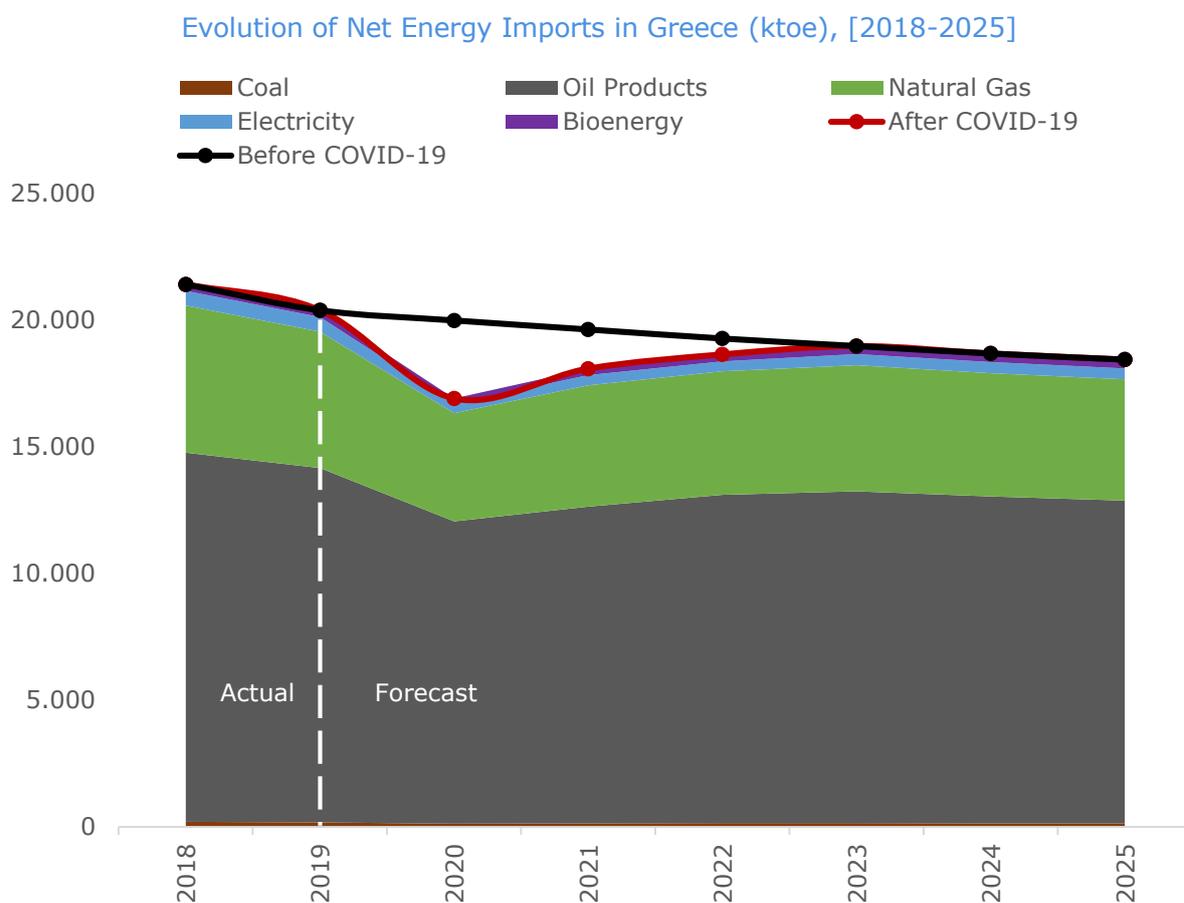


Source: HAEE's analysis

Highlights

- By the end of 2025, RES are anticipated to represent 75% of total energy produced in Greece, since both coal and oil will follow a downward trend.
- In order to achieve the increased penetration of RES, flexible and quick-response technologies such as Batteries and Demand Response are needed.
- For 2019, coal consumption represented 45% out of total domestic energy production while RES stood at 48% and oil at 6%.
- COVID-19 significantly affected the future projections of primary energy production in Greece since the updated estimations for 2020 are reduced by 20%.
- Based on the National Plan for Climate & Energy, oil production in Greece is anticipated to represent a steady share of 6% throughout the projected period.

Net energy imports, are projected to suffer a huge drop of almost 15% for 2020, attributed to the overall collapse of the domestic demand

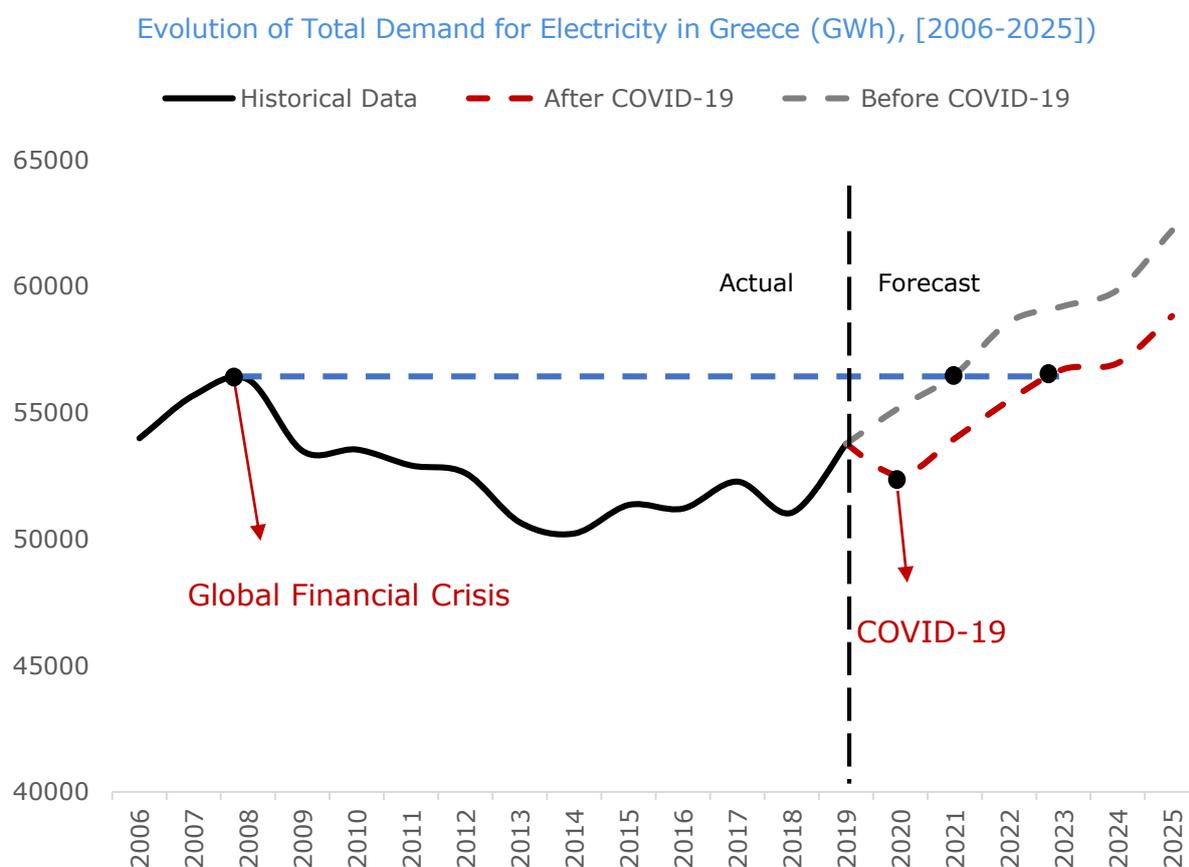


Source: HAEE's analysis

Highlights

- This short-term drop in energy imports will end by 2021, when energy related imports will increase by 6% reaching more than 18.000 ktoe.
- After 2021, a gradual increase of net energy imports is anticipated, reaching the prior estimations provided by the National Plan for Energy & Climate.
- Oil products currently represented 68% out of total energy imports and this share is expected to remain stable until 2025.
- Both projections of net energy imports follow a downward trend that is reduced by 14% in 2025 compared to 2018 levels.
- This tendency is driven by the increased penetration of RES into the system and the gradual replacement of the imported natural gas absorbed in electricity generation.

Following the COVID-19 crisis, the target for returning to 2008 levels in terms of electricity demand is projected for 2023 instead of 2021



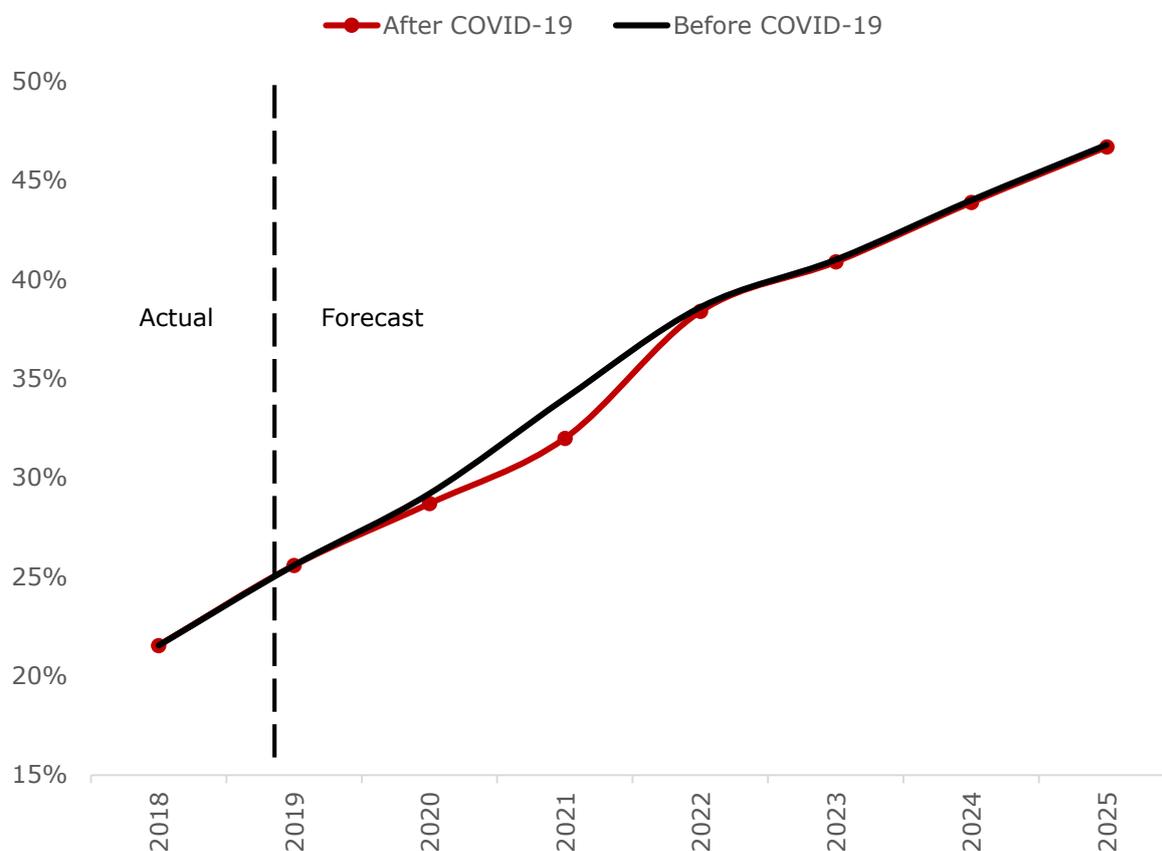
Source: HAEE's analysis

Highlights

- The economic crisis during the last decade, heavily affected the total demand for electricity which, compared to 2008 levels, dropped by almost 11% in 2014.
- The projections based on the increased demand for electricity during 2019, forecasted that by 2021 the demand would equal 56.5000 GWh.
- However, following the outbreak of COVID-19, this scenario was revised for 2023, meaning that the expected growth in electricity demand will fall short by 2 years.
- This negative effect from the electricity market, partially reflects the adverse outcome that is anticipated in the aggregate consumption in Greece.
- This U-shaped return, could be easily modified to a V-shaped return or even an L-shaped based on the resurgence of the COVID-19 crisis.

The share of RES in gross electricity consumption will be slightly affected by the impact of the pandemic reaching 46% in 2025

RES share in Gross Electricity Consumption in Greece (%), [2018-2025]



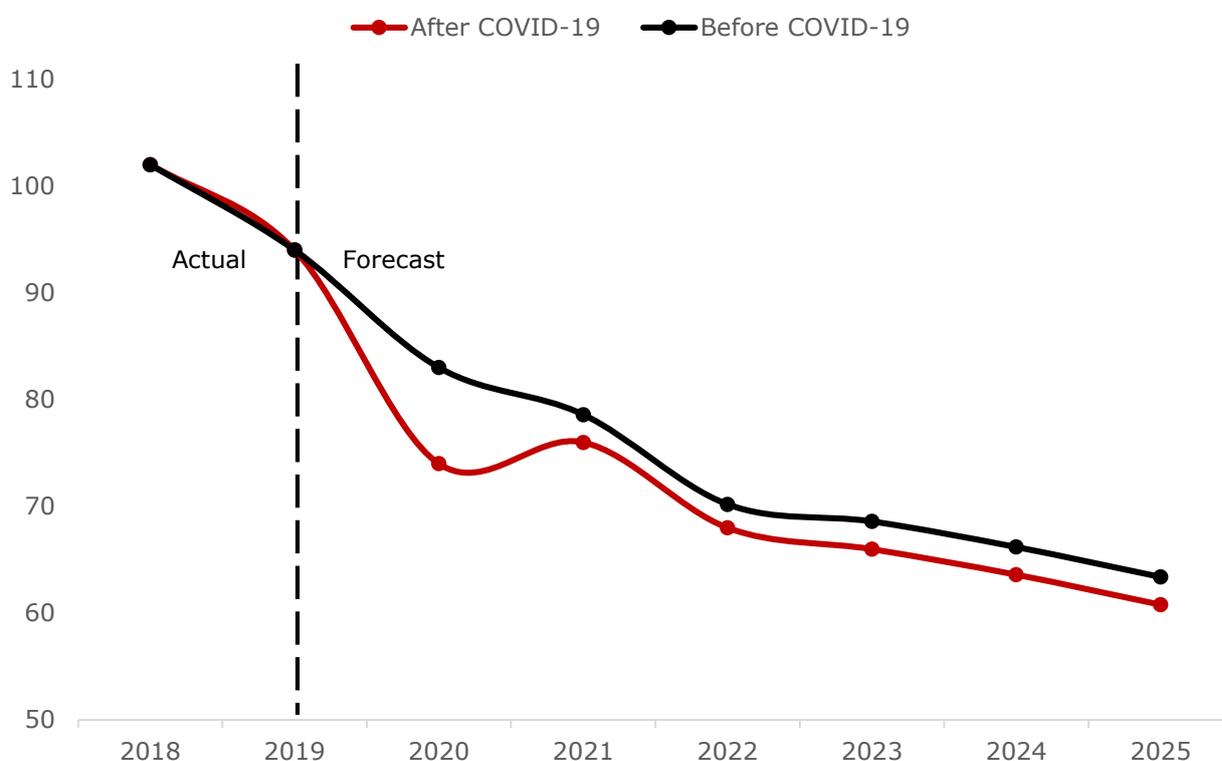
Source: HAEE's analysis

Highlights

- This small drop of 2% compared to previous estimations is attributed to minor delays related to the construction and financing of new RES projects.
- Since investments in RES are expected to be supported at national level during the COVID-19 crisis, the trajectory returns back to the path of steady growth quite soon.
- Under development RES projects who secured Tariffs through a tender face strict connection deadlines, with the risk of bank guarantees forfeiture.
- Supported mainly by the European Commission, national authorities need to guarantee flexibility for the development and completion of renewable projects.
- The European Green Deal aims to completely decarbonize the energy sector over the upcoming decades by moving to clean and circular economy.

On the positive side of the current crisis, the total amount of CO2 emissions in Greece is expected to sharply decrease in 2020

Evolution of Total CO2 Emissions in Greece (MtCO2), [2018-2025]



Source: HAEE's analysis

Highlights

- Tackling air pollution will not just save millions of lives but will also bring multiple benefits to issues including climate change and sustainability across the globe.
- Air pollution is a global problem but the burden on health is disproportionately higher in poorer countries and has a pronounced impact on economic progress.
- A significant drop in air pollution has been observed in Athens since the government took strict precautionary measures to counter the spread of the Coronavirus.
- Based on a comparison of the average daily values, in March 2020 there was an annual decrease of 11.4 % in nitrogen dioxide pollutants.
- Member-states are required under European Union directives to draw up and implement programs to limit their annual emissions.

2. Energy Transition



Highlights



The share of **RES** in final gross energy consumption of Greece is anticipated to rise at **least at 35%** until 2030



45% of Greece's **energy requirements** are currently covered by imports of **oil** products



By 2030, **natural gas** will represent **22%** of final energy consumption and **32%** of total electricity generation



Greece targets to accomplish a **30% increase** of electrical vehicles in the share of new registrations

Electricity generation by **coal** will completely **phase-out** by **2023**



Compared to 1990 levels, the National Plan for Energy projects reduction of total **greenhouse gas emissions** by **40%** in 2030



RES contribution for electricity generation is projected to reach **61%** by 2030



Greece aims to achieve improvement in **energy efficiency** by **38%**



The **dependency rate** of Greece on energy imports reached **70.4 %** in 2018



Overview

The European Green Deal is a roadmap for the promotion of clean, affordable and secure energy for a sustainable future. Supportive towards this direction is the Emissions Trading System which is considered as the cornerstone of the EU's policy to combat climate change. Over the past decade, significant progress is observed in terms of the Greek energy market development and liberalization. In that context, the three pillars of the revised National Energy and Climate Plan announced by national authorities at the end of 2019 are (i) Reduction of greenhouse gas emissions, (ii) Increase of Renewable Energy Sources penetration, and (iii) Achieve improvement in Energy Efficiency.

Currently, in terms of the energy balance, imports in Greece are almost double compared to exports, fact that highlights energy security issues. Greece imports the majority of its oil and gas needs, which crucially affects the security of supply. However, the interplay between energy supply and consumption in Greece reveals a significant drop of oil products over the past decade. Still, due to the COVID-19 impact, both values representing net energy imports and energy consumption by sector decreased for 2020.

For 2018, transportation and households absorbed 64.7% of final energy consumption in Greece. One crucial issue that national authorities need to tackle is the percentage of homes unable to get warm, which is still high in Greece and is expected to increase even more due to the COVID-19 crisis.

At the same time, the country reports sufficient progress in terms of Environmental Sustainability which peaked at 135% in 2019. By 2030, CO2 emissions are expected to primarily reduce in the electricity generation sector, mainly due to the phase-out of coal units. In parallel, Renewable Energy Sources will gradually occupy increased proportion of both domestic production and consumption. By 2030, more than 1/3 in terms of final energy consumption will be generated by RES. Besides, total electricity generation from RES is projected to double in 2030, reaching 38.1 TWh.

The target for installed capacity of RES until 2030 is to reach 18.9GW from 10.1GW in 2020. The ambitious progress of Renewable Energy Sources to reach 2030 targets differs among sectors and timing. Considering the developments in Natural gas market, it will continue to play major role, as a bridging fuel, in terms of electricity generation, supporting the ongoing Energy Transition. Finally, by 2030, Greece aims to achieve a sharp increase in the share of electrical vehicles following the plethora of incentives announced in June 2020.

The European Green Deal is a roadmap for the promotion of clean, affordable and secure energy for a sustainable future



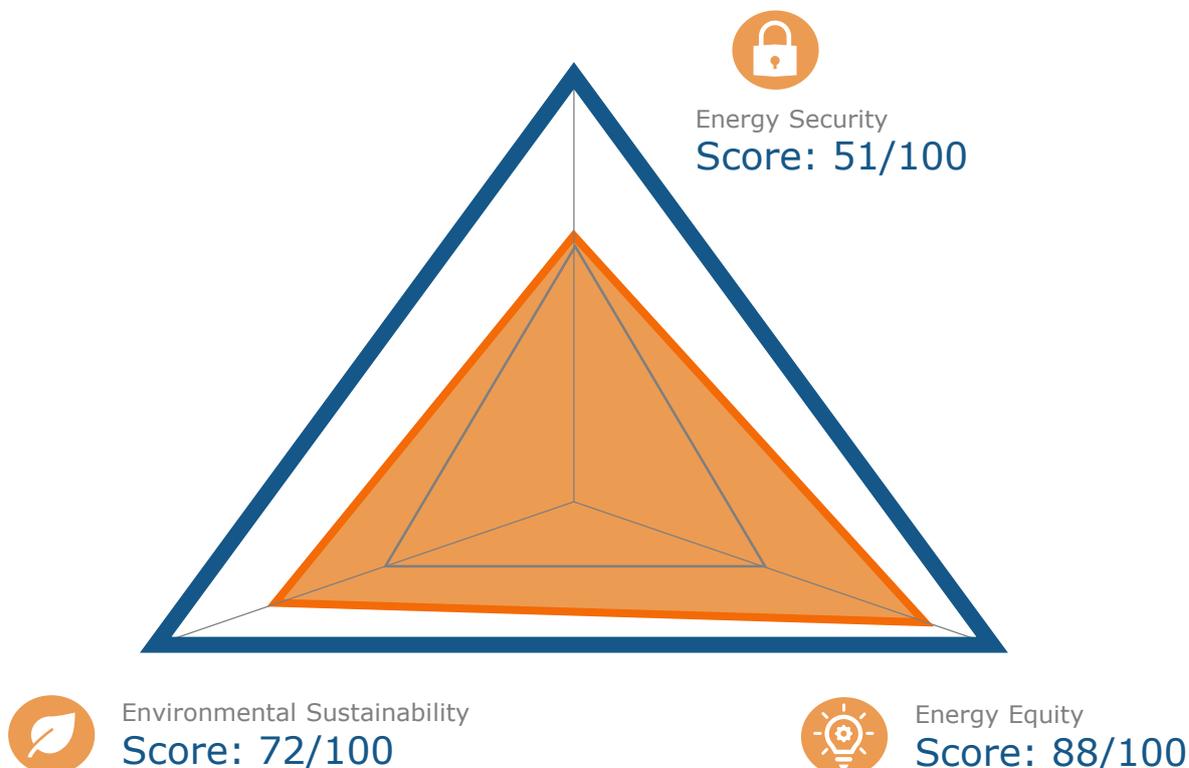
Source: European Commission, HAEE's analysis

Highlights

- Between 1990 and 2018, EU reduced greenhouse gas emissions by 23%, while the economy grew by 61%.
- Currently, the production and use of energy across economic sectors account for more than 75% of the EU's greenhouse gas emissions.
- To achieve climate neutrality, a 90% reduction in transport emissions is needed to be accomplished by 2050.
- The Commission has estimated that achieving the current 2030 climate and energy targets will require €260 billion of additional annual investment (1.5% of 2018 GDP).
- According to the new European Green Deal, at least 30% of the "InvestEU" Fund will contribute to fighting climate change.

Greece ranks 47th in the Trilemma Global Index with diverse performance across the three dimensions

Trilemma Global Index [2019]



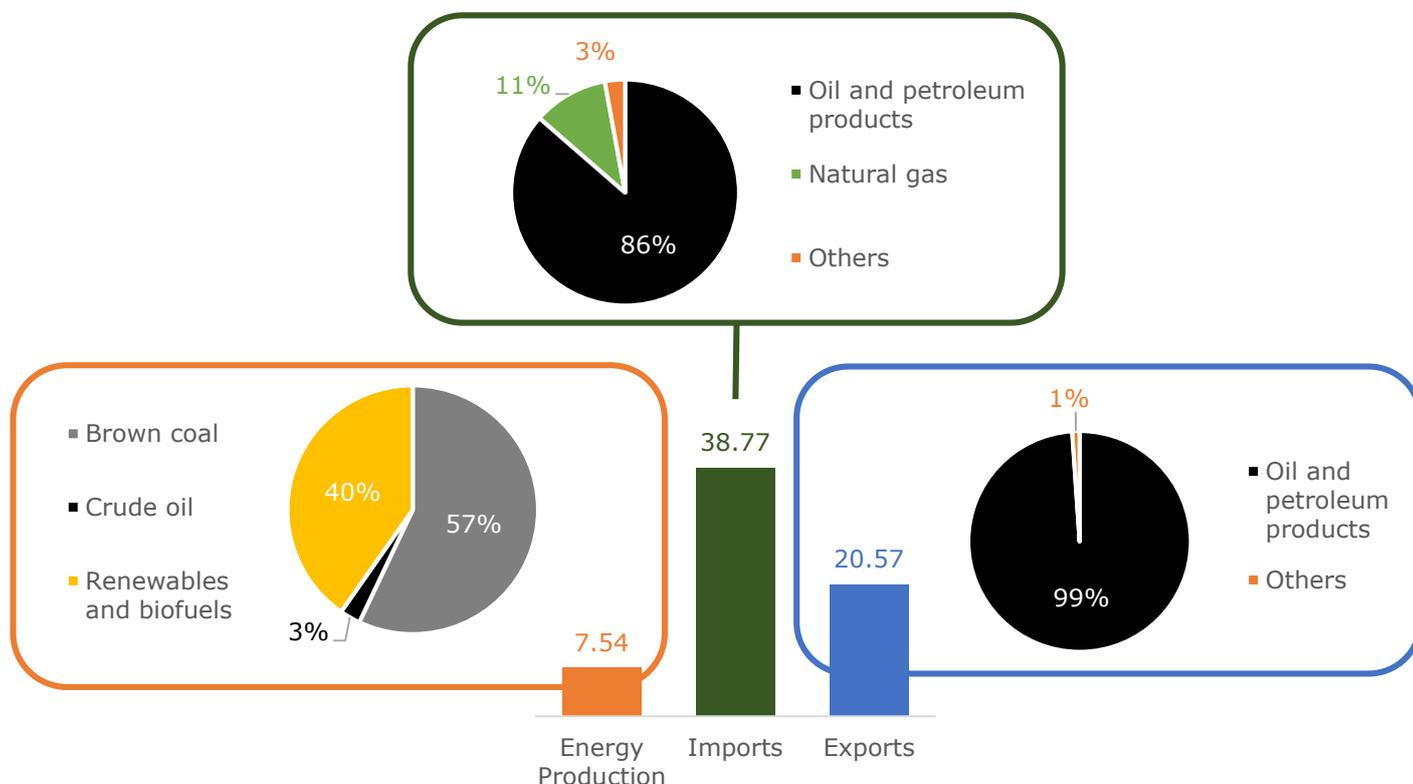
Source: World Energy Council, HAEE's analysis

Highlights

- Greece has achieved a relatively high Energy Equity score (88/100) and a sufficient ranking in terms of Environmental Sustainability (72/100).
- The country has put in place a number of policy instruments to meet the increasing electricity demand, favoring the market uptake of Renewable Energy Sources.
- The aim is to minimize the share of coal in electricity generation in order to improve the country's environmental sustainability performance.
- High dependence on energy imports such as oil and natural gas, significantly affects the Energy Security Index.
- Strict policies and precise targets have been announced by the revised National Plan for Energy and Climate which aims to increase environmental sustainability.

In terms of the energy balance, imports in Greece are almost double compared to exports, fact that highlights energy security issues

Energy Balance (Mtoe), [2018]



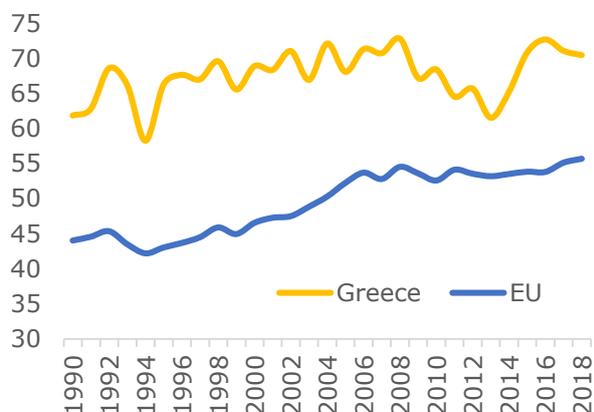
Source: European Commission, HAEE's analysis

Highlights

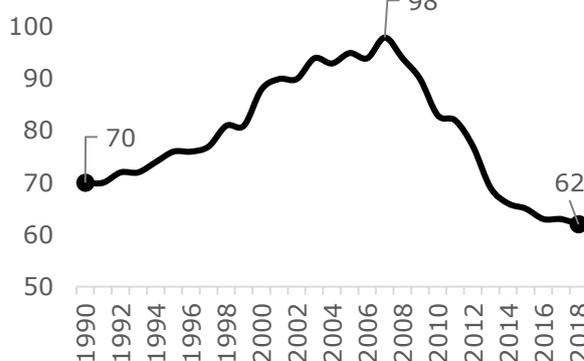
- Greece produced 7.54 Mtoe of energy for 2018, out of which 57% stands for brown coal, 40% for renewables and 3% for crude oil.
- Energy imports reached 38.77 Mtoe in 2018 with oil and petroleum products representing 88% of the total amount and natural gas 11%.
- For 2018, oil and petroleum products denoted 99% of energy exports, or almost 20.57 Mtoe.
- As the figures reveal, the high dependence on oil and gas imports is driving Greece towards exploration efforts.
- In general, large-scale RES development can significantly contribute towards improving the energy security ranking of Greece.

Greece imports the majority of its oil and gas needs, which crucially affects the security of supply

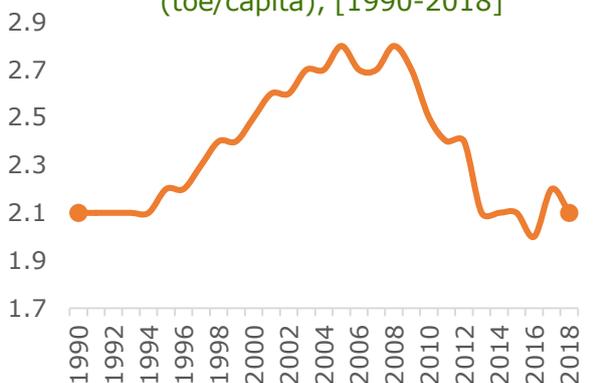
Energy Dependence (%), [1990-2018]



Total CO2 Emissions (Mt of CO2), [1990-2018]



Total Primary Energy Supply per Capita (toe/capita), [1990-2018]



Net Energy Imports (Mtoe), [1990-2018]



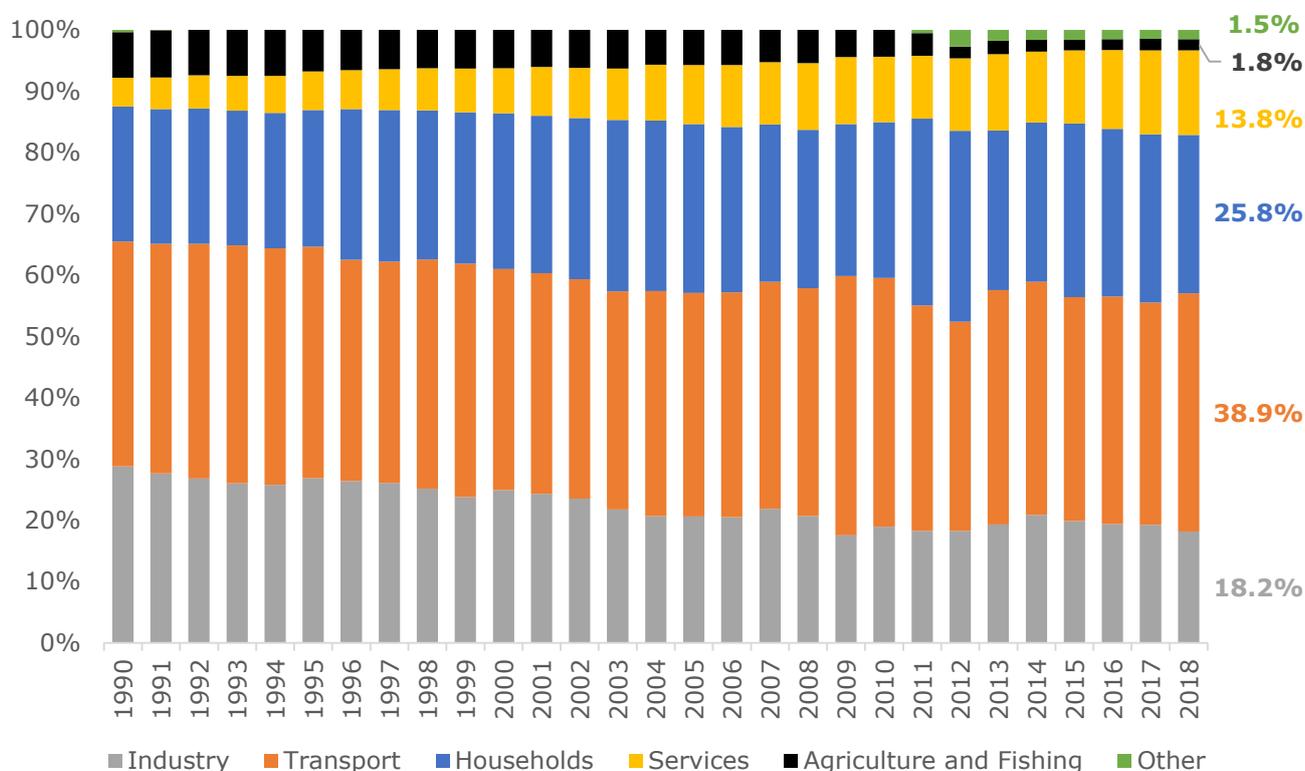
Source: Eurostat, IEA, HAEE's analysis

Highlights

- Over a 28-year period (1990-2018), energy dependence in Greece is constantly fluctuating above EU's average, reaching 70.46% in 2018.
- A steady upward trend is apparent in EU's energy dependence since the percentage hiked from 44% in 1990 to the maximum ever recorded 55.7% in 2018.
- Crude oil largely dominated EU's imports of energy products in the first semester of 2019 with a share of 71%, followed by natural gas with 24%.
- Total CO2 emissions and total primary energy supply per capita in Greece depict identical patterns and this symmetry reflects the correlation between the two graphs.
- Since 1990, net energy imports have been constantly rising until 2008, when a sharp decrease followed up to 2013.

For 2018, transportation and households needs represented 64.7% of final energy consumption in Greece

Final Energy Consumption by Sector (%), [1990-2018]



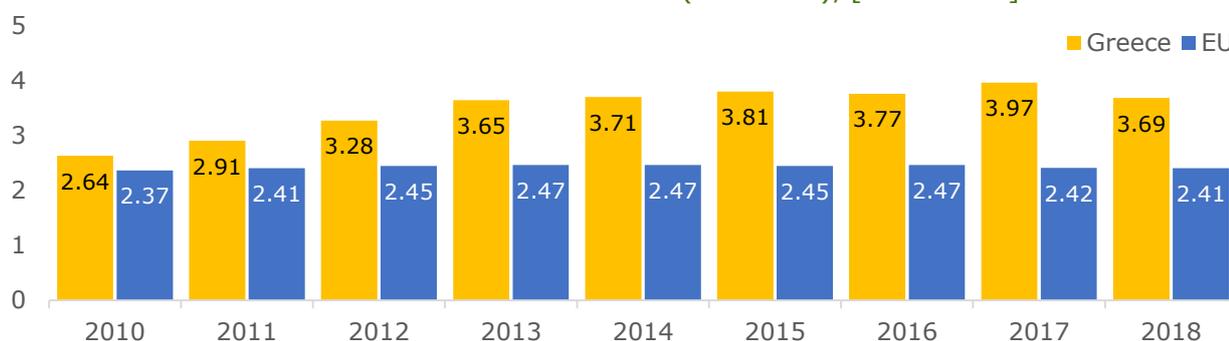
Source: European Commission, HAEE's analysis

Highlights

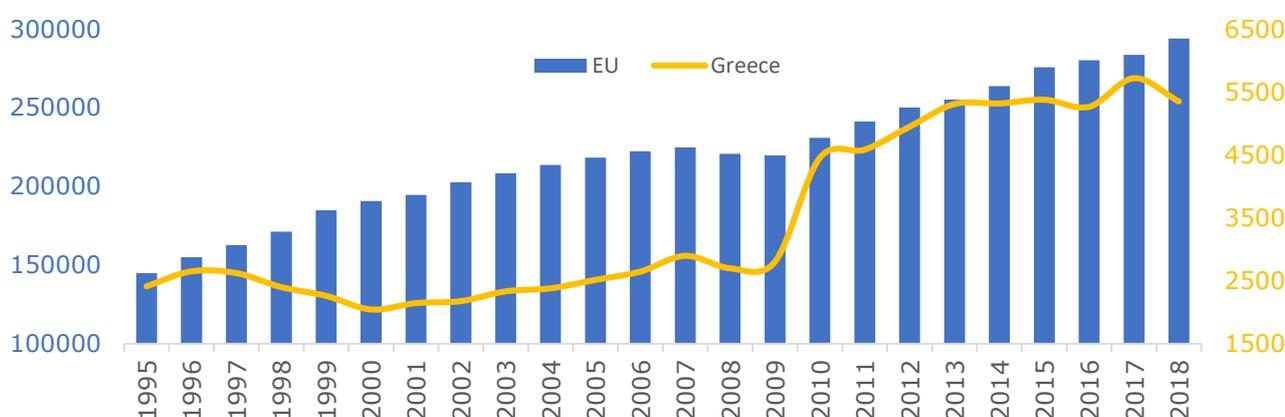
- Final energy consumption for 2018 is consisting by the following categories: Industry 18.2%, Transport 38.9%, Households 25.8%, Services 13.8% and Others 3.3%.
- The industrial sector follows a constant decline in terms of final energy consumption since 1990, when it represented almost one third of total consumption.
- The share of services has almost tripled compared to 1990 percentage (4.7%), while agriculture and fishing dropped to 1.8% in 2018 from 7.5% in 1990.
- Given the significant share that corresponds to the transport sector in terms of final consumption, the country's quick shift towards eco-mobility is crucial.
- At the same time, since household consumption represents more than 25% of final consumption, the need to focus on energy efficiency policies is vital.

Following 2009, data reveal a sharp increase in energy taxation revenues compared to the corresponding average value for the EU members

Environmental Tax Revenues (% of GDP), [2010-2018]



Energy Tax Revenue (millions €), [1995-2018]

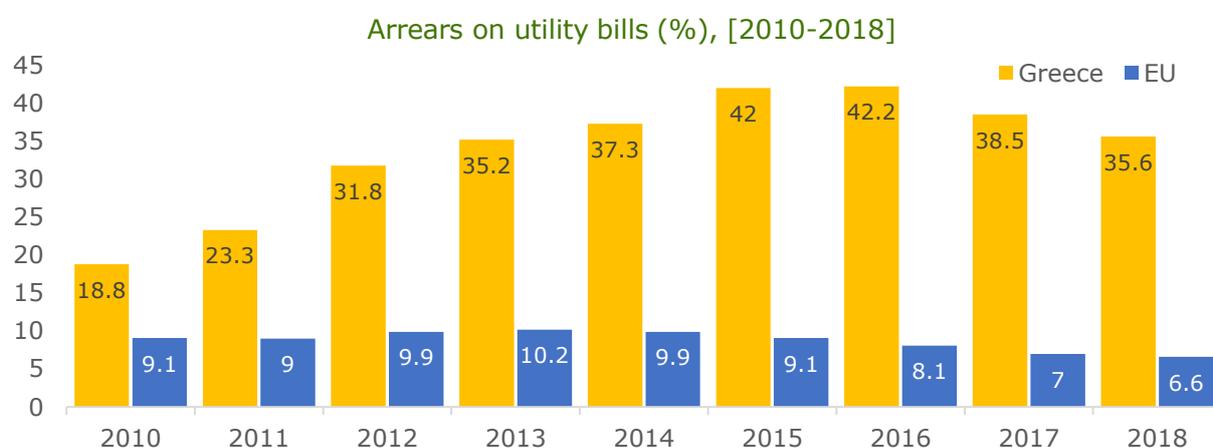
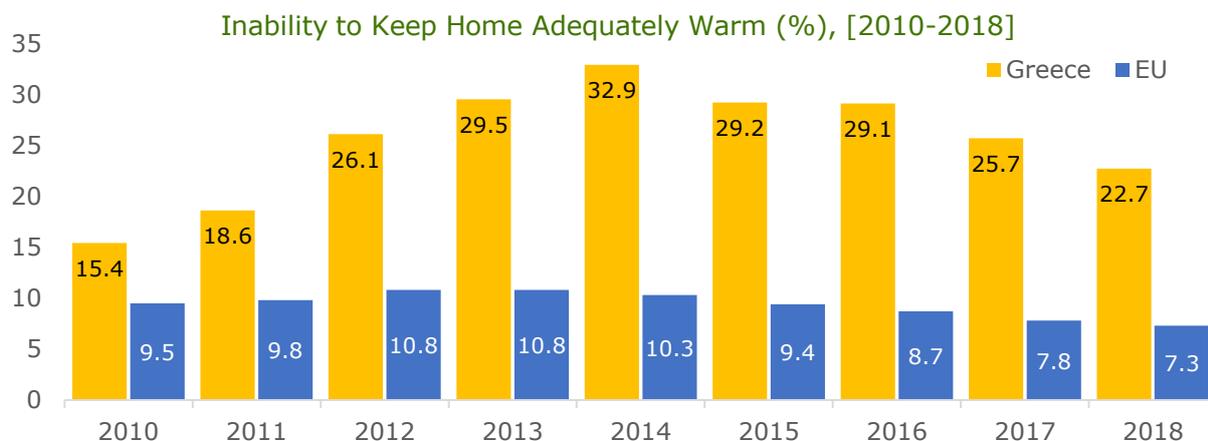


Source: Eurostat, HAEE's analysis

Highlights

- Across the European Union, the environmental tax revenue-to-GDP ratios for 2018 ranged from the lowest 1.6 % in Ireland to the highest 3.7 % in Greece.
- This percentage met in Greece (3.7%) is significantly greater compared to the average rate of EU Member States which is 2.4%.
- For the majority of the countries the ratio decreased in 2018, with the largest decrease recorded in Greece (-0.28 percentage points).
- At national level, the European Green Deal will create the context for broad-based tax reforms, mainly by removing subsidies for fossil fuels.
- EU's Just Transition Mechanism, will mobilize at least €150 billion in investments over the period 2021-2027 to support a fair and just green transition.

The percentage of homes unable to get warm is still high and is expected to increase even more due to the COVID-19 crisis



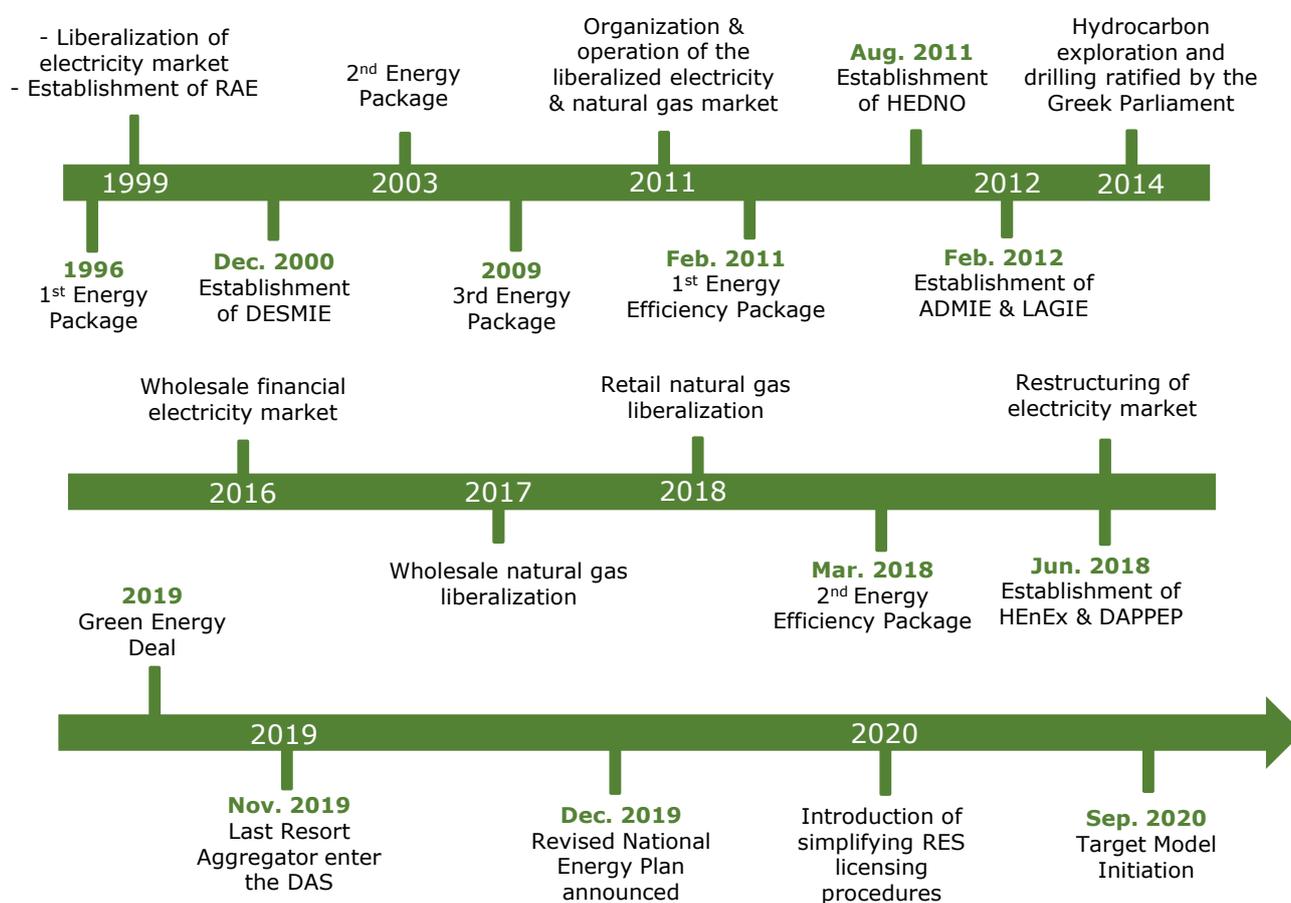
Source: Eurostat, HAEE's analysis

Highlights

- Energy poverty is defined as the inability to keep homes adequately warm or to pay off energy utility bills.
- Among the EU countries, Greece has experienced the biggest increase concerning the inability to keep homes adequately warm, though this trend seems to decline.
- The impact of the financial crisis in Greece increased the inability of households to meet the energy utilities obligations, peaking at 42.2% in 2016.
- In particular, the percentage of households which encountered difficulties in utility bills, was 18.8% in 2010, while it reached 35.6% of households for 2018.
- Currently, the majority of European Union countries introduce national measures in order to curb the sources of energy poverty.

Over the past decade, significant progress is observed in terms of the energy market development and liberalization

Timeline of the Liberalization Process in the Greek Energy Market



Source: HAEE's analysis

Highlights

- Plethora of measures have been adopted since 1996 to address market access, transparency, regulation, consumer protection and interconnections support.
- Competition in electricity market is still weak, since PPC's dominates the market share (71.48% in January 2020).
- The same holds also for the wholesale and retail gas markets since currently only a small but growing number of competitors exist in the specific market.
- The constant implementation of electricity and gas market reforms are the necessary steps towards the implementation of the Target Model in 2020.
- The main priority of the new National Plan for Energy and Climate includes a sustainable development model along with environmental protection.

The three pillars of the revised National Energy and Climate Plan announced by the Ministry of Environment and Energy by the end of 2019

Reduction of Greenhouse Gas Emissions and other Environmental Targets

Total greenhouse gas emissions to be reduced by at least 40% compared to 1990 (percentage achieved reduction > 42%)

- Achieve equivalent objectives in terms of emissions reduction in the individual areas inside and outside of the trading system of allowances.
 - Quantitative achievement of national targets for the reduction of specific air pollutants.
 - Withdrawal of lignite units power generation by 2023.
-

Increase of Renewable Energy Sources penetration

The share of RES in final gross energy consumption to rise at least at 35%

- The share of RES in final gross electricity consumption energy to rise at least 60%.
 - The share of RES for the heating needs and cooling to overcome 40%.
 - The share of RES in transport sector to exceed 14% (achieves 19%) according to the relative methodology calculation of the EU.
-

Achieve improvement in Energy Efficiency

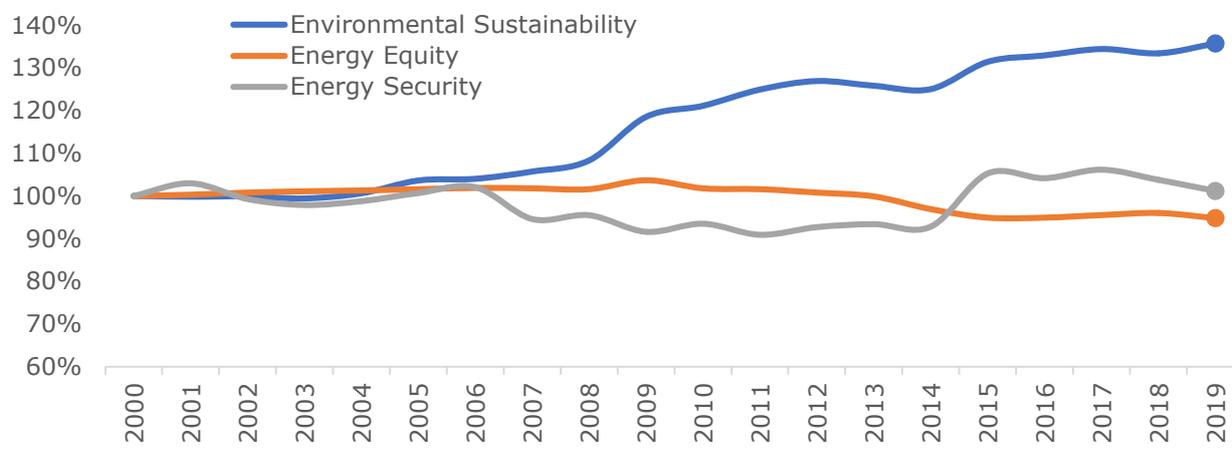
Achieve improvement in energy efficiency by 38% according to European methodology

- The final consumption of energy should not to exceed 16.5 Mtoe the year 2030.
- The primary energy consumption should not exceed 22.5 Mtoe in the year 2030.
- To be achieved at least 7 M toe cumulative energy saving in the period 2021 2030.
- 3% annually energy renovation of the total buildings area of the central public administration by year 2030.

Source: National Energy and Climate Plan, Ministry of Environment and Energy (2019)

The country reports sufficient progress in terms of Environmental Sustainability which peaked at 135% in 2019

Historical Trilemma Scores (Baseline=2000), [2000-2019]



Energy Dependency (%), [2020-2030]



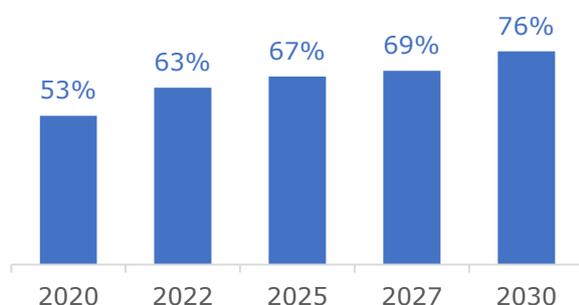
Highlights

Source: World Energy Council & National Energy and Climate Plan

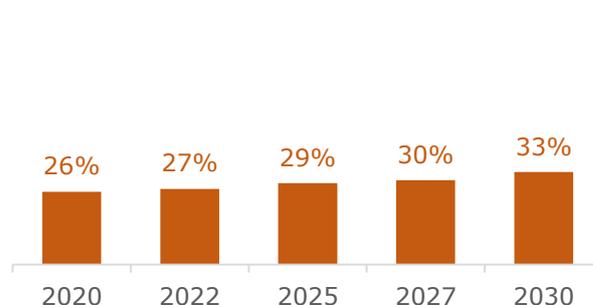
- Most sustainability indicators have been improving considerably since the late 2000s, particularly low carbon electricity generation and GHG emissions.
- However, the equity index has been decreasing during the same period, mainly due to higher electricity prices that are among the highest in Europe.
- Diversity of the energy mix remains a challenge for security, with lower performance in this dimension due to increased dependence on oil and natural gas.
- The Greek energy sector is still largely dependent on fossil fuels, most of which are imported, with 45% of its energy requirements covered by petroleum products alone.
- These petroleum products are not only used in the transport sector, but they are also converted in relevant amounts into electricity, mainly at non-interconnected islands.

The European Union Emissions Trading System is the cornerstone of the EU's policy to combat climate change

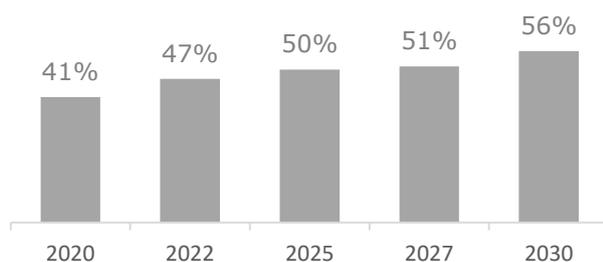
Targets for Emission Reductions for the Sectors Included in ETS Compared to 2005 (%), [2020-2030]



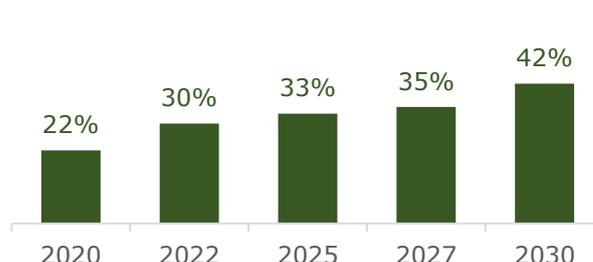
Targets for Emission Reductions for the Sectors in non-ETS Compared to 2005 (%), [2020-2030]



Total Greenhouse Gases (GHG) Emission Reductions Compared to 2005 (%), [2020-2030]



Total GHG Emissions Reduction Compared to 1990 (%), [2020-2030]

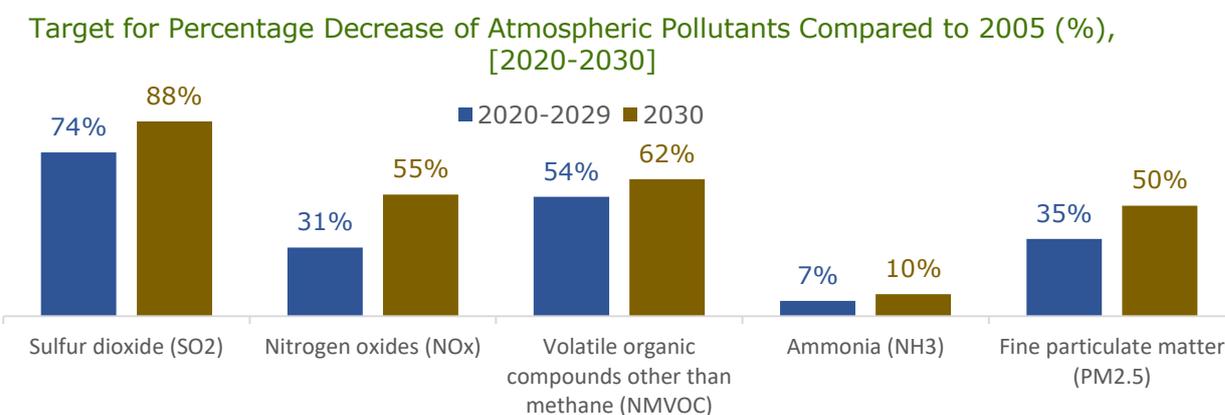
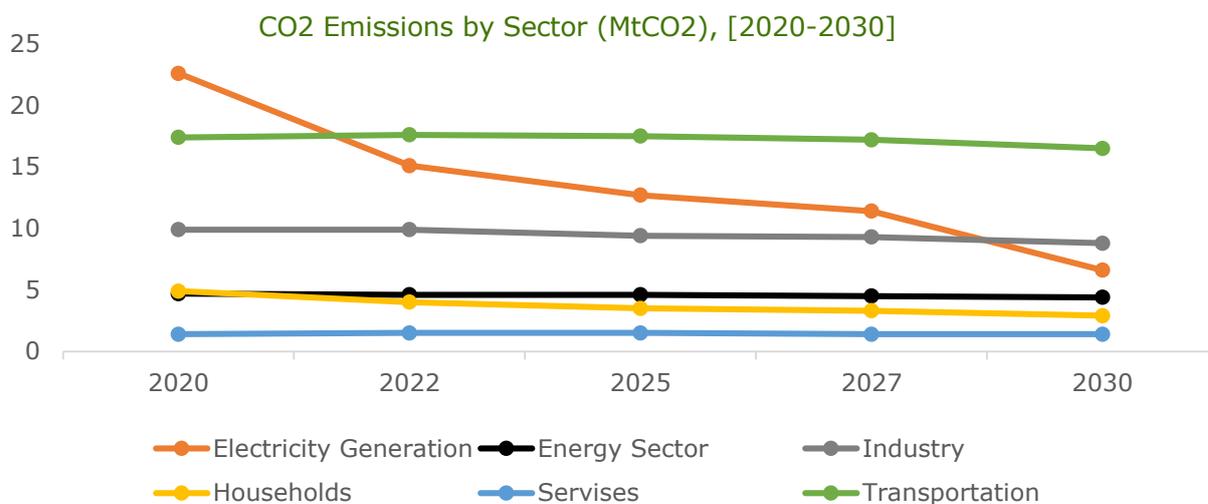


Source: National Energy and Climate Plan, HAEE's analysis

Highlights

- The 76% reduction for sectors included in the ETS compared to 2005 levels is more intense compared to the corresponding 33% for non-ETS sectors.
- Through a complete guide of policies, total emissions from greenhouse gases in 2030 are anticipated to be reduced by more than 50% compared to 2005 levels.
- Compared to 1990 levels the total GHG emissions are aimed to be lessened by almost double (42%) in 2030, compared with the current level of 22%.
- Apart from the operating airlines, these targets limit emissions from heavy energy-using installations, such as power stations and industrial plants in Greece.
- Following the above targets is a key tool for reducing greenhouse gas emissions in a manner that could be characterized as cost-effective.

By 2030, CO2 emissions are expected to primarily reduce in electricity generation sector, mainly due to the phase-out of coal units



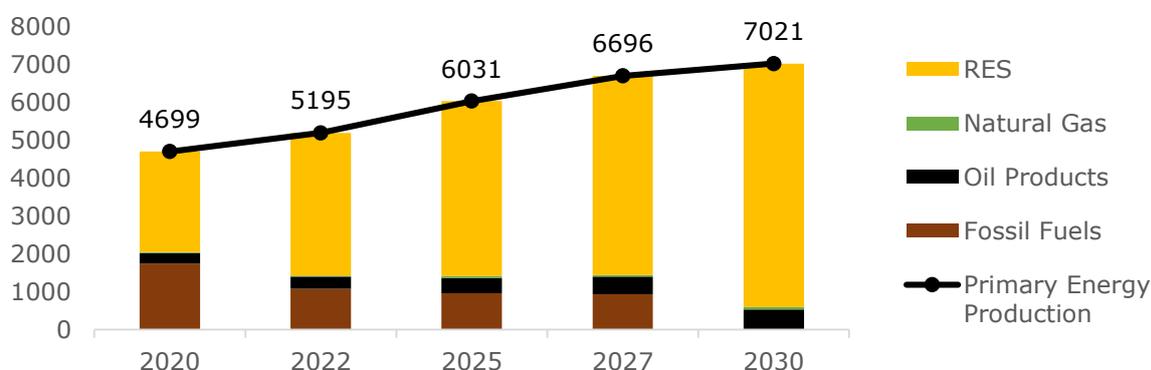
Highlights

Source: National Energy and Climate Plan, HAEE's analysis

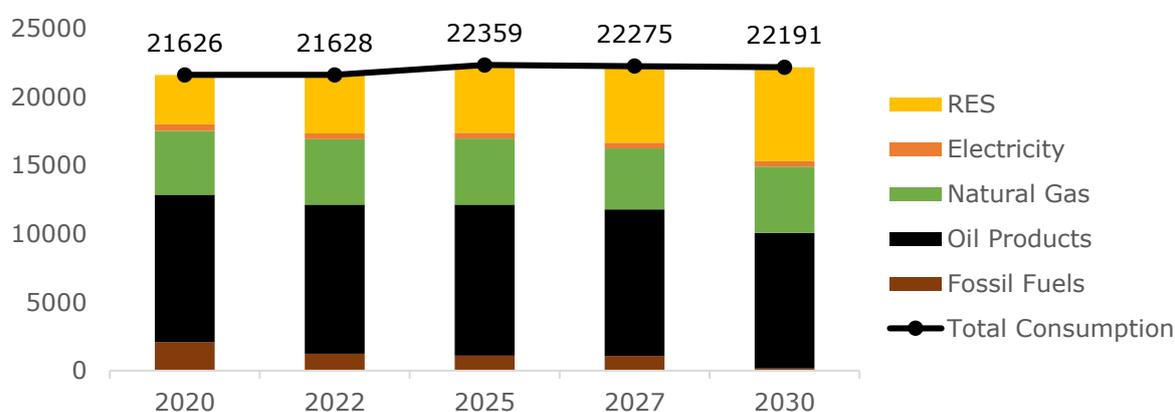
- According to the revised version of the National Energy and Climate Plan (2019), sulfur dioxide (SO2) will decrease by 88% in 2030, compared to 2005 levels.
- Nitrogen oxides (NOx), volatile organic compounds other than methane (NMVOC) and Fine particulate matter (PM2.5) are expected to decrease by more than 50%.
- The most significant reduction in terms of CO2 emissions, is anticipated to take place in the electricity generation sector by a decline of more than 70%.
- The projections reveal no significant reduction of CO2 emissions in terms of the remaining sectors, such as industry, households, services and transportation.
- In overall, several measures have been taken or are in the process of implementation, in an effort to improve the existing air quality conditions.

Renewable Energy Sources will gradually occupy increased proportion of both domestic production and consumption

Evolution of Primary Energy Production in Greece (ktoe), [2020-2030]



Evolution of Gross Energy Consumption (ktoe), [2020-2030]



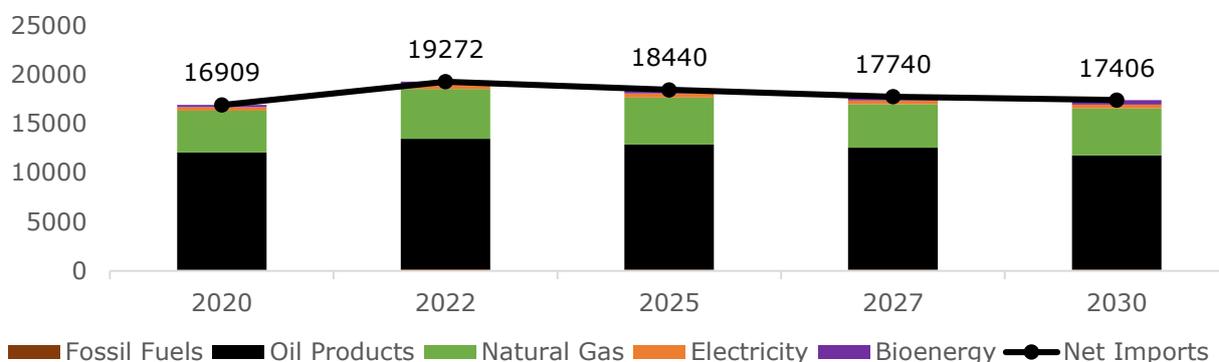
Source: National Energy and Climate Plan, HAEE's analysis

Highlights

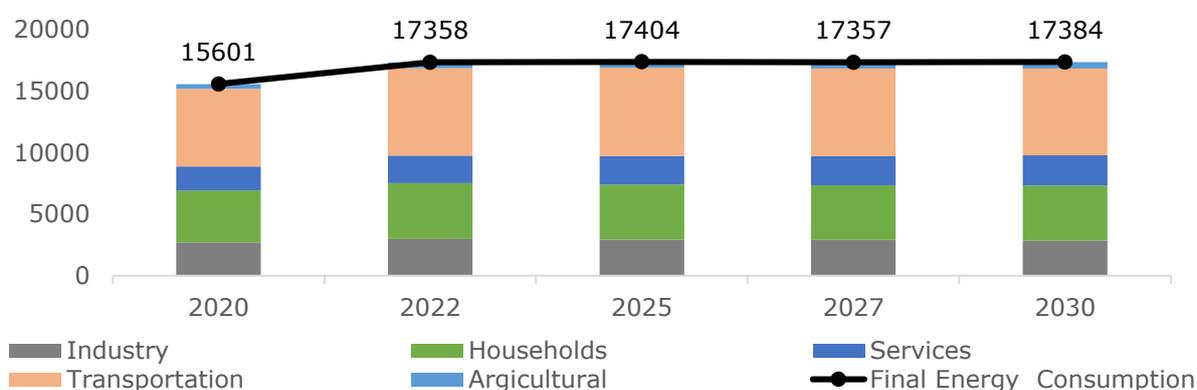
- A sizeable gap between the total energy produced in Greece relatively with the total demand for consumption is observed, fact that underlines energy security issues.
- The most important figure from the evolution of primary energy production in Greece is the ongoing reduction of fossil fuels that is almost zero in 2030.
- At the same time, regarding the production from RES, a sharp increase of almost 90% is expected to take place during the next decade.
- In terms of the gross energy consumption the pattern that can be derived from the projections is the downward trend in total consumption due to the phase-out of coal.
- Total energy consumed by RES is again expected to be 90% greater at the end of 2030, while natural gas and oil will slightly reduce.

Due to the COVID-19 impact, both values representing net energy imports and energy consumption by sector will be affected in 2020

Evolution of Net Energy Imports in Greece (ktoe), [2020-2030]



Evolution of Final Energy Consumption by sector (ktoe), [2020-2030]



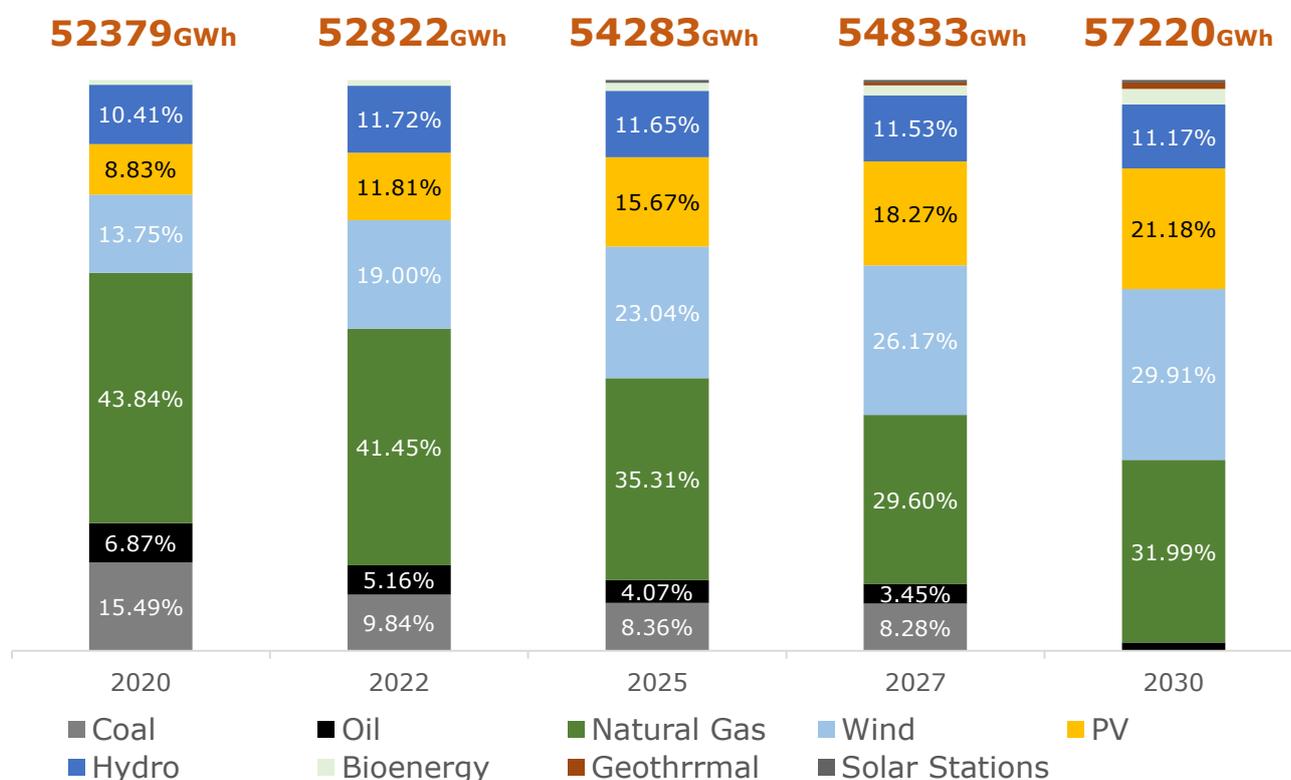
Highlights

Source: National Energy and Climate Plan, HAEE's analysis

- Greece aims to decrease the net energy imports in the long run, which is in contrast with the general trend observed in EU, where imports of primary energy are growing.
- The increase in terms of the domestic RES production will allow the steady decline of net energy imports and at the same time will foster energy security.
- Imports from oil products will gradually increase from 11941 ktoe in 2020 to 13292 ktoe in 2022, while natural gas will rise from 4261kt in 2020 to 5074kt after 2 years.
- Considering the evolution of final energy consumption by sector, no significant change is observed after 2022, since all sectors restrain their current shares.
- Transportation holds a substantial share of final energy consumption in 2020 (40.3%), Households (27%), Industry (17.3%) and Services (12.5%).

Coal phase-out and substantial penetration of Renewable Energy Sources are the two most important trends until 2030

Evolution of Electricity Generation by Source (%) & Total Electricity Generation (GWh), [2020-2030]



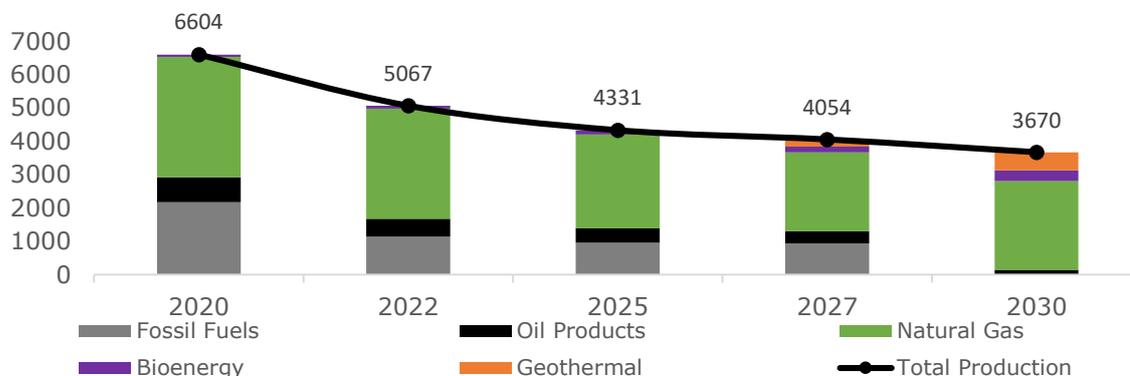
Source: National Energy and Climate Plan, HAEE's analysis

Highlights

- In general, electricity generation in Greece will slightly increase each year reaching 57.220 GWh in 2030 from the level of 52.379 GWh in 2020.
- Greece aims to eliminate the use of coal for electricity generation by 2030, and at the same time drop the use of oil mainly in non-interconnected islands to 1.45%.
- Natural gas will continue to play a dominant role as a bridging fuel in the ongoing energy transition, since its share is estimated to be 31.9% in 2030.
- Electricity produced by Renewable Energy Sources will follow a sharp increase reaching 51% in 2030. An increase of 28% compared to current levels (22.58%).
- The levels of Hydro will remain relatively stable (around 10%), while the proportions of Geothermal and Bioenergy will slightly increase.

Natural gas will continue to play major role as a bridging fuel in terms of electricity generation, supporting the ongoing Energy Transition

Evolution of Electricity Generation by Fuel (ktoe), [2020-2030]



Energy Savings by Sector (Mtoe), [2020-2030]

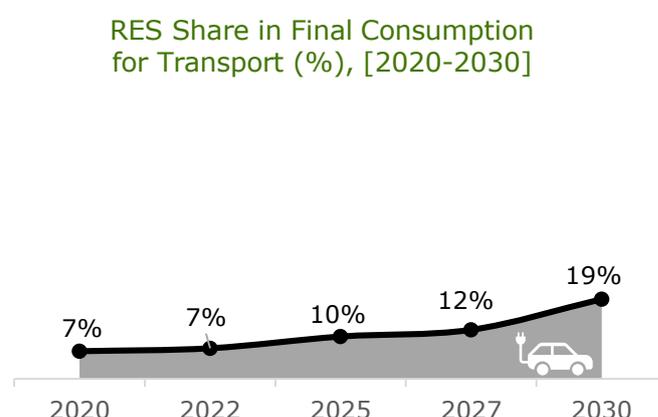
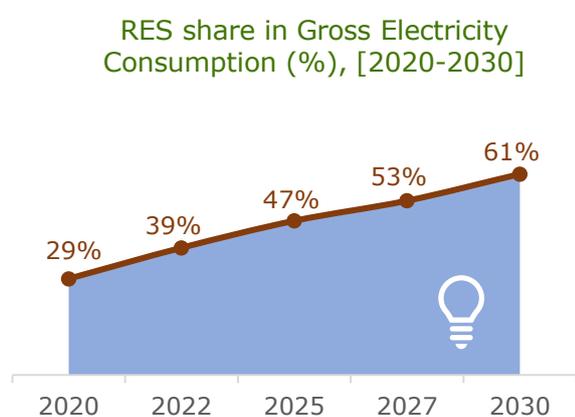
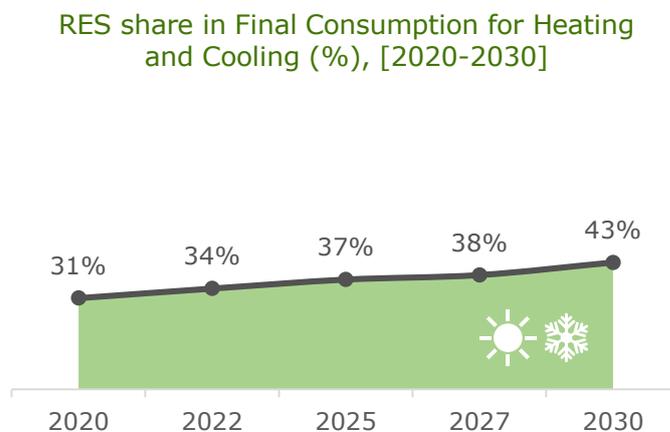
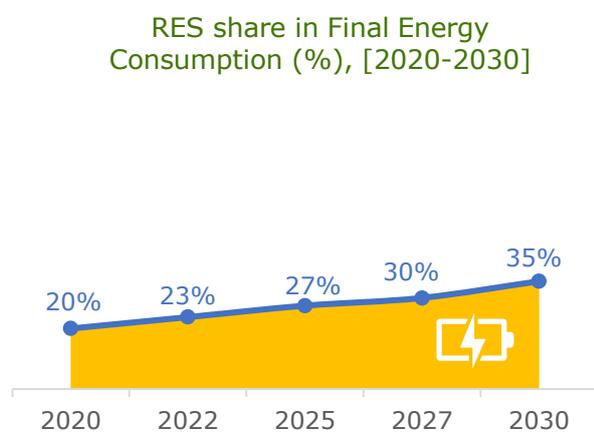


Highlights

Source: National Energy and Climate Plan, HAEE's analysis

- The total amount of electricity generation provided by fuels such as, coal, oil and natural gas is anticipated to be reduced by 44.4% over the next years.
- This sizeable reduction in terms of electricity generation will occur due to the gradual elimination of coal and oil that currently represent more than 40% of generation.
- The projection regarding the use of bioenergy and geothermal is that those two sources of generation will end up representing 23% of total generation by fuels.
- Greece has introduced measures and incentives that promote total energy savings, that are anticipated to reach 10.3 Mtoe by 2030.
- The greatest proportion of those savings will originate from Transportation (36%), Households (33%), Services and Agriculture (16.5%), and Industry (14.5%).

By 2030, more than 1/3 in terms of final energy consumption will be generated by Renewable Energy Sources

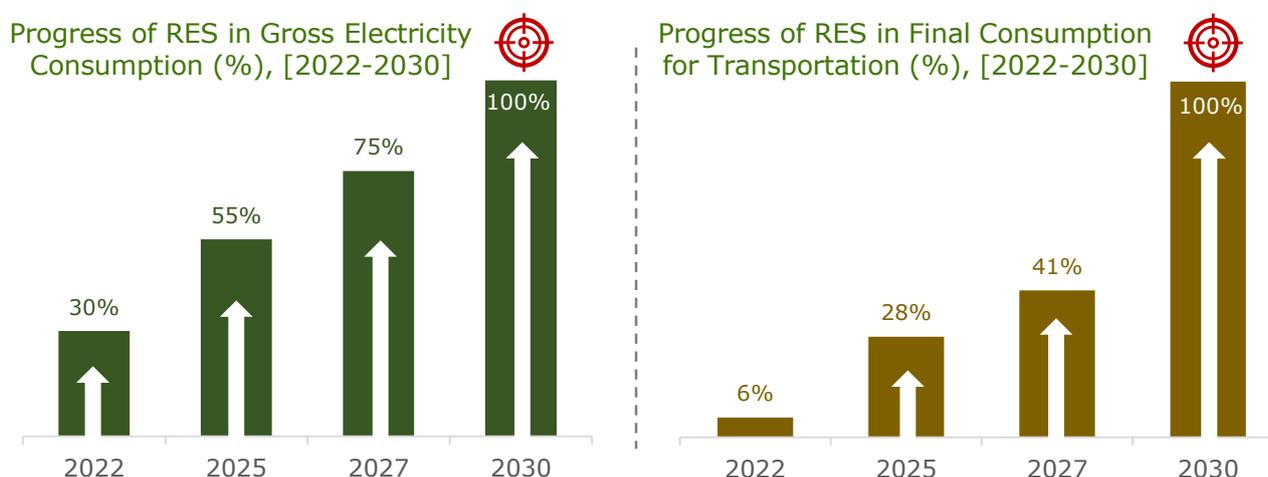
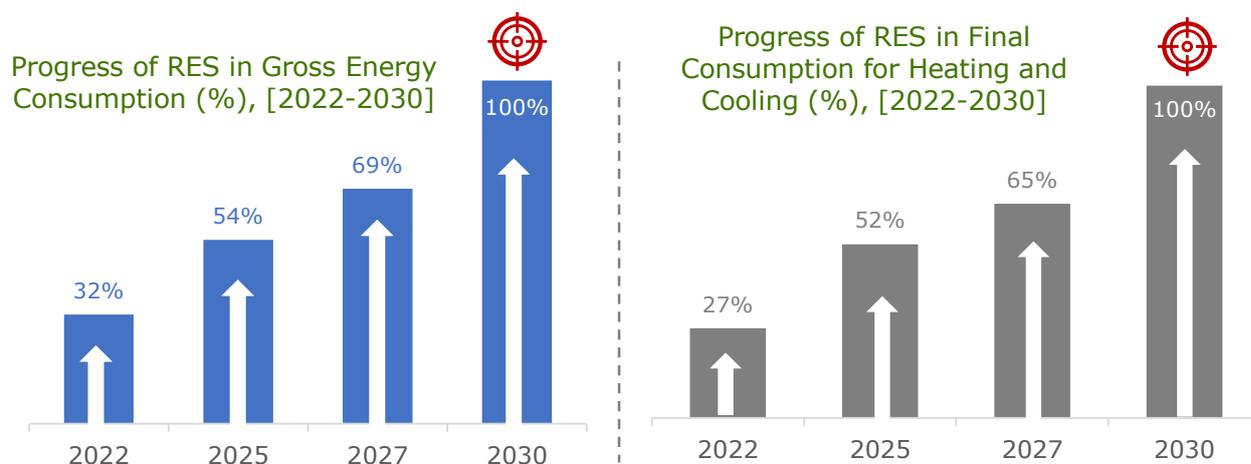


Highlights

Source: National Energy and Climate Plan, HAEE's analysis

- Final energy consumption from RES is currently at 20%, while this share is expected to increase by 15% and reach the level of 35% in 2030.
- Significant contribution of RES is also projected to occur for heating and cooling purposes given that the share will amplify from 31% in 2020 to 43% in 2030.
- The most important increase of RES share is attributed in terms of gross electricity consumption since the share is projected to triple at the level of 61%.
- However, more progress should be reported in transportations since RES share in terms of final consumption at this sector is currently at disappointing levels.
- Despite major growth in renewables, the targets for total emission reduction are challenging, demonstrating once again that urgent action is needed on all fronts.

The ambitious progress of Renewable Energy Sources to reach 2030 targets differs among sectors and timing



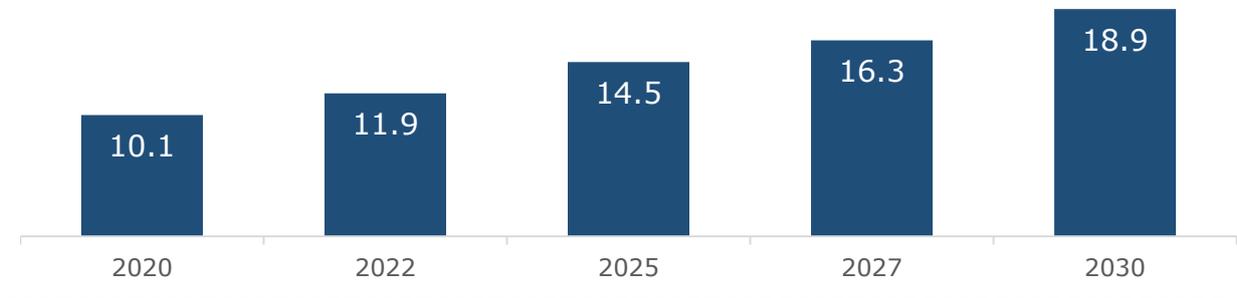
Highlights

Source: National Energy and Climate Plan, HAEE's analysis

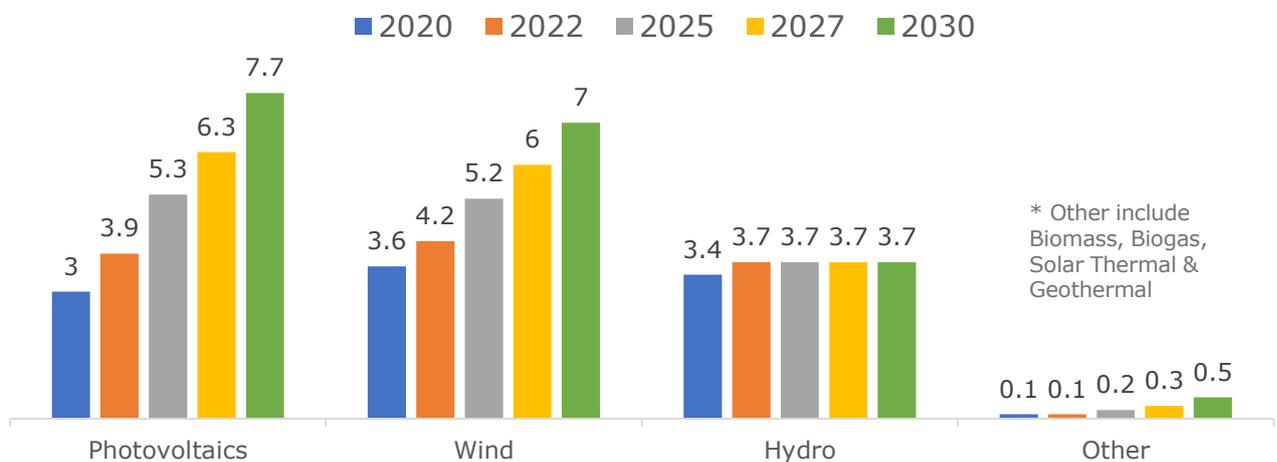
- Over the next decade, we observe a relatively steady growth in the growth of RES use in gross energy consumption.
- Regarding the utilization of RES for heating and cooling purposes, the majority of the progress (35%) is estimated to be achieved as we approach in 2030.
- In terms of electricity consumption, the gradual phase out of coal units and decrease of oil use will allow RES increase their penetration reaching 61% in 2030.
- Achieving this goal requires doubling the current installed capacity of almost all RES technologies with the exception of large hydroelectric projects.
- During the next five years, slow progress is reported in terms of RES contribution in Transportation, since 59% of the progress will be accomplished after 2027.

The target for installed capacity of Renewable Energy Sources until 2030 is to reach 18.9GW from 10.1GW in 2020

RES Electricity Generation – Total Installed Capacity (GW), [2020-2030]



RES Electricity Generation - Installed Capacity by source (GW), [2020-2030]



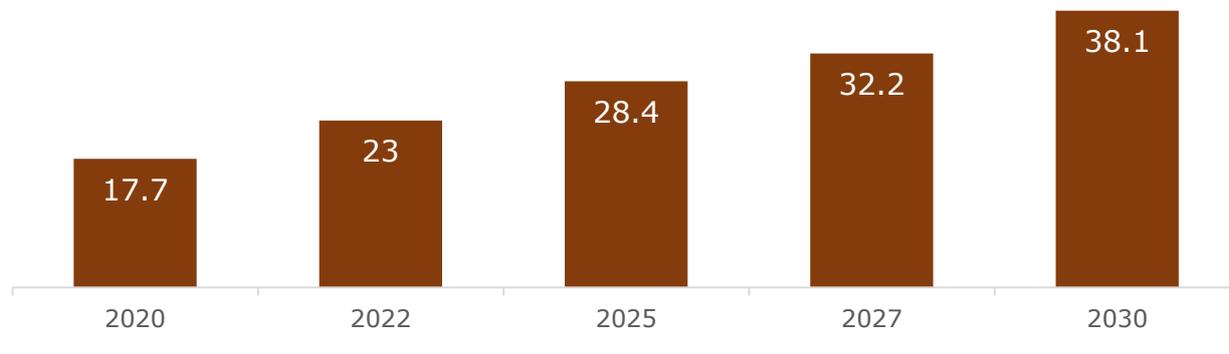
Highlights

Source: National Energy and Climate Plan, HAEE's analysis

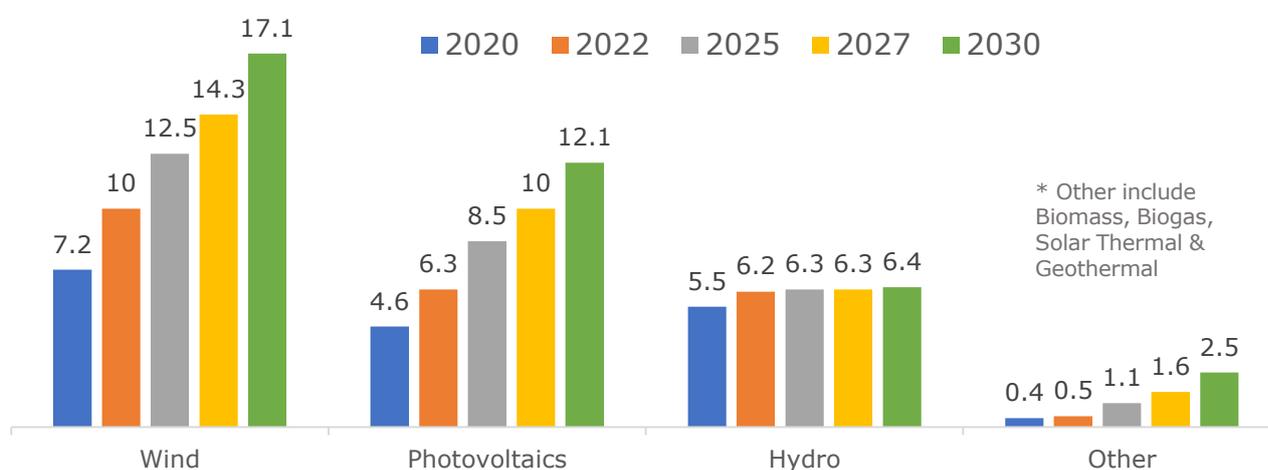
- Photovoltaics are anticipated to achieve a huge rise in terms of total capacity, reaching 7.7GW in 2030 which is 150% greater compared to current levels.
- Substantial increase in total installed capacity is also anticipated in terms of wind parks from 3.6GW in 2020 to 7GW in 2030.
- The projection regarding the capacity of hydro units is to remain at stable levels throughout the next decade, contributing with 19% in total capacity of 2030.
- Small but gradually increasing proportion of total electricity capacity will originate from other RES, such as biomass, biogas, solar thermal and geothermal.
- The current design of policies in terms of total installed electricity capacity prioritize the steady growth of RES, and more precisely Photovoltaics and Wind.

Total electricity generation from Renewable Energy Sources is projected to double in 2030, reaching 38.1 TWh

RES Electricity Generation (TWh), [2020-2030]



RES Electricity Generation (TWh), [2020-2030]

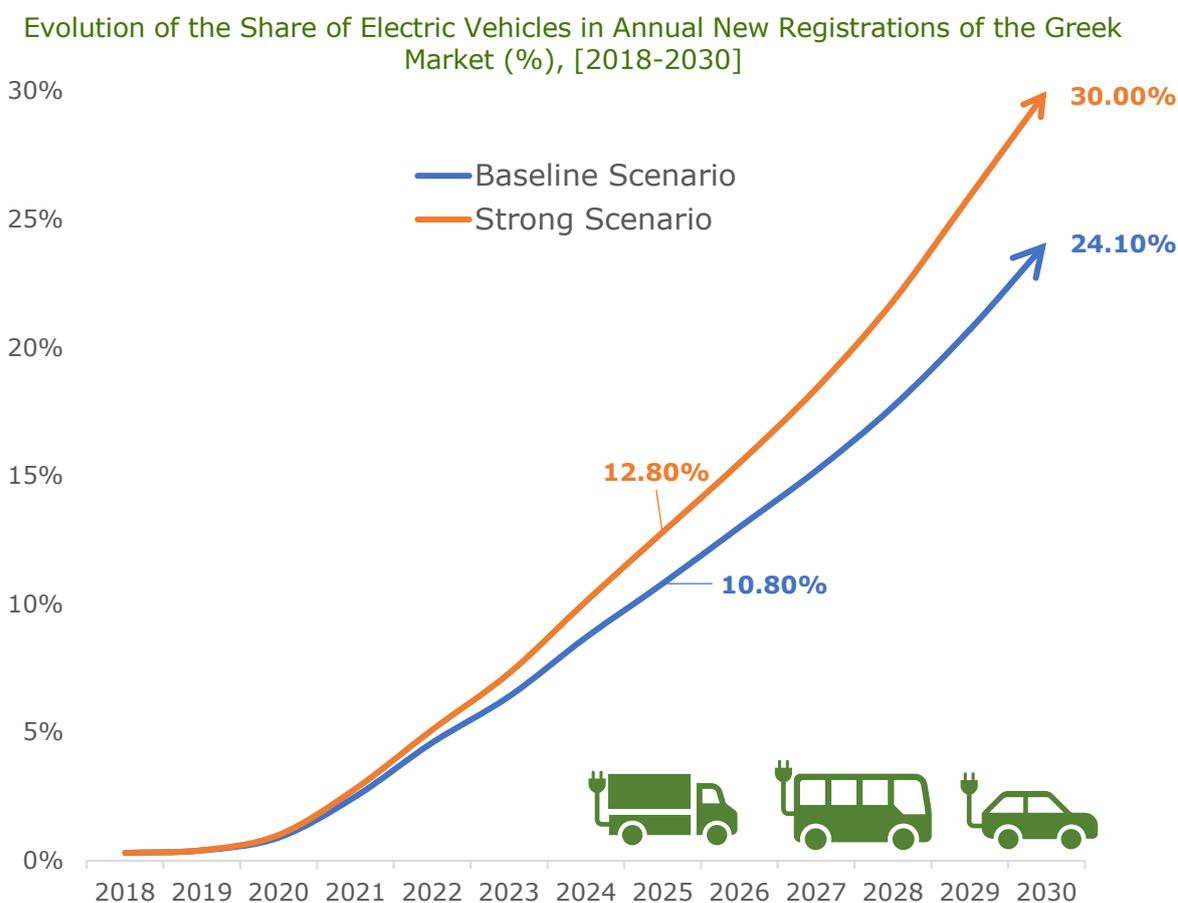


Highlights

Source: National Energy and Climate Plan, HAEE's analysis

- Energy Transition is about to allow Renewables to become the main source of energy, while guaranteeing security of supply to all citizens, at an affordable price.
- In 2030, almost 45% of total electricity generated from RES will come from Wind, 32% from Photovoltaics, 17% from Hydro and the remaining 6% from other RES.
- Over the years, significant increase of electricity generation is observed in terms of Wind and Photovoltaics, while Hydro remains relatively stable.
- Due to the stochastic nature of Photovoltaics and Wind, Greece should emphasize on other RES that can provide flexibility and lessen severe price fluctuation.
- In that context, electricity generation from RES such as Biomass, Biogas, Solar thermal and Geothermal is projected to be 5 times greater in 2030 (2.5TWh).

By 2030, Greece aims to achieve a sharp increase in the share of electric vehicles following the plethora of incentives announced

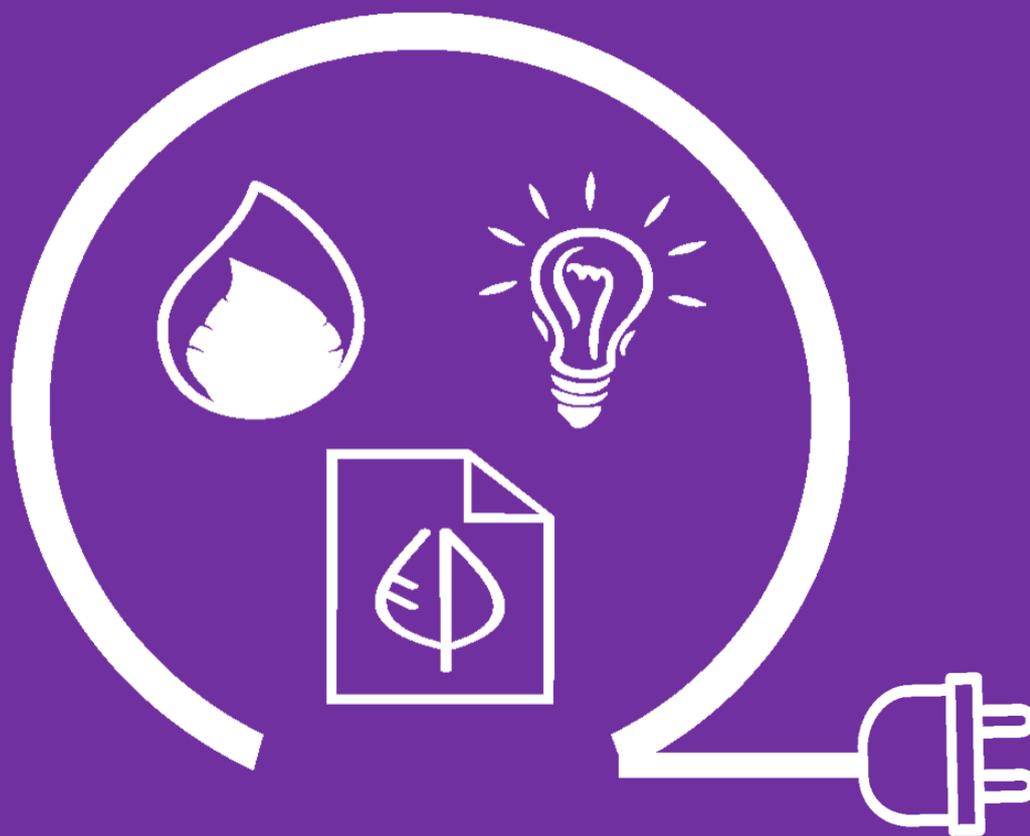


Highlights

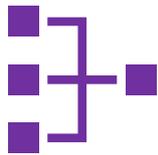
Source: National Energy and Climate Plan, HAEE's analysis

- According to the "baseline scenario", the share of electric vehicles in terms of annual new registrations will reach 10.8% in 2025 and 24.1% in 2030.
- However, the more ambitious "strong scenario" indicates that new registrations of electric vehicles will be 12.8% in 2025 and will reach 30% in 2030.
- In overall, during the next three years, we observe a slow progress in terms of new electric vehicle registrations that will start to gain significant growth after 2023.
- Electric vehicle buyers in Greece benefit from various incentives, still substantial progress needs to be made in order to boost eco-mobility and reach targets.
- Innovative actions concerning electric vehicles and their charging strategies will be supported, with emphasis on the electricity consumed from RES and hydrogen.

3. Hellenic Energy Exchange



Highlights



Aggregators have entered the Day-Ahead Scheduling as of the **1st of November 2019**



Liquidity in the Energy Derivatives Market is almost **zero** after 3 months of operation



EUPHIMIA Algorithm which couples the Paneuropean Intraday markets is expected to be available by the end of **2022**



HEnEx complies with various European licenses, such as **REMIT, EMIR, MIFID II, MAR CAD** and **CRD**

Target Model is going to be implemented in **September of 2020**



Energy Derivatives Market launched its operations in **March 2020**



Continuous Trading and **Complementary Regional Intraday Auctions** are anticipated to be available at the beginning of **2021**



The market design of a fully operational **Natural Gas Exchange** is currently under development



Covid-19 has delayed the implementation of the **Target Model** and negatively affected the liquidity of **Energy Derivatives Market**



Overview

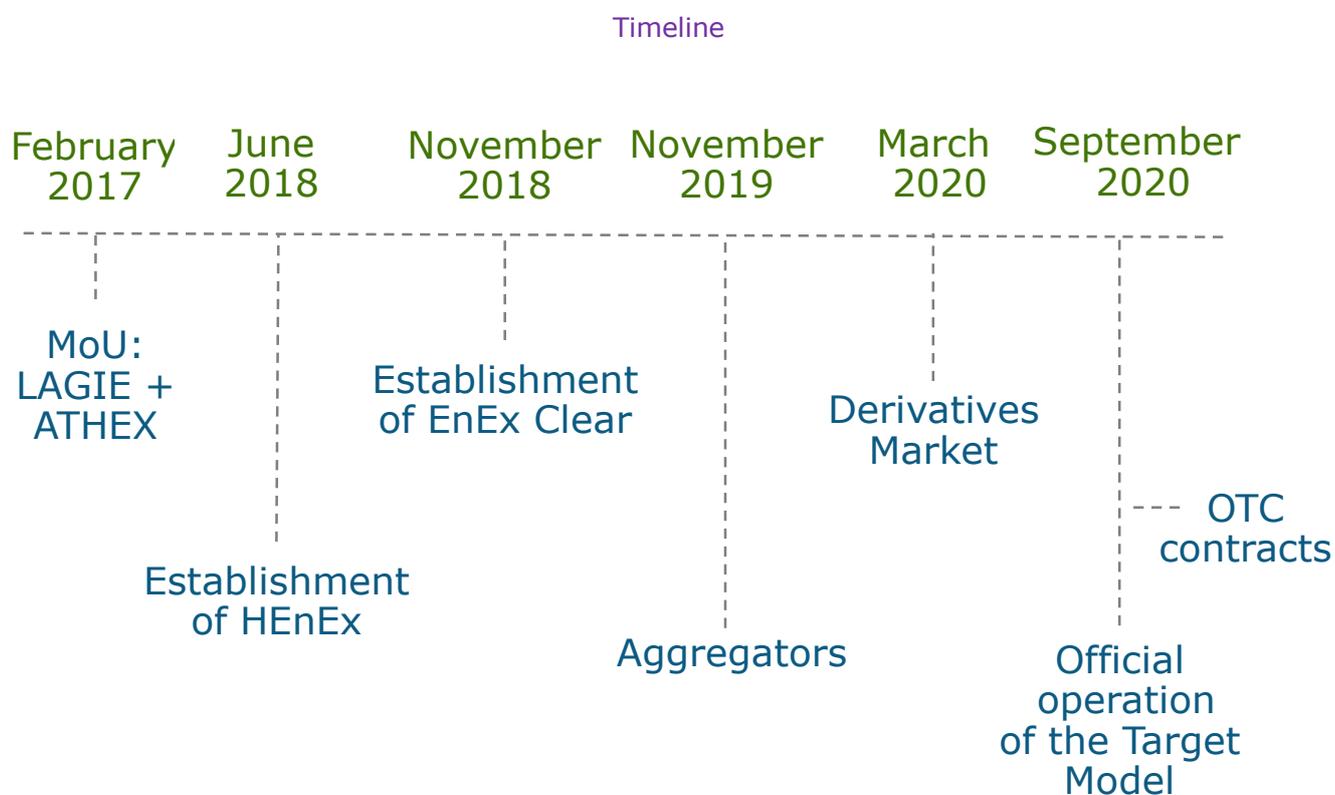
After a long delay the Hellenic Energy Exchange is expected to launch its operations under the Target Model on September 2020. The new market structure involves the cooperation of various entities such as the HEnEx, the EnEx Clear, the Athex Clear and ADMIE as the Transmission System Operator. Besides, the Regulatory Authority for Energy and the Hellenic Capital Market Commission cooperate for the effective implementation of the legal framework that supervises the daily operation of all energy markets. The newly established clearing house, EnEx Clear, is responsible for invoicing to market participants, financial settlement and risk management of all transactions. The requirements for being a General or a Direct Clearing Member are identical both for the Day-Ahead and the Intraday Market.

The sharp volatility of spot prices has always preoccupied producers, suppliers and electricity traders. The sudden rise of the System Marginal Price, following a prolonged downward trend since the beginning of 2020, is one example and seems to be of great concern to all market participants. These changes may be due to a number of factors, unforeseen or predictable. Such factors are the change in demand, the availability of units and interconnections, the prices of natural gas and carbon dioxide emissions, the variability of renewable sources, but also in general social and economic turmoil such as those caused by the COVID-19 raid. Hence, participants can take advantage of the flexibility provided by the Derivatives Market that has started its operations since March 2020.

The design of electricity markets varies in terms of market time units, auction mechanisms, allocation of interconnection capacities and participation. Apart from the Day-Ahead Market and the Intraday Market participants can take advantage of the Continuous IDM assisting European Coupling. The clearing price for each hour of the day is settled when the aggregate curves of demand and supply intersect. HEnEx submits buy and sell orders on behalf of the participants of energy financial instruments executed within the energy derivatives market and Over-The-Counter transactions. In that context, HEnEx aspires to play a crucial role in the development of the national and regional economy through the implementation of the Target Model. The participation of RES aggregation in the market will decrease the reliance on support schemes since RES units with capacity greater than 400 kW will face multiple market obligations.

Despite the outbreak of the coronavirus, the market design of a fully operational Natural Gas Exchange is currently under development. Following the electricity market, natural gas trading platform will be available to participants at a later stage. Creating a gas market within the limits of the Energy Exchange would be a huge step for the energy sector, since it is an initiative that could be based on the latest developments in Cyprus and Northern Greece with TAP, as well as the other major projects being promoted.

After a long delay the Hellenic Energy Exchange is expected to launch its operations under the Target Model on September 2020



Source: HAEE's analysis

Highlights

- In line with the Third Energy Package, the transition to the new Target Model, includes the formation of a Power Exchange and Over the Counter (OTC) contracts.
- HEnEx will allow participants to submit different orders for the supply of electricity for different production levels and time intervals, and keep record of all OTC contracts.
- On January 2018, HEnEx was established as the successor of LAGIE, and currently is assigned with all the responsibilities considering the operation of the energy market.
- On March 2020, HEnEx announced the launch of the Derivatives Market, aiming to replace the gap created following the abolishment of "NOME" type auctions.
- Due to the COVID-19 outbreak, the initial planning for the implementation of the Target Model had to been postponed to the September of 2020.

The new structure involves the cooperation of various entities such as the HEnEx, the EnEx Clear, the Athex Clear and ADMIE

Functional Breakdown by Entity in Spot and Derivatives Markets

Market	Day Ahead	Intraday	Balancing	Energy Derivatives Market
Type of Market	Physical	Physical	Physical	Cash Settlement with optional Physical Delivery
Market Operator	Hellenic Energy Exchange	Hellenic Energy Exchange	ADMIE	Hellenic Energy Exchange
Clearing, Settlement & Risk Management	EnEx Clear	EnEx Clear	ADMIE	Athex Clear
Platforms & Technical Services	Athex Group	Athex Group	ADMIE	Athex Group

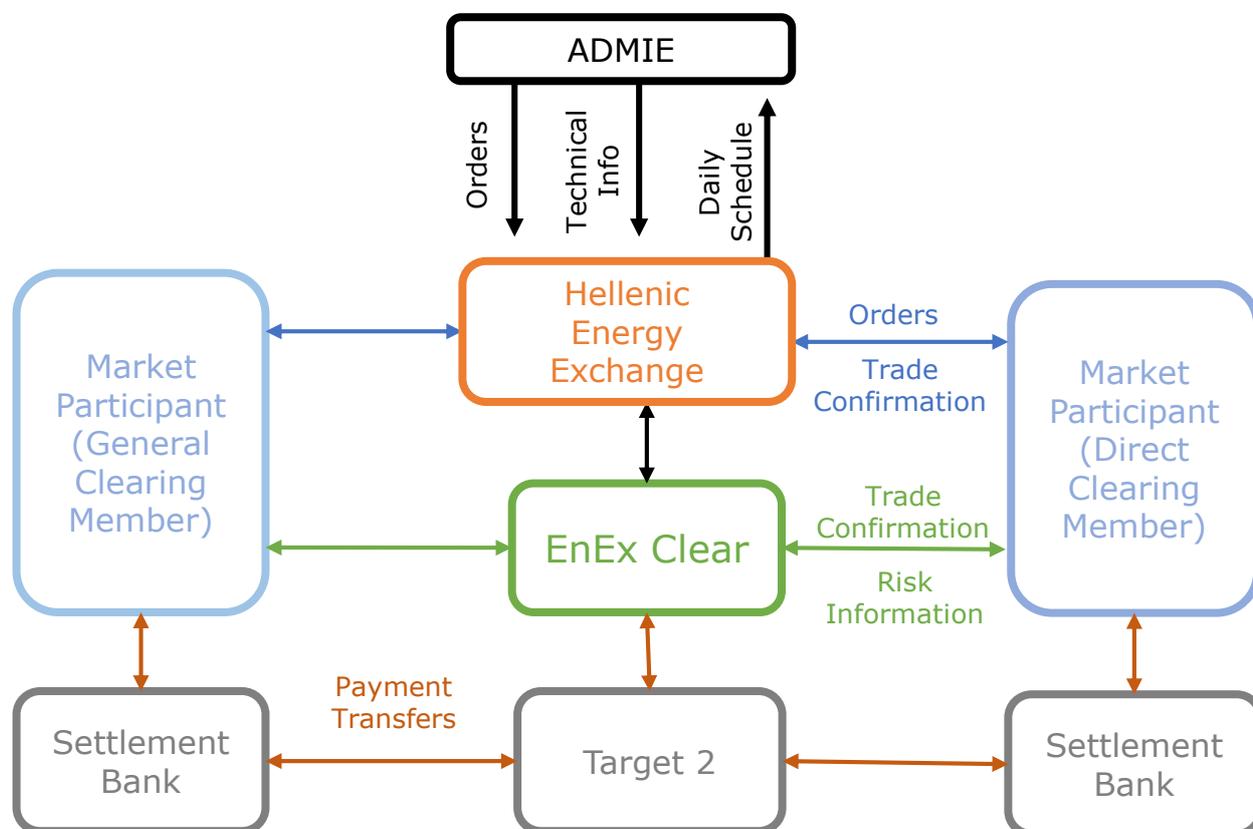
Source: HEnEx, HAEE's analysis

Highlights

- Spot Markets include physical delivery of electricity, while energy Derivatives market includes cash settlements with optional physical delivery.
- Hellenic Energy Exchange is the Market Operator for the Day Ahead Market, Intraday Market and Energy Derivatives Market.
- EnEx Clear is responsible for clearing settlement & risk management of the Day Ahead and Intraday market while Athex Clear is responsible for Derivatives Market.
- Athex Group supervises the smooth operation of the platforms as well as the technical services for all markets.
- ADMIE is the Market Operator for the Balancing market and is responsible for the clearing, settlement, risk management and technical assistance.

The EnEx Clear is responsible for invoicing to market participants, financial settlement and risk management of all transactions

Interplay Among Market Participants in the Wholesale Market



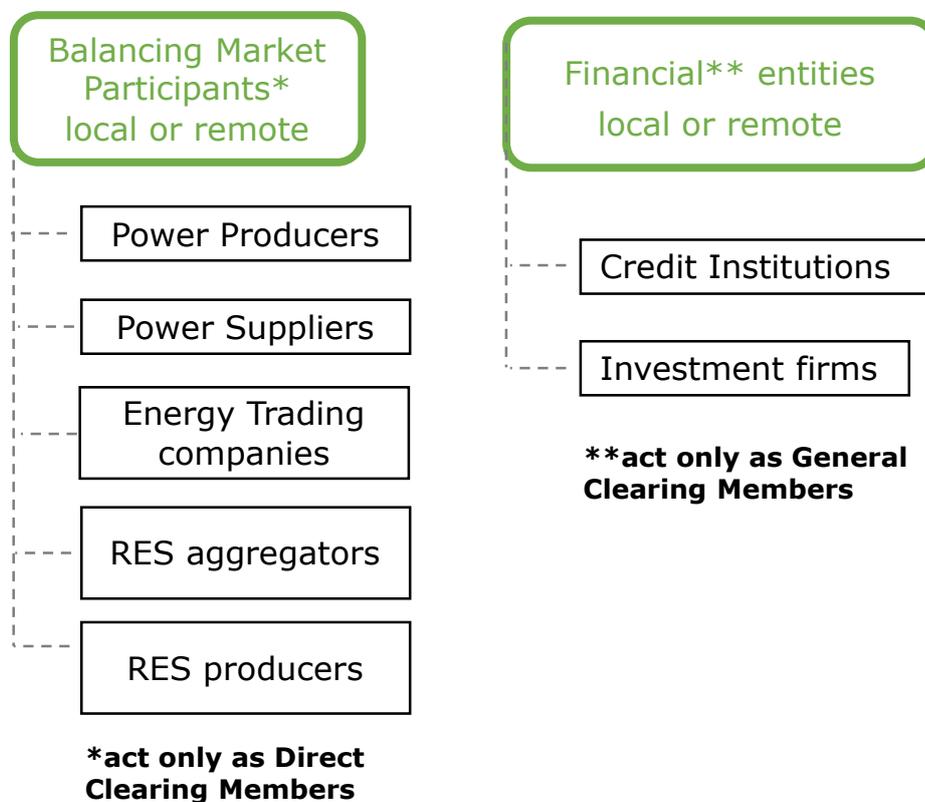
Highlights

Source: HEnEx, HAEE's analysis

- EnEx Clear intervenes between counterparties transactions and undertakes the role of buyer vs each seller and vice versa for the clearing of transactions.
- The clearing house is responsible for the completion of the financial obligations before the delivery process starts by the Transmission System Operator.
- It performs the financial settlement of the transactions, the collaterals management and the clearing fund contribution management under the Target 2 system.
- Members could be either Direct Clearing Members which are common energy market participants or General Clearing Members such as banks and investment firms.
- Default takes place when there is no sufficient amount, in the settlement account of the Clearing Member in Target 2, to match their obligations.

The requirements for being a General or a Direct Clearing Member are identical both for the Day-Ahead and the Intraday Market

Entities Eligible to apply for EnExClear Membership



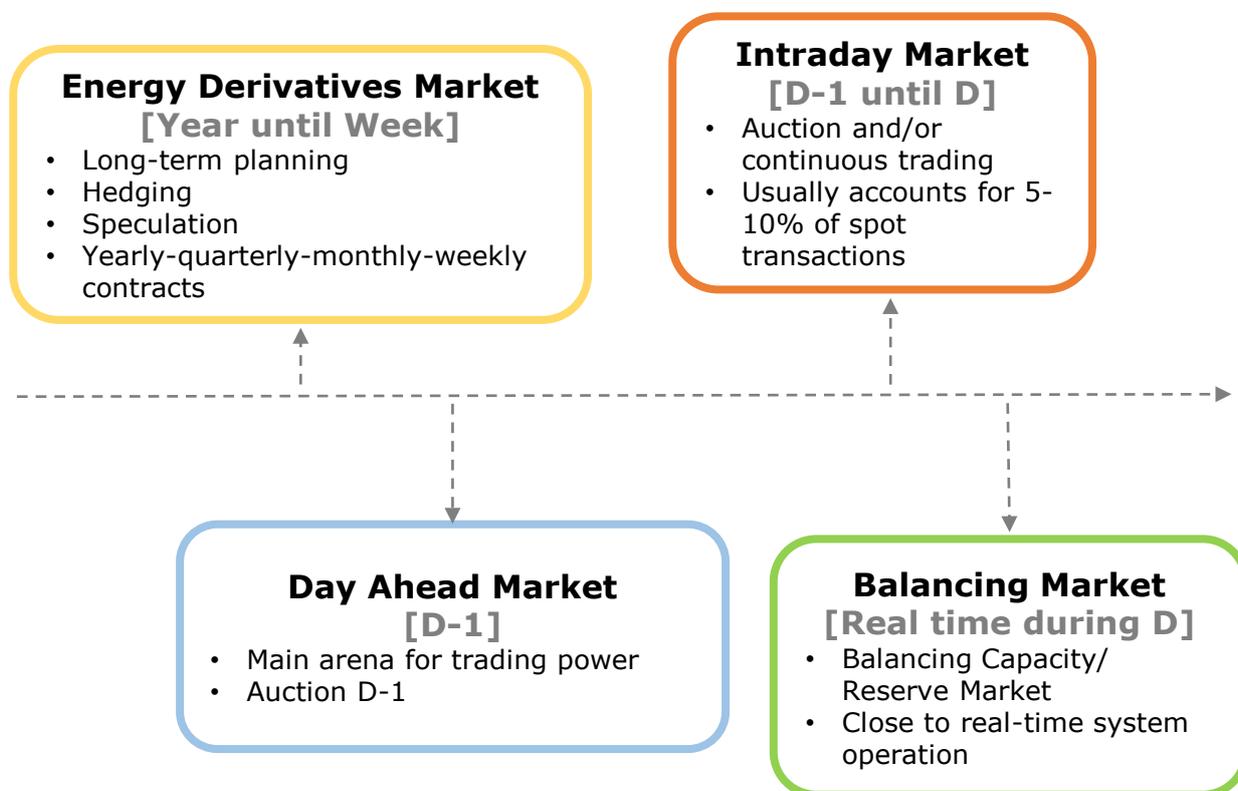
Source: HEnEx, HAEE's analysis

Highlights

- Companies need to prove organizational and financial reliability and need to have minimum equity capital and minimum contribution to the clearing fund.
- The minimum equity capital for a General Clearing Member is 3.000.000 € and the minimum contribution to the clearing fund is 500.000 €.
- Consistently, the minimum equity capital for a Direct Clearing Member is 500.000 € and the minimum contribution to the clearing fund is 30.000 €.
- All clearing members need to have at least one Certified Energy Trader who meets EnEx Clear professional qualification and has completed the certification program.
- Every clearing member should maintain suitable technical infrastructure and maintain clearing accounts for the well functioning of the clearing process.

Participants can take advantage of the flexibility provided by the Derivatives Market and Intraday sessions

Sequence of the Introduced Markets at HEnEx



Source: HEnEx, HAEE's analysis

Highlights

- The Derivatives market refers to agreements between two participants for buying or selling a specific quantity of electricity at a specific price, on a specified future date.
- Currently the Derivatives market at HEnEx faces low liquidity and zero activity, since due to the COVID-19 crisis, spot prices are lower than expected.
- Day-Ahead market refers to transactions in each D-1 calendar day, where supply contracts are auctioned for each market time unit of physical delivery in day D.
- Intraday is the market in which transactions to buy and sell electricity with physical delivery obligation are auctioned after the gate closure of the Day-Ahead market.
- The objective of balancing market is the optimal use of available resources to balance generation and load by introducing significant technical complexity.

The design of electricity markets varies in terms of MTUs, auction mechanisms, allocation of interconnection capacities and participation

Design of DAM, IDM and Continuous IDM

Day - Ahead	Intraday Market	Continuous Intraday Market
Auctions with marginal pricing	Auctions with marginal pricing	Continuous Trading
Hourly Market Time Units	Hourly Market Time Units	Half- Hourly Market Time Units
Single Auction once per Delivery Day	3 Auctions per Delivery Day	
Algorithm: EUPHIMIA	Algorithm: EUPHIMIA	Algorithm XBID
Allocation of interconnection capacities <ul style="list-style-type: none"> • Explicit during isolated phased • During coupling implicit allocation of interconnection capacities (with coupled bidding zones) 	Allocation of interconnection capacities <ul style="list-style-type: none"> • 1st Phase: Explicit (LIDA-local level) • 2nd Phase: Implicit (CRIDA –regional level) • 3rd Phase: Implicit (IDA –European level) 	Products <ul style="list-style-type: none"> • Hourly • Half-hourly • User-defined Blocks
Asset-based participation	Asset-based participation	Asset-based participation
Mandatory Participation for Producers	Optional Participation	Optional Participation

Highlights

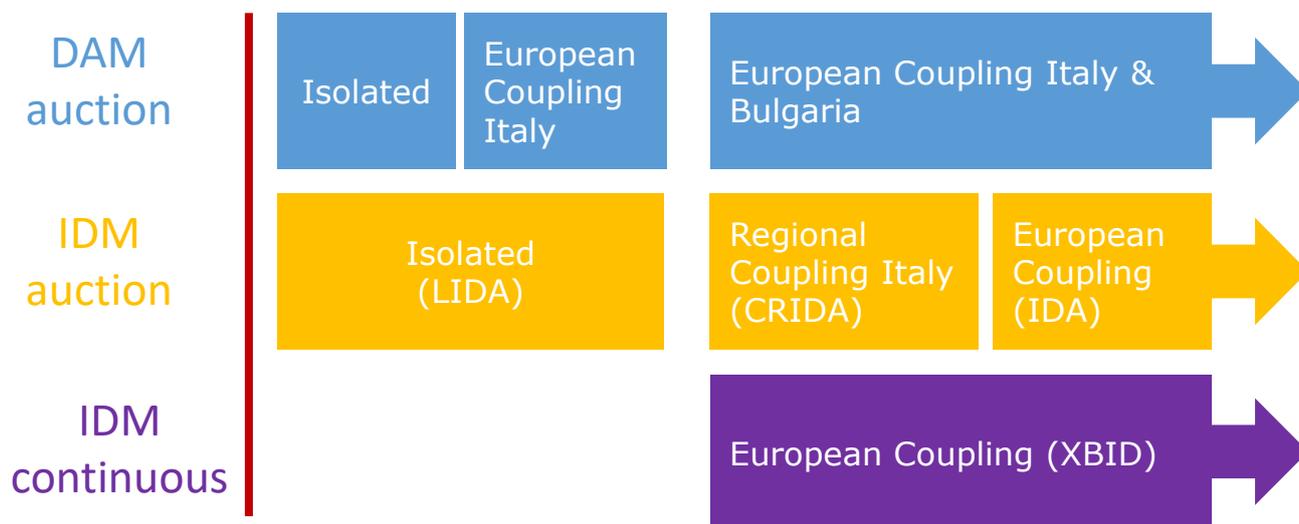
Source: HEnEx, HAEE's analysis

- The Spot Market products include energy products that are traded by MWh and comprise of commercial contracts of electricity with physical delivery.
- Delivery takes place within the Bidding Zones, defined as the geographical area within which participants are able to exchange energy without capacity allocation.
- Currently, there is a single Bidding Zone in Greece as provided by the TSO, but this will probably be modified when Crete is going to interconnect with the mainland.
- The reference point of sell orders is the metering point at interconnection node (for imports), while for buy orders is the Transmission/ Distribution network Boundary.
- EUPHIMIA algorithm solves the market coupling problem on PCR, by maximizing the social welfare through efficient cross-boarder capacity allocations.

Apart from the Day-Ahead and the Intraday Market participants can take advantage of the Continuous IDM assisting European Coupling

Implementation Phases of the Various Markets

Local Go-Live



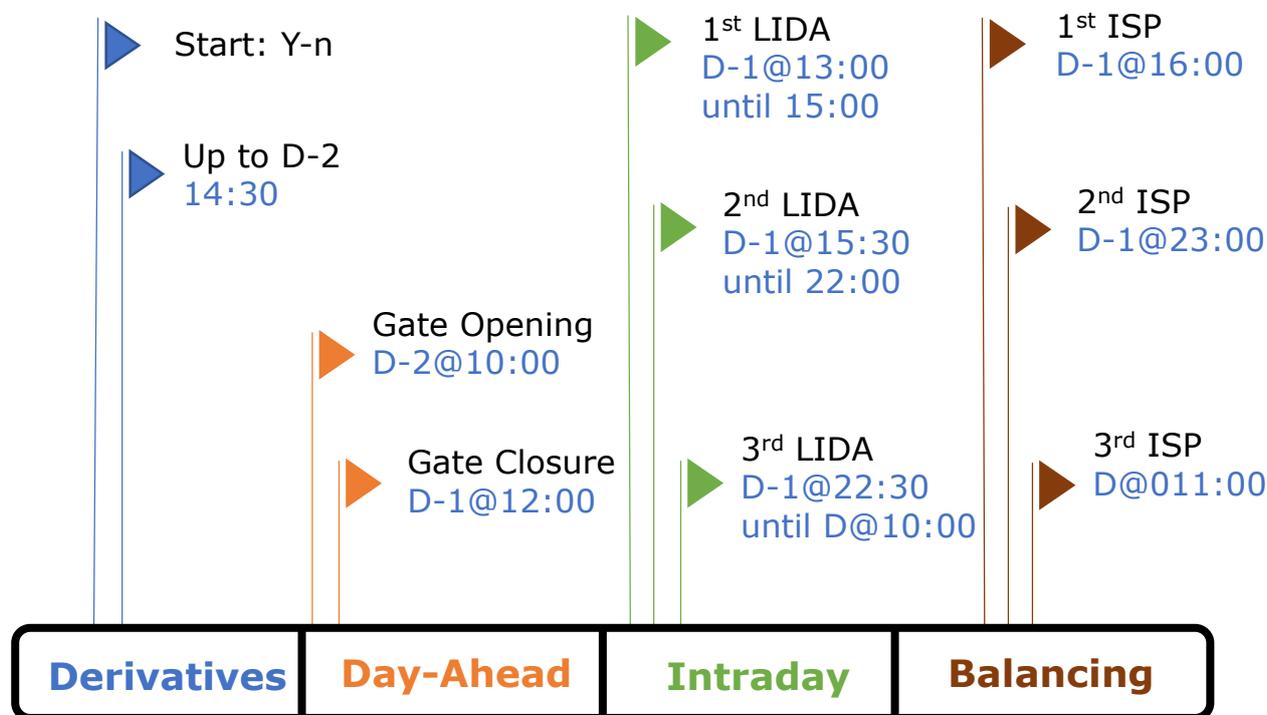
Source: HEnEx, HAEE's analysis

Highlights

- The Day-Ahead market is divided into three phases, included the isolated mode, the European coupling with Italy and later on with Bulgaria.
- The Intraday market again is introduced into three different phases, first comes the Isolated Local Intraday Market, then the Regional and finally the European coupling.
- The XBID solution is based on a common IT system with one Shared Order Book (SOB), a Capacity Management Module (CMM) and a Shipping Module (SM).
- This means that orders entered by participants for Continuous Matching in one bidding zone can be matched by orders similarly submitted by market participants.
- Bids can be placed in any other bidding zone within the project's reach as long as transmission capacity is available, both for explicit and implicit trading.

The clearing price for each hour of the day is settled when the aggregate curves of demand and supply intersect

Electricity Markets – Timeline Overview



Source: HEnEx, HAEE's analysis

Highlights

- The trading system is a daily Double-side (generation and demand) auction for every hour to match transactions at a single price.
- The delivery day (D) of DAM consists of twenty-four purchased time units while the gate opening time is at 10:00 (D-2) and the gate closure time is at 12:00 (D-1).
- The product traded is an hourly contract that specifies the size (MWh) and value (€/MWh). Hourly bids are the most common type of bids in Power Exchanges.
- The essential information required on each bid includes: participant's details, type of bid (sale or buy), hour of the day, quantity and price.
- The types of orders that can be submitted by participants in the Day-Ahead market are the following: Step-wise Orders, Linear piecewise Orders, Block Orders.

HEnEx submits buy and sell orders on behalf of the participants of energy financial instruments executed within the Derivatives Market and OTC

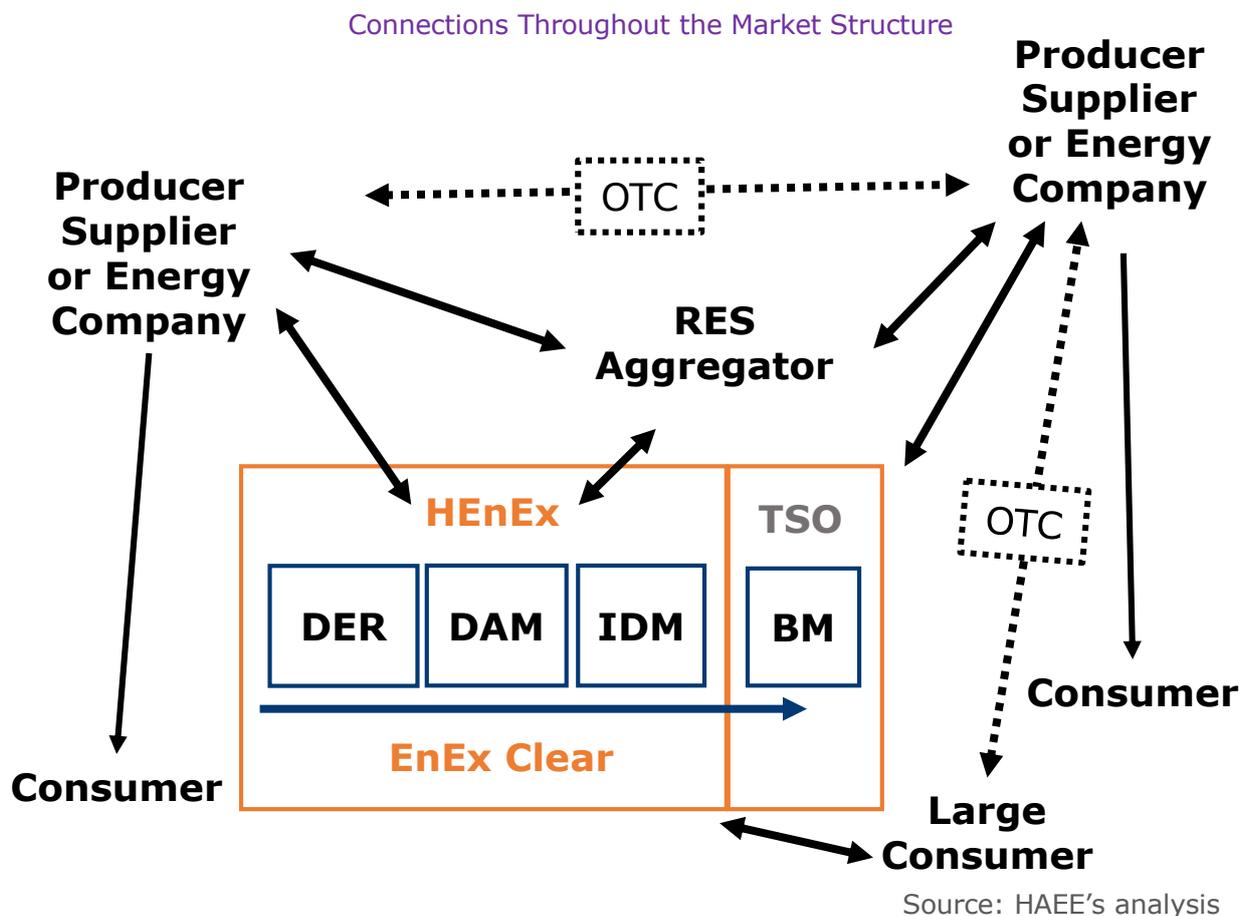
Participant	Asset
Producer RES Producer / RES Aggregator Last Resort Aggregator	Generating Unit Pumping Unit RES Portfolio (Dispatchable & Non-Dispatchable)
Supplier / Self-Supplying Consumer Last Resort Supplier Universal Services Supplier	Load Portfolio (differentiated per Voltage Level)
Traders / Suppliers / Self-Supplying Consumers	Non-coupled Interconnection
TSO	Generation Unit (under Commissioning & Testing, Mandatory Hydro) RES Portfolio ((under Commissioning & Testing) Transmission System Losses
RES & GO Operator	RES FiT Portfolio Rooftop Photovoltaics Dispatchable High Efficiency CHP Unit
HENEX	Above assets for nominated quantities

Source: HEnEx, HAEE's analysis

Highlights

- Registration in Energy Derivatives Market is required only for contracts with Physical Delivery and the registration is performed by the Central Counter Party.
- Considering the OTC Market, registration is required again and one of the two counter parties registers the contract in ETSS and the other accepts or reject it.
- The TSO shall submit to the ETSS of HEnEx, the available capacity of generating units and RES units or Dispatchable RES units Portfolio.
- For each MTU of Day D, the Net Delivery Position for each Participant is calculated as the sum of sales minus the sum of purchases of the Energy Financial Instruments.
- Following each successful submission of Physical Delivery Nominations and Physical Offtake Nominations, the ETSS recalculates for each MTU of Delivery Day D.

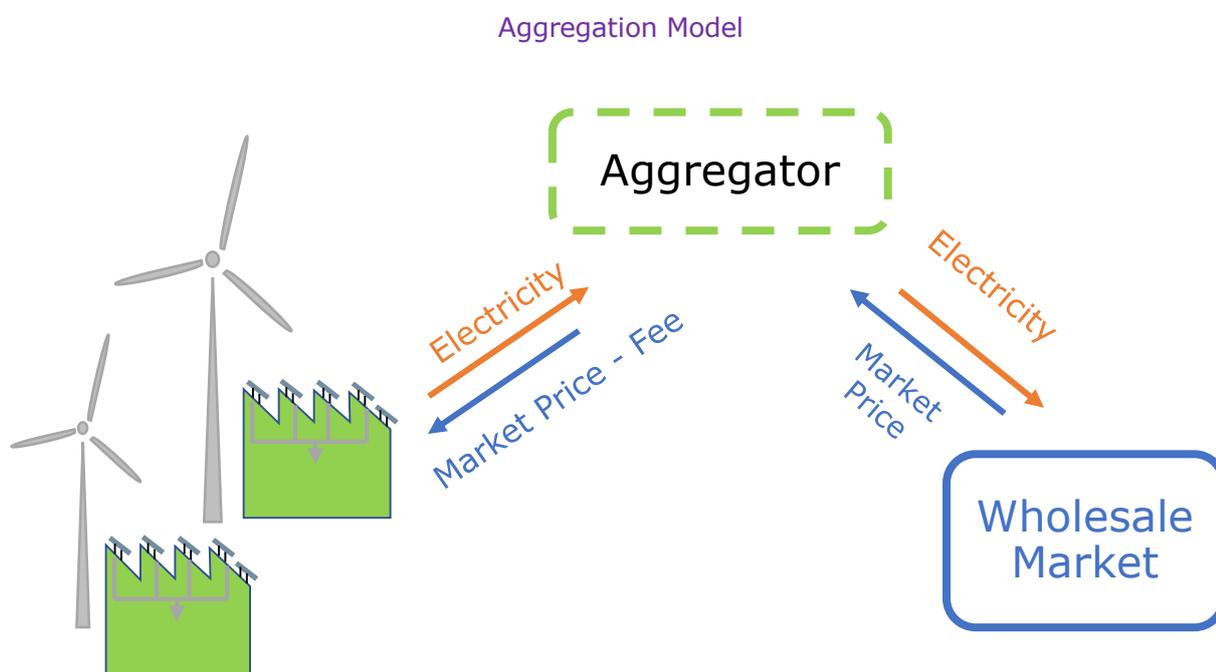
HEnEx aspires to play a crucial role in the development of the national economy through the implementation of the Target Model



Highlights

- In the upcoming energy market, generators, suppliers, traders and consumers can trade electricity either via OTC contracts or on a power exchange.
- Due to the confidentiality of the OTC market many players may use the Power Exchange price index as a reference for their bilateral contract.
- Transactions ensure greater liquidity in the energy market, and at the same time provide a competitive environment for the benefit of the final consumers.
- HEnEx is expected to act as a central risk-taking and risk-management platform for all participants, enabling them to diversify their variable costs and pricing policy.
- Those radical reforms, will allow participants to enhance their expertise in energy trading and develop risk-taking and risk-management strategies.

RES aggregation will decrease the reliance on support schemes since RES units with capacity greater than 400 kW will face market obligations



Source: HAEE's analysis

Highlights

- Under the Target Model, RES producers will gain increased incentives to be competitive and undertake the responsibility of production forecast.
- RES producers will be financially responsible for the additional balancing cost between their forecasts and their actual production.
- The design of Hellenic Energy Exchange accounts for the participation of RES Aggregators since they could minimize the balancing cost.
- RES Aggregators, through which many RES producers participate in the market and in the balancing mechanism within larger portfolios, will play an important role.
- 14 RES Aggregator companies have already received licence, while the application of 6 more companies is under review by the Regulatory Authority for Energy.

There are 18 Aggregators in the market, 12 of them with trading licence and 10 already participating at the Hellenic Energy Exchange

RES Aggregators in the Greek Electricity Market

Aggregator Name	MW	Date of Application	Status	Member of HEnEx
Optimus Energy	1,250	8/10/2018	Approved	✓
Mytilineos	500	12/3/2019	Approved	✓
Renoptipower	400	10/4/2019	Approved	✓
Solar Energy	100	23/5/2019	Approved	✓
Elpedison	1,500	10/9/2019	Approved	✓
Motor Oil	300	10/9/2019	Approved	✓
Inaccess	600	10/9/2019	Approved	✓
Eunice	300	20/9/2019	Approved	✓
Vatt & Volt	350	18/11/2019	Pending	-
Sentrade	200	18/11/2019	Approved	-
Solaris Energy	100	13/12/2019	Pending	-
NC Energy	250	13/12/2019	Pending	-
HELPE Renewables	300	13/12/2019	Approved	-
NRG Trading House	200	27/1/2010	Approved	✓
Forena Energy	200	29/1/2020	Approved	✓
Arinomario Limited	200	5/2/2020	Approved	-
PPC R	1,000	12/3/2020	Pending	-
Vootis	200	12/3/2020	Pending	-

Despite the outbreak of the Coronavirus, the market design of a fully operational Natural Gas Exchange is currently under development

Timeline of Natural Gas Exchange Implementation Steps

	2020	2020	2021	2021	2021
	Q3	Q4	Q1	Q2	Q3
Regulatory Development					
Contractual Development					
Technical and Operational Aspects					
Financial Aspects					
DESFA Starts using HEnEx Trading Platform for Balancing					
HEnEx NG Spot Starting date of operations					

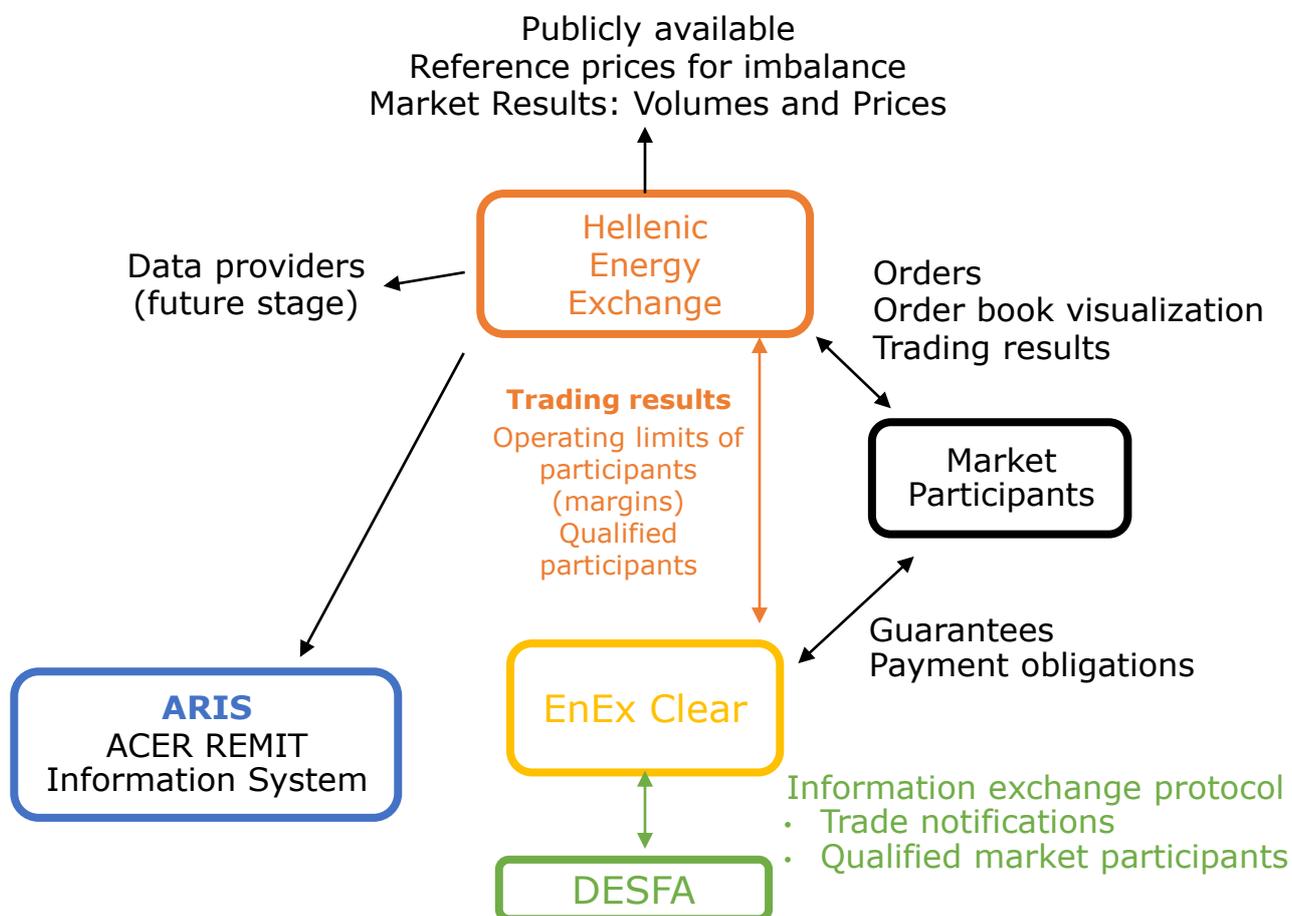
Source: HAEE's analysis

Highlights

- The initial phase of a Natural Gas Exchange includes the development of a spot market, including both the regulatory and contractual development.
- In parallel, technical, operational and financial aspects need to be addressed and then the switch from DESFA's Trading platform to the Exchange will take place.
- HEnEx Natural Gas Spot market is anticipated to start during the first quarter of 2021 and then the expansion phase with futures market will follow in 2022.
- The natural gas trading platform is anticipated to guarantee transparency, non-discriminatory access and anonymous trading.
- The EnEx clear could play the role of the clearing house for risk management, settlement and payment procedures.

Following the Electricity market, Natural Gas Trading Platform will be available to participants at a later stage

Information Exchange System of Natural Gas Trading Platform

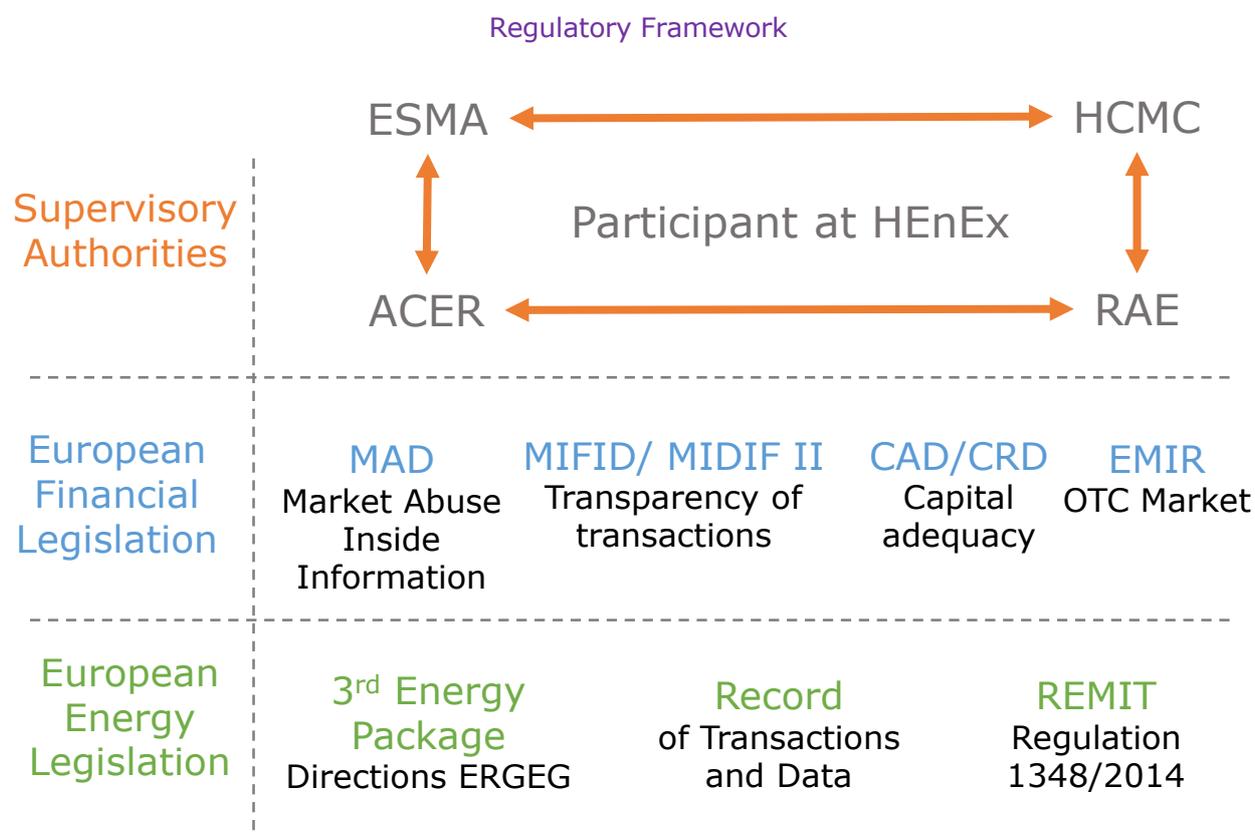


Source: HAAE's analysis

Highlights

- HEnEx will proceed with the establishment of a Natural Gas exchange to cover the needs of the domestic and regional wholesale market.
- This involves the operation of a Natural Gas Trading Platform, where anonymous transactions between gas market participants will take place.
- The basic characteristics of this platform is to provide easy access to users, possibility of cross-border transactions, liquidity and transparency in transactions.
- It will act as a supply source assisting diversity and connectivity, while transparency on data and regulatory processes would directly reduce risk for market participants.
- The establishment of a Greek Gas Hub will facilitate the wholesale trading of Natural Gas between participants and enable competitive markets to function in SE Europe.

RAE and the HCMC cooperate for the effective implementation of the legal framework that supervises the operation of all energy markets



Source: HAEE's analysis

Highlights

- A set of Directions and Regulations imposed by the European Union, ensures confidence in the integrity of Hellenic Energy Exchange.
- Effective oversight of wholesale energy markets requires the regular monitoring of details of contracts including orders, capacity, assets, consumption and transmission.
- HEnEx complies with various European licenses, such as the REMIT, the EMIR, the MIFID II, the MAR and CAD/CRD.
- EU countries are obliged to ensure the monitoring of security of supply and to define technical safety criteria to ensure the integration of their markets at a regional level.
- In addition, the national regulatory authorities are to cooperate with the ACER to guarantee the compatibility of regulatory frameworks between regions.

4. Electricity



Highlights



Natural gas represented **42.3%**, RES **25.5%** and coal **25.4%** of total electricity generated in Greece for 2019

Electricity generation by **coal** and **oil** will drop to **zero** by 2030



Only behind Poland, Greece faces the **2nd** most **expensive** wholesale **electricity price** throughout Europe



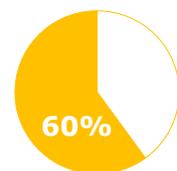
Taxes and levies represent almost **31%** of the electricity price paid by the final consumer

Electricity Prices in Greece follow a downward trend reaching **27 €/MWh** on average for March **2020**



During May 2020, **PPC's market share** in the retail market dropped to **66%**

60% of Greece's electricity imports for 2019 came from **Italy** and **Bulgaria**



Cheap **electricity imports** contribute considerably to the **reduction** of the wholesale price

Due to the COVID-19 crisis, a **U-Shaped recovery** is anticipated in terms of total electricity demand



Overview

Greece's legislative framework on the electricity market is strongly governed by law and regulation that is in line with European Directions and guidelines. Focusing on sustainability and achieving a Fair Energy Transition during the next decade are the foremost goals of national authorities. Aiming to achieve environmental targets Europe needs to rapidly decarbonize its power sector, a trend that is apparent all over the continent. At the same time, CO2 emission allowances directly affect electricity prices and contribute to emissions reduction through Europe.

Greece faces the 2nd most expensive wholesale electricity price throughout Europe only behind Poland which is also a coal-based market. During 2018 electricity prices increased, however a downward trend was apparent throughout 2019, mainly due to the cheap imports of natural gas.

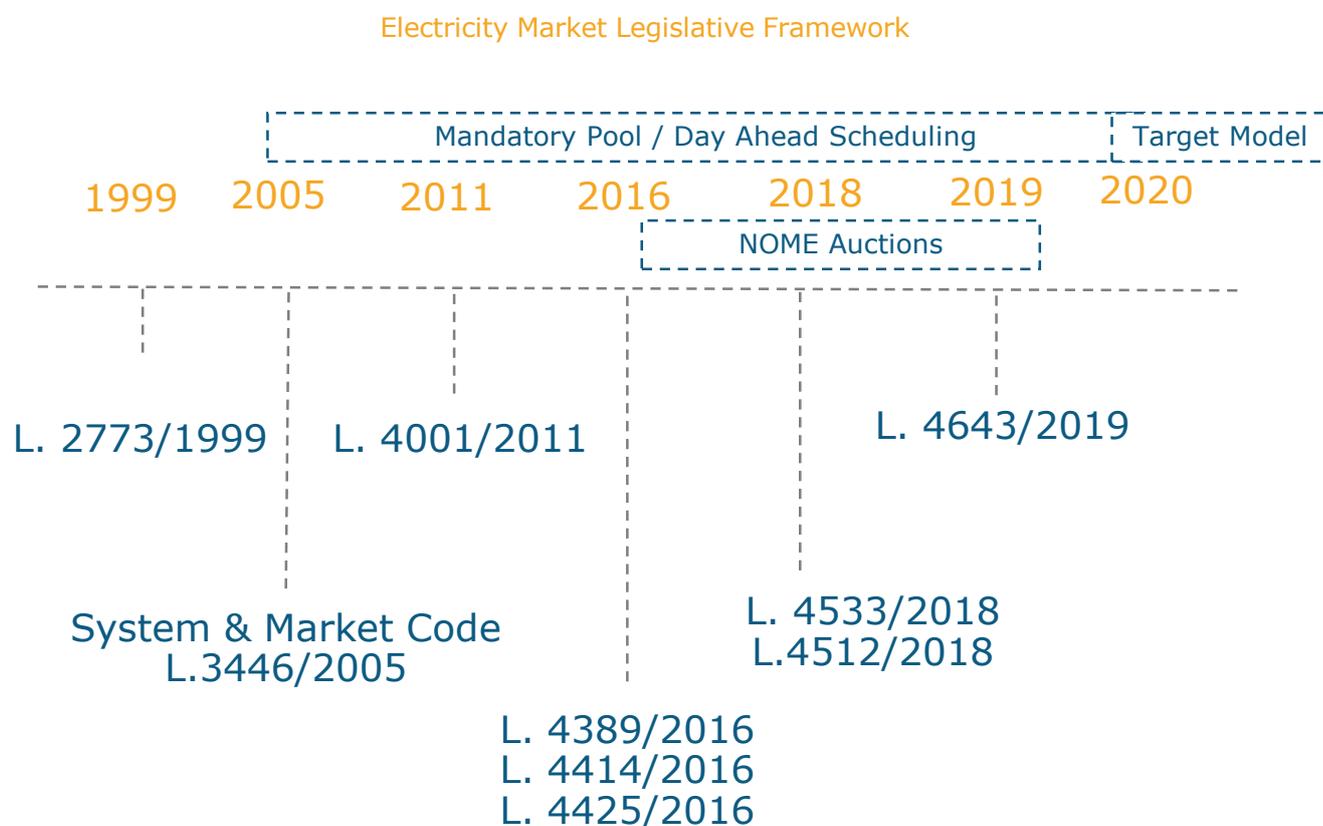
During the COVID-19 outbreak, wholesale electricity price dropped at historical levels reaching 18 €/MWh throughout the first week of April 2020 when strict mobility restrictions were imposed. Another impact of the pandemic is that electricity consumption in Greece declined in the short-term and is expected to rebound after 2022. An average drop of 20% in electricity load during the 2nd week of April 2020 reveals the negative externalities expected in the Greek economy, as well. The collapse in electricity load is apparent during the lockdown period, plunged by 32.4% and 35.5% compared to 2018 and 2019, respectively. In the short-term, COVID-19 crisis is anticipated to significantly hamper the annual demand for electricity.

Gross electricity generation for 2018 dropped to 51GWh while electricity imports increased from 11.8% to 23.4% in 2019. Greece is well connected with neighboring countries and active in electricity trading mainly with Italy and Bulgaria. Cheap electricity imports during March, April and November of 2019 contributed considerably to the reduction of the System Marginal Price.

Furthermore, as part of the economic adjustment programme, Public Power Cooperation (PPC) share in the retail market has to fall below the benchmark of 50%. For 2019, the incumbent PPC, retained a dominant share in electricity generation (43.2%), while RES and Hydro represented bigger capacity compared to Coal and Natural Gas combined.

Finally, European Union countries provide plethora of both financial and non-financial incentives towards Eco-mobility. The Greek government announced in June 2020 a package of incentives supporting the promotion of electric cars. These incentives and the necessary infrastructure are anticipated to support the penetration of electric vehicles in Greece at this initial stage of development.

Greece's legislative framework on the electricity market is strongly governed by regulations that are in line with EU Directions and guidelines

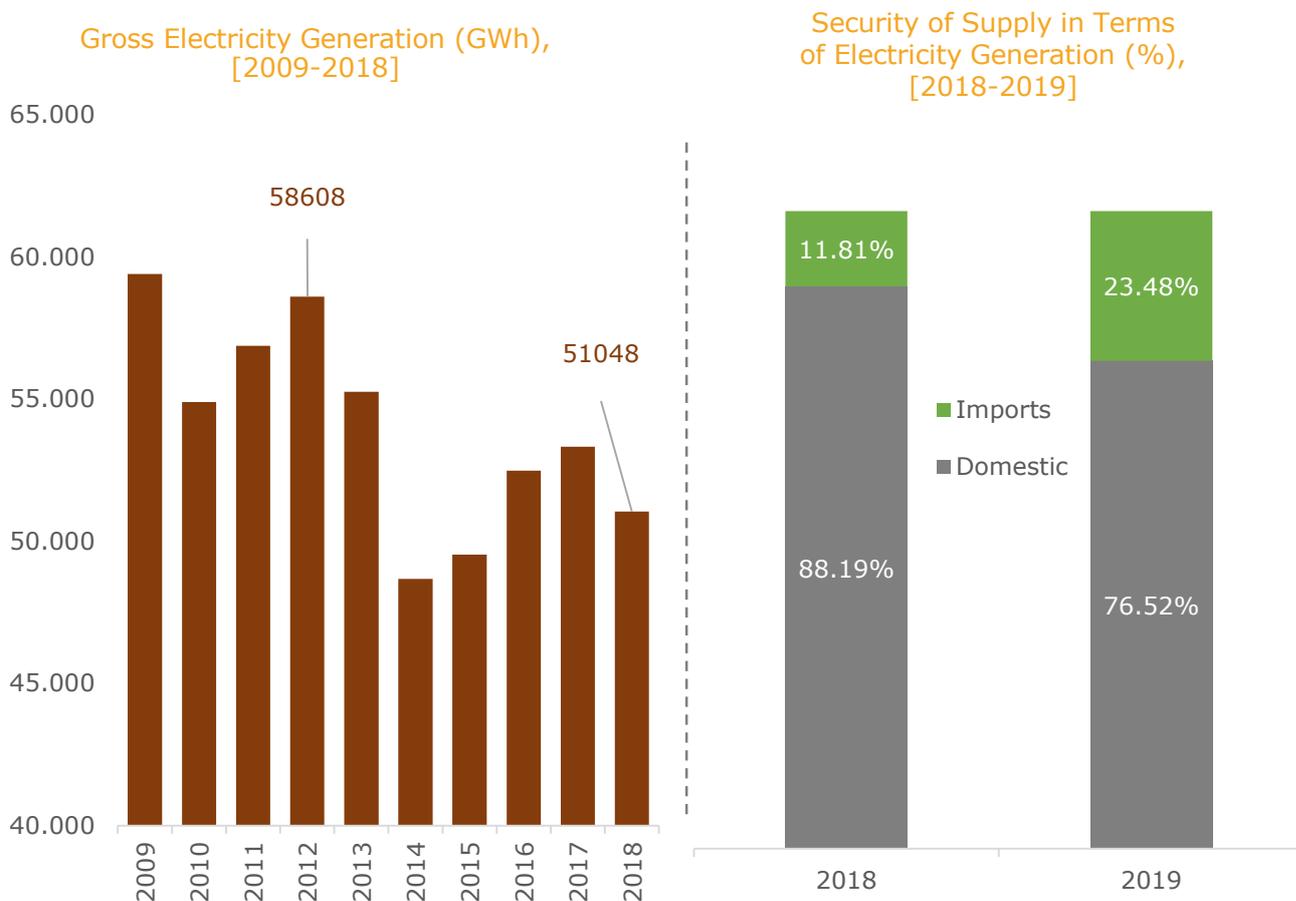


Source: HAEE's analysis

Highlights

- NOME-type auctions officially abolished in November 2019 and currently the operated Derivatives Market is anticipated to provide source of diversification.
- Besides, the current legislative framework, law 4643/2019 introduces all the necessary regulations to support energy production from Renewable Energy Sources.
- The same law includes regulations regarding the organization and supervision of Energy Markets, including regulations for the organization and operation of PPC.
- In order to cover the gap that is going to be created by the phase-out of the thermal generation units, legislation should support the gas-fired generation units.
- Finally, the new energy laws 4643/2019 and 4685/2020 introduce new regulations on energy efficiency and the promotion of electrification in transportations.

Gross electricity generation for 2018 dropped to 51 GWh while imports increased from 11.8% to 23.4% in 2019



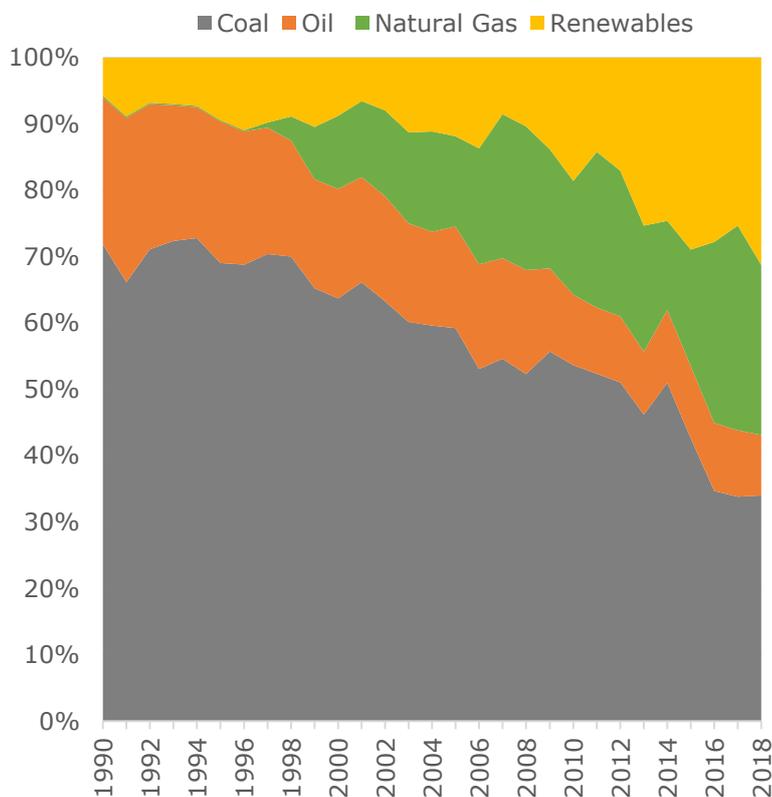
Source: Eurostat, HEnEx, HAEE's analysis

Highlights

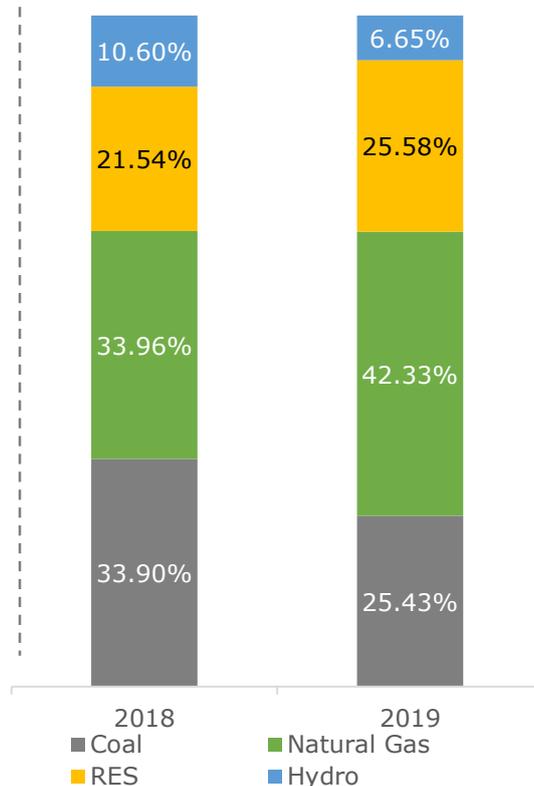
- Following the economic crisis, gross electricity in Greece decreased by 15% since 2009 when the corresponding value was 59.4 GWh compared to 51 GWh in 2018.
- Greece uses its own sources for electricity generation at 76.5% while imports of electricity stand at 23.4% for 2019.
- Greece still uses a substantial share of fossil fuels for electricity generation. This reflects higher cost of production that eventually increases the share of imports.
- Given the increase in electricity imports, it is apparent that the availability of cheap electricity from neighboring countries will gradually lead to market coupling.
- Energy Transition demands the promotion of an environmental friendly electricity market design based on the increased penetration of RES and Natural Gas.

Focusing on sustainability and achieving a Fair Energy Transition during the next decade are the two foremost goals of national authorities

Gross Electricity Generation by Fuel (%) , [1990 – 2018]



Gross Electricity Generation by Fuel (%), [2018-2019]



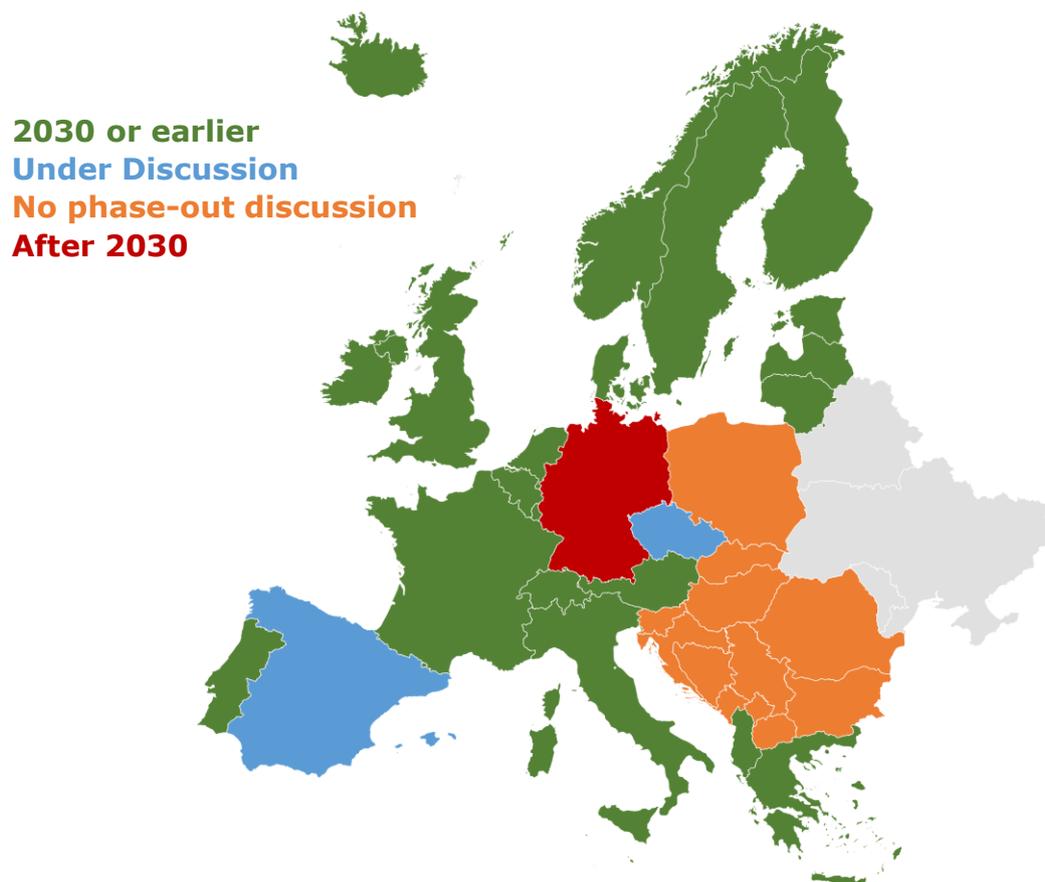
Highlights

Source: IEA, HEnEx, HAEE's analysis

- Fossil fuels have played an important role in Greek power generation, and accounted for more than 70% of the total electricity generated in the early 1990s.
- Based on historical data, the dominance of fossil fuels has significantly decreased compared to 1990 levels, while RES increased to 25% over the same period.
- By 2028, the share of coal in Electricity generation is projected to gradually reach zero, while Natural Gas and RES will cover the additional needs in terms of demand.
- For 2019, Natural Gas represented 42.33% of Electricity generation, RES 25.58%, Coal 25.43% and the remaining 6.65% is attributed to Hydroelectric stations.
- Compared to the values of 2018, we observe a major increase in terms of Natural Gas and RES use, while Hydro and coal lost substantial share out of total generation.

Aiming to achieve environmental targets Europe needs to rapidly decarbonize its power sector, a trend that is apparent all over the continent

Timeline of Coal Phase-out in Europe



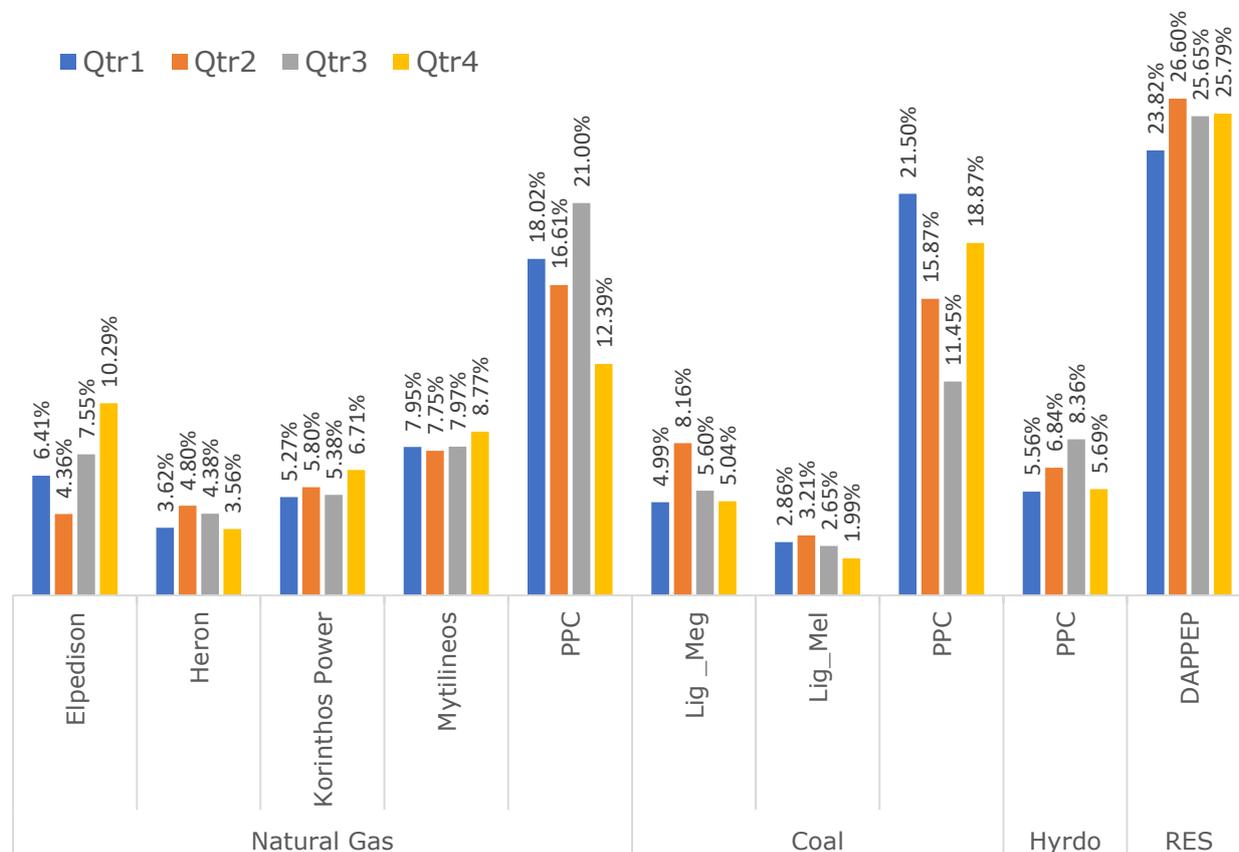
Highlights

Source: HAEE's analysis

- According to the Paris Agreement, the European Union pursue efforts to limit temperature increases to 1.5°C above pre-industrial levels.
- A significant portion of the EU's emissions comes from coal-fired power plants, and phasing-out coal is one of the most cost-effective methods to achieve its targets.
- Currently, there are 14 operating coal-fired power plants in Greece which will gradually phase-out by 2023.
- Reducing coal usage in Greece will also provide significant benefits in terms of air quality and health. However, energy security ranking will deteriorate.
- Handling the new coal-fired plant "Ptolemaida V", an investment of at least 950 million euros, is the most difficult task for national authorities.

For 2019, the incumbent Public Power Cooperation (PPC), retained a dominant share in electricity generation (43.28%)

Percentage of Total Quarterly Generation per Participant and Fuel Type (%), [2019]



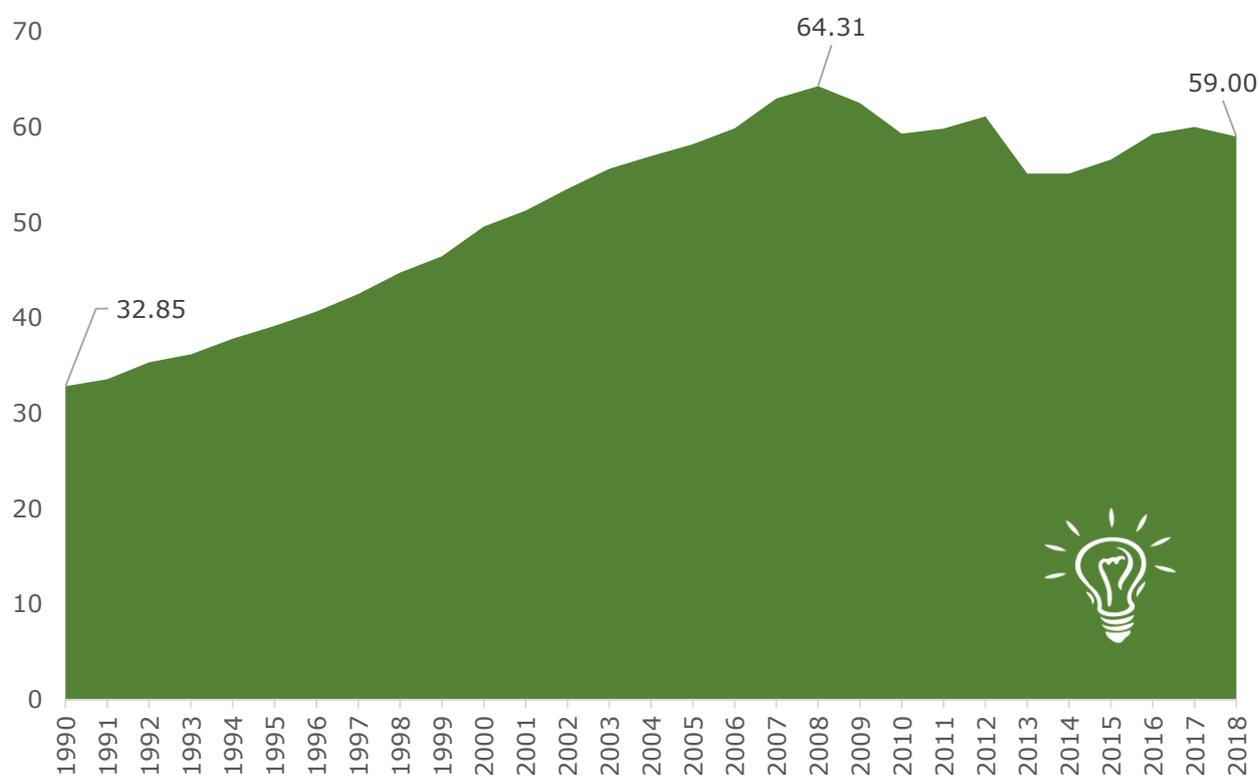
Highlights

Source: HEnEx, HAEE's analysis

- The electricity generation mix of Greece shows some differences compared to the EU average with the dominance of Natural Gas, Coal and RES.
- The liberalization process delivered private investment in gas-fired generation. In 2013 generation from private gas-fired units accounted for 18% of total generation.
- In 2019 gas-fired plants of PPC (12.3%), Elpedison (10.2%), Mytilineos (8.7%), Korinthos Power (6.7%) and Heron (3.5%) contributed to total generation.
- Interestingly, RES preserve their share of 25% on average throughout the four quarters of the year, while Coal is mainly used during the winter months.
- Aiming to comply with environmental policies, the expected reduction in the share of lignite production, raises concerns about adequacy of supply during winter months.

Another impact of the pandemic is that the electricity consumption in Greece will decline in the short-term and rebound after 2022

Total Electricity Consumption in Greece (TWh), [1990-2018]



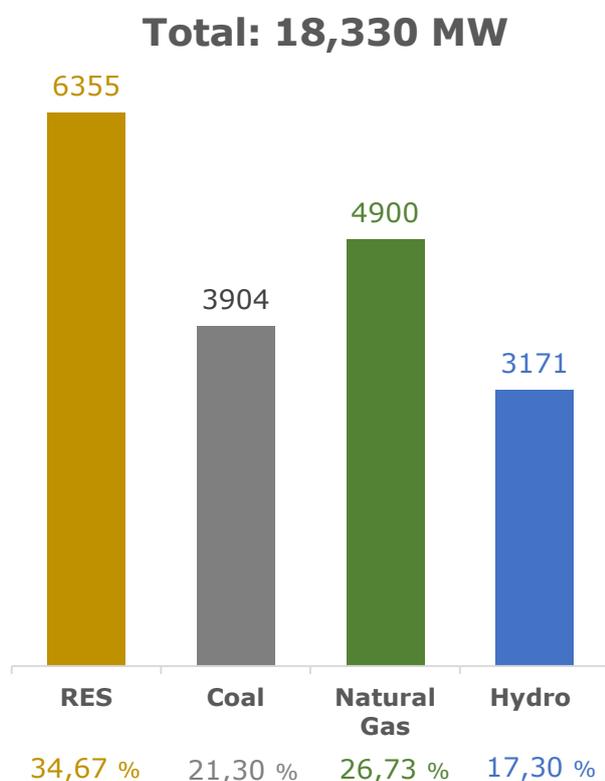
Highlights

Source: IEA, HAEE's analysis

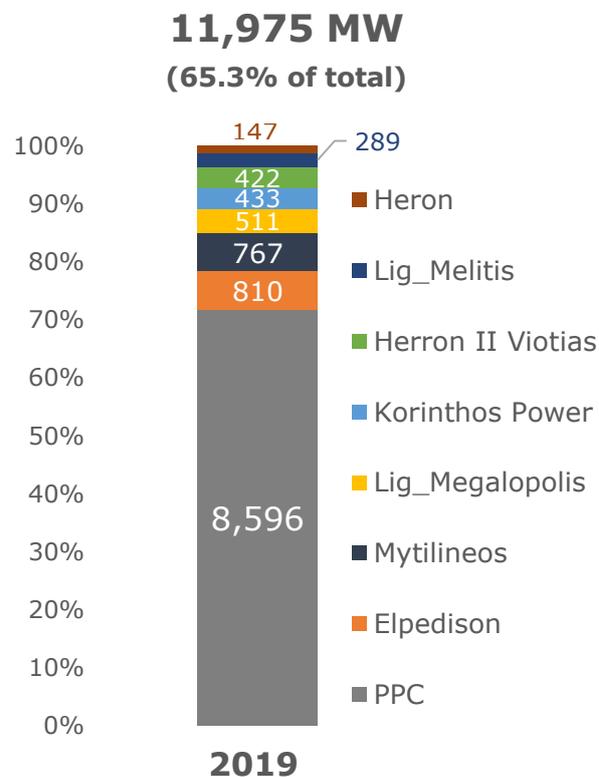
- Electricity consumption can be affected by various factors, such as, the various types of activities, weather conditions and the overall macroeconomic framework.
- Greece's electricity consumption was increasing steadily until it reached a peak of 64.3 TWh in 2008, while, in the aftermath of the economic crisis, a decline followed.
- According to the most recent data, electricity consumption seems to recover at levels prior to the COVID-19 crisis following a long period under restrictions in mobility.
- Current electricity consumption in Greece is estimated to be around 5500 kWh per person annually, while in 1990 the corresponding size was about 3000 kWh.
- The discrepancy between the amount of electricity generated/imported and the amount consumed/exported is considered as a loss in transmission and distribution.

For 2019, RES and Hydro represent bigger capacity compared to Coal and Natural Gas combined

Total Electricity Capacity per Fuel (MW), [2019]



Electricity Capacity of Conventional Units, Hydro Included, per Producer (MW), [2019]



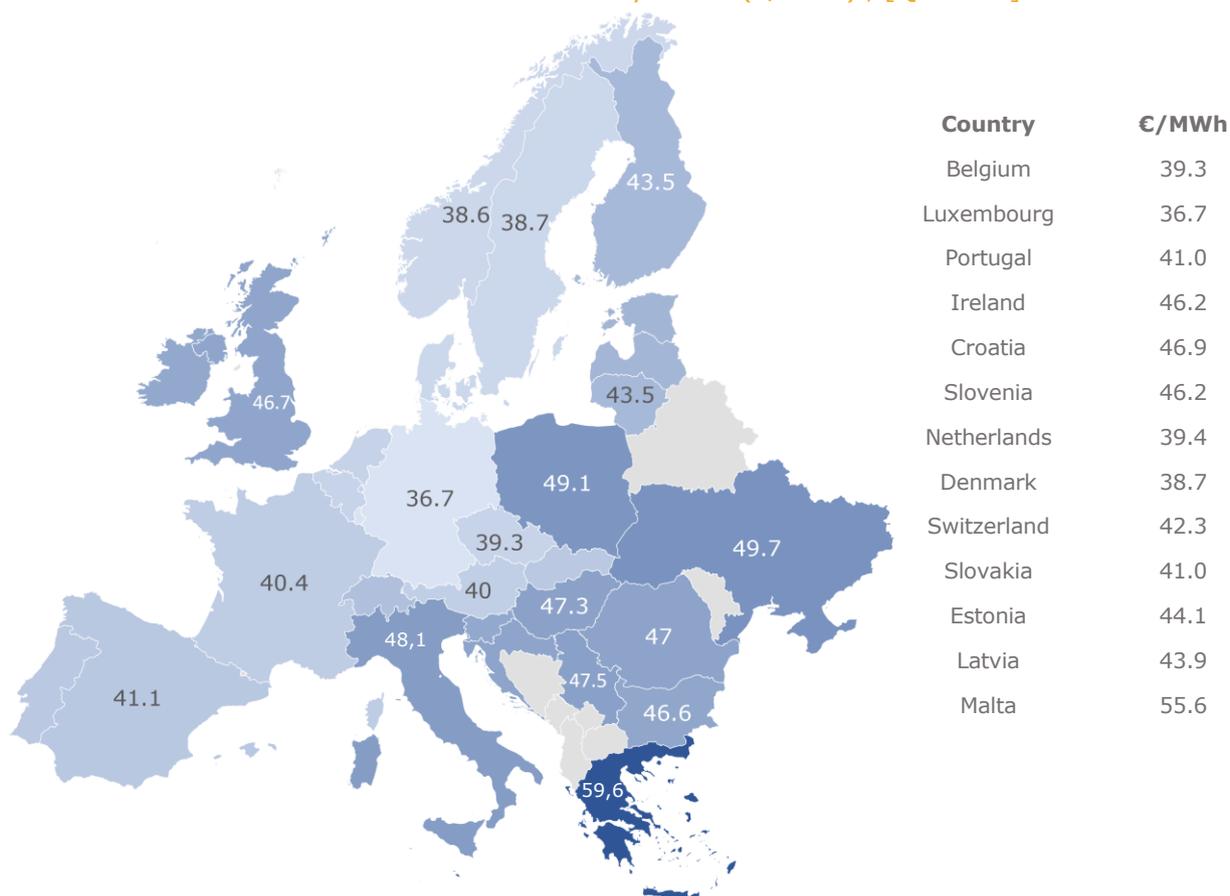
Highlights

Source: IEA, HAEE's analysis

- Total electricity capacity for 2019 in Greece was 17,444 MW, out of which 34.6% is attributed to RES, 26.7% to Natural Gas, 21.3% to Coal and 17.3% to Hydro.
- It is apparent that conventional power plants are still crucial for the balance of the system since their capacity stands at 65.3% of total electricity capacity in Greece.
- Coal used to be a significant domestic fossil fuel in Greece, however current policies lead to its gradual replacement mainly by RES and Natural Gas.
- Yet, PPC's huge investment of a new lignite unit with a total capacity of 660MW is anticipated to be ready for use until the end of 2022.
- Greece has a large potential to grow the shares of clean power once its non-interconnected islands (NIIs) become integrated into the mainland electricity system.

Greece faces the 2nd most expensive wholesale electricity price throughout Europe only behind Poland which is also a coal-based market

Wholesale Baseload Electricity Prices (€/MWh) , [Q4 2019]



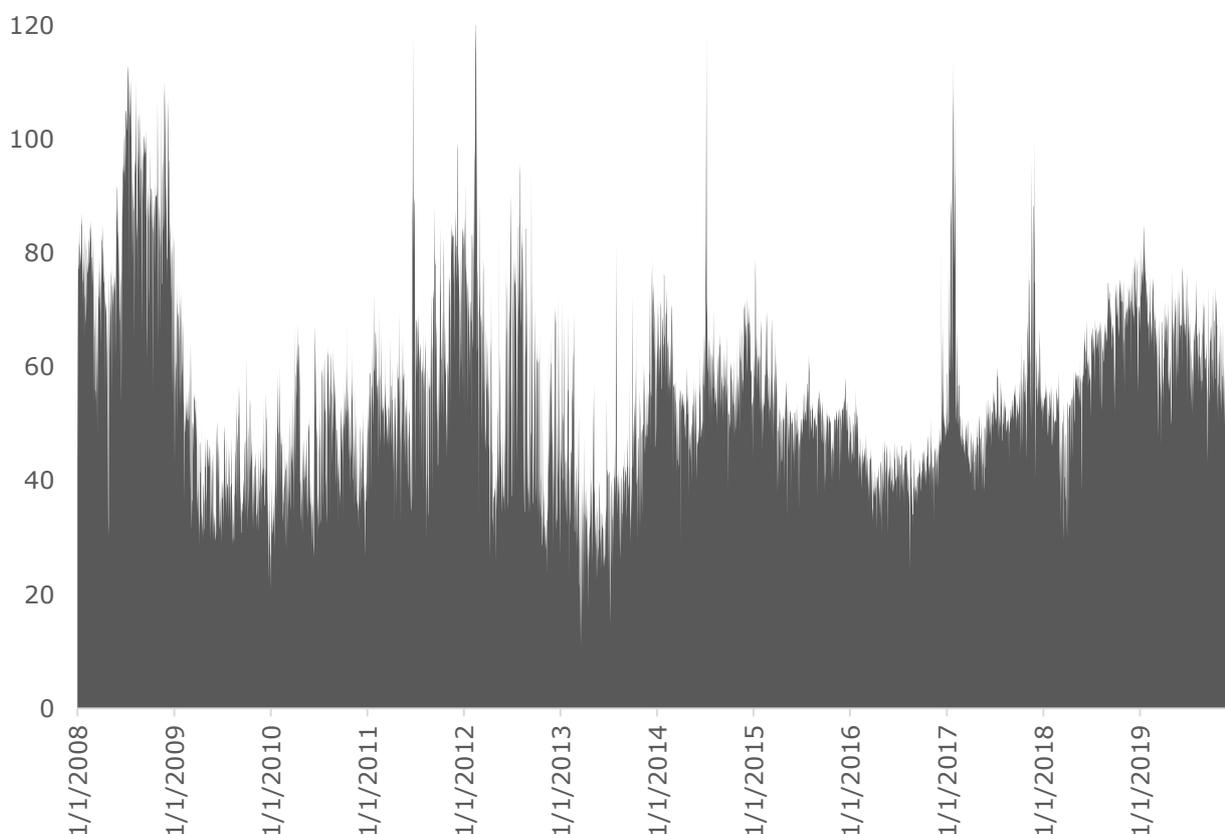
Highlights

Source: European Commission, HAAE's analysis

- During the fourth quarter of 2019, the average wholesale baseload electricity price among countries in Europe was 44.2 € per MWh.
- The lowest price recorded in Germany (36.7 €/MWh), while the most expensive wholesale electricity price recorded in Greece 59.6 €/MWh and Poland 49.1 €/MWh.
- Apart from the increased electricity prices, another common characteristic between Greece and Poland is the fact that both countries are still highly dependent on coal.
- Market coupling is intended to link market areas in order to harmonize different systems of electricity exchanges and, in particular, to reduce price differences.
- Market coupling systems exist both in Day-ahead trading and in Intraday markets, and this interconnection among markets ensures efficient electricity trading.

Following 2018 when electricity prices increased, a downward trend was apparent throughout 2019 mainly due to the cheap imports of gas

Daily System Marginal Price (€/MWh), [2008-2019]

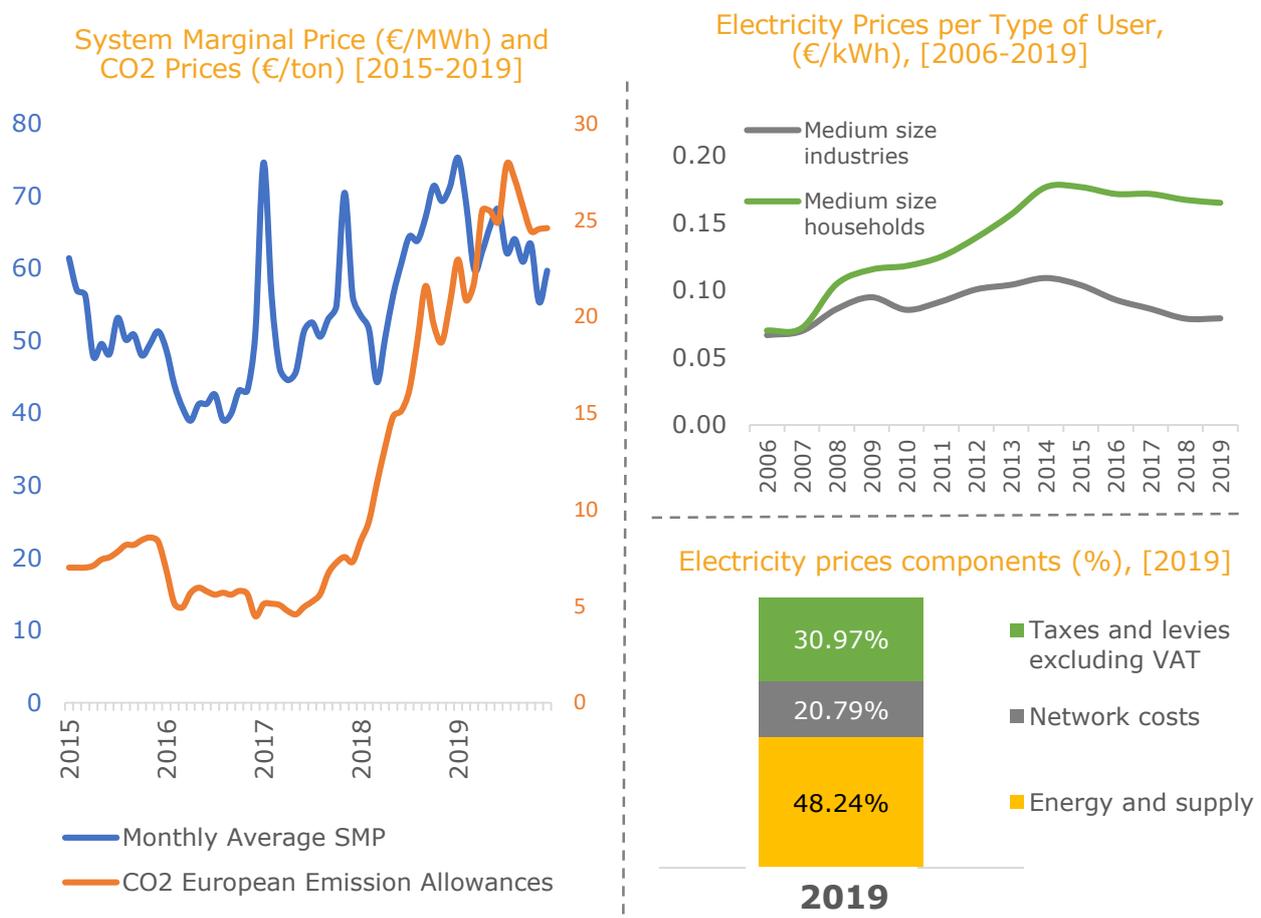


Highlights

Source: HEnEx, HAEE's analysis

- Wholesale prices are highly sensitive to available production and transmission capabilities, mainly due to lack of storage and the need for instant consumption.
- Over the last decade, wholesale prices in Greece fluctuate around 40 to 60 €/MWh, however in 2018 prices followed an upward trend reaching the level of 80 €/MWh.
- At the end of 2019, prices fluctuated around 60 €/MWh which is considerably higher than the EU average wholesale electricity price for the same period (43.3 €/MWh).
- The maximum price ever recorded over the period 2008 – 2019 was in February 2012 (118 euros per MWh), while the minimum, in February 2013 at 10 euros per MWh.
- This increased sensitivity of price fluctuations is anticipated to surge even more as the penetration of RES increases, heavily affecting the profitability of participants.

CO2 emission allowances directly affect electricity prices and contribute to emissions reduction through Europe

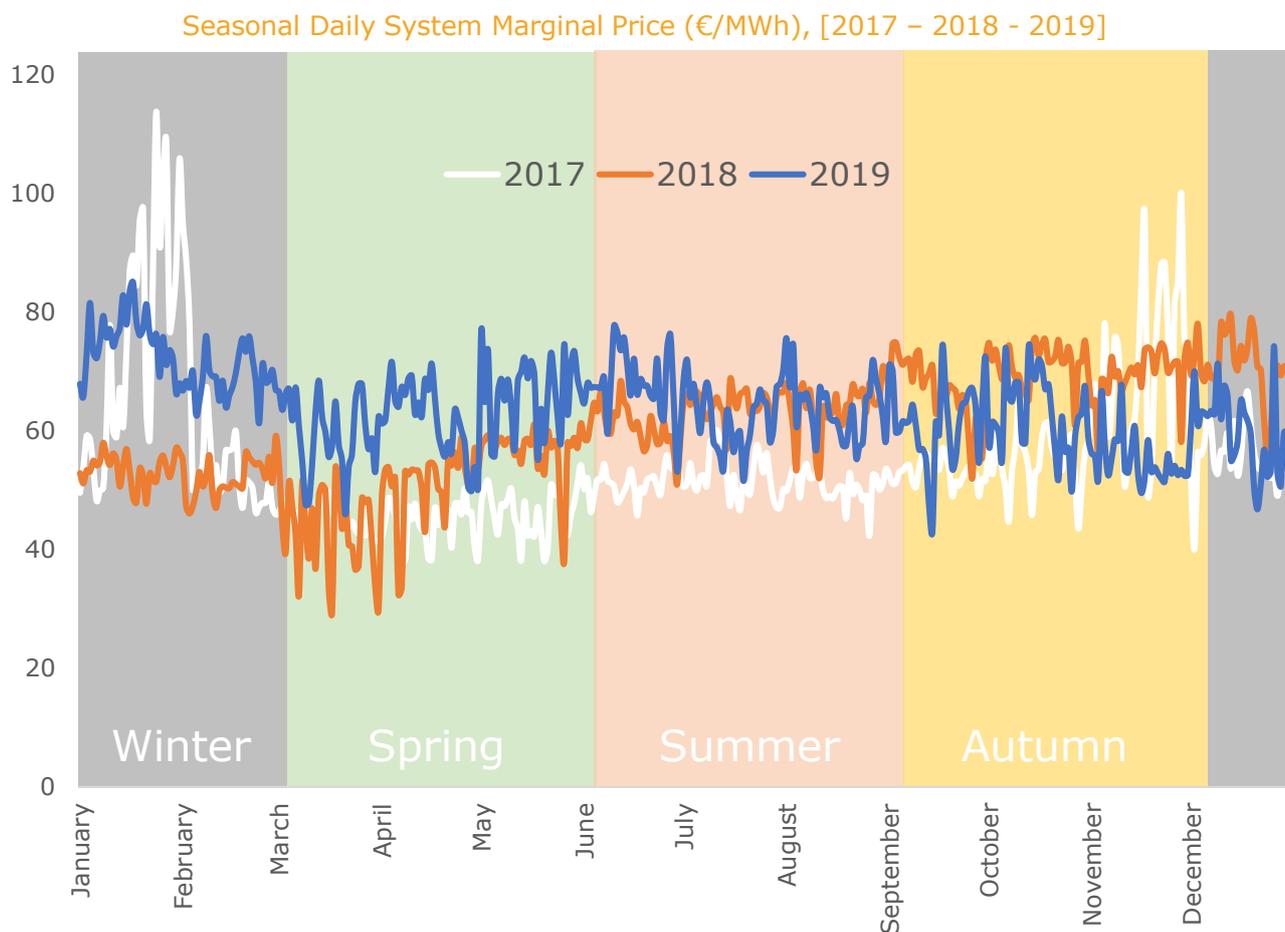


Highlights

Source: Eurostat, HEnEx, HAEE's analysis

- Since 2018, carbon emission allowances are almost six times greater, climbing from less than 5 euros to historical peak of 28 euros in 2019.
- Accompanied by a decrease of CO2 emission allowances, the monthly average system marginal price in Greece encountered a steady drop during 2019.
- In terms of electricity prices by type of user, medium size households experience a constant stable trend, with prices reaching the point of 0.17 €/kWh in 2019.
- In contrary, since 2006, prices in medium size industries are significantly lower all over the period at the level of 0.10 €/kWh, dropping to 0.08 in 2019.
- Taxes and levies represent 30,9% of the final electricity price, while network cost covers 20.7% and the remaining 48.2% corresponds to energy and supply.

Despite the fact that electricity prices are high, a clear downward trend is apparent for 2019 in Greece

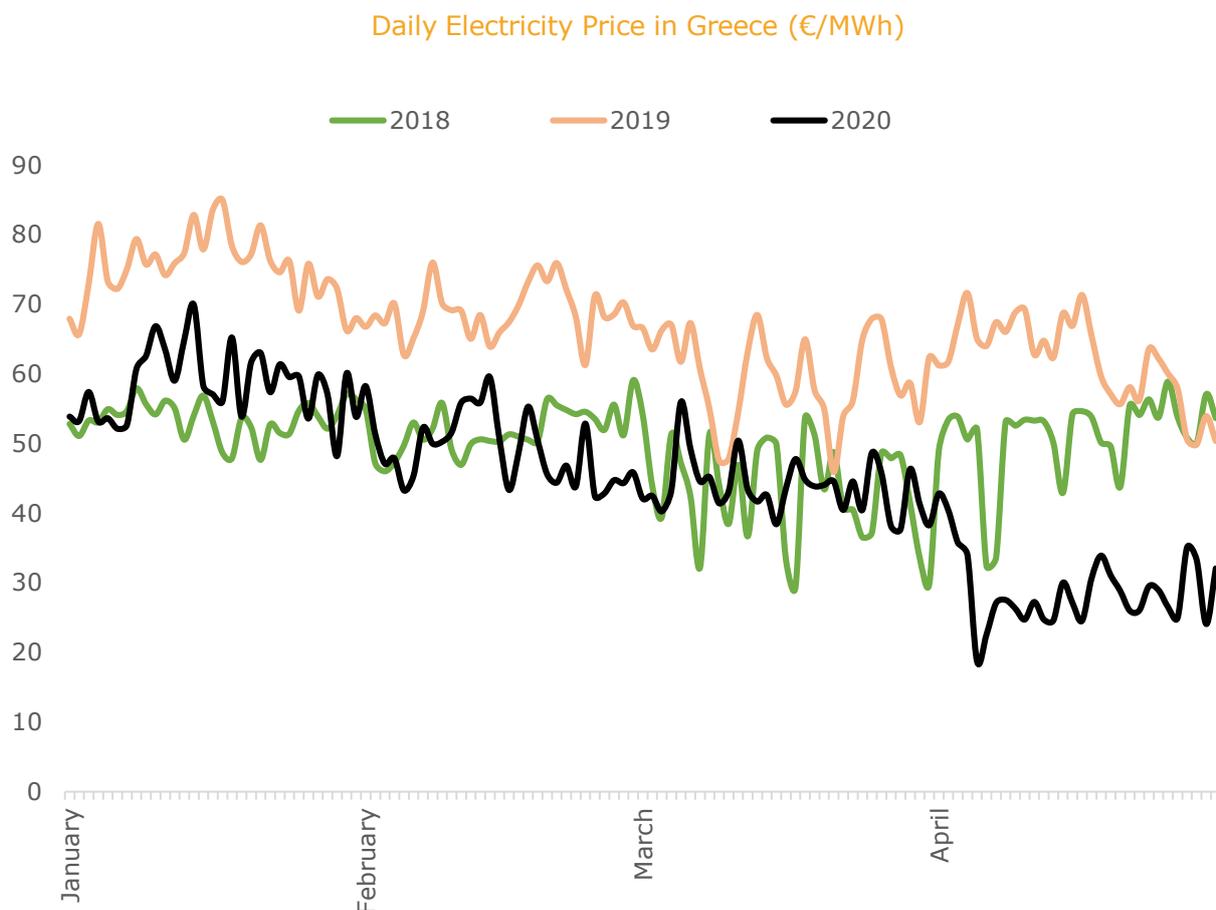


Source: HEnEx, HAEE's analysis

Highlights

- Aiming to identify the effect of seasonality on prices, the daily system marginal price is plotted over the past three years, with no clear evidence supporting seasonality.
- 2017 was a year of great discrepancies since both during winter and autumn months, the daily SMP escalated above 100 euros per MWh.
- In the first semester of 2018, prices were lower on average compared to 2017 and 2019 but gradually increased following an upward trend until the end of the year.
- Wholesale electricity price for 2019 in Greece follows a slight downward trend and fluctuates among 85 to 43 euros per MWh, without any spike recorded over the year.
- Based on recent data, the comparison among other EU countries continue to show that wholesale electricity prices in Greece are still the highest recorded in the Union.

Wholesale electricity price dropped at historical levels at 18 €/MWh during the first week of April 2020 when strict restrictions were imposed

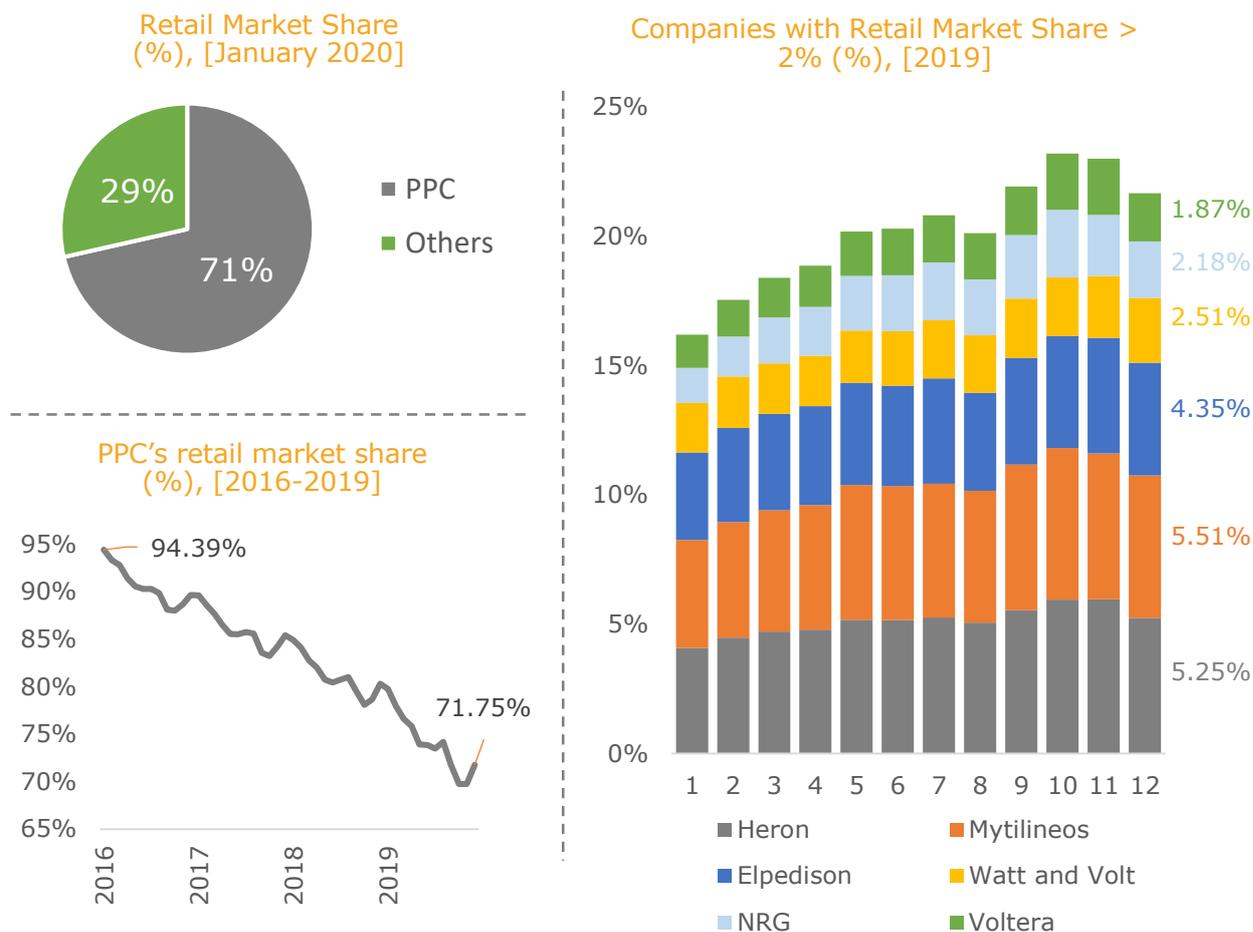


Source: HEnEx, HAEE's analysis

Highlights

- In terms of daily electricity prices in Greece the graph depicts the first four months of 2020 compared to the respective months of 2018 and 2019.
- The reduction in electricity prices is significant all over the period, but especially during April when the restrictions were more severe, prices dropped to 27.5 €/MWh.
- This is a historical low for an average monthly price for Greece, since the normal fluctuation of electricity prices was around 40 to 60 €/MWh over the previous years.
- In that context, a historical minimum of 18.7€/MWh was recorded during the first week of April 2020.
- This drop is interpreted as a 70% decrease compared to the price of 64€/MWh that was recorded for the same day one year earlier in 2019.

As part of the economic adjustment programme, PPC's share in the retail market has to fall below the benchmark of 50%



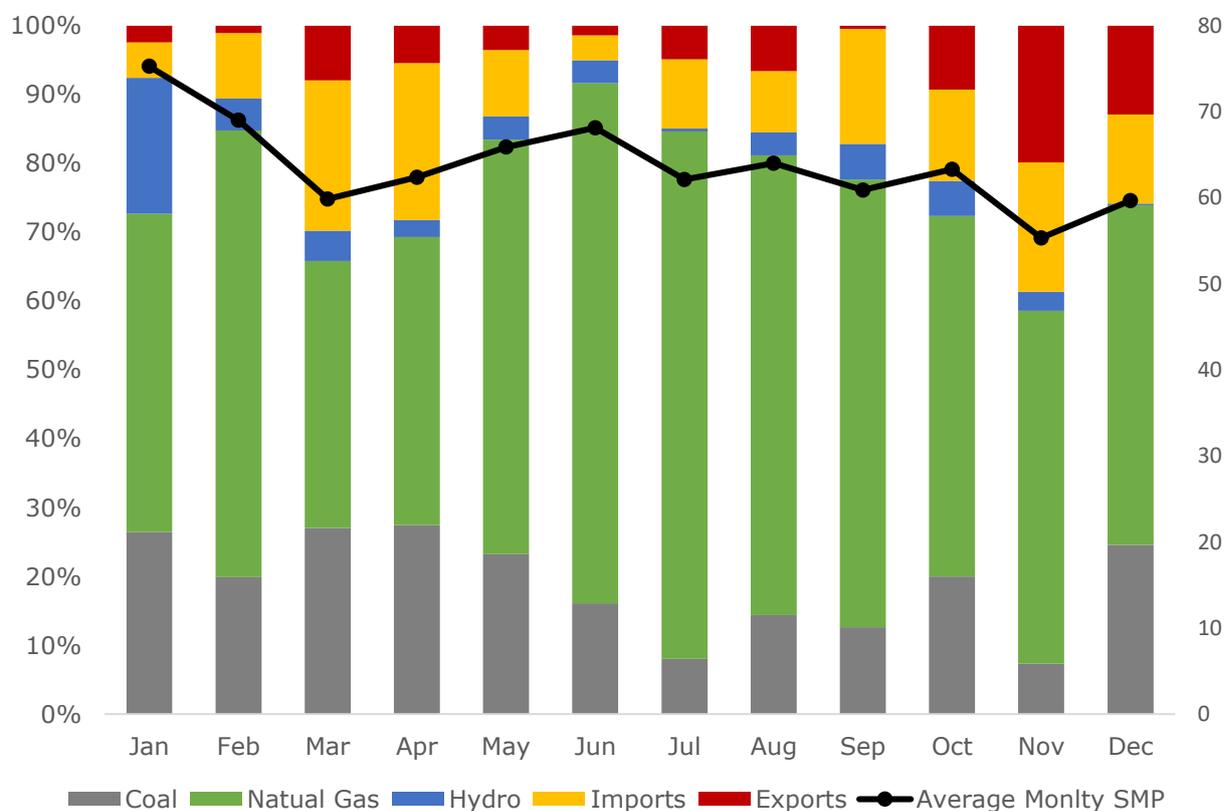
Source: HEnEx, HAEE's analysis

Highlights

- Market share in January 2020 was still dominated by PPC at 71%, while the remaining 29% is distributed among the rest 25 active companies.
- The majority of this share is attributed to 6 companies that try to strengthen their position in the retail market, since they represent 21.6% of retail market share.
- In December 2019 we observe the following shares: Mytilineos 5.51%, Heron 5.25%, Elpedison 4.35%, Watt and Volt 2.51%, NRG 2.18% and Voltera 1.87%.
- The introduction of NOME-type auctions were supposed to serve as the tool to reduce PPC's significant market share, however, NOME auctions repealed at the end of 2019.
- The Derivatives Market that officially started to operate in March 2020 aims to replace the gap that was created after the abolishment of NOME-type auctions.

Cheap electricity imports during March, April and November of 2019 contributed considerably to the reduction of the System Marginal Price

Monthly Percentage (%) - Left Axis) by Source of Generation that Determined the SMP (€/MWh - Right Axis), [2019]



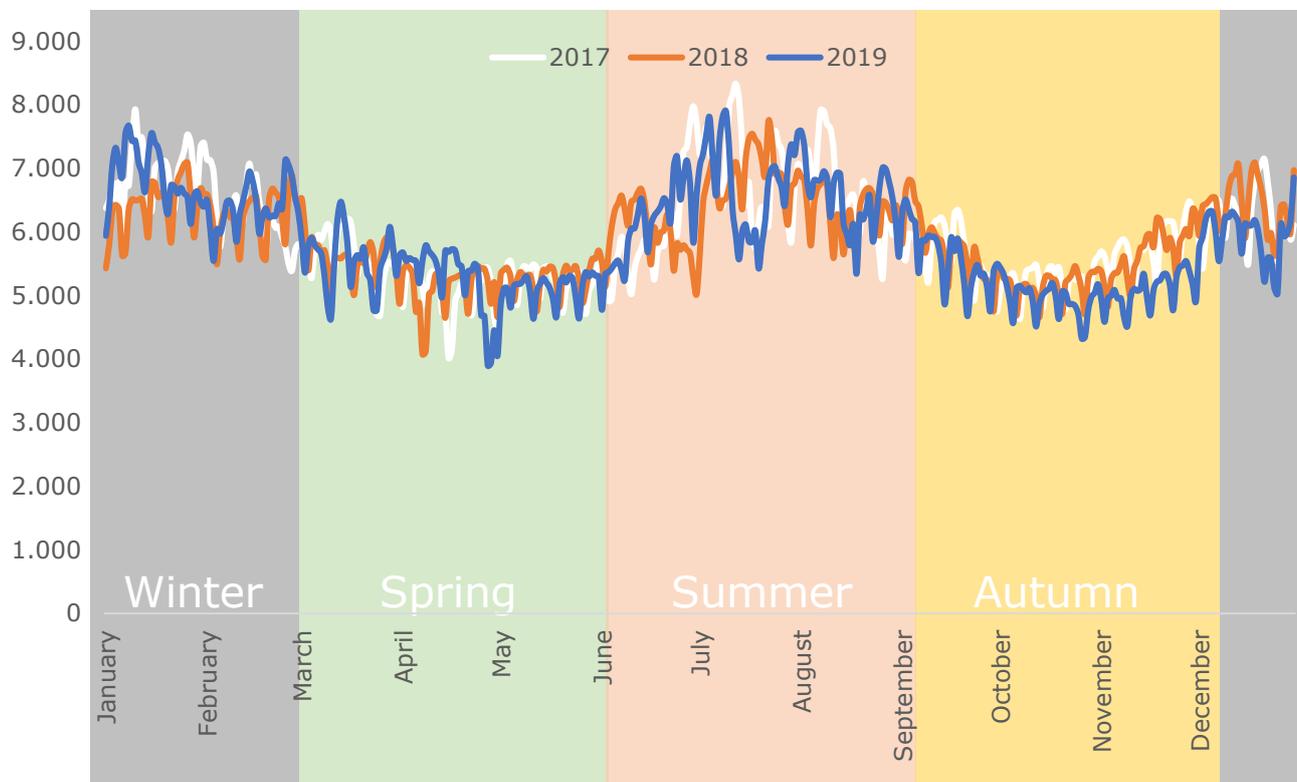
Highlights

Source: HEnEx, HAEE's analysis

- Throughout 2019 the average System Marginal Price is 63.8 €/MWh, while for Spring 62.7 €/MWh, Summer 64.7 €/MWh, Autumn 59.8 €/MWh and Winter 68 €/MWh.
- During March and November 2019, increased percentage of cheap electricity imported from neighboring countries (20%), led to a drop of SPM below 60 €/MWh.
- However, during January and June 2019, the share of imports was reduced to lower than 5% and prices fluctuated around 70 €/MWh.
- Natural Gas is the fuel that mostly determines the System Marginal Price such as during June 2019 when it contributed to almost 80% in the system.
- For 2019, the average contribution of Coal towards the formation of the System Marginal Price was 20% while Hydro stations mainly used during January 2019.

Electricity demand is higher during winter and summer, compared to spring and autumn, for heating and cooling purposes respectively

Seasonal Daily Load Declarations (MW), [2017 - 2018 - 2019]

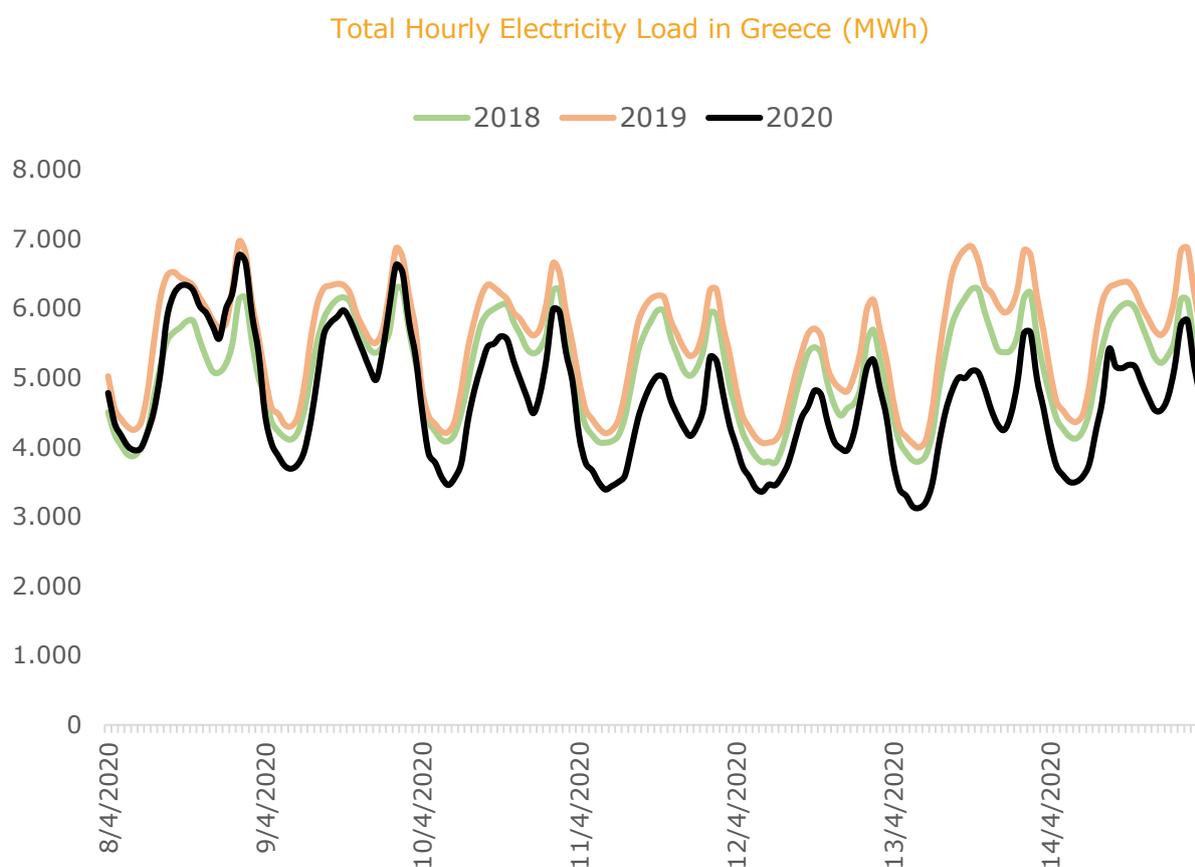


Source: HEnEx, HAEE's analysis

Highlights

- Heating and cooling purposes modify significantly the need for electricity and create the difference among the four seasons of the year.
- The use of smart grids are changing the way electricity has traditionally been generated, supplied and consumed.
- Smart meters provide valuable information, such as real time electricity demand, voltage levels, and power quality.
- For the case of Greece, HEDNO promotes the appropriate framework for the development of two pilot smart island projects in Tilos and Ikaria.
- The pilot projects aim to ensure proper operation and management of RES electrical systems, reduce operational cost and support environmental protection.

An average drop of 20% in electricity load during the 2nd week of April 2020 reveals the negative externalities expected in the Greek economy



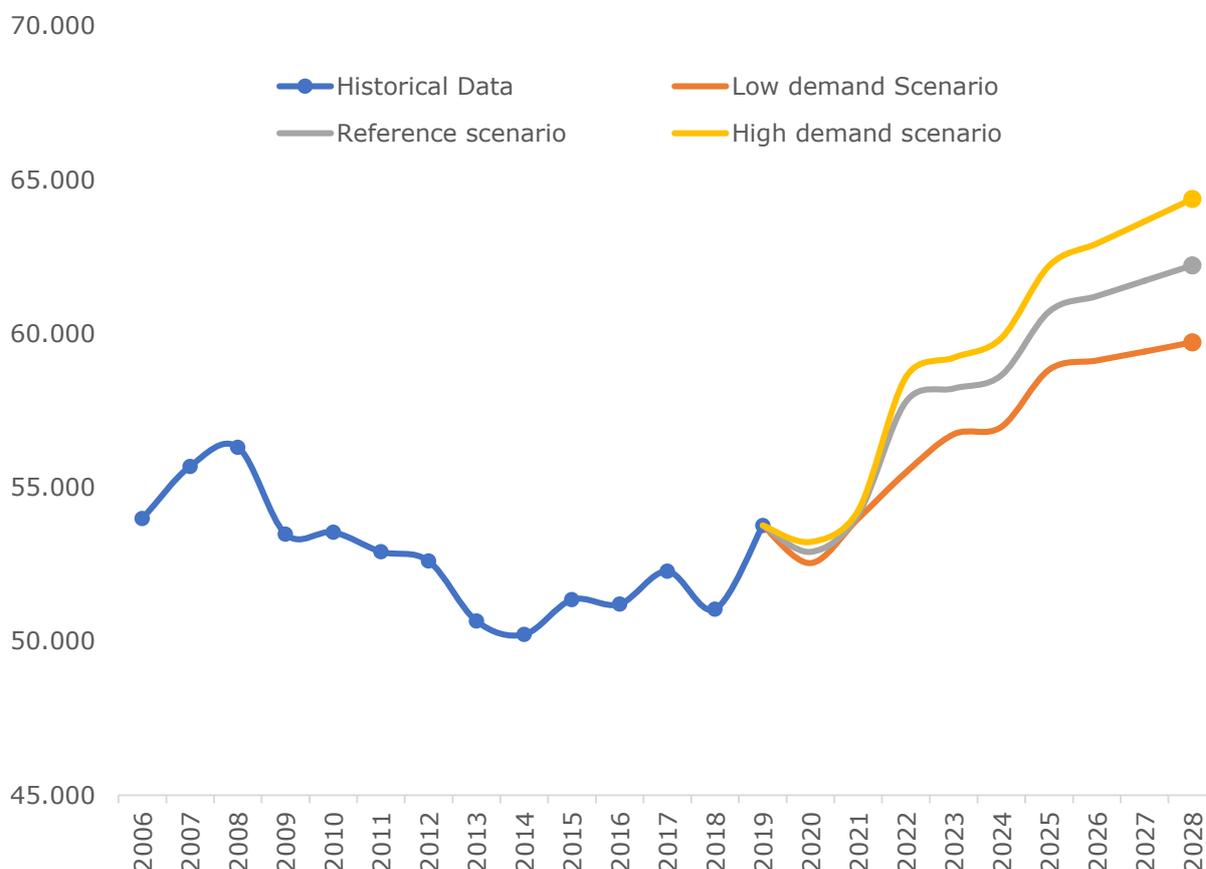
Source: HEnEx, HAEE's analysis

Highlights

- The graph focuses on the total hourly electricity load during the second week of April compared to the same series during 2019 and 2018.
- Due to the effects of the pandemic, demand decreased by 13% and the lignite power generation in April 2020 recorded a drastic fall of 88% compared to 2019 levels.
- On the other hand, the Renewable Energy Sources recorded a large increase of +50%, the Hydroelectric power plants of +32%, the Gas Units of +16%.
- Given the absence of lignite units, the system faced a major downturn in demand during the COVID-19 outbreak and responded without any issues of stability.
- This framework underlined by the increased penetration of RES and Natural Gas use in Electricity generation has been characterized as a "Window to the Future".

COVID-19 crisis is anticipated to significantly hamper the annual demand for electricity, and this is apparent in all three scenarios

Forecast of Total Annual Demand for Electricity (GWh), [2006-2028]



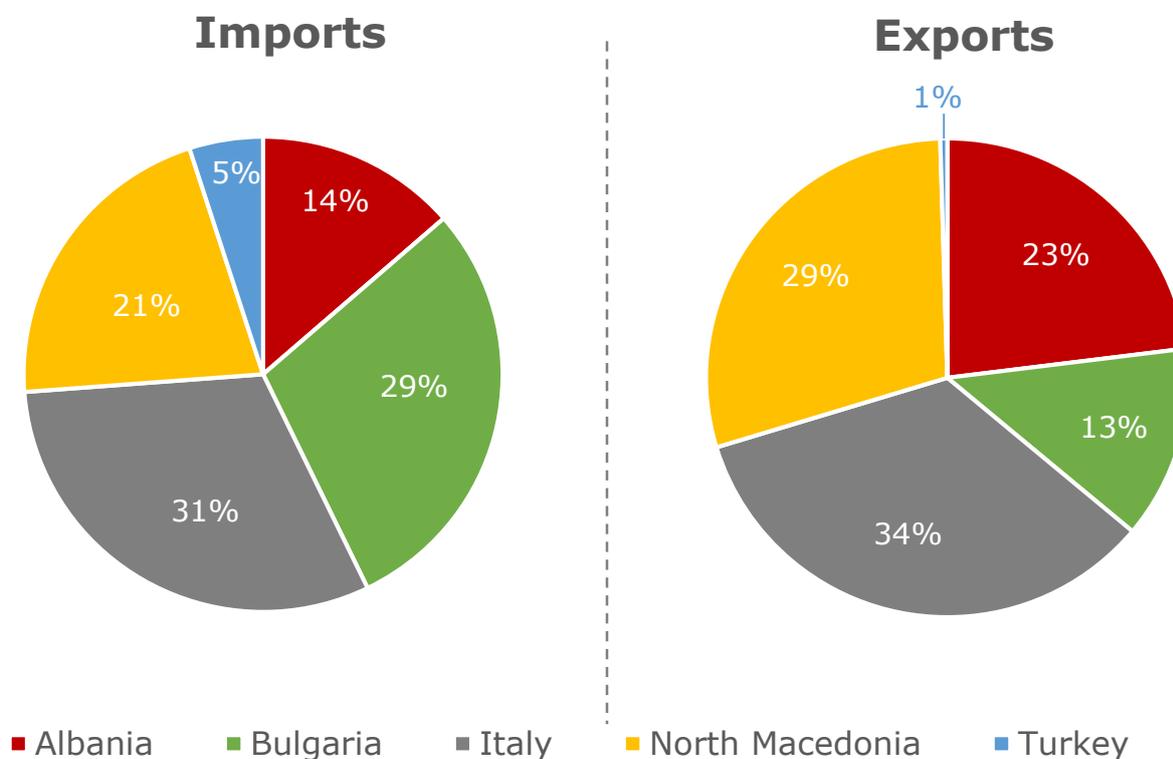
Highlights

Source: ADMIE, HAEE's analysis

- According to HAEE's projections, demand for electricity during the upcoming years will increase in different scenarios, but with a 2 year delay due to Covid-19 crisis.
- In all three scenarios electricity demand will face a U-shape trend that depending on the duration of lock-down measures will decrease aggregate demand.
- The sharp rise that will follow in 2022, is mainly attributed to the general recovery of the Greek economy that is anticipated to boost electricity consumption.
- Compared to the 56.310 GWh which were generated in 2008, the low demand scenario projects that in 2023 electricity demand in Greece will stand at 56.750GWh
- Upcoming years require rapid changes of market structure within a relatively short time frame, since authorities need to re-organize the wholesale electricity market.

Greece is well connected to neighboring countries and active in electricity trading mainly with Italy and Bulgaria

Imports and Exports with Neighboring Countries (%), [2019]



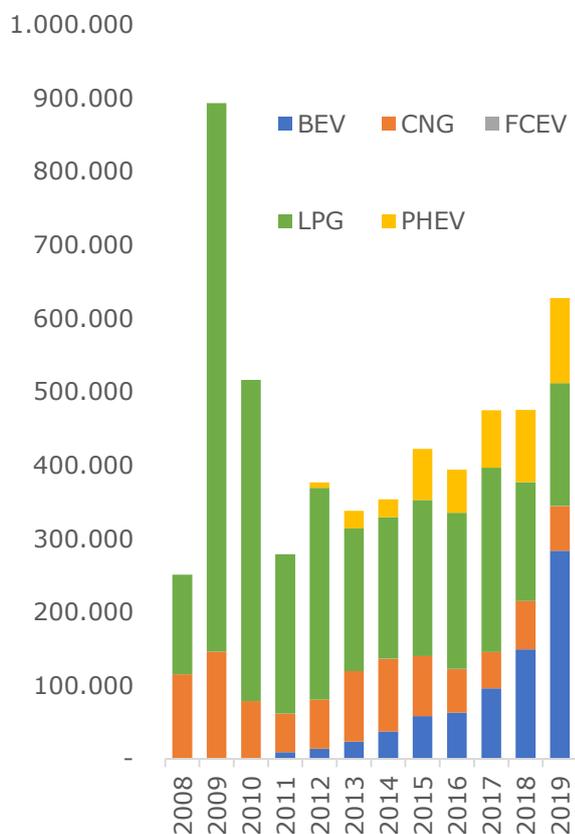
Highlights

Source: HEnEx, HAEE's analysis

- Greece imported 31% of its electricity needs from Italy, 29% from Bulgaria, 21% from North Macedonia, 14% from Albania and 5% from Turkey.
- In terms of electricity exports, 34% is directed towards Italy, 29 towards North Macedonia, 23% towards Albania, 13% towards Bulgaria and 1% towards Turkey.
- The fluctuations in the volume of electricity imports, can be explained by a number of factors such as the excess of electricity supply in some countries.
- Electricity imports are being carried out mainly for competitive reasons since the price is lower than the generation cost of domestic plants.
- However, electricity imports in Greece are expected to decrease significantly in the next years due to the constantly increasing penetration of RES in the system.

Financial incentives and infrastructure will support the penetration of electric vehicles in Greece at this initial stage of development

Alternative Fuel Vehicle Registrations in Europe [2008-2018]



Car Sales in Greece [2017-2018]

	2017	2018	Growth
Electric cars (BEV)	50	87	(+74%)
Plug-in Hybrid (PHEV)	141	228	(+61,7%)
Hybrid (HEV)	2.356	3.635	(+54,3%)
Alternative fuel vehicle (NG)	359	1.030	(+186,9%)
Gasoline	46.068	61.320	(+33,1%)
Diesel	39.014	36.885	(-5,50%)
Total	87.988	103.185	(+17,3%)

Highlights

Source: Alternative Fuel Observatory, HAEE's analysis

- The advantage of zero emissions of electric vehicles transforms them to an excellent choice for transportation in large and crowded urban centers.
- The gain from the transition to electric mobility can be extremely large, taking into account the additional benefit of the significant reduction in noise pollution.
- Despite the fact that sales of electric cars is slowly increasing, by the end of 2019, there were only 140 charging stations for electric cars throughout the country.
- The National Plan for Climate and Energy provides incentives such as subsidizing the purchase price and tax exemptions to reduce the cost of registration and use.
- The whole effort will be largely based on the expected reduction in the cost of batteries, so that electric vehicles alone can approach the conventional ones.

The Greek government announced in June 2020 a series of incentives supporting the promotion of Eco-mobility

Incentives for the Promotion of Eco-Mobility



Cars: Discount equal to **15%** of the retail price before taxes with a limit of **5.500€**. Besides, **500€** for those who will proceed with the installation of a home charger.



Scoters: Discount equal to **20%** of the retail price before taxes with a limit of **800€**.



Bicycles: Discount equal to **40%** of the retail price before taxes with a limit of **800€**.



Withdrawal bonus amounting to **1.000€** for cars and **400€** euros for motorcycles if the buyer of the electric vehicle proceeds to withdraw the old one

The **budget** of **100 million€** comprises an amount that will subsidize the purchase of 1.700 cars, 1.500 motorcycles, 1.500 bicycles, 1.000 taxis, 6.000 corporate vehicles and the installation of 1.000 home charging points.

Highlights

Source: HAEE's analysis

- The amount of 100 million euros covers the period 2020-2021 and similar packages are anticipated to follow in the coming years.
- The European Union embraces electric mobility and provides funding for 1 million chargers across Europe.
- The cost of fuel for a conventional vehicle that travels 10.000 km annually is 1.200€, while for an electric vehicle, the cost for the same distance is 420€.
- In case night tariff is included in the calculations, the cost drops to 220€, or in other words 80% lower than the conventional one.
- Apart from low cost of maintenance, electric cars are exempted from road tax, circulate freely in the city center and will not be charged for parking for two years.

European Union countries provide plethora of both financial and non-financial incentives towards Eco-mobility

Fiscal and Non-Fiscal Incentives Towards Eco-Mobility for All EU Countries

Country	Purchase incentive or subsidies	Tax benefits and exemptions	Other Benefits (i.e. free parking)	Infrastructure promotion measures	Traffic Regulations (i.e. bus lanes, low emission zones)
Austria	•	•	•	•	
Belgium	•	•		•	
Bulgaria	•	•		•	
Croatia		•			
Cyprus	•	•			
Czech Republic	•	•			
Denmark	•	•		•	•
Finland	•	•			
France	•	•	•	•	
Germany	•	•	•	•	•
Greece	•	•	•	•	•
Hungary		•	•		•
Iceland	•	•	•	•	
Ireland	•	•	•	•	
Italy		•		•	
Latvia		•	•		•
Lithuania		•	•		•
Luxembourg	•	•			
Malta	•	•		•	
Netherlands		•		•	
Norway	•	•	•	•	•
Portugal	•	•	•	•	
Slovakia	•	•		•	
Spain	•	•	•	•	•
Sweden	•	•		•	•
Switzerland	•	•			
United Kingdom	•	•	•	•	•

Source: European Fuel Observatory, HAEE's analysis

5. Natural Gas



Highlights



Natural gas **consumption** in Greece grew in 2019 by almost **10%** reaching an all time high at around **5 bcm**



For the first time in 2019 the primary entry point for natural gas in the country was **Revithousa**, from which **48%** of the gas was imported



The **penetration rate** in the region of Thessaloniki reached **50%**, in Thessaly **51%**, while in Attiki it has reached only **39%**



CNG and **LNG** technologies can offer **reliable solutions** to remote areas in which pipeline construction is costly

Natural gas **import price** following the COVID-19 outbreak dropped to **11.8 €/MWh** in March 2020



TAP pipeline will become available by the **end of 2020**, bringing natural gas quantities from Azerbaijan to Europe



In 2019, **50 cargos** were unloaded in Revythousa coming from **10 different countries**, thus enhancing the country's energy security of supply



Household consumption prices dropped from almost **50 €/MWh** to less than **40 €/MWh**, while taxes fluctuate around **10-12 €/MWh**



Future technologies around natural gas are coming to bridge the gap to a **zero-carbon transition**



Overview

Natural gas consumption in Greece hit an all-time high in 2019, while the March 2020 average natural gas import price was the lowest in a 5-year period. In 2019, the Revithousa LNG terminal was for the first time, the major entry point of natural gas in Greece, and exports to Bulgaria increased dramatically. Existing and proposed infrastructure will transform Greece to a natural gas hub, increasing the importance of the country in terms of security of supply.

In that context, LNG was the main source of natural gas imports in Greece, diversifying the suppliers and enhancing security of supply. The most challenging future project is the East Med Pipeline, proposing to transfer 10 bcma of natural gas from the Levantine basin to the European market crossing the Mediterranean Sea. The final investment decision is expected to be taken in 2021 and the pipeline is planned to be ready by 2025.

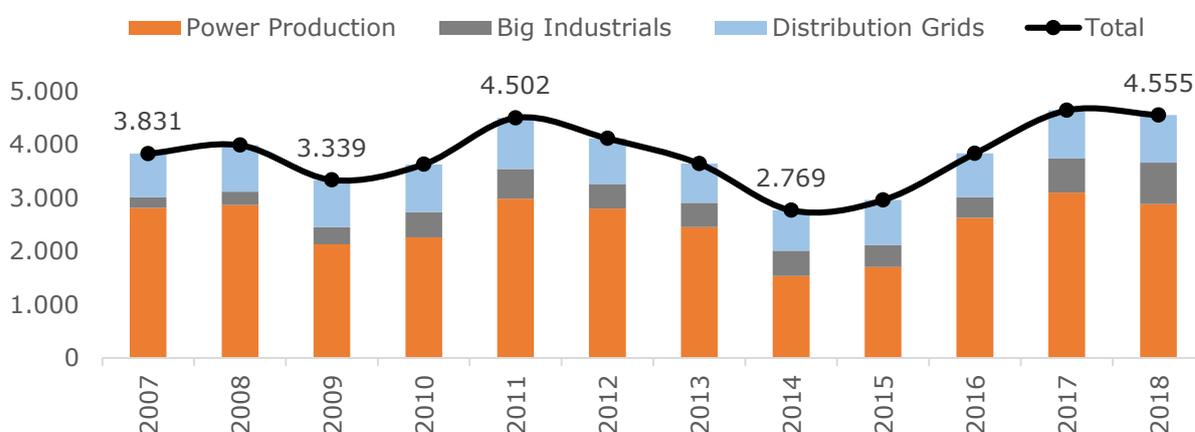
Besides, the binding market test for capacity booking for the proposed FSRU in Alexandroupolis was completed in March 2020 with binding offers of 2.6 bcm of gas. The final investment decision is expected to be taken in Q1 2021. The FSRU will have a regasification capacity of 6.1 bcma and is planned to be connected with the IGB interconnector. The planned Under Ground Storage (UGS) in Kavala, which will consist the first and only natural gas storage facility, where depleted gas fields, can allow the storage of 1 bcm. UGS Kavala is a project handled by HRADF and has been already included in the 4th PCI list by the European Commission and the Member States.

Retail market exists mainly in the regions of Thessaloniki, Thessaly and Attiki, yet there is an ambitious plan for expansion of the market through new grid construction and use of CNG/LNG technologies for remote areas. The areas of Thessaloniki and Thessaly are under "EDA THESS" DSO, being the first areas to have been provided with natural gas. The area of Attiki is under "EDA Attiki" DSO, being the area with the lowest penetration rate and therefore with the greatest dynamic for market expansion. "DEDA" is the DSO for the rest of Greece. 2019 was the first year that licenses for gas distribution were issued to private companies. Retail market is almost nonexistent, and the Grid expansion plan is the most ambitious of all. Natural gas retail prices have decreased substantially the past years both for household and non-household users.

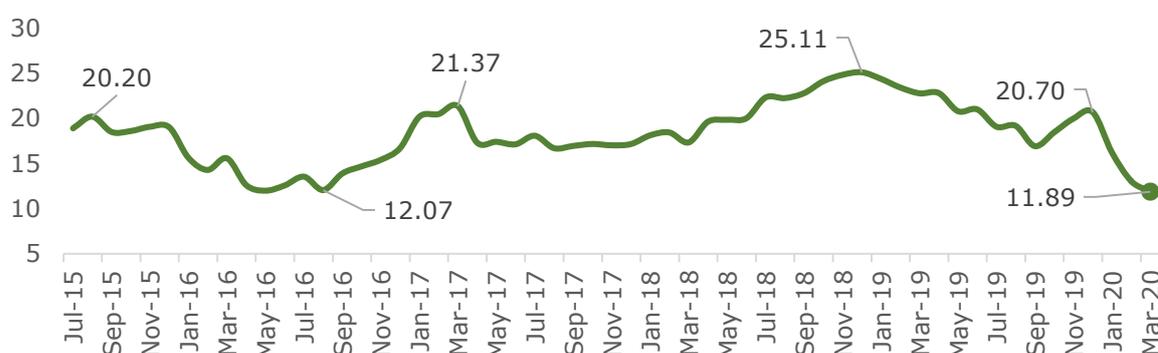
CNG & LNG technologies can offer reliable solutions to remote areas in which pipeline construction is costly, and at the same time are considered as ideal technologies for the expansion of the market to the islands. The retail market consists of more than 8 active suppliers some of which have started selling quantities in the B2B market before 2018. Future technologies around natural gas are coming to bridge the gap to a zero-carbon transition.

Natural gas import price during March 2020 was the lowest in a 5-year period, while consumption hit an all-time high in 2019

Natural Gas Consumption in Greece (mil. Nm³), [2007-2018]



Natural Gas Weighted Average Import Price in Greece (€/MWh), [2015- 2020 Q1]



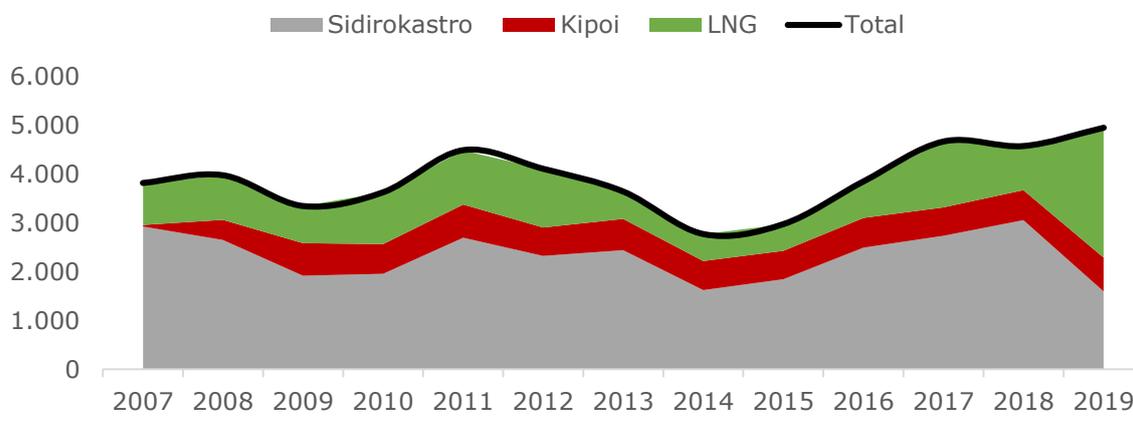
Source: DESFA, RAE and HAEE's analysis

Highlights

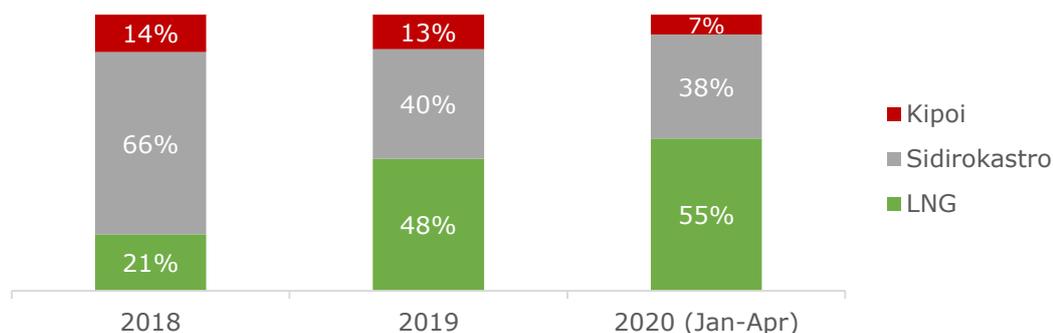
- The natural gas consumption in Greece grew in 2019 by almost 10% reaching an all time high at around 5 bcm.
- More than 60% of natural gas used was for power generation, followed by 20% by the distribution grids for household and small industries consumption.
- From 2014 and onwards the consumption of gas has almost doubled and is expected to grow even more until 2030 according to current projections.
- The average import prices have dramatically reduced in the first three months of 2020 due to low global prices of LNG.
- The lower demand from Asian countries due to the COVID-19 pandemic led to a 40% drop in the average import prices from December 2019 to March 2020.

In 2019, the Revithousa LNG terminal was for the first time the major entry point of Natural Gas in Greece

Entry Points and Quantities (mil. Nm³), [2007-2019]



Import Entry Points (%), [2018-2020]



Source: DESFA, HAAE's analysis

Highlights

- There are three entry points from which natural gas is flowing to Greece. One in Sidirokastro, at the Greek Bulgarian borders, carrying Russian gas.
- The second entry point is at Kipoi located at the Greek-Turkish borders, bringing Azeri gas and the LNG terminal at Revithousa island near Athens.
- For the first time in 2019 the primary entry point for Natural Gas in the country was Revithousa, from which almost half of the gas was imported.
- This trend continues in 2020 with more than 55% of Natural Gas imports getting in the country in LNG form.
- Furthermore the expansion of the Revithousa terminal made possible the increase of exports to Bulgaria, that in 2019 reached more than 0,65 bcm of Natural Gas.

Infrastructure will transform Greece to a Natural Gas Hub, increasing the ranking of the country in terms of security of supply

Route of Trans Anatolia Pipeline (TANAP) and Trans Adriatic Pipeline (TAP)



Route of IGB , East Med and Poseidon Pipelines



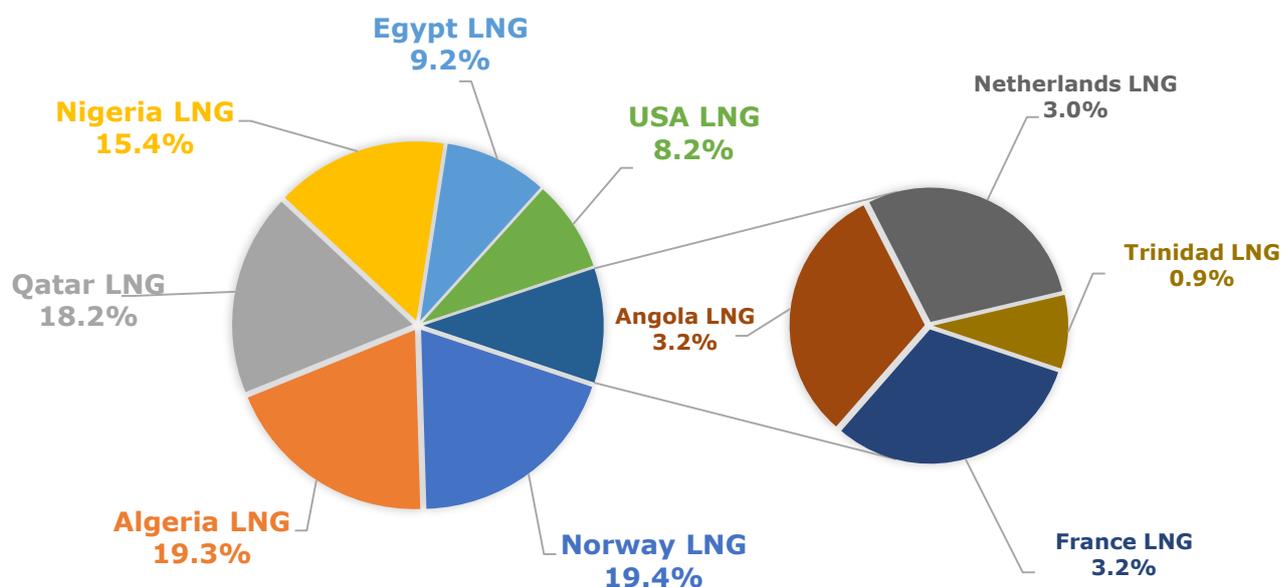
Source: TANAP, TAP, IGI Poseidon, HAAE's analysis

Highlights

- TAP pipeline will become available by the end of 2020, bringing Natural Gas quantities from Azerbaijan to Europe.
- Its capacity within the European ground will be 10 bcma. At the end of June 2020, 96% of the pipeline has been installed.
- Interconnector Greece Bulgaria, with 3 bcma capacity, is going to connect Bulgarian with the Greek Natural Gas system, the TAP pipeline and the FSRU Alexandroupolis.
- East Med Pipeline, is proposed to transfer 10 bcma of Natural Gas from the Levantine basin to the European market crossing the Mediterranean Sea.
- The Alexandroupolis FSRU will have a regasification capacity of 6.1 bcma and is planned to be connected with the IGB interconnector.

LNG was the main source of Natural Gas imports in Greece, diversifying the suppliers and enhancing security of supply

LNG Imports by Partner Country in Greece (%), [2019]



Source: DESFA, HAEE's analysis

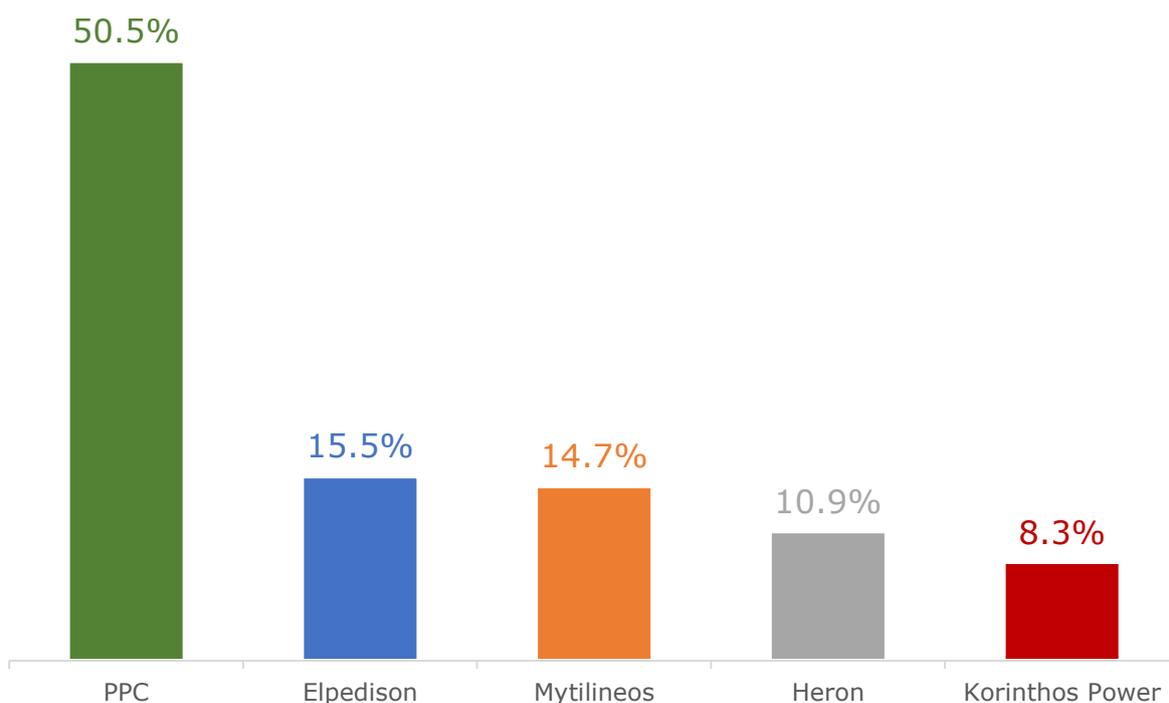
Highlights

- In December 2018, the expansion of the storage capacity at the Revithousa LNG terminal took place and the upgrade in the regasification facilities was completed.
- The expansion of the port facilities now allow the unloading of 260k m³ ships and the upgrade of cryogenic facilities led to a regasification capacity of 7 bcma.
- In 2018 only 3 countries delivered LNG cargoes in Greece, among them it was the USA with the first ever cargo delivered in December 2018.
- In 2019 50 cargoes were unloaded in Revythousa coming from ten different countries, thus enhancing the country's energy security of supply.
- The main LNG counterparties in 2019 were Norway, Algeria and Qatar, followed by Nigeria and Egypt and the USA.

The installed capacity of Natural Gas-fired power plants exceeds 5 GW, while plans for development of further 4 GW are underway

Natural Gas-Fired Power Plants per Operator (%), [2010]

Total Installed Capacity: 4,900 MW



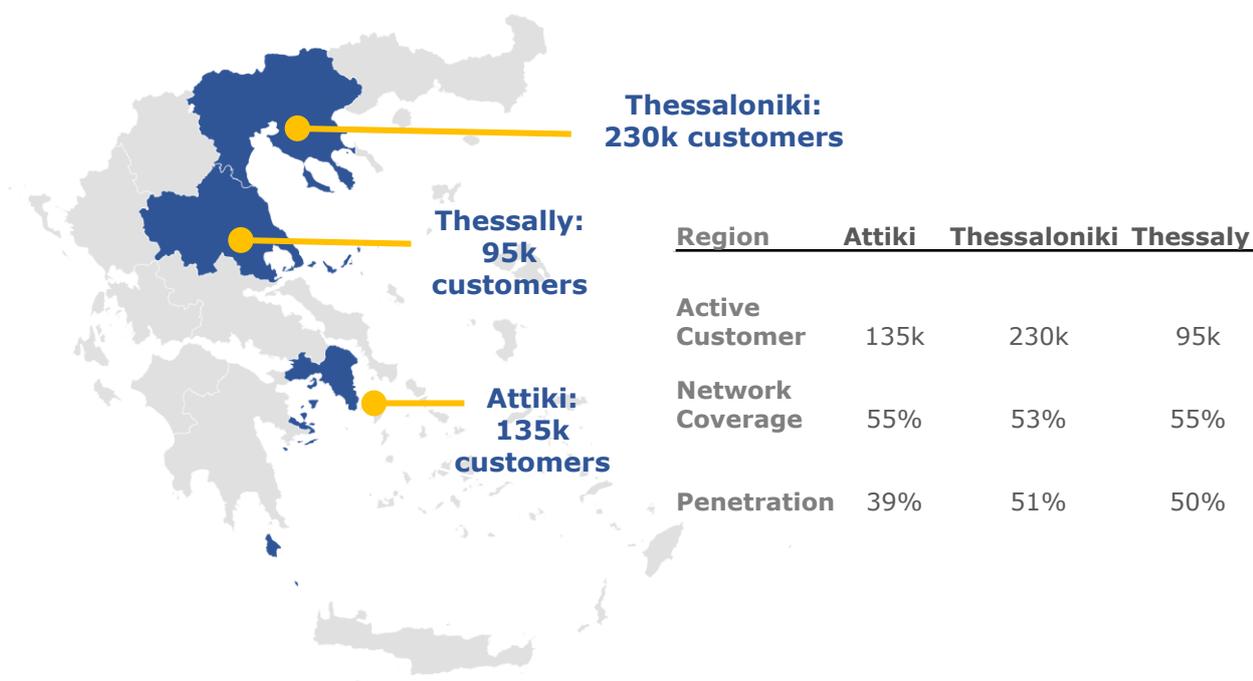
Source: HEnEx, HAEE's analysis

Highlights

- More than 50% of total Natural Gas installed capacity is operated by the PPC, in five power plants in Megalopoli, Lavrio, Komotini and Aliveri.
- Independent Power Producers (IPPs) like Mytilineos, Elpedison, Heron and Korinthos Power have installed capacity of 2,580 MW, representing the rest 49.5%.
- Elpedison has two power plants one in Thessaloniki and one in Thisvi, while Mytilineos has two power plants in Viotia and Heron 4 more plants in Viotia.
- A number of companies have plans for the construction of new power plants using natural gas as fuel. The capacity of all these projects is more than 4 GW.
- Mytilineos has already started the construction of a new Combined Cycle Gas Turbine (CCGT) plant of 826 MW installed capacity in Viotia.

Retail market exists mainly in the regions of Thessaloniki, Thessaly and Attiki, yet there is an ambitious plan for market expansion

Active Customers in the Three Regions of EDAs, [2019]



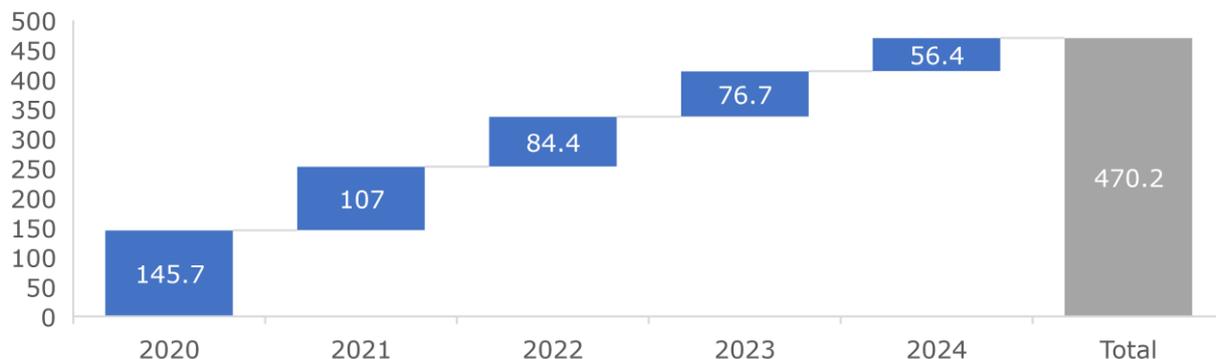
Source: EDA Attiki, EDA Thessaly & EDA Thessaloniki, HAEE's analysis

Highlights

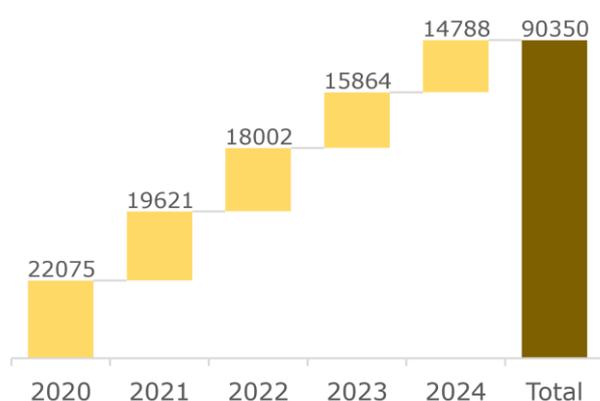
- Attiki Region is estimated to serve 135k customers (connections), Thessaly 95k customers and Thessaloniki 230k customers.
- The penetration rate in the region of Thessaloniki reached 50%, in Thessaly 51%, while in Attiki it has reached only 39%.
- Until 2019, DEDA DSO was responsible for the development and operation of distribution networks in the rest of the Greek regions.
- Private companies obtained licenses to develop and operate distribution networks in cities that were excluded from DEDA's development program.
- DEPA Infrastructure owns 51% of EDA THESS, with the rest 49% belonging to ENI. In EDA Attiki, DEPA Infrastructure is the sole shareholder.

The areas of Thessaloniki and Thessaly are under “EDA THESS” DSO, being the first areas to have been provided with natural gas

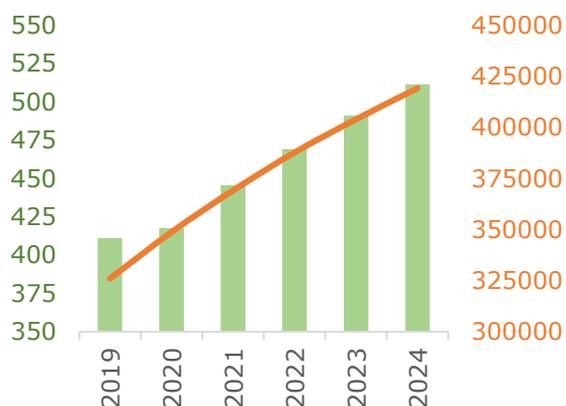
EDA THESS 5-Years Plan: Grid Construction (km), [2020-2024]



EDA THESS 5-Years Plan: New Connections (thousand costumers), [2020-2024]



EDA THESS: Active Customers and Distributed Quantities (mcm), [2020-2024]

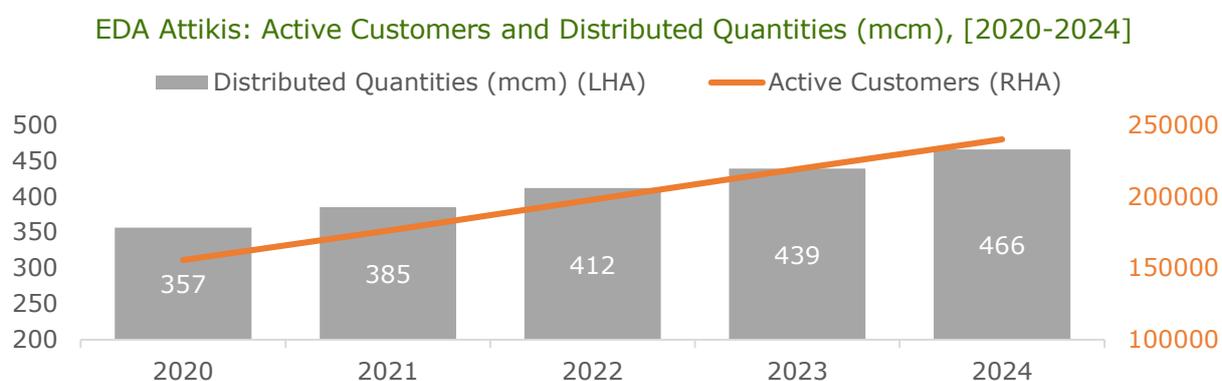
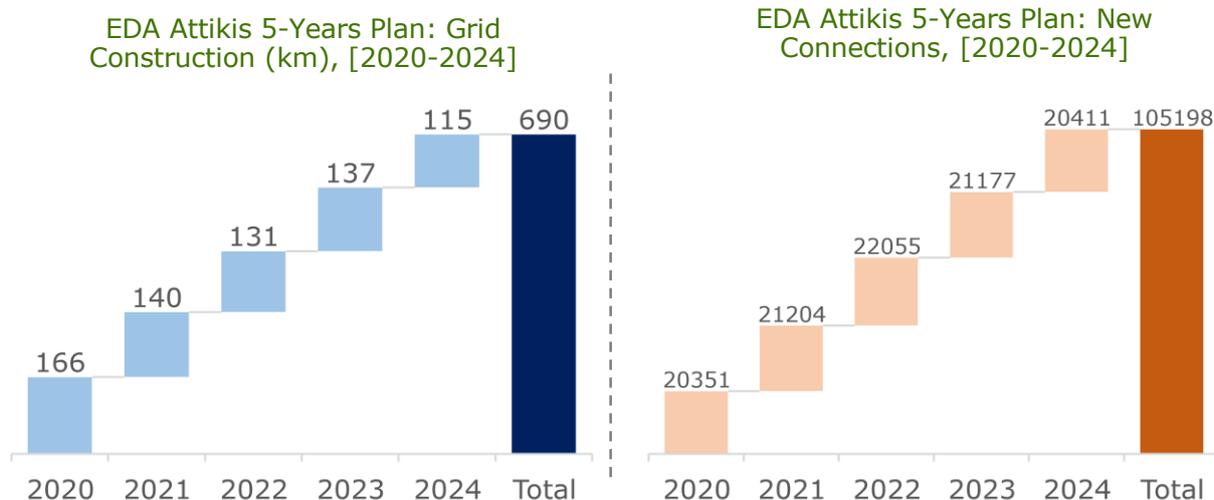


Highlights

Source: EDA Thess, HAEE’s analysis

- The region of EDA THESS is the one with the biggest penetration rate, including 13 and 14 municipalities in the prefecture of Thessaloniki and Thessaly respectively.
- The expansion of the grid includes also the supply of regions outside the medium pressure pipeline system, through CNG technology.
- The 5-year plan of EDA THESS is designing a grid expansion of 470km (250km in Thessaloniki and 170km in Thessaly) until 2024.
- The final number of active customers is projected to increase by 30% reaching 420k, while the distributed quantities are estimated to surpass 0.5 bcm.
- The cost of the total investment of the expansion of the Network is estimated at 135 million euros, which are intended for investments in Distribution Networks.

The area of Attiki has the lowest penetration rate and therefore has the greatest dynamic for market expansion

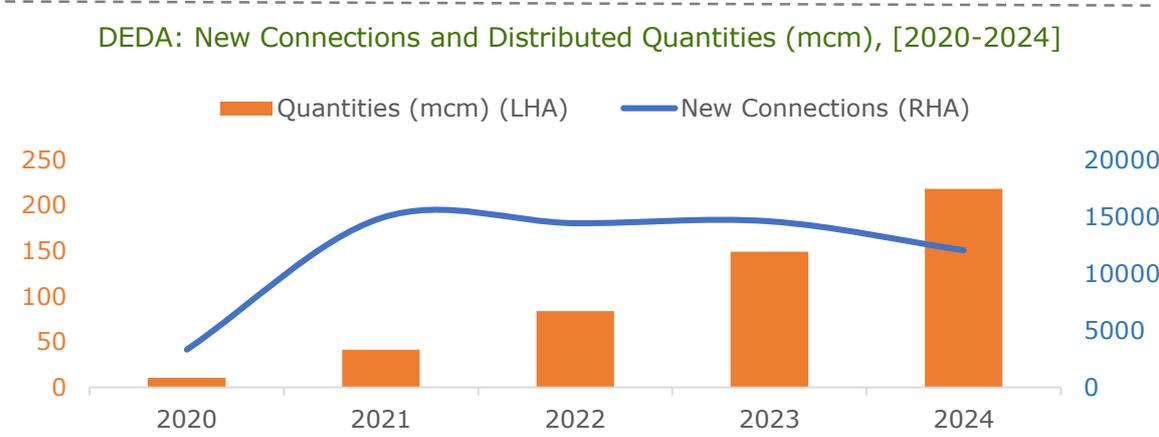
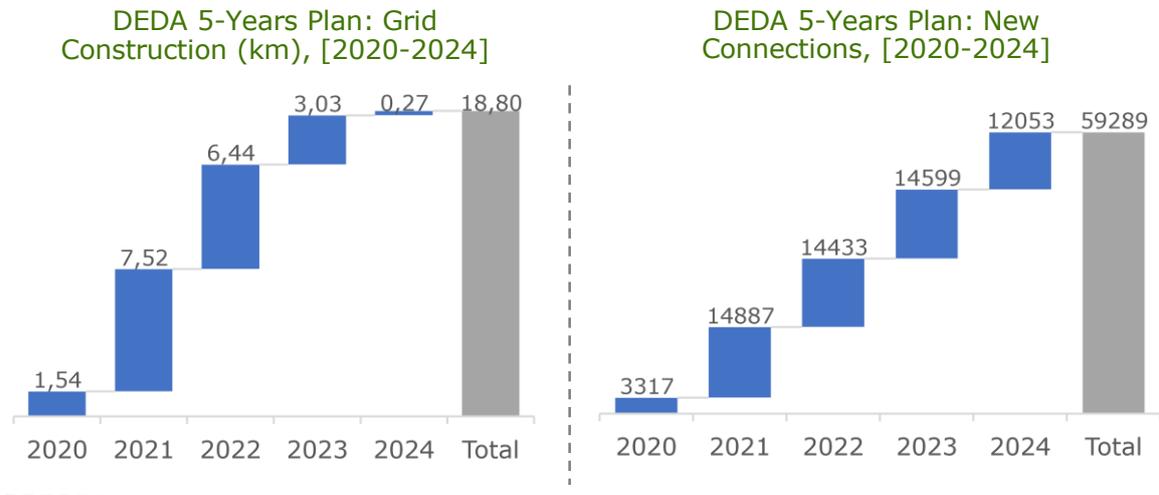


Highlights

Source: EDA Attikis, HAEE's analysis

- The areas of Attiki covered by the existing distribution network include 52 municipalities in the Prefecture of Attiki.
- The existing distribution network covers around 55% of the road network where there is the basic infrastructure for further network development.
- The penetration of the natural gas is very low at 39%, thus EDA Attikis has a very ambitious plan to further construct 665 km of low-pressure network.
- The new connections are expected to be more than 20k per year, with a number of active customers increasing by more than 60% compared to 2019 levels.
- The distributed quantities are expected to be more than 450 mcm by 2024, a 30% increase from 2019 levels and the planned investment cost will reach € 140 million.

“DEDA” is the DSO for the rest of Greece, where retail market is almost non-existent and the Grid expansion plan is the most ambitious of all



Source: DEDA, HAEE’s analysis

Highlights

- DEDA has designed the most ambitious 5-year plan until 2024, compared to the other two DSOs.
- DEDA is planning to construct 1700km of low pressure pipelines and more than 140 km of medium pressure pipelines in more than 25 cities in continental Greece.
- According to the plan Natural Gas will be available to 60k customers in comparison with less than 1k that have access today.
- The distributed quantities of Natural Gas are expected to reach more than 200 mcm per year by 2024.
- In certain areas where the network expansion is not economically viable, the supply of Natural Gas will be achieved through LNG and CNG.

Natural Gas retail prices have decreased substantially the past years both for household and non household users

Retail Price for Non-Household Consumers in EU 28, Band I3 (€/MWh), [2012-2019]



Retail Price for Non-Household Consumers in Greece (€/MWh), Band I3 [2012-2019]



Retail Price for Household Consumers in EU 28, Band D2 (€/MWh), [2012-2019]



Retail Price for Household Consumers in Greece, Band D2 (€/MWh), [2012-2019]

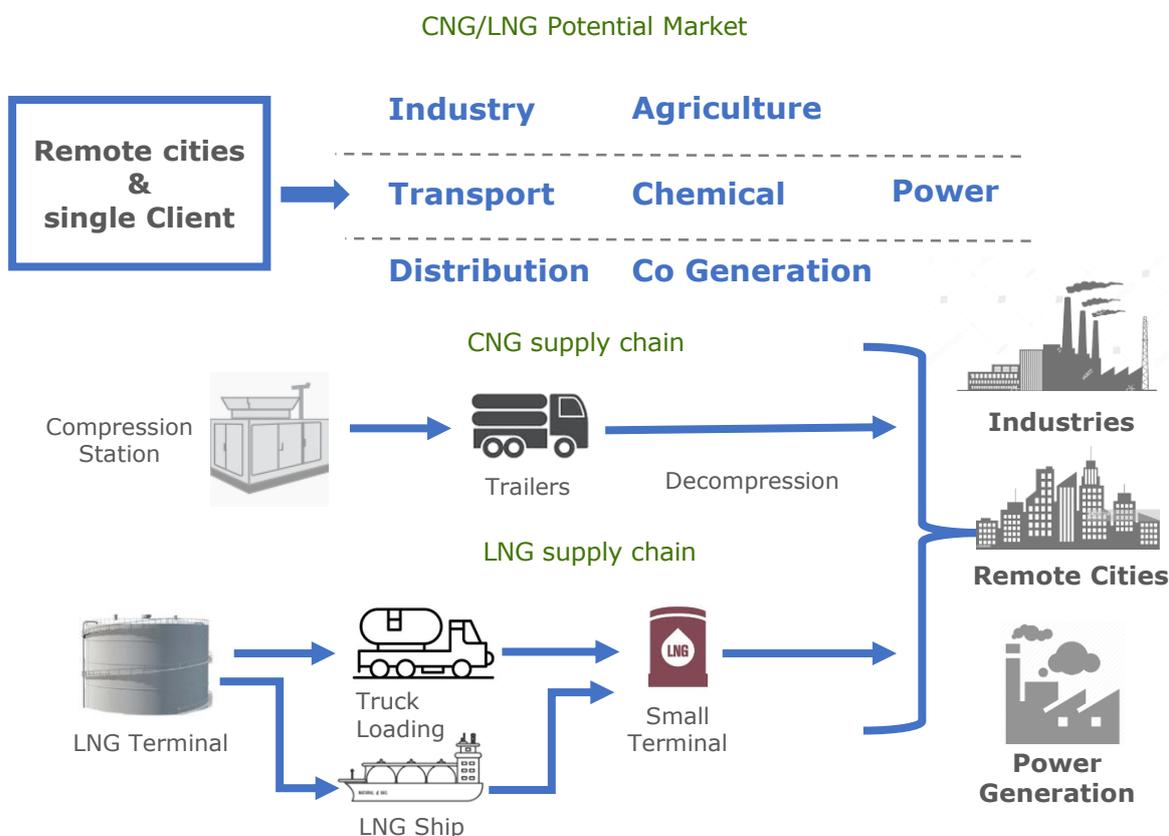


Highlights

Source: Eurostat, HAEE's analysis

- The average retail price for a household with medium gas consumption has significantly decreased since S1 2013.
- Prices dropped from almost 50 €/MWh to less than 40 €/MWh. The taxes fluctuate in the range of 10-12 €/MWh.
- On the other hand, in Greece the retail price for these consumers is almost half in S2 2019 compared to S2 2012, reaching at 35 €/MWh.
- The European Union average price for non-household users has been fluctuating around 70 €/MWh for the last years.
- In Greece the price for non-household users has witnessed a sharp drop, especially after 2015, while the current price is close to 60 €/MWh.

CNG and LNG technologies can offer reliable solutions to remote areas in which pipeline construction is costly



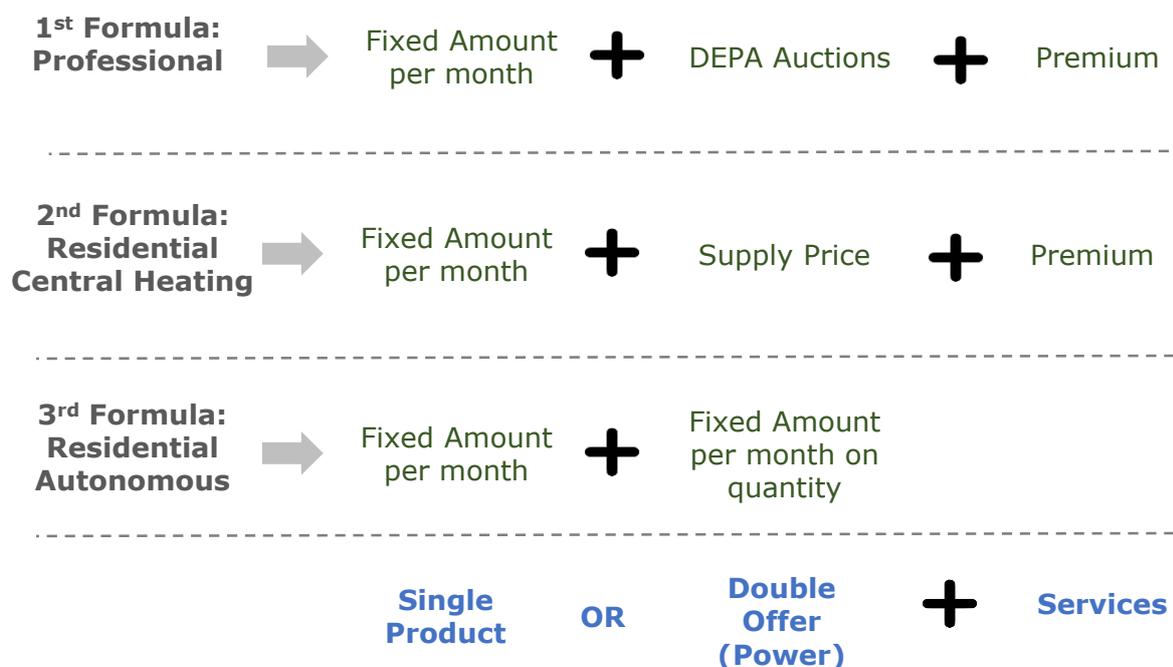
Source: HAEE's analysis

Highlights

- Greece's specific geographic characteristics have hindered the expansion of the pipeline grid to certain remote areas and islands.
- Through CNG & LNG technologies, DSOs can provide natural gas to areas where the market is inexistent.
- Individual suppliers/providers of Natural Gas, will have the chance to provide big industrial consumers with gas, allowing the reduction of the energy costs.
- There are 3 compression stations that operate in Thessaloniki, Larissa and Thessaly, providing CNG to city grids which are not connected with the system.
- LNG truck loading is not an option currently, as there is no relevant infrastructure constructed in Revithousa terminal.

The retail market consists of more than 8 active suppliers some of which have started selling quantities in the B2B market before 2018

Pricing Formulas used by Greek Natural Gas Suppliers



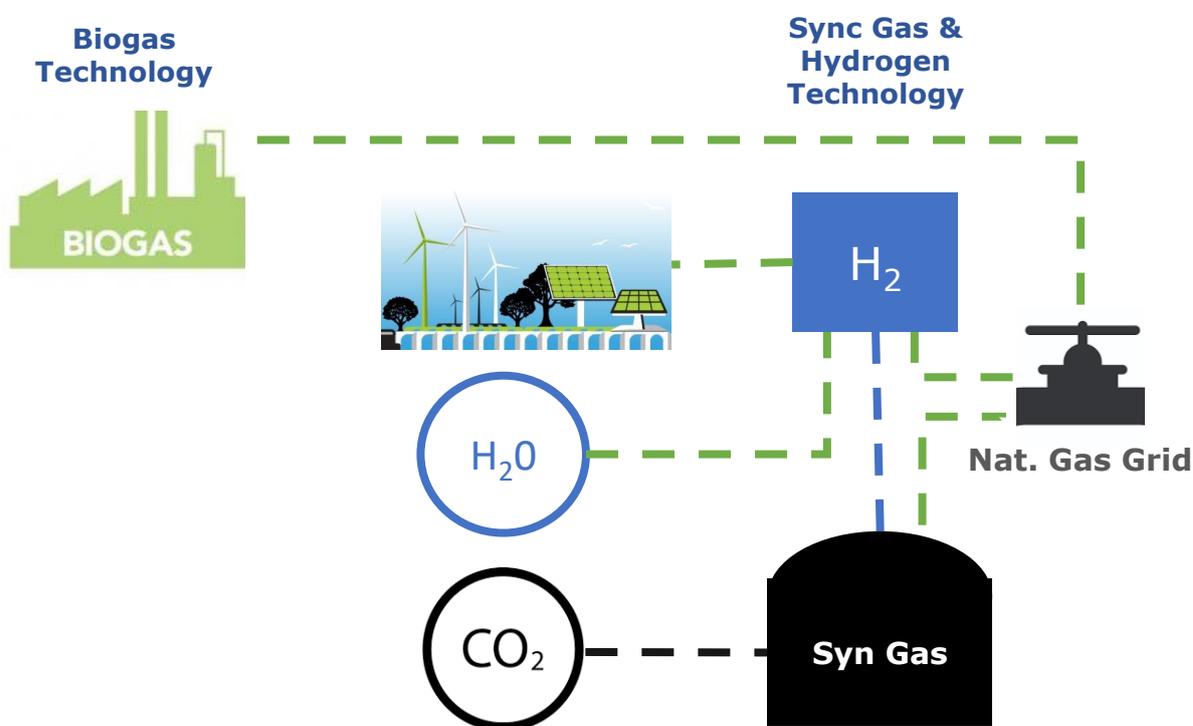
Source: HAEE's analysis

Highlights

- The type of companies which are active in the market are mainly power utilities (producers and suppliers of electricity) and electricity retail suppliers.
- Except for the 2 dominant companies (Zenith & Aerio Attikis), there are currently more than 8 suppliers actively providing products and services.
- The main pricing principles of the market participants are not yet sophisticated and remain relatively simple.
- One of the two common pricing formulas offered by suppliers, is based on the DEPA auctions, while the 2nd formula is based on the cost of supply.
- The third formula used is based on a fixed price, which does not change according to the supply cost or the level of competition in DEPA auctions.

Future technologies around natural gas are coming to bridge the gap to a zero-carbon transition

Penetration of Biogas and Sync Gas Into the Natural Gas Grid

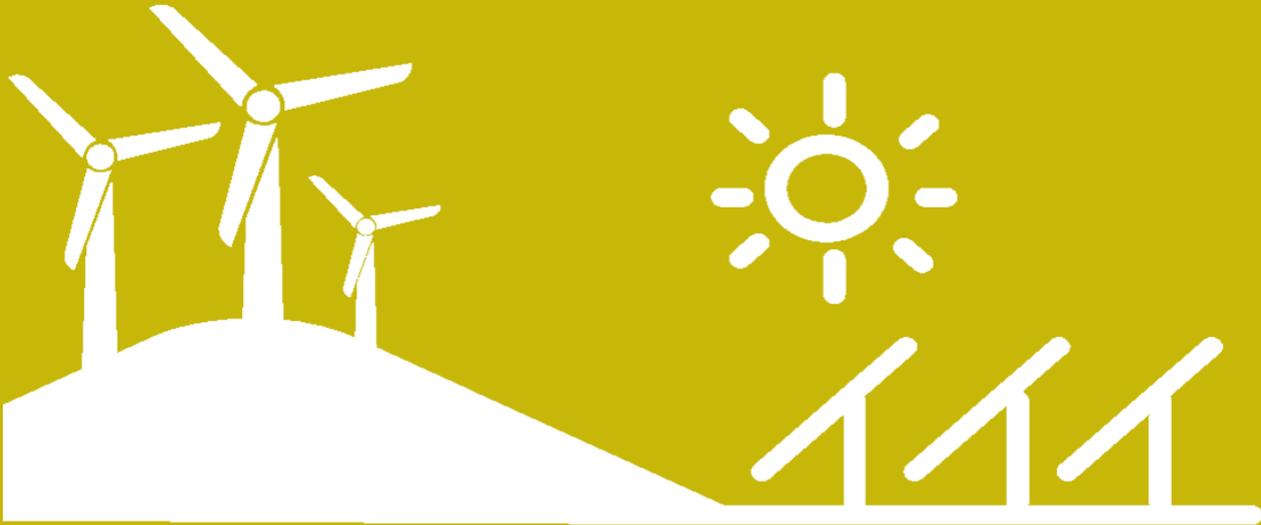


Source: HAAE's analysis

Highlights

- According to the new Energy Directive of the EU, among the new targets set, there is an end target of 14% renewables in the transport sector by 2030.
- This target aims to promote the further deployment of electric mobility, but it also includes a sub-target of 3.5% for advanced biofuels and biogas.
- Biogas is planned to substitute fossil Natural Gas, being transported in the same grid infrastructure that Natural Gas is already using.
- Biogas starts being acknowledged worldwide as one of the most upfront technology for upgrading waste to valuable fertiliser and renewable energy.
- Syn Gas is produced from a mixture of carbon monoxide, carbon dioxide, and hydrogen and it can be also used in the existing natural gas infrastructure.

5. Renewable Energy Sources



Highlights



The majority of the increase in terms of installed capacity is credited to **Wind power**, with **728 MW** being commissioned within **2019**



During **2019**, the installed RES capacity increased by **15.6%** reaching a total of **6,355 MW** at the end of the year



During the last **auctions** of December 19 and April 2020, the **awarded tariff prices** continued their **declining** trend



As of the end of **2019**, **more than 50%** of the total RES installed capacity is from **Wind stations**



The implementation of the **Target Model** will modify the daily obligations of **RES producers**



Another **964 MW** of RES capacity (**482 MW** for Wind & **482 MW** for Solar) are expected to be auctioned within **2020**



The majority of the **Wind** capacity is located at **Central Greece** with a share equal to **25.3%**, while **Central Macedonia** accounts for **17.2%** of **PV** installations



The **revised estimations** are more optimistic than last year's, and indicate that the total RES capacity could reach **15,674 MW** by **2030**



The new Energy Law **L.4685/2020** aims to **accelerate** the **Licensing** procedure by providing strict deadlines and regulations

Overview

European Union member states, as well as Greece, continued to increase their energy share generating from RES in 2019. RES installed capacity in Greece increased by 16% compared to 2018, mainly due to the significant increase of Wind capacity. This growth peaked at 6,355 MW of RES installed capacity at the end of 2019. Wind remains the dominant RES in Greece, with the majority of the capacity located in Central Greece. Solar production shows more dispersion around the various regions in Greece compared to Wind production.

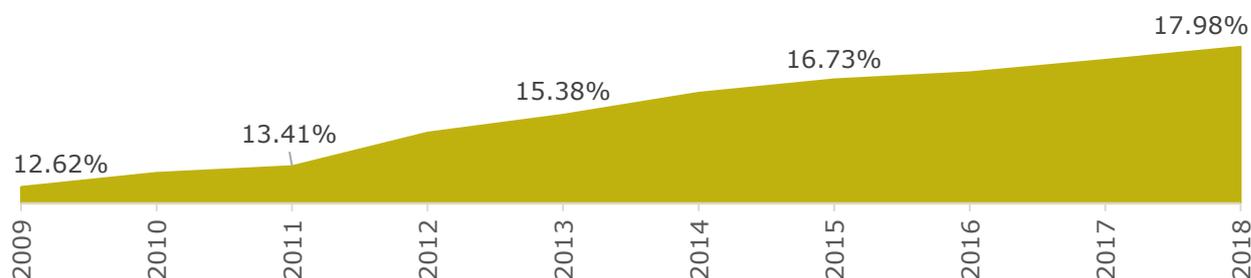
The impact of the COVID-19 is anticipated to slightly affect the share of RES in gross electricity consumption in Greece, mainly due to minor delays related to the construction of new projects. This reduction is not anticipated to be severe, since only a drop of 2% compared to prior projections is expected and then the trajectory returns back to the prior rising path. In that context, it is important to have key segments of Renewable Energy value chains within Europe, as a “strategic” approach so as to reach the sustainable growth targets set out in the EU “Green Deal”. By the end of 2025, RES are anticipated to represent 75% of the total energy produced in Greece, since both primary energy production from Coal and Oil will follow a downward trend. Hence, until that time, it is important to secure the development of flexible and quick-response technologies such as batteries and Demand Response to support this high RES penetration.

Following the implementation of the Target Model, RES market is heavily affected as well, since the upcoming scheme includes significant operating costs such as, clearance charges, deviations charges and non-compliance charges. The Feed-in Premium (FiP) mechanism for the support of Renewable Energy Sources has been adopted in Greece since 2016. This mechanism includes the constant balance by crediting or charging the difference of Reference Value with monthly Renumeration Market Price (RMP) technology. The Renumeration Market Price is based on the hourly production of energy by the specific RES technology.

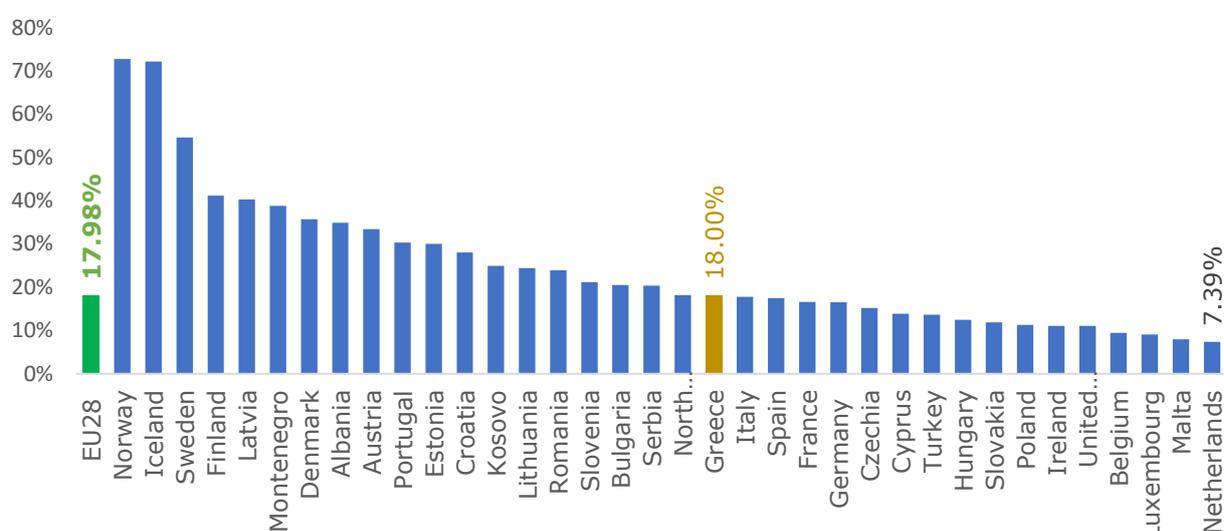
Since 2018, four auctions for Renewable Energy projects per technology have been held by the Regulating Authority for Energy (RAE). Except from the auctions per technology, two common auctions (technology neutral) have been held in 2019 and 2020. The new Energy Law aims to accelerate the Licensing procedure and invite significant investments by providing strict deadlines and obligations. Finally, RES capacity is projected to rapidly increase until 2030, in order to reach the National Energy Targets.

European Union member states, as well as Greece, continued to increase their energy share from RES in 2018

EU-28 RES Share Evolution (%), [2009-2018]



Share of Energy from Renewable Sources in the EU Member States (%), [2018]



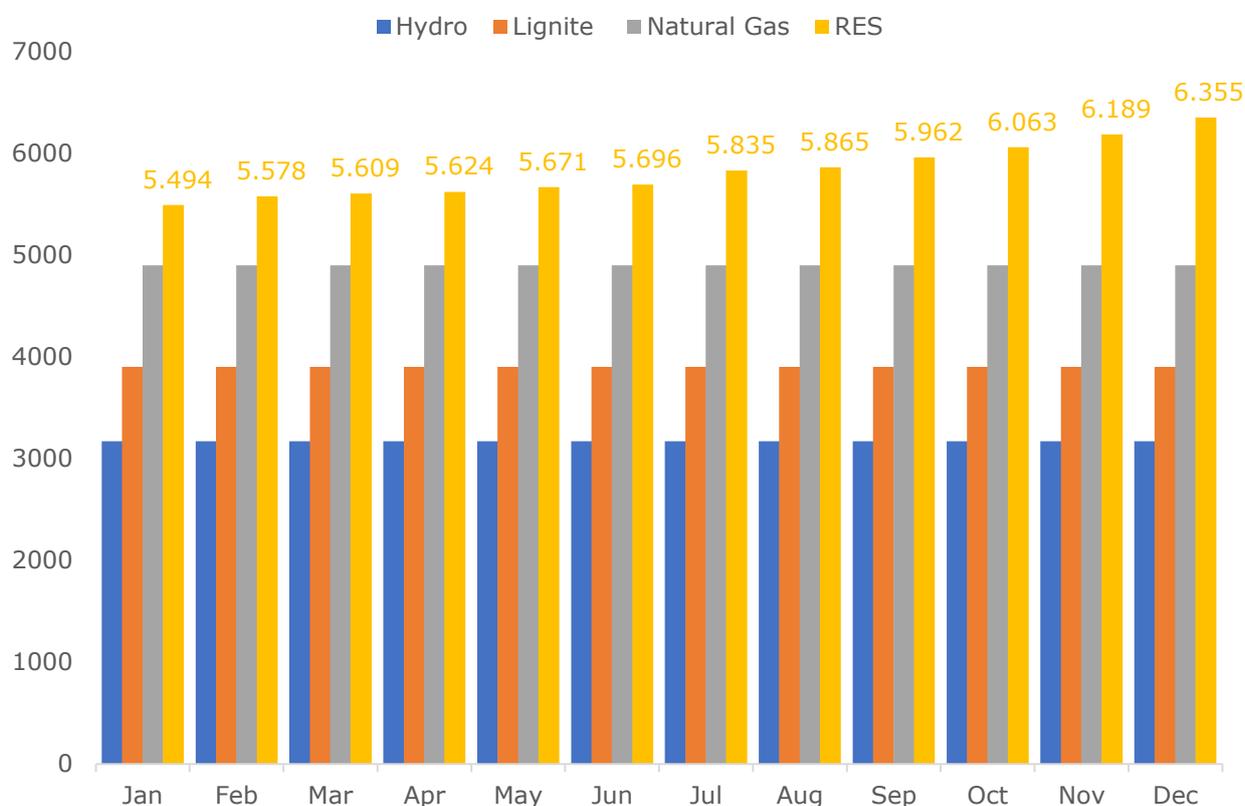
Highlights

Source: Eurostat, HAEE' analysis

- Following the medium and long-term goals set by EU, Member States continued to increase their share of energy from RES.
- EU 28 (as an average of the 28 member states) has steadily increased its RES share during the last years, from 12.62% in 2009 to 17.98% in 2018.
- Most of the EU Members have achieved their 2018 goals, nevertheless, some countries still have not reached their targets and additional effort should be made.
- Greece has reached the share of 18% in 2018 and 19.5% in 2019, compared to the 16.9% achieved in 2017.
- Greece is expected to remain on the same path, aiming to reach a 20% by the end of 2020, which is set as a RES national target.

The installed Renewable Energy Sources capacity is steadily increasing reaching 6,355 MW at the end of 2019

Installed Capacity in Greece by Month (MW), [2019]



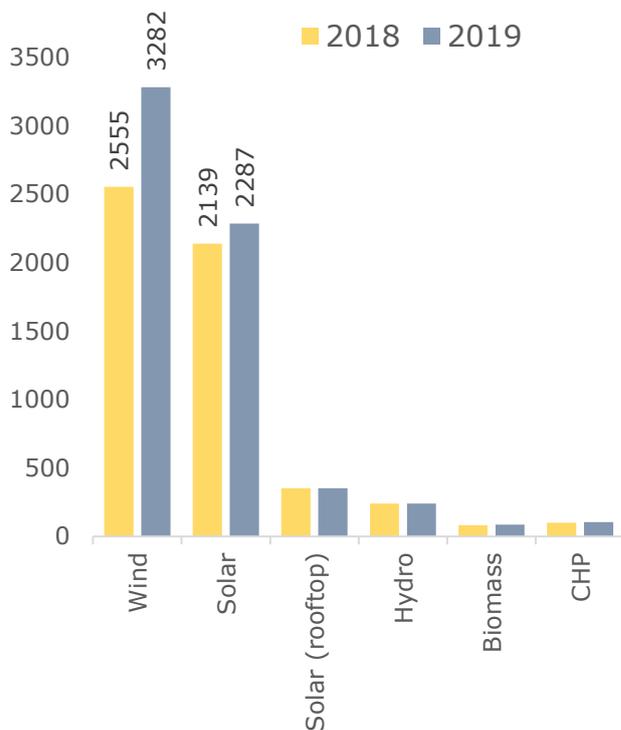
Source: DAPEEP, HAEE's analysis

Highlights

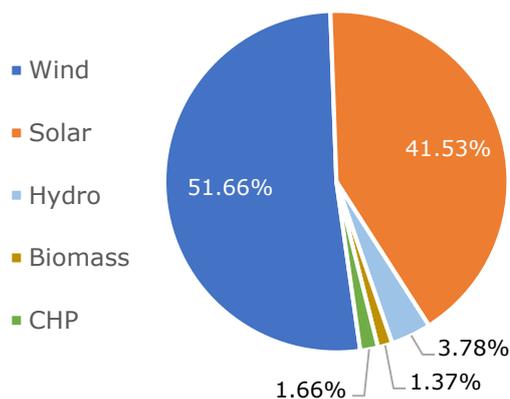
- As the figure illustrates, in 2019, the total RES installed capacity continued to show an increasing trend.
- Especially after June, the increase seems to be more rapid with the total capacity reaching 6,355 MW by the end of the year.
- The capacity of the Hydro, Lignite and Natural Gas remained stable throughout the year since no modifications occurred.
- However, this is expected to change in the following period, as several lignite stations are scheduled to be decommissioned.
- The resulting "capacity gap" is expected to be covered mainly by RES stations, meaning that, RES capacity is expected to grow even more in the future.

In 2019, RES capacity increased by 16% compared to 2018, mainly due to the significant increase of Wind capacity

Installed Capacity of RES by Type in Greece (MW), [2018 - 2019]



RES Share by Type in Greece (%) [2019]



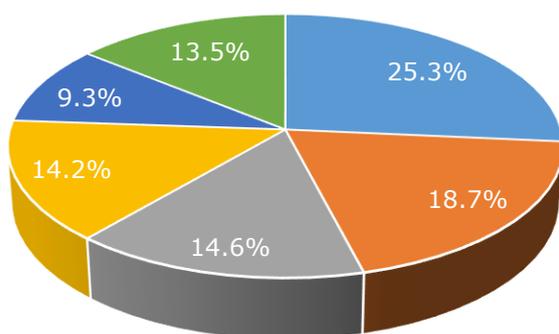
Source: DAPEEP, HAEE's analysis

Highlights

- The increase of RES capacity continued in 2019, with an annual increase of 16%, from 5,469 MW in 2018 to 6,355 MW in 2019.
- Renewable Energy Sources capacity now holds a 34.6% or 18,329 MW of the total installed capacity in the country.
- For another year, Wind capacity showed the most significant increase, from 2,555 MW in 2018 to 3,283 MW in 2019, an increase of almost 28.5%.
- Solar capacity increased by almost 148 MW while Hydro, Biomass and CHP stations remained practically at the same levels.
- The solar capacity is expected to show a significant increase in the following years, as thousands of applications for PV installations have been submitted to RAE.

Wind remains the dominant RES in Greece, with the majority of the capacity located in Central Greece

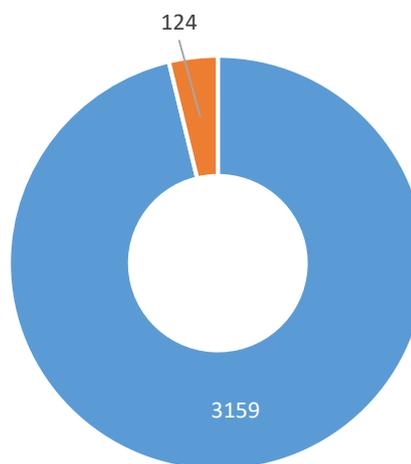
Installed Wind Capacity by Region (%), [2019]



- Central Greece
- Peloponnese
- Euboeia
- East Macedonia & Thrace
- Western Greece
- Rest of Greece



Installed Wind Capacity by Project Size (MW), [2019]



- Projects above 5 MW
- Projects below 5 MW

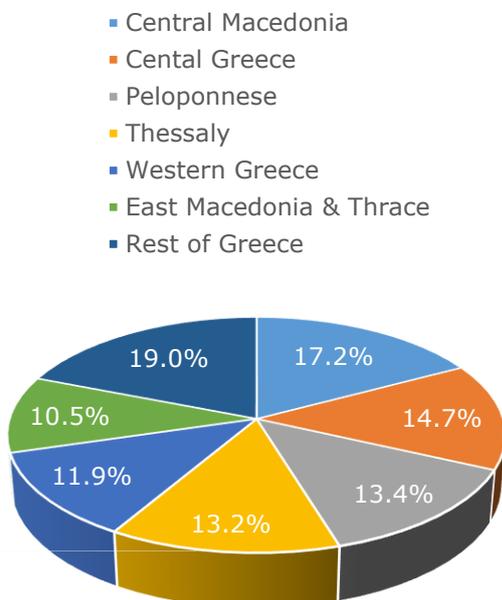
Source: DAPEEP, HAEE's analysis

Highlights

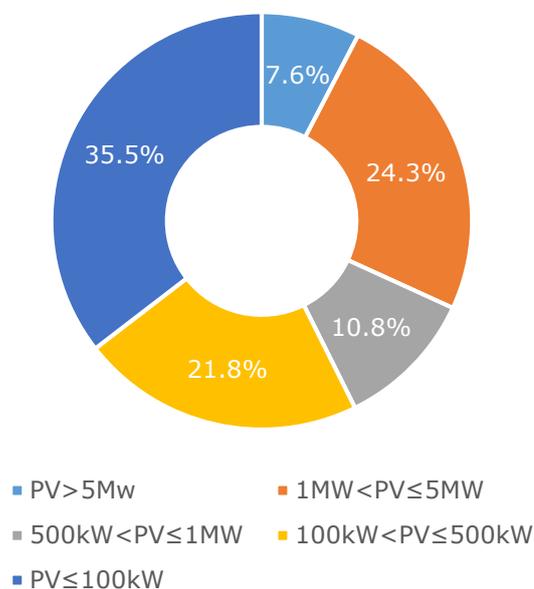
- The total installed wind capacity in Greece was 3,283 MW in December 2019, and many project are now awaiting for the Issuance of "Production Certificate".
- The majority of the wind capacity is located at Central Greece with a share equal to 25.3% while a significant amount is also installed in Peloponnese, at 18.7%.
- Euboea represent 14.6%, East Macedonia and Thrace 14.2%, Western Greece 9.3% and the remaining 13.5% found at the rest of Greece.
- Most of the installed capacity concerns Projects that have capacity of at least 5 MW, 3,159 MW or 96% out of the total 3,283 MW.
- Only 123 MW of the total capacity are small-scale wind installations below 5 MW. Nevertheless, projects below 5 MW show a significant increase compared to 2018.

Solar production shows more dispersion around the various regions in Greece compared to Wind production

Solar Capacity by Region (MW), [2019]



Installed MW per PV Station Capacity (%), [2019]



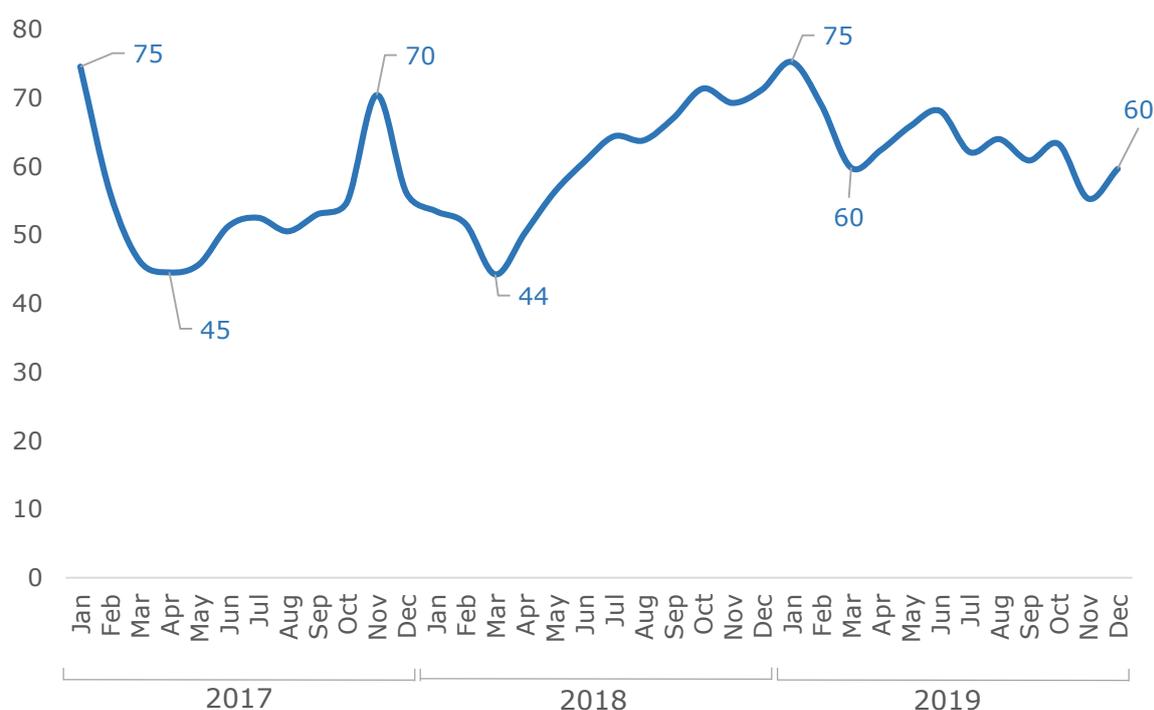
Source: HEDNO, ELETAEN, HAEE's analysis

Highlights

- PV installations are nearly evenly dispersed across the mainland Greece, with Central Macedonia showing the biggest concentration (17.2%).
- Next, Central Greece represents 14.7%, Peloponnese 13.4%, Thessaly 13.2%, Western Greece 11.9% and East Macedonia & Thace 10.5%.
- At the end of 2019, the total installed solar capacity in Greece was 2,288 MW and only 7.6% of this amount was provided by large scale PVs (above 5 MW).
- The majority of the solar production comes from small PV installations ($P < 100\text{kW}$), holding a 35.5% of the total solar capacity.
- This is explained by the rapid growth of PVs during 2011-2013, when a significant number of individuals installed PVs due to the subsidies that were provided.

The deviation of the System Marginal Price showed signs of stabilization during the last months of 2019

Evolution of System Marginal Price (€/MWh), [2017 – 2019]



Source: HEnEx, IPTO, HAEE's analysis

Highlights

- SMP is calculated based on the combination of the capacity (and price) offered by the producers and hourly load demand determined by the consumers.
- SMP is the actual price that each electricity producer is being paid and each consumer pays at each time of the year.
- The Average System Marginal Price for 2019 was equal to 63.82 €/MWh, increased by 3.43 €/MWh compared to 2018.
- The lowest SMP was recorded on March 2018 (44.2 €/MWh), while the highest price was recorded on January 2019 (75.2 €/MWh).
- The deviation between lowest and highest SMPs was significant on 2017 and 2018 but seems to be steadily normalizing in 2019.

The upcoming scheme includes significant operating costs such as, clearance charges, deviations charges and non-compliance charges

New RES Framework

Participation in all relevant markets

Market participants Registry / Plant's Registry

Possibility for representation by RES aggregators or even last resort RES aggregator

Forecasting adjustment during IDM

Imbalances settlement at the level of the balancing market with the final position after IDM

Provision for charges of non-compliance (strategic bidding) similar to the charges and methodology that are applicable to all market participants

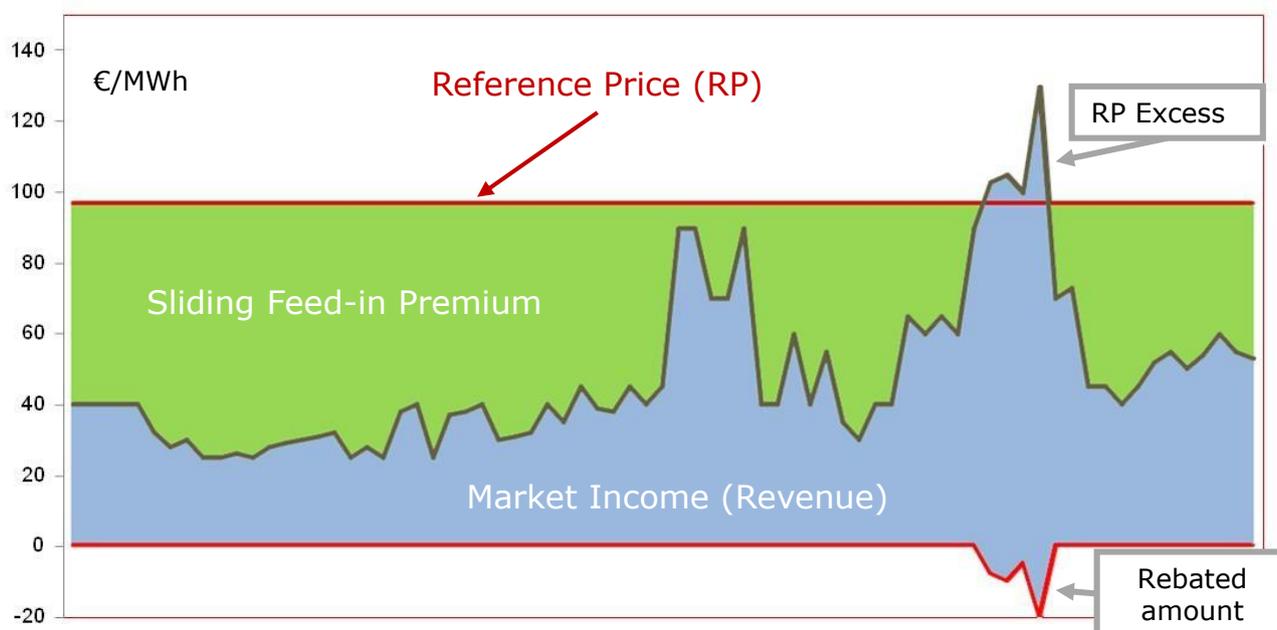
Source: HAEE's analysis

Highlights

- RES Producers are obliged to participate in wholesale markets, submit bids autonomously or through Aggregators or through the Last Resort Aggregator.
- Following the participation to the market, RES producers are committed to optimal forecasting accuracy.
- For the transitional period, until the official operation of the Target Model, participants will be credited with a Fixed Management Premium equal to 1€/MWh.
- For the same period, RES producers will be charged by the Mechanism for Accurate Forecasting (MAF) that equals 2.91 €/MWh for 2020.
- In overall, RES producers should be balanced by crediting or charging based on the Sliding FiP which is the difference of Reference Value with monthly RMP technology.

The Feed-in Premium (FiP) mechanism for the support of Renewable Energy Sources has been adopted in Greece since 2016

Graphical Illustration of the FiP Support Scheme



Source: HAEE's analysis

Highlights

- Renewable projects receive a premium, in the form of a variable (sliding) premium, on top of their income from the market.
- This amount is calculated on a monthly basis and its sum with the reference market price results to a total price, which is called Reference Price (RP).
- Reference market price is calculated as the hourly system marginal price increased by the value corresponding to other wholesale market mechanisms, if existed.
- The Reference Value (RV) that is defined for every project, remains valid for a period of 20 years (contract with the Electricity Market Operator).
- In case that the market income of a project exceeds its Reference Price (RP), the differential amount is rebated to a special RES account.

Renumeration Market Price is based on the hourly production of energy by the specific RES technology

Historical Prices of Renumeration Market Price by Month

Technology	2019		2020			
	November	December	January	February	March	April
Wind	54.01	56.19	56.65	46.52	41.53	27.07
PV	56.73	61.56	58.98	45.83	37.81	25.07
Hydro	55.23	59.53	58.33	49.20	43.84	28.38
Biomass	56.42	61.36	59.85	50.29	45.43	29.50
CHP	56.42	61.36	59.85	50.29	45.43	29.50

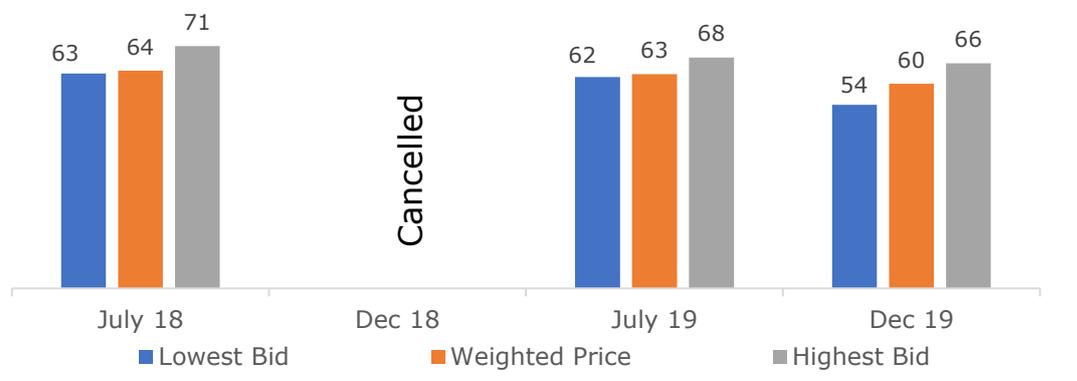
Source: HAEE's analysis

Highlights

- The total production of energy by all units of the same RES technology is being taken into consideration, no matter if the contract is FiT or FiP.
- The solution of RMP leads to the monthly calculation of the sliding premium which is identical for all producers of each RES technology.
- Hence guaranteeing that the total profits in terms of technology is the Reference Price multiplied by the total production for the specific time unit.
- The outcome of RMP should not be linked with the "Quality" of the forecasting procedure by each participant but only to reflect the overall picture.
- Hence, the "Quality" of the forecast by each participant, should count for any expenditure or revenue for his participation in the electricity market.

Since 2018, four auctions for Renewable Energy projects per technology have been held by the Regulating Authority for Energy (RAE)

Auction Results, **PV≤20MW** (1MW≤PV≤20MW for July & Dec 18), [€/MWh]



Auction Results, **Wind≤50MW** (3MW≤Wind≤50MW for July & Dec 18), [€/MWh]



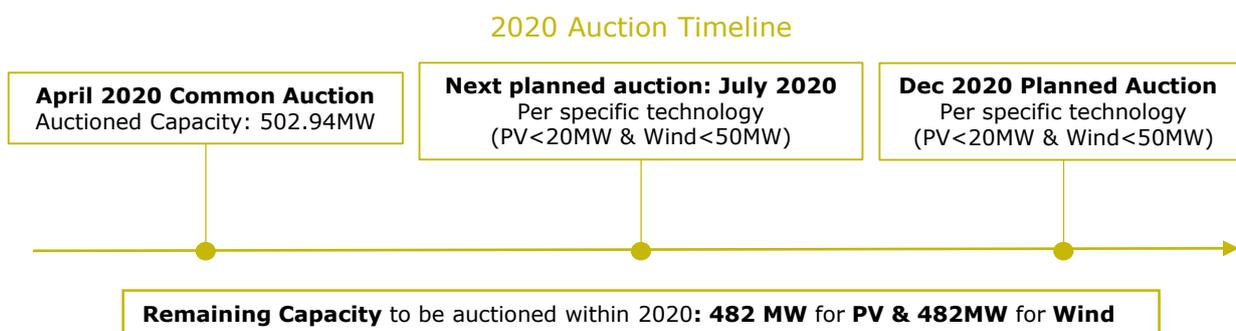
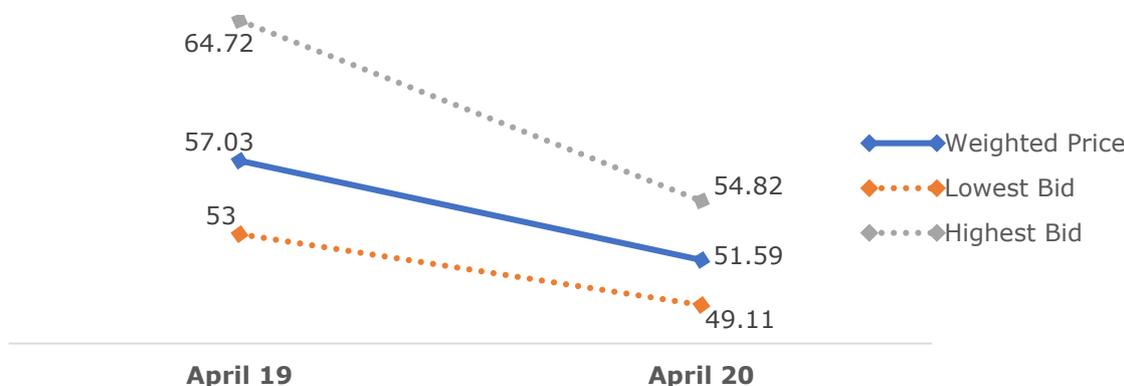
Highlights

Source: RAE, HAEE's Analysis

- Small PV plants (PV<1MW) are unified with the 1MW≤PV≤20MW category, thus creating Category PV≤20MW which is still the case until today.
- For the PV<1MW category, a total of 115.47 MW were auctioned while the weighted auctioned price was 78.4 €/MWh in July 18 and 66.6 €/MWh in December 18.
- In total, 416.67 MW of solar capacity have been auctioned, while for wind projects, 742 MW have been auctioned (337.33 MW in 2018 and 404.95 MW in 2019).
- Overall, the weighted price of PVs seems to be steadily decreasing, from the 63.81 €/MWh in July 2018 to 59.98 €/MWh in December 2019.
- In the wind projects case, the price is also decreasing despite the unexpected increase in the price occurred in the July 2019 auction.

Except from the auctions per technology, two common auctions (technology neutral) have been held in 2019 and 2020.

Common Auction (Technology Neutral) Results, **PV \geq 20MW & Wind \geq 50MW**, [€/MWh]



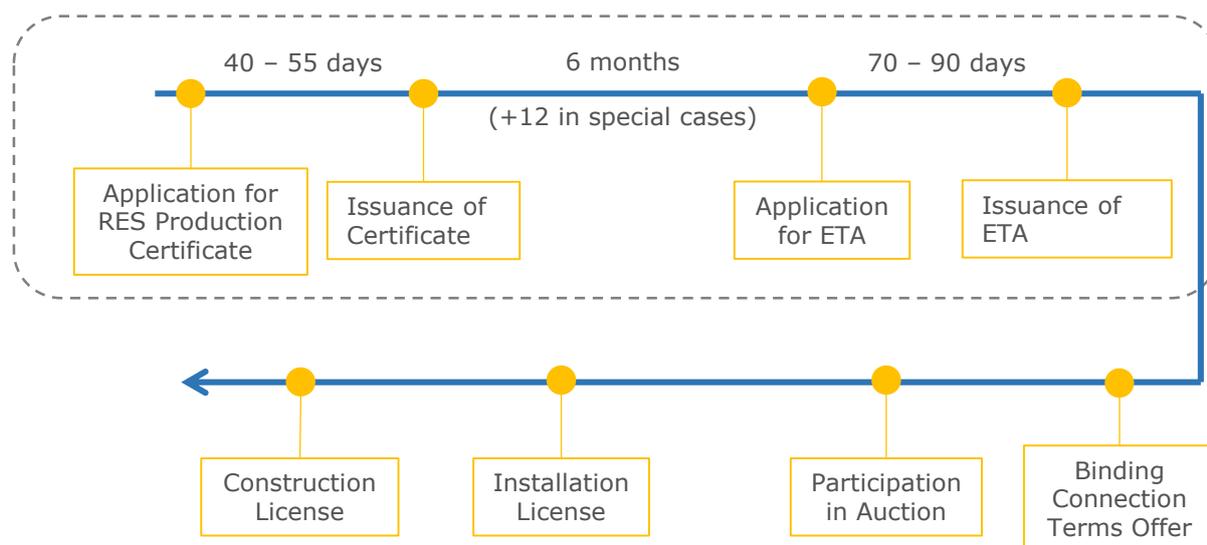
Source: RAE, HAEE's Analysis

Highlights

- The common auctions concern Solar and Wind projects of big capacity (PV \geq 20MW and Wind \geq 50MW).
- So far, a total of 940.72MW have been auctioned with the most recent auction taking place in April 2020, while the next auction is scheduled to be held in July 27.
- During April 2020 auction, 502.94MW were auctioned with a weighted price of 51.59 €/MWh.
- The prices in this category are also steadily decreasing and are expected to continue following this trend in the following period.
- According to RAE's timeline, another 964 MW of capacity are expected to be auctioned within 2020 (482 for PV and 482 for Wind).

The new Energy Law aims to accelerate the licensing procedure and invite significant investments by providing stricter deadlines

Chart Flow of the New RES Licensing Procedure



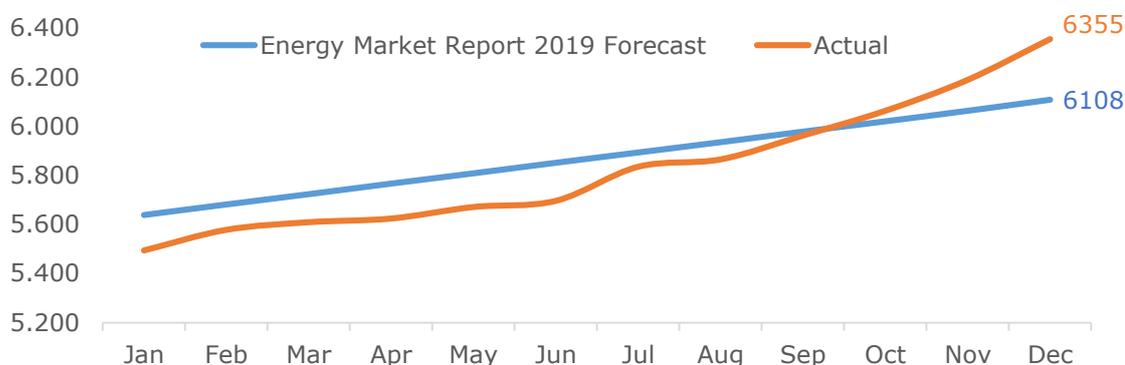
Source: HAEE's analysis

Highlights

- The RES Production Certificate replaces the RES Production License and applications submitted after September 2018 will be assessed based on this new procedure.
- From the moment of the submission of the application, the Certificate must be issued within 40 days (55 days in case of objections from third parties).
- Within 6 months of the RES Production Certificate issuance (+12 months in special ecological cases) the applicant must apply for ETA.
- Within 70 days (90 days for cases that some Opinions may be absent, and the Regional Environmental Licensing Council is called) the ETA is issued.
- Overall, the new Energy Law significantly accelerates the licensing procedure and reduces the potential bottlenecks in the process.

RES capacity is expected to rapidly increase until 2030, in order to reach the National Energy Targets

Forecast and Actual RES Installed Capacity in Greece (MW), [2019]



Long-Term Forecast of RES Installed Capacity in Greece (MW), [2020 – 2030]



Source: DAPEEP, ADMIE, HAEE's analysis

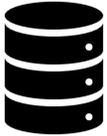
Highlights

- The recorded actual increase in RES capacity exceeded the estimations of the previous year reaching 6,355 MW at the end of 2019.
- Projections presented in 2019 Greek Energy Market Report, forecasted 6,108 MW of RES installed capacity for 2019, which is 4% lower than the actual values.
- Especially during Q3 and Q4 of 2019, a significant increase was recorded, which was equal to almost 700 MW in 6 months.
- This increase is expected to even accelerate the following years, reaching 15,674 MW at the end of 2030.
- In fact, the new estimations are significantly higher compared to the last years calculations, with almost a 12% increase in the prediction for 2030.

6. Oil & Refining



Highlights



Oil consumption in Greece is picking up the last years to reach slightly more than **7.2 billion tonnes** in 2019



In 2018, **25%** of the output was road diesel, while fuel oil and motor gasoline make up **20%** and **16.3%** of the refined products



The main source of crude oil in Greece for 2019 was **Iraq**, representing almost **50%** of the imports, with imports of **82 million barrels** of crude oil



The average **unleaded price** in 2019 in Greece was **1.5 €/litre**, when the average price a decade ago was less than **1 €/litre**

As result of the **pandemic** the West Texas Intermediate (**WTI**) hit for the first time in history **negative prices**



Domestic **crude oil production** was less than **170 thousand tons** in 2019 and has slumped to **zero** in March and April 2020



The sector with the major part in the oil and oil products **final consumption** is **transportations** both at European level - **68.6%**, and in Greece - **70.5%**



Crude oil imports in Greece have risen by **20%** since 2011 to reach almost **23 million tons** in 2019



In April 2020 the retail price of **unleaded** decreased to **1.3 €/litre**, yet **72%** of the final price stood for taxes



Overview

At the beginning of 2020 and before the outbreak of the pandemic, global Oil was expected to grow, mainly driven by the better economic conditions worldwide. Hence, world and EU Oil production have taken a major hit from the pandemic, since Oil demand will struggle to regain an upward trajectory. However, even before the COVID-19, oil consumption in the European Union was growing at a slower pace, with gas oil and diesel oil representing almost 50% of the total consumption. The refinery output at European Union level has remained relatively stable over the past decade with road diesel representing the biggest share.

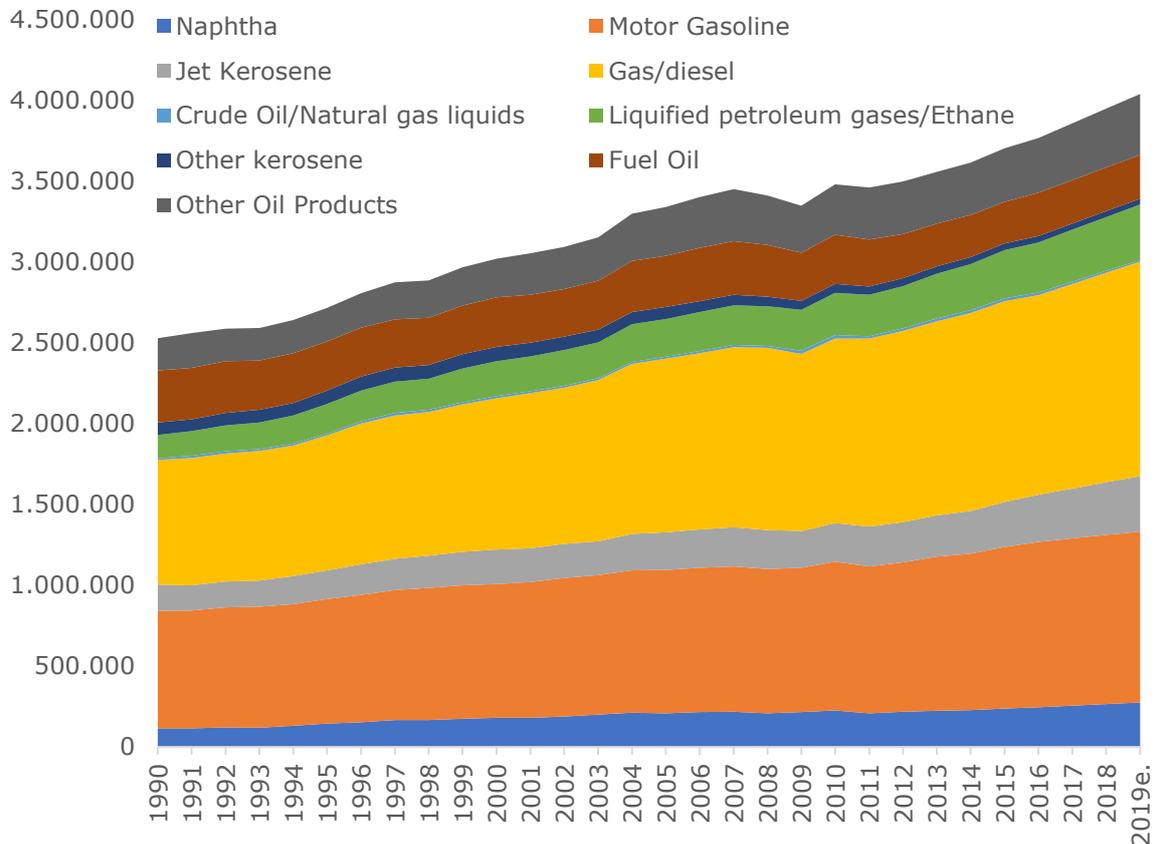
Regarding the case of Greece, Oil consumption is showing a slight upward trend, after a steep fall during the first four years of the economic crisis. The Greek domestic Oil market consists of three different sectors and is dominated by two refining companies. Greece's Oil production is small, yet its refining capacity is substantial, adding extra value to the country's economy. Greece's refining capacity has significantly grown over the past ten years by almost 50%, providing the country with various distillates. Currently, the transport sector represents more than 2/3 of the Oil final consumption both at European and national level. Greece has developed trade relations with a number of countries to fulfil its crude Oil import needs.

Although the transition to alternative sources of energy has started, the country's dependency on imports of crude Oil and petroleum products remains high. In that framework, retail prices of unleaded and diesel oil are burdened by significant taxes both in Greece and in European Union. Following the 2009 financial crisis heating oil price gap between Greece and the EU increased, while the prices of fuel oil remained lower in Greece.

Nowadays, the impact of COVID-19 is evident in the retail prices of Oil products, since prices in March, April and May 2020 reduced by almost 30%. In February and April 2020, production of crude Oil in Greece was zero barrels per day compared to 2.3 thousands barrels per day in February 2020. Finally, over the following years, refining sector is expected to evolve in a way that mitigates climate change by adopting new low-carbon technologies. Thus, future refineries are expected to become hubs for the production and distribution of low-emission products and raw material.

Before the outbreak of the pandemic, global oil was expected to grow in 2020, mainly driven by the better economic conditions worldwide

Oil Products Consumption Globally (thousand tons), [1990-2019]



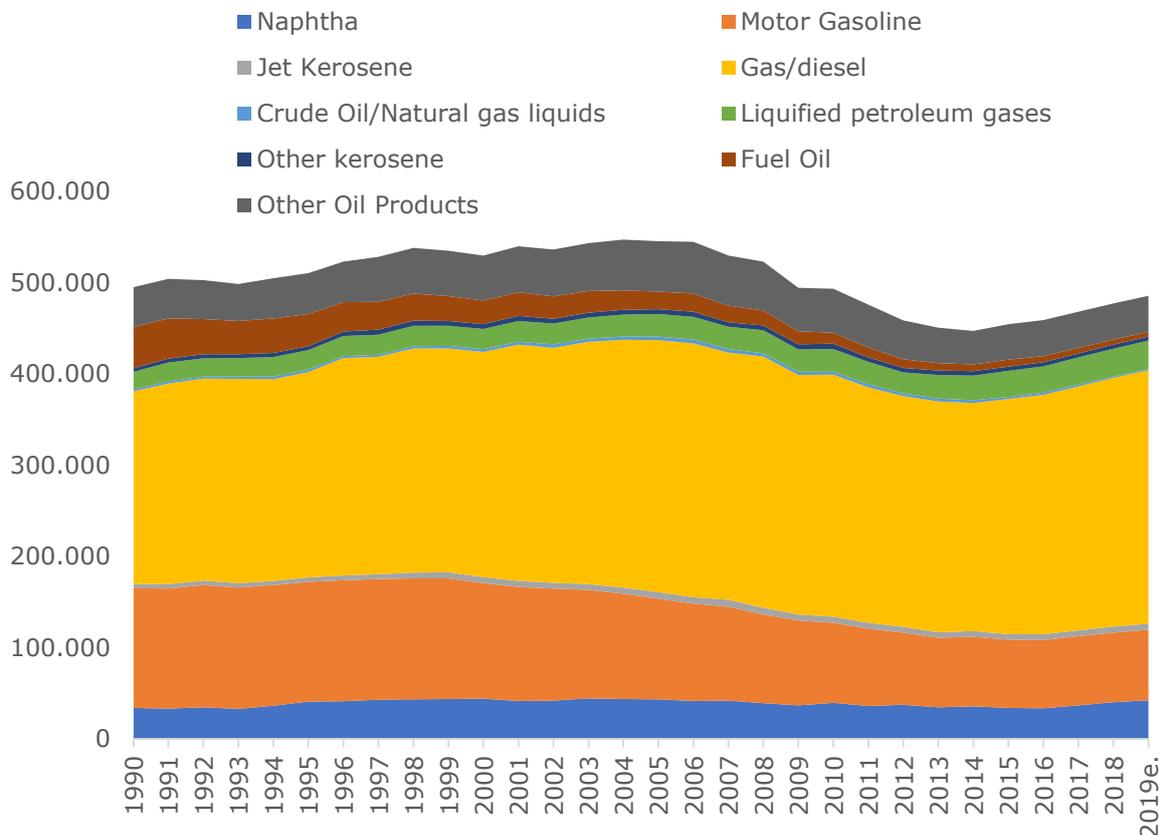
Highlights

Source: IEA, HAEE's analysis

- Worldwide Oil products consumption since 1990 is dominated by gas/diesel and motor gasoline.
- The global consumption of Oil and products continued to increase in 2019 globally following the trend of the past 30 years.
- Due to the effects of the COVID-19 Pandemic global Oil demand is expected to be almost 8 mb/d lower in 2020 than in 2019.
- As result of the pandemic the West Texas Intermediate (WTI) hit for the first time in history negative prices.
- That means Oil producers are paying buyers to take the commodity off their hands over fears that storage capacity could run out in May 2020.

Oil consumption in the European Union is growing at a slower pace, with gas oil and diesel oil representing almost 50% of the consumption

Oil Products Consumption in the EU 28 (thousand tons), [1990-2019]



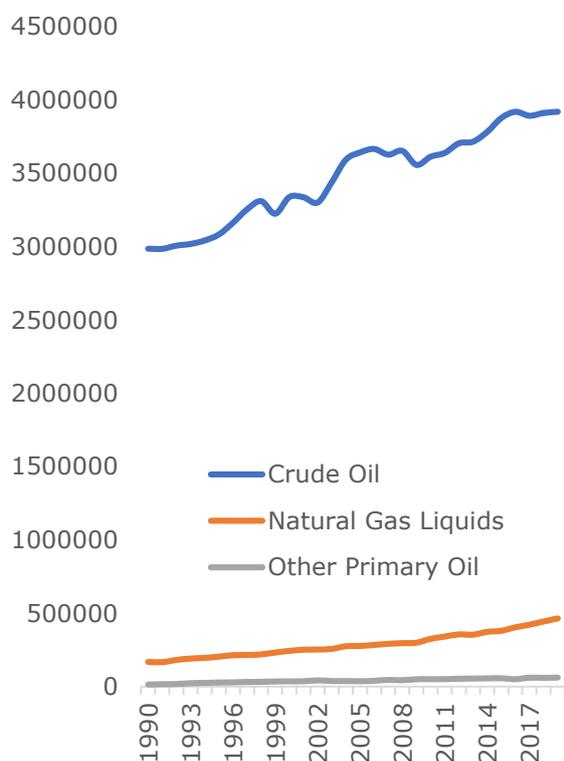
Highlights

Source: IEA, HAEE's Analysis

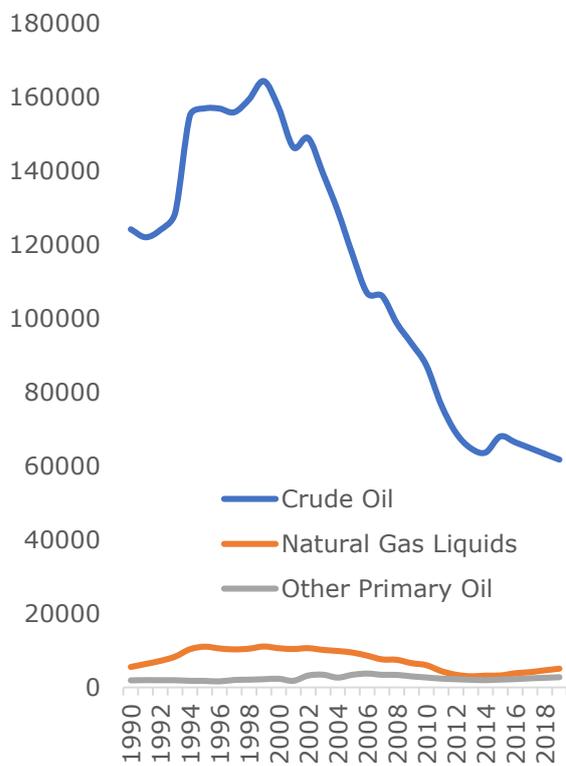
- For decades, crude oil and petroleum products have had the largest share in gross inland energy consumption in the EU-28.
- Despite decreasing production and consumption in the EU in recent years, crude oil and its derived products remain the largest contributors to energy consumption.
- Historically, the major oil imports in Europe come from Russia, Norway, Iraq, Kazakhstan and Saudi Arabia.
- The pandemic has revealed deep-seated structural vulnerabilities in our fossil fuel-dependent economy.
- Under the current conditions it is likely to take more than a year before demand in Europe reaches the pre-pandemic levels.

World and EU oil production have taken a major hit from the pandemic since oil demand will struggle to regain an upward trajectory

Oil Production - Crude and Other Products Globally (thousand tons), [1990-2019]



Oil Production - Crude and Other Products in the EU 28 (thousand tons), [1990-2019]



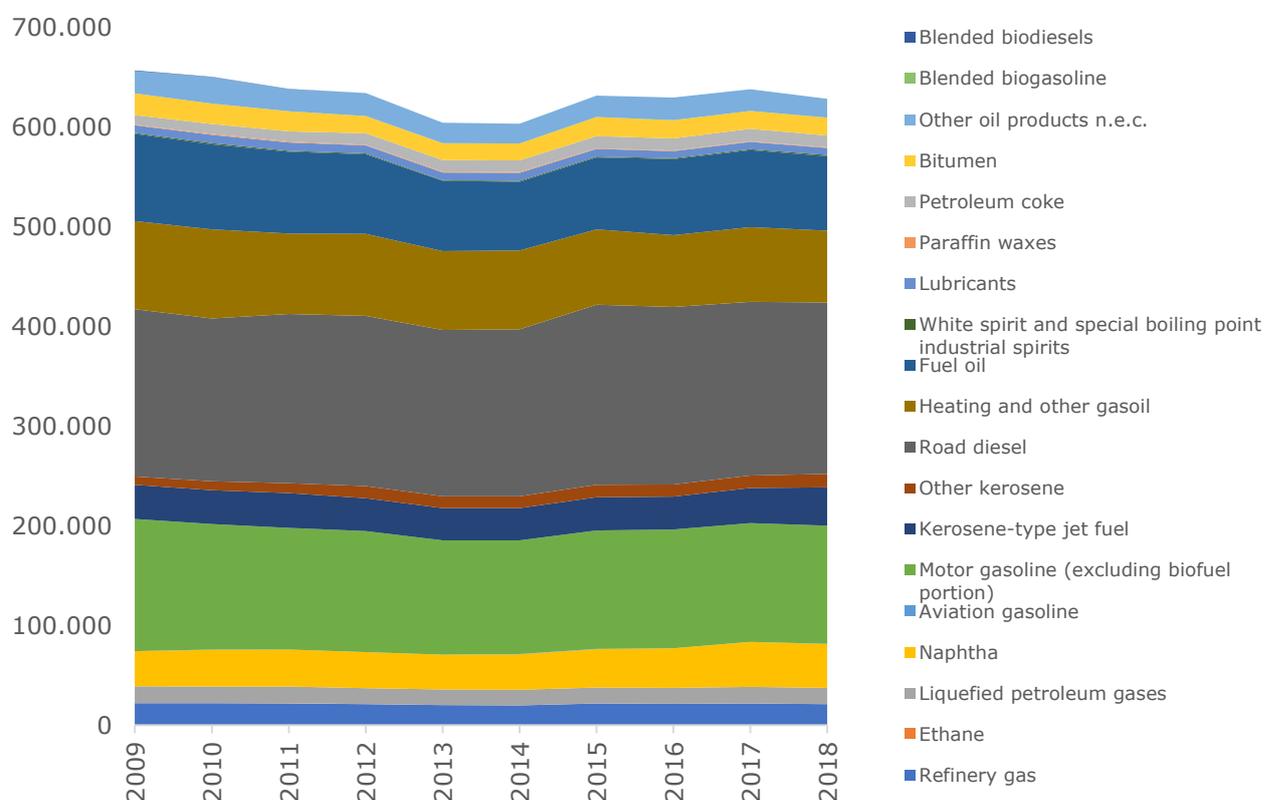
Source: IEA, HAEE's analysis

Highlights

- The oil production globally was expected to rise in 2020 but due to the pandemic and according to new estimations there will be a decrease of 7.2 mb/day.
- In May 2020, the OPEC+ countries along with the United States have agreed in an unprecedented accord to cut oil production by 12 mb/d.
- The forecast for 2021 production is to expect an increase in production by 1.8 mb/d from 2020 levels.
- The production of crude oil at EU level has been decreasing steadily since 2000, to reach less than 70 million tons in 2019.
- The production of crude oil at EU level is expected to decrease further after Brexit, since the UK was the major oil producing country of the Union.

The refinery output at European Union level has remained relatively stable over the past decade with road diesel representing the biggest share

Oil Refining Products in EU (thousand tons), [2009-2018]



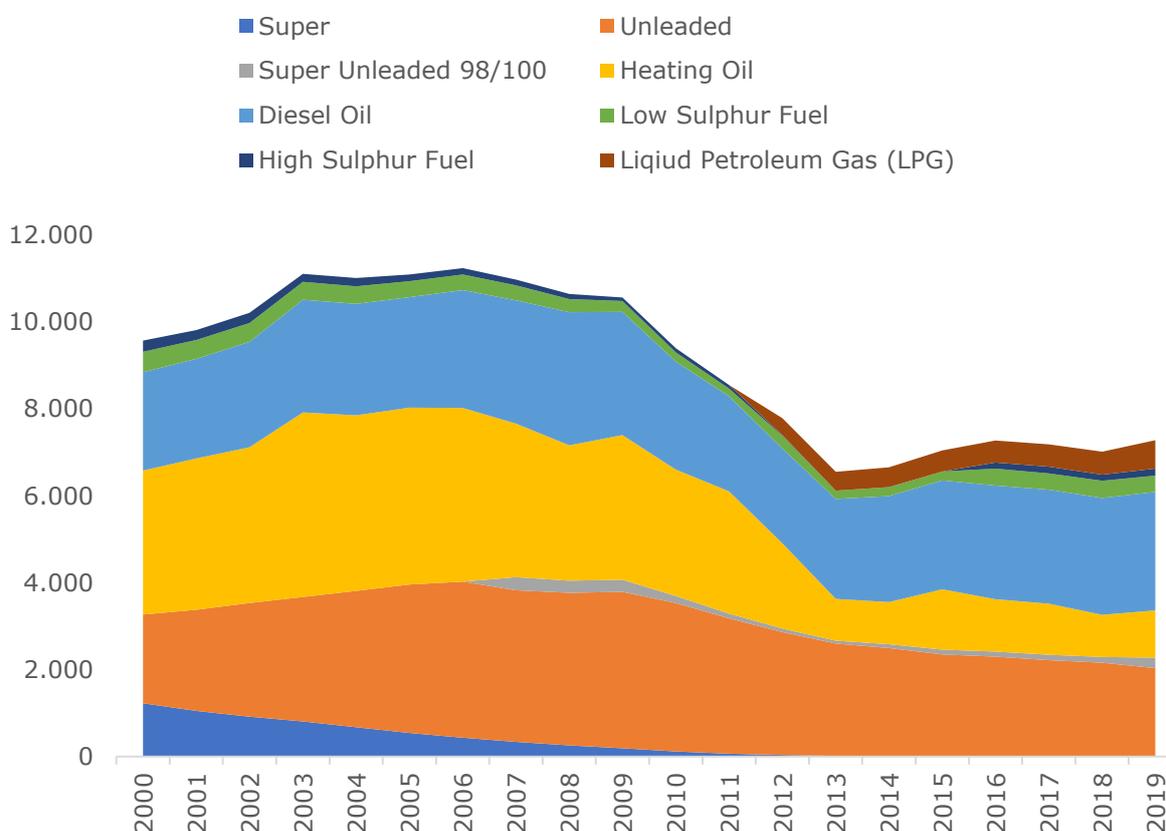
Highlights

Source: Eurostat, HAEE's analysis

- Refineries process crude oils into finished products by breaking them down into their components and selectively reconfiguring them into new products.
- The total refining capacity of the European Union was more than 630 million tons of oil products.
- The main output of the European Union refineries for 2018 is road diesel, with a production of 172 million tons.
- Motor gasoline is the second major output from the refineries, representing 18% of the total production while fuel oil production was more than 11% of the total.
- Heating oil, Naphtha, and Jet-fuel kerosene production was 72 million tons, 44 million tons and 38 million tons, respectively.

Oil consumption in Greece is showing a slight upward trend, after a steep fall during the first four years of the economic crisis

Oil Products Consumption in Greece (thousand tons), [2000-2019]

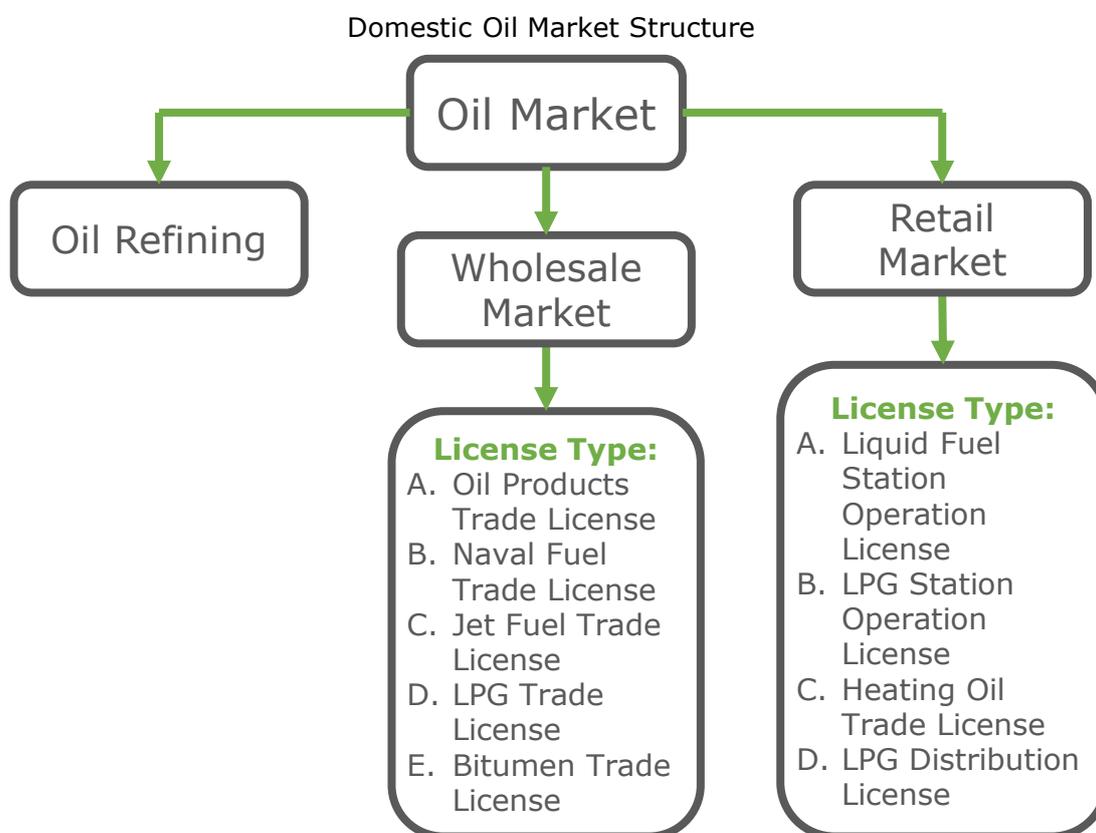


Highlights

Source: Elstat, HAEE's analysis

- The financial crisis has totally changed the shape of the oil consumption in Greece, with a decline in consumption of 35% from 2009 to 2013.
- The consumption is picking up the last years to reach slightly more than 7.2 billion tonnes in 2019.
- Diesel has taken the lead from unleaded as the most consumed oil product over the past years, representing almost 37% of the total consumption.
- Unleaded consumption corresponds to 27%. The demand for heating oil is still very low compared to the pre-crisis level, demonstrating the shift to alternative fuels.
- Finally another result of the crisis is the increase of LPG use as a transport fuel. In 2011 LPG consumption was practically zero, but in 2019 consumption made 9%.

The Greek domestic Oil market consists of three different sectors and is dominated by two refining companies

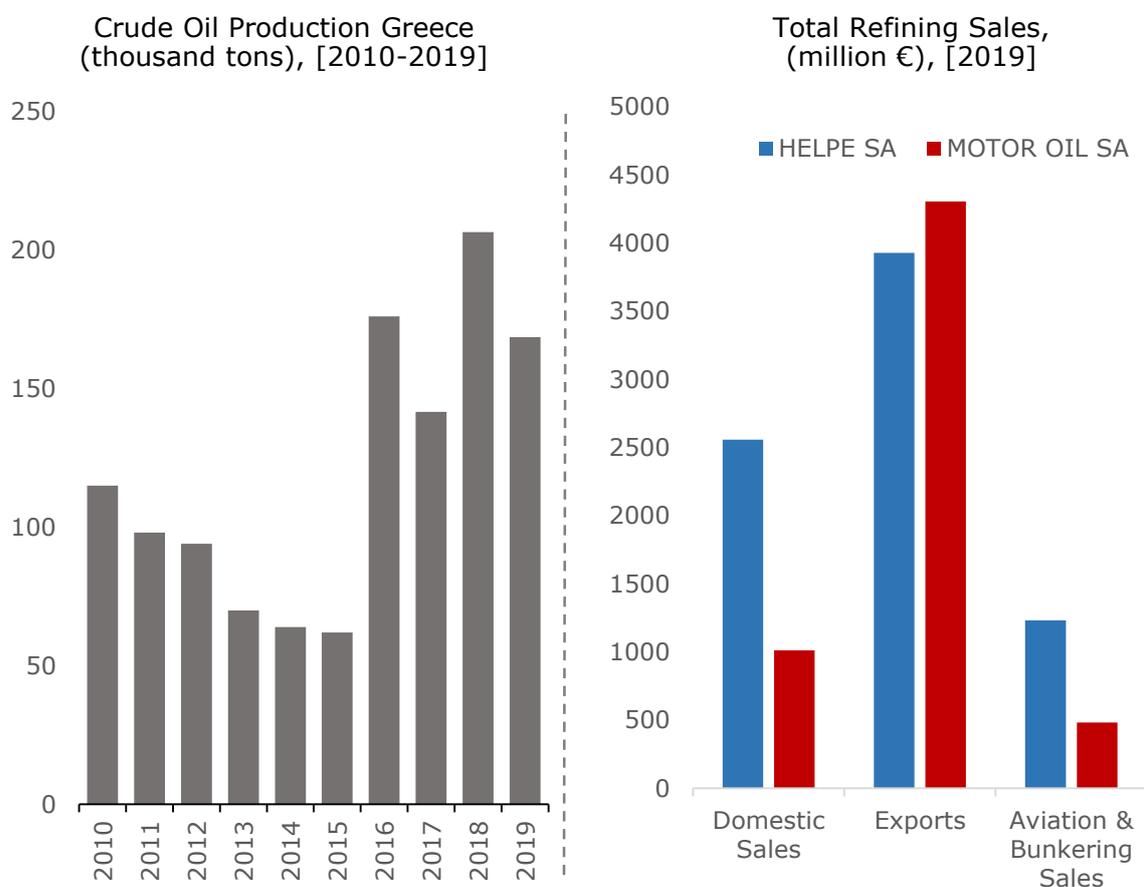


Highlights

Source: HAEE's analysis

- The Oil Refining sector consists of 4 refineries, which are owned by two different companies, HELPE and Motor Oil.
- The whole Greek Oil market is principally served by these two refining companies and their subsidiaries in the wholesale and retail markets.
- In the wholesale petroleum sector, over 53 companies operate, holding 80 licenses, with HELPE currently holding a wholesale market share of about 65%.
- Regarding the retail market, HELPE merged its two retail companies in 2016 into one company which accounts for over 30% of the market.
- Motor Oil's subsidiary (Avin Oil) alongside the Shell network (which is owned by Motor Oil) account for another 32% of the total retail market.

Greece's Oil production is small, yet its refining capacity is substantial, adding extra value to the country's economy



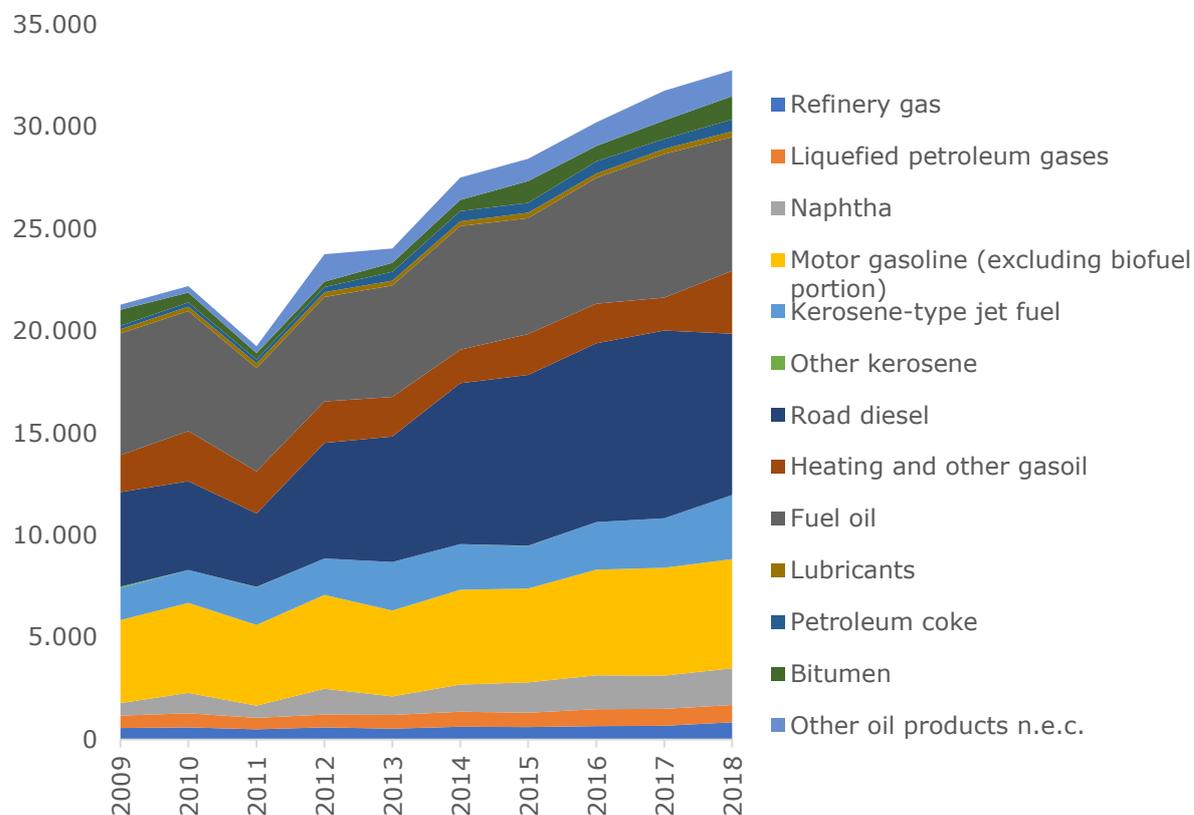
Source: Eurostat ,HELPE, Motor Oil, HAEE's analysis

Highlights

- Private company Energean Oil & Gas SA is the country's current only crude oil producer. The producing offshore fields, are located in the North Aegean Sea.
- Domestic crude oil production was less than 200 thousand tons in 2019, which is expected to be even lower in 2020, as a result of low crude prices by the COVID-19.
- Three refineries are owned by HELPE and are situated in Aspropyrgos, Elefsina, and Thessaloniki. These refineries account for almost 2/3 of Greece's refining capacity.
- The fourth refinery is owned by Motor Oil, covers rest of the capacity and is located in Agioi Theodoroi, near Korinthos.
- The Greek refineries offer a wide range of products serving domestic and international market with sales of over 15 billion € in 2019.

Greece's refining capacity has significantly grown the past ten years by almost 50%, providing the country with various distillates

Oil refining products in Greece (thousand tons), [2009-2018]



Highlights

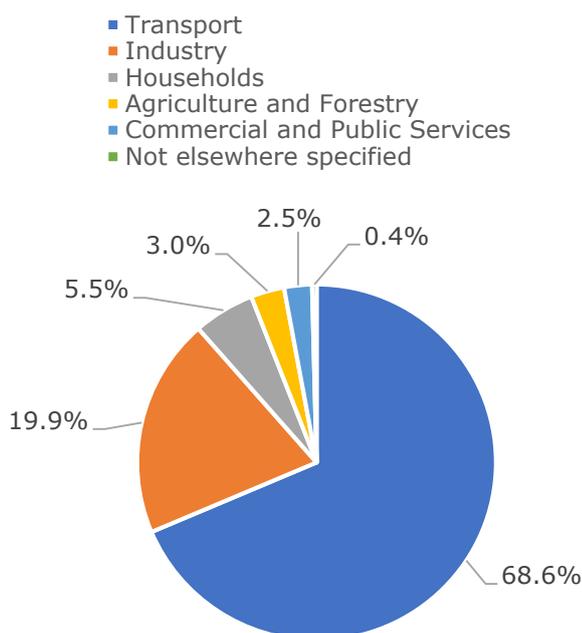
Source: Eurostat, HAEE's analysis

- The Greek refining groups have made significant investments the past decade in order to increase the refining output, increasing it by 50% to 32 million tons.
- In 2018, 25% of the output was road diesel, with a total output of 7.3 million tons, slightly reduced compared to last year's production.
- Fuel oil and motor gasoline make up 20% and 16.3% of the refined products in 2018.
- Jet fuel kerosene and heating oil production stood at 3.1 million tons each represent together another 20% of the refining capacity.
- Jet fuel kerosene and heating oil production stood at 3.1 million tons each represent together another 20% of the refining capacity.

The transport sector represents more than 2/3 of the Oil final consumption both in the EU and Greece

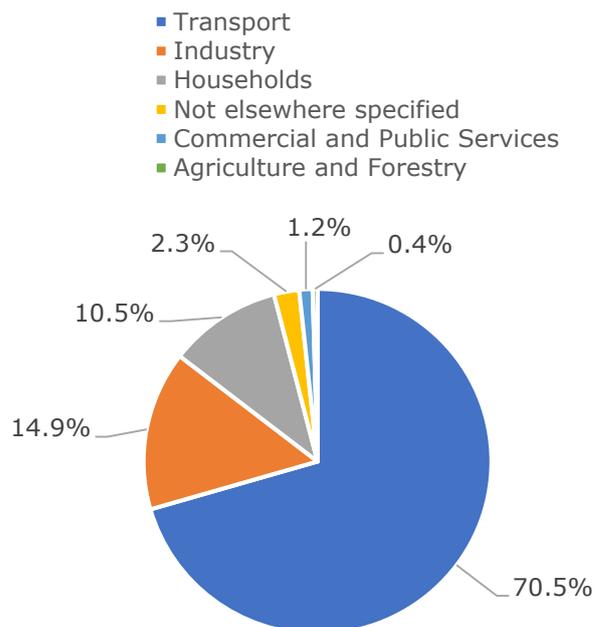
Final Consumption of Oil and Products by Sector in EU 28 (%), [2018]

Final Consumption: 534 mil. tons



Final Consumption of Oil and Products by Sector in Greece (%), [2018]

Final Consumption: 9 mil. tons



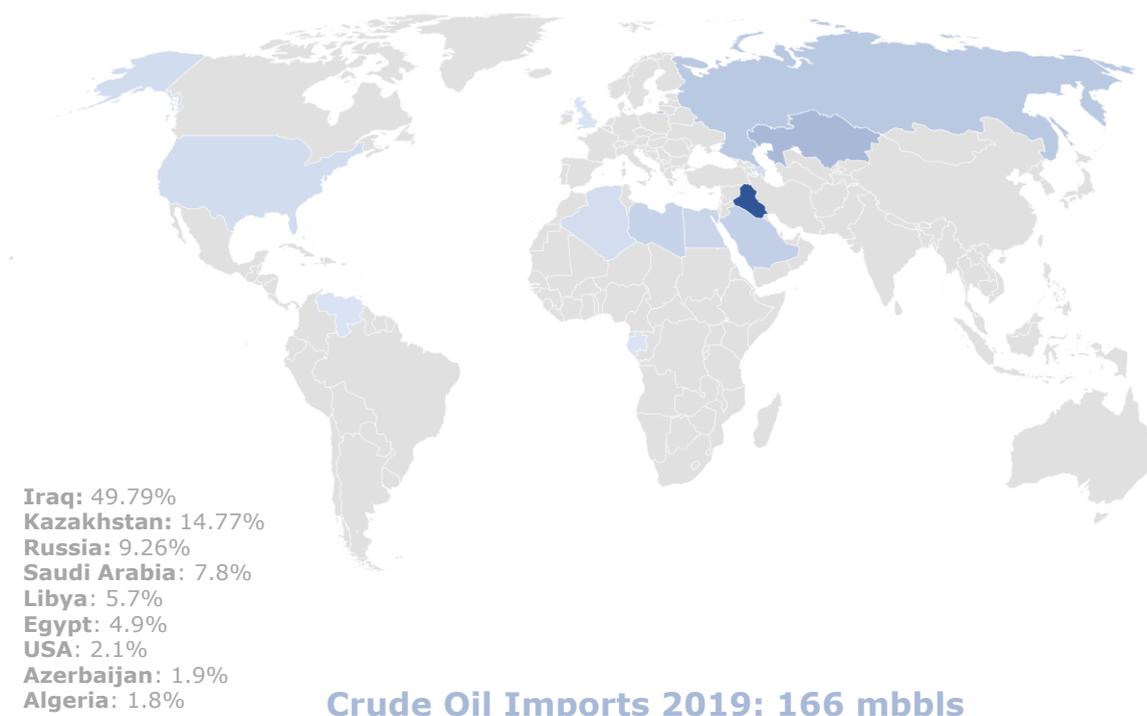
Source Eurostat, HAEE's analysis

Highlights

- The sector with the major part in the Oil and Oil products final consumption is the transport sector both at European level (68.6%) and in Greece (70.5%).
- In the EU, 366 million tons of Oil and products was consumed for transport in 2018, while in Greece 6 million tons were consumed for transport.
- The second largest final consumer is the industry which consumed 106 million tons in the EU and 1.4 million tons in Greece over 2018.
- At EU level the rest 12% of the consumption is divided among households (5%), agriculture and forestry (3%) and commercial and other uses represent the final.
- In Greece households represent 10% of the final consumption due to the use of Oil for heating. The rest 4% is consumed by other uses, commercial and agriculture.

Greece has developed trade relations with a number of countries to fulfil its Crude Oil import needs

Crude Oil Imports in Greece per Country (%), [2019]

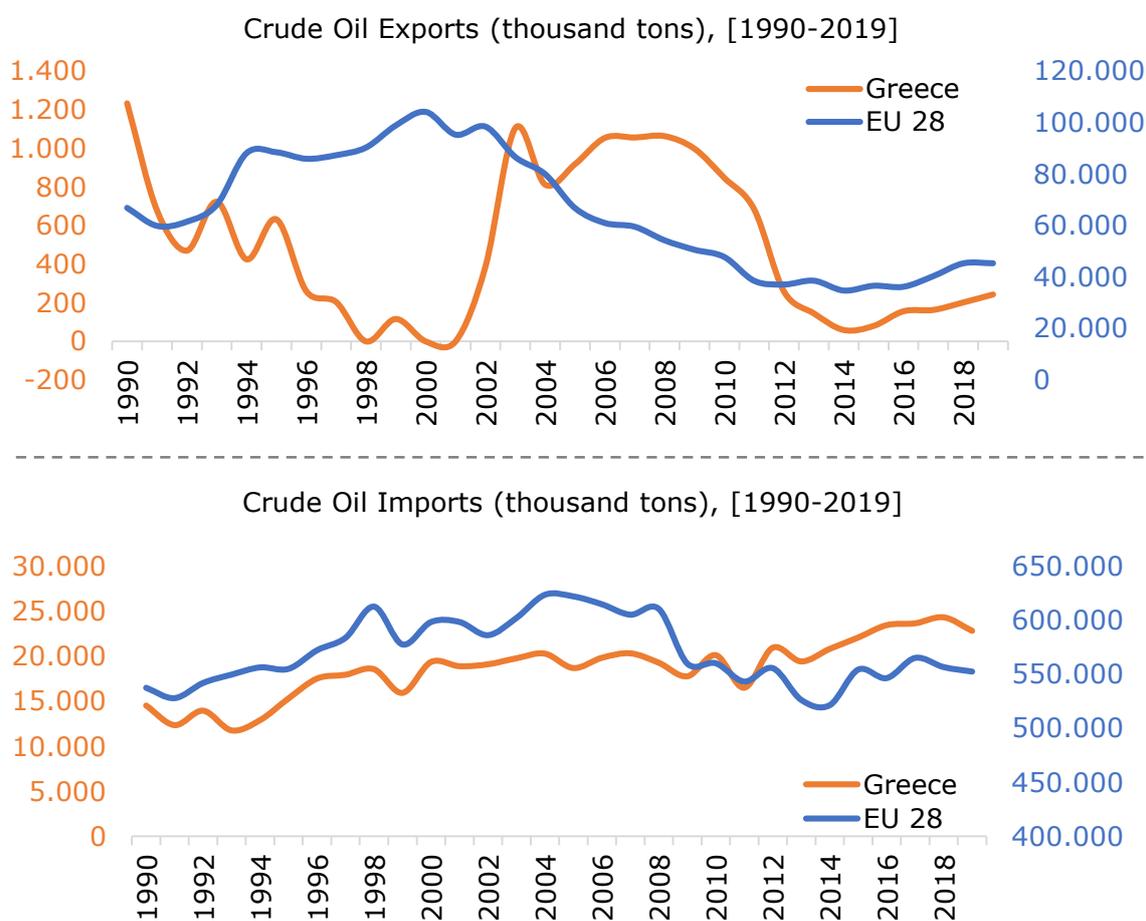


Highlights

Source: European Commission, HAEE's analysis

- Greece imports crude Oil from different sources from all over the world, to cover the needs of its refining sector, since crude production is small.
- The main source of crude Oil in 2019 was Iraq, representing almost 50% of the imports, with imports of 82 million barrels of crude oil.
- Another 25% of the imports was from Kazakhstan (14.77%) and Russian Federation (9.26%), with imports of 24 million barrels and 15 million barrels respectively.
- Other Oil producing countries that export crude oil to Greece are Saudi Arabia (7.8%), Libya (5.7%), Egypt (5%), USA (2.1%), Azerbaijan (2%) and Algeria (2%).
- The respective volumes of crude oil are 12 mbbls from Saudi Arabia, 10 mbbls from Libya and 8 mbbls from Egypt.

Although the transition to alternative sources of energy has started, dependency on imports of Crude Oil and Petroleum Products remains high



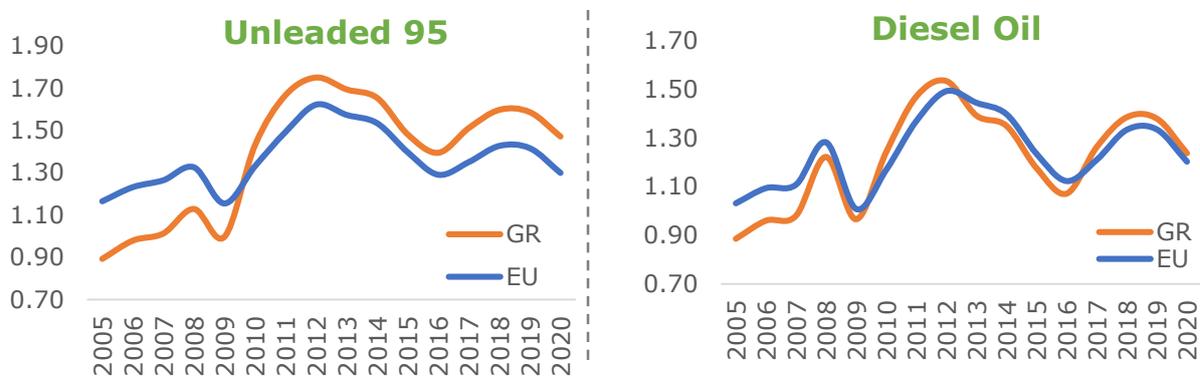
Highlights

Source: Eurostat, HAEE's analysis

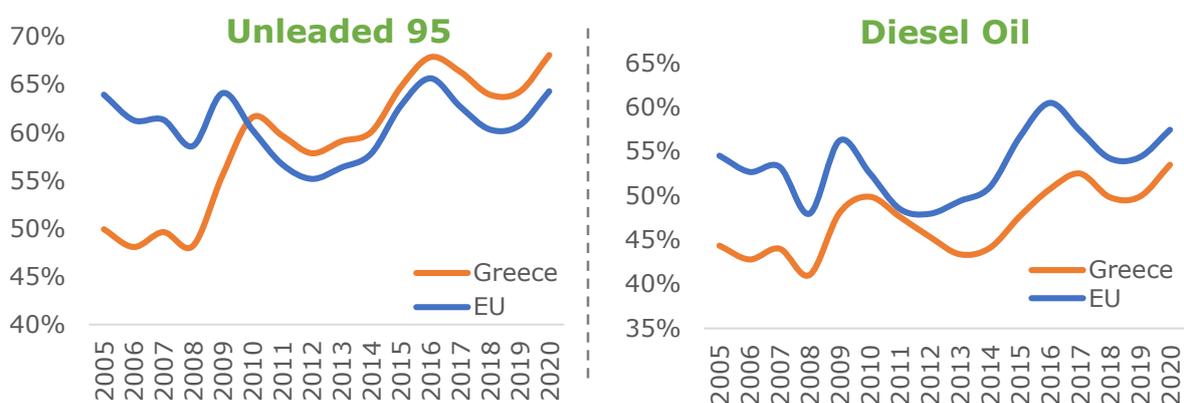
- Crude oil exports are declining at EU level since 2000 reaching in 2019 only 45 million tons, a slight pick up from 36 million tons in 2015.
- In Greece a similar trend is observed with a pickup of crude oil exports in 2003 only to reach 240 thousand tons of crude oil exports in 2019.
- The EU crude oil imports are also in a downward trend since the mid 00s, standing at 550 billion tons in 2019, while fifteen years ago the volume was 610 billion.
- On the contrary crude oil imports in Greece have risen by 20% since 2011 to reach almost 23 million tons in 2019.
- Russian oil exports to Europe are set to hit their lowest levels in two decades in July 2020, with an output cut deal prompting other suppliers to fill the gap left.

Retail prices of Unleaded and Diesel Oil are burdened by significant taxes both in Greece and in the European Union

Retail Prices of Petroleum Products (€/litre), [2005-2020]



Taxes as Share of the Final Price (%), [2005-2020]



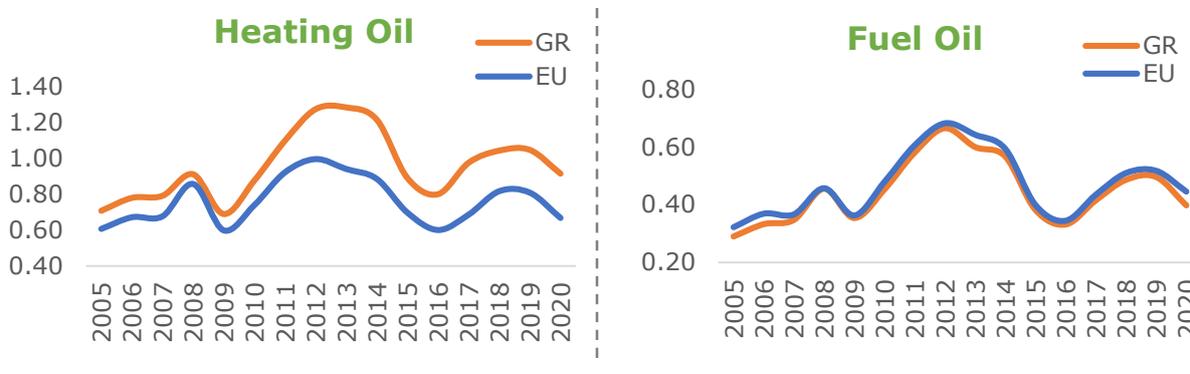
Highlights

Source: European Commission, HAEE's analysis

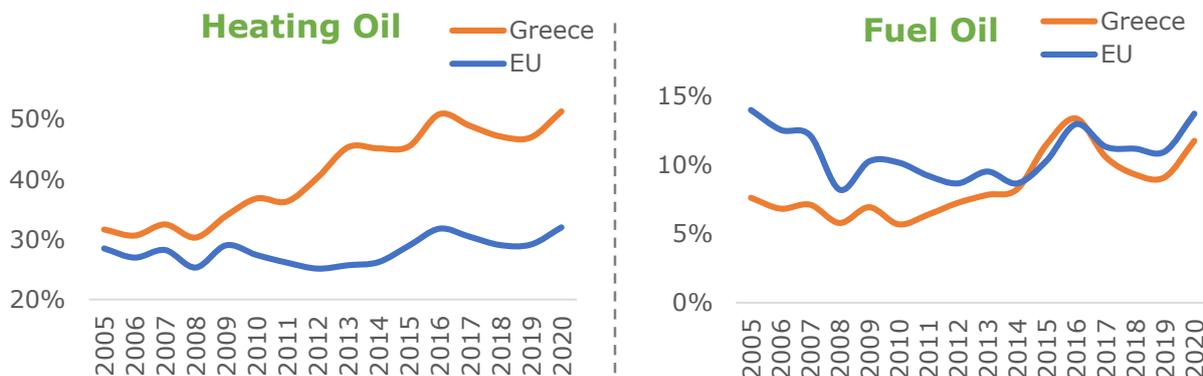
- Since 2010 the retail price of Unleaded in Greece is higher than the average EU price, as a result of a tax increase due to the financial crisis of 2009.
- The unleaded average price in 2019 in Greece was 1,586 €/litre, when the average price a decade ago was less than 1 €/litre. In 2019 the EU price was 1,416 €/litre.
- The tax burden for unleaded in 2019 in Greece was close to 65% of the final retail price while at EU level it stood lower at 60%.
- As far as diesel oil is concerned the average price in Greece and the EU are quite close, with the price in Greece settling at 1,380 €/litre and 1,336 €/litre in the EU.
- Taxes on diesel consumption are significantly higher in the EU than Greece, representing 55% for the EU price and 50% for the Greek price in 2019.

After the 2009 financial crisis, Heating Oil price gap between Greece and the EU increased, while the prices of Fuel Oil remained lower in Greece

Retail Prices of Petroleum Products (€/litre), [2005-2020]



Taxes as Share of the Final Price (%), [2005-2020]

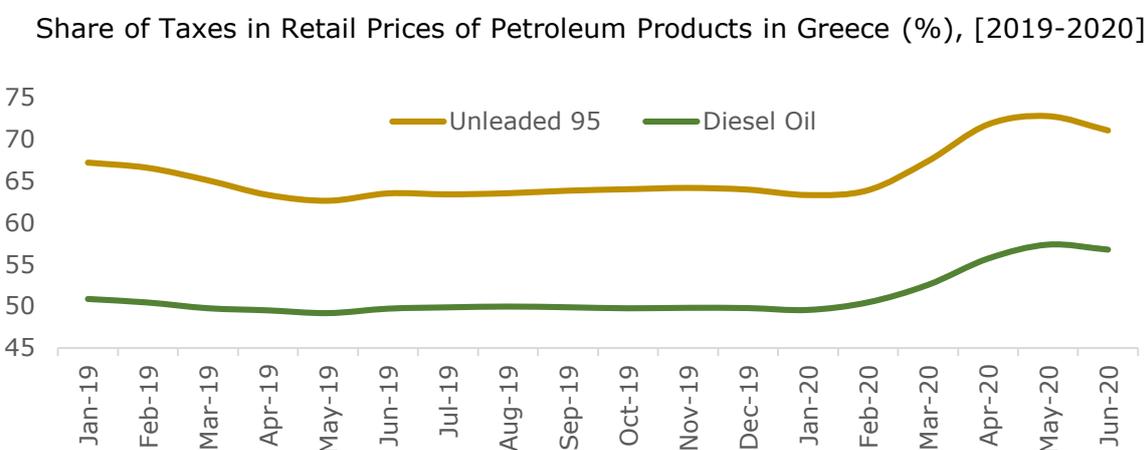
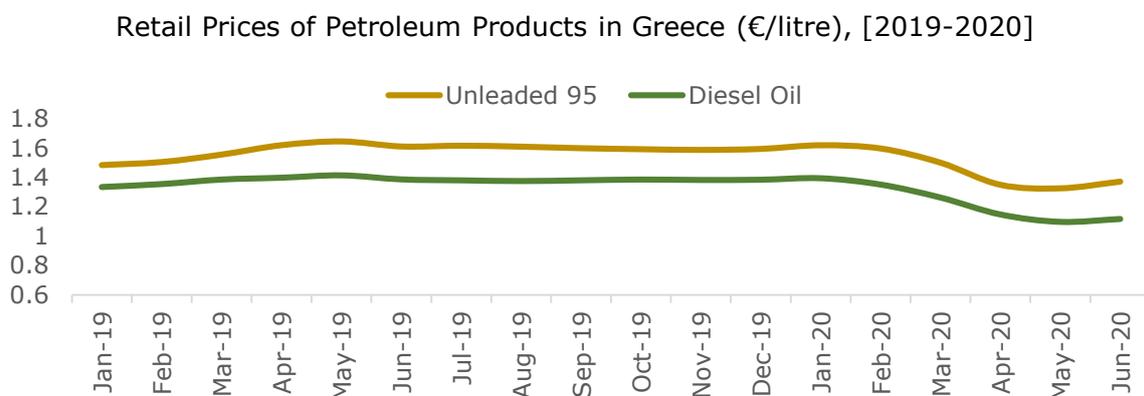


Highlights

Source: European Commission, HAEE's analysis

- Heating oil prices discrepancy between the EU average and Greece as a result of the increased taxes imposed by the Greek Governments due to the 2009 crisis.
- Greek consumers pay on average 25% more for Heating Oil than the EU average. The price in Greece for Heating Oil was around 1 €/litre in 2019.
- The taxes imposed in Greece for the consumption of Heating Oil are 60% higher than the EU average for 2019.
- Fuel Oil prices are lower in Greece than the EU average by almost 15%, settling 2019 at 0,496 €/litre in Greece while the EU price was 0,561 €/litre.
- Taxes on Fuel Oil remain both in Greece and the European Union well below 15% of the final price.

The impact of COVID-19 was evident in the retail prices of Oil Products in March-May 2020, with a reduction of almost 30%



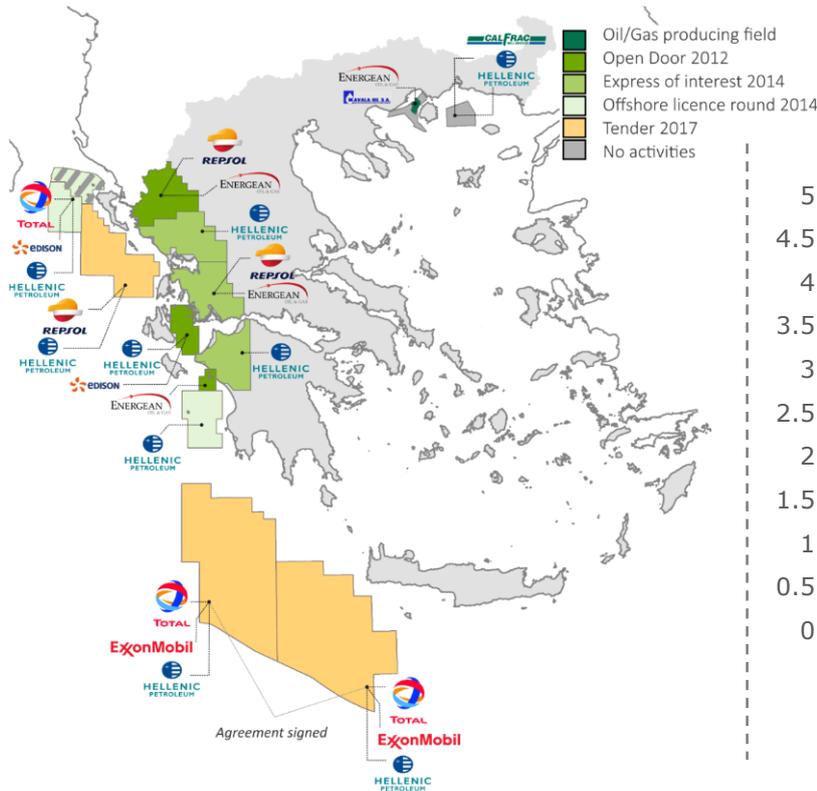
Highlights

Source: European Commission, HAEE's analysis

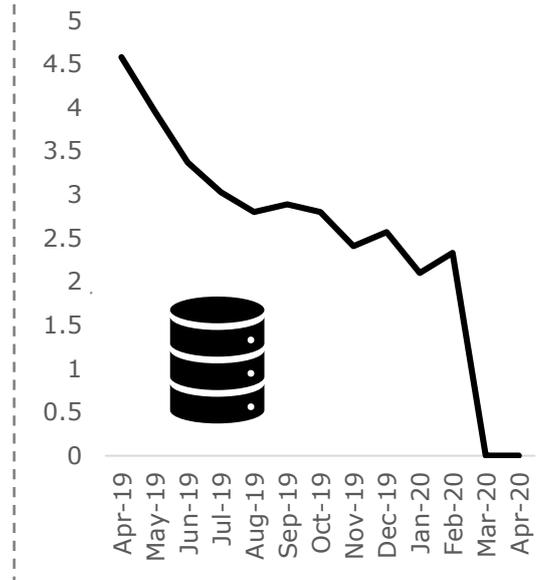
- As a result of the COVID-19 pandemic the retail prices of oil products have collapsed in March, April and May of 2020.
- In April 2020 the retail price of Unleaded was 1,3 €/litre when in April 2019 the price was 1,6 €/litre. More than 72% of the unleaded price in April were taxes.
- The price of diesel in April was 1,097 €/litre when the February 2020 price was 1,352 €/litre. The taxes in April and May represented more than 55% of the price.
- The low prices of heating Oil led to the extension of its distribution from April 31st to May 15th. The price of heating Oil in May 2020 was less than 0.75 €/litre.
- The gradual relaxing of the containment measures led to a slight increase in the prices in June 2020.

In February and April 2020, production of crude oil in Greece was zero barrels per day from 2.3 thousands barrels per day in February 2019

Exploration and Discovery, [March 2019]



Crude Oil Production in Greece (k barrels per day), [2019 -2020]

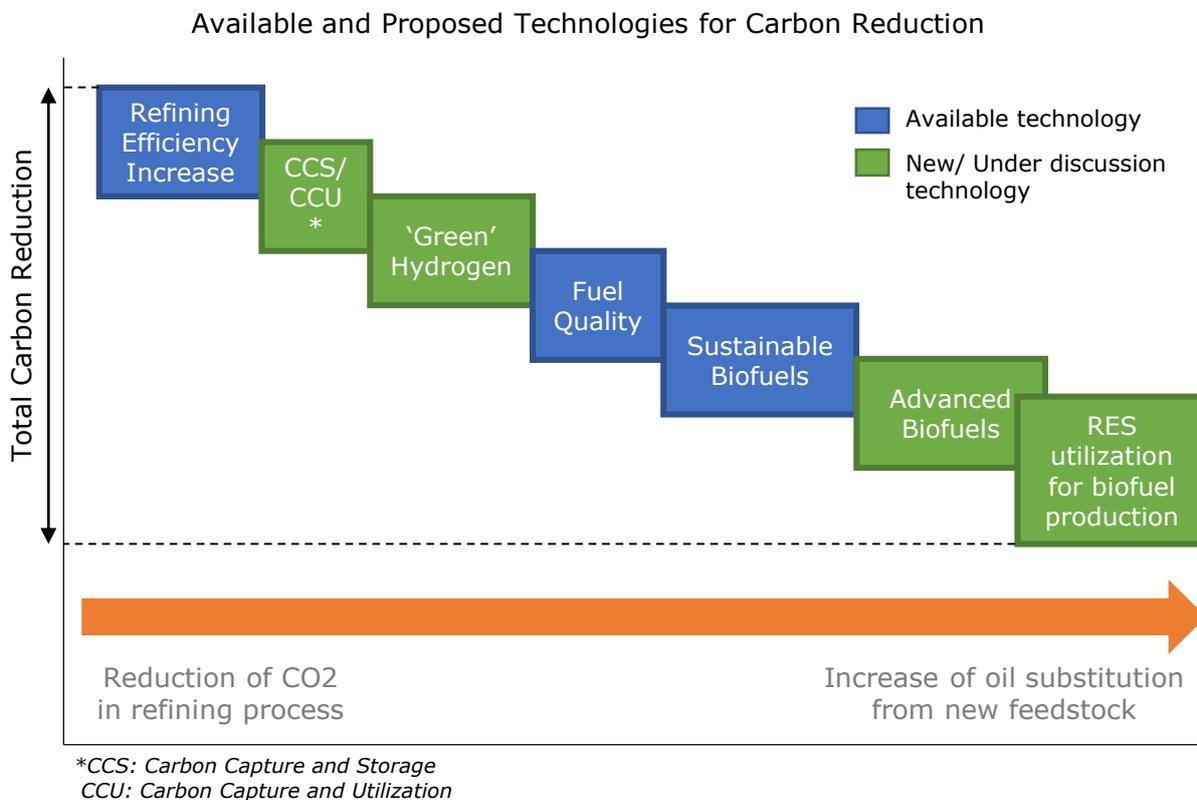


Highlights

Source: HHRM, HAEE's analysis

- The output of Prinos turned loss-making long before the slump in Oil rates, forcing Energean, the developer of the Oil field, to slash its investment program.
- Since Oil prices plummeted, Energean informed the government that production will cease without funding, as it cannot continue to keep operating at a loss.
- The outcome will depend on the answer the government gives to the dilemma over whether or not the state participates in Prinos Oil extraction.
- Apart from COVID-19 developments, a number of new Oil exploration blocks could lead to further investment and increased domestic production.
- Nevertheless, the confidence shown by investors in the Greek economy could be an important catalyst for further investment in the energy sector and beyond.

Refining sector is expected to evolve in a way that mitigates climate change by adopting new low-carbon technologies in the following years

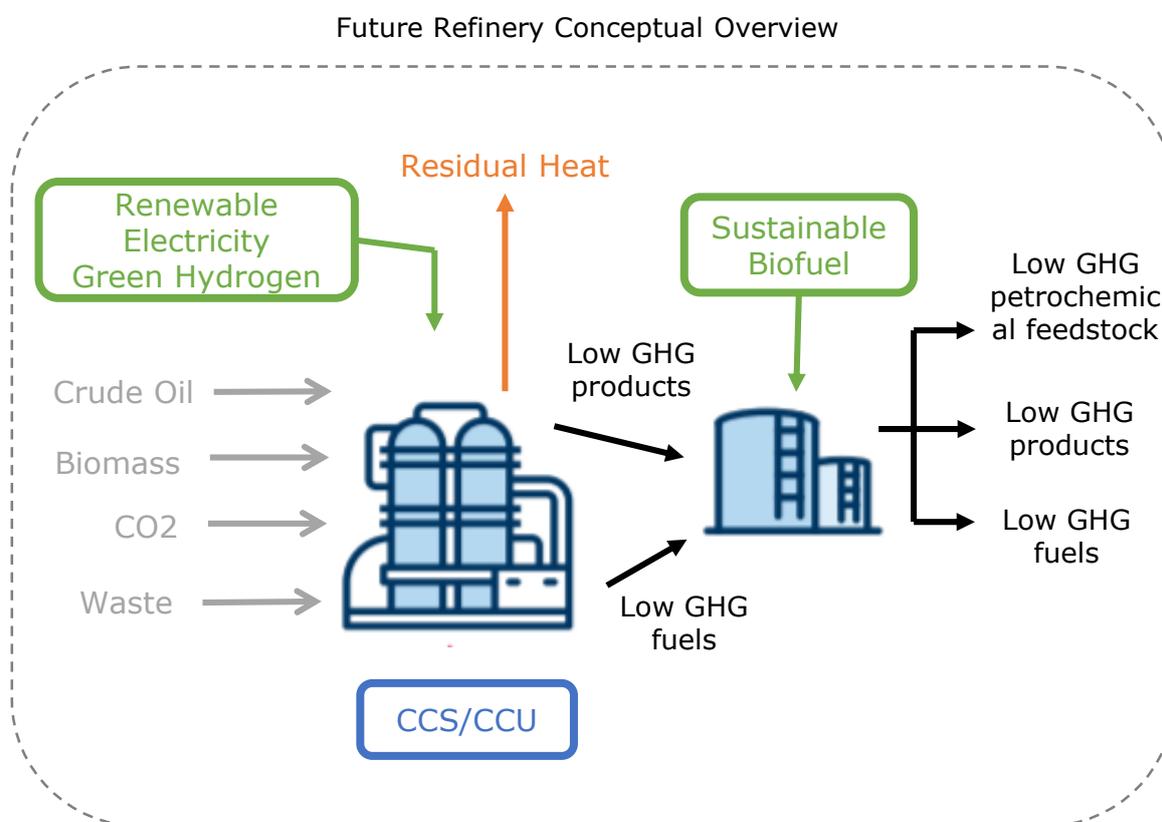


Source: Fuels Europe, HAEE's analysis

Highlights

- The refining system is expected to play a vital role in the transition to the low carbon economy as the global demand for liquid hydrocarbons will continue to grow.
- Refining industries are required to develop new business plans and evolve in order to gradually reduce the liquid hydrocarbon CO2 emissions.
- This can be achieved by the utilization of alternative raw material mixes (such as biomass, waste and captured CO2) in a very efficient manner.
- This evolution of the refining sector could be divided in three different steps-phases: Early stage, Evolution stage and Future stage.
- In the Future stage, refineries are estimated to become efficient manufacturing centers, processing a variety of feedstocks and products.

Future refineries are expected to become hubs for the production and distribution of low-emission products and raw materials



Source: Fuels Europe, HAAE analysis

Highlights

- Refineries will find ways to reduce CO₂ emissions through a combination of operational measures and targeted investments.
- Low-grade heat resulting from refinery operations could be used to produce electricity for both internal and external consumption.
- The extension of heat-pump technology to achieve higher temperatures and alternatives to electric power could also be a point for development.
- Closer integration with other industries such as petrochemicals, which are often located within the same industrial hub, could also be pursued.
- The development of alternative fuels for production and for distribution is also an area of high interest for companies active in Oil and refining industry.

8. Energy Efficiency



Highlights



Energy productivity in Greece is **10%** less than EU-27

European energy efficiency **target** for 2030 will be **revised** after Brexit



39% of **energy** is consumed by **transport sector**

Oil represents **53%** of the Greek **energy consumption**



RES and biofuels are used **34% more today** compared to the previous decade

39% of **industry's** energy consumption stems from **electricity**



17% is the energy efficiency **index** for **transportation**

Households energy consumption has **decreased** by **12%** over the last years



The **recovery** of the Greek economy should be accompanied by decreased energy consumption and increased **Energy Efficiency**



Overview

The global decline in energy efficiency underlines the necessity for additional policies that will reverse the prevailing trend and simultaneously boost economic growth. In this direction, Europe introduced specific targets for energy efficiency to mitigate climate change and ensure efficiency in energy markets. Brexit will cause reasonable adjustments to those targets which refer to 2030 and 2050.

The European Commission's plan includes austere fiscal and monetary policies namely green bonds, efficient public and private buildings, and eco-mobility, amongst others. Hence, it aims at increasing energy productivity, dropping the units of energy used per unit of GDP and thus increasing energy efficiency.

Greece, as a member of the European Union, has managed to attain the corresponding energy efficiency target concerning energy consumption. Nevertheless, the reduction of energy consumption does not imply efficiency. The primary cause of energy reduction is the European debt crisis which reduced the aggregate demand for energy rather than the establishment of energy-efficient policies.

On the other hand, Greek performance on energy efficiency indicators attests two notable outcomes. Firstly, it has adopted a series of energy-efficient policies as an EU-28 member, and thus it has managed to increase efficiency. Secondly, the Greek energy performance is considerably weak compared to the rest of European countries and hence, should initially exploit the totality of EU tools for energy efficiency and then implement further policies at a national level.

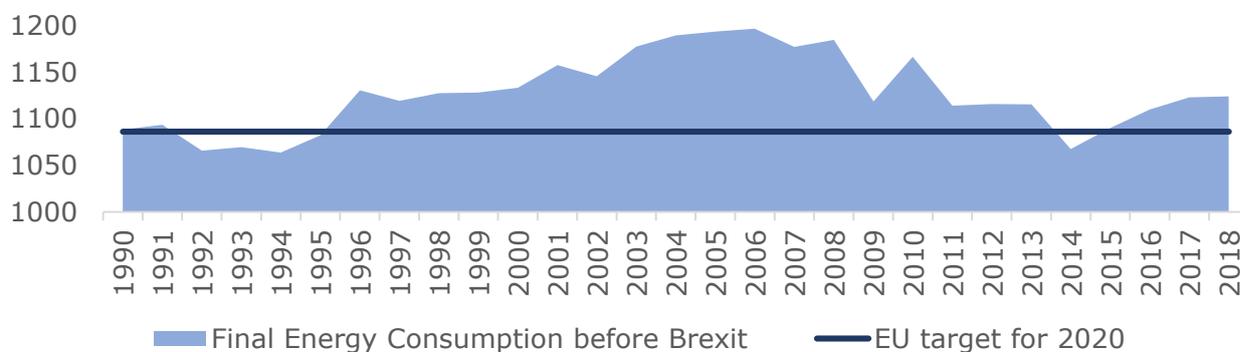
Decomposing the Greek economy into sectors, transportation constitutes the most energy-consuming one, which is responsible for 39% of the overall energy consumption. Industry accounts for 18%, households for 26% and services for 14%. In terms of fuels, the Greek economy is based solely on oil & petroleum products, while efforts have been made for the reduction of oil share in total energy consumption.

Furthermore, electricity which is used intensively in the industry sector, possess the second-highest share in total energy consumption. The effect of renewables on the Greek economy has been more conspicuous during the recent years, while the natural gas which is considered as the transition fuel, is expected to grow its share in the upcoming years.

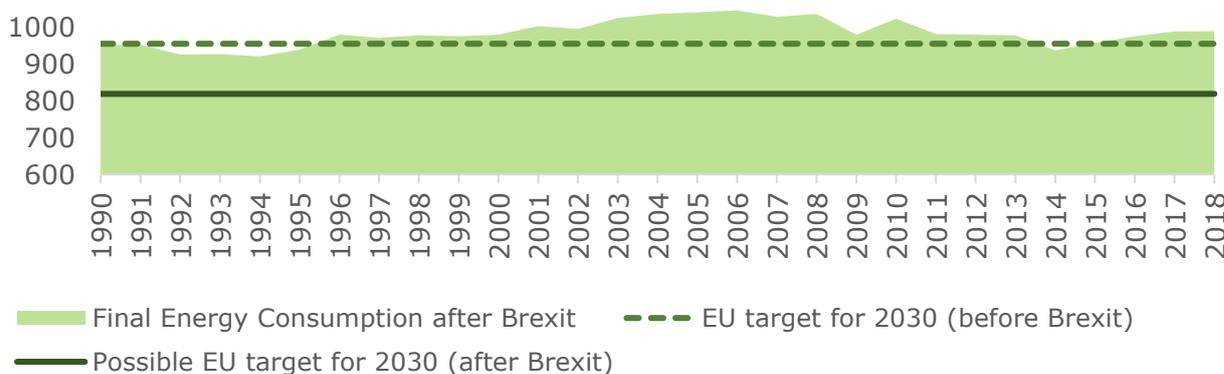
Last but not least, COVID-19 is probable to cause a severe world recession which will question the ability of Greece to immediately respond to it in a national level, which means that shortly energy efficiency may be considered as a secondary issue. However, climate change remains a priority and to cope with it, COVID-19 has taught us some very important tutoring, such as that we are all vulnerable to global crises, we should trust the experts and act immediately.

European Union needs further environmental policies and guidelines to meet 2030 energy efficiency targets

Final Energy Consumption for EU-28 and the Corresponding Target for 2020 (Mtoe), [1990-2018]



Final Energy Consumption for EU-27 and the Corresponding Target for 2030 (Mtoe), [1990-2018]



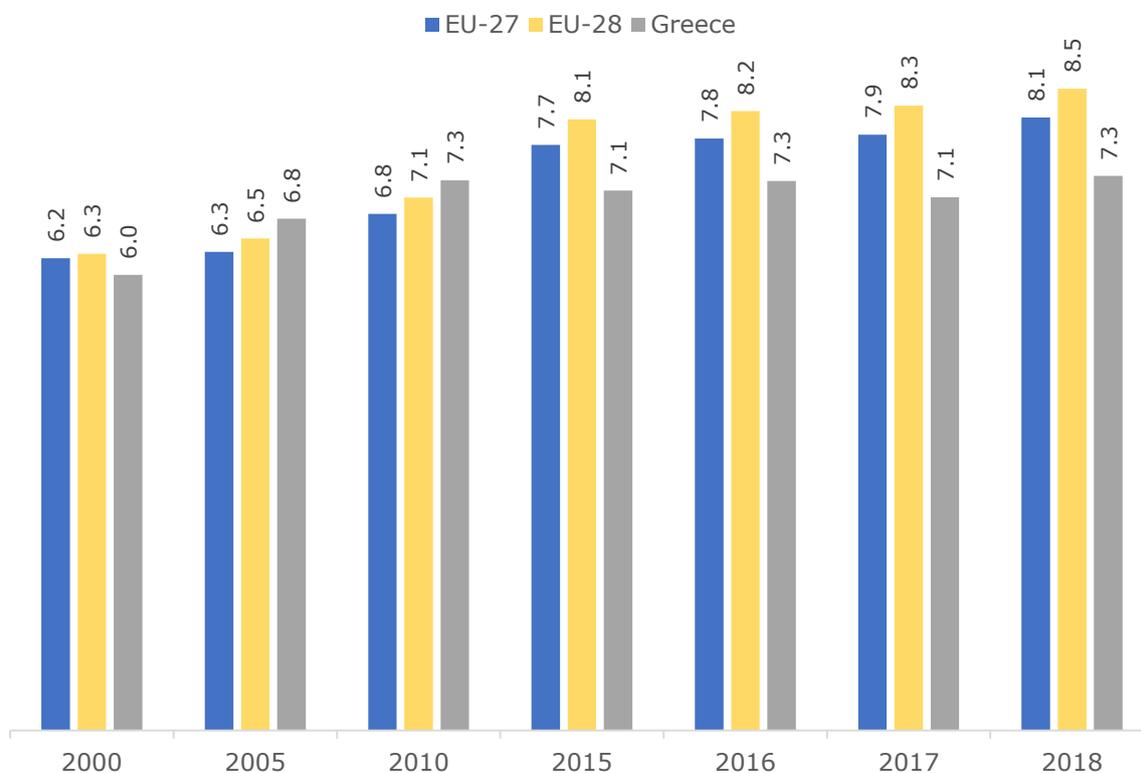
Source: Eurostat, HAAE's analysis

Highlights

- The EU-28 has introduced a maximum bound for final energy consumption at 1.086 Mtoe for 2020, a target that can be partially achieved due to the recent recession.
- The corresponding target for 2030 is at the level of 956 Mtoe, but it will downward adjust after Brexit.
- Each European country is obligated to conduct a national energy plan to accomplish the efficiency target set by the European Union for 2030.
- Another target revision will be made in 2023 following observation of the Energy Efficiency performance of European countries.
- EU has primarily used fiscal policy to mitigate climate change, but the role of monetary policy will be more prominent in the achievement of the 2030 target.

Energy productivity is a pivotal factor which ensures that economic growth aligns with energy efficiency

Energy Productivity for EU-28, EU-27 & Greece (€/Mtoe), [2000-2018]



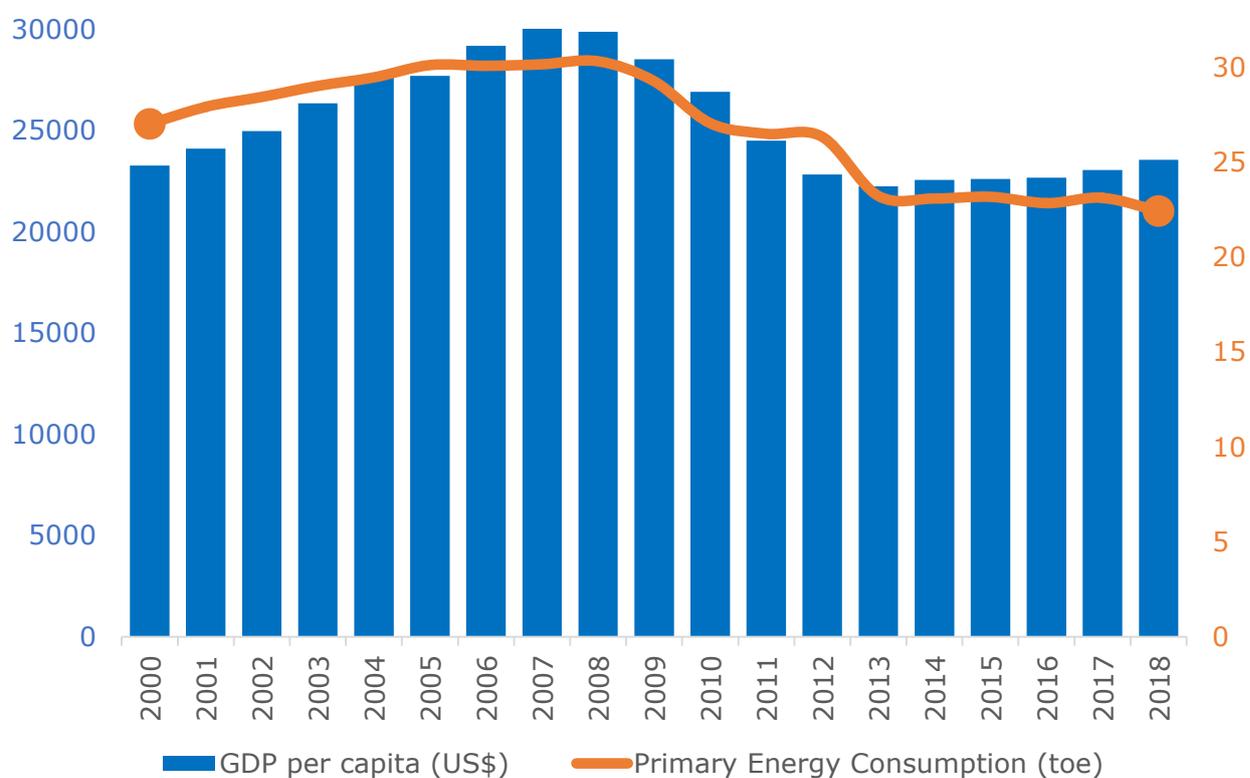
Source: Eurostat, HAEE's analysis

Highlights

- Energy Efficiency can be spuriously increased when the aggregate economic output declines and thus generates a decrease in the level of energy used for that output.
- Consequently, high energy productivity secures that a decrease in energy usage is associated with expanding growth rates.
- Energy productivity improved by 22% during the previous decade in Greece, but thenceforth Greek productivity is inferior to the European Union's average.
- EU-28 and EU-27 have increased energy productivity by 35% and 27% in 2018, reaching 8.5 and 8.1 €/Mtoe respectively.
- Despite the sanitary and financial measures against it, COVID-19 has already caused another lasting crisis and thus the role of energy productivity becomes essential.

The recovery of the Greek economy is accompanied by decreased energy consumption and increased Energy Efficiency

GDP per Capita (constant 2010 US\$) & Primary energy Consumption (toe) in Greece, [2000-2018]



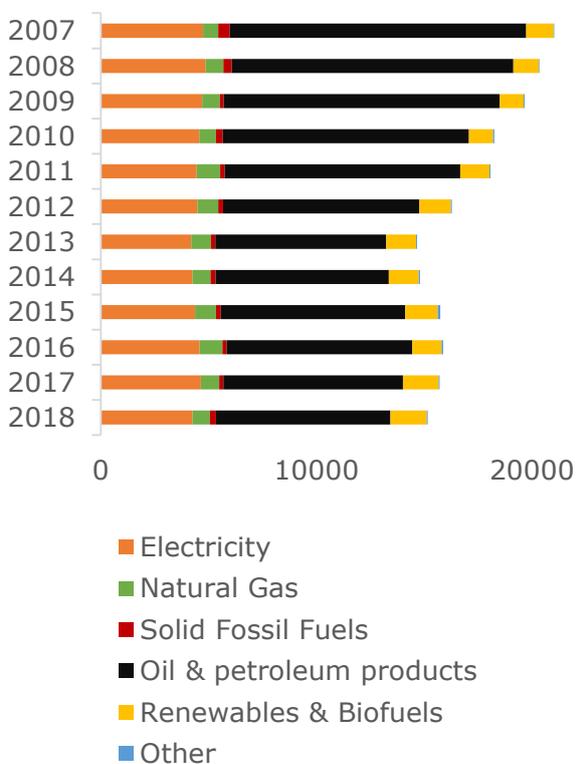
Source: World Bank, Eurostat, HAEE's analysis

Highlights

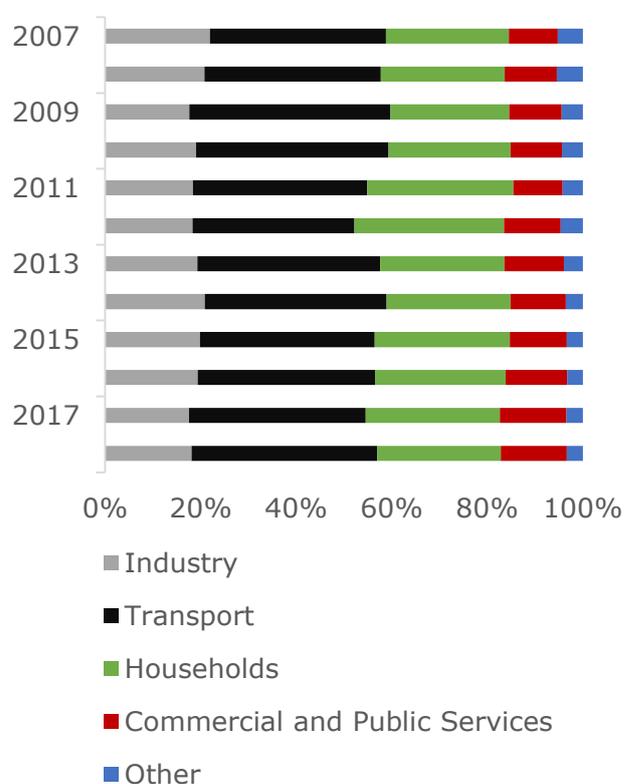
- Energy efficiency analysis can be decomposed into the trends of GDP per capita and final (or primary) energy consumption.
- GDP per capita continues to follow an upward trend in the Greek economy reaching 23.558 US\$ in 2018 (constant 2010) whereas energy consumption contracts.
- Particularly, GDP has increased by 6% from 2012 to 2018 while primary energy consumption decreased by 15%, indicating evidence of energy efficiency.
- Nevertheless, Greece must follow the National Plan for Energy and Climate which includes aggressive actions for the completion of the 2030 energy efficiency targets.
- The revised Plan takes into account the diversification of fuels that contribute to Greek energy consumption and additionally, the peculiarities of the Greek market.

Oil and Petroleum products dominate the Greek fuels while transport is the sector driving the energy consumption

Final Energy Consumption by Fuel (toe)
[2007-2018]



Final Energy Consumption by Sector (%)
[2007-2018]



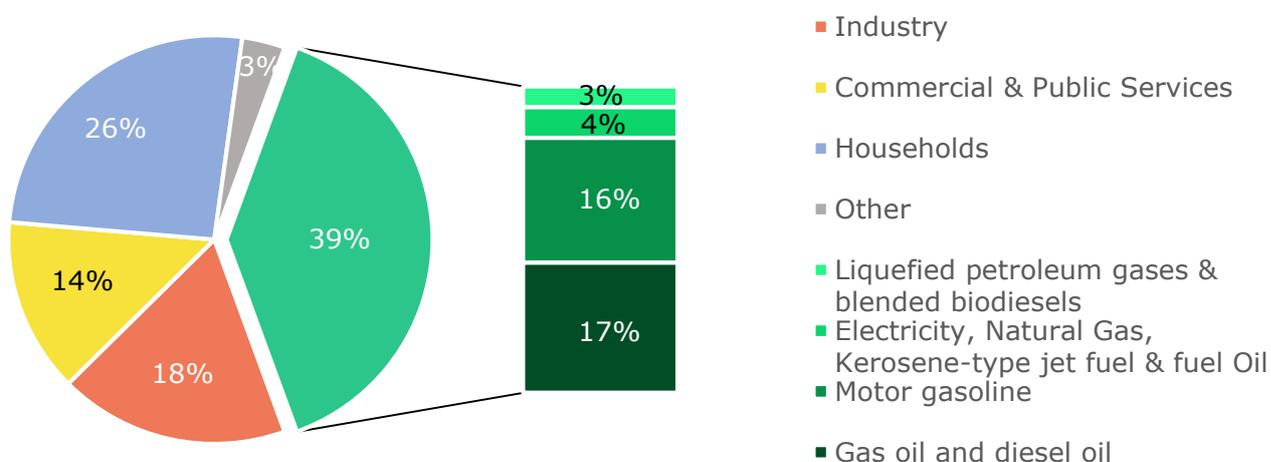
Source: Eurostat, HAEE's analysis

Highlights

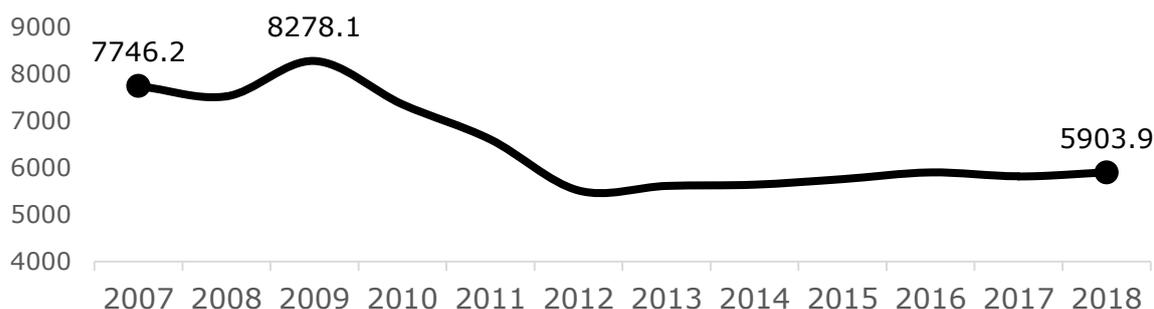
- The intensity of oil and petroleum products on Greek energy consumption has been decreased the last decade but remains the fuel with the highest share.
- The share of electricity is approximately constant (28% in 2018), while the exploitation of renewables and biofuels has been enlarged (11% in 2018).
- The role of Natural Gas is crucial for the energy transition and cannot be neglected, albeit it has been decreased by 23% from 2016 to 2018 in the Greek economy.
- In terms of economic activity, the shares of sectors remain almost steady throughout this decade with transportation to lead the consumption of energy.
- On a decade average, industry utilizes 19% of the national energy, while the shares of transportation, households and services are 38%, 27% and 12% respectively.

Gas oil, diesel oil and motor gasoline are the prevailing fuels in transportation, representing 33% of final consumption in transportation

Fuels Contribution to the Final Energy Consumption of Transportation (%), [2018]



Final energy consumption of transportation sector (toe), [2007-2018]

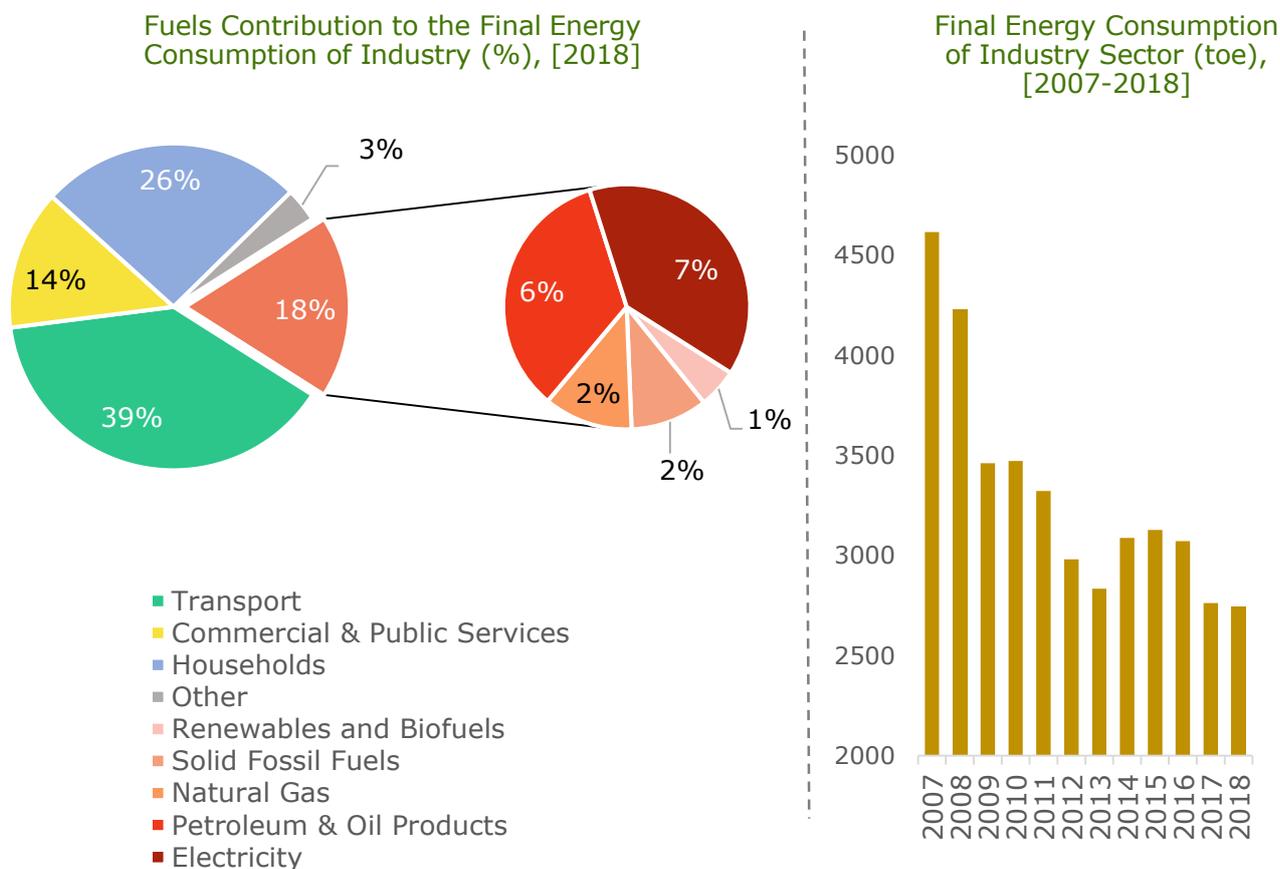


Source: Eurostat, HAEE's analysis

Highlights

- The final energy consumption of transport was 5.904 toe in 2018 (39%), but different fuels contribute disproportionately to this aggregate amount.
- Gas oil and diesel oil used in transportation account for 42% of the transport energy consumption and 17% of the total energy utilized, which translates to 2.504 toe.
- Another principal fuel utilized in transportation is the motor gasoline which is responsible for 16% of the entire energy consumption.
- The notable shares of those fuels highlight the need of eco-mobility since they are primarily used in road transportation.
- Finally, the Greek crisis in 2009-2012 led to a 33% decrease in energy used in transportation, while hereafter a slightly increasing trend prevails.

Electricity, Petroleum and Oil Products dominate the fuels market while energy consumption of industrial sector has shrunk by 40% since 2007



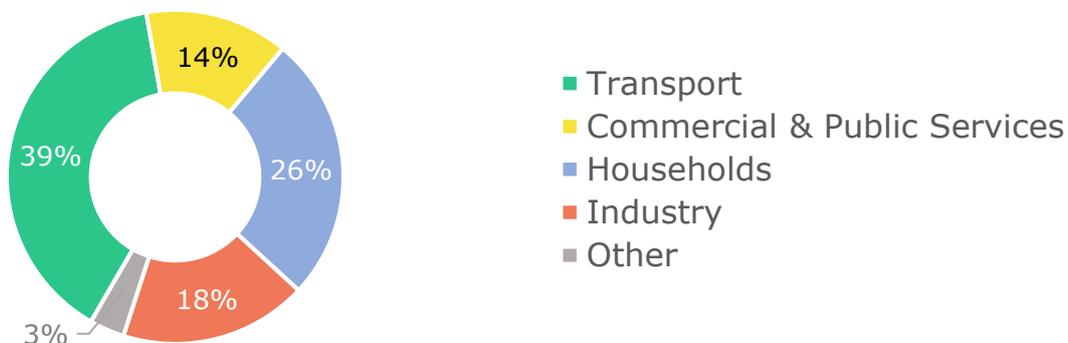
Source: Eurostat, HAEE's analysis

Highlights

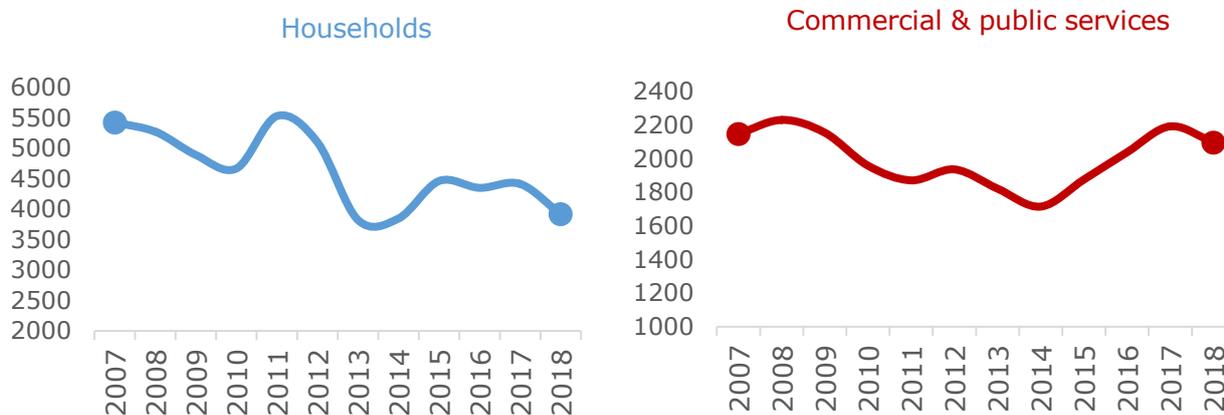
- Some fuels supply more than others to the energy consumption of industry, namely petroleum products and electricity constitute the dominant energy sources.
- Specifically, electricity is responsible for 39% of the energy utilized in the industry sector and 7% of the total energy consumption, which is equivalent to 1.067 toe.
- The % of petroleum & oil products in overall energy usage is notable (6%), as well as the share of this fuel in the energy consumption of the industry sector (34%).
- Natural Gas, solid fossil fuels, Renewables and biofuels are the remaining crucial sources of energy consumption of the industry sector.
- Moreover, the final energy used in the industry sector follows a downward trend since the Greek crisis in 2008 and onwards.

Households, commercial and public services are responsible for almost 40% of overall energy consumption

Final Consumption of Energy by Sector in Greece (%) [2018]



Energy Consumption for Households and Commercial & Public Services (toe), [2007-2018]



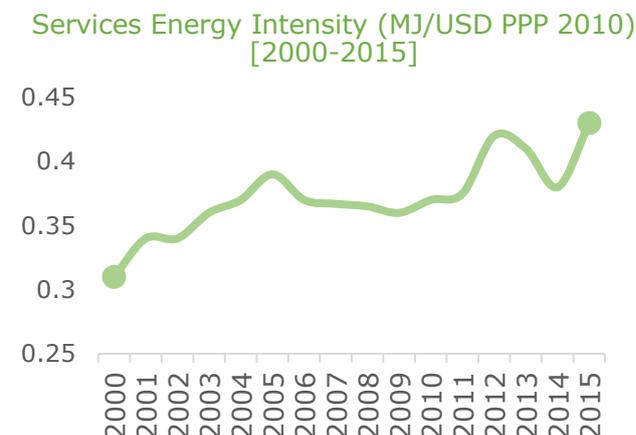
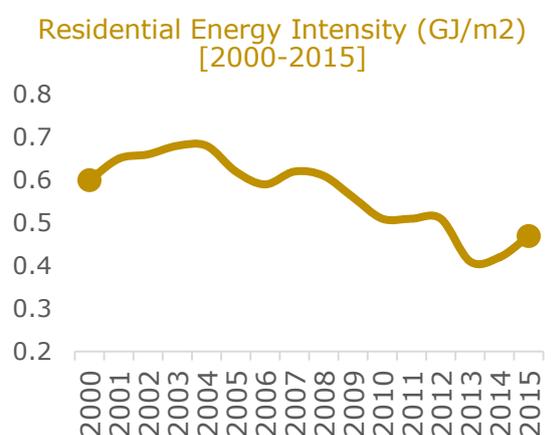
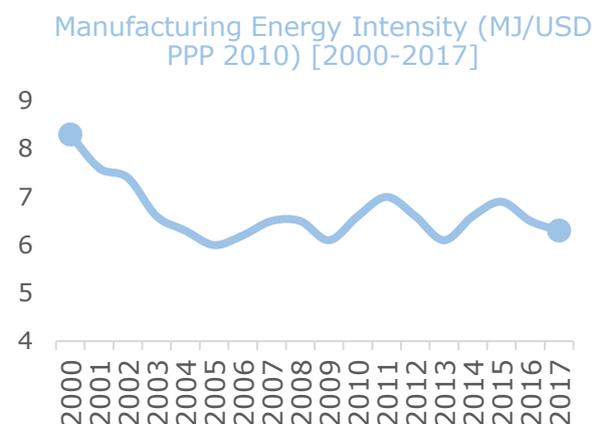
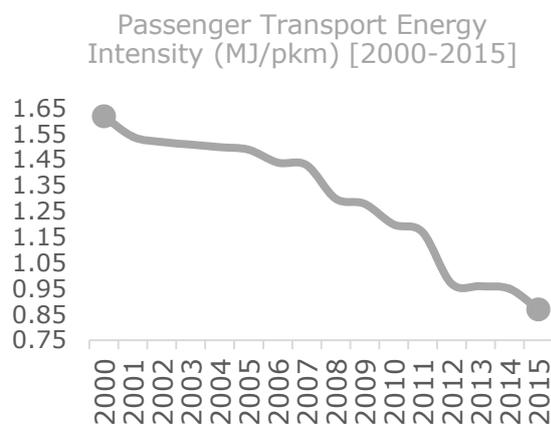
Source: Eurostat, IEA, HAEE's analysis

Highlights

- Although most emphasis is given to transport and industry sectors, households and services are crucial sectors that can drastically improve the overall energy efficiency.
- The final energy consumption of services sector is largely dependent on electricity, while renewables & biofuels, natural gas and oil play a significant role as well.
- The share of electricity is also crucial in households' consumption (1.532 toe), as well the gas & diesel oil (952 toe) and the primary solid biofuels (658 toe).
- The final energy consumption of households has experienced a substantial decrease by 28% during the period 2007-2018.
- The energy consumption of services sectors mirrored the recovery of the Greek GDP, and hence the energy consumption remained considerably high at 2.095 toe.

Energy efficiency significantly varies across sectors in the Greek economy, yet a downward trend is apparent in all of them

Energy Intensity by Sector



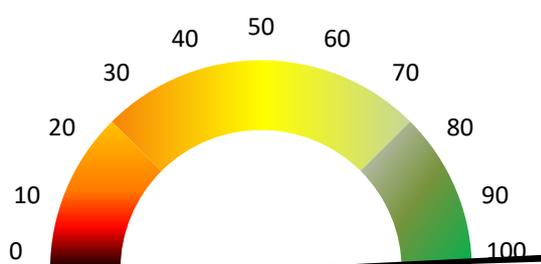
Source: IEA, HAEE's analysis

Highlights

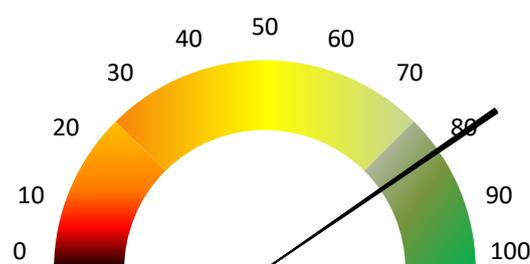
- Energy-efficient policies should aim at the entirety of the economy, but every sector reacts differently depending on its particular characteristics.
- Energy intensity of transportation has undergone the largest percentage decline (46%) among all economic sectors, through the period 2000-2015.
- In the same time period, residential energy intensity reduced by 22%, reaching the value of 0,47 GJ per m^2 in 2015.
- Manufacturing energy intensity has undergone several fluctuations during 2000-2017, succeeding to reduce energy dependence by 2 MJ/\$.
- The upward trend of energy intensity in the services sector, questioning the current energy effectiveness and calls for further action in this sector.

Participation in EU guarantees successful performance in a range of efficiency indicators, but further effort is still required

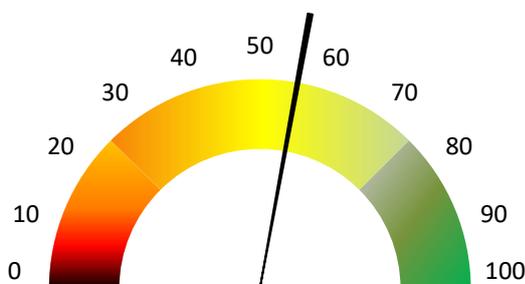
Energy Efficiency Indicators for Greece (%)



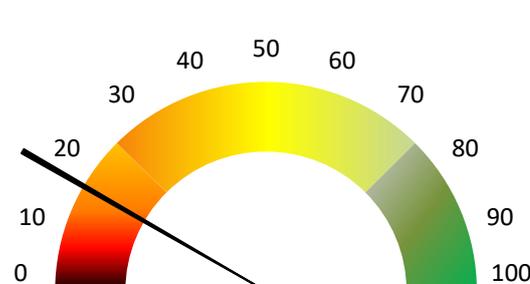
Carbon Pricing & Monitoring (%)



Information Provided to Consumers about Electricity Usage (%)



Energy Labeling Systems (%)



Transport (%)

Source: RISE, HAEE's analysis

Highlights

- Greece has accomplished to receive the highest possible score for Carbon Pricing & Monitoring due to the participation in the European Union Emission Trading System.
- The rating for electricity usage information is also satisfactory, but further improvements are possible, e.g. comparison between current and previous bills.
- There is room for improvement in "Energy Labeling Systems" which could have also included industrial electric motors, other industrial equipment and vehicles.
- Transport indicator is very low due to lack of both a national reporting system for efficiency metrics and a mandate to support the reduction in transport demands.
- Overall, the Greek economy has achieved a sufficient level of energy efficiency, but more policies needed in-country and international level to meet the current targets.

9. Investments



Highlights



Due to the **COVID-19** crisis, **fuel supply** investments have been hit hardest in 2020, while utility-scale **renewable** power has been more resilient



Over the upcoming years, about **8,200 MW** of **RES** projects or **investments** equivalent to **8.5 billion euros** will proceed to implementation



For every **single euro of investments** in RES, another **3 to 8 euros** is returned to the economy, depending on the technology and the local conditions



The total **outstanding loans** in energy sector stood at **€5.2bn** in 2020 increasing steadily by almost **11%** since 2017

Global new investments in **RES** for 2019 account for **41%** of **new investments** in upstream and downstream of **Oil** and **Gas** sector



The revised National Energy Plan of 2019 is increased by **11.1 billion euros** compared to 2018 projections reaching the total of **43.8 billion** in terms of future energy related investments



€1.5 billion of new investments will be directed towards new **interconnections** in the **Greek islands**



The **energy sector** outperforms in terms of credibility with an annual rate of **non performing exposure** for 2018 at **3.4%**



Technology cost of Solar panels, Wind parks and battery storage have declined by **85%**, **49%** and **85%** respectively, since 2010



Overview

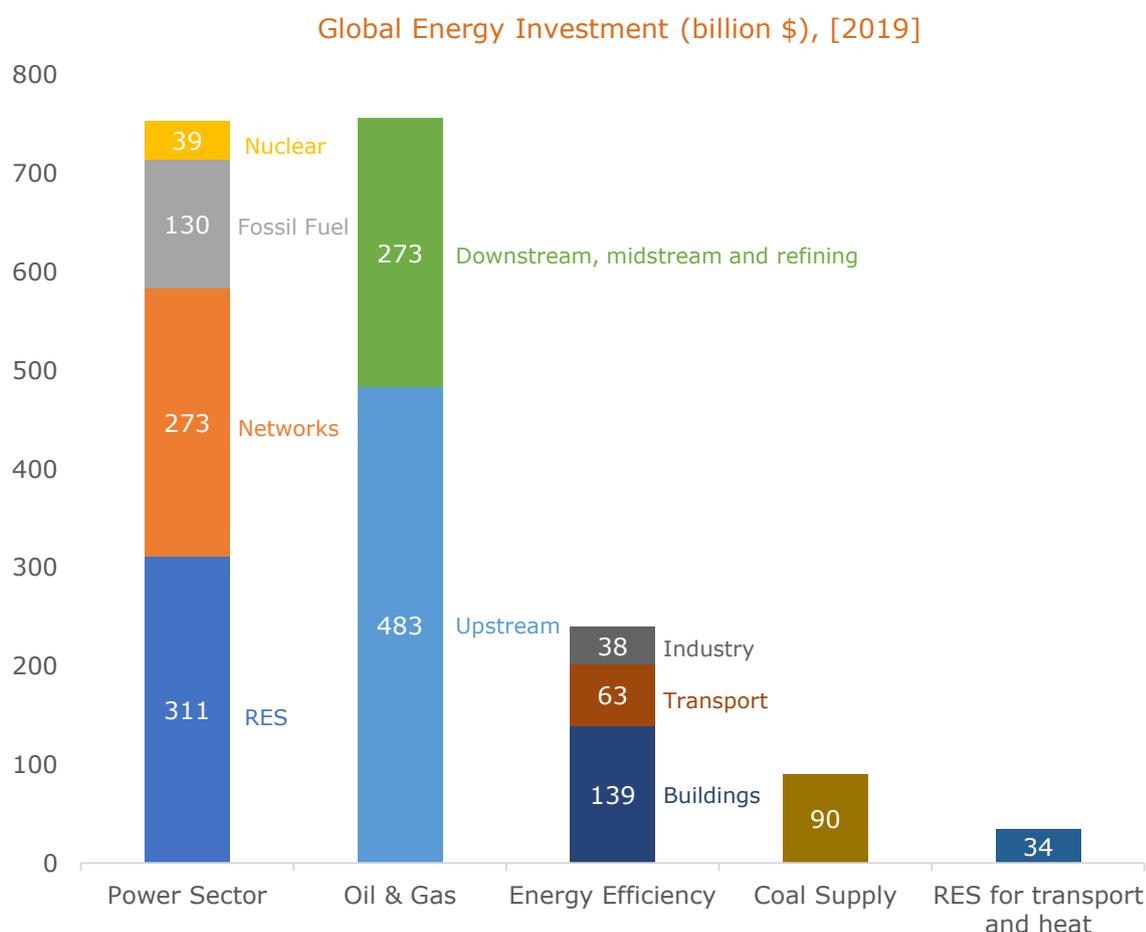
Current investment trends at a global scale, show the need for bolder decisions required to make the energy system more sustainable. Energy investments should satisfy the world's growing demand for low-carbon technologies to accelerate the pace of global energy transition. Wind and Solar are anticipated to represent almost 50% of world electricity in 2050 and help put the power sector on track for 2 degrees to at least 2030. Specifically, by 2050, Solar and Wind make up 80% of the energy mix in Europe, 78% in Australia, 55% in India, 48% in China and 35% in the USA.

Global clean energy investment in 2019 reached 364 billion dollars, growing by 86% compared to a decade ago in 2009. However, no significant annual growth in new global investments for clean energy recorded in 2019, since the various renewable energy sources preserved at 2018 levels. The European Union is leading the way of RES penetration and is actively promoting Europe's evolution to a low carbon society and facilitates new investments in the clean energy transition.

Considering the case of Greece, the ample availability of Renewable Energy potential show that the country could be a key player in the formulation of the European Union energy mix. In parallel, the Greek banking system favors to provide loans on the robust Greek Energy sector, since its non-performing exposure share is considerably low. In that context, loans towards the Energy sector rose by 10.7% compared to 2017 levels, despite the huge drop in terms of total lending. The next day for Greek banking system is to provide a set of new investment opportunities that could assist win-win potentials in the market. Currently, borrowing at Corporate level, Project and Acquisition Financing remain the basic source of funding.

Despite the COVID-19 outbreak, major energy investments have already been announced which are unaffected by the overall deterioration of economic activity and at the same time, Greece creates energy investment opportunities due to the availability of RES potential and the ongoing sizeable infrastructure projects. Finally, huge investment amounts will be directed towards the support of Circular Economy, Climate Change and Refining adding €8.5 billion in the projections included in the revised National Plan for Climate and Energy. The total projected amount until 2030, equal 43.8 billion euros with RES and Energy Efficiency representing almost 46% of the total new investments.

Current investment trends show the need for bolder decisions required to make the energy system more sustainable

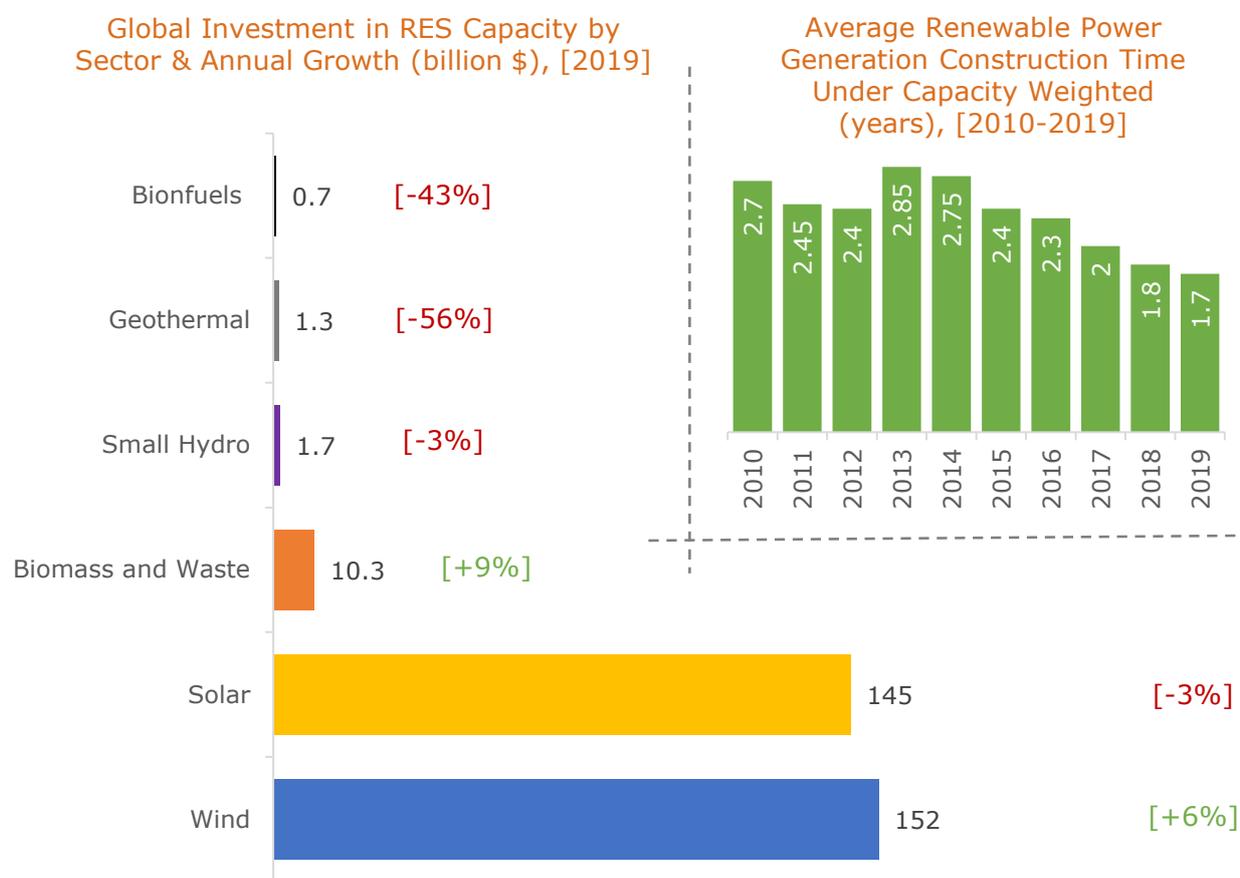


Highlights

Source: IEA, HAEE's analysis

- Energy investment remained at \$1.85 trillion in 2018, while a rise in fossil fuel supply investment offset lower power and stable efficiency spend.
- Despite the shift, power was the largest sector for the third year in a row, representing almost 38% of total energy investments.
- The largest investment growth was in the United States, which has been catching up with China, mainly due to Oil and Gas supply and electricity networks.
- Investment decisions for coal power are down by 80% this decade, but the fleet continued to grow in Asia in 2019.
- While energy R&D spending rose modestly in 2019, led by the USA and China, most countries are not spending more of their economic output on energy research.

Energy investments should satisfy the world's growing demand for low-carbon technologies to accelerate the pace of global energy transition



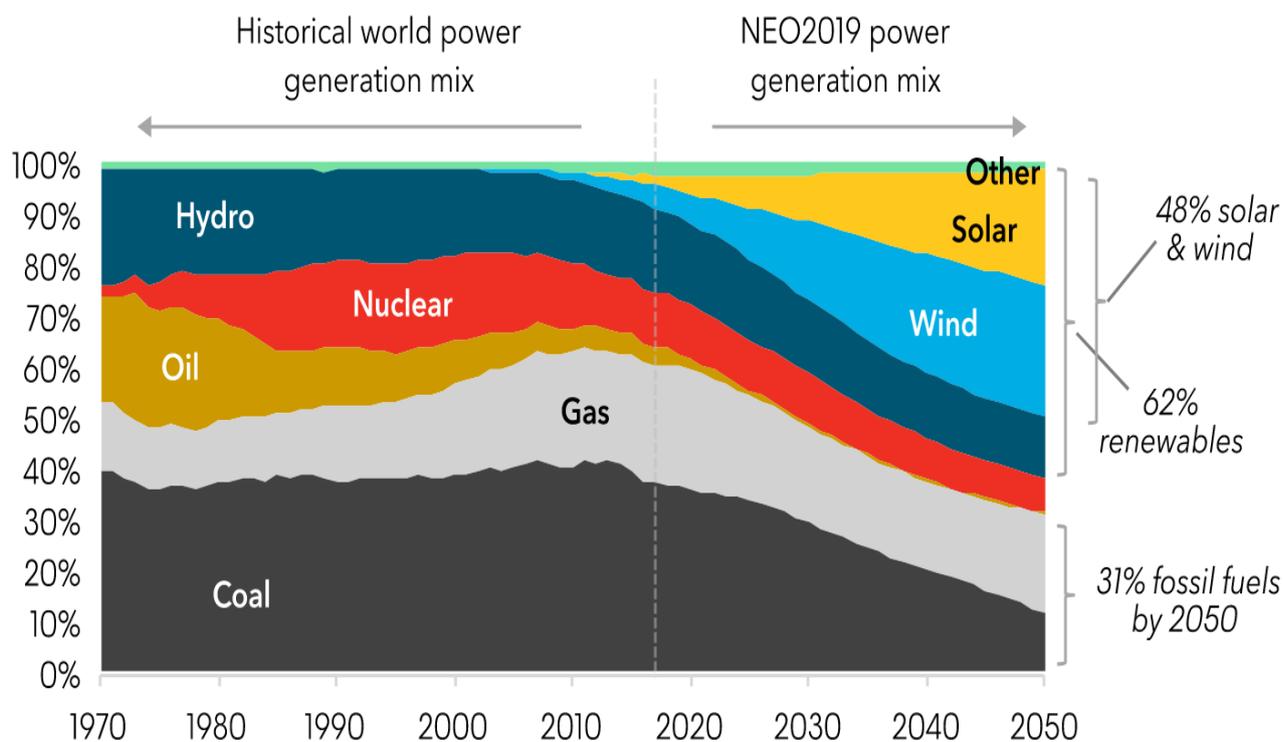
Source: IEA, HAEE's analysis

Highlights

- Renewables investment edged down, as net additions to capacity were flat and costs fell in some technologies, but was also supported by plants under development.
- Lower solar PV investment in China was partly offset by higher renewable spend in some areas such as the United States and developing Asia.
- Adjusting investment to 2018 cost levels shows a rising trend in spending activity for renewable power, up around 55% since 2010.
- Compared to 2015, investment in renewable power remained relatively stable, but at high levels, with China being the largest market for energy investments in RES.
- In 2019, renewable spending continued to exceed that for fossil fuel-based power, supported by tendering for solar PV and Wind.

Wind and solar make up almost 50% of world electricity in 2050 and help put the power sector on track for 2 degrees to at least 2030

Global Power Generation Mix (%), [1970-2050]



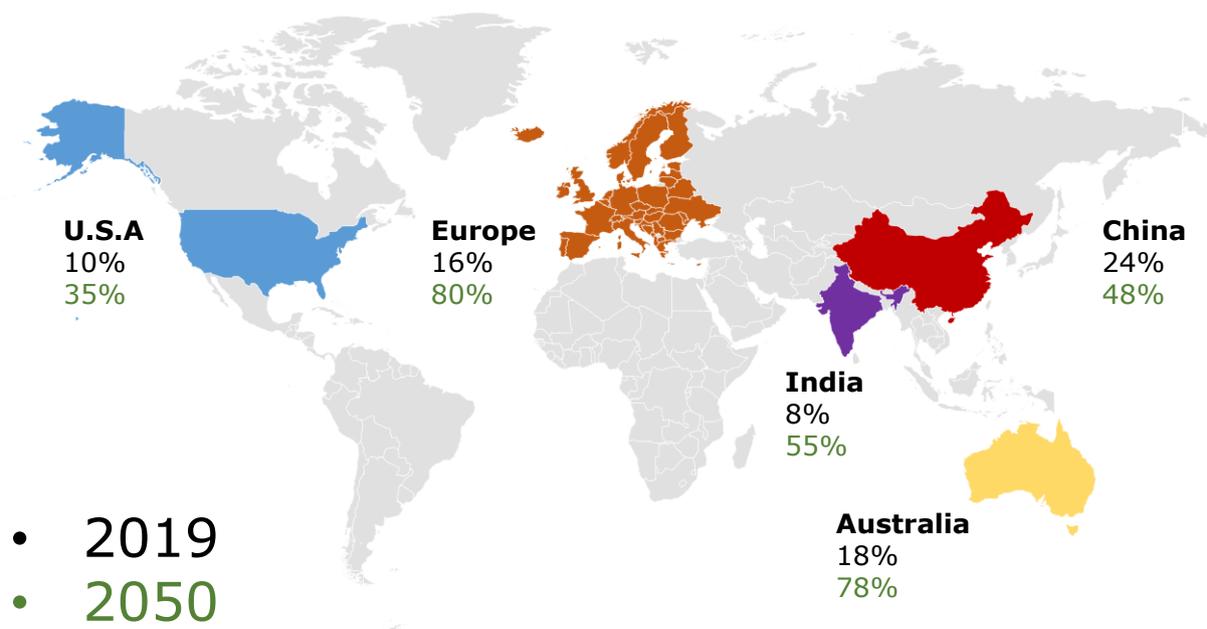
Source: Bloomberg NEF, HAEE's analysis

Highlights

- A 12TW expansion of generating capacity requires about \$13.3 trillion of new investment between now and 2050, 77% of which goes to renewables.
- Europe decarbonizes further and faster while Coal-heavy China and Gas-heavy U.S. play catch-up.
- Wind and Solar are now the cheapest across more than two-thirds of the world. By 2030 they undercut commissioned coal and gas almost all over the world.
- Technology cost of Solar panels, Wind parks and battery storage has declined by 85%, 49% and 85% respectively, since 2010.
- Consumer energy decisions such as rooftop solar and behind-the-meter batteries help shape an increasingly decentralized grid all over the world.

By 2050, solar and wind make up 80% of the energy mix in Europe, 78% in Australia, 55% in India, 48% in China and 35% in the USA

Solar and Wind Penetration in the Energy Mix (%), [2019 & 2050]



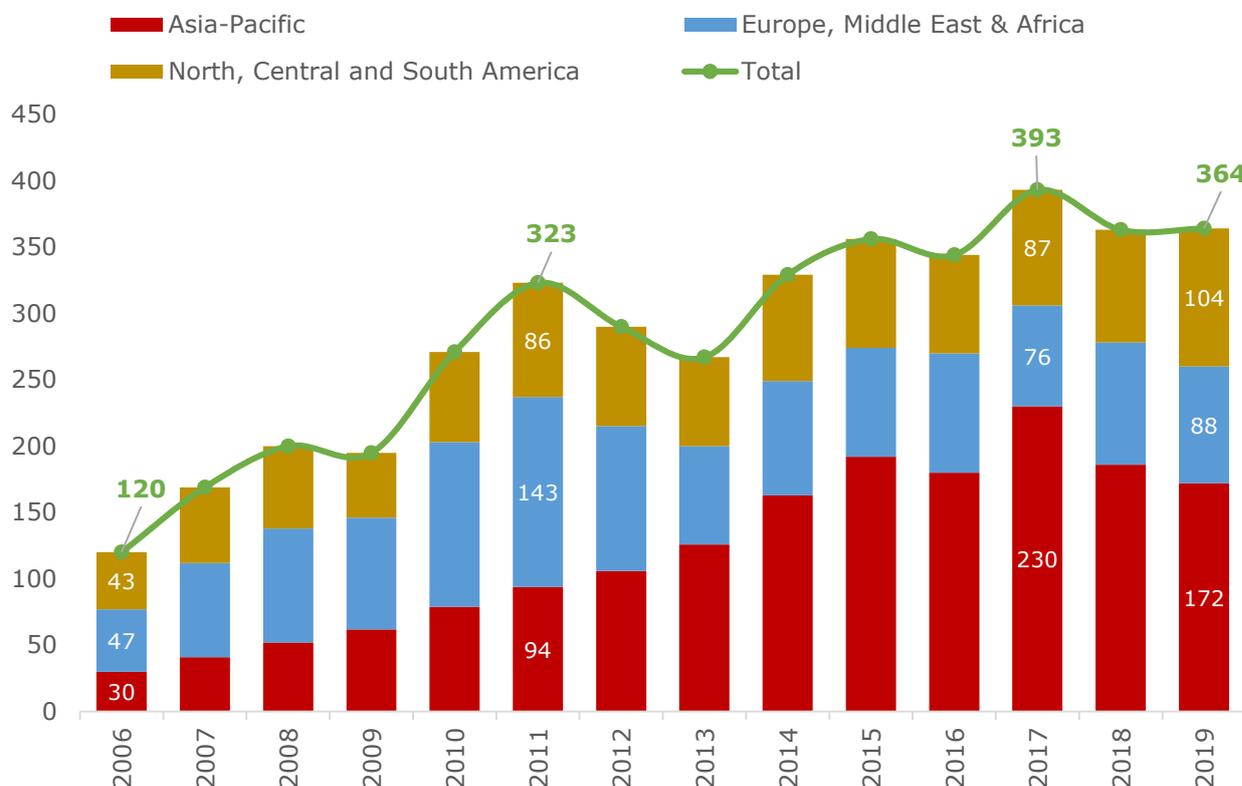
Source: Bloomberg NEF, HAEE's analysis

Highlights

- The U.S electricity system continues to replace aging coal and nuclear with cheaper renewables and gas, which become the premier source of power generation.
- Cheap renewables, flexible demand and batteries shift the European power system away from fossil fuels and nuclear to one built around emission-free energy.
- India's sustained electricity demand growth drives more than a sixfold increase of the power system.
- China sees peak coal generation and emissions in 2027, as the world's biggest electricity system reaches 37% renewables penetration.
- Australia's power system is on track to become the most decentralized in the world, with consumer PV and behind-the-meter batteries making up 38% of all capacity.

Global clean energy investment in 2019 reached 364 billion dollars, growing by 86% compared to a decade ago in 2009

Global New Investment in Clean Energy by Region (\$bn), [2006-2019]



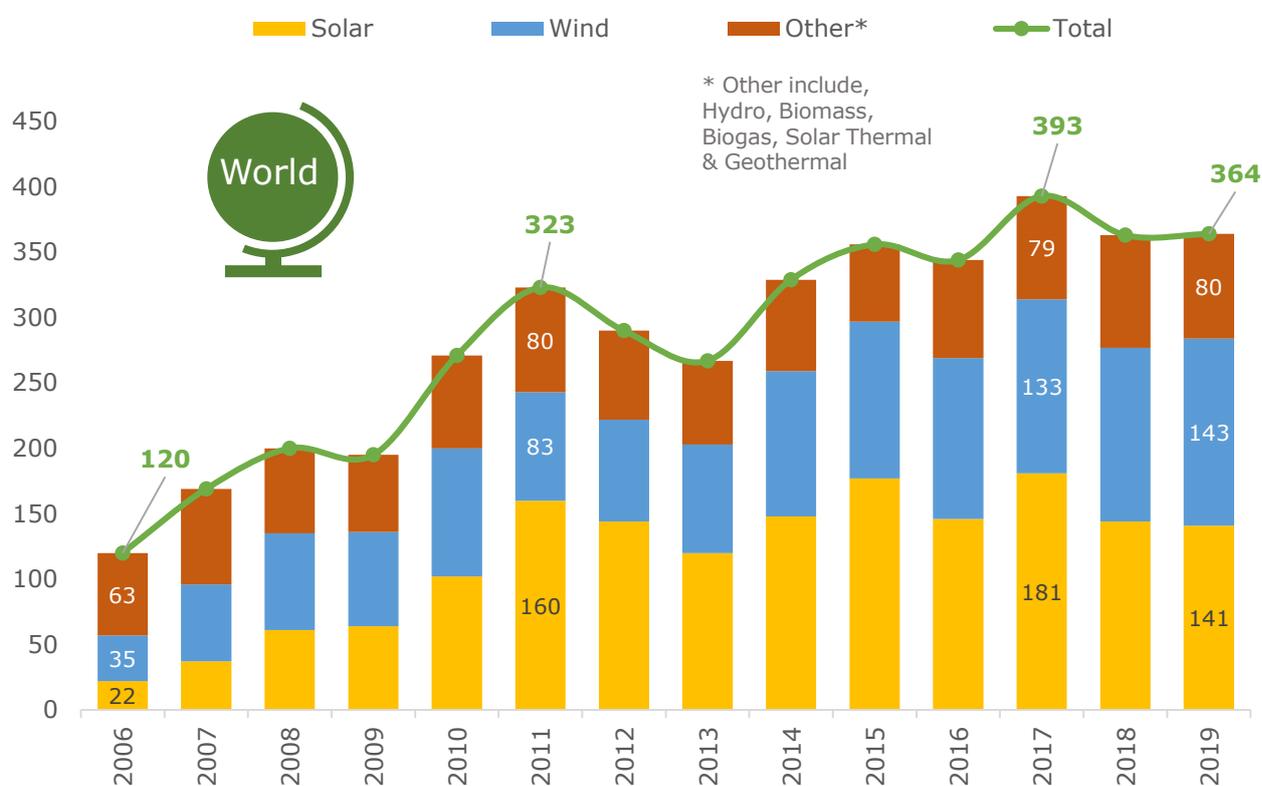
Source: Bloomberg NEF, HAEE's analysis

Highlights

- China was yet again the biggest investor in renewables, at \$83.4 billion in 2019, but this was 8% down on 2018 and the lowest since 2013.
- China, saw a 10% rise in wind investment to \$55 billion, but solar fell 33% to \$25.7 billion, less than a third of the boom figure reached in 2017.
- New investments in clean energy in Europe, Middle East & Africa stood at \$88 billion in 2019, meaning that no significant acceleration occurred over the past decade.
- On the other hand, the latest data coming from North, Central & South America reveal a substantial increase, from \$88 billion in 2018 to \$104 billion in 2019.
- By 2032, there is more Wind and Solar electricity in the world than coal-fired electricity and by 2050, Coal-fired generation stands at 12% of electricity generation.

No significant annual growth in new investments recorded in 2019 since the various renewable energy sources preserved at 2018 levels

Global New Investment in Clean Energy by Sector (\$bn), [2006-2019]



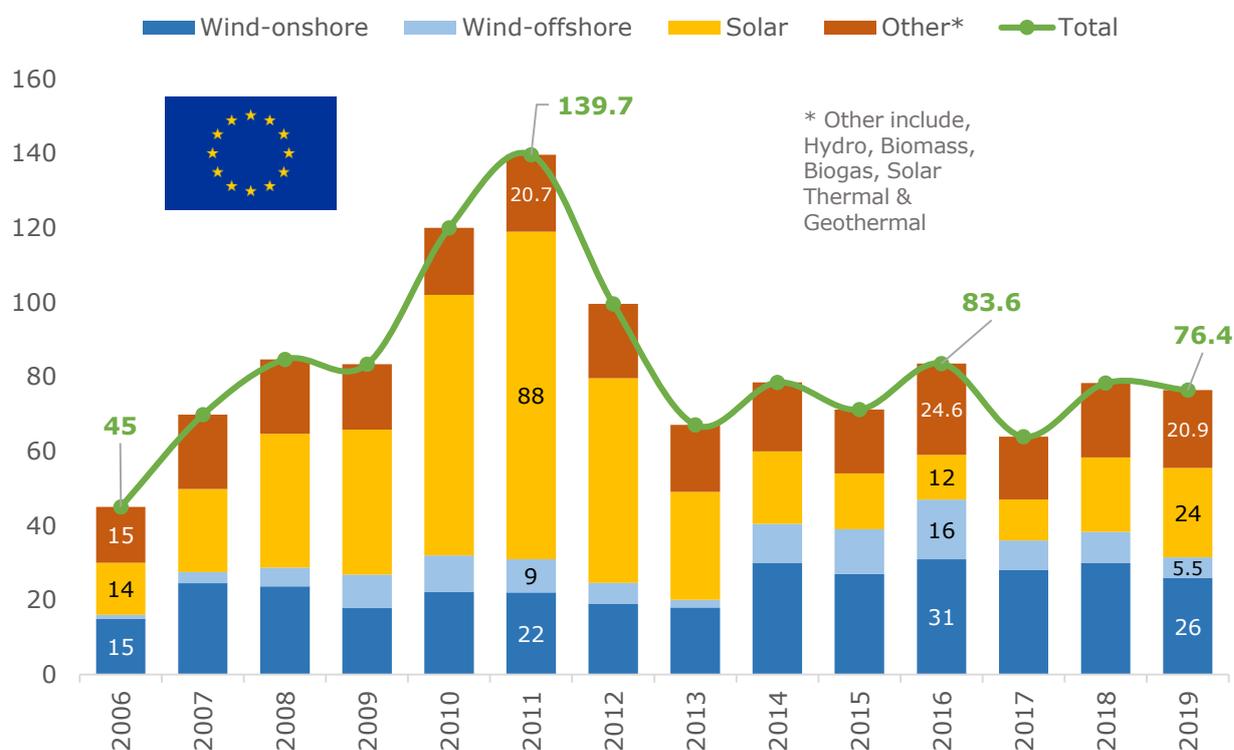
Source: Bloomberg NEF, HAEE's analysis

Highlights

- Compared to 2006, new investment in clean energy has grown from \$120 billion to \$364 billion in 2019, however this amount is relatively stable over the last five years.
- The first peak is observed in 2011, reaching at the record price of \$323 billion, due to an unprecedented spike in solar energy investments at the level of \$160 billion.
- Next, in 2017 new clean energy investments stood at the maximum level until today, with solar representing 46% and wind 34% of the total amount.
- Interestingly, hydro, biomass, biogas, solar thermal and geothermal maintain a share of 27% on average over the whole period under examination.
- Due to the COVID-19 crisis, fuel supply investments have been hit hardest in 2020 while utility-scale renewable power has been more resilient.

The EU is actively promoting Europe's transition to a low-carbon society, and facilitates new investments in the clean energy transition

European New Investment in Clean Energy, by Sector (\$ bn) [2006-2019]

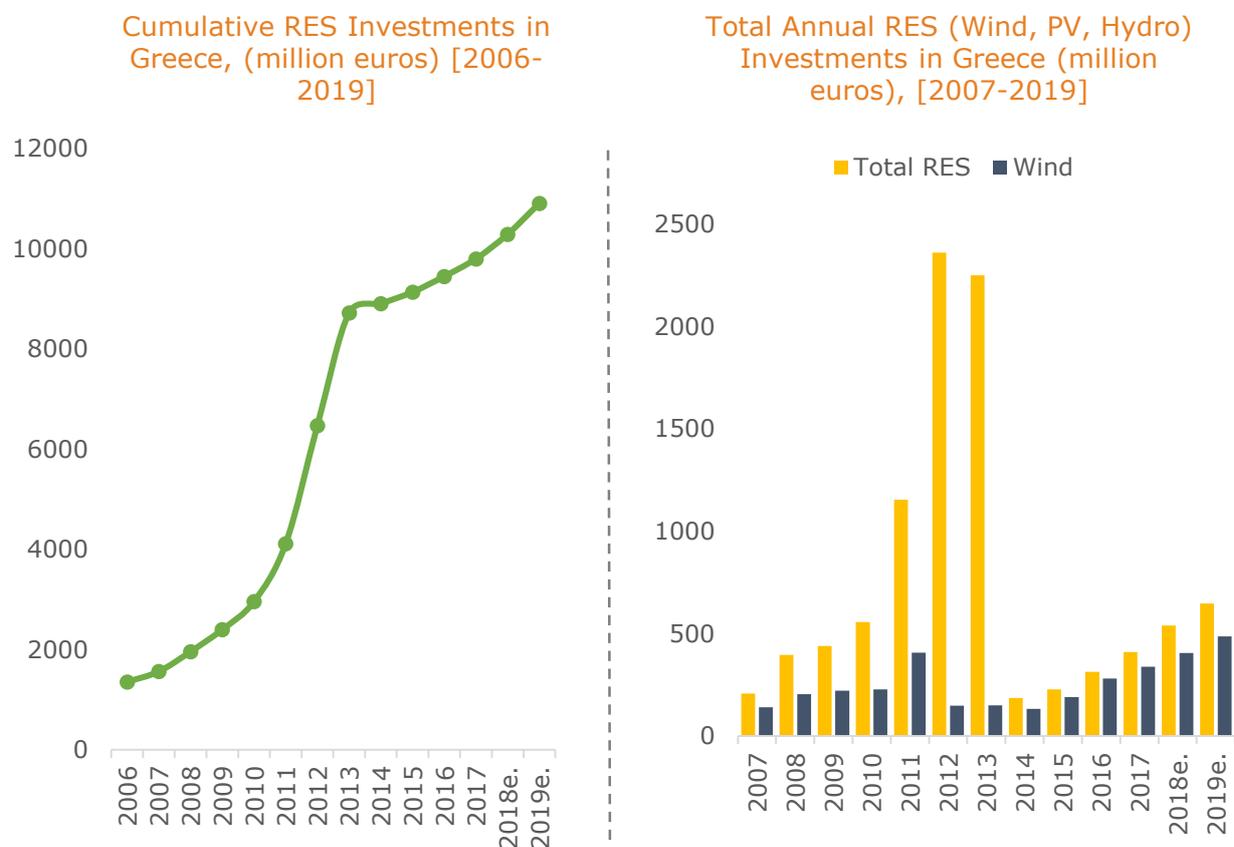


Source: Bloomberg NEF, HAEE's analysis

Highlights

- In terms of total annual investments in clean energy over the whole European Union, a stagnation at the level of around \$80 billion is apparent since 2013.
- From the level of \$45 billion in 2006, total new clean energy investments rapidly increased to almost \$140 billion in 2013 mainly due to the boom in the solar sector.
- European new investments in onshore Wind were relatively stable over the past decade, however, after 2014 offshore investments grew considerably.
- The rapid decrease in the cost of renewables, combined with improved design of support policies, has already benefited consumer welfare across the member states.
- In line with the European Green Deal, further decarbonizing the energy system is critical to reach climate objectives in 2030 and 2050.

The ample availability of renewable energy potential show that Greece will be a key player in the formulation of the EU energy mix



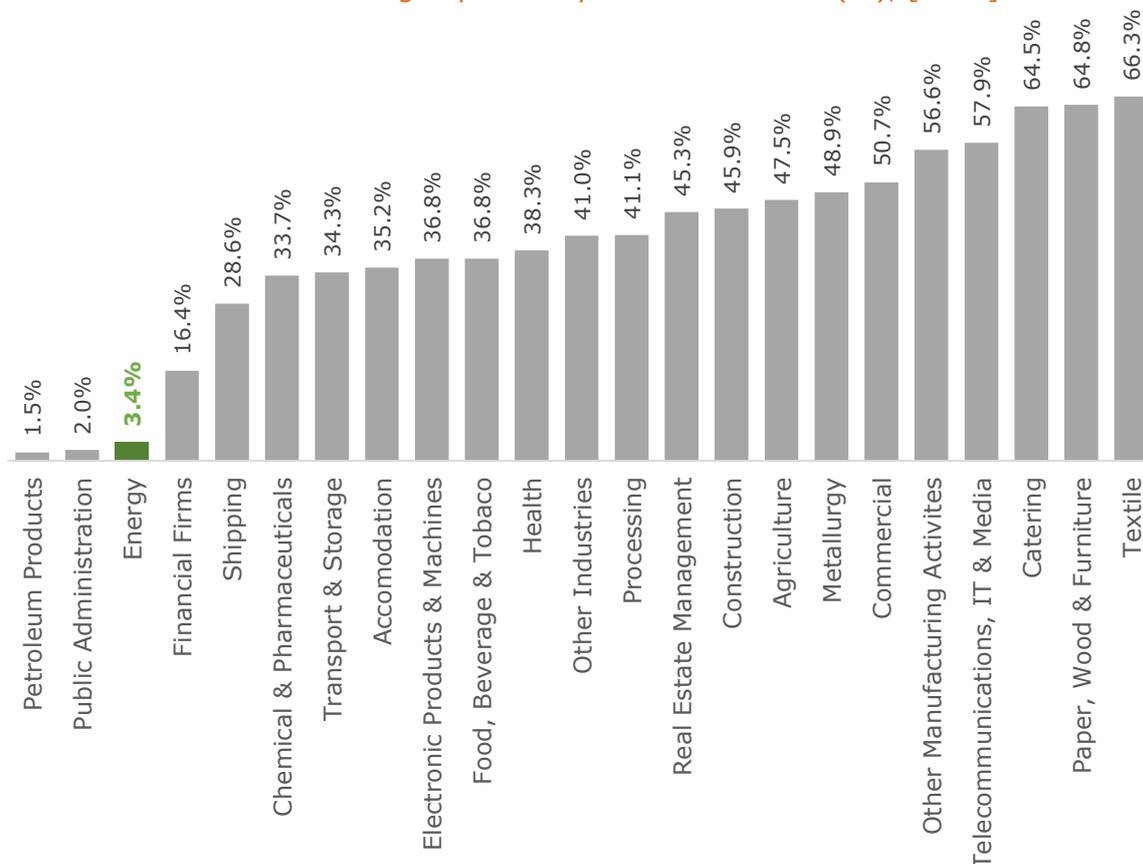
Source: HAEE's analysis

Highlights

- The Greek energy system is characterized by increased RES electricity production, reflecting Greece's efforts to adopt European and national policies.
- Investments in renewable energy sources could evolve into a vital recovery factor for the Greek economy in the post-coronavirus era.
- Currently, there are ready, fully licensed investments in RES with a total capacity of 2,400 MW per annum.
- At the same time, another 5,800 MW of RES projects have already secured environmental clearance.
- This means a total of about 8,200 MW of RES projects, adding up to some € 8.5-9 billion, can immediately proceed to implementation within the next three years.

The Greek banking system favors to provide loans on the robust Greek Energy sector, since its NPE percentage is considerably low

Non-Performing Exposure by Sector in Greece (%), [2018]



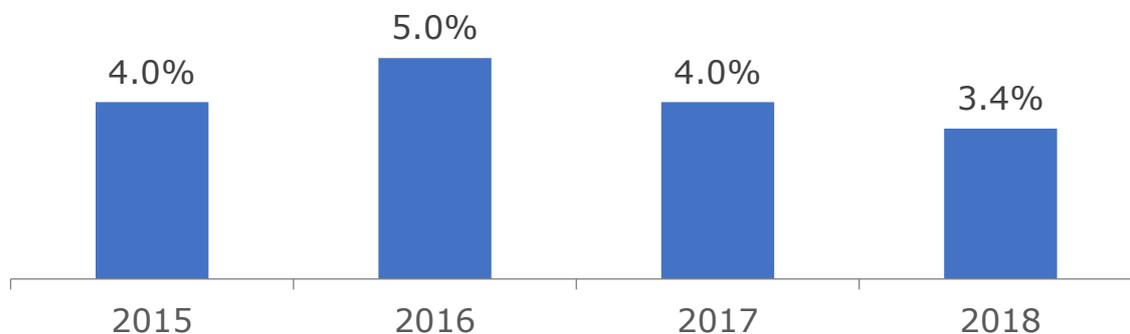
Highlights

Source: Bank of Greece, HAEE's analysis

- Despite the gradual banking sector's deleverage in key sectors of the economy, a different trend is observed with new target – sectors for creditworthiness.
- According to the latest figures coming from the Bank of Greece, Energy is, inter alia, a sector which face an increasing trend of its credibility starting from 2017.
- The average non performing exposure of all 23 sectors for 2018 is 38.1%, with petroleum products being the most creditworthy sector at 1.5%.
- On the other hand, the sectors of, Catering with 64.5%, Paper, Wood & Furniture with 64.8% and Textile with 66.3% are not considered as reliable borrowers.
- The energy sector outperforms in terms of reliability and credibility with an annual rate of non performing exposure for 2018 at 3.4%.

Loans towards the Energy sector rose by 10.7% compared to 2017 levels, despite the huge drop in terms of total lending

Non-Performing Exposure of the Energy Sector (%), [2015-2018]



Outstanding Loans in All Sectors (mil. €), [2015 – Feb. 2020]



Outstanding Loans in the Energy Sector (mil. €), [2015 – Feb. 2020]



Source: Bank of Greece

Highlights

- Over the last years, the non performing exposure of the energy sector, remained at significant low levels around 4%, compared to 45% of the overall economy.
- The total outstanding loans in energy sector stood at €4,7bn in 2017 increasing steadily by almost 11% up until today.
- On the other hand, the total outstanding loans including all economic sectors was reduced by 19% from 2015 and afterwards.
- The banking sector heavily supports investments on RES since those are considered as strategic investments of both EU's and Greece's.
- The pandemic did not affect the development of new RES investments in Greece, since both domestic and foreign investors continue to finance RES projects.

The next day for Greek banking system is to provide a set of new investment opportunities that could assist win-win potentials in the market

The New Energy Framework in Line With the Challenges of the Banking Sector



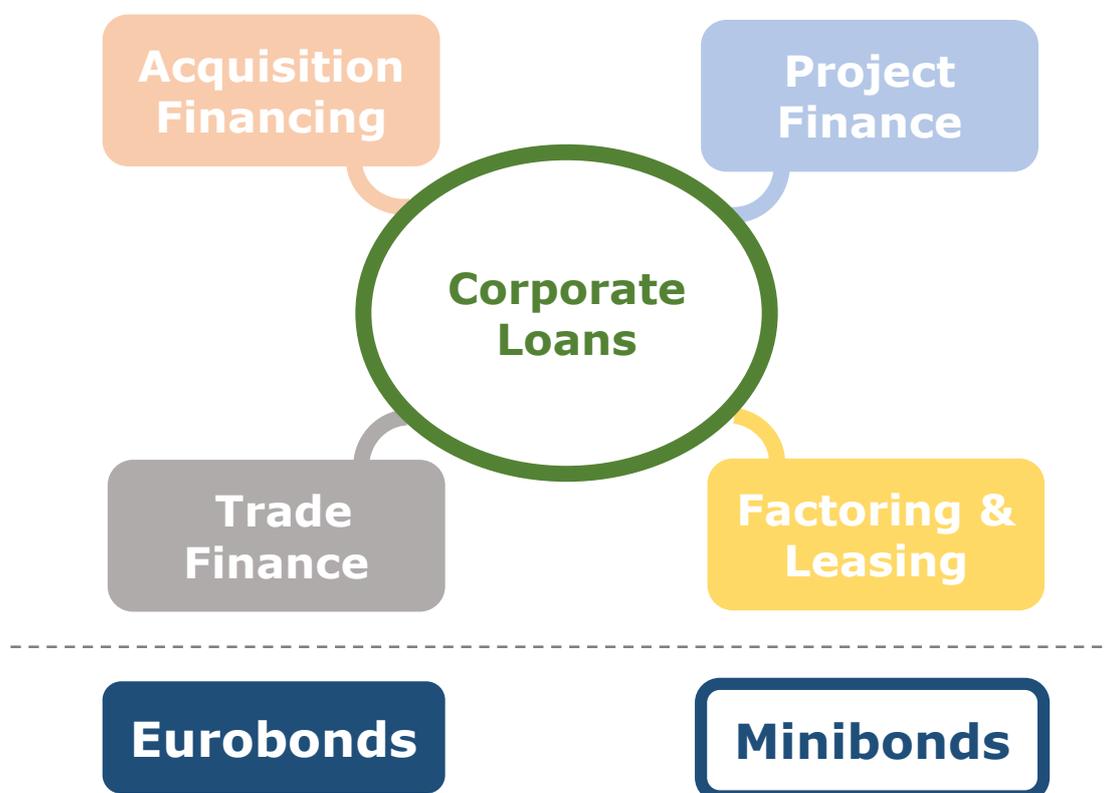
Source: HAEE's analysis

Highlights

- The new energy projects and the upcoming privatization of significant energy assets create a promising collaboration between energy and banking sector.
- The digital era and the effort of both energy companies and banks to transform their operations making them more efficient develop gradually multiple synergies.
- The new RES Model combining with a planning integrated operation and mergers of energy companies create a more solid sector's function.
- The new operation model and the upcoming transformation of energy sector given the low credit risk allow banks to invest in a relative safe sector.
- The efficient collaboration between the energy sector and the banking system, adds value for all the participants and maximizes their capital efficiency.

Borrowing at Corporate level, Project and Acquisition Financing remain the basic source of funding

Various Financing Mechanisms

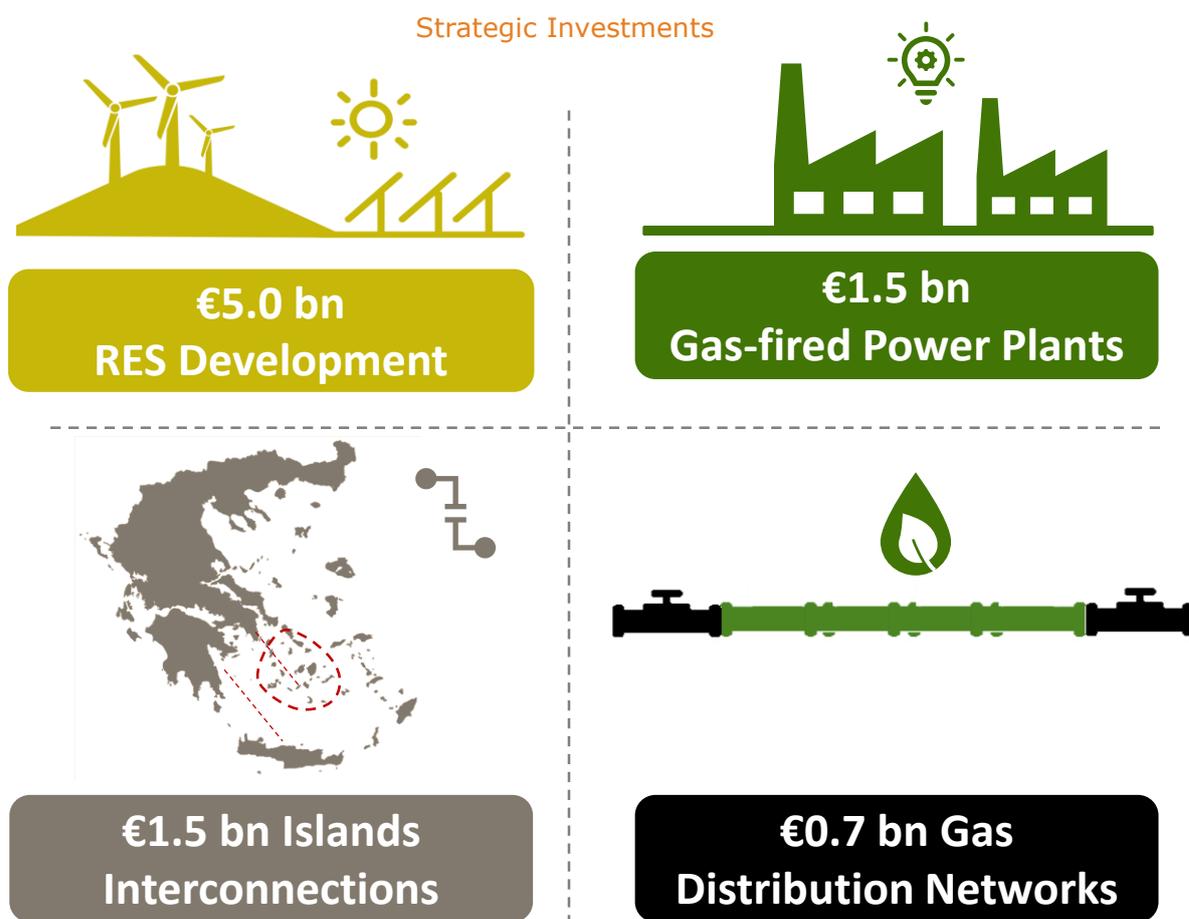


Highlights

Source: HAEE's analysis

- Corporate loans remain the main financing tool for the largest and most traditional energy groups and companies in Greek economy.
- Project finance is also a basic source funding especially for the development of RES becoming increasingly a useful financing tool due to the upcoming Investments.
- Acquisition financing is another specialized way to support new investors who intend to invest in Greek economy, acquiring an established energy company.
- Euro Bonds and Mini Bonds are funding instruments which are used increasingly by companies following the country's risk decline the recent years.
- Banks participate to the issuance (consulting or/and underwriting) of Bonds through the primary market becoming a major financing part of energy companies.

Major energy investments which remain unaffected by the impact of COVID-19 have already been announced



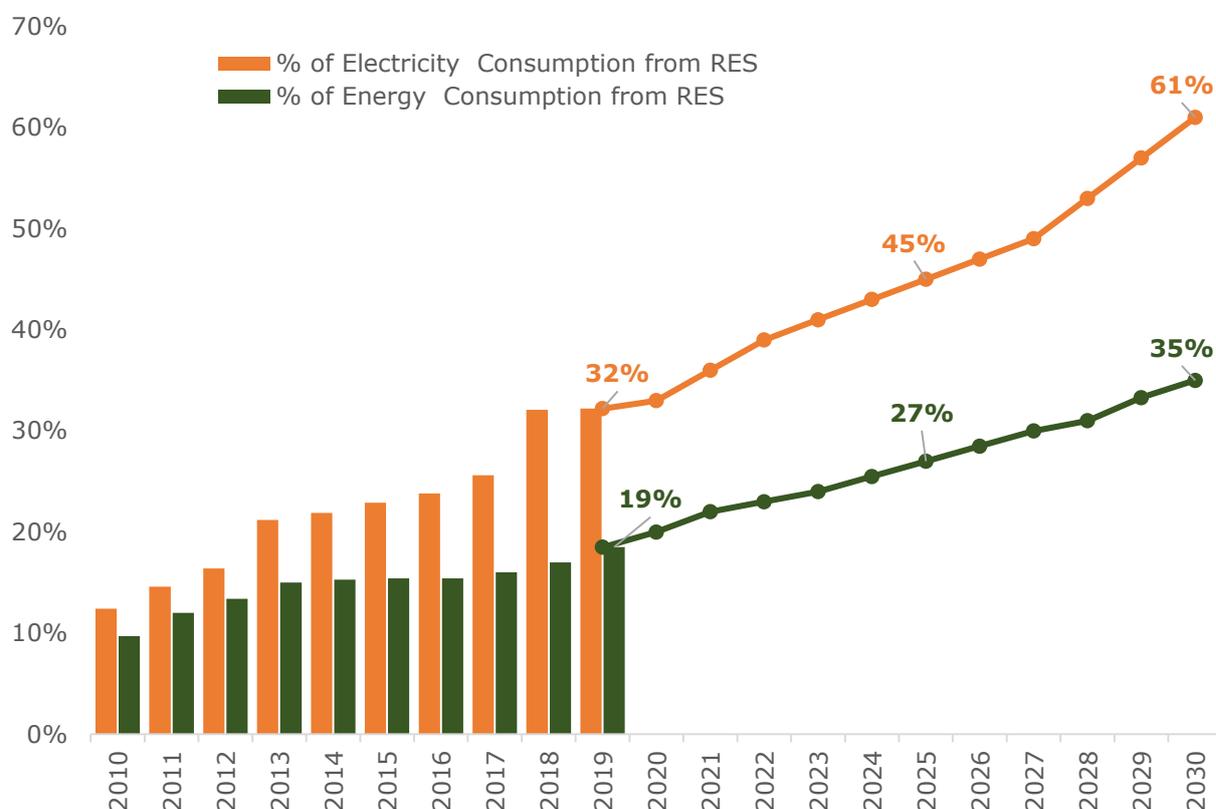
Highlights

Source: HAEE's analysis

- The announced and already planned major energy projects by large energy Groups and Companies seem to be most likely unaffected by the implication of COVID-19.
- Gas networks, islands interconnections and RES are the most preferable investments due to the predetermined tariffs.
- The RES development is highly correlated with the islands interconnections since the Greek islands are the preferable location for the development of Wind Projects.
- The investment in new power plants are mainly driven by the gradual decarbonization of energy production and the transition to the preferable natural gas.
- Plethora of new applications concerning natural gas fired plants have been submitted to RAE and some of them are currently under construction.

Greece creates energy investment opportunities due to the availability of RES potential and the ongoing sizeable infrastructure projects

RES Share in Final Energy and Electricity Consumption %, [2010-2030]



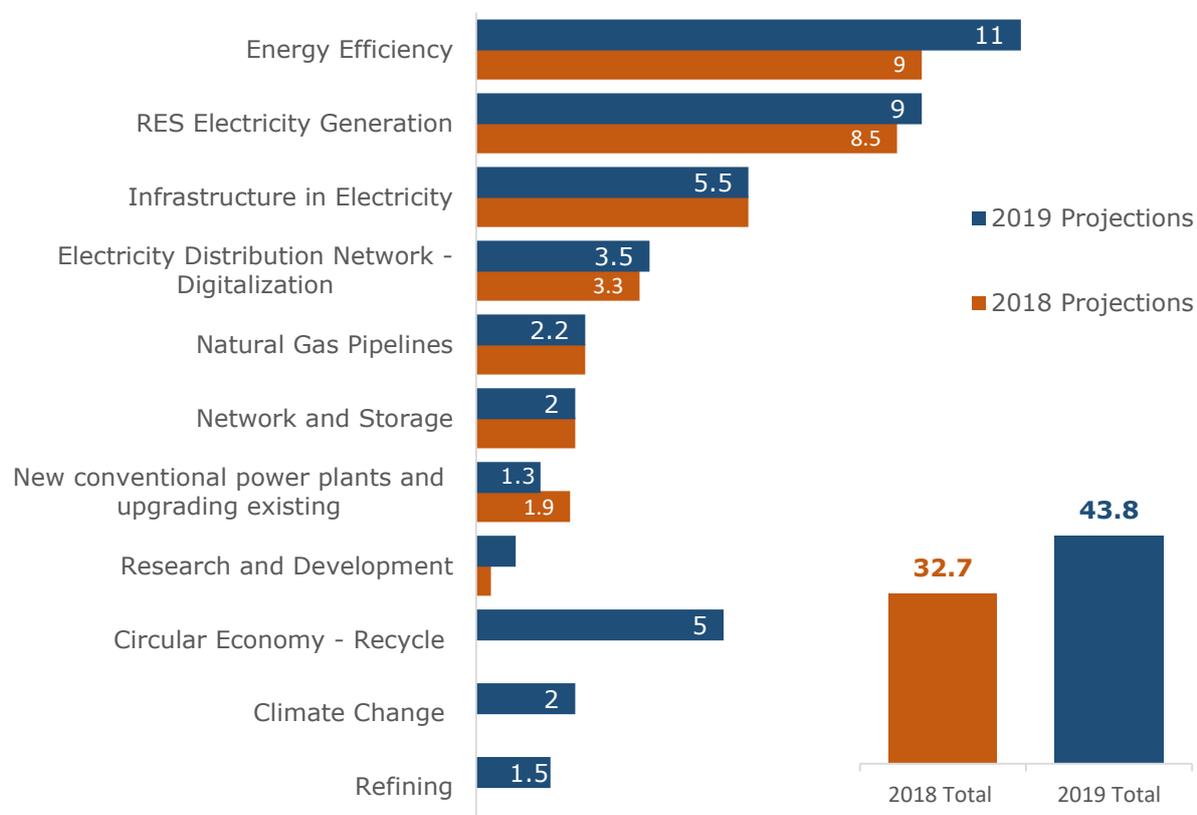
Highlights

Source: National and Climate Plan 2019, HAEE's analysis

- Apart from the announced investments in Wind and Solar, an extra 1,000 MW of electricity storage projects worth €1.5-2 billion are also mature in terms of licenses.
- Green energy projects have a high added-value rate with Wind energy projects have a 50% rate, Hydro 70% and power storage projects 75%.
- According to a study published by IRENA in 2020, investments in RES also have a great multiplier effect in the national economy and employment.
- For every single euro of investments in RES, another 3 to 8 euros are returned to the economy, depending on the technology and the local conditions.
- In terms of employments, RES investments could quadruple the number of jobs in the sector in the medium to long term.

Funds towards the support of Circular Economy, Climate change and Refining add €8.5 billion in the revised National Plan for Climate and Energy

Projected Figures of National Plan for Energy and Climate (billion €), [2020-2030]

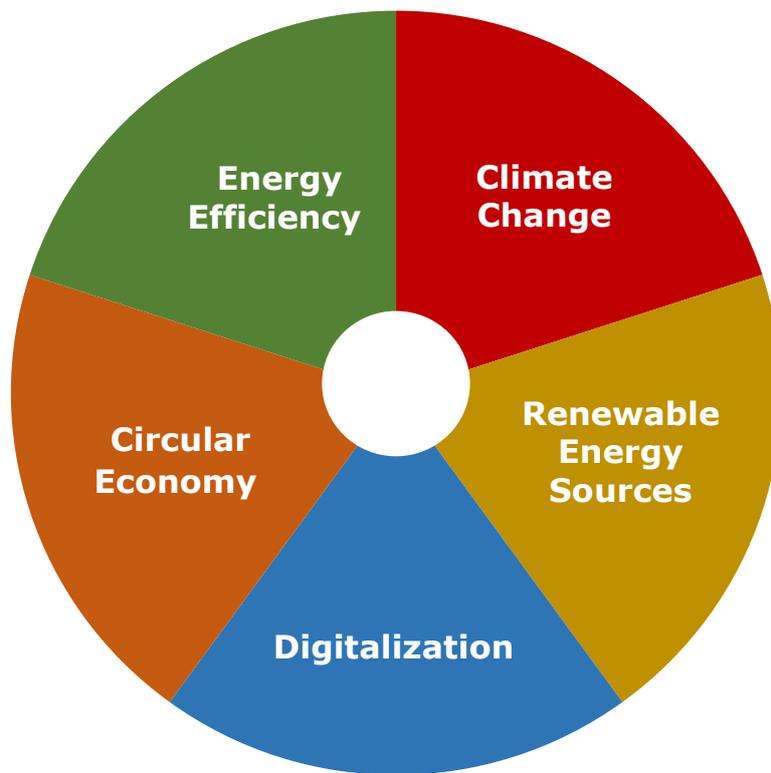


Source: National Plan for Climate & Energy (2018 & 2019), HAEE's analysis

Highlights

- The National Energy Plan is in accordance with the UN Agenda 2030 and with the recently adopted European Green Deal, setting challenging goals at national level.
- The revised National Energy Plan of 2019 is increased by 11.1 billion euros compared to 2018 projections, which represent a growth of 33%.
- This substantial increase came up from reviewed estimations on Energy Efficiency, RES electricity generation, R&D, Circular economy, Climate Change and Refining.
- In line with the aim of national authorities to support clean energy, the new Plan projects reduction of total €0.6 billion towards conventional power plants.
- Greece is currently emerging as a key player in the transportation of energy through pipeline projects and electricity grid interconnectivity ensuring security of supply.

Five Global Trends Shaping our Future



Five Global Trends Shaping our Future

In response to the extraordinary circumstances stemming from the coronavirus pandemic, the “Greek Energy Market Report 2020” has extended its analysis to include all the developments to date and possible future directions. The uncertainty surrounding public health, the economy and, hence, the energy over the rest of 2020 is unprecedented. This analysis, therefore, not only charts a possible path for energy use in 2020 but also highlights the many factors that could lead to differing outcomes.

In that context, today’s global energy industry is characterized by significant shifts, which are creating new opportunities. New trends and technologies are changing the way energy is produced, delivered and consumed. In parallel, and under the current production-consumption model, world demand for raw materials could double by 2050. Investment, innovation and public-private collaboration are needed to accelerate the transition to a more sustainable, secure and affordable energy system, while optimizing the net social and economic value delivered by materials. Aiming to achieve the above, 5 global energy trends shape current and future way of living:

1. Climate Change

Today, our world is changing faster and in more ways, than we could have ever imagined. With social and economic disruption on a scale rarely seen since the end of World War II, 75 years ago, the pandemic is also forcing us to completely rethink the notion of ‘business as usual’. As some countries start to emerge from the first acute phase of the pandemic, the COVID-19 crisis is shifting people’s thinking substantially. Human health and healthcare in general have rightly become the number-one priority for global leaders, and a healthy planet remains fundamental to all of our actions to make the world healthier and more sustainable.

2. Renewable Energy Sources

Additional deployment of Renewable Energy Sources beyond 2020 is vital in order to further reduce greenhouse gas emissions and lead to low-carbon growth. Countries worldwide have already agreed to increase renewable energy penetration, however, challenges for further progress in renewable energy are multiple. For instance, a key challenge is to arrive at a more unified and comprehensive market design for energy. The ideal design would maximize the use of intermittent renewable energy sources through cross-border interconnections, energy storage, wholesale trading and a flexible consumer demand.

3. Digitalization

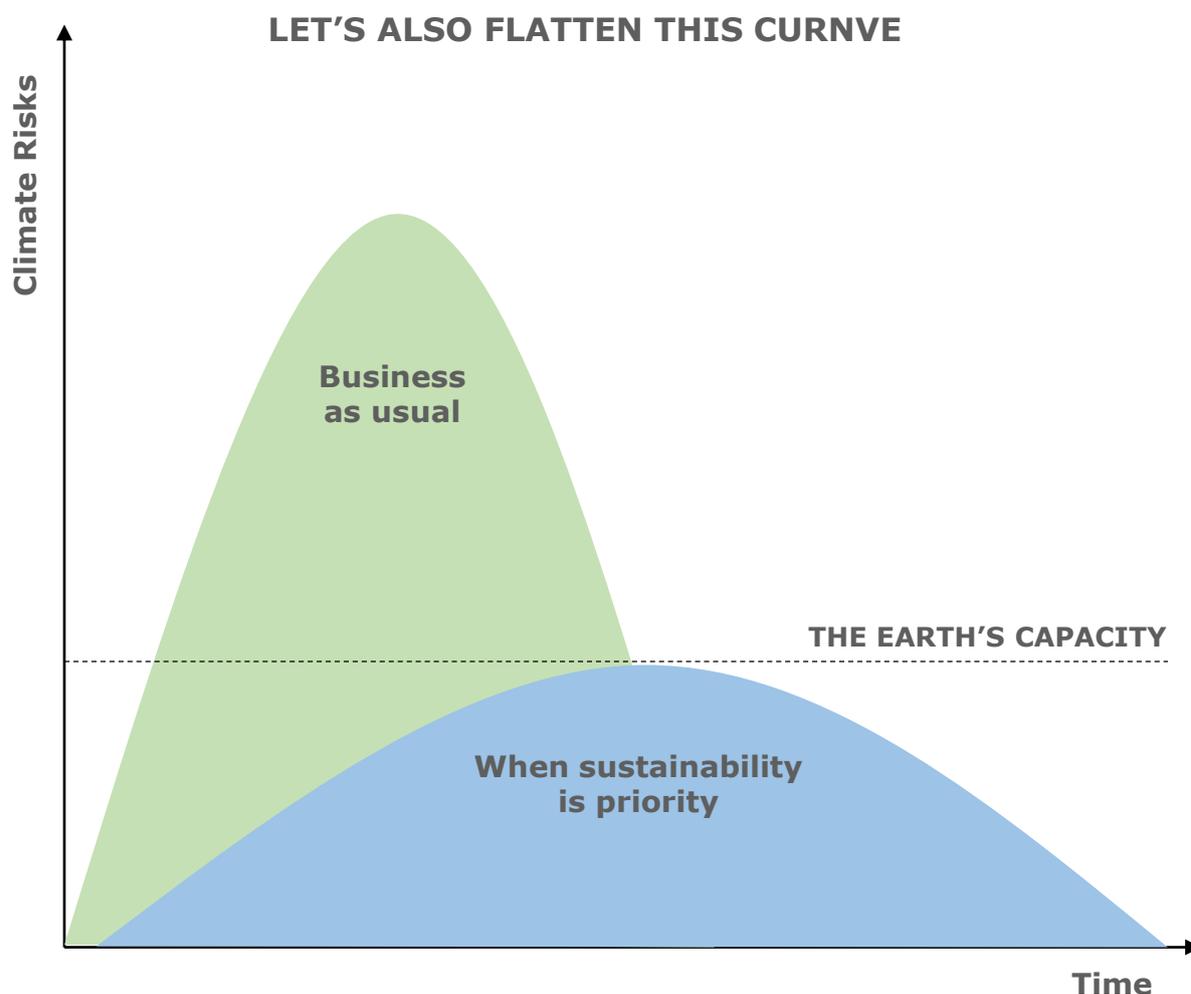
Digitalization is a game-changer with profound impacts in the economy, society and cities as it can be considered as a broader and long-term societal transition, affecting among others the way of how people work and communicate. Digital innovation is at the heart of discourse around Smart Cities to build more efficient and livable urban environments, by using data and digital technology. Digitalization is anticipated to improve citizens’ life and create sustainable cities through connectivity, publicly accessible data, IT platforms communicating with each other, sensors and other advanced technologies.

4. Circular Economy

The circular economy concept is gaining attention as the consumption and use of resources increases to serve a fast-growing population with rising standards of living. Circularity refers to the circular flow and efficient use and reuse of resources, materials and products. This new economic model represents sustainable green growth, moving from a consumption and disposal-based linear model to a system that extends the life of products and materials and minimizes waste. The circular model has many environmental, climate, social and economic benefits.

5. Energy Efficiency

By using energy more efficiently and thereby consuming less, citizens can lower their energy bills, help protect the environment and reduce reliance on oil and gas. In order to achieve these benefits, energy efficiency needs to be improved throughout the full energy chain, from production to final consumption. At the same time, the benefits of energy savings must outweigh the costs, for instance those that result from carrying out renovations. National policies therefore should focus on sectors where the potential for savings is the greatest, such as energy efficient buildings, appliances and reduction in energy intensity of industrial output.



Data Sources



THE WORLD BANK

<https://www.worldbank.org/>



European
Commission

<https://ec.europa.eu>

eurostat

<https://ec.europa.eu/eurostat>



International
Energy Agency

Secure • Sustainable • Together

<https://www.iea.org/>



<https://www.oecd.org/>

Bloomberg
NEW ENERGY FINANCE

<https://about.bnef.com/>



INTERNATIONAL GAS UNION
UNION INTERNATIONALE DU GAZ

<https://www.igu.org/>



ΡΥΘΙΣΤΙΚΗ ΑΡΧΗ ΕΝΕΡΓΕΙΑΣ
REGULATORY AUTHORITY FOR ENERGY

<http://www.rae.gr>

EnEx

Energy Exchange Group

<http://www.enexgroup.gr/>



<https://ape.dapeep.gr>



ΑΔΜΗΕ
ΑΝΕΞΑΡΤΗΤΟΣ ΔΙΑΧΕΙΡΙΣΤΗΣ
ΜΕΤΑΦΟΡΑΣ ΗΛΕΚΤΡΙΚΗΣ ΕΝΕΡΓΕΙΑΣ

<http://www.admie.gr/>



<https://www.deddie.gr/en/>



Hellenic Gas Transmission System Operator S.A.

<http://www.desfa.gr/>



ΕΛΕΤΑΝ
Ελληνική Επιχειρησιακή Ένωση Ανταλλαγής Ενέργειας

<http://eletaen.gr/en>



<http://helapco.gr/en/>



<http://iobe.gr/>



Hellenic Statistical Authority

Digital Library (ELSTAT)

<http://www.statistics.gr/>



HELLENIC HYDROCARBON
RESOURCES MANAGEMENT

<https://www.greekhydrocarbons.gr/>

Useful links



Ministry of Environment and Energy
<http://www.ypeka.gr/>



ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
Υπουργείο Οικονομικών

Ministry of Finance
<https://www.minfin.gr/>



Regulatory Authority for Energy
<http://www.rae.gr/old/en/>



Centre for Renewable Energy Sources and Saving
http://www.cres.gr/kape/index_eng.htm



HELLENIC REPUBLIC ASSET
DEVELOPMENT FUND

Hellenic Republic Asset Development Fund
<https://www.hradf.com/en/fund>



THE HELLENIC
COMPETITION COMMISSION

Hellenic Competition Commission
<https://www.epant.gr/en/>



The Independent Power Transmission Operator
<http://www.admie.gr/nc/en/home/>



Natural Gas System Operator
<http://desfa.gr/>



Energy Exchange Group
<http://www.enexgroup.gr/nc/en/home/>



Hellenic Electricity Distribution Network Operator
<https://www.deddie.gr/en/i-etaireia/profil>

Acronyms and abbreviations

ADMIE	Independent Power Transmission Operator
CRES	Centre for Renewable Energy Sources and Saving
DAS	Day-Ahead scheduling
DEDA	Gas Distribution Company Rest of Greece
DEPA	Public Gas Corporation S.A.
DESFA	Hellenic Gas Transmission System Operator
DSO	Distribution System Operator
EC	European Commission
ETMEAR	Existing renewable energy source levy
ETS	Emissions Trading System
EU	European Union
FiT	Feed-in Tariff
FiP	Feed-in Premium
FSRU	Floating Storage and Regasification Unit
GDP	Gross Domestic Product
HCC	Hellenic Competition Commission
HENEX	Hellenic Energy Exchange
HEDNO	Hellenic Electricity Distribution Network Operator
HELPE	Hellenic Petroleum
HHRM	Hellenic Hydrocarbon Resources Management S.A.
HRADF	Hellenic Republic Asset Development Fund
IPP	Independent Power Producers
ITO	Independent Transmission Operator
LAGIE	Hellenic Electricity Market Operator
LNG	Liquefied Natural Gas
NII	Non-Interconnected Island
NNGS	National natural gas system
NOME	Nouvelle Organisation due Marché de l'Electricité
PCI	Project of Common Interest
PPC	Public Power Corporation
PV	Photovoltaic
RAE	Regulatory Authority for Energy
R&D	Research and Development
TFC	Total Final Consumption
TPES	Total Primary Energy Supply
TSO	Transmission system operator

Units of measurement

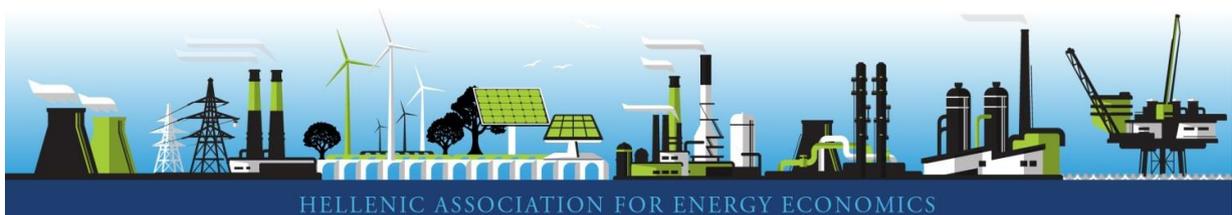
bcm	billion cubic meters
CO ₂	carbon dioxide
GJ	gigajoule
GW	gigawatt
kL	kilolitre
km	kilometre
ktoe	thousand tonnes of oil equivalent
kW	kilowatt
kWh	kilowatt hour
m ³	cubic meter
mcm	million cubic metres
Mt	million tonnes
MtCO ₂	million tonnes of carbon dioxide
MtCO ₂ -eq	million tonnes of carbon dioxide equivalent
Mtoe	million tonnes of oil equivalent
MW	megawatt
MWh	megawatt hour
tCO ₂	tonne of carbon dioxide
toe	tonne of oil equivalent
TWh	terawatt hour

Hellenic Association for Energy Economics (HAEE)

The Hellenic Association for Energy Economics (HAEE - www.HAEE.gr) is a non-profit research and professional organization acting as an interdisciplinary forum for the exchange of ideas and experiences among energy experts. It acts as an independent consulting body for national and international organizations to whom it provides a broad contribution on issues related to energy, economics, policymaking and theory. HAEE is the Greek affiliate of the International Association for Energy Economics (www.IAEE.org)

Copyright @ 2020 Hellenic Association for Energy Economics

The use or translation of the content of this report is strictly forbidden without the prior consent of the publisher.



HAEE

HELLENIC
ASSOCIATION *for*
ENERGY ECONOMICS

WWW.HAEE.GR

Click & Connect with us:



@haeegr (Hellenic Association for Energy Economics – HAEE)



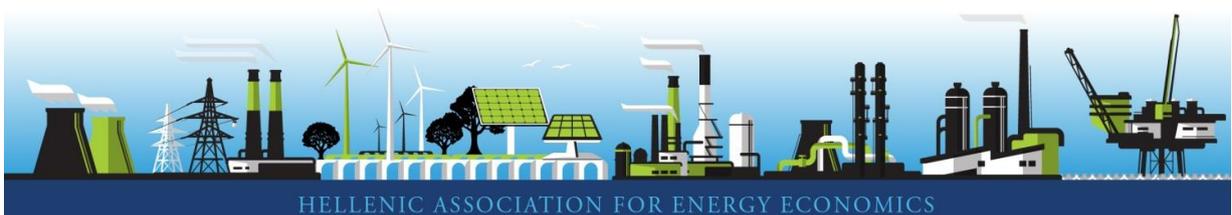
@HAEE_Greece (HAEE)



Hellenic Association for Energy Economics (HAEE)



HAEE Information (Hellenic Association for Energy Economics)



Greek Energy Market

Report 2020



31, Charilaou Trikoupi Str.
Kifissia, 14562
Athens, Greece

Tel +30 210 92 30 422
E-mail : info@haee.gr