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Greek Energy Market

REPORT 2021

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| Greek Energy Market Report |

2021

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HAEE 2021

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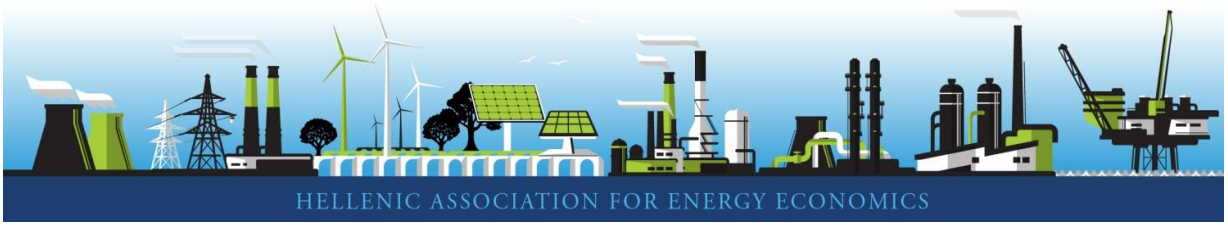


Hellenic Association for Energy Economics

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

With its 180-year participation in the country's economic and social life, NBG is a financial organization which plays an important 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 total exposure of €4.8 billion in corporate customers, of which €1.5 billion in renewable energy sources of total capacity (either in operation or under construction) amounting to about 1.7 GWatt. Furthermore, the Bank issued the first green senior bond in the Greek market, totaling €500 million, with the aim to finance investments in renewable energy projects, thus supporting the country's transition to the green economy.

Being committed to the backing of major projects that foster economic growth, NBG provides tangible support to the country's aspiration to evolve into a key energy hub for whole Europe, with obvious benefits for the domestic economy.

Foreword

Assoc. Prof. Dr. Spiros Papaefthimiou
Chairman HAEE

During last year, the pandemic significantly affected the lives of most of us, while 2020 was a dramatic year for the global energy sector, with slashed demand for energy resources and decreased revenues for oil and natural gas companies. Nevertheless, this unexpected and unprecedented crisis created opportunities for a fast economic recovery, where the Clean Energy Transition initiatives, such as: faster large-scale deployment of Renewables, electricity market liberalization, as well as the development of innovative technologies (like e-mobility, hydrogen and storage) are in the core of policymakers' discussions. Considering the Greek energy market, 2020 was a milestone year, as the long-awaited Target Model was initiated and the investment interest for Renewable Energy projects was interestingly high.

The Hellenic Association for Energy Economics presented the "Greek Energy Market Report" two years ago aiming at creating a regular companion and a valuable reference tool for our members and energy experts. Thus, the current "Greek Energy Market Report 2021" is a comprehensive analysis and review of the Greek energy market based on the most recent data and valuable insights. In this regard, this 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 via the use of detailed statistics.

On behalf of HAEE, 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. Paul Mylonas, for endorsing the production of this report, Mr. Vassilis Karamouzis, and of course Ms. Argyro Banila and Mr. Harry Vovos for an excellent collaboration.

Foreword

Prof. Dr. Kostas Andriosopoulos
Project Coordinator

More than a year has passed since the shocking outbreak of the Covid-19 pandemic and the Greek economy is gradually moving towards its prior levels of activity, as vaccinations proceed rapidly, and lockdown restrictions are progressively being lifted. Under such circumstances, the Energy sector witnessed profound shifts during this past year, with oil hitting historically low prices, the European Union (EU) pushing even harder for emissions reduction, and demand fluctuating rapidly.

Nowadays, the Energy Transition is at a turning point. The initial wave of Renewables rollout in Europe has been completed after more than ten years of intense efforts. Nevertheless, preparations must be carefully made for the second stage that will be even more intense, with a targeted penetration rate of 40% during the current decade. Existing technologies will not be enough to cover the growing demand and new solutions such as Offshore Wind, Storage and Hydrogen will have to mature, hence assisting the further decarbonization of the energy market.

In Greece, the National Energy & Climate Plan is currently being reviewed in order to incorporate the EU's latest 2030 targets. At the same time, new regulatory initiatives are anticipated concerning Offshore Wind and Storage. Another significant and very positive development is the recently presented National Recovery Plan, "Greece 2.0", which will use European recovery funds to accelerate the green and digital transitions. Among the various initiatives, the energy market will benefit from the funding of the power grid upgrade, the advancing of electric mobility, a new robust Renewables Special Account, green certificates scheme, as well as interconnections and big-scale energy saving. Aiming to optimally capitalize on the above potentials, we need to identify the current status of the energy market in Greece and in parallel envision the path towards the future.

The latter is the target of the latest version of HAEE's Greek Energy Market Report. By presenting detailed and comprehensive data and analysis for all energy sectors, the Report attempts to clarify the energy landscape and support professionals in their effort to navigate effectively. The Greek Energy Market Report 2021 contains dedicated chapters on Electricity, the Target Model, Natural Gas, Renewables, Oil and Refining, Energy Efficiency and of course, special attention is paid on the energy related Investments and market potentials. This third annual edition aims to maintain the recognition of a valuable tool for market participants and policy makers, as well as act as a catalyst for public dialogue.

Foreword

Mr. Kostas Skrekas
Minister of the Environment and Energy

It is my pleasure to introduce the "Greek Energy Market Report 2021" presented by the Hellenic Association for Energy Economics (HAEE) and supported by the National Bank of Greece (NBG). This unique study provides illustrative information related to the existing opportunities and challenges arising in the Greek energy market, by using the most recent available data. Precisely, the Report illustrates a solid analysis for several sectors affecting the path of Greece towards the Energy Transition.

This Transition to a climate-neutral economy is not being considered as a long-term vision, but an essential, imminent and multidimensional transformation that we are called upon to implement, consciously and in a structured way. A fundamental adjustment of our economic model is needed, in order to meet the production and consumption needs by 2050. Such change will ensure environmental compatibility and resilience to the challenges of climate change, providing substantial quality and strong growth potential. Undoubtedly, the government has set ambitious goals for the country's Energy Transition, reflecting the commitment of the Prime Minister, Kyriakos Mitsotakis, in the fight against climate change. Those goals are achievable, precisely since they are accompanied by a coherent and comprehensive action plan.

Greece is moving towards decarbonization faster than any other European country, by implementing the withdrawal of all existing lignite plants by 2023 and a fuel shift at Ptolemaida 5 by 2025. Given that CO2 prices have already reached 58 euros per ton, in anticipation of the forthcoming Emission Trading System (ETS) reform, the pace of the aforementioned developments should be sharp and precise. In this context, our energy mix is substantially redefined. The share of Renewable Energy Sources (RES) in electricity consumption has already exceeded 34% over the current year. Simultaneously, natural gas, as a bridging fuel, reached 36% in 2020, with lignite share shrinking to 11% compared to 38% in 2015.

At this stage, we are reviewing the National Energy and Climate Plan to align with the new European CO2 emission reduction target of at least 55%. The updated plan will incorporate the 21 green actions of the Recovery Fund, which exceed 5 billion euros, and will also capture the strong dynamics of RES, as well as new technologies, such as Storage, Offshore Wind, Biomethane, Hydrogen and Circular economy applications. The Ministry is working intensively on all these key topics, in order to derive, quickly, a modern institutional framework, which will adopt best practices and remove bureaucratic entanglements.

In addition, the government provides a stable investment environment through specific support schemes, which yield visibility, clarity and fair compensation of crucial services. These schemes will support the flexibility and stability required given the increased penetration of RES, which are anticipated to overcome 67% by the end of the decade. This combination of our policies will make new business models feasible, redefining the energy sector and enhancing the circular dimension.

Investments in energy savings are expected to exceed 11 billion euros, while investments in RES as well as in networks, along with storage, will be of a similar scale. Thus, the foremost aim is to shield the reliability of our energy system, implement the interconnections of our islands and release additional RES potential. The scale of the electricity market has already expanded, through the market coupling with Italy and Bulgaria. The coupled interconnection capacity, around 1,000 MW, will be further enhanced by the activation of the new line with Bulgaria, planned in 2022.

Furthermore, the participation in short-term markets, the initiation of bilateral contracts and the removal of prior restrictions on trading are expected to boost liquidity, with a positive impact on the balancing market. In this direction, a significant change that is taking place is the implementation of continuous trading in the Intraday market within the first quarter of 2022. At the same time, during October 2021, the wholesale gas market will be activated. Initially, spot transactions will be available to market participants and in the second stage, futures products as well, thus acting as a starting point for the establishment of a regional energy hub.

The developments in the gas market are of particular importance. More specifically, 18% of imports now come from the TAP pipeline, while our new infrastructure, such as the IGB pipeline, the FSRU Alexandroupolis and the Northern Macedonia pipeline, are part of a rapidly growing Balkan market, with projected consumption of over 25 bcm. Our gas networks can accommodate biomethane, with a domestic potential estimated at 1 bcm, but also hydrogen. EastMed's design is also hydrogen-ready. The practice of hedging, through futures products, is critical to manage volatile factors, such as CO2 prices. Risk management by suppliers, through the derivatives market, can protect electricity consumers from escalating, additional charges, arising from wholesale price clauses in retail products.

In conclusion, our energy policy is based on a functional and modern triangle:

- To create a stable and simplified institutional framework, without bureaucratic complications, so as to attract green investments and innovation, creating quality jobs and enlarging the boundaries of the energy sector.

- To ensure a Fair Transition for all our citizens, without exclusions, with well-focused policies, extending from urban centers to our islands and lignite regions.

- To guarantee the upgrading of critical infrastructure, enhancing energy security, with emphasis on the diversification of resources, the resilience of our networks, their digitization and efficiency.

By applying this approach, we will be able to adapt the energy sector to the challenges of the Energy Transition, with transparency, innovation and minimum costs.

All things considered, in response to the extraordinary circumstances stemming from the Covid-19 crisis, the "Greek Energy Market Report 2021" has extended its analysis to include all the developments to date and possible future directions. From my standpoint, this report acts as an important tool, for anyone interested in studying the Greek energy market and successfully outlines the fascinating path of the energy sector in the current decade.

Foreword

Mr. Paul Mylonas
CEO, National Bank of Greece

It is a pleasure to introduce for a third consecutive year the "Greek Energy Market Report", the annual release of the Hellenic Association of Energy Economics (HAEE), sponsored by National Bank of Greece (NBG). This publication is an important tool and source of information for anyone interested in the specifics of the Greek energy market. By initiating, together with HAEE, and continuously supporting this report, NBG aspires to be viewed by investors as the expert and market leader in financing Energy initiatives in Greece and the Southeastern Europe area. The rapid changes accompanied by the unprecedented crisis of Covid-19 further highlighted the need towards a transition towards a cleaner and more sustainable future. The EU's decision to tackle the coronavirus crisis by launching the Recovery and Resilience Facility (RRF) is pivotal. The emphasis on the green and digital transition creates expectations that Europe is adopting a uniform strategy that meets current challenges.

Despite the long dated financial crisis that lasted more than a decade, and the recent pandemic crisis, Greece has been on the right path, if not overachieving, its ambitious targets announced through the National Plan for Energy and the Climate: two-thirds of Greek electricity production to come from renewable sources by 2028. To add to this, the Greek National Recovery and Resilience Plan (RRF) announced by the Greek government is expected to accelerate the achievement of those targets, as the energy-related projects stand as a basic pillar of the RRF construct. In that context, the national renewable energy targets will require more than doubling the country's solar and wind power capacity. In total, investments associated with the transformation of Greece's energy system – from increasing RES capacity to new energy infrastructure to waste management – will amount to an estimated €44 billion over a 10-year horizon, the majority of which will come from the private sector.

NBG expects to play a leading role in Greece's energy transition. Already, it is leading the market in energy projects, with total energy portfolio that exceeds €2.6bn in drawn facilities, and almost €5bn if one includes the unutilized credit limits and off-balance sheet exposures. The portfolio has grown by 9% in the first 5 months of 2021 and 26% since 2019. It comprises both renewable and conventional energy financing, with 40% of our funding directed 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.

NBG supports all the initiatives for the transition to the European target model and remains committed to supporting the country's energy transition and the path towards a cleaner and more sustainable future. Apart from financing, we provide a full span of clearing services (being the sole Greek bank member of the European Commodity Clearing) and OTC transactions. Our solid capital base and extensive experience in providing holistic support to complex energy initiatives enable NBG to be the partner of choice for all energy projects.

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 Centre for Energy Management. Dr Andriosopoulos is currently Chairman of the Energy Committee of the American-Hellenic Chamber of Commerce. In September 2019 he was appointed Vice Chairman of the Board of Directors of the Hellenic Public Gas Company (DEPA), a position he also held for the period 2014-2015. 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 is a Certified Energy Trader from the Hellenic Energy Exchange and holds an MSc in Banking and Finance from the School of Economics, Business Administration and Legal Studies (International Hellenic University, Thessaloniki, Greece). Moreover, Filippos holds 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 Analyst of the Hellenic Association for Energy Economics.

Research Team

Konstantinos Sfetsioris is a Project Development Manager for the Hellenic Association for Energy Economics. He holds an MSc in Mechanical Engineering with a postgraduate degree in Energy Production and Management from National Technical University of Athens. Since 2019, he has been an Advisor to the General Secretariat for Energy & Mineral Resources at the Ministry of Environment and Energy. Since December 2020, he is a Regular Member of the Committee for the drafting of the National Hydrogen Strategy.

Thanos Nastoulis is a Research Analyst and Energy Consultant of the Hellenic Association of Energy Economics, holding an MSc in Production Engineering and Management, from the Technical University of Crete (TUC), Greece. Thanos also holds a MSc in Energy and Environmental Management from University of Piraeus. His expertise lies in the Renewable Energy Sources Sector, and in the past, he worked for the Regulatory Authority for Energy(RAE).

Kimon Kailoglou is an Energy Advisor of the Hellenic Association of Energy Economics, holding an MSc in Production Engineering and Management, from the Technical University of Crete (TUC), Greece, where his thesis was ranked 2nd for the scholarship in memory of Th. Loverdos. He was also awarded an MSc with distinction in Energy Management from ESCP Business School following his studies in London, UK and Paris, France.

Georgia Giannakidou is a Research Analyst and Energy Advisor in the Hellenic Association of Energy Economics. Georgia has been recently graduated from ESCP Business School, where she obtained her MSc in Energy Management in London, UK. Georgia holds a bachelor's degree with distinction in Political Science, with a major in Geopolitics, from the National and Kapodistrian University of Athens, Greece. Since May 2021, she is a Regular Member of the Project Management Team for the Decarbonization Fund of the Greek islands at the Ministry of Environment and Energy.

Konstantinos Stathopoulos holds a BSc in Accounting and Finance from Athens University of Economics and Business (AUEB). His expertise lies in the Economy Sector and specifically in Analysis and Valuation of Financial Statements, as well as in both Micro and Macro-Economics. Konstantinos is currently a Research Associate on fiscal and energy topics for the Hellenic Association for Energy Economics (HAEE).

Executive Summary

In line with the previous publications of 2019 and 2020, the third edition of the "Greek Energy Market Report 2021" considers all the advances related to the Greek energy sector, by providing the most recent available data. Given the outstanding effect that Covid-19 had on global energy markets since the beginning of 2020, special attention is paid to the impact both on demand and energy supply. The Report illustrates a solid analysis for several sectors affecting the road towards the Energy Transition. The applied methodology remained the same, since the study captures global and European energy trends and evaluates the progress of Greece towards a more sustainable future.

Furthermore, the report highlights all energy aspects that Greece is lagging, hampering the accomplishment of the country's energy and climate targets. The overall objective of this year's Report is to act as a valuable tool for anyone interested in studying the Greek energy market, throughout a high-level analysis accompanied by key points in every aspect under consideration. The Report consists of nine distinct chapters, covering most of the developments in 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**.

- The next chapter, focuses on the **Electricity** sector, highlighting various issues related to generation, capacities, prices, imports, exports, and the emerging market of Eco-mobility.

- A robust examination of the formation and role of the newly established **Hellenic Energy Exchange** under the official operation of the Target Model, is provided in Chapter 4.

- Chapter 5 is dedicated to **Natural Gas** and explores all the developments that occurred in the market followed by the recent liberalization. The section highlights, all the characteristics affecting supply, demand, and import prices, while mid-term and long terms projects are depicted as well.

- Chapter 6 focuses on the significant penetration of **Renewable Energy Sources** in Greece, by providing unique data, market analysis, and an update regarding the recent regulatory framework.

- Chapter 7 covers the **Oil and Refining** market, which continues to play a crucial role for the country, since it heavily contributes to the overall economic growth of Greece.

- **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 the ongoing and future energy investments, that are anticipated to substantially contribute to the effort of Greece to recover from the devastating crisis of Covid-19.

During 2020, the presence of the renewed National Energy & Climate Plan, and the introduction of the green legislative framework, paved the way for the higher penetration of Renewable Energy Sources (RES) in the country's energy mix. Greece follows the EU "Green Deal" directions and has set its own ambitious goals for climate change, which lead to a radical transformation of the country's energy sector away from its strong lignite dependency. The country will receive approximately €750 million, which will be directed to Clean Energy, Smart agricultural production, Sustainable tourism, Industry, Trade, Technology and Educational Projects.

In addition, the Master Plan for decarbonization was released, announcing the phase-out of all operating lignite plants with a total capacity of 3.34 GW, until 2025. Simultaneously, 2020 was a milestone year for the energy transition in Greece. In 2021, record-breaking CO2 prices, exceeding 55€/tCO2, led to increased RES generation, which exceeded fossil-fuel generation during the first quarter of 2021. At the same time, the legislative framework for e-mobility was introduced, by providing high economic and tax incentives to the interested citizens and entities. Natural gas consumption reached an all-time high, while LNG prices fell significantly.

The electricity market is considered as key sector in Greece, since generation, transportation, distribution, supply and trade of electricity produce 2% of national Gross Added Value of the total economy. April 2020 was characterized a "Snapshot from the Future" when natural gas and RES prevailed in the electricity mix. A major energy market reform was achieved as the Target Model, a long-term specific commitment, went live on the 1st of November 2020. The new format of the markets including Day-ahead, Intra-day and balancing market, will allow for better price discovery, wider participation and market access to different services. The new market design is compatible with other EU markets, allowing for the Intraday coupling with the neighboring markets of Italy and Bulgaria, which in turn will increase energy security, support further renewable energy sources integration and wholesale price competition.

The interconnection of the islands and the implementation of green and sustainable technologies are two main pillars of the Energy Transition in Greece. During the next years Astypalea, Chalki and other Greek islands will implement green energy, electromobility and other smart innovative technologies. The gradual interconnection of Crete, Cyclades, North Aegean and Dodecanese with the mainland and the electrification of transport and heating/cooling will increase the electricity demand up to 61 TWh by 2030.

The Long-term energy vision 2050 for Greece shows a clean path to other forms of alternative fuels, such as hydrogen, biomass and synthetic fuels. The transition to a climate-neutral economy requires high-RES integration, which leads to high energy Storage demand. Green hydrogen will become key component of the energy mix in Europe during the period 2025-2030, boosting the installed power at the level of 40GW. In Greece, the proposed project "White Dragon" is a game changer of the energy transition in lignite areas and the Greek first proposed hydrogen valley.

Finally, Greece, as a member of the European Union, has managed to attain the corresponding energy Efficiency Target concerning energy consumption. The effect of renewables on the Greek economy has been more visible 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.

Contents

"Everything that an investor needs to know about the Greek Energy Market in 2021"

1. Country Profile

Highlights

The **Greek economy** is estimated to grow by **3.5%** in **2021** and by **5%** in **2022**

Greece's Economic Sentiment Indicator **raised** by more than **10%** since the outbreak of the pandemic

The unemployment rate **reached 18%** in 2020, and is expected to decline even more in the next years

Despite the third wave of restriction measures, the Greek 10-year **bond yield remained below 1%**

The Greek **debt to GDP** ratio hit record-high **213.1%** in 2020, however it is expected to drop at **180%** by 2026

Oil is the dominant fuel in final energy consumption due to the "oil-based" transport sector, which is the leader in terms of the total **final consumption** in Greece

Gross energy consumption in Greece kept on **declining by another 2.2%** in 2021

In April 2021, **RES** represented **63%** of the primary energy production, breaking Autumn's 2020 historic record of **51%**

In May 2021, the carbon price rocketed to **56.6€/tnCo2** for the first time in history

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. Containment restrictions introduced in November brought tourism to a near halt, and significantly reduced business in many other consumer services. However, the losses have been less than during the earlier lockdown. Turnover in February 2021 was about 50% lower than a year earlier in the sectors required to stop operating. Manufacturing, including of medical and pharmaceuticals products, was more robust in late 2020 and the first months of 2021. Banks have increased new lending to businesses, supported by the government's loan guarantees and interest subsidies. Households continued to increase their savings through the latest lockdown – excess bank deposits rose by over 7% of GDP in 2020. Housing construction has grown strongly. Overall, firms hired workers in the first months of 2021, even as they suspended contracts of 260 thousand workers.

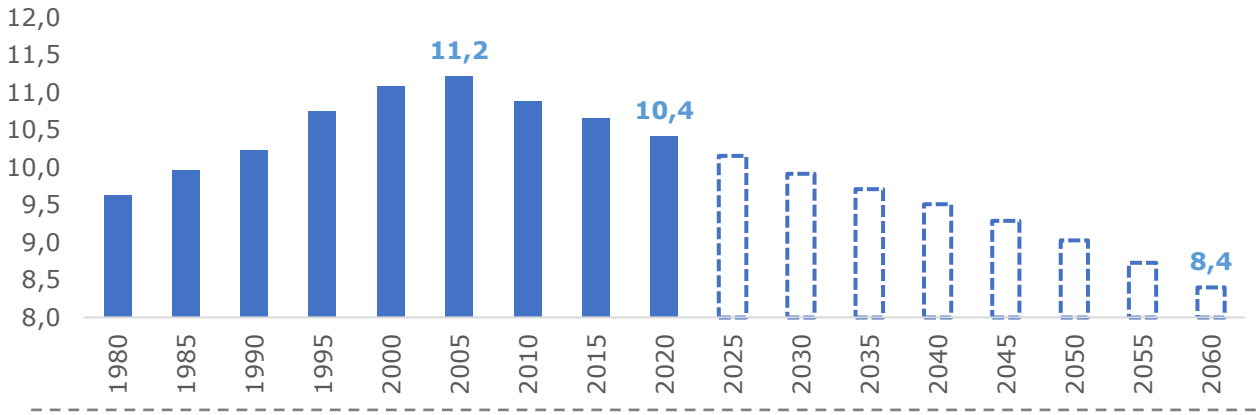
The economy's recovery is projected to accelerate into 2022 as services and travel activity resume and disbursements of Greece's Recovery and Resilience Plan support investment. Exports are projected to recover gradually from the second quarter of 2021, led by tourists arriving from countries with high vaccination rates. Tourism receipts in 2021 are projected to recover almost half of the decline of 2020. The strength in global merchandise trade is projected to support Greece's shipping services and goods exports. These developments will boost employment and households' incomes, which, along with a modest drawdown in savings accumulated over the crisis, will support a recovery in consumption. Economic slack will damp price pressures, while reforms underway are likely to add flexibility to the labor market. The recovery would be set back by more than in most countries, if vaccination campaigns are less effective than expected at enabling travel and tourism to resume. If recent reforms contribute less than expected to improving Greece's public investment spending, the strengthening in domestic activity, employment and long-term prospects would be smaller than projected.

Despite the unprecedented impact of the pandemic in the Greek economy, the energy sector continued to play an important role towards recovery. During 2020, the presence of the renewed National Energy & Climate Plan, and the introduction of the green legislative framework, paved the way for the higher penetration of RES in the country's energy mix. At the same time, the legislative framework for e-mobility was inaugurated, by providing high economic and tax incentives to the interested citizens and entities. Gas consumption reached an all-time high, while LNG prices fell significantly. In addition, the Master Plan for de-lignification was issued, announcing the phase-out of all operating lignite plants with a total capacity of 3.34 GW, until 2023.

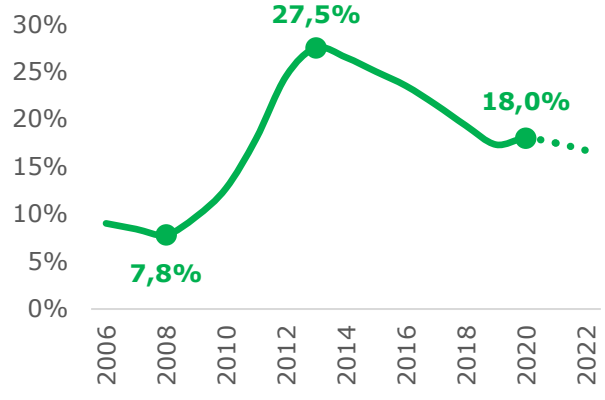
Considering future projections, gross energy consumption in Greece is anticipated to decline below 22,000 ktoe by 2040, while RES share will gradually exceed petroleum products. Between 2020 and 2040, RES are anticipated to dominate energy generation, by increasing their share up to 36%.

Although unemployment rate is currently stabilized and predicted to be reduced, the demographic problem will be intensified

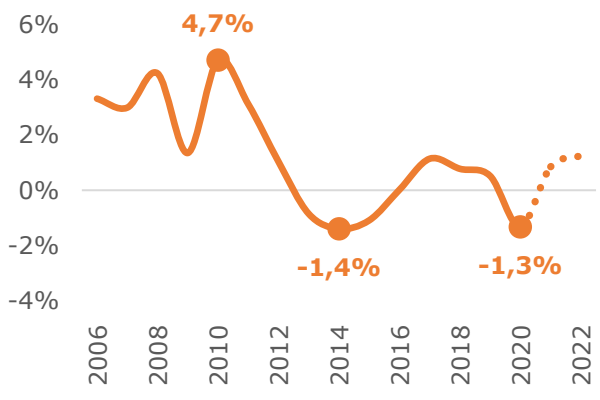
Total Population in Greece (millions), [1980 – 2060]



Unemployment Rate (%), [2006 – 2022]



Consumer Price Index (% annual change), [2006 – 2022]

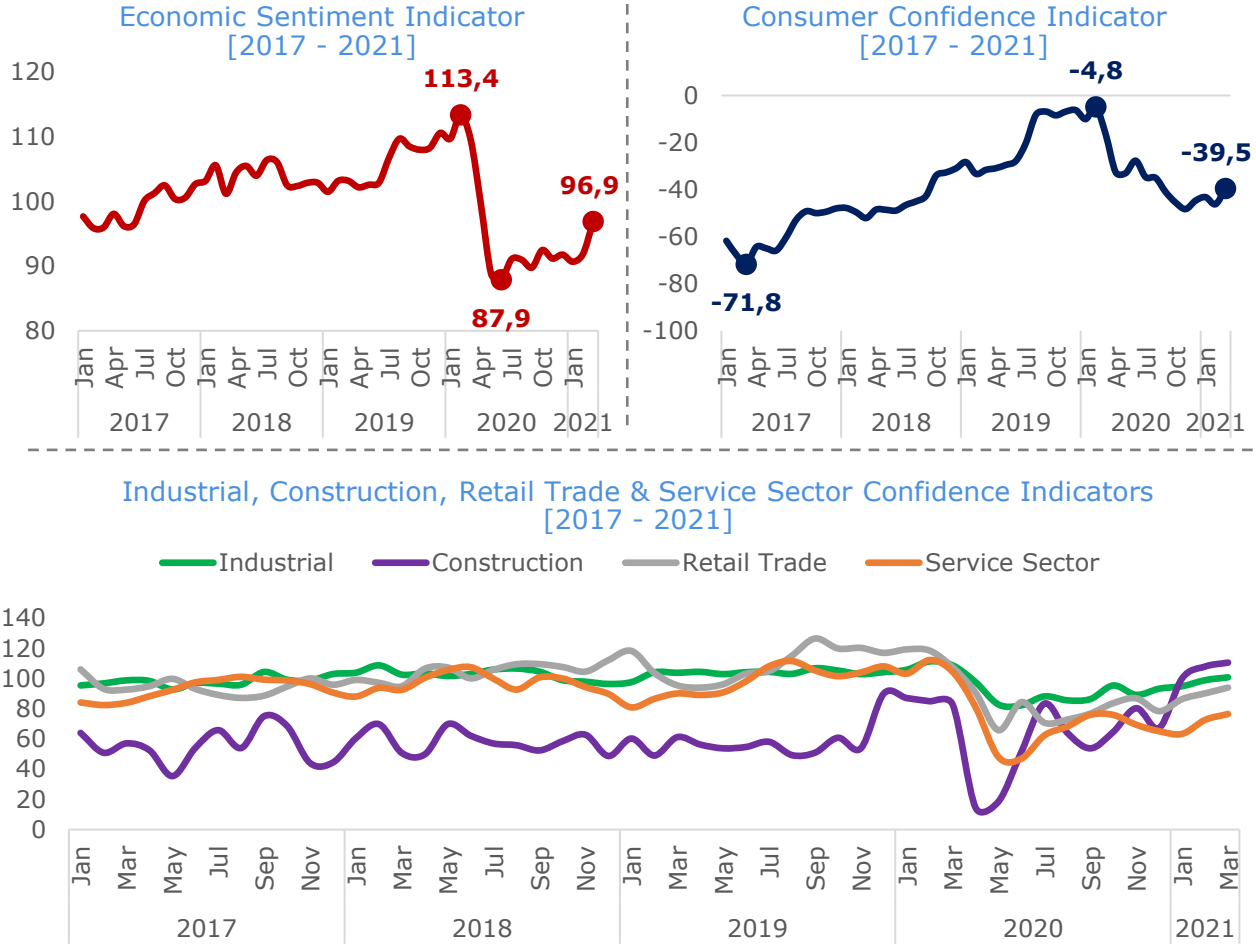


Source: United Nations, AMECO, HAEE's analysis

Highlights

- The Greek population numbered 10.4 million people in 2020. Its declining trend could be linked to the brain drain and the low birth rate, triggered by the economic crisis.
- Greece reports the highest unemployment rate of all European Union states, which was equal to 16.3% in March 2021.
- Following the Covid-19 outbreak, unemployment rate was expected to surpass 20%. However, it only reached 18% and is expected to decline during the next years.
- Youth unemployment rate reached a record share of 34% in December 2020, the second highest rate in EU.
- After 3 years of consecutive decline, inflation rate is forecast to record a positive trend, as the Covid-19 restrictions on economic activity are gradually being dropped.

Although business confidence dropped severely after the Covid-19 outbreak, the Confidence Index seems to have a speedy recovery



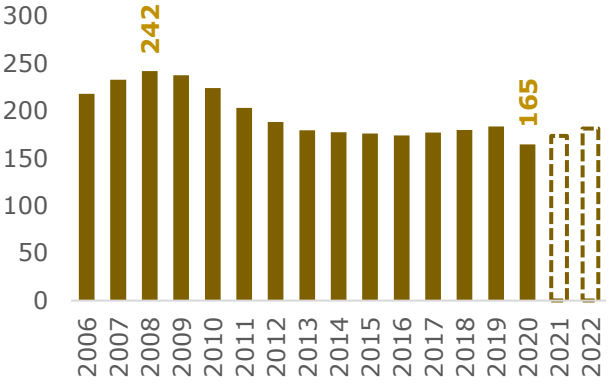
Source: IOBE, HAEE's analysis

Highlights

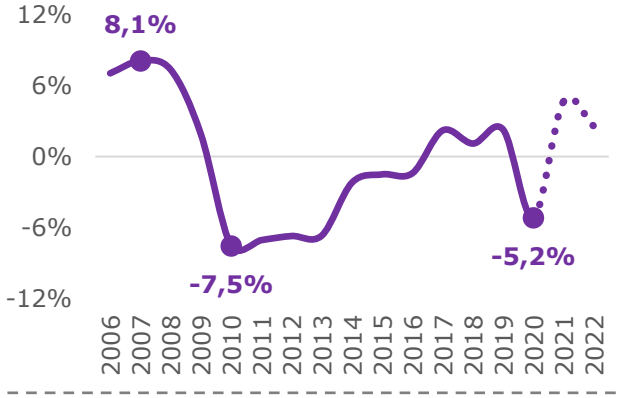
- The strict lockdown measures led to a dramatic decline in the Economic Confidence Index, as every single Indicator recorded severe losses.
- Just before the pandemic outbreak, the Economic Sentiment Indicator reached its highest level within the last 5 years. 4 months later the Indicator dropped by 22%.
- According to the data, the Consumer Confidence Indicator had been less affected by the pandemic than ESI, however it also recorded significant losses.
- Considering the Confidence Indicators, the Sector of Construction and Services was affected more, especially, during the first months of 2020.
- The Economic Sentiment Indicator is expected to return to its pre-pandemic levels, in the next 2 years.

The Covid-19 impact on GDP was huge, however all indicators suggest GDP growth will soon rebound

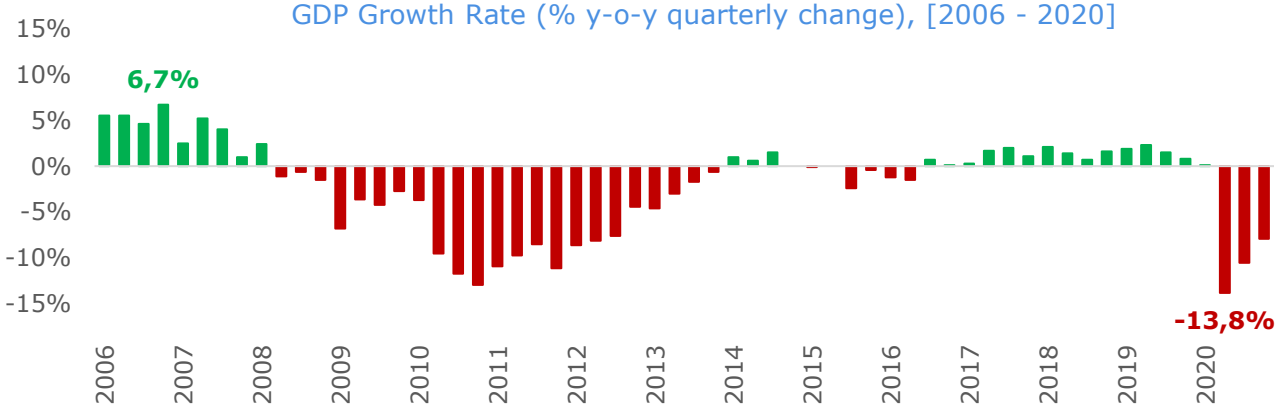
GDP at Current Prices (billion €), [2006 - 2022]



Final Consumption (% annual change), [2006 – 2022]



GDP Growth Rate (% y-o-y quarterly change), [2006 - 2020]

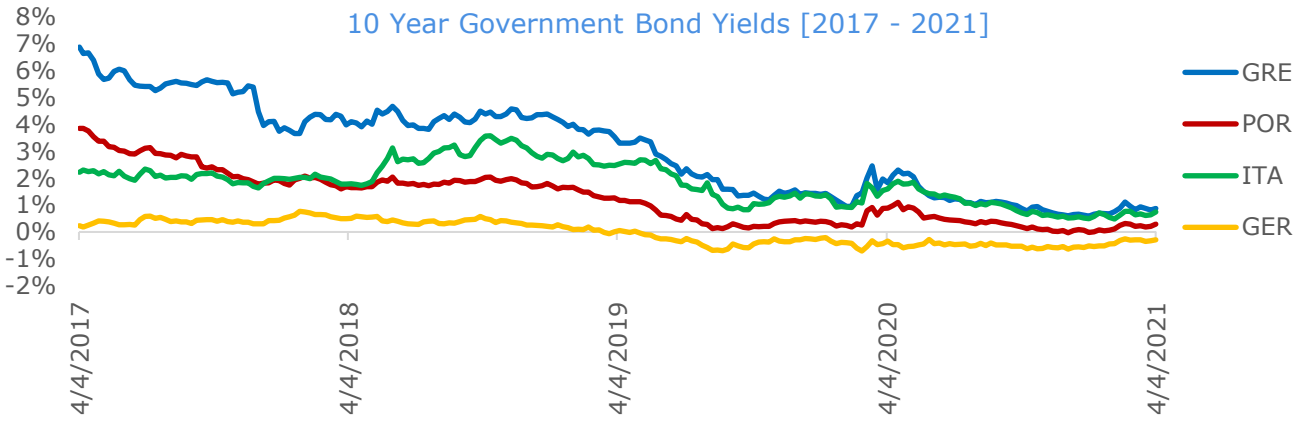


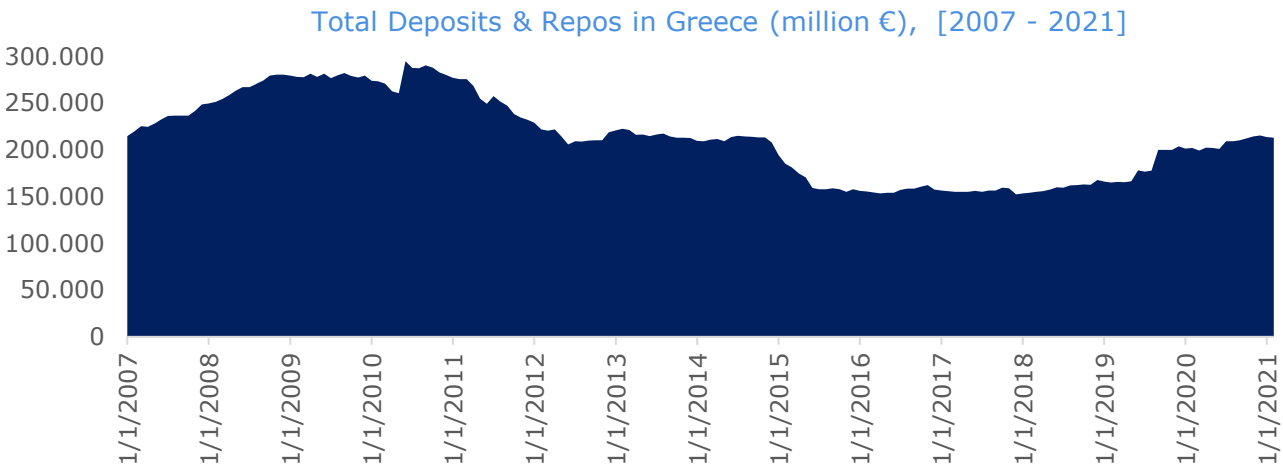
Source: ELSTAT, HAEE's analysis

Highlights

- Just before the Covid-19 outbreak, the Greek GDP was estimated to grow by 2.4% in 2020 and another 2% in 2021, according to the EC 2020 Winter Forecast.
- The lockdown measures shrunk the economy by 19 bn in 2020, however estimations for 2021 and 2022 project a gain of 9 and 8 bn, respectively.
- Second quarter of 2020 ended a series of 15 quarters of consecutive GDP growth, recording an unprecedented loss of almost 14%.
- According to European Commission 2021 Winter Forecast the Greek GDP will grow by 3.5% in 2021 and, 5% in 2022.
- Final Consumption, which has been reduced by over 5% is anticipated to be increased by almost 10% in 2021, exceeding pre-pandemic levels.

Greece's 10-year government bond yield remains steadily below 1%, while liquidity has increased by over 15 billion in the last couple of years



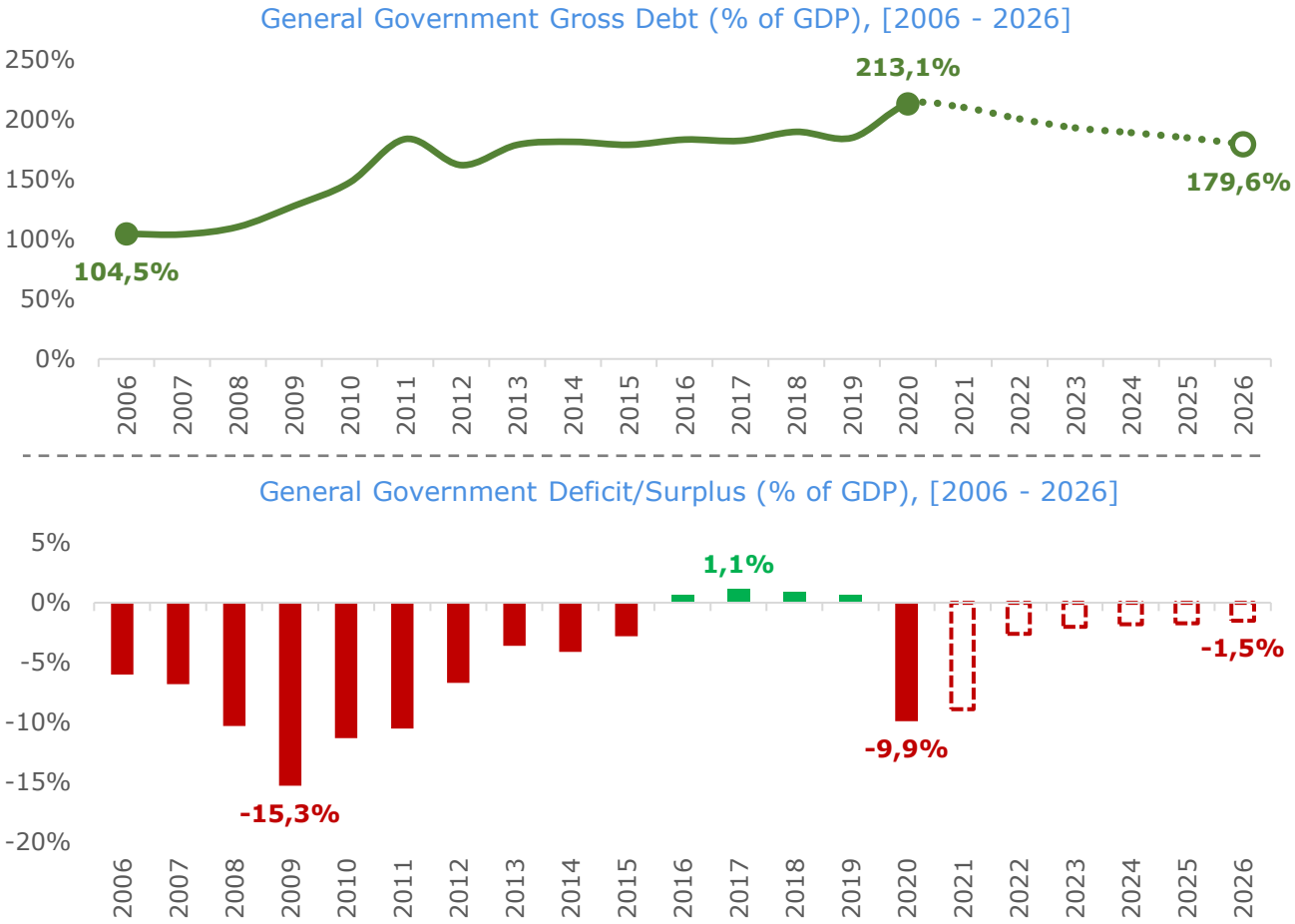


Source: Bank of Greece, HAEE's analysis

Highlights

- Given the damage caused by the pandemic to every single economy, the EU established the Recovery Fund in order to provide funding to Member-States.
- The markets were bullish and led all EU-member government bond yields to decline, reaching levels close to 0%.
- In November 2020, Moody's upgraded the Greek Credit Rating by 1 scale (Ba3), retaining the outlook of the Greek economy as stable.
- In March 2021, Greece repaid 3.3 bn to the IMF, 2 years before their maturity date, improving its long-term debt sustainability.
- Since the elimination of capital controls, liquidity in all economic sectors improved and the country's total deposits and repos were increased by €15 bn.

Government debt hits record of 213% of GDP, while lockdown measures have a dramatic impact on Government balances



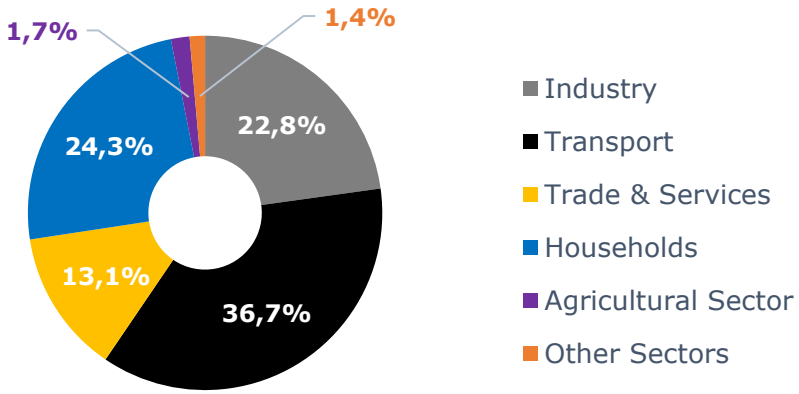
Source: IMF, HAEE's analysis

Highlights

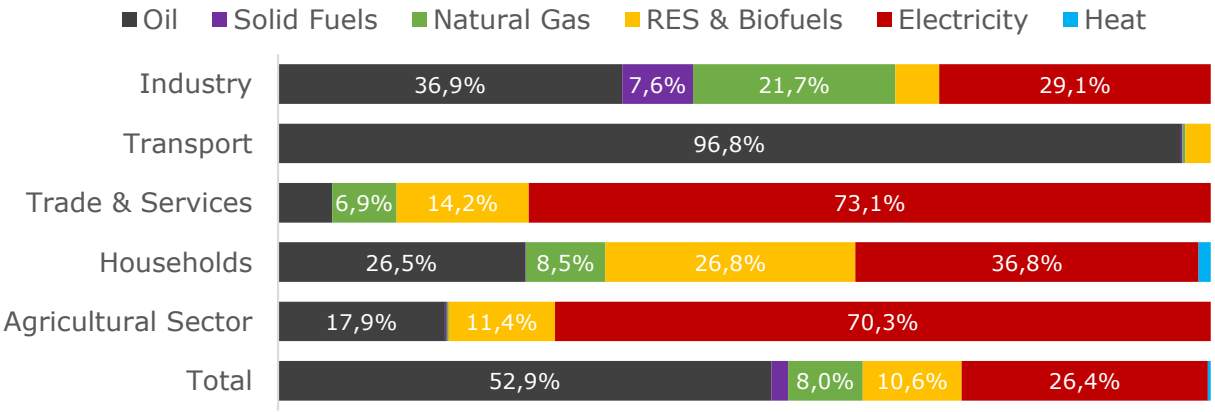
- Greece holds the Eurozone's highest ratio of public debt as share of its GDP, reaching a record 213.1% in 2020.
- IMF's 2026 forecast suggests the ratio will decline to 180%, still way too far from the level prior to 2009 crisis, when the ratio was below 150%.
- After 4 years of consecutive surplus, the General Government Balance recorded a 10% deficit in 2020, the worst outcome in 10 years.
- Estimations for the upcoming years suggest a deficit of 2% by 2026, mainly due to the country's spending to recover from the pandemic's consequences.
- All funding and supporting mechanisms clarify that the Greek Government should follow the path of economic reforms.

In 2018, Oil remained the dominant energy source of final consumers, while Renewables covered 10.6% of final energy consumption

Final Energy Consumption by Sector (%), 2018



Fuel Share in Final Energy Consumption (%), 2018



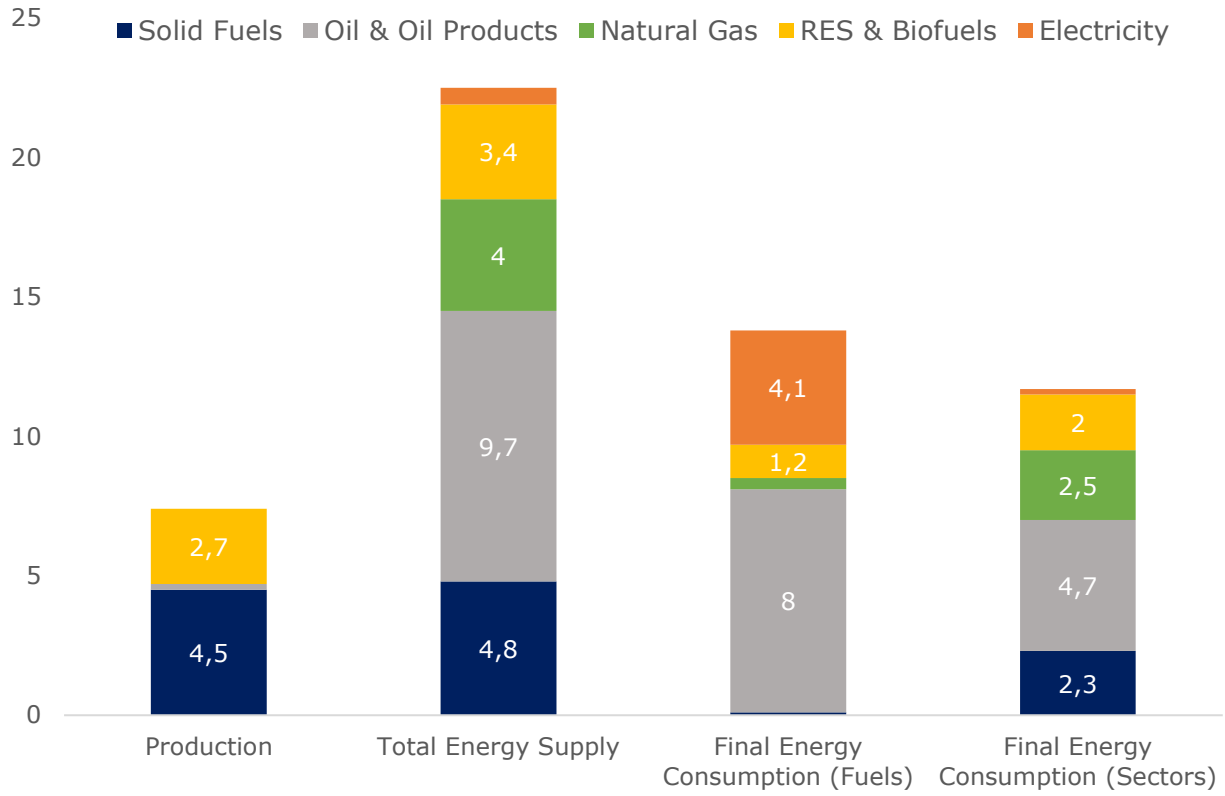
Source: Eurostat, HAEE's analysis

Highlights

- Transport is a carbon-intensive sector, since Oil covered 98% of the total energy consumption for 2018.
- Households responsible for one quarter of final energy consumption use mainly electricity (37%), Oil (27%) and RES (26.8%).
- In the industry sector, only 4.7% of the final consumption is covered by RES, while the share of fossil fuels in total reaches 66.2%.
- Oil is the dominant fuel in final energy consumption due to the "oil-based" transport sector, which is the leader in the total final consumption in the country
- Trade & services and agricultural sector consume mainly electricity (above 70%) while Renewable Energy Sources around 11 and 14%, respectively.

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

Energy Generation & Consumption (million ktoe), 2018



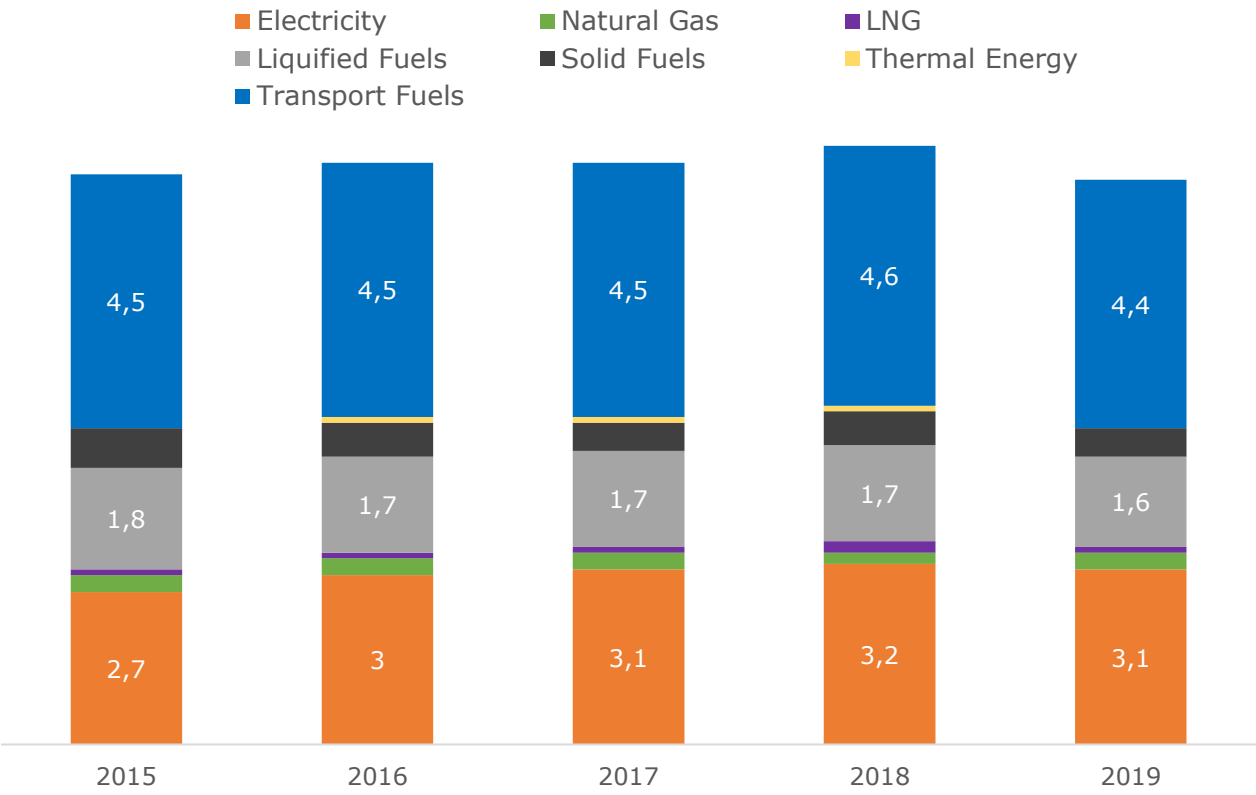
Source: IEA, HAEE's analysis

Highlights

- Greece produced 7.54 Mtoe of energy for 2018, out of which 57% stands for Lignite, 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.

Energy cost represented around 10% of the total household expenditures in 2019, while transport fuels account for 4.5% on average

Household Expenditure for Energy Products as Share of Total Household Expenditure (%), [2015 - 2019]



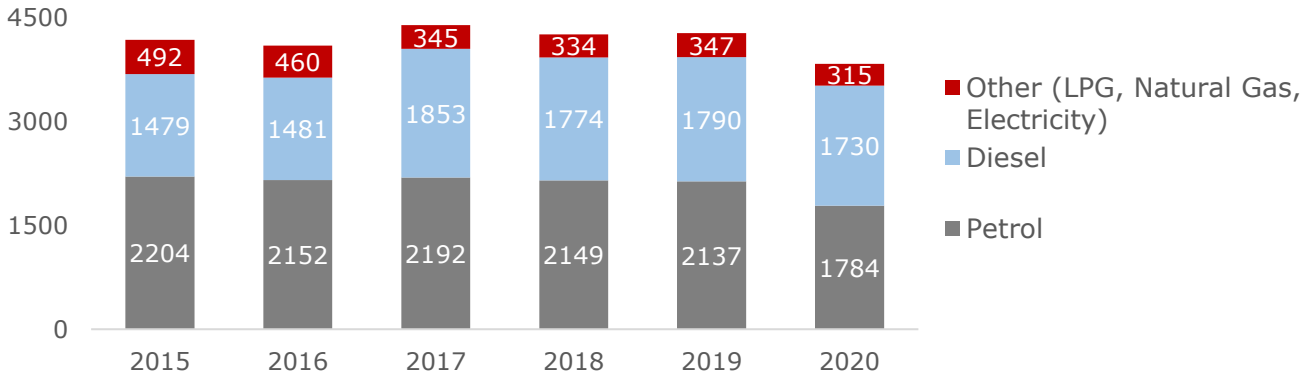
Source: Eurostat, HAEE's analysis

Highlights

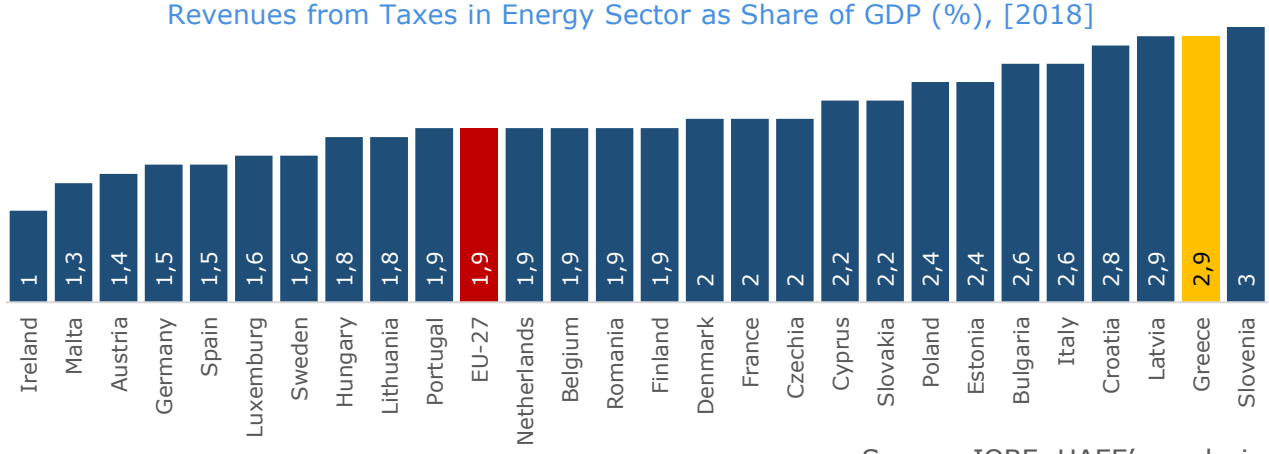
- The Household expenditure for energy products is higher in Greece than EU27 average.
- Transport fuels hold the biggest share of household expenditure in energy sector, which is shaped around 4,5% from 2015 until 2019.
- The second most important energy related household expenditure in Greece, is the electricity cost, since it represented more than 3% in 2019.
- 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 percentage of households which encountered difficulties in utility bills, was 18.8% in 2010, while it reached 35.6% in 2018.

Greece records the second highest share of revenues from Taxes in the energy sector as share of GDP, in the EU-27

Revenues from Excise Duties on Energy Products (million €), [2015 - 2020]



Revenues from Taxes in Energy Sector as Share of GDP (%), [2018]



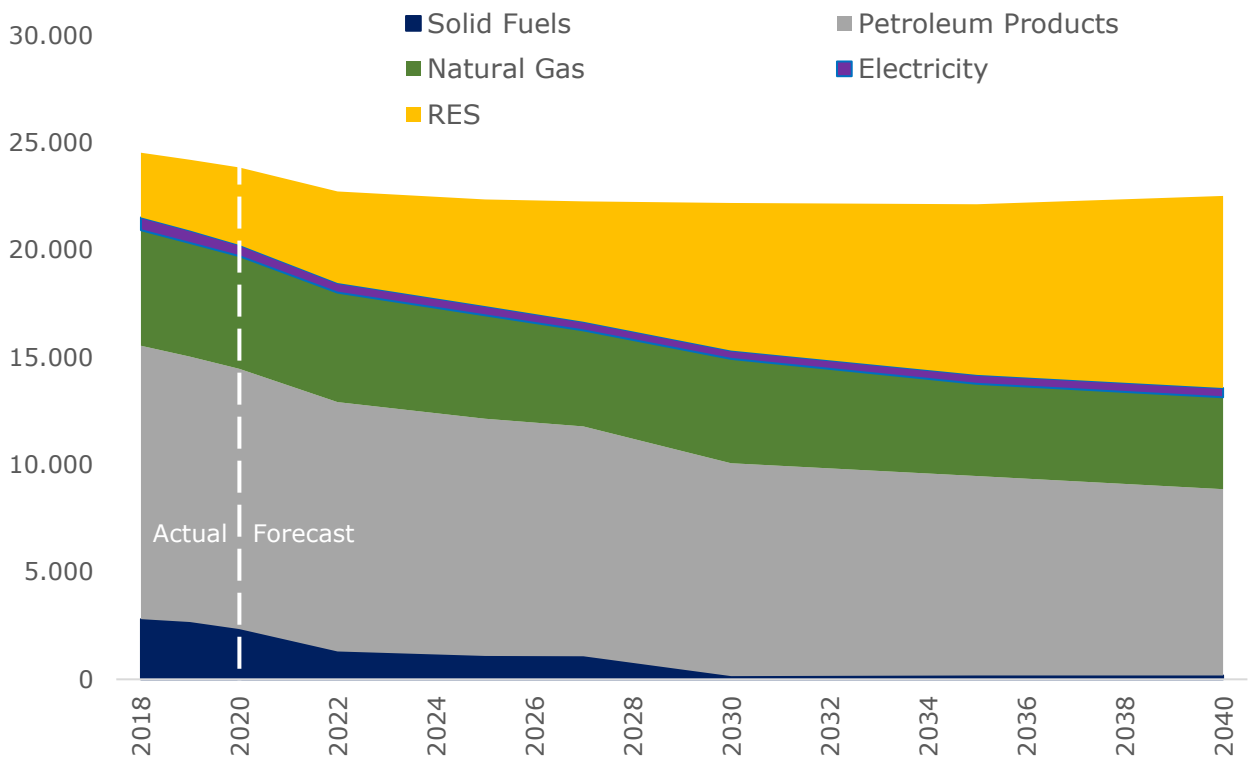
Source: IOBE, HAEE's analysis

Highlights

- In 2020 the Excise Duties on Petrol accounted for the highest share of total revenues from the special taxation of energy products.
- Between 2019 and 2020 total revenues from Excise Duties declined by 10%, while revenues from petrol decreased by 16% and diesel by 3%, respectively.
- Revenues from excise duties in energy reached 2.9% of GDP in 2018, only behind Slovakia which records the highest share at 3%.
- Neighboring countries, hold lower share of revenues from energy taxation. For instance, Italy accounts for 2.6%, Bulgaria 2.6% and Cyprus 2.2%.
- Greece owes 7.4% of its total tax revenue to excise taxes on energy, a rate that exceeds the European average.

Gross energy consumption in Greece is anticipated to reach 22.000 ktoe by 2040, while RES share will overcome petroleum products

Evolution of Gross Energy Consumption in Greece (ktoe), [2018 – 2040]



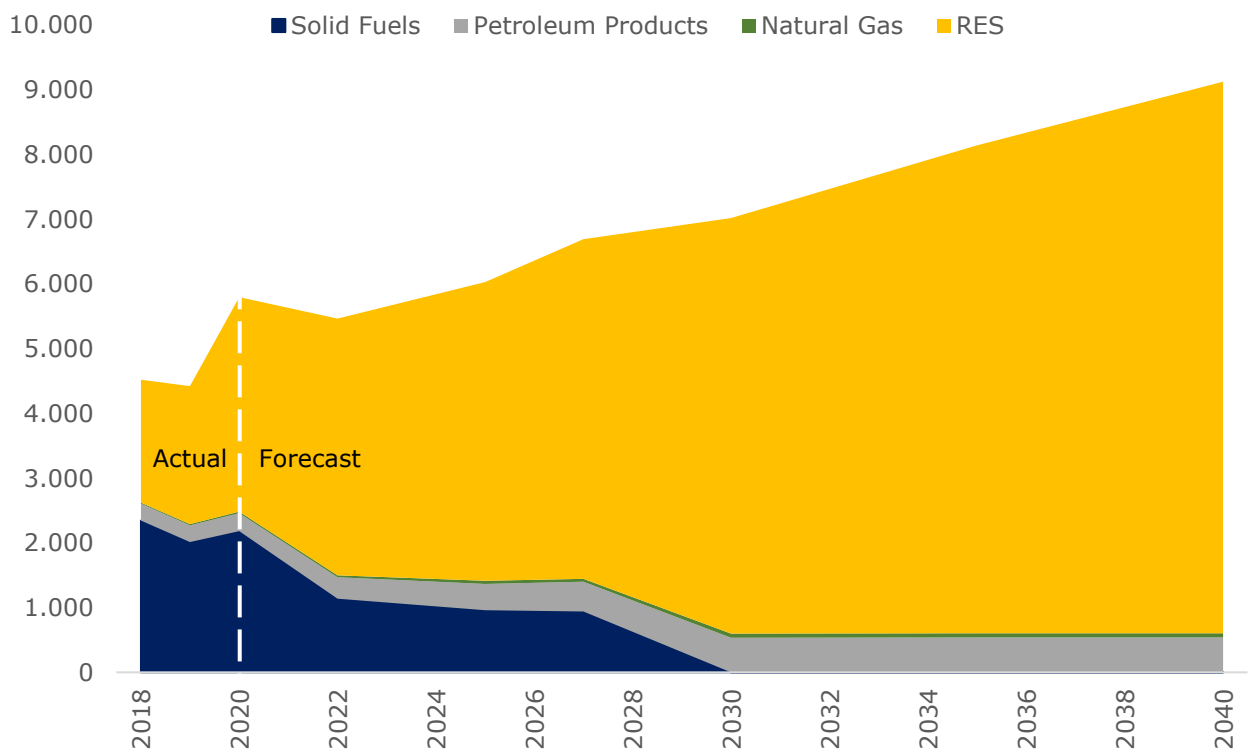
Source: National Energy & Climate Plan & HAEE's analysis

Highlights

- Energy consumption is anticipated to decline, due to implementation of energy efficient technologies and improvement of existing energy intensive systems.
- According to the governmental Master Plan, existing lignite units should shut down until 2023, except Ptolemaida5, which will continue its operations as a CCGT unit.
- Petroleum products are estimated to continue the declining trend which was noticed during Covid-19 pandemic, as NECP obliges the prevalence of RES.
- Natural gas share is expected to remain stable, around 22%, ensuring its role as the bridging fuel of the country's Energy Transition.
- Renewable Energy Sources share is projected to gradually increase from 19% in 2020 to 40% in 2040.

Between 2020 and 2040, RES are anticipated to dominate energy generation, by increasing their share up to 36%

Evolution of Primary Energy Generation in Greece (ktoe), [2018 – 2040]



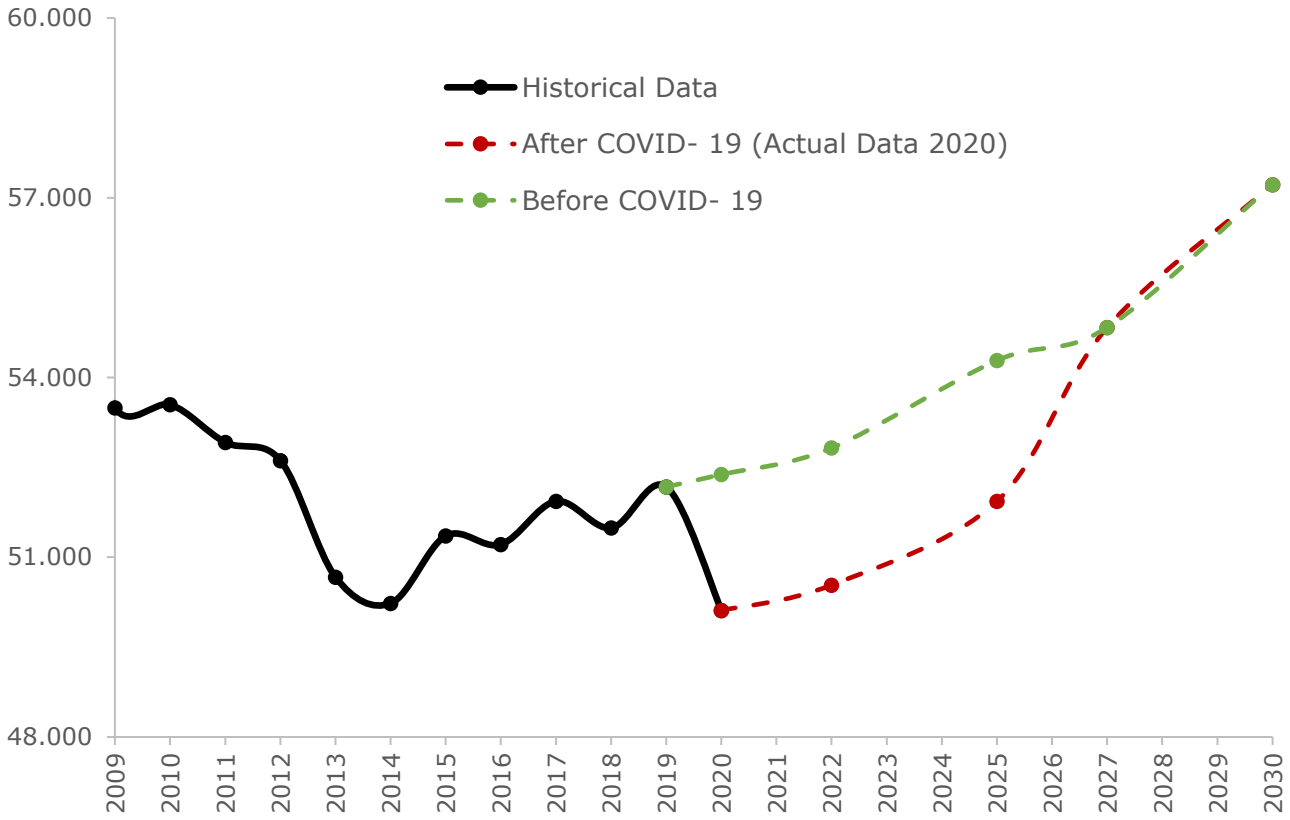
Source: National Energy & Climate Plan & HAEE's analysis

Highlights

- Towards a climate neutral Greek economy by 2050, RES are expected to dominate the energy production over the following years.
- By the end of 2030, RES are projected to reach 91% of total energy produced in Greece, since lignite fuel will be eliminated from the energy system.
- After 2022 Natural gas in Greece is anticipated to represent a steady share of 1% while the share of oil is expected to remain at approximately 7%.
- To increase primary energy production, is required to be coupled with electricity storage systems, and hydrogen technologies.
- Two Committees for the development of National Hydrogen Roadmap and the development of Energy Storage Regulatory Framework were established recently.

In 2020, electricity demand was crucially affected by the COVID- 9 crisis and deviated from the goal of National Energy Climate Plan by 5%

Evolution of Total Demand for Electricity (GWh), [2008-2030]



Source: HAEE's analysis

Highlights

- From 2009 to 2014, the total demand for electricity exponentially decreased and dropped to 50.000 GWh in 2014.
- During the following years, the electricity demand slightly increased and reached 52.174 GWh in 2019.
- The negative impact of COVID-19 outbreak, will be eliminated after 2025 and the expected growth in electricity demand will be increased at a higher rate.
- 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 forecast anticipates that the electricity demand is going to achieve the goal of 57.220 GWh.

The Greek energy market has been extensively reformed generating, challenges and uncertainties for market participants

Key Barriers specific to Retail Energy Market in Greece:

Has not been raised, indicated or identified as a barrier:

- Wide-reaching price regulation
- Small market or customer value
- Low liquidity on wholesale market
- Lack of data for innovative product development

Has been raised or indicated as a barrier:

- Advantage of vertically integrated market players
- Low margin of regulated offer
- Low customer awareness or interest
- Poor or no access to operations-critical data
- Missing market value or novel products
- Insufficient price signals for end-users
- Lack of data hub

Has been identified as a barrier:

- Uncertainty around current regulatory environment or its development Low margin of regulated offer
- Uncertainty around regulatory future for digitalization and new technologies
- Customer do not trust new suppliers or technology
- Discriminating, strategic behavior of incumbent, and obstruction by other market players
- High complex or country-specific systems & processes
- Discrimination against new and small players in capacity and ancillary services markets
- Suppliers tasked with collecting tariffs unrelated to energy

Source: European Commission, HAEE Analysis

2. Energy Transition

Highlights

2.5 GW of **RES** to be installed in Western Macedonia and Megalopoli, areas heavily affected by the decarbonization process

RES contribution for electricity generation is projected to reach **67%** by 2030, as EU GHG emissions target for 2030 will be increased up to **55%**

4-28 GW energy storage capacity required to meet RES generation needs by 2050

The operation of White Dragon Project will annually save **11.5 Mt CO_2**

Electricity generation by **lignite** in Greece will completely **phase-out** by **2023**

3,740 TWh RES are estimated to be annually generated in Western Macedonia and Megalopoli **by 2024**

Crete, Cyclades, North Aegean and Dodecanese will be **interconnected with the mainland S**ystem gradually till **2029**

320,000 tons of **Green Hydrogen** to be produced by 2029 in Western Macedonia under the **White Dragon project**

Overview

2020 was a milestone year for the energy transition in Greece. In December 2019, the National Energy and Climate Plan, presented significant goals and suggested transformational changes in domestic energy production and consumption. In 2021, record-breaking CO2 prices, exceeding 55€/tCO2, led to increased RES generation, exceeding fossil-fuel generation during the first quarter of 2021.

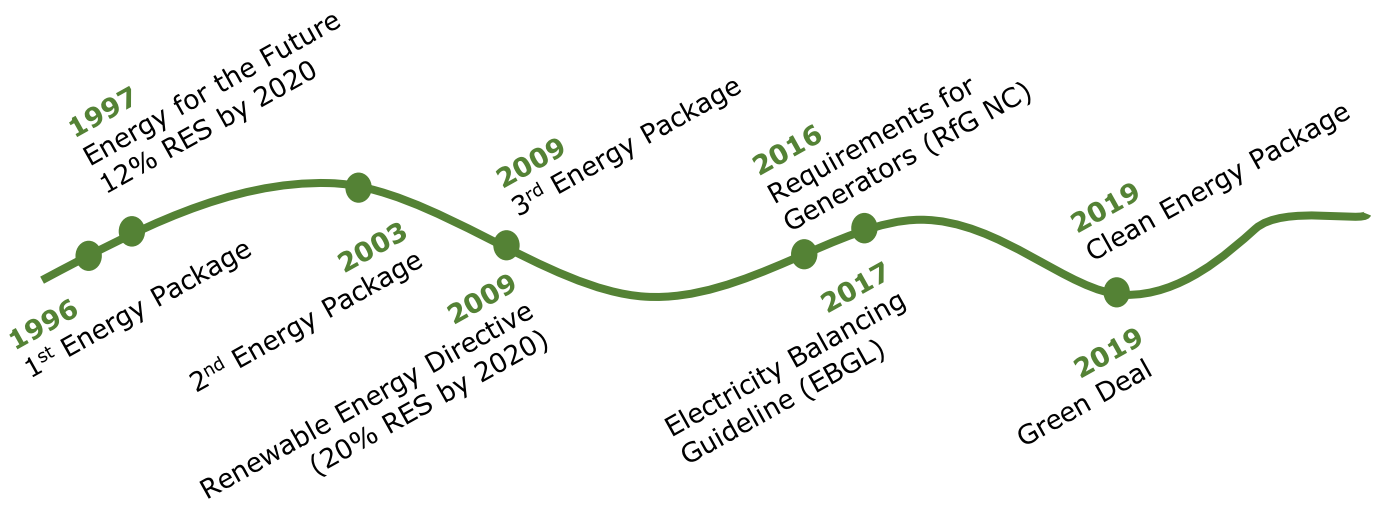
Lignite phase-out, which was announced in September 2019 is accelerating. PPC sets the end date of the operation of lignite power plants earlier than predicted with Ptolemaida 5 to change fuel by 2025. The Just Transition Fund will mainly provide grants in the affected lignite areas. Greece will receive approximately €750 million, which will be absorbed by Clean Energy, Smart agricultural production, Sustainable tourism, Industry and Trade and Technology and Education Pjocets.

From 2021 to 2028, 2 GW PV power and 550 MW will be installed in Western Macedonia and Megalopolis respectively, with the majority to be installed between 2023 and 2025. PV parks in Western Macedonia are expected to 3,000TWh annually by 2024 and 740GWh in Megalopolis by 2024. The interconnection of the islands and the implementation of green and sustainable technologies are a main pillar of the energy transition in Greece. During the next years Astypalea, Chalki and other Greek islands will implement green energy, electromobility and other smart innovative technologies. The gradual interconnection of Crete, Cyclades, North Aegean and Dodecanese with the mainland and the electrification of transport and heating/cooling will increase the electricity demand up to 61 TWh by 2030.

The Long-term energy vision of 2050 shows a clean path to other forms of alternative fuels, such as hydrogen, biomass and synthetic fuels. The transition to a climate-neutral economy requires high-RES integration, which leads to high Energy Storage demand. In EU Hydrogen Strategy, the first period 2020-2024 is characterized by the progressive decarbonization of hydrogen and a gradual escalation of investments in electrolysers, reaching 6 GW by 2024. Green hydrogen will become key component of the energy mix in Europe during the period 2025-2030, boosting the installed power at the level of 40GW.

In Europe, the average projected capacity for H2 projects is 2,131 MW by 2024, which is far from the EU target of 6 GW green hydrogen capacity. The new financial instruments, such as IPCEI, will boost the investments in the sector. In Greece, the proposed project "White Dragon" is a game changer of the energy transition in lignite areas and the Greek first proposed hydrogen valley. The main objective of the proposed project is the gradual replacement of the lignite power plants with the production of green hydrogen and the transition to clean energy systems. The "White Dragon" project will use large-scale renewable electricity, approximately 1.5 GW and 3.8GW electrolysers to produce nearly 320,000 t green hydrogen per year.

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



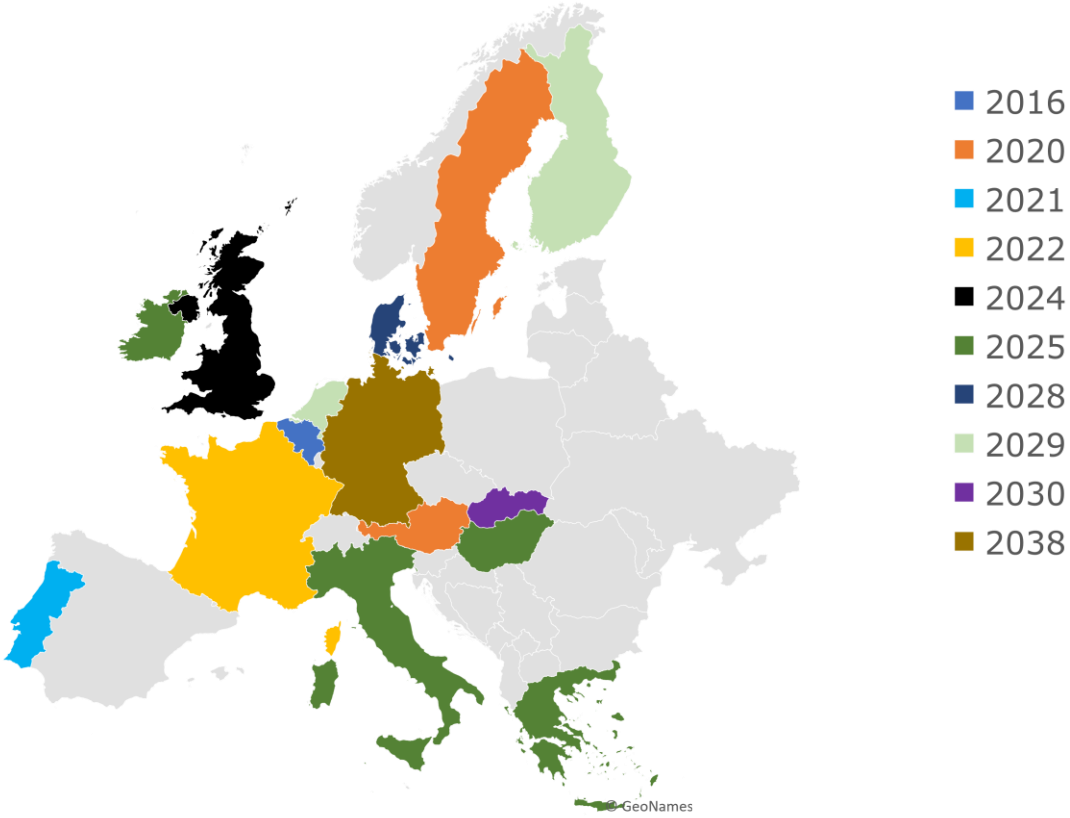
Source: HAEE analysis

Highlights

- Between 1996 and 2019, the EU introduced various Directives and Acts, hence it managed to reduced greenhouse gas emissions by 23%, compared to 1990 levels.
- 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.
- According to the new European Green Deal, at least 30% of the "Invest EU" Fund will contribute to the fight against climate change.

The phase-out of Coal-fired power plants, have been announced by several European Union countries

Lignite Phase-Out Plans [April 2021]



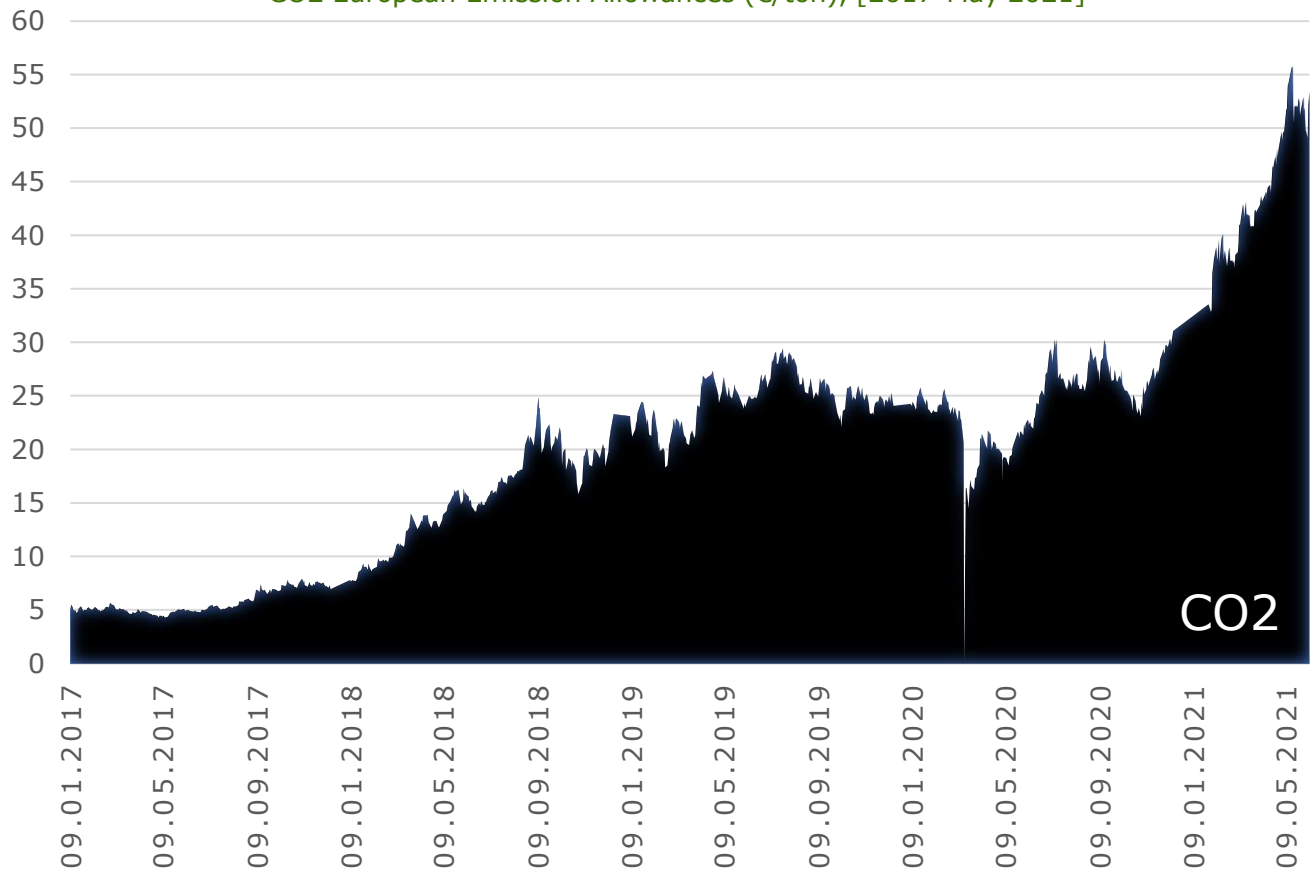
Source: Europe Beyond Coal, HAEE's analysis

Highlights

- Climate change, increased CO2 prices, and green financial incentives led most of the EU countries to withdrawn coal from the energy mix by 2030.
- A total of 35.4 GW of coal power capacity will be phased-out by 2030, corresponding to 25% of Europe currently operational coal fleet.
- Germany's announcement to phase out coal by 2038 (or possibly 2035) means that further 17 GW are set to close their operations after 2030.
- Greece will shut down 3.35 GW of currently running lignite power plants and additional 610MW of Ptolemaida 5 unit will change fuel by 2025 (instead of 2028).
- PPC announced that the complete decarbonization process will be completed earlier than the original plan, since all running PPC power plants will be phased-out by 2023.

The constant increase of CO2 European Emission Allowances make the Energy Transition of the country imperative

CO2 European Emission Allowances (€/ton), [2017-May 2021]

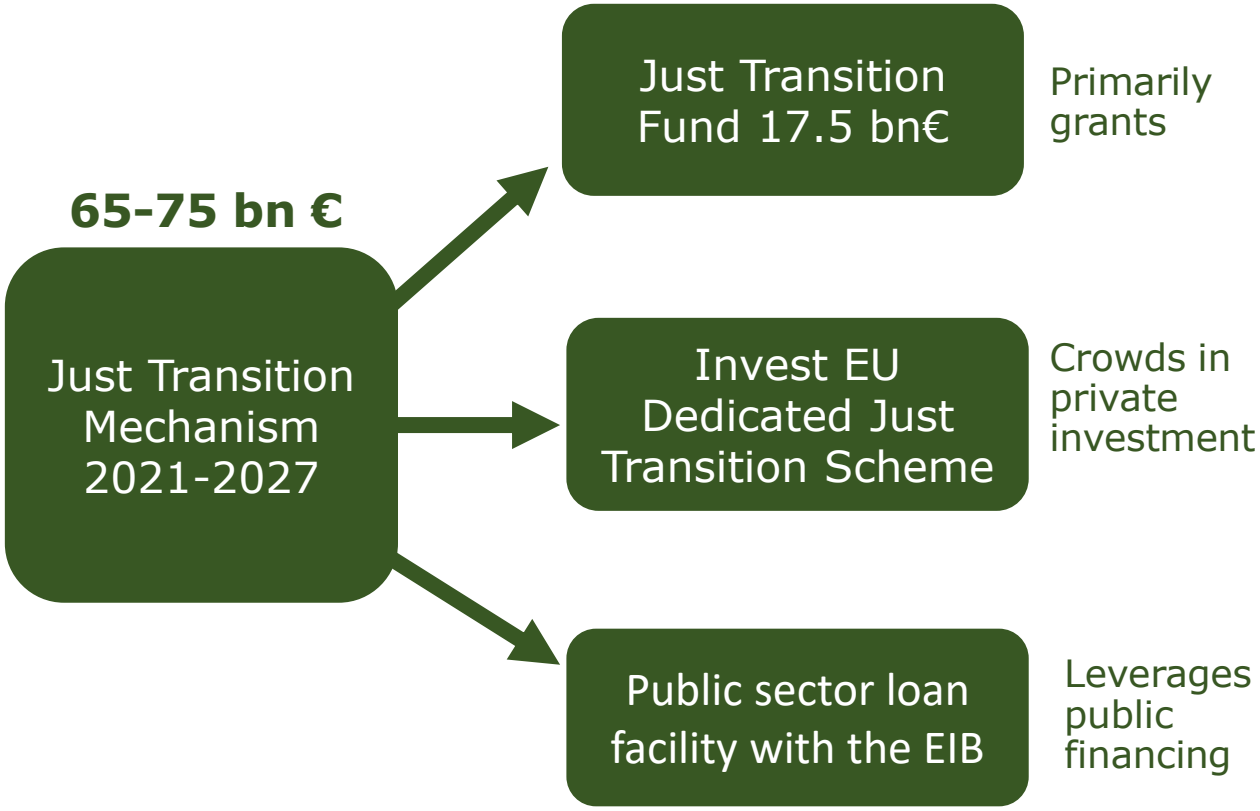


Source: EEX, HAEE's analysis

Highlights

- CO2 prices exceed 55€/tCO2 in 2021, increased by over 140% compared to the levels as reordered one year earlier in 2020
- The current levels of CO2 prices exceed prior estimations, which predicted fluctuations close to 40€/tCO2 in 2021 and 46€/tCO2 in 2022.
- The increased CO2 prices will generate additional pressure to the daily operation of natural gas-fired plants and boost even more the generation from RES.
- EU envisages a reduction of at least 55% in net greenhouse gas emissions by 2030, compared to 1990 levels, and zero net emissions by 2050.
- Hydrogen, green fuels and CCS technologies will capitalize high CO2 prices and along with enhanced financial incentives will be developed to a greater extent.

EU ensures the transition of the affected lignite and coal areas, through the Just Transition Mechanism



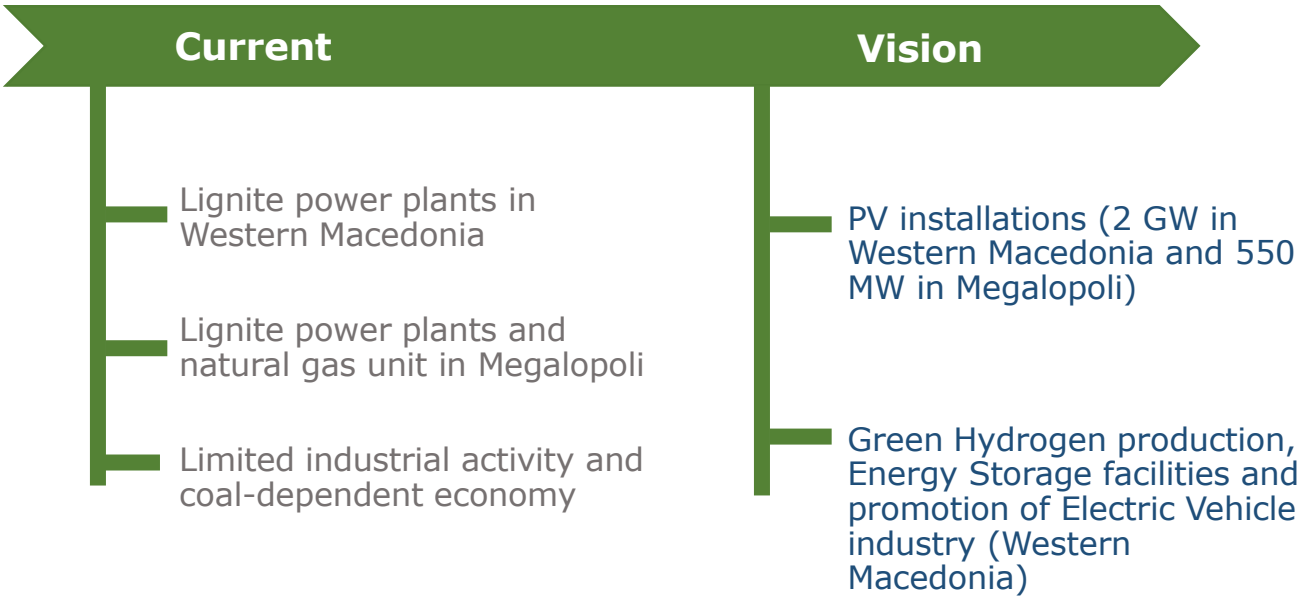
Source: European Commission, HAEE's analysis

Highlights

- Just Transition Fund (JTF) promotes job-seeking assistance for workers and support climate and environmental sustainability by enhancing green energy investments.
- The JTF consists of €7.5bn from the 2021-2027 Multinational Financial Framework (MMF) and an additional €10bn from the EU Recovery Plan (leverage €30bn more).
- Greece will receive 430 million € from EU recovery plan and 324 million € from MMF, 4.3% of total EU allocation.
- A so-called green rewarding mechanism will be added in case of a fund extension after 2024, so countries that make better progress would be able to get more cash.
- Greece is currently drafting 3 territorial Just Transition Plans for Western Macedonia, Megalopoli and the Greek islands.

The Greek Just Transition Master Plan underlines the vision for the next day in the area, promoting green public and private investments

Energy and Industry



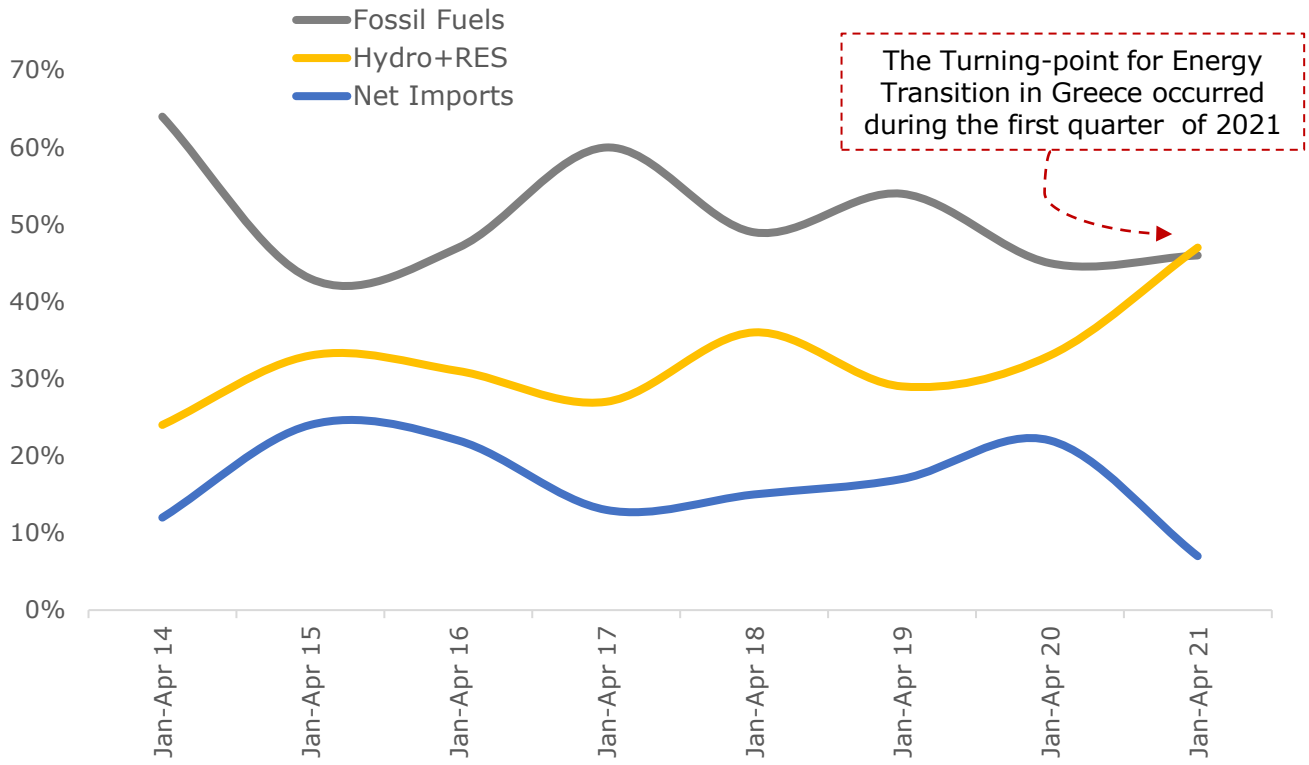
Source: Greek Just Transition Master Plan, HAEE's analysis

Highlights

- The vision is based on seven key pillars: Clean Energy, Smart Agricultural Production, Sustainable Tourism, Industry, Trade, Technology and Education.
- Construction of solar parks: 2 GW, of which 0.4GW are under construction in Western Macedonia, and 550MW in Megalopolis. 50 MW out of them are under construction.
- In Western Macedonia, the solar parks will enable the green hydrogen production, supported by the White Dragon Project.
- A new Industrial Electromobility Park with the provision of a battery power plant and car parts industry will significantly increase the competitiveness of the country.
- This roadmap will restructure the productive model of the transition areas, while capitalizing on the diverse comparative advantages of the affected areas.

Renewable Energy Sources and Hydropower generation in Greece take the lead in energy production of the interconnected System

Electricity Generation Share in the Interconnected System (%), 2014- Q1 2021]



Source: HTSO, HAEE's analysis

Highlights

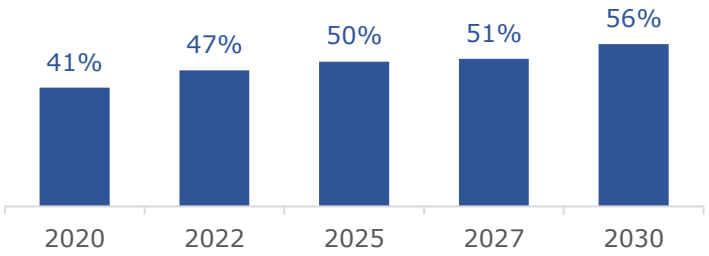
- During the first quarter of 2021, Renewables and Hydro share overpassed fossil fuels share for the first time in history in Greece.
- Lignite share continues to decrease from 64% in January-April 2014 to 13% in January-April 2021.
- Natural gas, which is considered as the bridging fuel during the Energy Transition, increases its share from 15% in 2014 to 33% in 2021
- The decreased fossil fuel generation led to increased RES and not imports, which was the case in the previous years.
- The increased cost of fossil fuel-fired generation, due to high CO2 prices, will most likely remain over the next years, hence supporting even more RES penetration.

The National Energy and Climate Plan sets three main pillars, which will be revised due to new proposed EU target (55% instead of 45%)

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%)

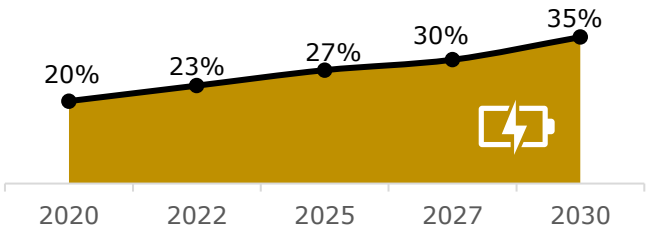
Total Greenhouse Gases (GHG) Emission Reductions Compared to 2005 (%), [2020-2030]



Increase of Renewable Energy Sources penetration

The share of RES in final gross energy consumption to reach at least 35% and in final gross electricity consumption 61% (67% in the forthcoming update of NECP)

RES share in Final Energy Consumption (%), [2020-2030]



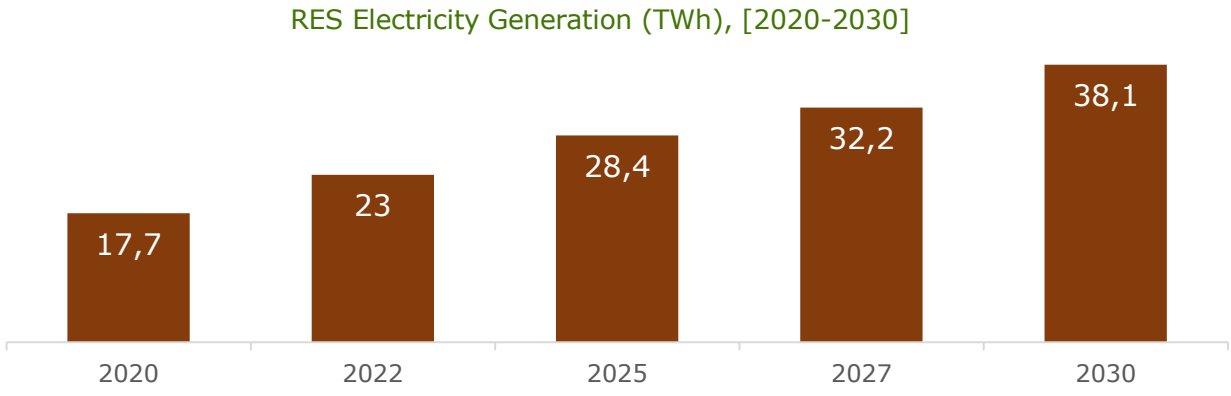
Achieve improvement in Energy Efficiency

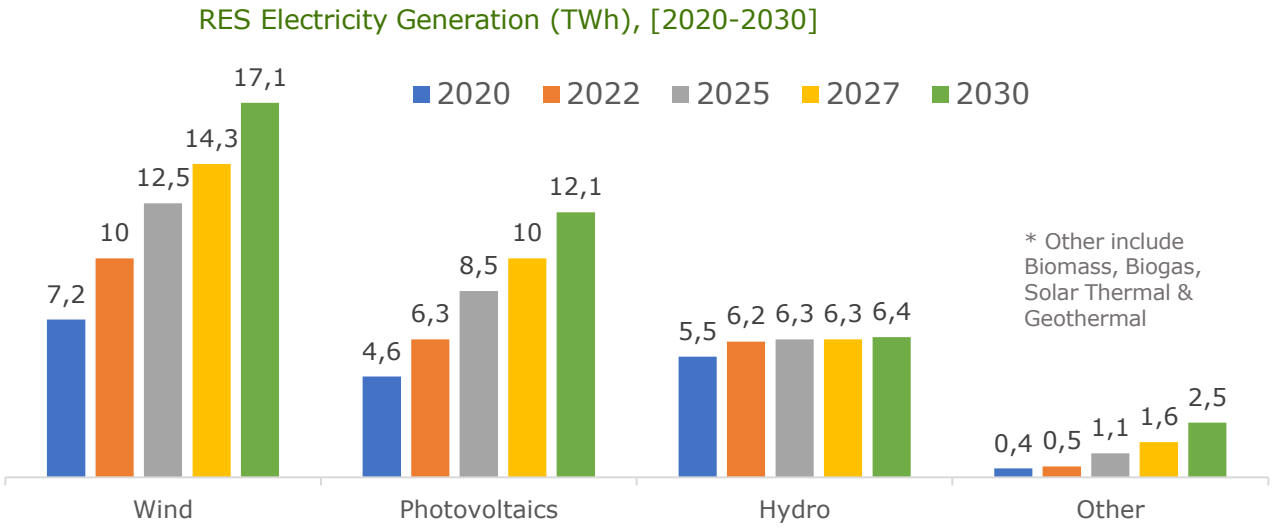
Achieve improvement in energy efficiency by 38% according to EU methodology

- The final consumption of energy **should not** exceed 16.5 Mtoe by 2030.
- The primary energy consumption **should not** exceed 22.5 Mtoe in 2030.
- To be achieved at least 7 Mtoe cumulative **energy saving** between 2021 and 2030.

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

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





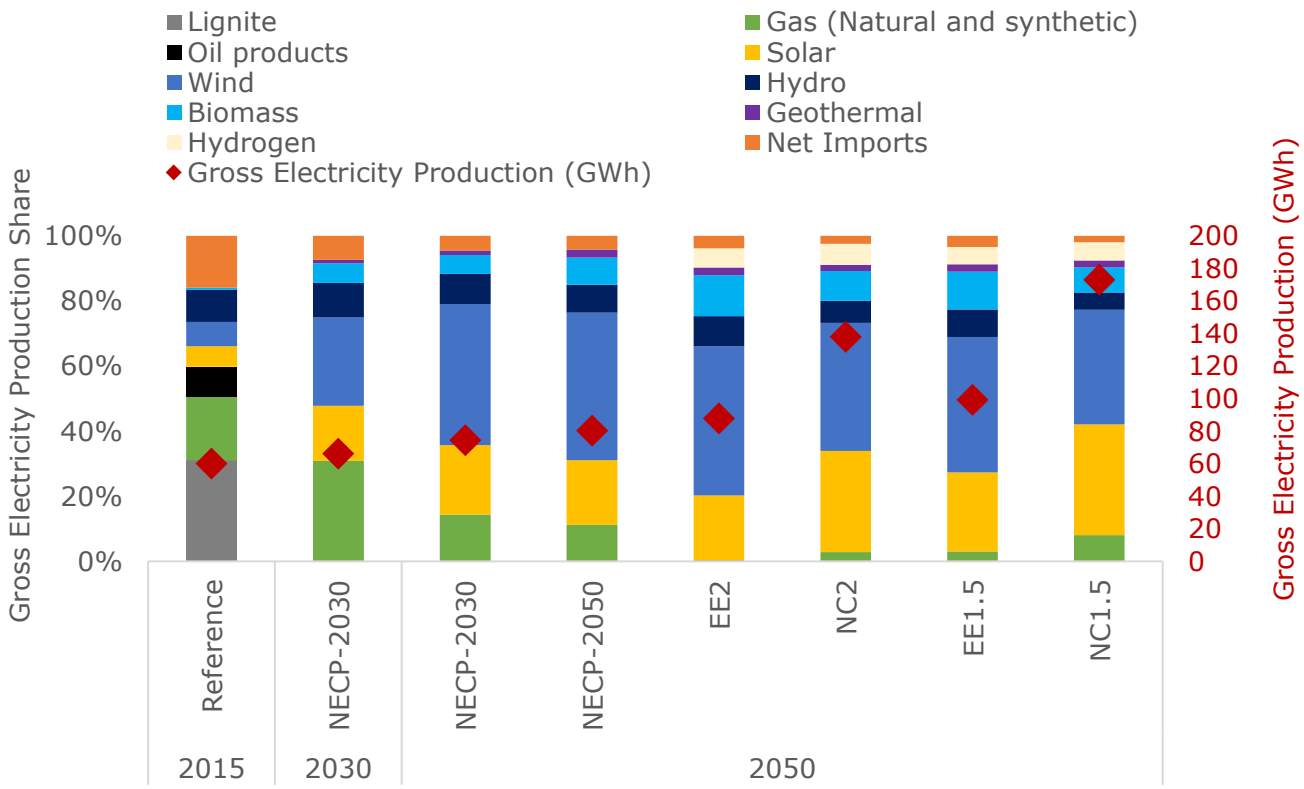
Source: National Energy and Climate Plan, HAEE's analysis

Highlights

- 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).

Long term energy vision of 2050, shows a clean path to alternative fuels, such as hydrogen, biomass and synthetic fuels

Gross Electricity Production Mix in Greece (%) & (GWh), [2015-2050]



NECP-2030: NECP provisions - no new policies up to 2050, NECP-2050: NECP provisions with new policies up to 2050, EE2: Energy Efficiency and Electrification for 2°C, NC2: New energy carriers for 2°C, EE1.5: Energy Efficiency and Electrification for 1.5°C, NC1.5: New energy carriers for 1.5°C

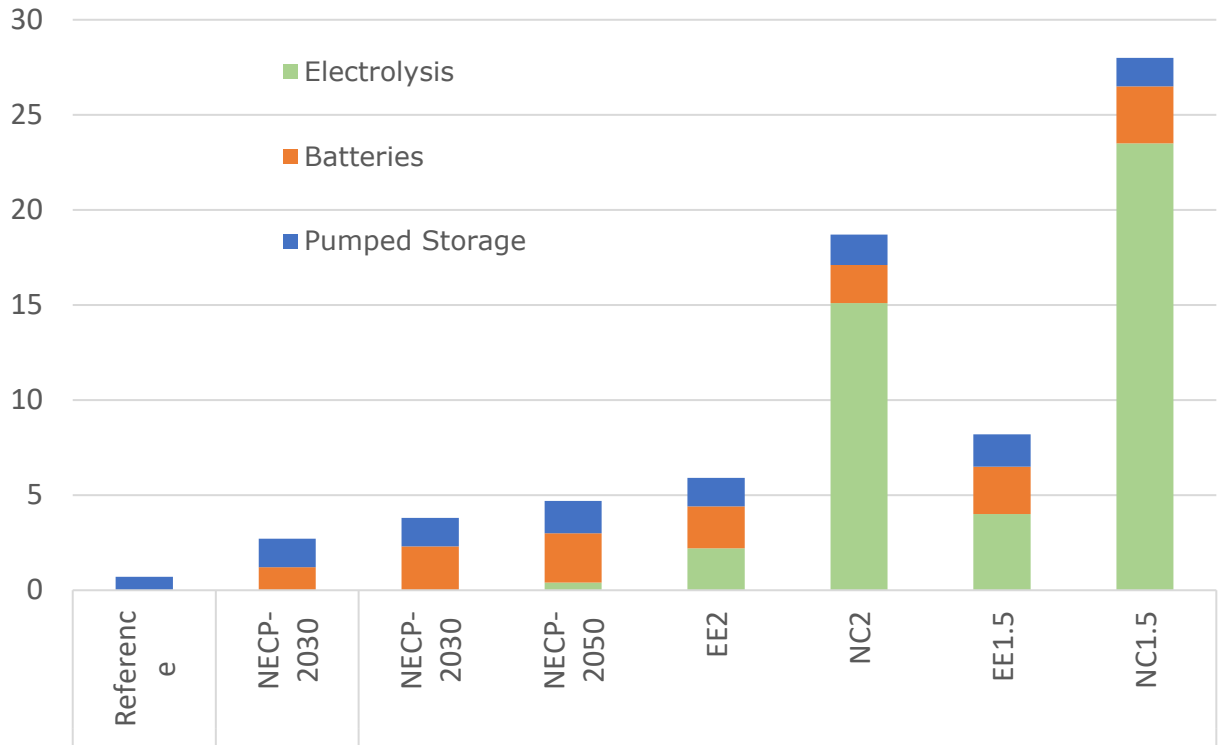
Source: Greek Long-term Energy Plan 2050, HAEE's analysis

Highlights

- Gross electricity consumption is projected to increase by 15% and 20% by 2050 compared to the basic policy scenarios.
- In all scenarios, RES electricity generation will be significantly increased, reaching 88-90% of the total demand in 2050.
- In EE2 scenario, hydrogen is completely replacing natural gas in power plants, while 10% of demand is covered from the operation of conventional thermal power plants.
- The required presence of fossil fuels in the energy mix leads to the utilization of Carbon Capture and Storage technology, aiming to achieve carbon-neutrality.
- The balancing of RES stochastic generation, will be achieved by maximizing pumped storage and developing battery installations in a decentralized and centralized scale.

The Transition to a climate-neutral economy requires increased RES penetration, which leads to high Energy Storage demand

Projections for Energy Storage in Greece (GW), [2015-2050]



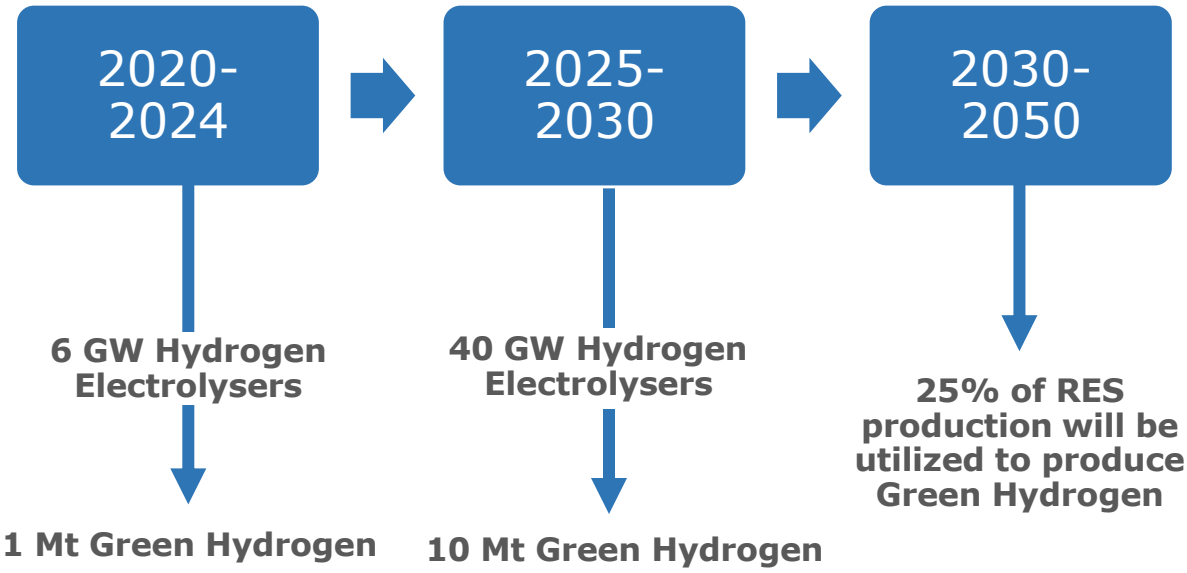
NECP-2030: NECP provisions - no new policies up to 2050, NECP-2050: NECP provisions with new policies up to 2050, EE2: Energy Efficiency and Electrification for 2°C, NC2: New energy carriers for 2°C, EE1.5: Energy Efficiency and Electrification for 1.5°C, NC1.5: New energy carriers for 1.5°C

Source: Greek Long-term Energy Plan 2050, HAEE's analysis

Highlights

- Energy Storage technologies are essential for the further RES penetration, ranging from 4-28 GW by 2050.
- In all scenarios, pumped storage stations are utilized, providing power in a daily or weekly cycle, while batteries will be are available for daily electricity storage.
- Hydrogen, which is produced by excess RES power, is the most suitable storage technology.
- NC1.5 and NC2. scenarios require up to 2 times higher RES installed power compared to NECP-2050, mainly due to high electricity demand.
- Hydrogen storage in high-RES scenarios (NC1.5 and NC2) dominates, covering 80-84% of total energy storage power.

The Hydrogen Strategy of European Union defines three development stages of "Green" Hydrogen until 2050

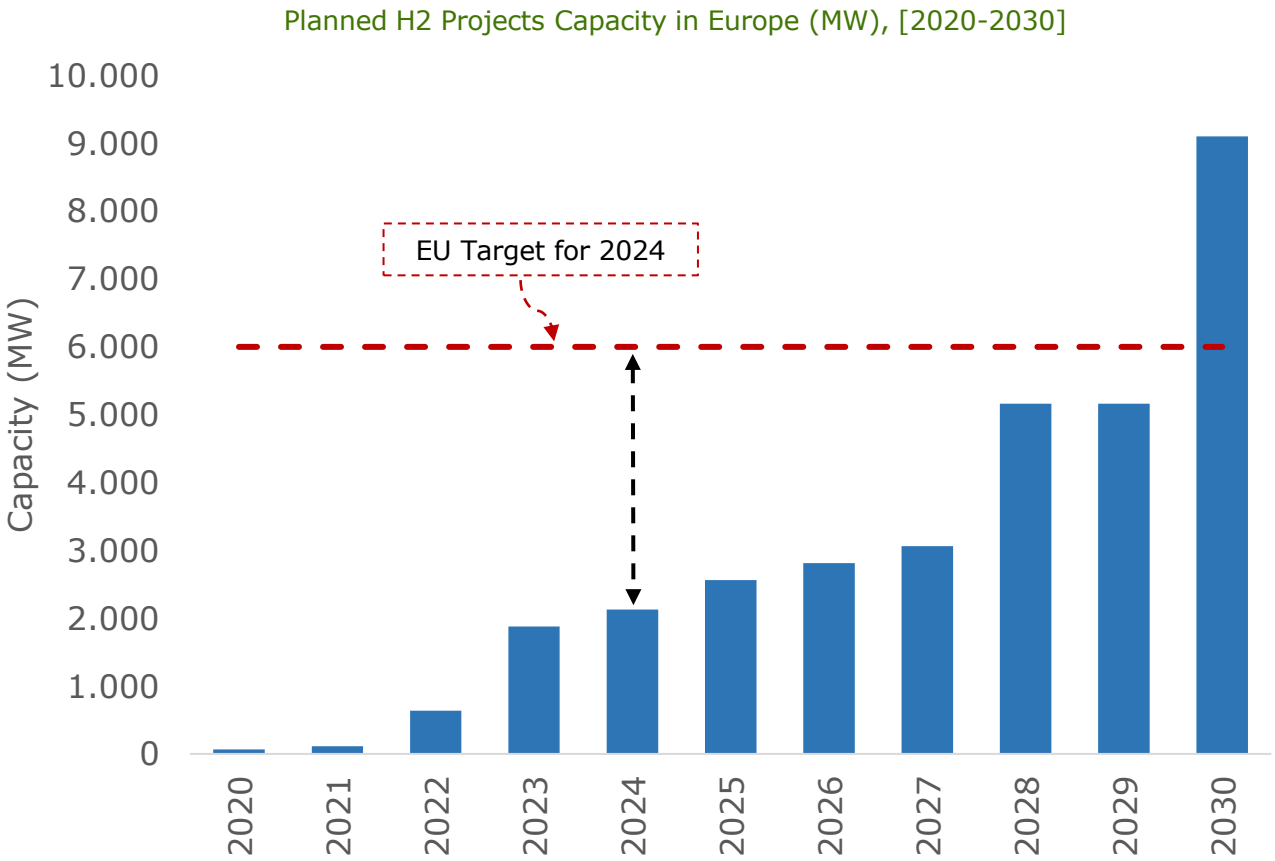


Source: EU Hydrogen strategy, HAEE's analysis

Highlights

- The period until 2024 is characterized by the progressive decarbonization of hydrogen and a gradual escalation of investments in electrolysers.
- Green hydrogen will become key component of the energy mix in Europe during the period 2025-2030, hence boosting the installed power at the level of 40GW.
- Considering the wide exploitation of hydrogen, Green Hydrogen production technologies are becoming cheaper and mature, followed by large scale investments.
- The cost from the generation of Renewable Energy Sources will be a key component for development of green hydrogen investments.
- The ideal case for hydrogen production combines a low LCOE with a high-capacity factor, considering the variabilities in Wind and Solar generation.

Planned European Union Hydrogen Projects are still lagging compared to mid-term targets, yet significant progress will take place by 2030

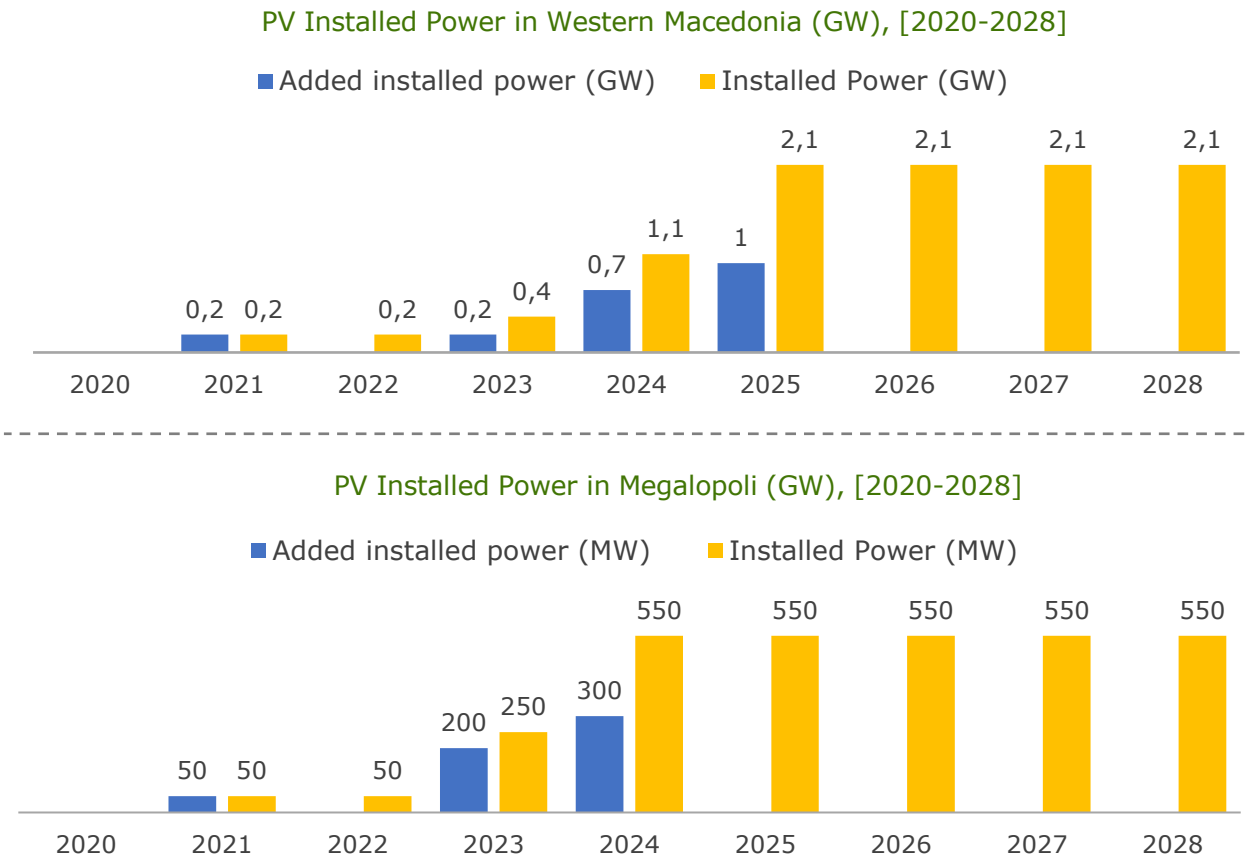


Source: Hydrogen Europe, HAEE's analysis

Highlights

- The average projected capacity by 2024 is 2,131 MW, which is far from the EU target of 6 GW green hydrogen capacity.
- Those projects have been developed in an unfavorable condition with regulatory gaps and limited financial incentives.
- 4 GW of electrolysers will be added in 2030, since multiple large-scale projects have expressed their interest to operate by the end of the current decade.
- Important Projects of Common European Interest (IPCEI) will support large scale development of green hydrogen projects.
- The 10 candidate projects under IPCEI includes one in Greece, the so-called "White Dragon" project, located in Western Macedonia region.

Based on the official Master Plan, Photovoltaic installation will substantially increase across the Transition areas by 2028



Source: Just Transition Development plan, HAEE Analysis

Highlights

- 2 GW PV power will be installed in Western Macedonia area during the period 2021 - 2028, with the majority to be installed in 2024 and 2025.
- The PV projects in Western Macedonia will create 1.000 to 1.200 direct jobs and a total of 2.500 direct and indirect jobs.
- In Megalopoli a total of 550 MW PV power will be added, recording a boost during the years 2023 and 2024.
- 290 direct jobs and a total of 630 direct and indirect jobs will be created during the development of PV projects in Megalopoli.
- PV parks in Western Macedonia will produce up to 3,000 TWh annually by 2024 and in Megalopoli 740GWh by 2024, respectively.

Greek Hydrogen Proposal "White Dragon" is a game changer in Western Macedonia and the first Greek proposed hydrogen valley

Project Name: White Dragon
Location: Western Macedonia

Total investment cost:
8.063 billion

Injection to pipelines:
250,000 t/a

New Jobs:
18,000 direct and 29,500 indirect

Project duration:
2022 – 2029

For other uses:
58,000 to 71,000 t/a

CO2 savings
11.5 Mt CO2/a

Source: HAEE's analysis

Highlights

- The main objective of the proposed project is the gradual replacement of the lignite power plants with green hydrogen production.
- "White Dragon" project will use large-scale renewable electricity, approximately 1.5 GW and 3.8GW electrolysers to produce nearly 320,000 t green hydrogen annually.
- The green hydrogen will be stored directly (short-term hydrogen storage) and indirectly (injection to DESFA's natural gas pipeline).
- This requires the preparation of the National Natural Gas Transmission System to receive such increasing rates of hydrogen.
- Trans Adriatic Pipeline (TAP) transport and export potential will be examined to supply green hydrogen to other European markets.

Sustainable Islands which aim to achieve energy independence and active citizen participation, support the ongoing Energy Transition in Greece

Astypalea

"A smart and sustainable island"

- ✓ **1,000 electric vehicles** are to replace 1,500 vehicles with internal combustion engines
- ✓ Establish the necessary **electric vehicle charging infrastructure**
- ✓ **Promote micro-mobility,** vehicle sharing, e-moped and e-bicycle services
- ✓ Construction of a **hybrid RES system** towards a zero-emission island

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Chalki

"An island with neutral environmental footprint"

- ✓ Utilization of a **Virtual Net Metering System**
- ✓ Installation of **PV power station** in each island
- ✓ Provision of **Electric vehicles and Charging Stations**
- ✓ Integration of efficient **Smart Lighting Systems**

Agios Efstratios

"The Green Island"

- ✓ **85% Penetration of RES** in the island's electricity system
- ✓ Installation of 900 kW **Wind** turbine and 225 kW of **PVs**
- ✓ Installation of 2,68 MWh/ 1,34 MW **lithium battery storage system**
- ✓ Construction of a **CHP network**

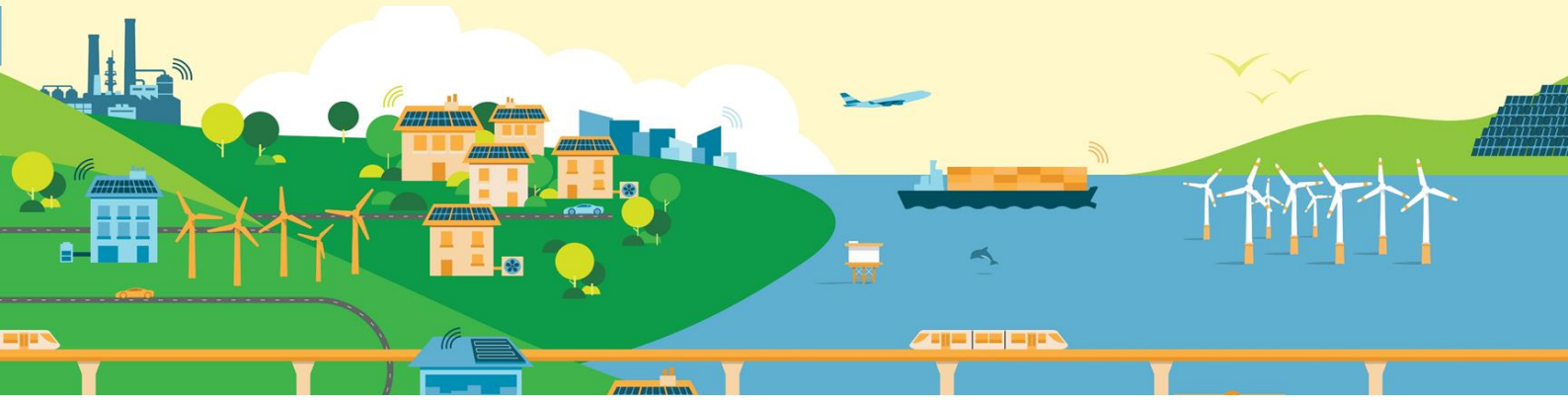
Tilos

"The first energy independent island in Mediterranean Sea"

- ✓ **S4S** (Storage for Sustainability, Smart Grid, solutions, Security)
- ✓ **Wind Turbine** of 800 kW
- ✓ **PVs** of 160kWp

Agios Georgios

- ✓ 73,2 MW **Wind turbines**
- ✓ **Interconnection** with PPC's plant in Lavrio



3. Electricity

Highlights

Natural gas represented **48.3%**, RES **35.3%** and coal **10.3%** of total electricity generated in Greece in October 2020

Electricity lignite generation is projected to reach zero levels by **2025**

Despite the change in electricity mix, Greece continue to face the **2nd** most **expensive** wholesale **electricity price** throughout Europe

Taxes and levies represent almost **36%** of the electricity price paid by the final industrial consumers

Electricity Prices in Greece followed an upward trend reaching **63 €/MWh** in May **2021**

During May 2021**, PPC's market share** in the retail market dropped to **64.2%**

In December 2020, the new EV registrations reached **10.6%** out of the **total registrations** in Greece

CO2

Since 2018, carbon emission allowances increased by 560%, climbing from around 7 €/ton to **51.7 €/ton in May 2020**

Following the COVID-19 crisis, a **U-Shaped recovery** occurred in terms of total electricity demand

Overview

Electricity market is considered as a key sector in Greece, since generation, transportation, distribution, supply and trade of electricity produce 2% of national Gross Added Value of the total economy. Gross electricity generation in 2019 remained relatively steady compared to 2018 levels, reaching 53,3 TWh. Covid-19 affected the total electricity consumption in Greece, an index which continued to decline for a third consecutive year.

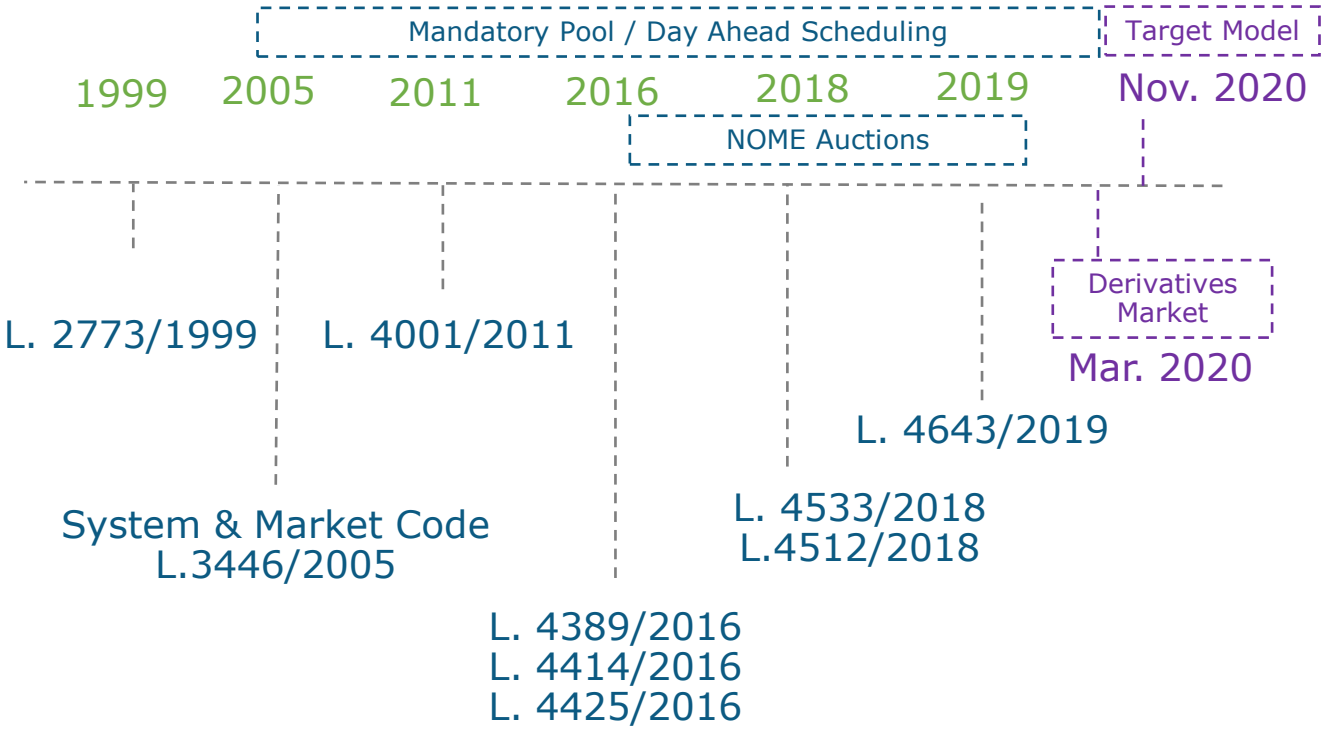
The further decarbonization process of the electricity generation in Greece continues, with the lignite share dropping at 10.3% in October 2020. The share of RES recorded the most significant growth in the electricity mix, increasing by 9.7% during the period December 2019 - October 2020. April 2020 was characterized a "Snapshot from the Future", when natural gas and RES prevailed in the electricity mix. CO2 emission allowances directly affect electricity prices and contribute to emissions reduction through Europe. Beyond lignite-fired units, natural gas-fired units are also affected by the increasing cost of CO2 emissions, however at a lower magnitude. In 2020, RES and Hydro together represented greater share of total capacity (53%) compared to Coal and Natural Gas combined (47%). The incumbent, Public Power Cooperation (PPC), retained a dominant share in electricity generation. PPC's share in the retail market continues the downward trend, reaching 64.2% in May 2020 from 94.3% in January 2016.

The Target Model was officially introduced in November 2020, while Derivatives Market is available to market participants since March 2020. A significant drop in wholesale electricity prices occurred during the 1st period of Covid-19 lockdown, reaching 28.5 €/MWh in April 2020. Greece continues to face the 2nd most expensive wholesale electricity price throughout Europe (52.9 €/MWh), for a second year in a row. Due to the Covid-19 effect, 2020 was an unusual year, and seasonality did not affect the variation of electricity prices. Since 2008, the daily average market clearing price in Greece fluctuated from 10 €/MWh the lowest to 123 €/MWh the highest value, with an average price at 54.1 €/MWh. Overall, 22% of electricity prices for non-household consumption in Greece is attributed to taxes, fees, levies and charges.

Finally, the Greek EV market has been rather immature, although from 2019 onwards an increasing trend has been recorded. Total fleet of Evs increased from 62 in August 2014, to 2.131 in August 2020. More specifically, sales rocketed right after the launch of "Kinoume Ilketrika" incentive, reaching 10% of monthly total market share in December 2020. The Greek government announced a variety package of economic incentives, tax reduction, exemptions and funding programs, supporting the promotion and the deployment of electric cars and charging stations.

The Target Model was officially introduced in November 2020, while Derivatives Market is available to market participants since March 2020

Legislative Framework of Electricity Market in Greece



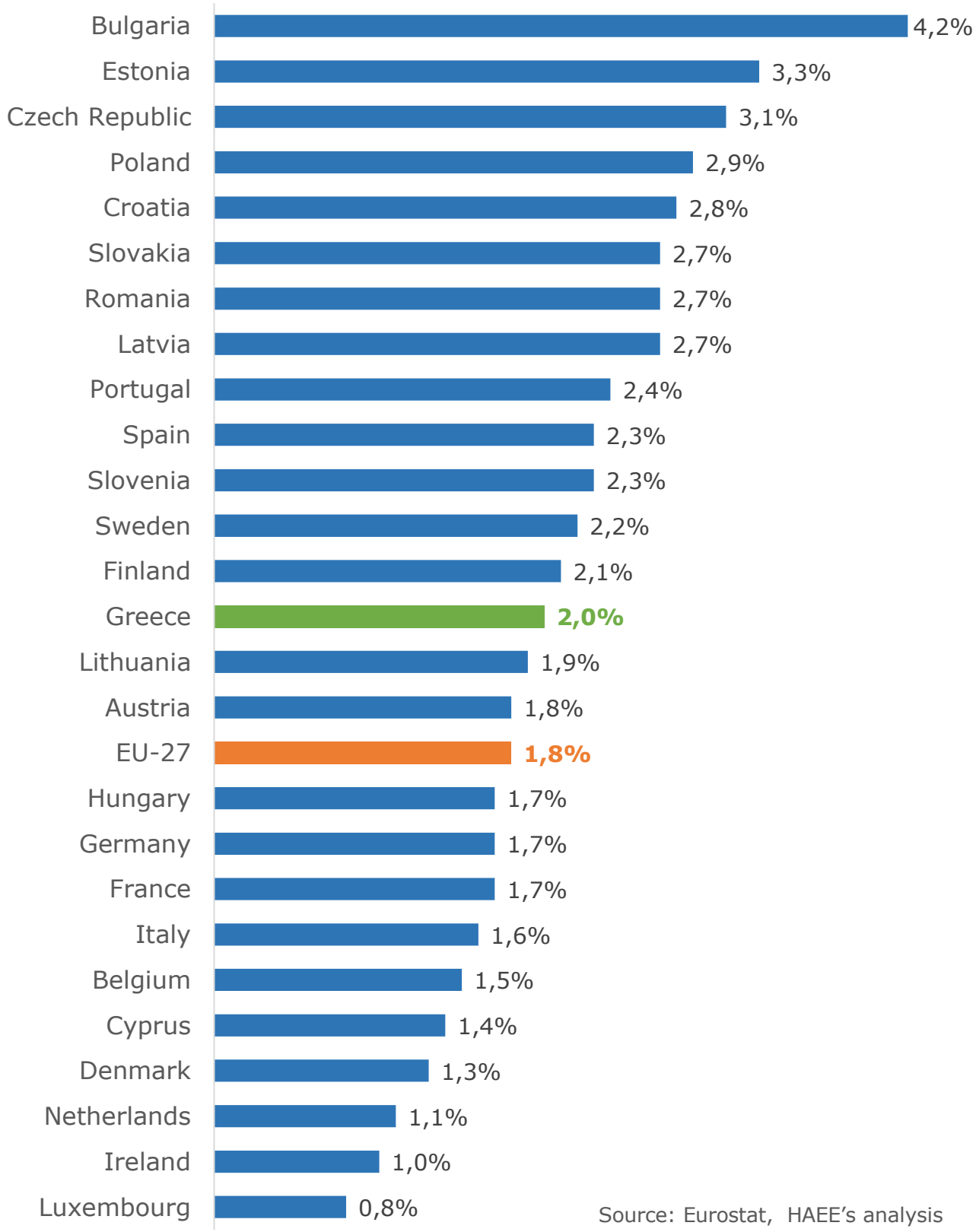
Source: HAEE's analysis

Highlights

- The operation of the Derivatives Market in the HEnEx, was implemented earlier than the Target Model, to act as a compensation for the abolition of the NOME auctions.
- This coincided with the start of restrictive measures due to Covid-19, when wholesale electricity market prices plummeted at historical levels.
- Due to the above misfortune, the Derivatives Market did not manage to attract significant amount of liquidity over the first months of operation.
- Since 1st of November 2020, the Target Model is officially applied on the wholesale electricity market of Greece.
- The transition to this new environment for market participants both in terms of technical aspects and market integration was relatively successful.

Generation, transportation, distribution, supply and trade of electricity produce 2% of national Gross Added Value in the Greek economy

Contribution of Electricity Market in Gross Value Added (GVA) in EU -27 (%), [2017]



Source: Eurostat, HAEE's analysis

Gross electricity generation in 2019 remained relatively steady compared to 2018 levels, reaching 53,3 TWh

Gross Electricity Generation (GWh), [2009-2019]

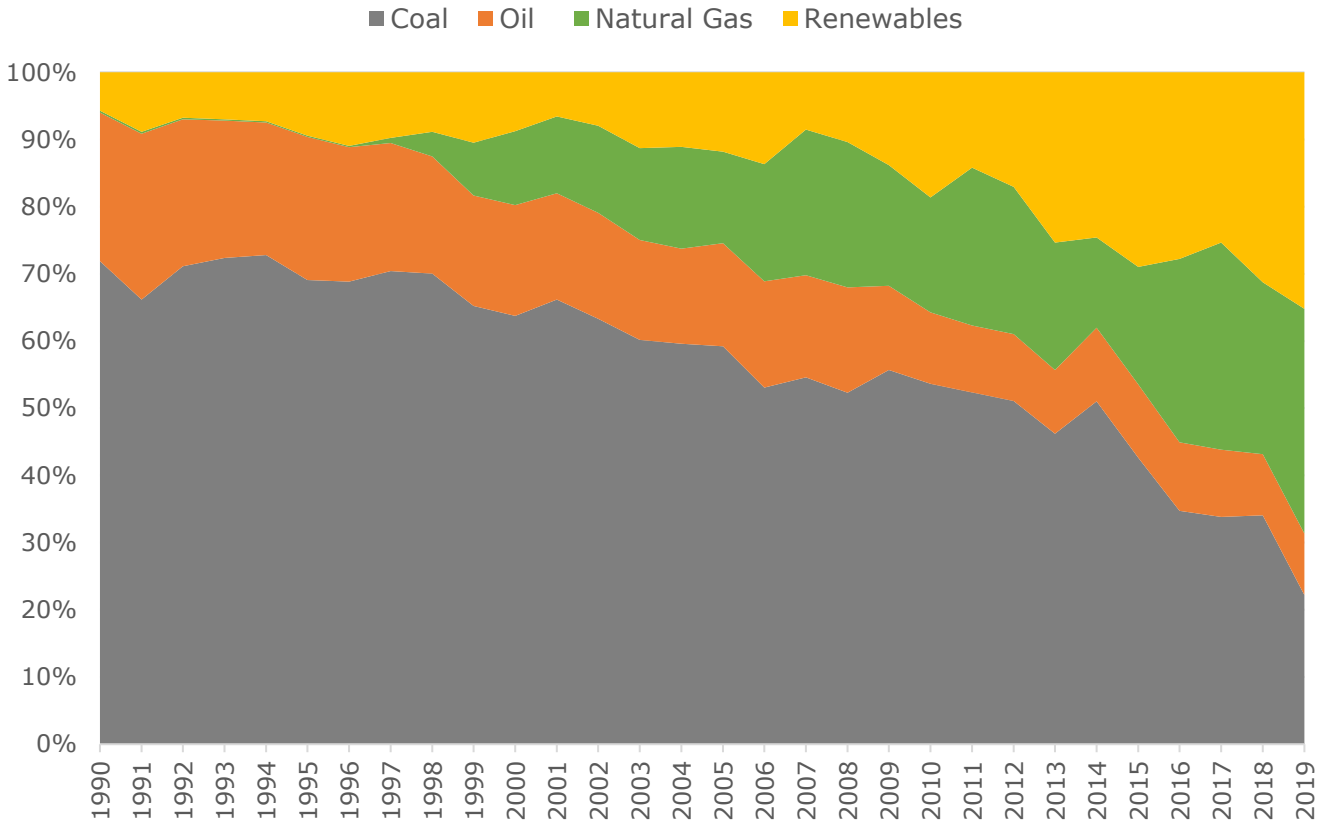
Source: Eurostat, HAEE's analysis

Highlights

- During the period 2009 - 2019, the gross electricity generation decreased by 10.2% dropping from 59,4 TWh in 2009 to 53,3 TWh 2019.
- Since the beginning of the economic crisis, domestic generation has been declining, with relatively sharp fluctuations.
- In 2019 the production was 16.5% lower compared to 2008 (63,7 TWh), yet electricity generation was 5.5% higher compared to 2014 (50,5 TWh).
- The participation of lignite, which has played an important role since the second half of the 1950s, has declined dramatically in recent years.
- In 2019, the total energy produced from lignite plants amounted to 10,4 TWh, representing 23% of total production from 50% in 2010 and 72% in 1990.

The further decarbonization process of the electricity generation in Greece continues, with the lignite share dropping at 25.4% in 2019

Gross Electricity Generation by Fuel (%), [1990 – 2019]



Source: IEA, HAEE's analysis

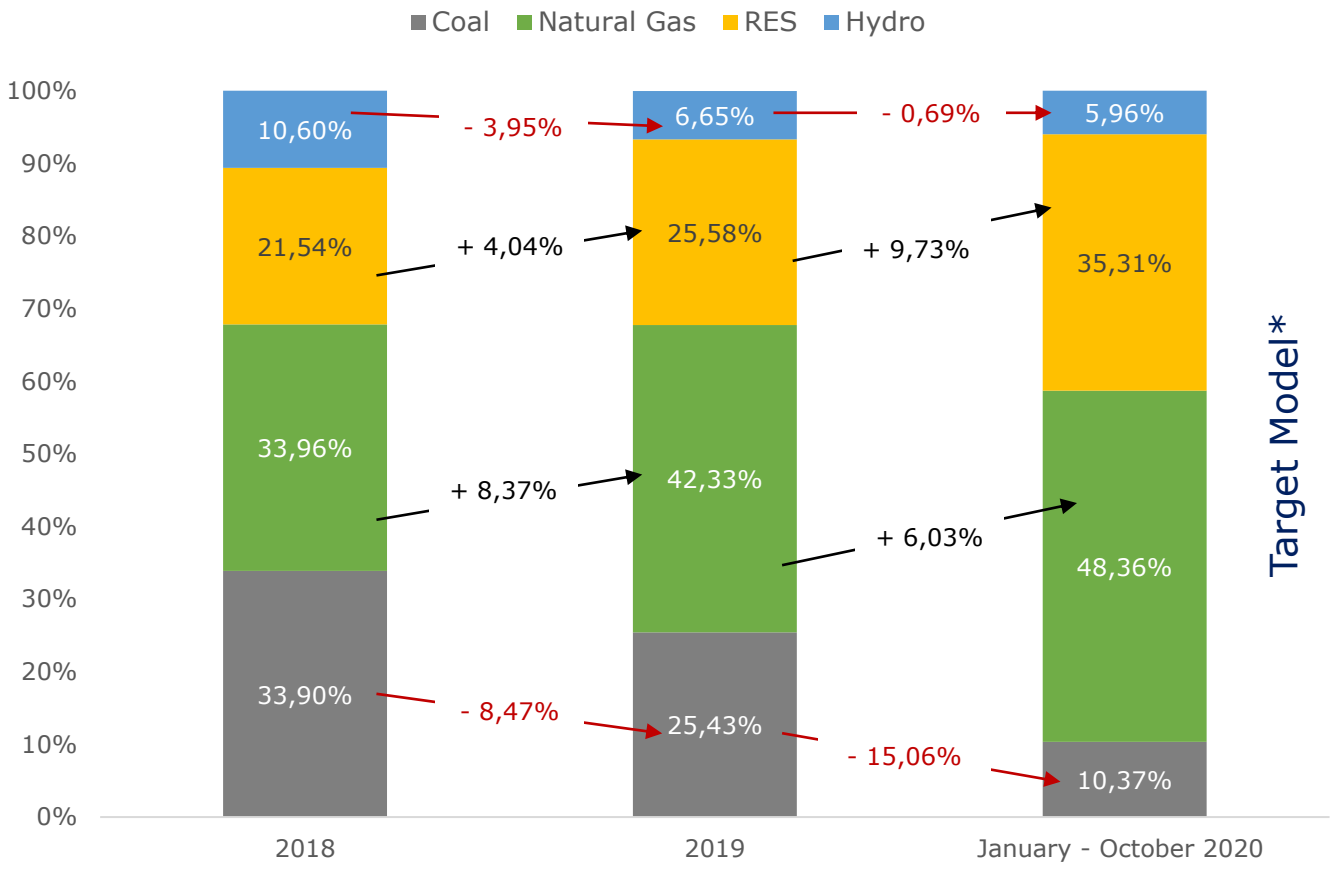
Highlights

- A significant increase in the production of electricity fueled by natural gas is apparent over the recent years. In 2019 the gas units dominated in the electricity mix.
- Natural gas represented 42.4% of total production in 2019, while the corresponding percentage in 2000 was 11% and 22% in 2010.
- The oil-fired plants, which mainly operate on the non-interconnected islands, participated in 2019 with a percentage of 10% in the produced energy.
- This share remained steady over the last decade yet is way lower compared to 1990 (22%), when oil-fired plants offered important balancing services in the System.
- The path of energy produced by RES* units is steadily upward, which amounted to 11.3 TWh in 2019, with their share being set at 25% in 2019 from 5% in 2010.

*Renewables include also the share of Hydropower plants in the above Figure.

The share of RES recorded the most significant growth in the electricity mix, increasing by 9.7% from December 2019 until October 2020

Gross Electricity Generation by Fuel (%), [2018 – 2019 –October 2020]



Source: HEnEx, HAEE's analysis

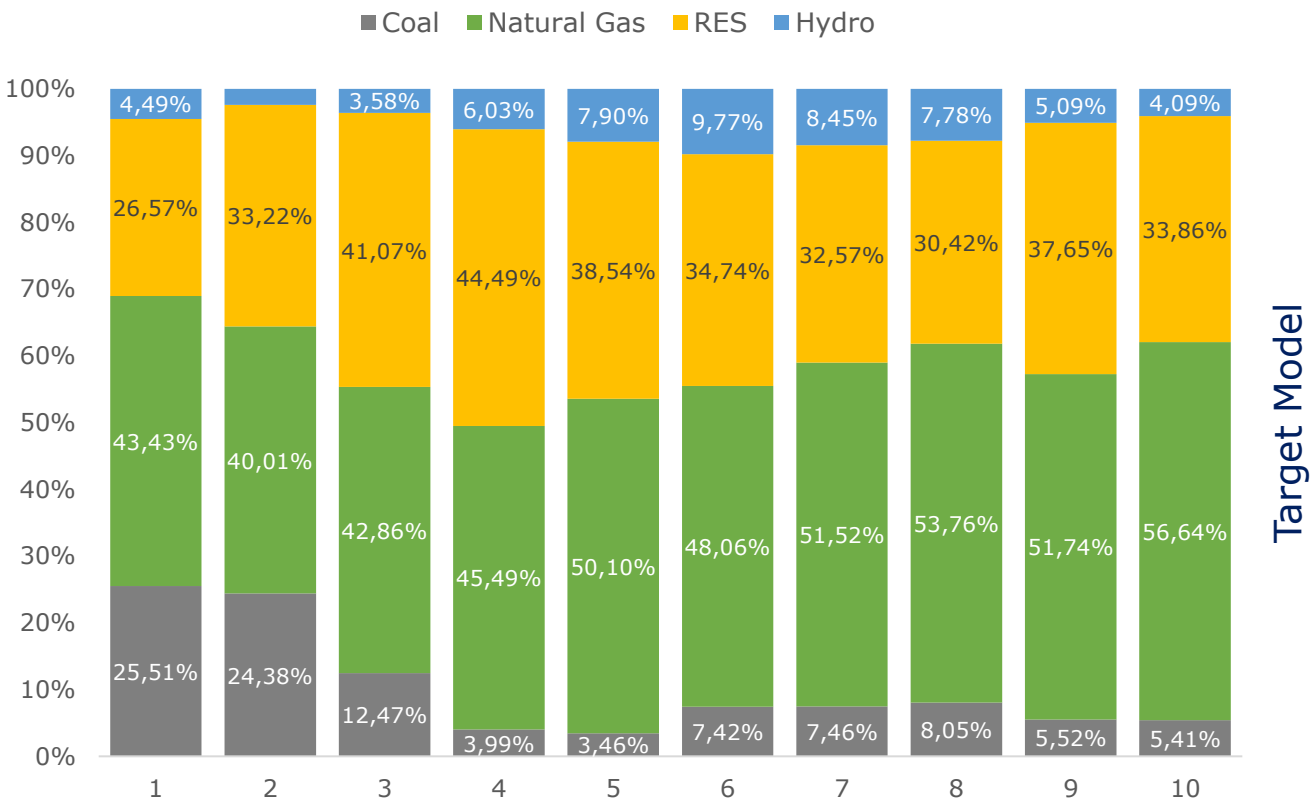
Highlights

- In less than a two-year period, lignite share declined from 33.9% in 2018 to 10.3% in October 2019, a drop equal to 23.6%.
- At the same time, natural gas-fired units and renewable energy sources replaced the carbon intensive and expensive lignite plants.
- Precisely, the percentage of natural gas grew by 8.3% from 2018 to 2019 and by 6% the following year, reaching 48.3% on average from January until October 2020.
- The significant growth of RES over the past years is apparent, since only in two-year period, their corresponding share climbed to 35.3% in 2020 from 21.5% in 2018.
- The contribution of hydropower plants decreased from 10.6% in 2018 to 6.6% in 2019 and 6% in October 2020.

*The analysis considering the corresponding data following the implementation of the Target Model are available in the next section of this Report.

April 2020 was characterized a "Snapshot from the Future", when natural gas and RES prevailed in the electricity mix

Gross Electricity Generation by Fuel (%), [January – October 2020]



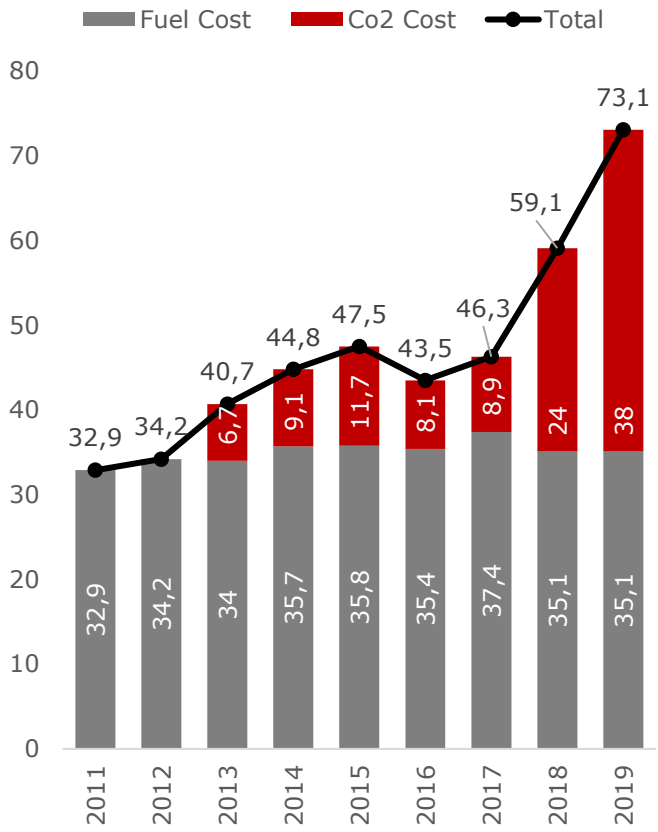
Source: HEnEx, HAEE's analysis

Highlights

- The impact of Covid-19 is apparent in electricity mix of Greece, since following the outbreak of the pandemic, CO2 prices spiked, and lignite plants could not compete.
- Due to the above developments, "Ptolemaida V", an upcoming lignite-fired plant, is anticipated to switch generation fuel to natural gas by the end of 2025.
- From January 2020, when the share of lignite was 25.5%, the contribution of lignite-fired plants gradually declined to the historical-minimum share of 3.4% in May 2020.
- In contrary, a sharp increase of renewable energy sources occurred during the same period, reaching 44.4% in April 2020 from 26.5% in January 2020.
- From June 2020 until October 2020, an identical pattern is apparent, with natural gas gaining progressively share in the mix, reaching the enormous percentage of 56.6%.

Beyond lignite-fired units, natural gas-fired units are also affected by the increasing cost of CO2 emissions, however at a lower magnitude

Estimation of Average Annual Variable Cost of Lignite-fired Units (€/MWh), [2011-2019]



Estimation of Average Annual Variable Cost of Natural Gas-fired Units (€/MWh), [2017-2019]

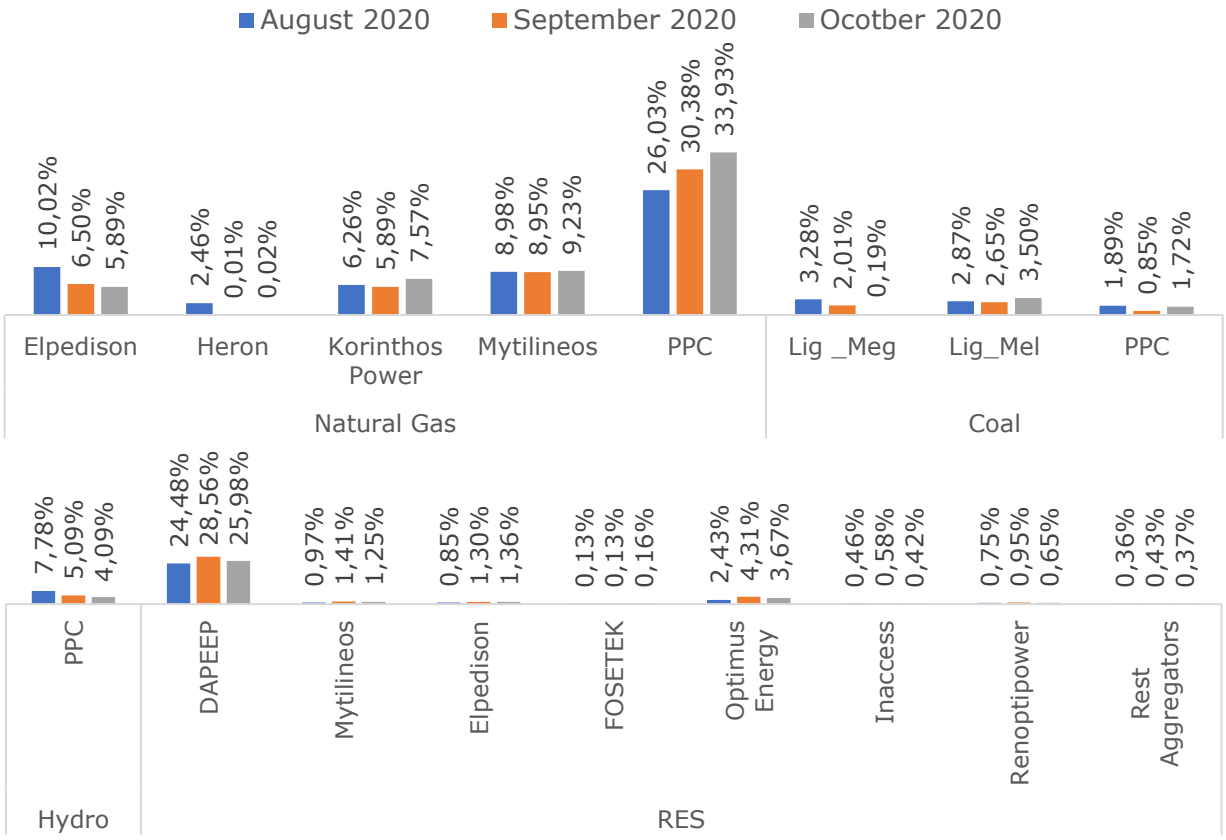
Source: IOBE, HAEE's analysis

Highlights

- The significant reduction in lignite power generation is due to the rapid deterioration of the competitiveness of this fuel, compared to natural gas units in recent years.
- It is estimated that the variable cost of lignite plants has more than doubled in recent years, from € 32.9 MWh on average in 2011 to € 73.1 MWh in 2019.
- This increase is due to the significant increase in CO2 costs, as the average price of emission allowances increased to € 24.8 per tCO2 in 2019, from € 4.4 in 2013
- In contrast, the emission allowance is much lower in gas-fired power generation, due to a significantly lower emission rate per unit of energy produced.
- Precisely for the case of natural gas the emission rate is 0.35 tCO2 / MWh versus 1.54 tCO2 / MWh on average for lignite production.

The incumbent Public Power Cooperation (PPC), retained a dominant share in electricity generation

Percentage of Total Monthly Generation per Participant and Fuel Type (%), [August, September and October 2020]



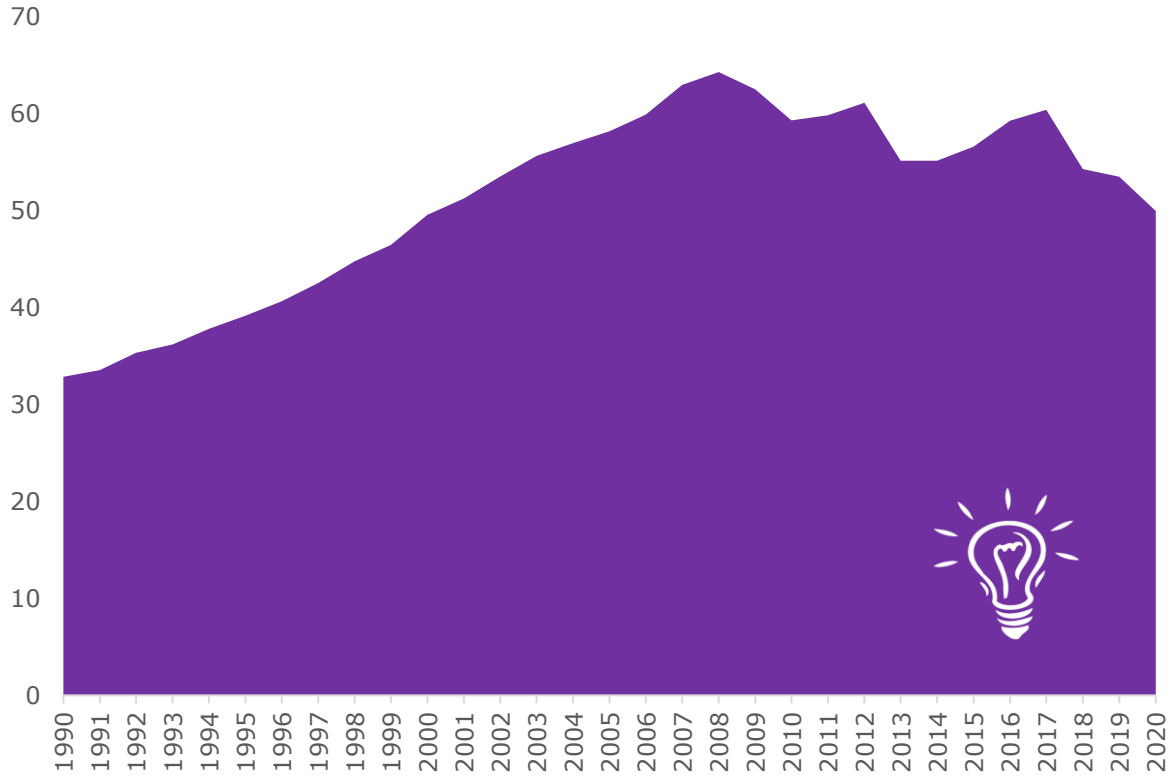
Source: HEnEx, HAEE's analysis

Highlights

- The electricity generation mix of Greece shows some differences compared to the EU average with the dominance of Natural Gas, and Renewable Energy Sources.
- In October 2020 gas-fired plants of PPC (33.9%), Elpedison (5.8%), Mytillineos (9.2%), and Korinthos Power (7.5%) contributed by 56.6% to the total generation.
- Interestingly, PPC's share in natural gas-fired units faced a remarkable growth from 26% in August 2020 to 33.9% in October 2020.
- Electricity generation from PPC's lignite units followed a diminished pattern, while the same holds for PPC's hydropower units which dropped to 4% in October 2020.
- DAPEEP represented 25.9% of total electricity generation in October 2020, with various RES aggregators steadily increasing their market shares.

Covid-19 affected the total electricity consumption in Greece, an index which continued to decline for a third consecutive year

Total Electricity Consumption in Greece (TWh), [1990-2020]



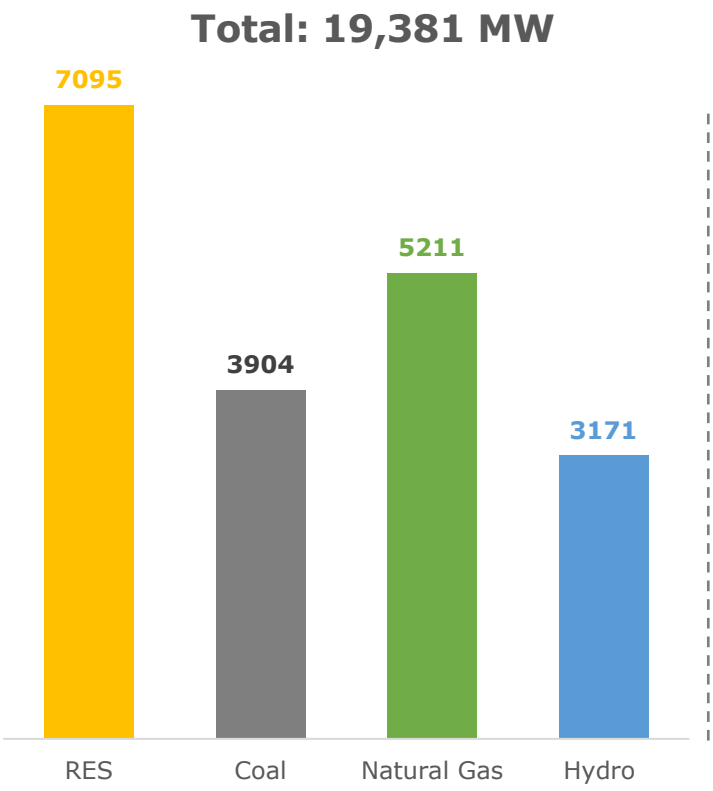
Source: IEA, HAEE's analysis

Highlights

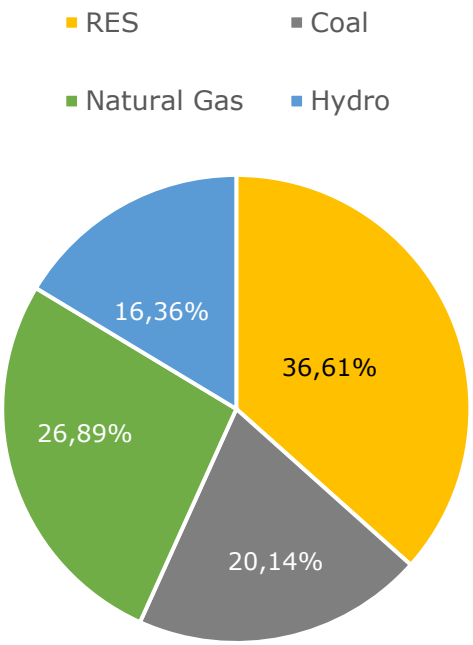
- Electricity consumption can be affected by various factors, namely the various types of activities, weather conditions and the overall macroeconomic framework.
- The discrepancy between the amount of electricity generated/imported and the amount consumed/exported is considered as a loss in transmission and distribution.
- 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.
- In the period 2014-2017, electricity consumption increased, as a result of increased consumption in the industrial and commercial sectors.
- Over the next three years 2018-2020 electricity consumption in Greece plummeted once again, reaching 49,9 TWh in 2020 from 60,4 TWh in 2017 (21% reduction).

In 2020, RES and Hydro together represented greater share of total capacity (53%) compared to Coal and Natural Gas combined (47%)

Total Electricity Capacity per Fuel (MW), [October 2020]



Total Electricity Capacity per Fuel (%), [October 2020]



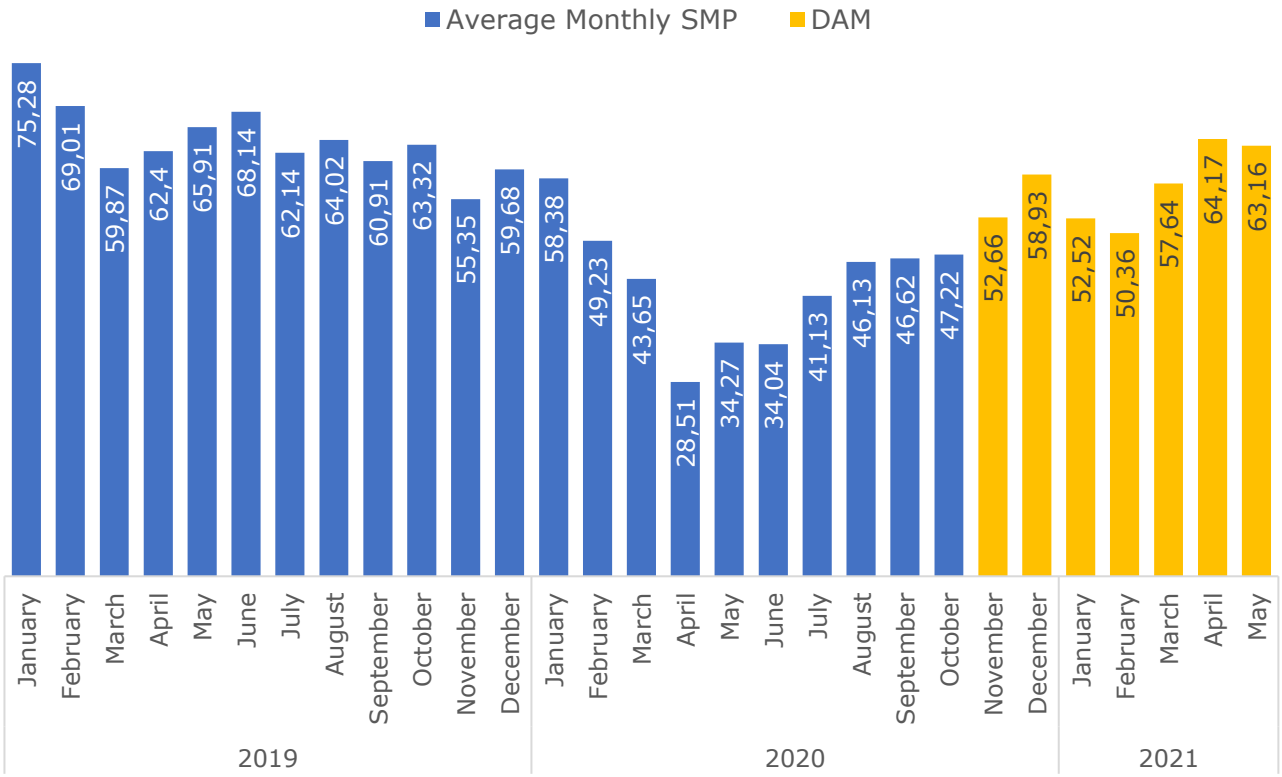
Source: HEnEx, HAEE's analysis

Highlights

- Total electricity capacity in October 2020 in Greece was 19,381 MW while the previous year (2019) the total capacity was 17,444 MW (an increase of 11.1%).
- The distribution of this share is as follows: 36.6% is attributed to RES (34.6% in 2019), 26.8% to Natural Gas (26.7% in 2019), 20.1% to Coal and 16.3% to Hydro.
- It is apparent that conventional power plants are still crucial for the balance of the system, yet their capacity dropped from 65.3% in 2019 to 47% in 2020.
- Coal, that used to be the main domestic fossil fuel in Greece, is gradually replaced Renewable Energy Sources and Natural Gas.
- In 2019, the installed capacity of PVs reached 2,791 MW from 522 MW in 2011, representing 41% of the total installed capacity of RES, from 21% in 2011.

A significant drop in wholesale electricity prices occurred during the 1st period of Covid-19 lockdown, reaching 28.5 €/MWh in April 2020

Wholesale Electricity Price in Greece (€/MWh), (2019 – May 2021]



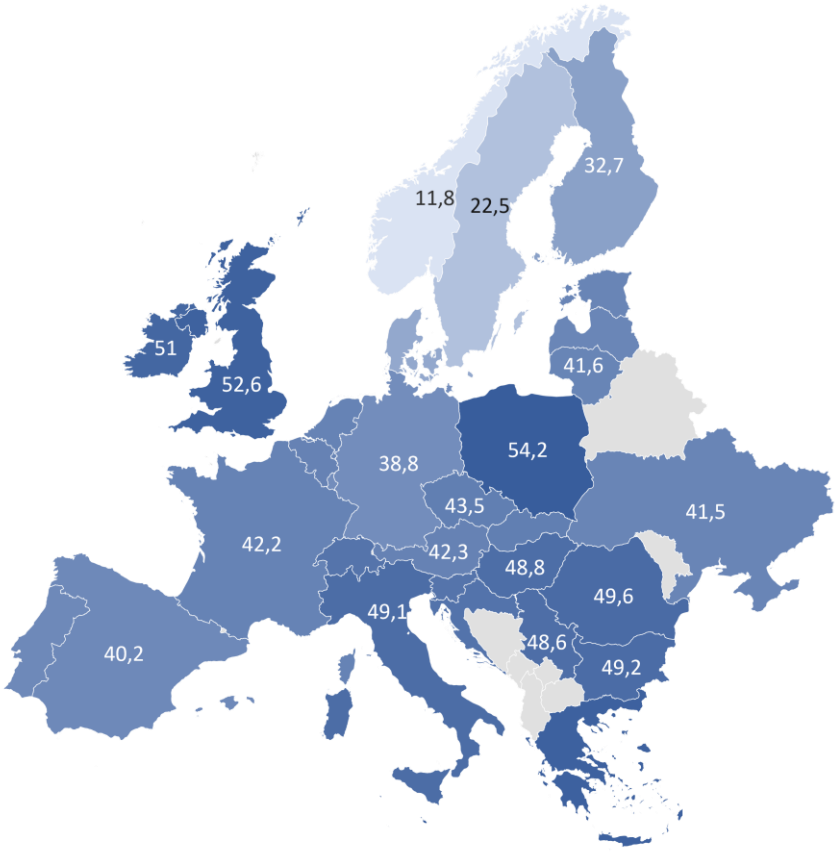
Source: HEnEx, HAEE's analysis

Highlights

- During the first quarter of 2019, prices fluctuated around 60 €/MWh, while during spring 2020 due to the Covid-19 effect, electricity prices dropped to historical levels.
- However, a clear upward trend followed from April 2020 (starting from 28.5 €/MWh) April 2021 (reaching 63.2 €/MWh).
- Since the implementation of the Target Model in Greece, the Market Clearing Price in the Day-Ahead Market spans from 50 to 64 €/MWh.
- Data reflect that the growth of wholesale electricity prices in Greece, (as well as in the rest of Europe), are mainly driven by the rise in CO2 prices and natural gas cost.
- Beyond the above rational, the growth in electricity prices is partially attributed to the overall growth in economic activity and the increase demand for electricity.

Greece continues to face the 2nd most expensive wholesale electricity price throughout Europe (52.9 €/MWh), for a second year in a row

Wholesale Baseload Electricity Prices (€/MWh), [Q4 2020]



Country	€/MWh
Greece	**52.9**
Belgium	42.3
Luxembourg	38.8
Portugal	40.2
Croatia	46.9
Slovenia	46.7
Netherlands	42.2
Denmark	30.5
Switzerland	46.7
Slovakia	43.5
Estonia	41.4
Latvia	41.2

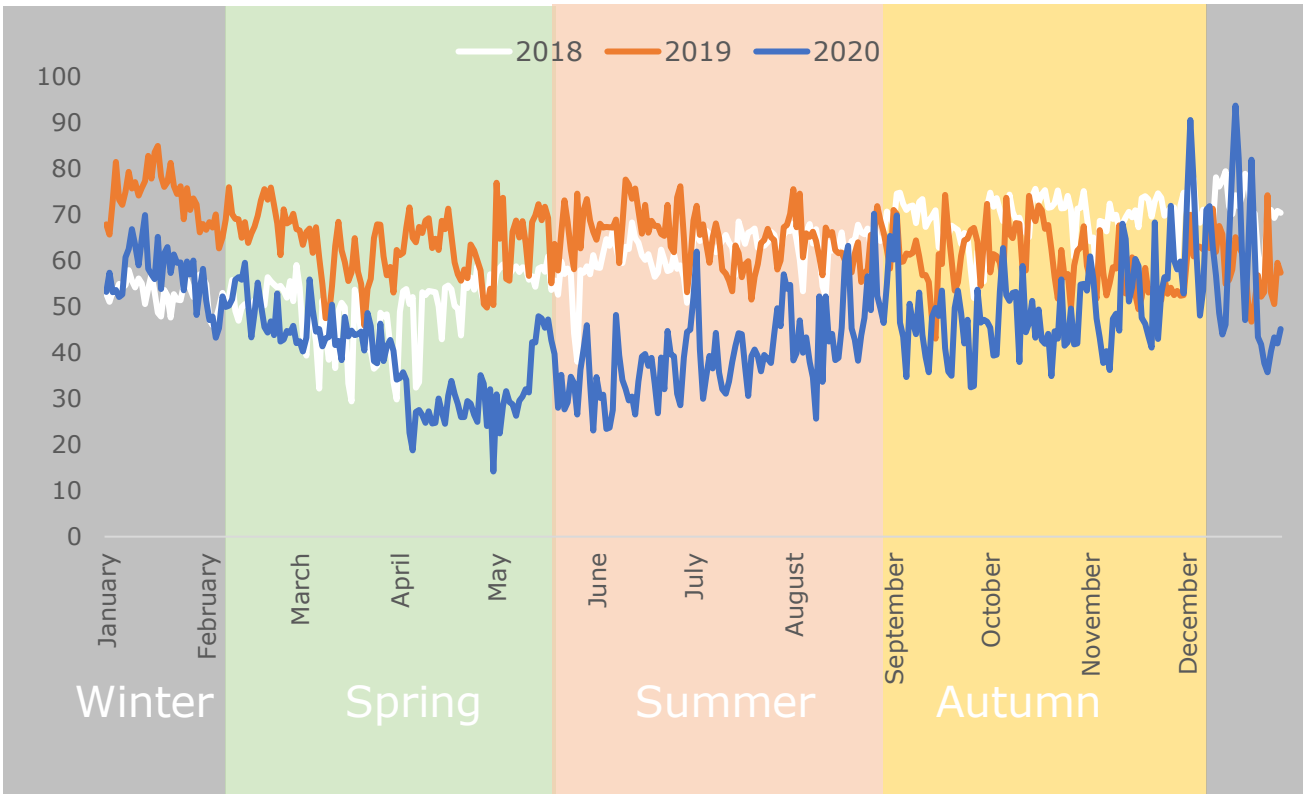
Highlights

Source: European Commission, HAEE's analysis

- During the fourth quarter of 2020, the average wholesale baseload electricity price among countries in Europe was 43.4 €/MWh (44.2 €/MWh in 2019).
- The lowest price recorded in Norway (11.8 €/MWh), while the most expensive wholesale electricity price recorded in Poland 54.2 €/MWh.
- Even though during the last quarter of 2020, Greece was not highly dependent on coal, the wholesale electricity price continued to remain at increased levels.
- Market coupling between Italy and Greece occurred on the 15th of December 2020, while coupling between Bulgaria and Greece occurred on the 11th of May 2020.
- Market coupling systems exist both in Day-ahead trading and in Intraday markets, and this interconnection among markets ensures efficient electricity trading.

Due to the Covid-19 effect, 2020 was an unusual year, and seasonality did not affect the variation of electricity prices

Seasonal Daily System Marginal Price (€/MWh), [2018 – 2019 - 2020]



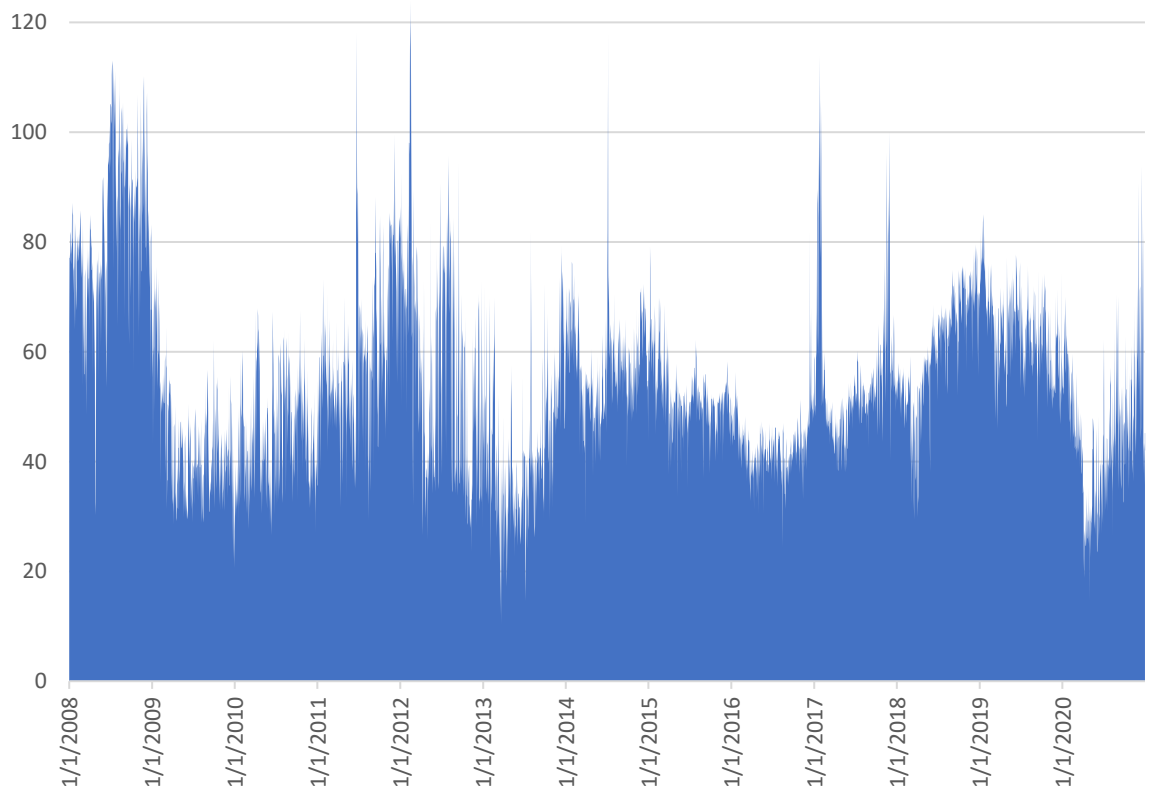
Source: HEnEx, HAEE's analysis

Highlights

- The average System Marginal Price amounted to 63.8 €/MWh in 2019, increased by 3.4 €/MWh or 5.8% compared to 2018.
- During the spring and summer of 2020, the unprecedented decline in whole electricity prices is apparently compared to the levels of the two previous years.
- Yet, during autumn and winter of 2020, wholesale electricity prices increased again, recorded prices greater than 90 €/MWh.
- Beyond the increased prices of CO2 emission allowances, the increased demand for natural gas drives fuel cost to rise, which eventually affects electricity prices.
- The increase in wholesale electricity price has a direct impact on the retail market, mainly affecting the energy-consuming industry in both MV and HV.

Since 2008, the daily average market clearing price in Greece fluctuated from 10 to 123 €/MWh, with an average price at 54.1 €/MWh

Daily Average Market Clearing Price (€/MWh), [2008-2020]



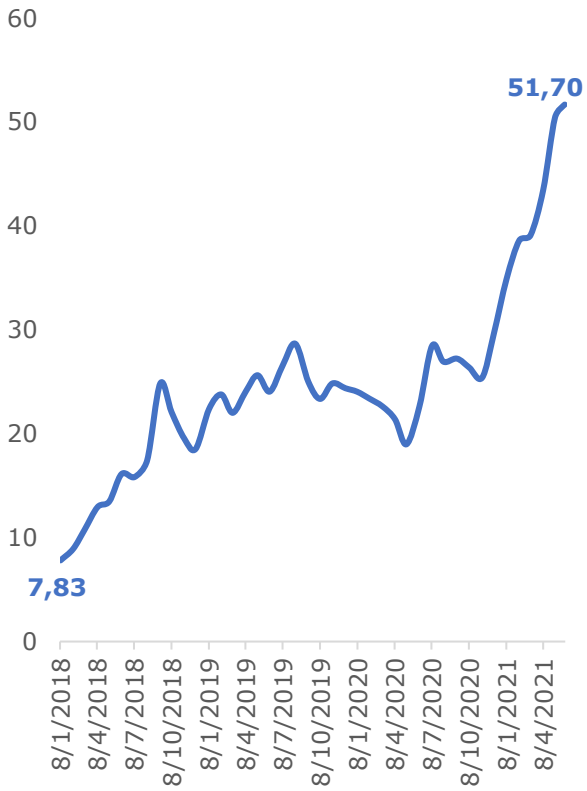
Highlights

Source: HEnEx, HAEE's analysis

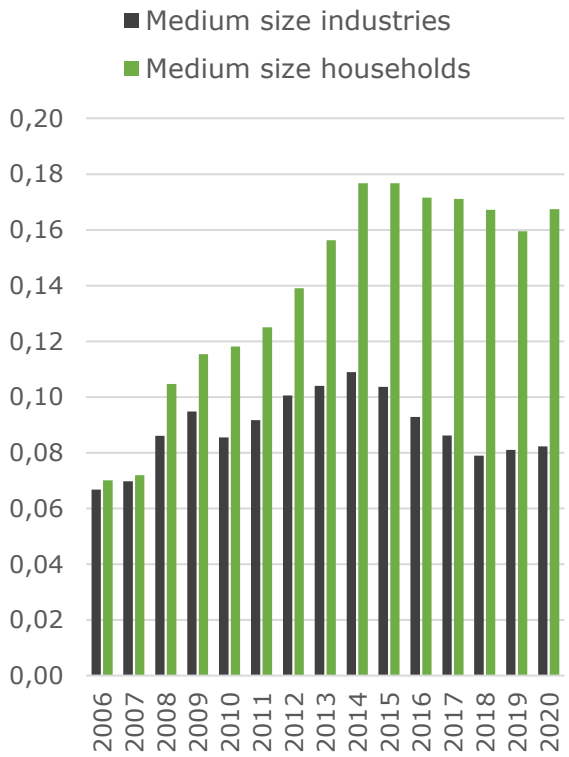
- The average annual wholesale electricity prices are the following: 82.2 €/MWh in 2008, 43.4 €/MWh in 2009, 44.8 €/MWh in 2010, 59.3 €/MWh in 2011.
- 56.6 €/MWh in 2012, 41.4 €/MWh in 2013, 57.5 €/MWh in 2014, 51.9 €/MWh in 2015, 42.8 €/MWh in 2016, 54.6 €/MWh in 2017, 60.2 €/MWh in 2018, 63.9 in 2019.
- For 2020, the corresponding price was 45.1 €/MWh. The distinct characteristic of electricity prices is the extreme volatility that is affected mainly on the supply side.
- This increased sensitivity of price fluctuations is anticipated to surge even more as the penetration of RES increases, heavily affecting the profitability of participants.
- The most important price drivers are the following:CO2 price, the cost of imported fuels, the availability and technical characteristics of thermal units and RES.

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

CO2 European Emission Allowances (€/ton), [2018-May 2021]



Electricity Prices per Type of User (€/kWh), [2006-2020]



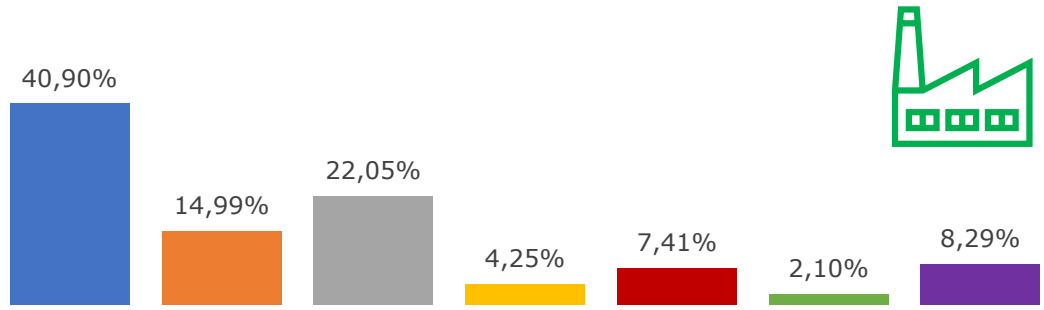
Highlights

Source: Eurostat, HAEE's analysis

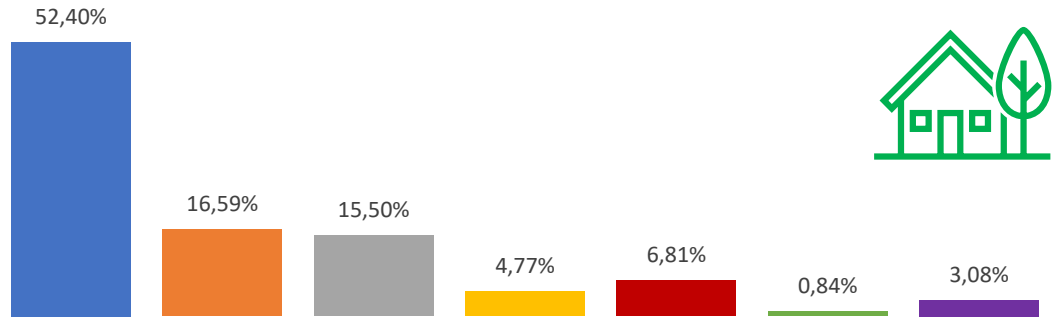
- Since 2018, carbon emission allowances are 560% higher, climbing from around 7 €/ton to historical peak of 51.7 €/ton in May 2020 (28 € /ton in 2019).
- CO2 price is estimated to reach 70 euros by 2025, while market participants expect a price of up to 100 euros at the end of the decade.
- Accompanied by an increase of CO2 emission allowances, the monthly average system marginal price in Greece encountered a steady surge following April 2020.
- 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 2020.
- In contrary, since 2017, prices in medium size industries are relatively steady at the level of 0.08 €/kWh, decreased by 37% compared to record high-year in 2014.

22% of electricity prices for non-household consumption in Greece is attributed to taxes, fees, levies and charges

Electricity Prices Components for Non-household Consumers (%), [2020]



Electricity Prices Components for Household Consumers (%), [2020]



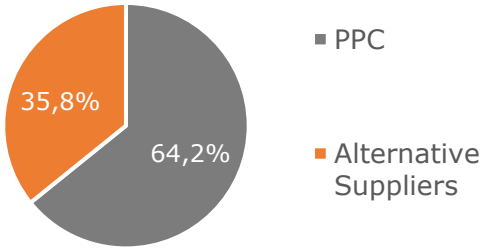
Source: Eurostat, HAEE's analysis

Highlights

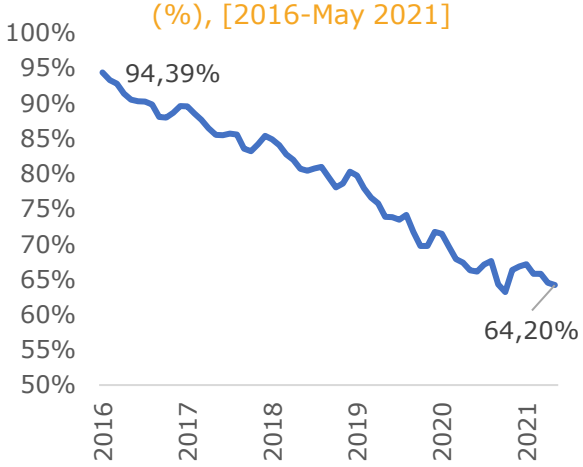
- For 2020, 40.9% of electricity prices for non-household consumption in Greece is attributed to energy and supply, 14.9% for network costs and 4.2% for VAT.
- The Ministry of Environment & Energy aims to reduce the fees for industrial consumption to alleviate the sector from increased electricity prices.
- Cheaper electricity will be available to the tourism and agricultural sector through a reduced charge of ETMEAR that currently represents 7.4% of total electricity cost.
- The reduced ETMEAR charges for farmers and businesses in the tourism sector will apply retroactively from 1st of January 2019 until 31st of December 2021.
- For 2020, 52.4% of electricity prices for household consumption in Greece is attributed to energy and supply, 16.5% for network costs and 15.5% for taxes.

PPC's share in the retail market continues the downward trend, reaching 64.2% in May 2020 from 94.3% in January 2016

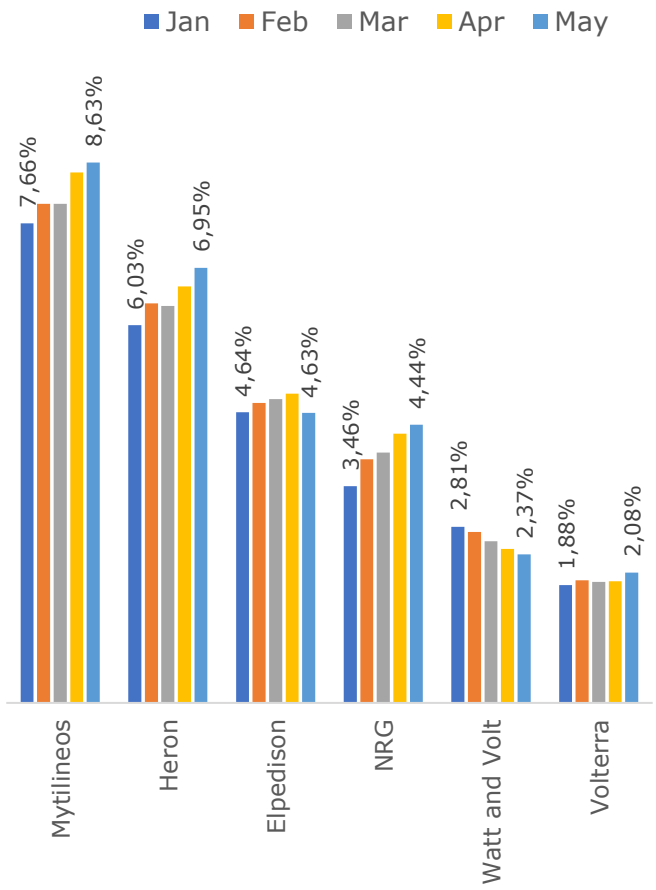
Retail Market Share (%), [May 2021]



PPC's Retail Market Share (%), [2016-May 2021]



Alternative Suppliers with Retail Market with Share > 2% (%), [May 2021]



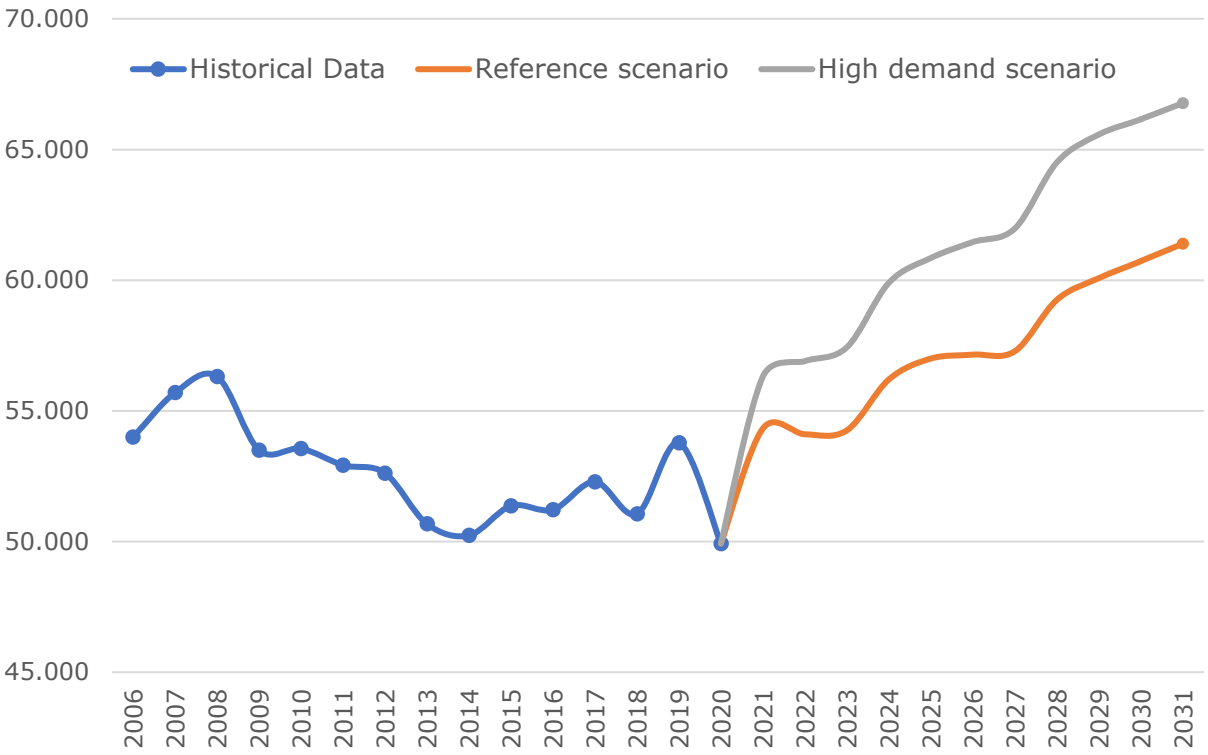
Highlights

Source: HEnEx, HAEE's analysis

- Market share in May 2021 was still dominated by PPC at 64.2%, while the remaining 35.8% is distributed among the rest alternative suppliers.
- Most of this share is attributed to 6 companies that constantly try to strengthen their position, since their share climbed from 21.6% in Dec 2019 to 29.1% in May 2021.
- In May 2021 the following shares are observed: Mytilineos 8.63%, Heron 6.95%, Elpedison 4.63%, NRG 4.44%, Watt and Volt 2.37% and Volterra 2%.
- The Derivatives Market that officially started to operate in March 2020 aim to replace the gap that was created after the abolishment of NOME-type auctions.
- The Derivatives Market that was launched simultaneously with the detrimental lockdown restrictions due to Covid-19, continue to face almost zero liquidity.

COVID-19 crisis has significantly hampered the annual demand for electricity in 2020, yet a quick recovery period is anticipated in 2021

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



Source: HTSO, HAEE's analysis

Highlights

- According to the projections of the Hellenic Transmission System Operator (HTSO), demand for electricity during the upcoming years will sharply increase.
- The Covid-19 effect was apparent in terms of total electricity demand, since only in one year period, the index faced a rapid decline of 7.6%, reaching 49.9 TWh in 2020.
- The significant 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 56.3 TWh which were generated in 2008, the Reference scenario projects that only in 2025 electricity demand in Greece will stand at identical levels.
- The High demand scenario projects total annual demand for electricity to reach 66,7 TWh in 2031, while the Reference scenario projects demand equal to 61,4 TWh.

Over 2020, the Greek government managed to provide plethora of incentives to promote the use of electric cars in transportation

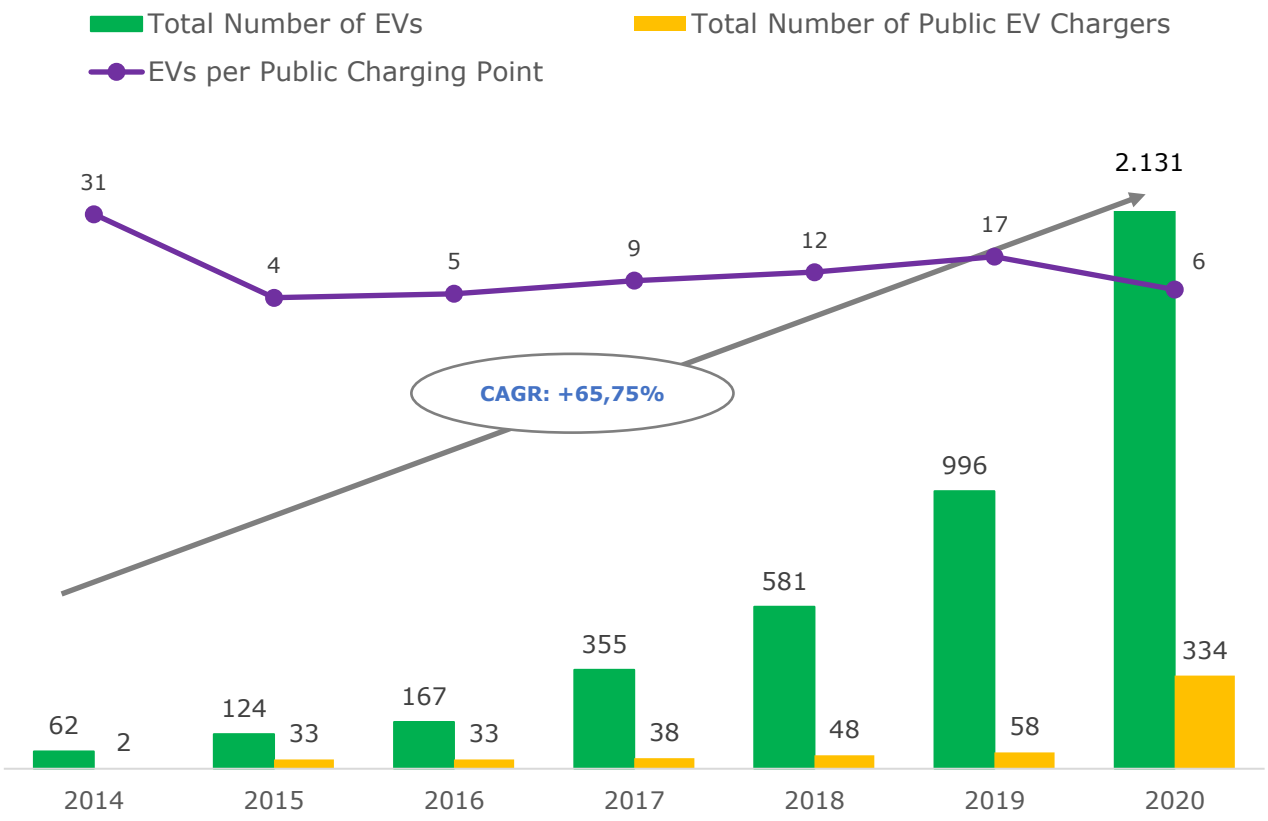
Fiscal and Non-Fiscal Incentives Towards Eco-Mobility for All EU Countries, [2020]

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

Since 2019, the Greek electromobility market is rapidly growing, reaching 2.5% of the total market share

Number of Electric Vehicle Fleet and Public Charging Points in Greece, [2014-2020]



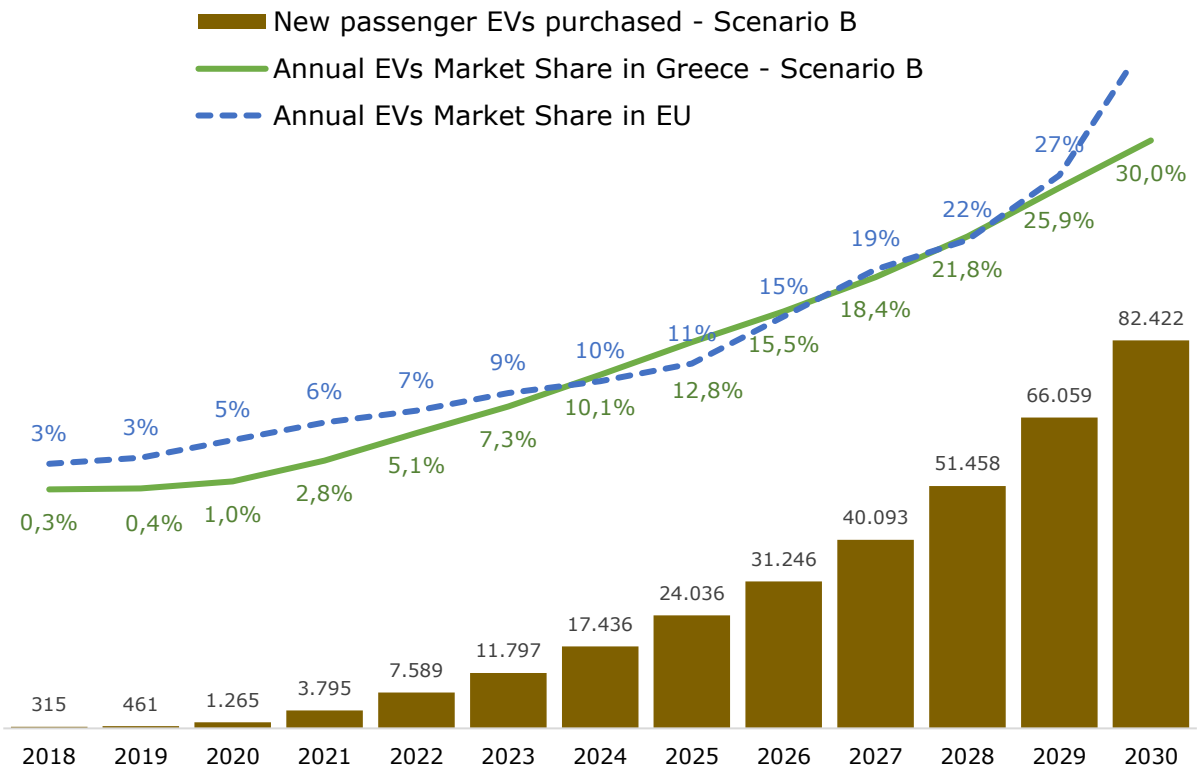
Source: HAEE's analysis

Highlights

- EV market evolution, is already developed in the Nordic and Central European countries, while Mediterranean countries, including Greece follow at a lower pace.
- The Greek EV market has been rather underdeveloped historically, although from 2014 onwards an increasing trend has been recorded.
- Greece experienced the second highest growth rate of electric passenger car registrations between EU countries in 2020, increasing by 113% compared to 2019
- Publicly accessible charging points are 6 times more than the existing ones in 2019, as a direct implication of the significant increase of EVs.
- Quick adjustments in the deployment of charging infrastructure restored the ratio of EVs per public charging point on the suggested EU levels - below 10 (6:1 in 2020).

According to the National Energy & Climate Plan, the target is to achieve 30% of new registrations by 2030 coming from electric vehicles

Annual sales of passenger BEVs and PHEVs
- Percentage of market share, [2018-2030]



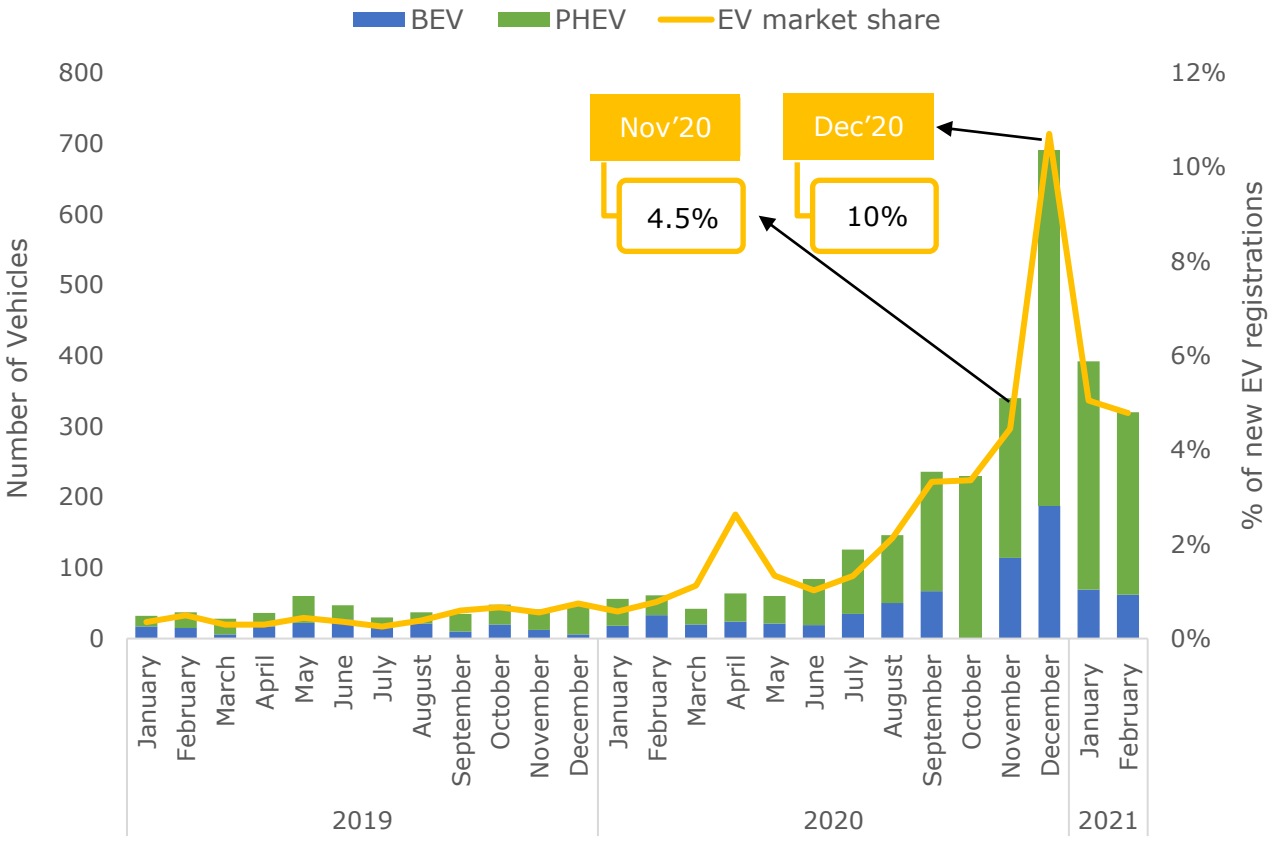
Source: HAEE's analysis

Highlights

- In line with the Directions of the EU, the goal for Greece is 1 out of 3 new cars to be electric by 2030. The annual growth is estimated to be of greater extend after 2025.
- The evolution of the annual number of registrations, with the implementation of increased policy measures, is targeting to reach more than 82.422 EVs by 2030.
- In 2020, the total number of cars sold in the country was 80.977, while 2.131 out of them were BEVs or PHEVs, exceeding the annual target by 10%.
- BEV and PHEV share of new car registrations is already at 5% between January and February 2021, surpassing the NECP target by 2.8% in 2021.
- The Greek vehicle fleet age is almost two times higher than EU average, and the transition time from traditional cars to EVs is expected to be shortened.

In December 2020, driven by the existing incentives, the new EV registrations reached 10.6% out of the total registrations in Greece

EV sales in Greece, EV market share (%), [2019-2021]



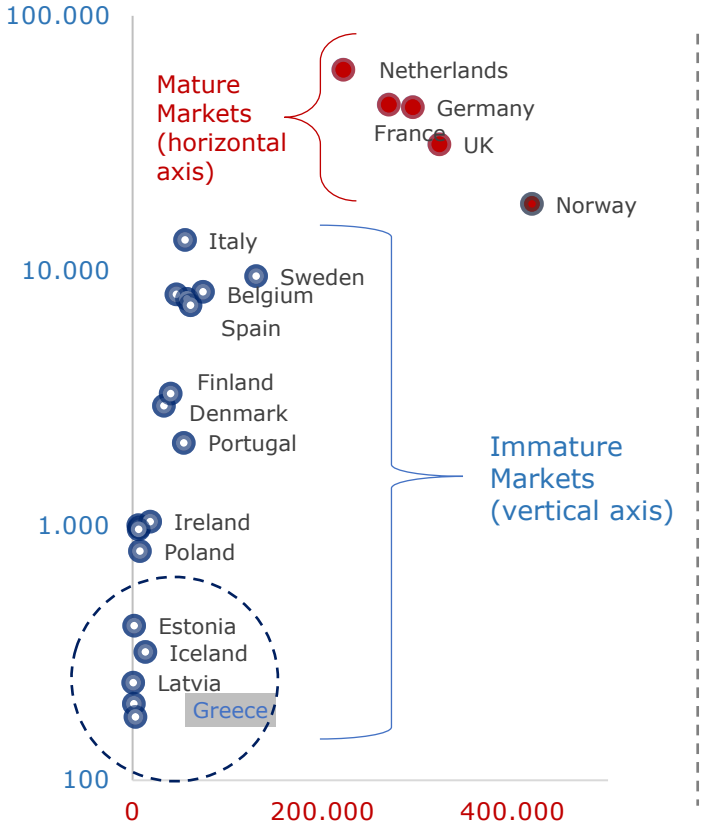
Source: HAEE's analysis

Highlights

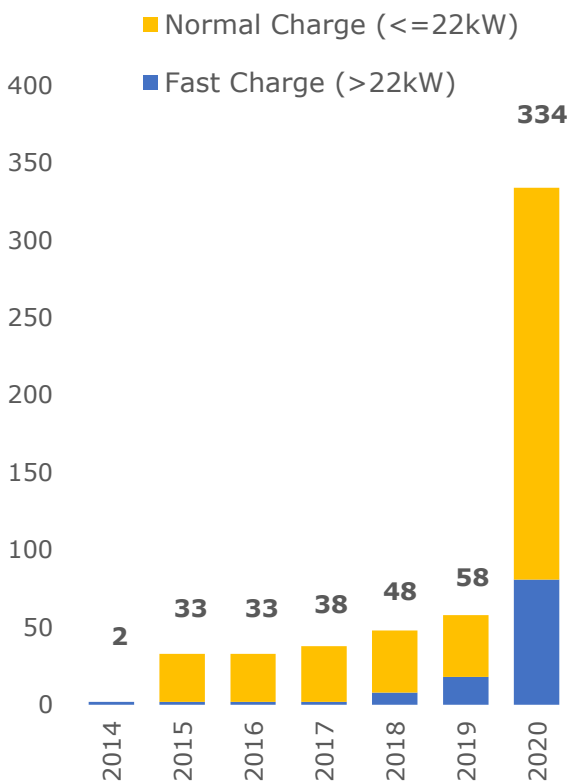
- Authorities provide incentives for the acquisition and use of e-vehicles, the development of charging points, and incentives for e-mobility product manufacturing.
- In 2020, 2.131 out of 80.977 car sold were BEVs and PHEV, exceeding the annual National Energy & Climate Plan goal by 10%.
- From August 2020 and only within 6 months, "Kinoume Ilektrika" incentive rocketed the electromobility market to 42 million euros.
- The annual share of new registered EVs increased from 0.4% in 2019 to 2.6% in 2020.
- Electromobility Market funding potential could reach up tp €510 millions, which could raise investments of approximately €1.2 billions (according to RRF multiplier factor).

The Greek charging infrastructure market is developing in accordance with European Union Directions, under the minimum ratio 1:10

Total Number of Public EV charging points in Europe, [2020]



Total Number of EV Charging Infrastructure in Greece, [2014-2020]

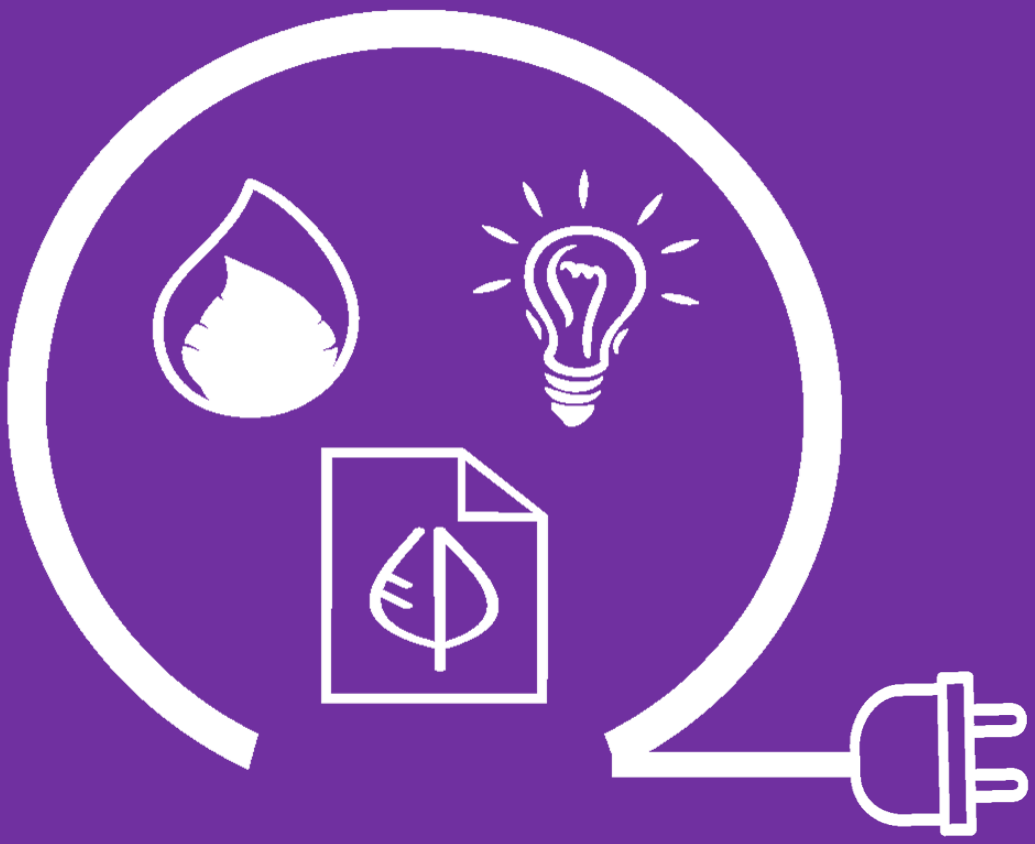


Source: HAEE's analysis

Highlights

- Immature electromobility markets, as the Greek one, with a low electric vehicle fleet on the road, have a significantly lower distribution of charging stations.
- However, the evolution of publicly accessible charging points is significant, given the fact that the charging pointed increased by 475% within the last year.
- Greek Law 4710/2020, followed by 4380/2020, sets specific directions for the installation of charging points.
- In 2020, 334 fast and normal chargers were installed in Greece and currently are fully operated.
- 252 Municipalities have participated the SFIO tender and 70% of them approved for funding, under EV charging station planning.

4. Hellenic Energy Exchange



Highlights

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

Target Model was officially introduced in **November 2020**

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

Liquidity in the Energy Derivatives Market is almost **zero** after more than a year of operation

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

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

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

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

Intraday Market can be used for further fine tuning of positions and reduction of imbalances prior to the TSO-managed Balancing Market

Overview

A major energy market reform was achieved as the Target Model, a long-term specific commitment, went live on 1 November, which is considered as an important step towards Greece fulfilling the obligations of the EU energy acquis. The new format of the markets with separated Day-ahead, Intra-day and balancing elements, will allow for better price discovery and wider participation and market access of different services – away from a "produce and forget" system, to one favoring flexibility. It remains to be seen how this combines with Greece's already established – yet currently underused – forward market. The new market design is compatible with other EU markets, allowing for the swift day-ahead and intraday coupling with the neighboring markets of Italy and Bulgaria, which in turn will increase energy security, support further renewable energy sources integration and wholesale price competition.

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.

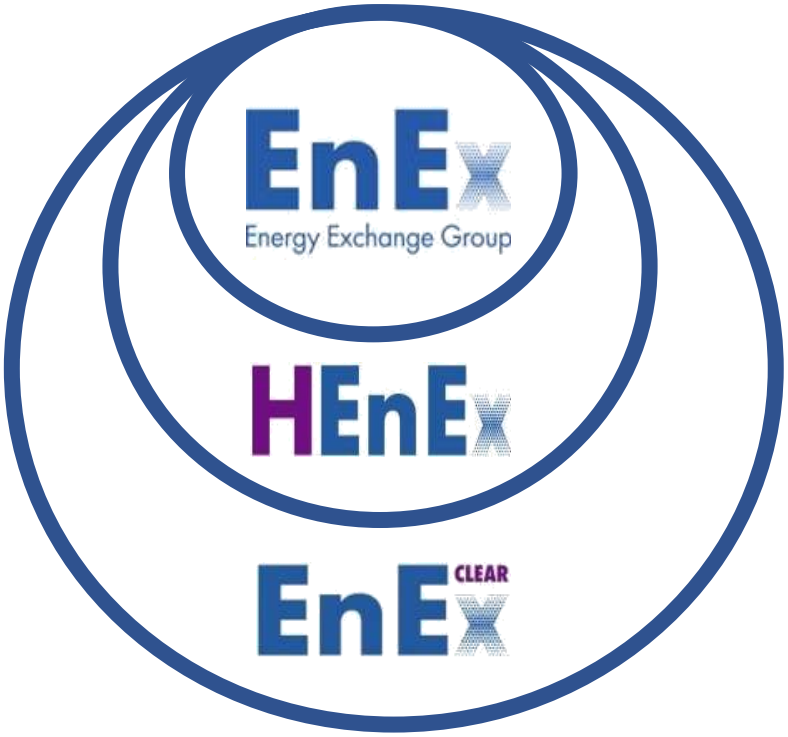
The sharp volatility of spot prices has always preoccupied producers, suppliers and electricity traders. These changes may be due to a number of factors, unforeseen or predictable. Such factors are the change in demand, the availability of units and interconnections, the prices of natural gas and carbon dioxide emissions, the variability of renewable sources, but also in general social and economic turmoil such as those caused by the Covid-19. Hence, participants can take advantage of the flexibility provided by the Derivatives Market that has started its operations since March 2020.

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.

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.

Hellenic Energy Exchange aims to encourage competition, guarantee transparency, enhance liquidity and facilitate EU market integration

Energy Exchange Group



Ownership

--- 22%

--- 20%

-- 21%

--- 20%

--- 10%

--- 7%

Source: HEnEx, HAEE's analysis

Highlights

- EnEx Group consists of two companies. HEnEx (Hellenic Energy Exchange S.A.) which is a private company operating Spot & Derivatives energy markets.
- EnExClear (EnEx Clearing House S.A.), which is a private company owned 100% by HEnEx, clearing Spot energy markets
- Derivatives are available to market participants since March 2020 and energy markets are cleared by ATHEXClear (company of ATHEX Group).
- HEnEx's shareholders are both private (ASE, EBRD, CSE, DESFA) and public (DAPEEP, IPTO) companies.
- Shareholders' structure is diverse, featuring two TSOs, the RES and GO Operator, two stock exchanges, and an international bank.

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

Wholesale Energy Market Operational Model

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

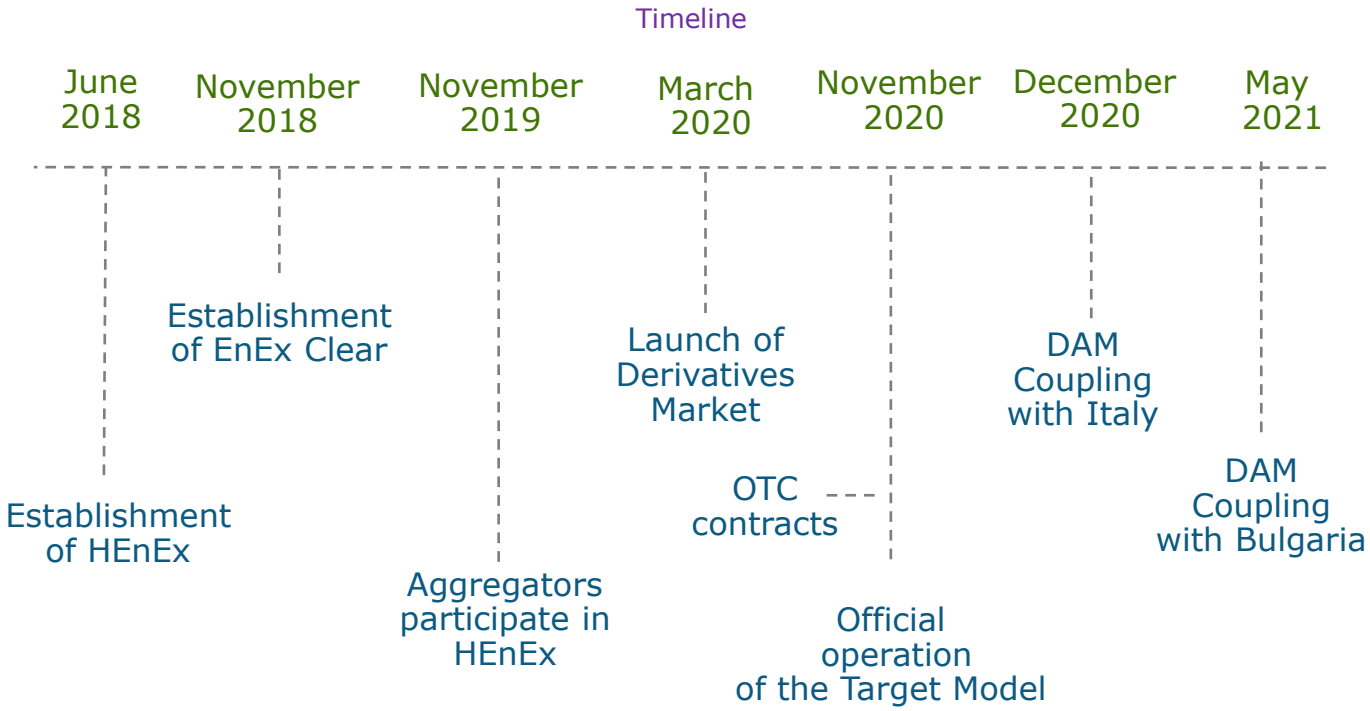
*Spot gas trading platform in progress

Source: HEnEx, HAEE's analysis

Highlights

- Spot Markets include physical delivery of electricity and gas, 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 for both power and gas, as well as for 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 of all markets.
- ADMIE and DESFA are the Market Operators for the Balancing of power and gas markets respectively, while they are responsible for clearing and settlement, as well.

After a long delay, the Hellenic Energy Exchange launched its operations under the Target Model in November 2020



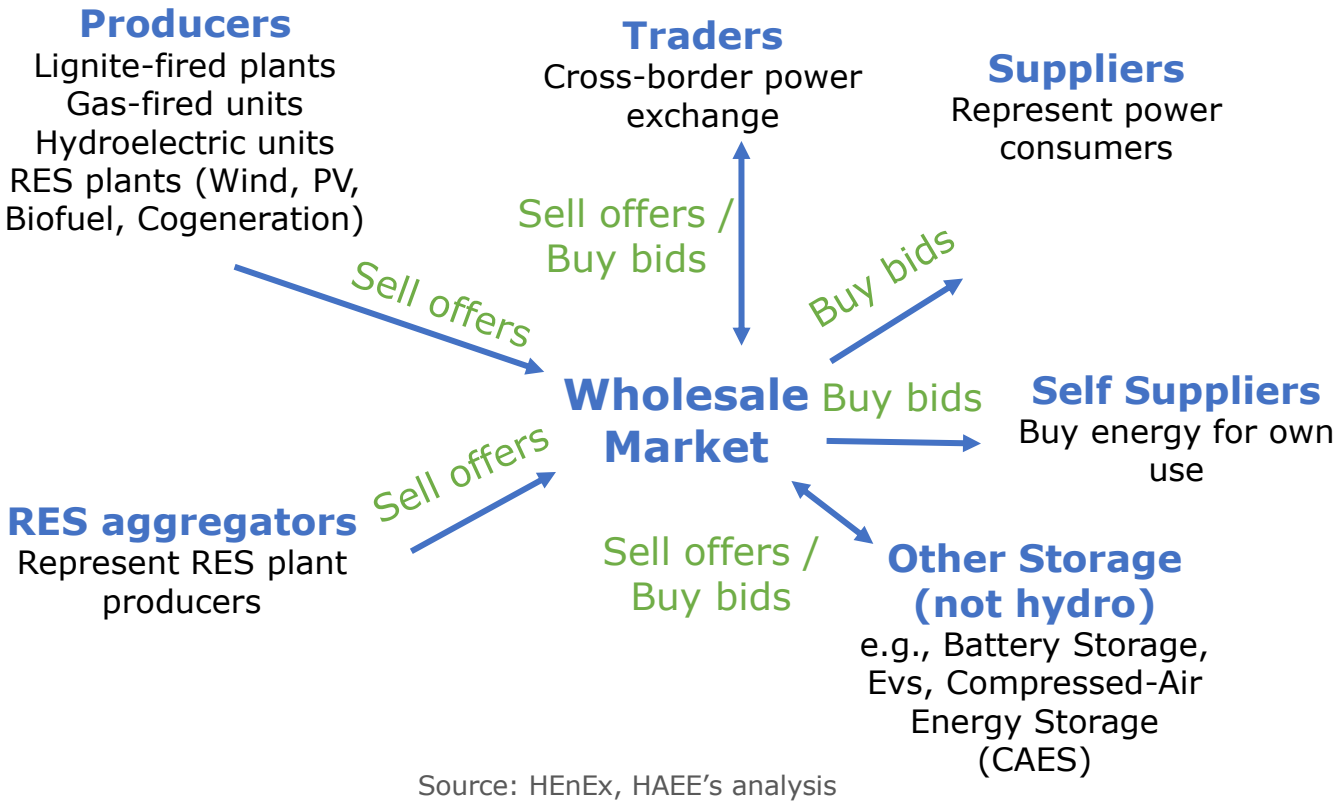
Source: HAEE's analysis

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 allow participants to submit orders for the supply of electricity ang gas 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.
- In December 2020, the Day-Ahead Market of HEnEx was officially coupled with the corresponding Italian Market, while coupling with Bulgaria occurred in May 2021.

Hellenic Energy Exchange provides state-of-the-art market mechanisms that facilitate efficient market operation and enhance competition

Wholesale Electricity Market Stakeholders



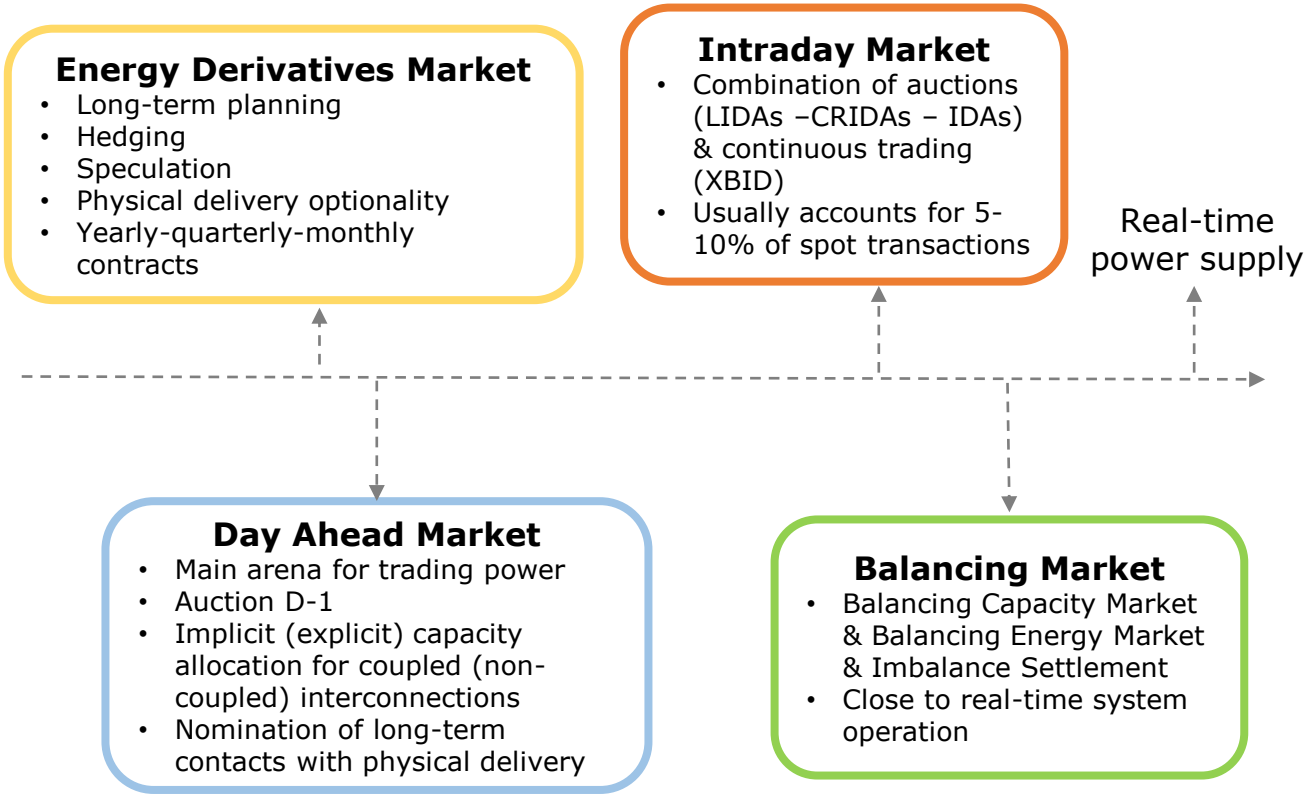
Source: HEnEx, HAEE's analysis

Highlights

- In the wholesale energy market, generators, suppliers, traders and consumers can trade electricity either via the power exchange or via OTC contracts.
- 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 acts 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, allow participants to enhance their expertise in energy trading and develop risk-taking and risk-management strategies.
- HEnEx promotes commercial exploitation of large energy projects and infrastructures, while it ensures compliance with common EU commitments.

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

Electricity Market Sequence (Target Model)



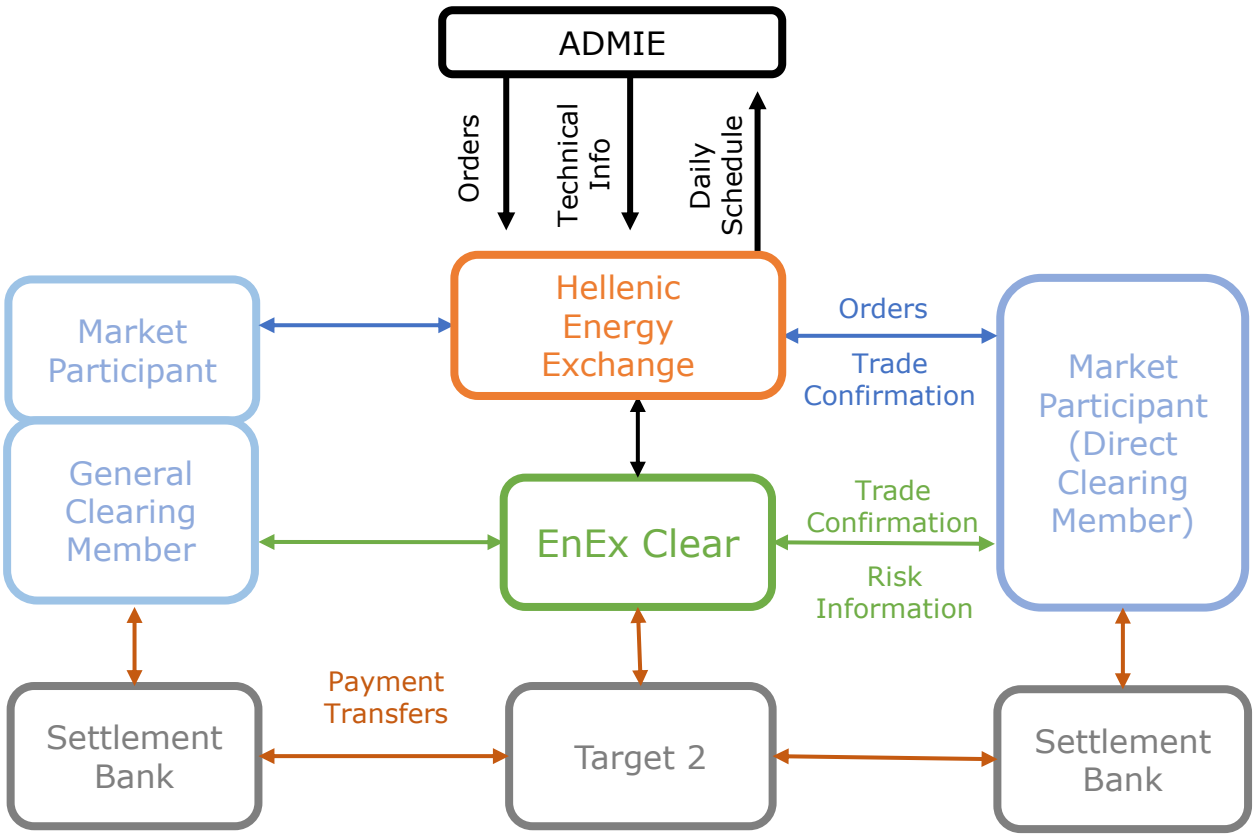
Source: HEnEx, HAEE's analysis

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.

Trading with flexibility and confidence due to efficient trading limits, robust risk management and protection against counterparty risks

Spot Markets Architecture



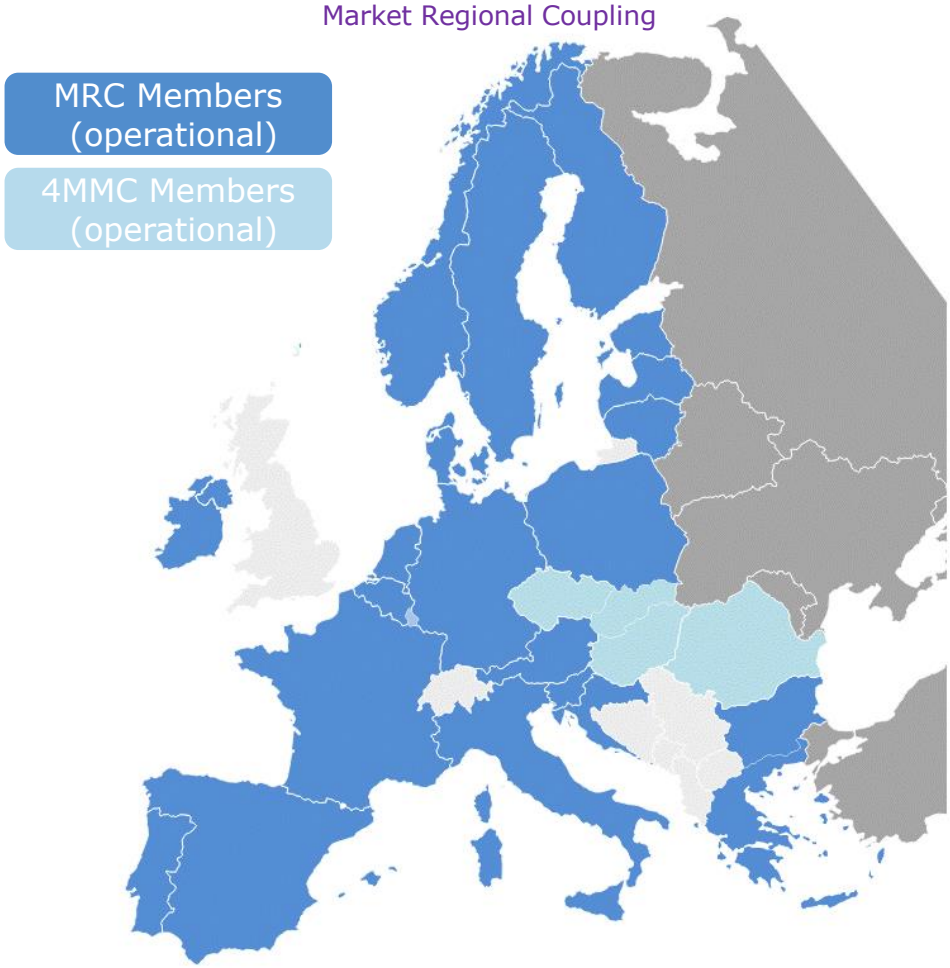
Source: HEnEx, HAEE's analysis

Highlights

- 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.
- Clearing Members could be Direct Clearing Members which are energy market participants or General Clearing Members such as banks and investment firms.
- Default takes place when there is not adequate amount, in the settlement account of the Clearing Member in Target 2, to match their obligations.

The Day-Ahead Market is still the main spot market which now also serves as the underlying market for the Derivatives market

Market Regional Coupling



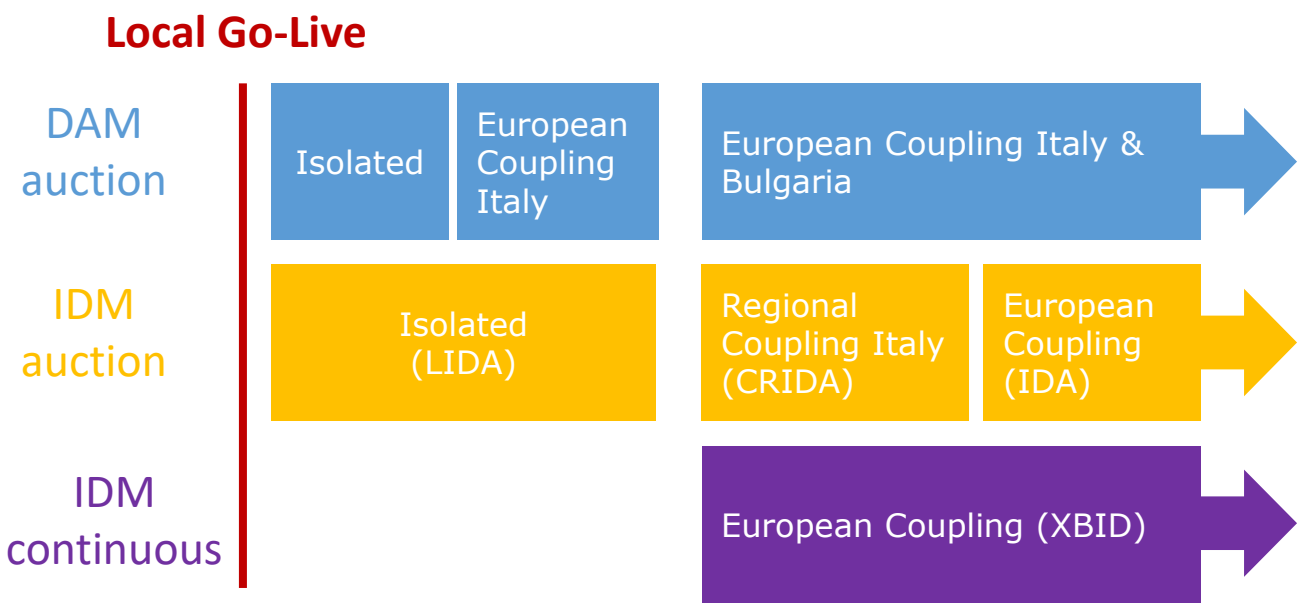
Source: ENTSO-E, HAEE's analysis

Highlights

- The Day-Ahead Market can be used for trading hourly load/generation profiles. Additionally, it can be used for position fine-tuning after the Derivatives Market
- The Day-Ahead Market can be used as well for the registration of physically settled Futures positions and OTC contracts.
- Implicit trading requires no a priori purchase of transmissions rights for coupled interconnections thus removing unnecessary trading risks.
- New order types can serve market participant needs, including those with complex physical assets, trying to optimize their bidding strategies and operational profiles.
- The optimization algorithm, EUPHEMIA, is a common algorithm across all Europe which guarantees a level and familiar playing field for all.

Intraday Market can be used for further fine tuning of positions and reduction of imbalances prior to the TSO-managed Balancing Market

Implementation Phases of the Various Markets



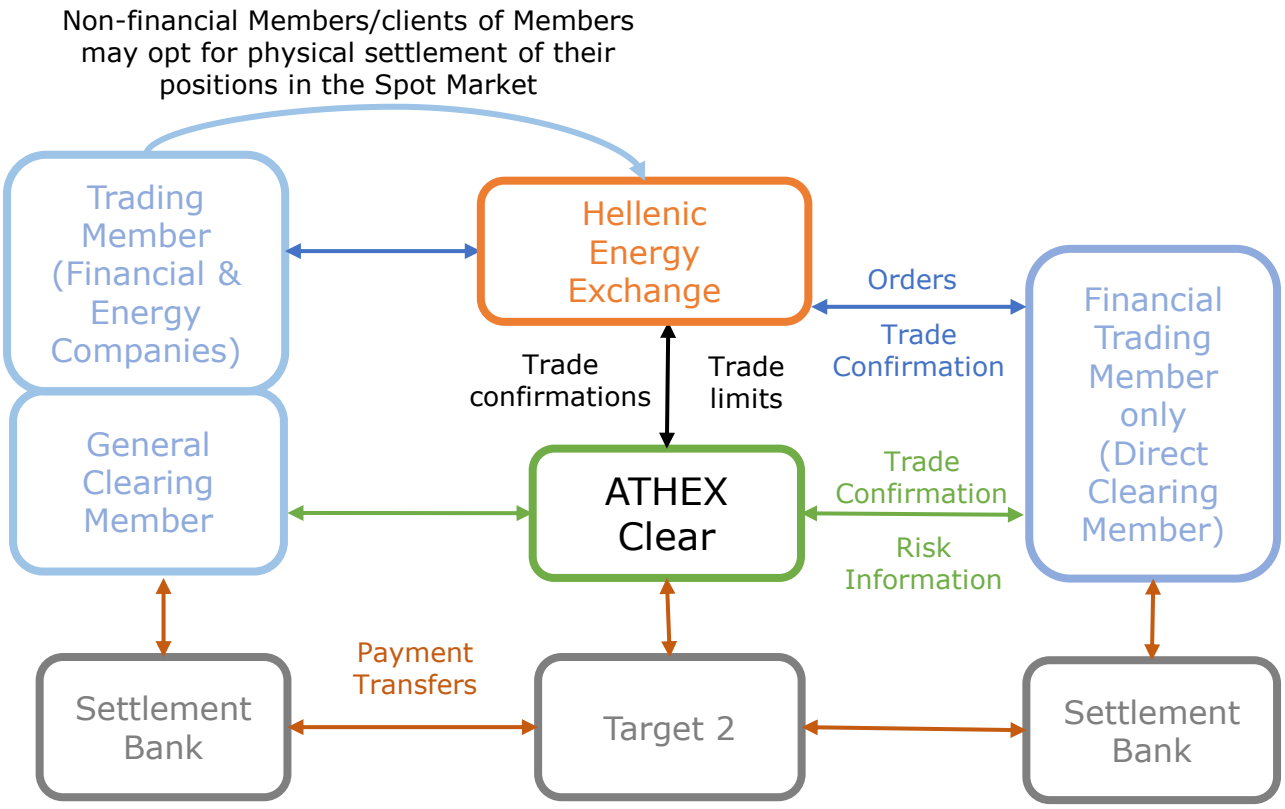
Source: HEnEx, HAEE's analysis

Highlights

- Intraday Market can be utilized, and market participants can update their trading position, in case of power plant outages or changes in demand.
- RES Producers and Aggregators handle the associated RES stochasticity, with the submission of more accurate short-term RES forecasts.
- Flexibility providers can leverage their portfolio to maximize the use of their resources while contributing to the energy balance.
- 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 if transmission capacity is available, both for explicit and implicit trading.

A MiFID II compatible market accompanied by an EMIR compliant CCP increases reliability, transparency, and minimizes counterparty risk

Derivatives Markets Architecture



Highlights

Source: HEnEx, HAEE's analysis

- Hedging opportunities are reinforced since all market participants can hedge against unforeseen prices in the spot market.
- Hedging price exposure helps companies make long-term plans and formulate new business cases, which, in turn, benefits consumers who receive low-cost services.
- Optional physical settlement can serve the Spot market participants needs through a simple, competitive and straight-through service.
- A competitive and liquid Derivatives Market will enhance competition on both spot and retail markets for the benefit of market participants as well as end-customers.
- Compliance with high EU regulatory standards (REMIT, MiFID II, EMIR) offers market transparency and trust.

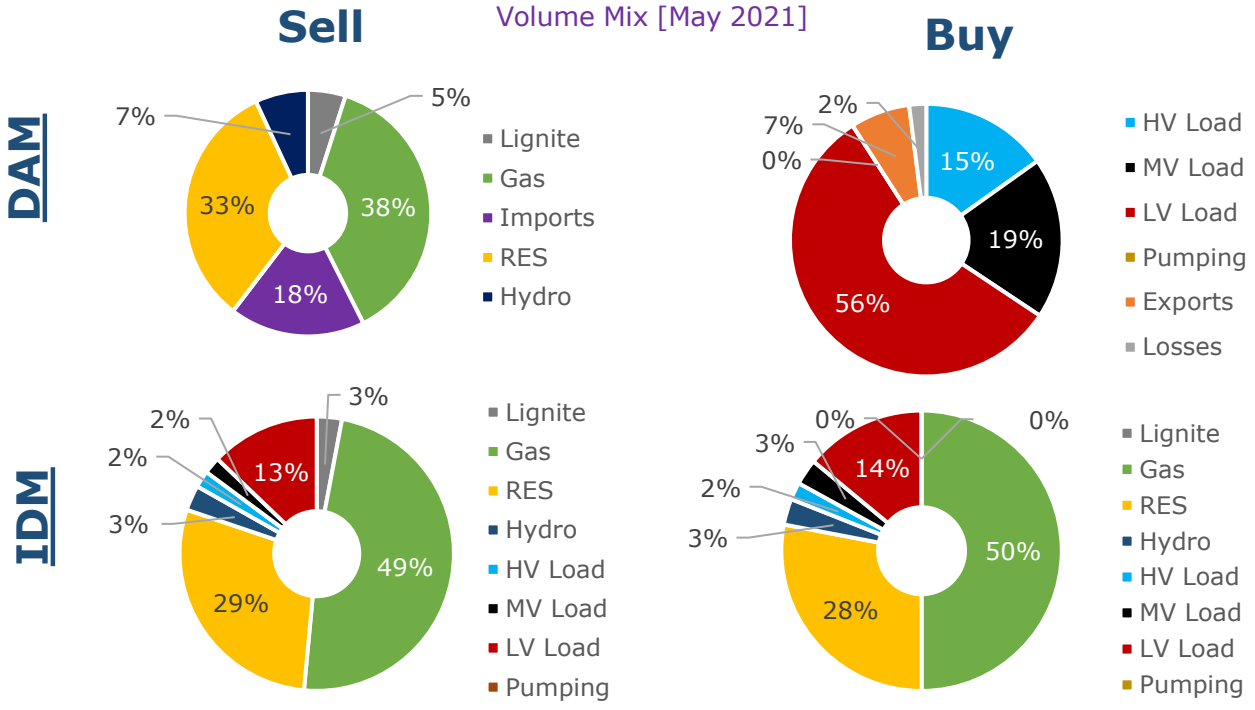
The average market clearing price in Day-Ahead Market was 64.1€/MWh, while DAM account for 98.6% of total volume traded in Spot markets

Summary of Main Figures [May 2021]

May 2021 Apr 2021	DAM	LIDA1	LIDA2	LIDA3
Price (€/MWh)	63.16 64.17	62.53 63.17	63.12 64.88	63.52 66.80
Volume (GWh)	3,972 4,176	28.2 37.8	14.6 17.0	11.3 9.7
Value (M €)	254.7 271.1	1.91 2.28	0.98 1.08	0.78 0,64

Source: HEnEx, HAEE's analysis

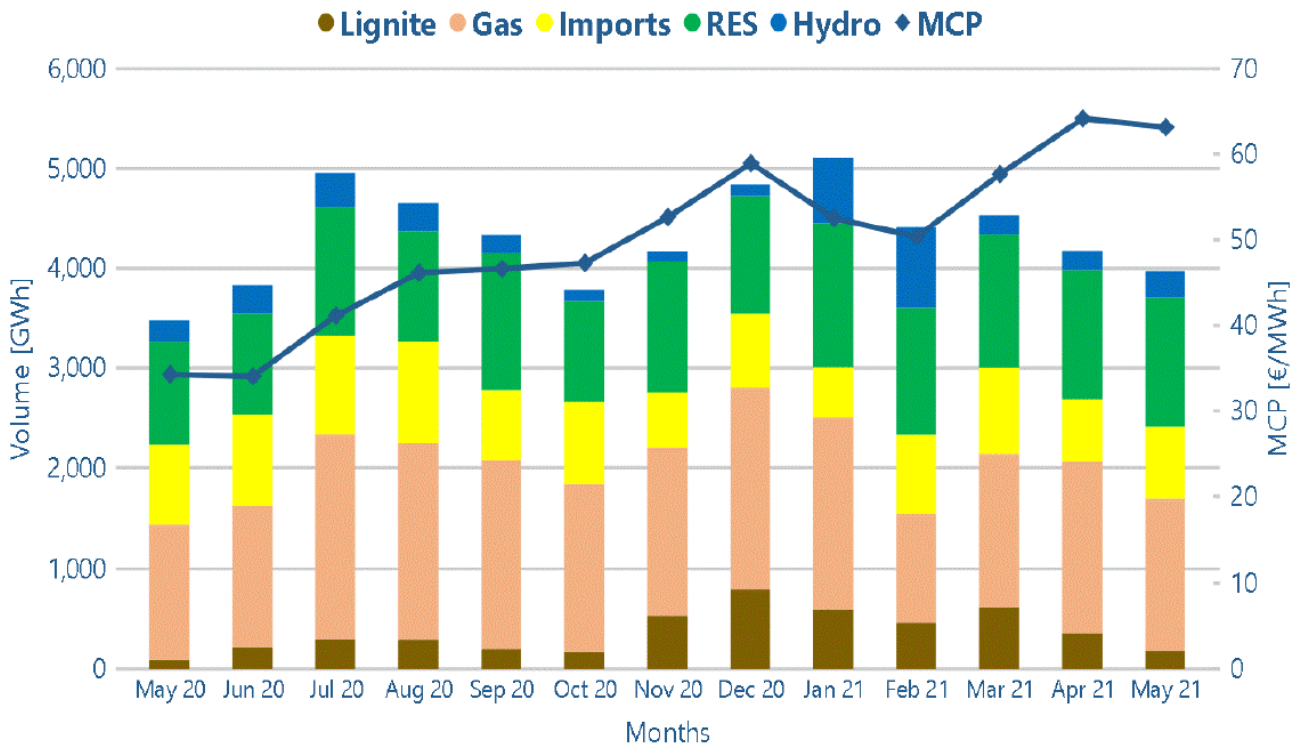
Volume Mix [May 2021]



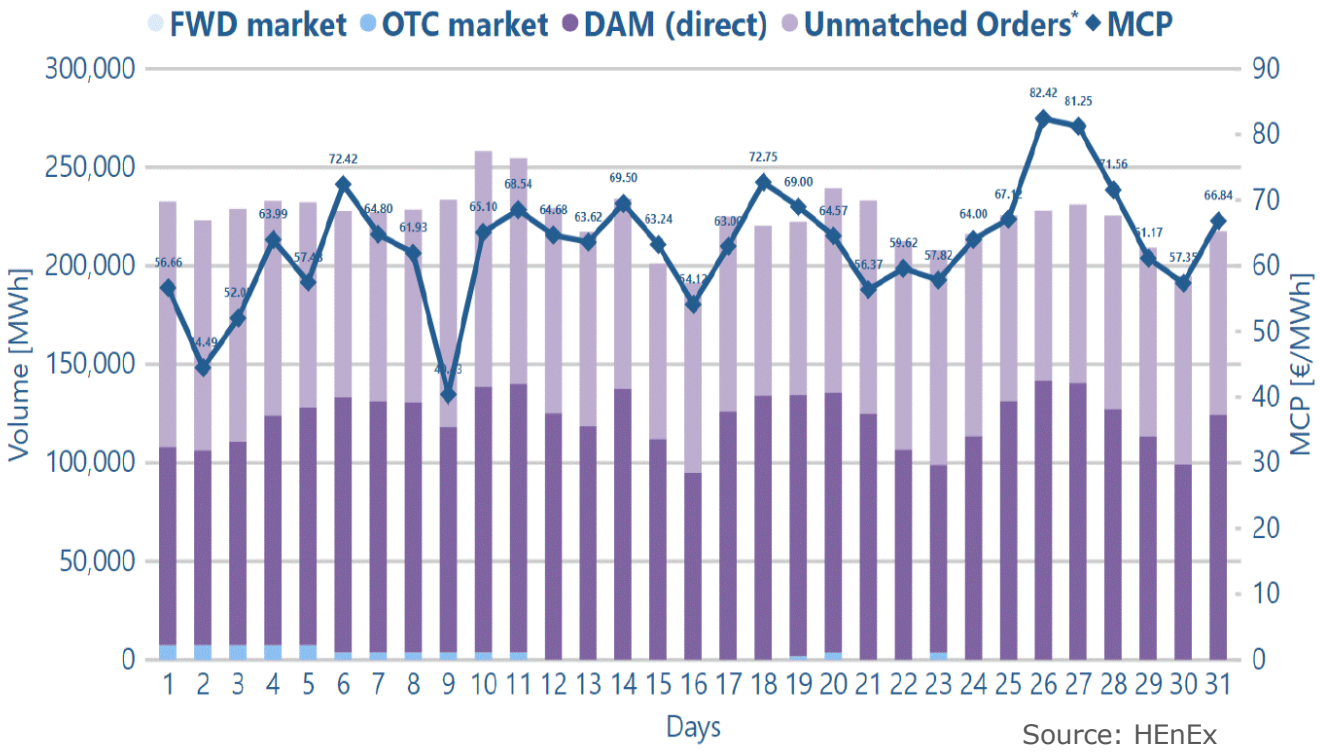
Source: HEnEx, HAEE's analysis

Over the past year, an upward trend is apparent in the monthly average MCP, while OTC and Derivatives market are not yet exploited

Volume Mix of Sell Side per Month (GWh) & Day-Ahead Market Clearing Price (€/MWh), [May 2020- May 2021]



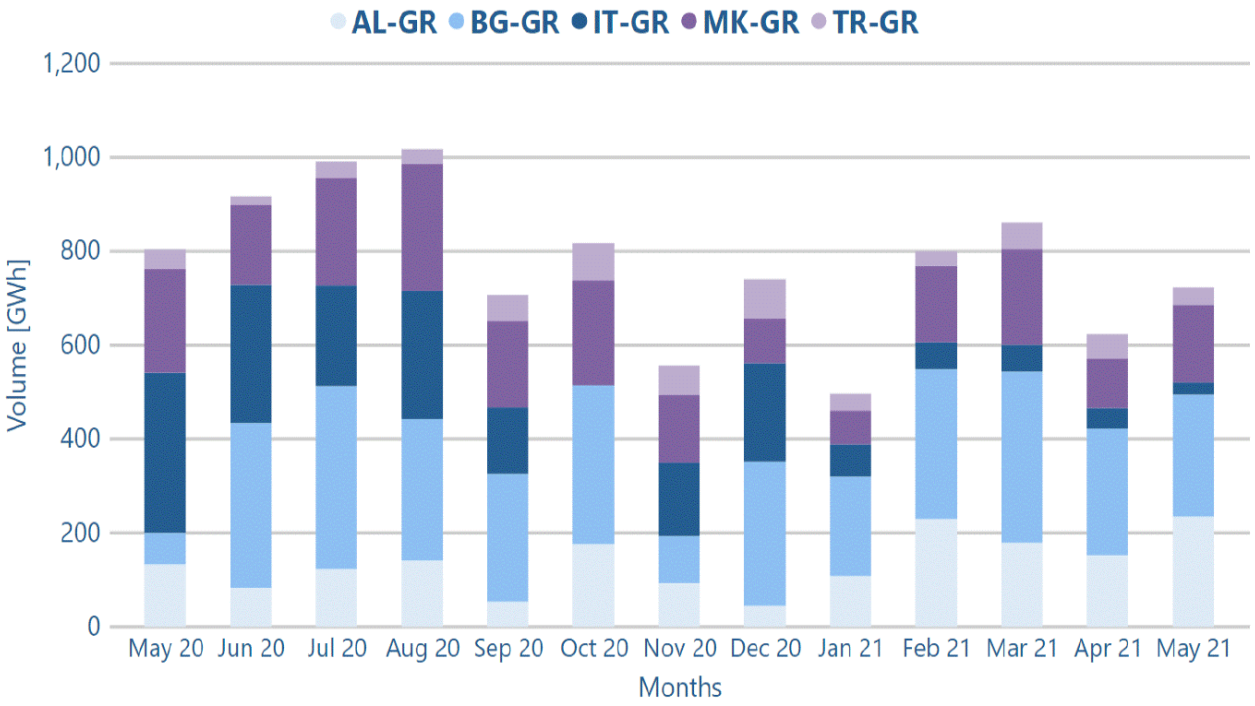
Total Volume and Traded Volume per Market Source of Sell Orders (MWh), [May 2021]



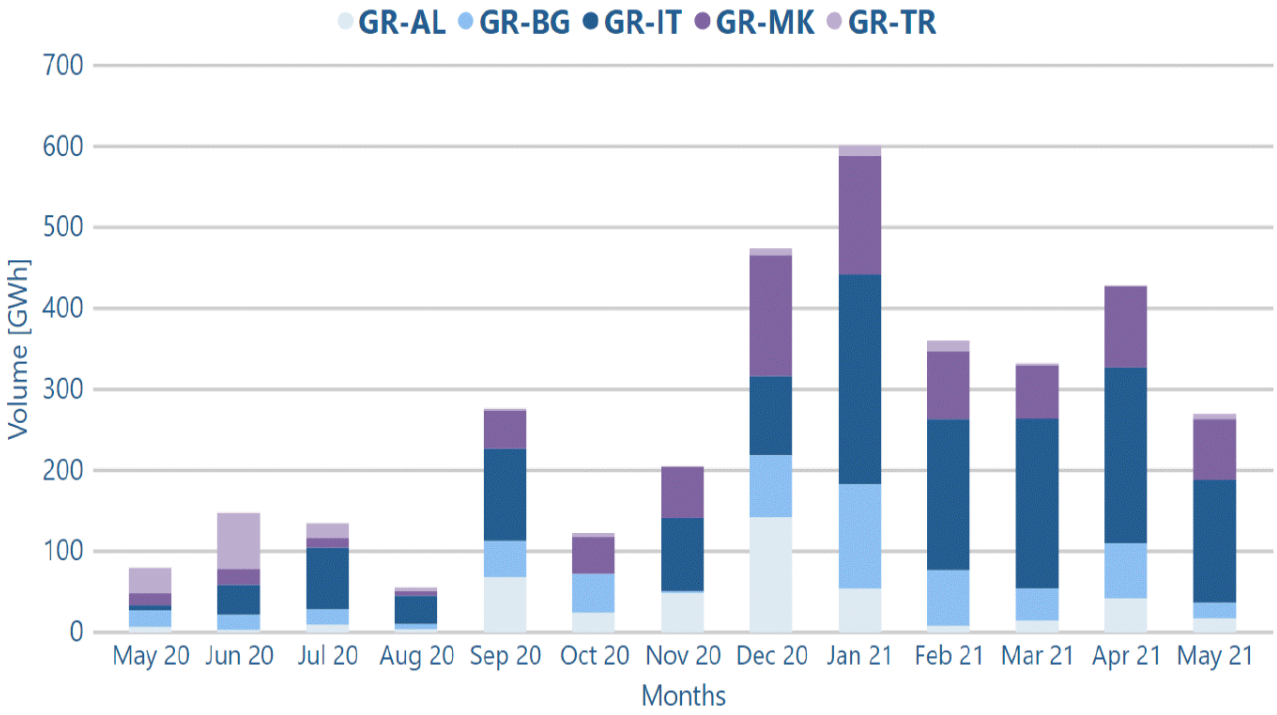
Source: HEnEx

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

Cross Border Imports per Month (GWh), [May 2020- May 2021]



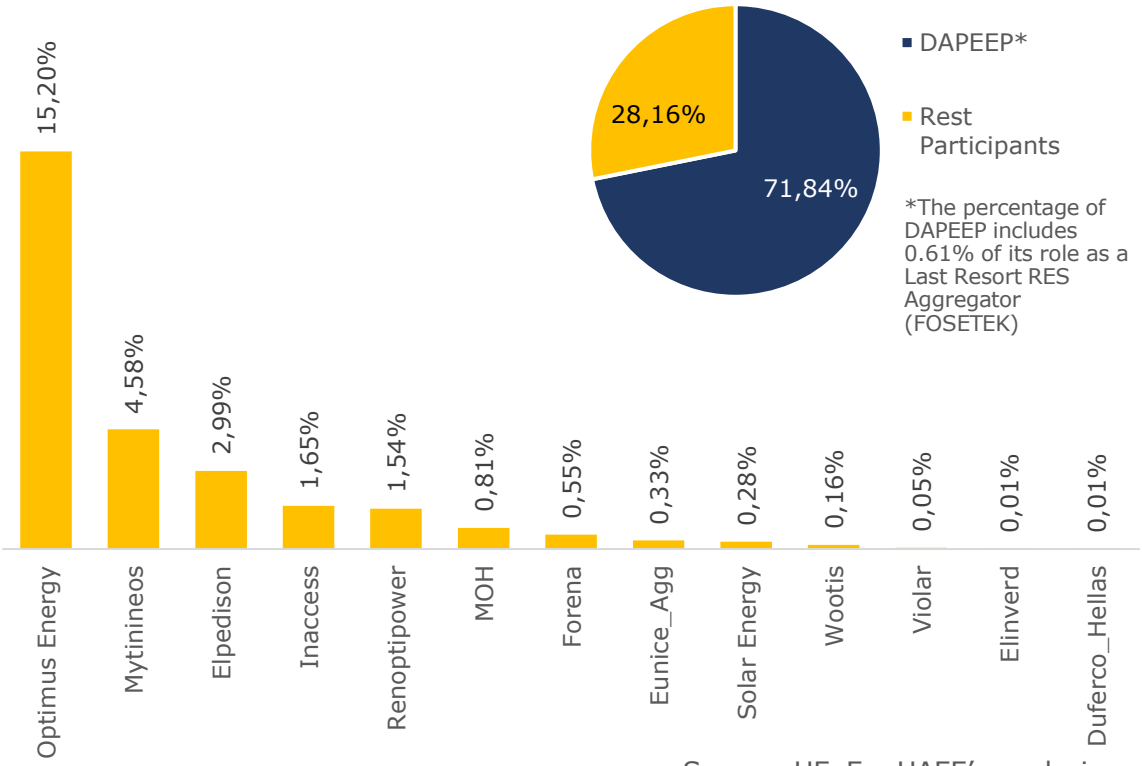
Cross Border Exports per Month (GWh), [May 2020- May 2021]



Source: HEnEx

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

Final Market Schedule Shares for RES production Units per Market Participants (%), [May 2021]



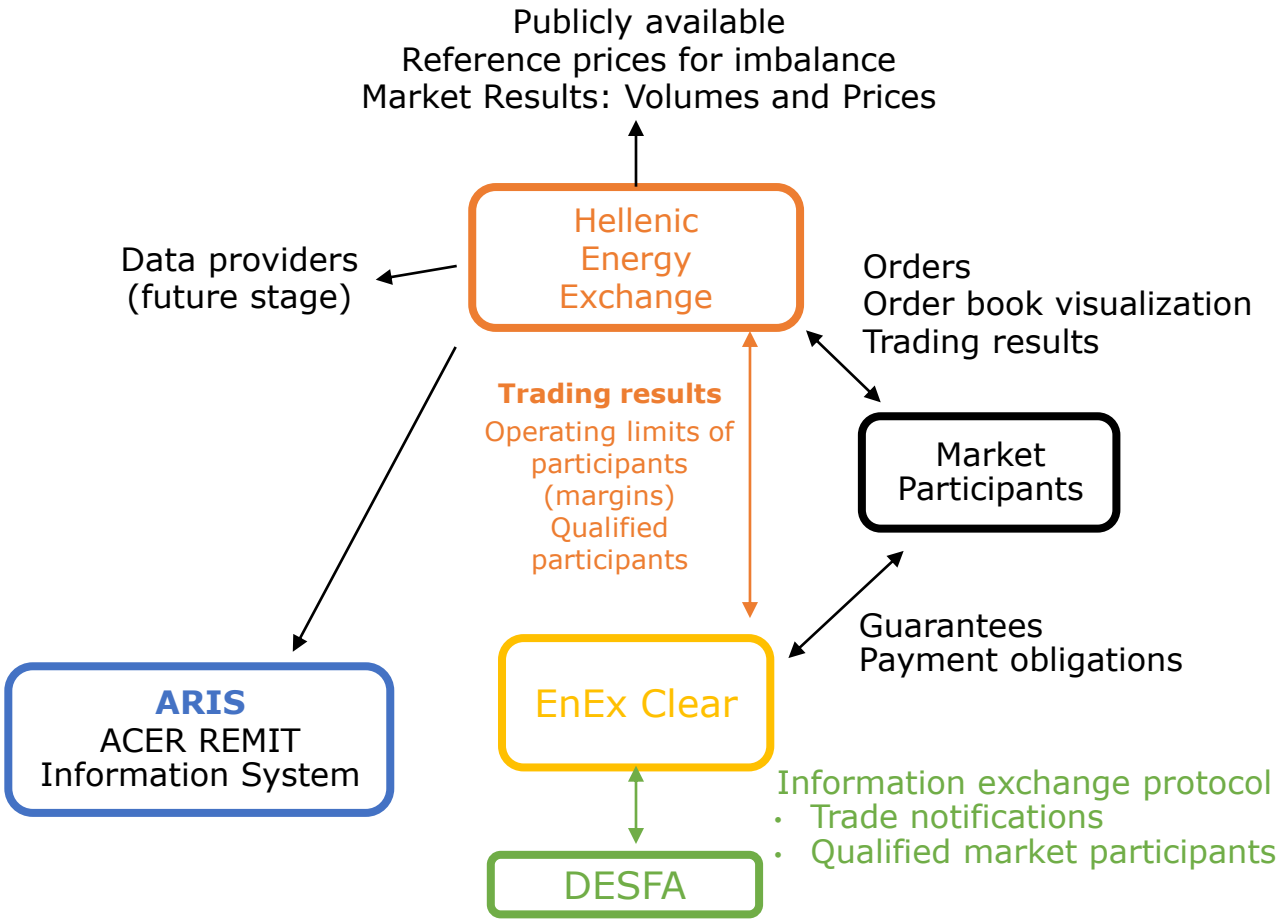
Source: HEnEx, HAEE's analysis

Highlights

- Under the Target Model, RES producers 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.
- 12 RES Aggregator companies are active market participants in the wholesale electricity market of Greece, accounting for 28.1% of RES production in May 2021.

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: HAEE's analysis

Highlights

- The scope of Gas Spot Market is the establishment of a Gas Trading Platform Operator (TPO) by HEnEx, and a Clearing House by EnExClear.
- In the current Balancing Platform, DESFA buys and sells through auctions the quantities of gas needed to balance the NG Transmission System
- In the new Trading Platform, anonymous transactions between gas participants will take place, providing marginal prices for the purchase and sale of natural gas.
- Gas-fired power plants, gas suppliers, traders & third parties will be able to trade depending on their gas needs within an efficient and safe market environment.
- The new products will be available first in the Spot Market, and then it will be added to the Derivatives Market after the Go-live of the Spot Market (underlying market).

Despite the delays due to Covid-19 crisis, the market design of the Natural Gas Trading Platform is currently under development

Timeline of Important Milestones Related to EnEx Group

Milestone	Date
Intraday Market Coupling through Italian Borders (from LIDAS to CRIDAs)	Sep. 2021
GAS Trading Platform Dry Runs	2021
GAS Trading Platform Go-live	2021
IDM Continuous Trading (XBID) Go-live	Start 2022

Source: HEnEx, 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 last 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.

5. Natural Gas

Highlights

Due to the rapid decarbonization in Greece, the consumption of Natural gas has increased during the past **18 months**, reaching record-high levels of **6.3 bcm.**

For **2020** the primary entry point for Natural Gas in the country was **Revithousa**, from which **48%** of natural gas was imported.

The **penetration rate** in the region of Thessaloniki and Thessaly reached **64%**, in Attiki **46%**, while in the Rest of Greece it less than **10%.**

CNG LNG and ssLNG 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 **5.4 €/MWh** in March 2020 but recovered by December 2020 to **13.4 €/MWh.**

TAP pipeline became available during **December 2020**, and through the pipeline **18%** of the total natural gas imported to Greece arrives from Azerbaijan.

In 2020, **49 cargos** were unloaded in Revithousa arriving from **8 different countries**, thus enhancing the country's energy security of supply.

Household consumption prices remained at low levels dropping from around **50 €/MWh** to almost **30 €/MWh,** while taxes fluctuate around **9-11 €/MWh.**

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

Overview

Consumption of natural gas in Greece reached record levels in 2020, according to DESFA data, which also show that almost half of the gas quantities came from the Liquefied Natural Gas (LNG) Terminal in Revithousa.

Domestic consumption last year amounted to 63.1 million megawatt hours (5.48 billion cubic meters) from 57.4 million MWh in 2019, an increase of 9.5%. At the same time, 46% of the quantity consumed came from imports of LNG cargo in the tanks of Revithousa. It is indicative that the quantities gasified in order to be channeled to the System increased by 500% compared to 2014 levels.

LNG, due to lower prices compared to pipeline gas, dominated gas imports during 2020. According to the most recent available data, the tankers that landed in Revithousa, transported cargo from 8 different countries of origin. Although in 2019 Algeria maintained a dominant position in the quantities of LNG imported into the country with a percentage of 20%, in 2020 the USA took over the first place with a percentage equal to 48%. Qatar also recorded double digits (22%), followed by Nigeria and Algeria with 9% respectively and Norway, Egypt, France and the Netherlands around 3%. Moreover, exports through the interconnection in Sidirokastro reached 7.3 MWh or 649 million cubic meters.

In the domestic market, the largest quantities of natural gas were consumed by electricity generators, which covered 65% of demand. This was followed by household consumers and businesses through distribution networks, with consumption of 19%, while 16% was requested by domestic industries. Those industries are directly connected to the high-pressure system of DESFA.

Until December 2020, Greece had three gas entry points: one at the Greek-Turkish border close to Kipoi, one at the Greek-Bulgarian border near Sidirokastro and one at the Revithousa LNG terminal. The import of natural gas at these points was shared as follows: 53.82% of natural gas was imported from Bulgaria (31.9 million MWh) and Turkey (6.1 million MWh), while 46.18 % was imported through the LNG terminal of Revithousa (32.6 million MWh).

From the end of December 2020, the entry point Nea Mesimvria was put into commercial operation, which connects the National Natural Gas System (ESFA) with the Trans-Adriatic Pipeline (TAP), and from which 650 MWh were imported until the end of 2020. Thus, Greece now has four gas entry points, while the connection with TAP significantly enhances the country's role in the regional energy landscape, as the Natural Gas System is now connected to one of the largest gas markets in Europe, that of Italy, which in turn connects to Northern Europe via Switzerland and Germany.

Natural gas wholesale prices in Europe fluctuate from 10.4€/MWh to 19.7€/MWh, during the fourth quarter of 2020

Comparison of EU Average wholesale gas prices (€/MWh), [Q4 2020]

Finland	*HUB* *LNG*	**14.36** **19.75**	**Italy**	*HUB* *EBP2* *EBP3* *EBP4* *LNG*	**14.72** **12.65** **13.25** **13.47** **12.64**	**Belgium**	*HUB* *EBP1* *EBP4* *LNG*	**14.51** **12.67** **13.70** **14.68**
Sweden	*EBP5* *LNG*	**13.66** **19.40**	**Romania**	*EBP2*	**14.05**	**Bulgaria**	*HUB* *EBP2*	**13.19** **13.40**
Poland	*HUB*	**16.63**	**Denmark**	*HUB*	**14.65**	**Slovenia**	*EBP2*	**12.74**
Spain	*HUB* *EBP3* *LNG*	**15.84** **13.28** **15.16**	**Czech Republic**	*HUB* *EBP2*	**14.78** **10.81**	**Republic of Latvia**	*HUB* *EBP2*	**13.42** **12.75**
France	*HUB* *LNG*	**14.56** **15.17**	**Portugal**	*LNG*	**13.23**	**Lithuania**	*HUB* *EBP2* *LNG*	**14.16** **10.26** **12.93**
United Kingdom	*HUB* *LNG*	**15.31** **16.63**	**Hungary**	*HUB* *EBP2*	**13.95** **12.76**	**Estonia**	*HUB* *EBP2*	**13.42** **10.43**
Netherlands	*HUB* *LNG*	**14.68** **14.43**	**Austria**	*HUB*	**13.90**	**Slovak Republic**	*EBP2*	**11.92**
Germany	*HUB* *Other*	**14.55** **14.68**	**Greece**	*EBP2* *LNG*	**12.31** **11.16**			

EBP1 prices are estimations of border prices for gas from Norway
EBP2 prices are estimations of border prices for gas from Russia
EBP3 prices are estimations of border prices for gas from Algeria
EBP4 prices are estimations of border prices for gas from Netherlands
EBP5 prices are estimations of border prices for gas from Denmark
Germany: BAFA data on border price for Germany reported as "Other"

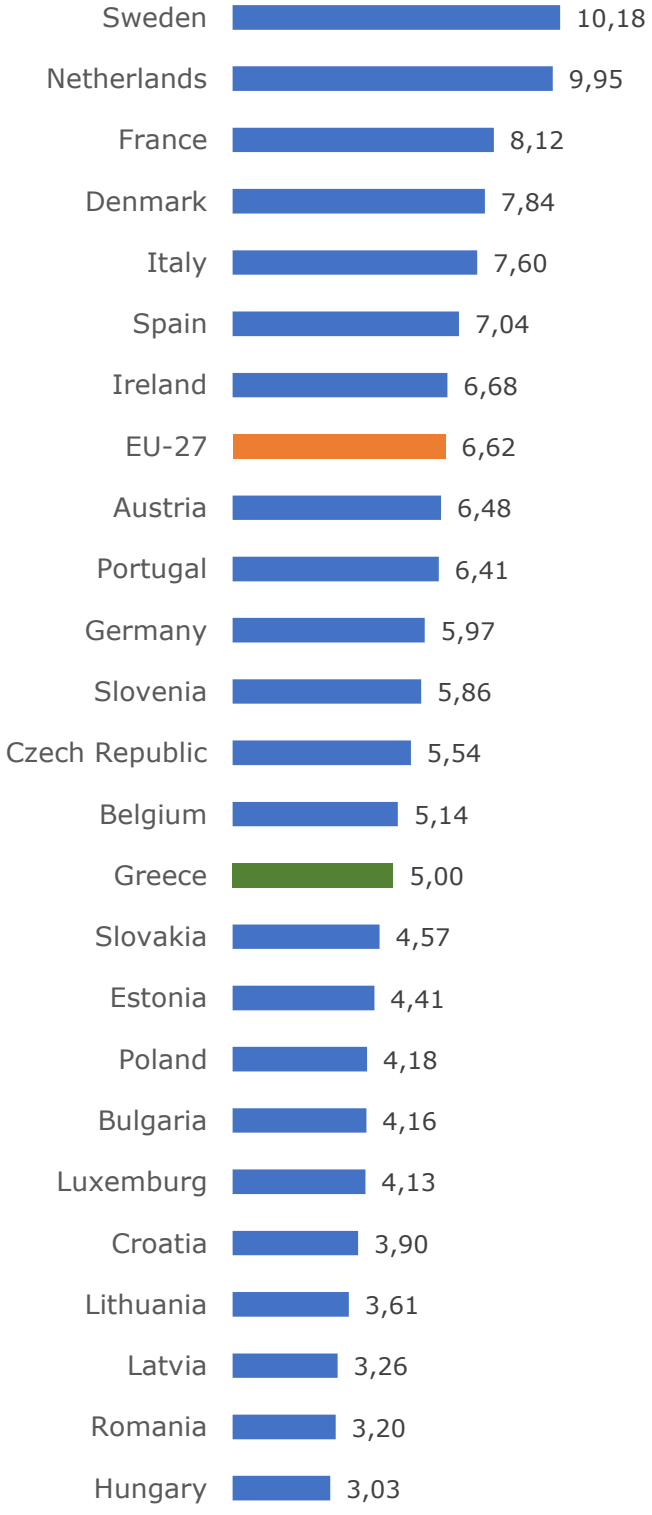
Source: European Commission, HAEE's analysis

Highlights

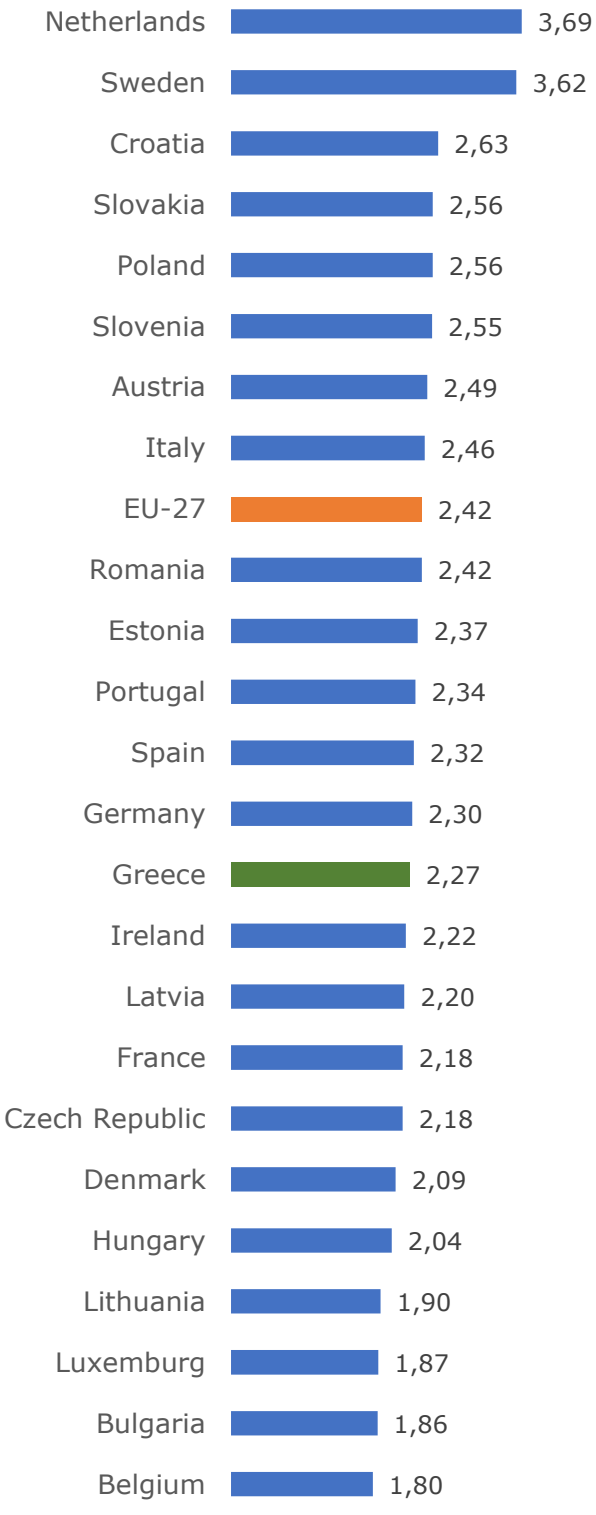
- The three countries with the highest wholesale prices in Europe, are Finland, Sweden and Poland, with the prices ranging from 16 to 20 €/MWh.
- Greece is one of the countries with the lowest gas import prices in Europe. Greece import price for LNG is 11,16€/MWh.
- Italy import LNG price is 12,63 €/MWh, similar to Portugal's, while Spain's is fluctuating around 15 €/MWh.
- Estonia is the country with the lowest gas import price, 10.43 €/MWh, importing Gas from Russia.
- Italy has the most diversified market, as imports are coming from Russia, Algeria and Netherlands. Italy is also importing LNG.

By the end of 2020, natural gas prices both for domestic and industrial consumers in Greece are lower compared to the EU average

Gas prices for Domestic Consumers (eurocents/kWh), [Q4 2020]

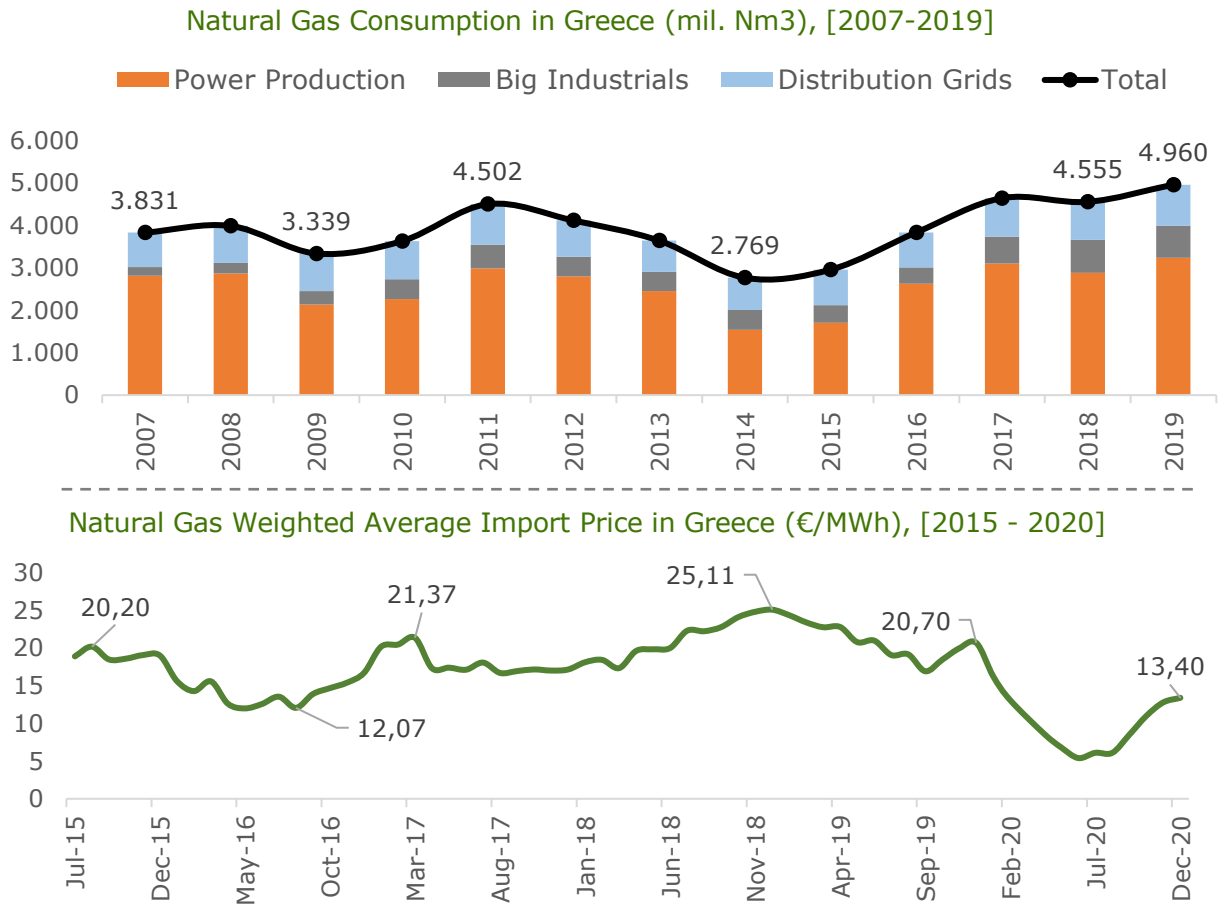


Gas prices for Industrial Consumers (eurocents/kWh), [Q4 2020]



Source: Eurostat, HAEE's analysis

Natural gas import price since June 2020 follows an upward trend, while consumption hits an all-time high record in 2020

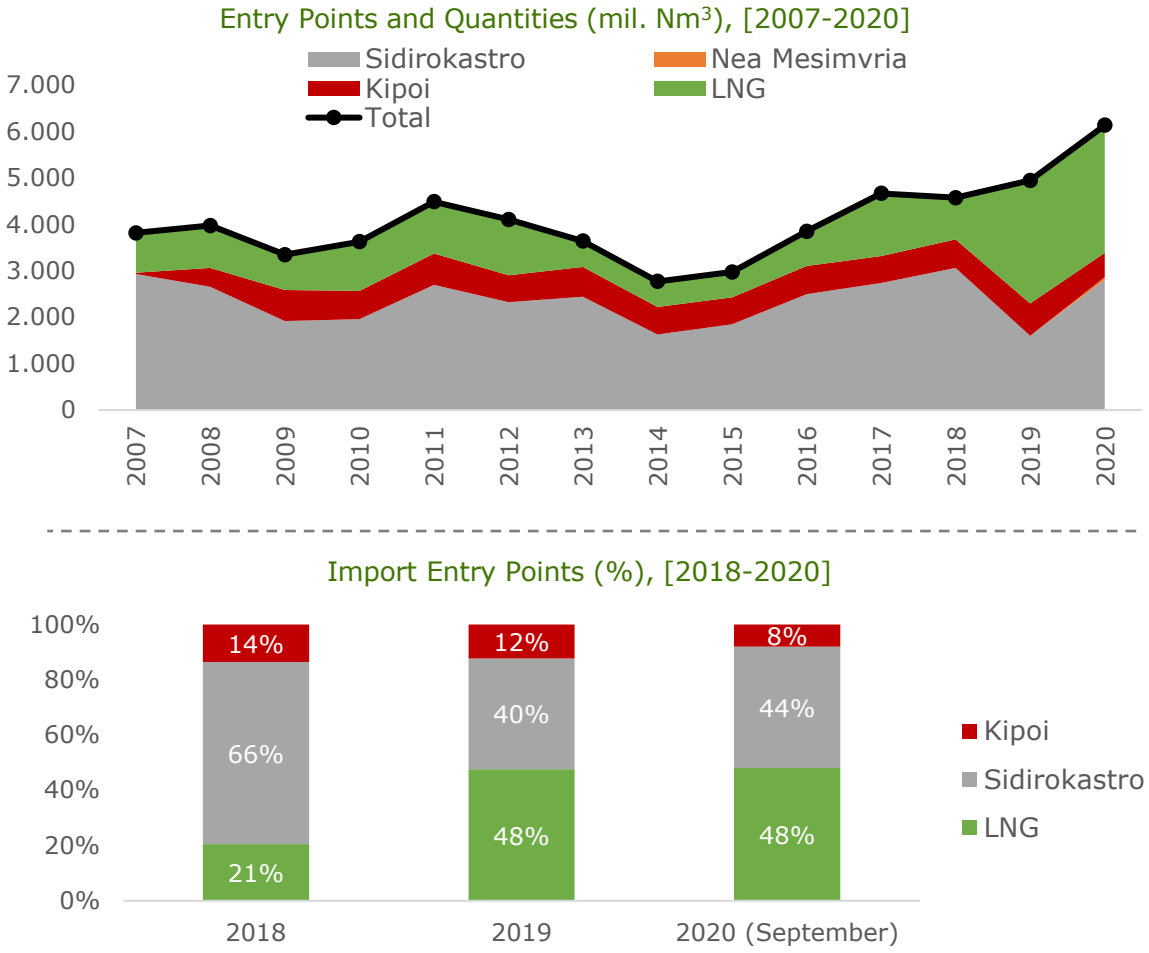


Source: DESFA, RAE and HAEE's analysis

Highlights

- The natural gas consumption in Greece grew in 2020 by almost 10%, reaching an all-time high record at around 5.48 bcm.
- More than 65% of natural gas used was directed to power generation, followed by 20% towards the distribution grids for the consumption of household and industries.
- From 2014 and onwards the consumption of gas has doubled and, according to current projections, consumption is expected to grow even more until 2030.
- The average import prices were reduced in the first half of 2020, due to the hampering of global LNG prices, but since July, an upcoming trend is evident again.
- The lower demand from Asian countries due to the COVID-19 pandemic led to a 70% drop in the average import prices from December 2019 to July 2020.

Since December 2020, the new entry point of Nea Mesimvria in Greece was put into commercial operation



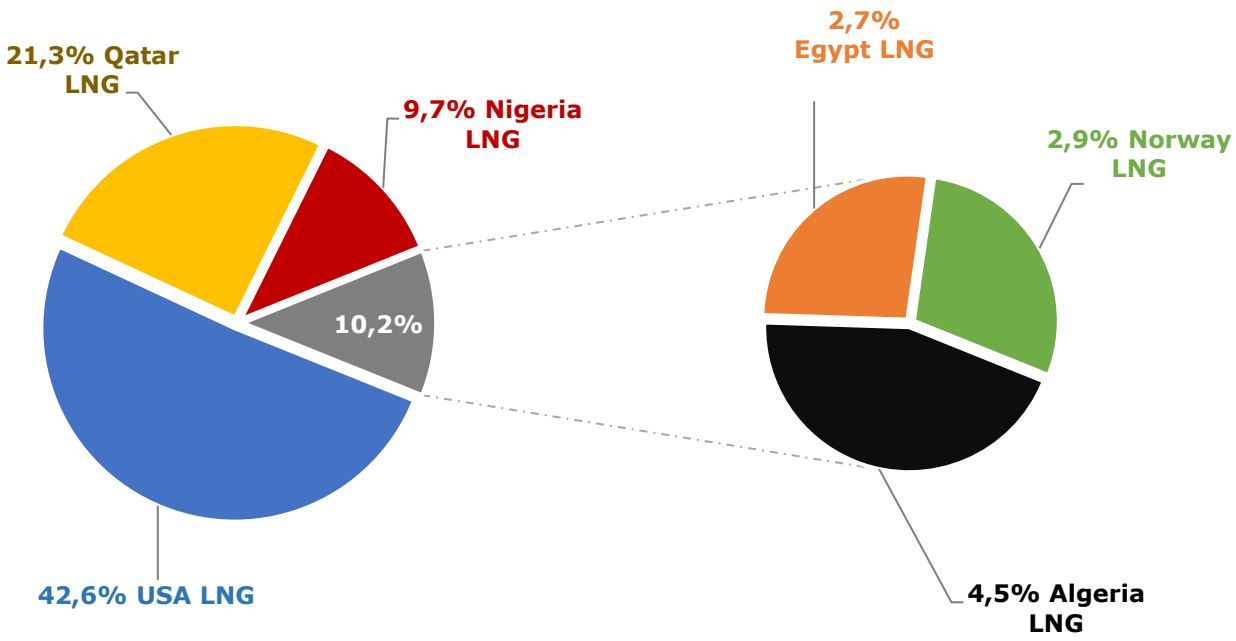
Source: DESFA, HAEE's analysis

Highlights

- There are four 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. The thirds entry point is the LNG terminal at Revithousa island.
- For 2020 the primary entry point for natural gas in the country was Revithousa, from which almost half of the gas was imported.
- The entry point of Nea Mesimvria was put into commercial operation, by December 2020, connecting the National Natural Gas System (DESFA) with TAP.
- The connection of Trans-Adriatic Pipeline (TAP), significantly enhances the country's role in the regional energy landscape.

USA was the largest LNG supplier of Greece during the third quarter of 2020, with a percentage greater than 42%

LNG Imports by Partner Country in Greece (%), [2020]



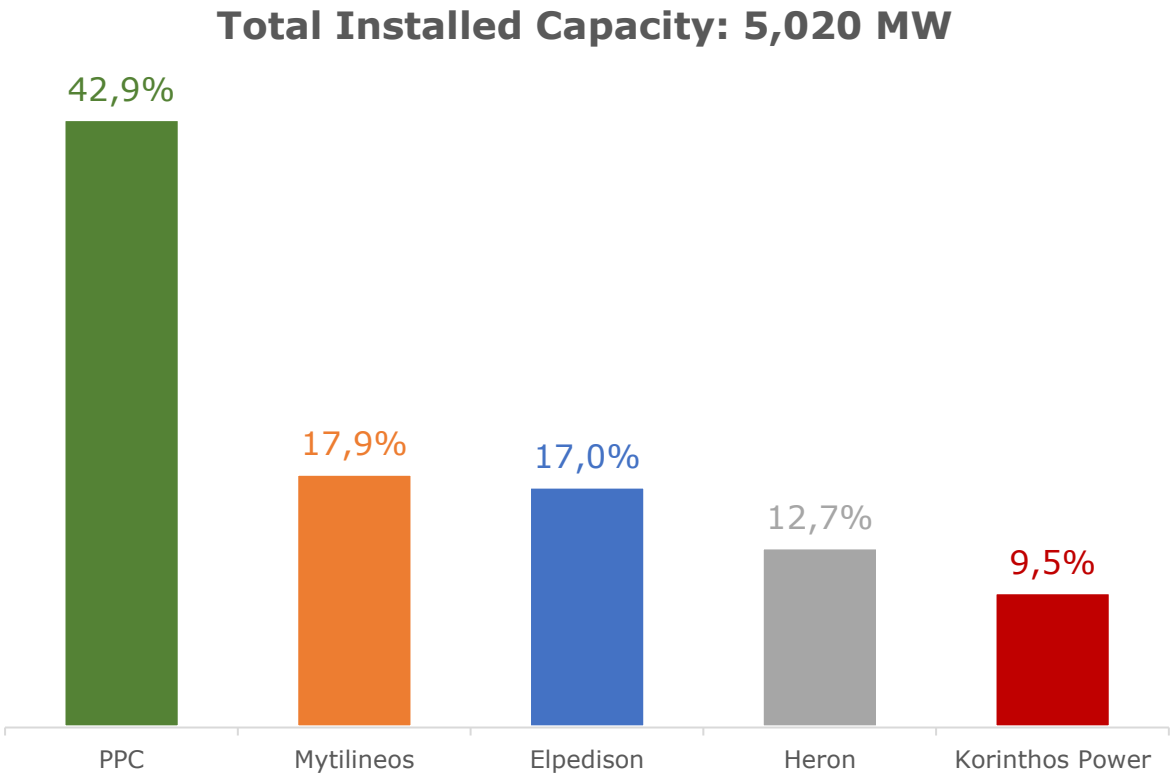
Source: DESFA, HAEE's analysis

Highlights

- LNG imports, due to lower prices compared to pipeline gas, dominated last year, since 46.1% of natural gas came from LNG cargo imports in Revithousa terminal.
- The gasification capacity of Revithousa Terminal increased significantly, with the upgrade and the installation of the 3rd storage tank, with a capacity of 225k m3.
- DESFA is planning to install a truck loading station and a small-scale LNG jetty that will be able to accommodate vessels from 1,000 m3 to 20,000 m3.
- The main LNG counterparties in 2020 were United States of America, Qatar and Nigeria, followed by Algeria, Norway and Egypt.
- During 2020, 49 cargos from 8 different countries unloaded in Revithousa terminal, thus increasing the regasification by 3,8%, comparing to 2019 levels.

The installed capacity of natural gas-fired power plants in 2020 exceeds 5 GW, while plans for the development of further 4 GW are underway

Natural Gas–Fired Power Plants per Operator (%), [2020]



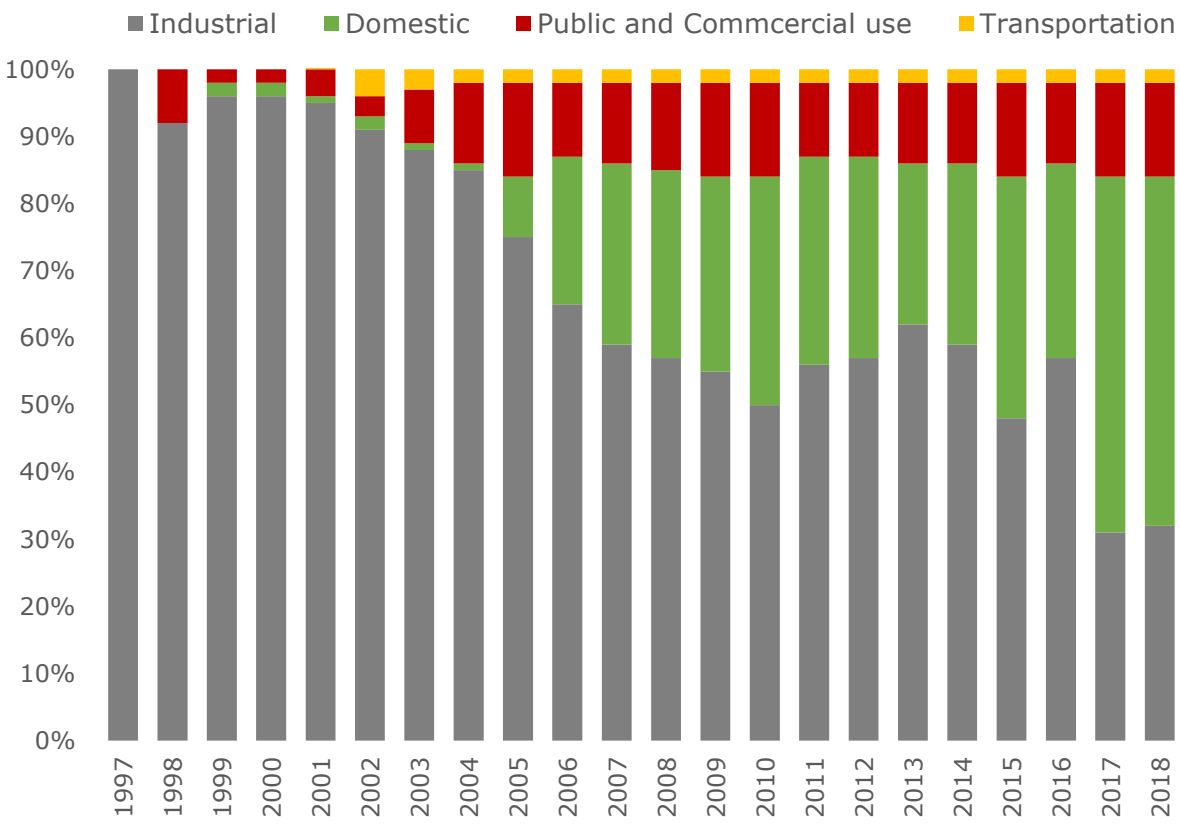
Source: HEnEx, HAEE's analysis

Highlights

- Most of 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 3,054 MW, representing the remaining 57.1%.
- Elpedison owns two natural gas-fired plants, in Thessaloniki and in Thisvi, Mytilineos owns two in Viotia, Korinthos Power one in Korinthia and Heron 4 plants in Viotia.
- Several companies plan to construct new natural gas-fired plants. The capacity of all these projects equals to more than 4 GW.
- Mytilineos new Combined Cycle Gas Turbine unit of 826 MW installed capacity in Viotia, is expected to operate by the 4th quarter of 2021.

The biggest NG consumer is the industrial sector, with households use and public-commercial sectors have increased their share since 2005

Energy Use of the Natural Gas sector (%), [1997 -2018]



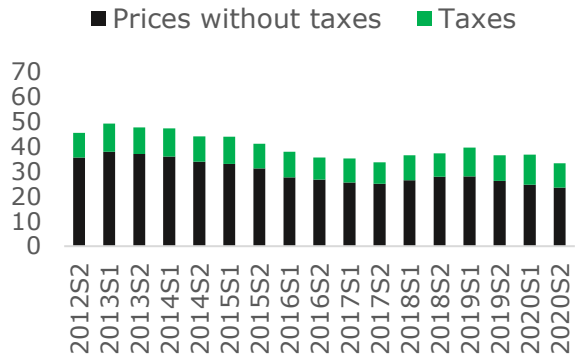
Source: Eurostat and HAEE's analysis

Highlights

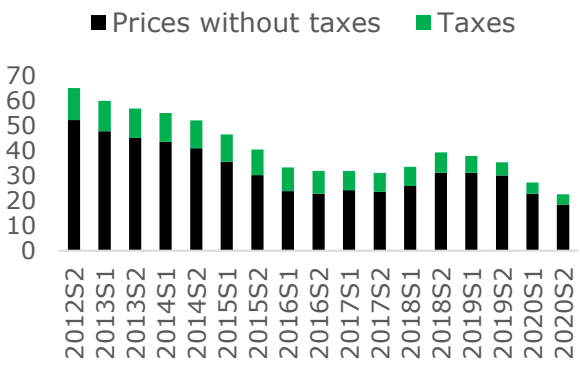
- The industrial sector has always been the biggest final natural gas consumer for energy use, over the past 20 years.
- However, the household and public/commercial sector have significantly strengthened their position since 2005.
- NG consumption for the commercial and public sector in 2018 rose to 17.7% of final NG consumption for energy use.
- On the contrary, transport sector faces limited use of natural gas, with consumption fluctuating around 2% of energy use, since 2001.
- In the industrial sector, the non-ferrous metals sector is the largest consumer for energy use (40.7% of energy use in industry in 2018).

By the end of 2020, natural gas retail prices in Greece were lower compared to the average EU level, both for household and non-household use

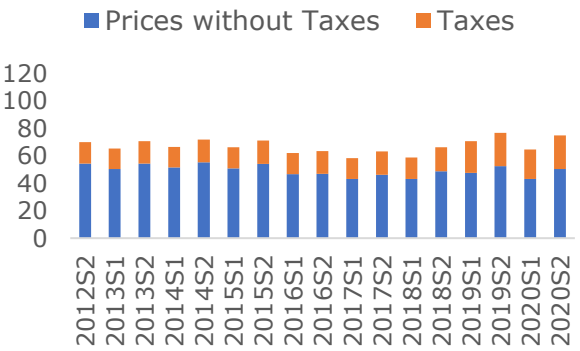
Retail Price for Non-Household Consumers in EU 28, Band I3 (€/MWh), [2012-2021]



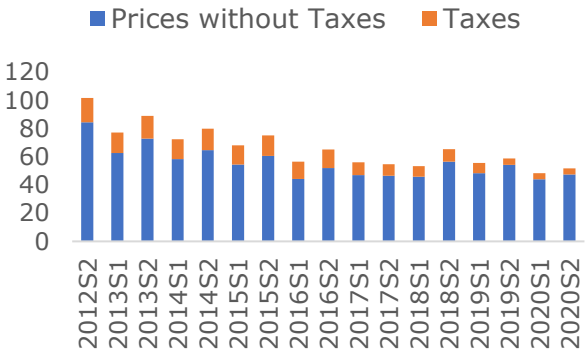
Retail Price for Non-Household Consumers in Greece (€/MWh), Band I3 [2012-2021]



Retail Price for Household Consumers in EU 28, Band D2 (€/MWh), [2012-2021]



Retail Price for Household Consumers in Greece, Band D2 (€/MWh), [2012-2021]



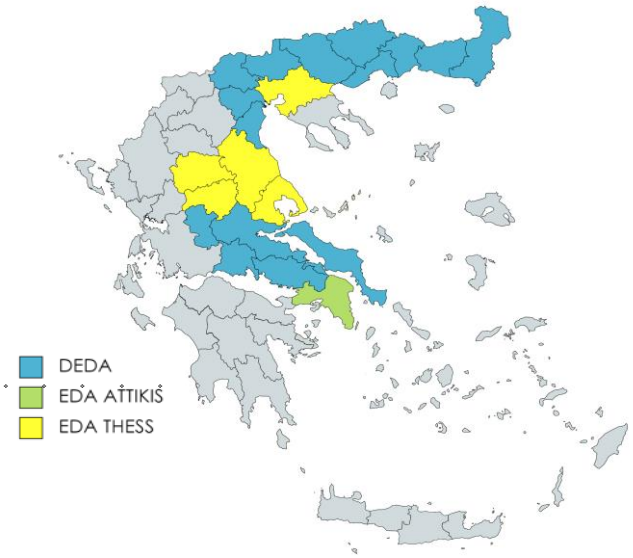
Highlights

Source: Eurostat, HAEE's analysis

- The average retail price for a household across EU, with medium gas consumption, has significantly decreased since the beginning of 2013.
- Total consumers prices in EU dropped from almost 50 €/MWh in 2013 close to 30 €/MWh in 2020. At the same time, taxes fluctuate in the range of 9-11 €/MWh.
- On the other hand, in Greece the retail price for household consumers is almost half in S2 2020 compared to S2 2018, reaching the all-time low level of 22,6 €/MWh.
- The European Union average price for non-household users has been fluctuating to 70 €/MWh for the last years, with an increase close to 75 €/MWh in S2 2020.
- In Greece, the price for non-household users has witnessed a sharp drop, especially following 2015, while the current price is close to 51 €/MWh.

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

Development Plans in the Three Regions of EDAs, [2019]



Region	Attiki	Thessaloniki & Thessaly	Rest of Greece
2020 Active Customer	135k	320k	>3k
2025 Active Customers Projections	240k	420k	68k
2020 Network Coverage	46%	64%	<10%
2025 Network Coverage	66%	77%	55%

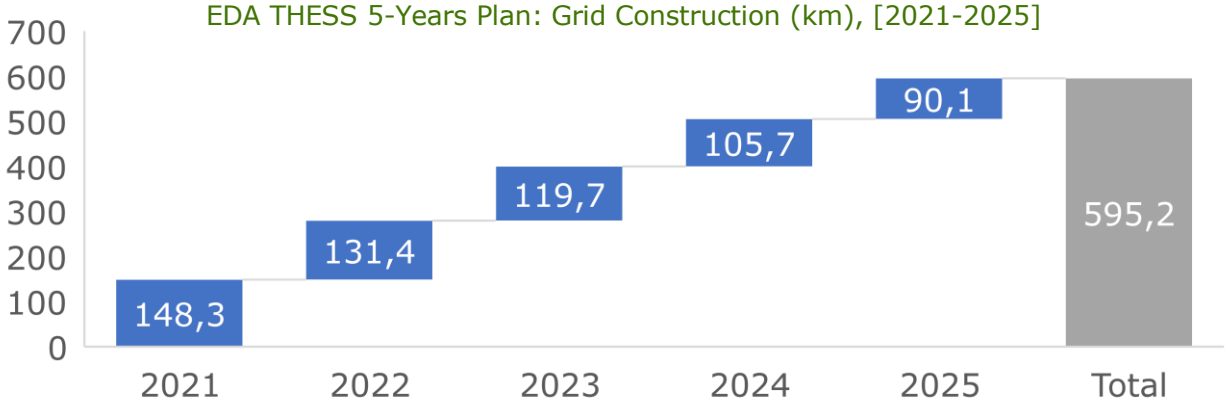
Source: EDA Attiki, EDA Thess, DEDA and HAEE's analysis

Highlights

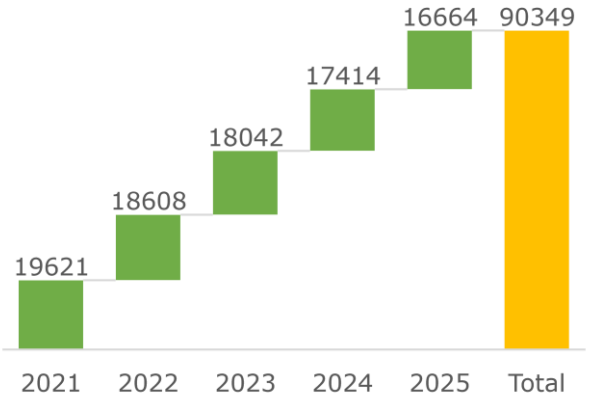
- Attiki Region is estimated to serve 240k customers by 2025, while the target for Thessaloniki & Thessaly is 320k customers and in the Rest of Greece 68k customers.
- The penetration rate of EDA THESS reached 64%, while for EDA ATTIKI it reached 46%. The projections is to reach 77% and 66% penetration accordingly by 2025.
- The new development plans of the three DSOs are front-loaded, as the 50% of the new connections are expected to connect to the grid, in the following 2 years.
- Private companies have published development plans in cities that were excluded from DEDA's development program.
- DEPA Infrastructure owns 51% of EDA THESS, with the rest 49% belonging to ENI, while concerning EDA Attikis, DEPA Infrastructure is the sole shareholder.

The new "EDA Thess" 2021-2025 investment program includes total investments of €158.2m, creating new growth prospects

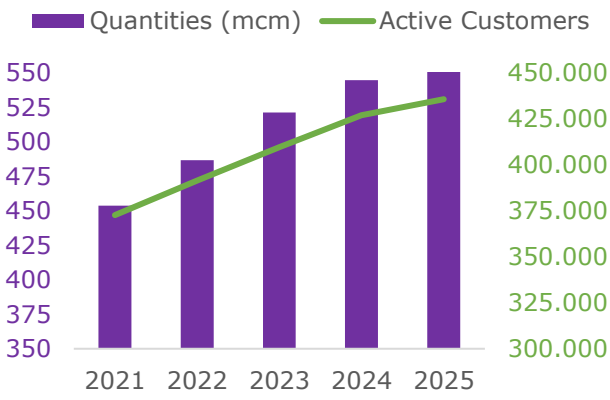
EDA THESS 5-Years Plan: Grid Construction (km), [2021-2025]



EDA THESS 5-Years Plan: New Connections (thousand costumers), [2021-2025]



EDA THESS: Active Customers and Distributed Quantities (mcm), [2021-2025]



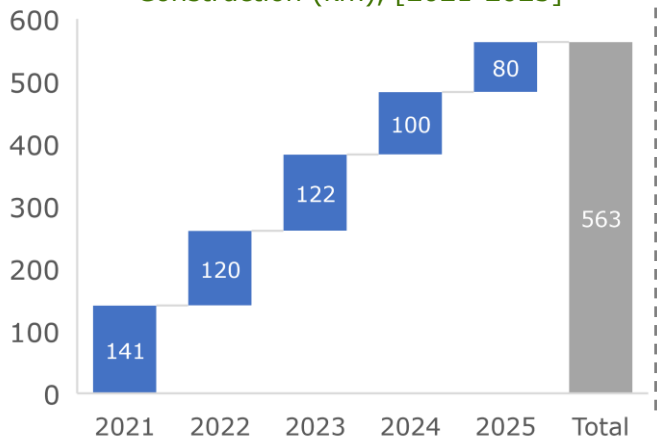
Source: EDA Thess, HAEE's analysis

Highlights

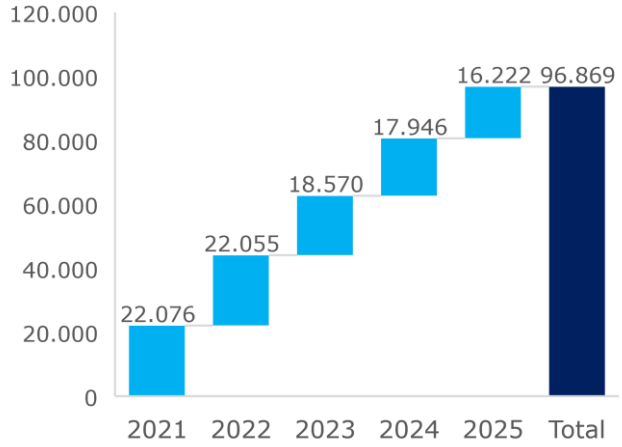
- The region of EDA THESS is the one with the biggest penetration rate, including 13 and 14 municipalities in the prefecture of Thessaloniki and Thessaly, respectively.
- The expansion of the grid includes also the supply of regions outside the medium pressure pipeline system, through CNG technology.
- The 5-year plan of EDA THESS foresees a grid expansion of 595km (330km in Thessaloniki, 265km in Thessaly) until 2025, an increase of 23% compared to 2020.
- 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 network expansion investment is estimated around 158.2 million euros, which are projected for investments in Distribution Networks.

Implementation of the Development Program 2021-2025 with an investment budget of about 132 million euros for "EDA Attikis"

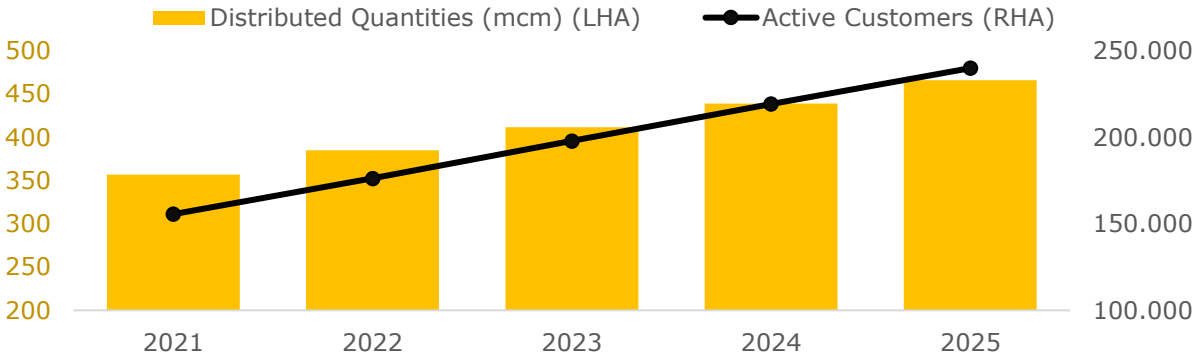
EDA Attikis 5-Years Plan: Grid Construction (km), [2021-2025]



EDA Attikis 5-Years Plan: New Connections, [2021-2025]



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



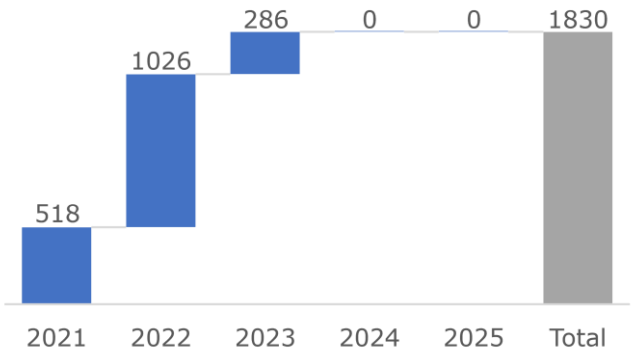
Source: EDA Attikis, HAEE's analysis

Highlights

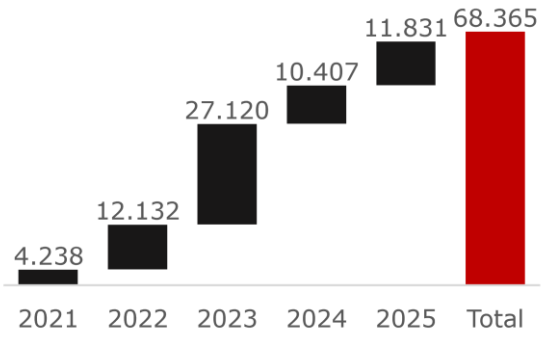
- 52 out of the total 58 municipalities in the Prefecture of Attiki are covered by the existing distribution network.
- The existing distribution network covers around 58% of the road network, where there is the basic infrastructure for further network development.
- The penetration of natural gas is at low levels (39%), while EDA Attikis has already constructed 160km of low-pressure network and targets to construct 563km more.
- The new connections are expected to be 15-20k per year, with the 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 2025, increased by 30% since 2019, while the planned investment cost will reach €132 mil.

The new Development Plan 2021-2025 of DEDA, with a total amount of 300 million euros, is anticipated to deliver natural gas to 34 cities

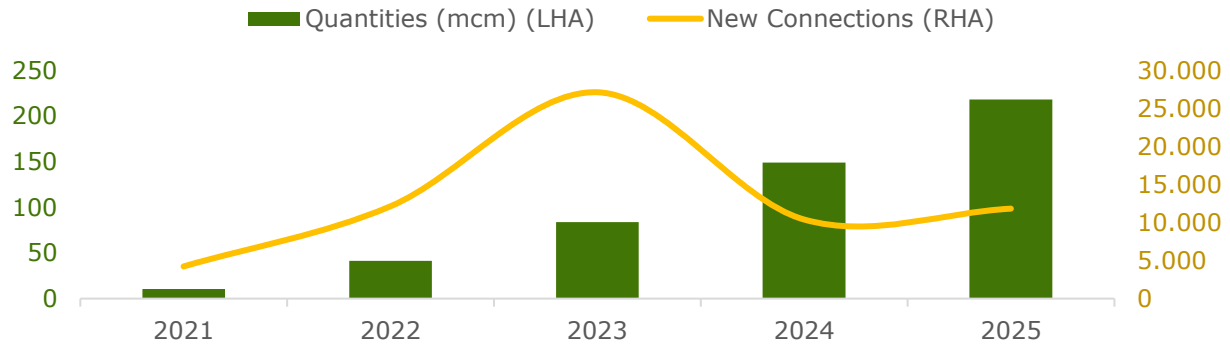
DEDA 5-Years Plan: Grid Construction (km), [2021-2025]



DEDA 5-Years Plan: New Connections, [2021-2025]



DEDA: New Connections and Distributed Quantities (mcm), [2021-2025]

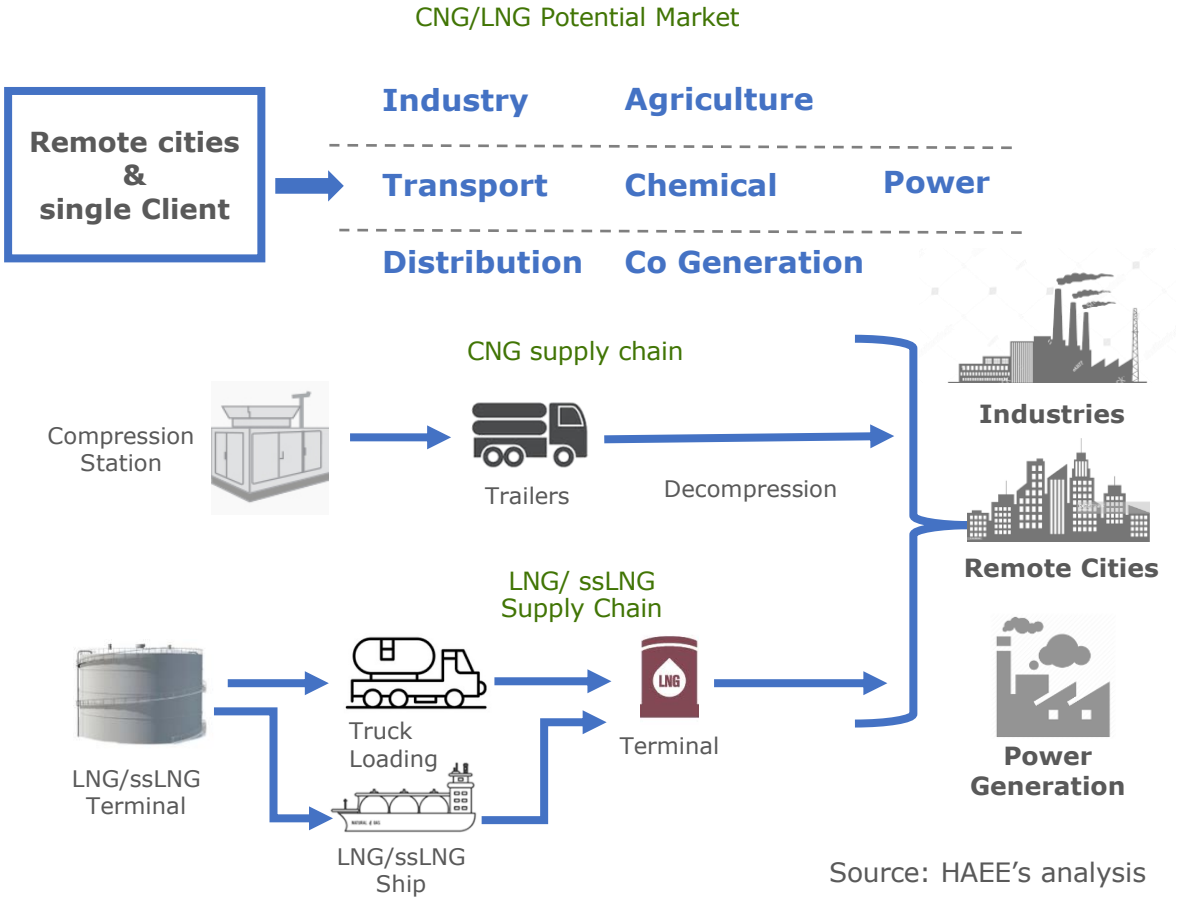


Source: DEDA, HAEE's analysis

Highlights

- DEDA has designed the most ambitious 5-year plan until 2025, compared to the announcements of the other two DSOs.
- DEDA is planning to construct 1.830km of low-pressure pipelines and more than 140 km of medium pressure pipelines in 34 cities in continental Greece.
- According to the plan natural gas will be available to almost 70k customers in comparison to less than 1k that have access nowadays.
- Based on current estimations, the distributed quantities of natural gas are expected to reach almost 500 mcm by 2025.
- In certain areas where the network expansion is not economically viable, the supply of natural gas will be achieved through LNG and CNG.

CNG, LNG and Small-Scale LNG technologies could offer reliable solutions to remote areas where 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.
- The nationwide network of gas stations, was extended with 4 new gas stations, while 16 more are under construction and will be put into operation within 2021-2022.
- DEPA and DESFA are planning to construct a small-scale LNG (ssLNG) unit and an LNG bunkering in the port of Patras aiming to supply the whole Western Greece.
- A ssLNG truck loading station is under construction in Revithousa, aiming to supply areas, by Dec 2021, where the transmission system has not yet been developed.
- A ssLNG jetty, that will be able to accommodate bunker and feeder vessels from 1,000 m3 to 28,000 m3 will start operation by Sep 2022 in Revithousa.

Huge infrastructure projects aim to gradually transform Greece to natural gas hub, and in parallel enhance 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, HAEE's analysis

Highlights

- TAP pipeline became available by December 2020, bringing 1bcm of natural gas by the first weeks of its operation, from Azerbaijan towards Europe.
- Its capacity within the European ground will be 10 bcm and an additional 5% of the initial capacity will be offered through standard short-term forward capacity products.
- Interconnector Greece-Bulgaria, with capacity of 3 bcma, is currently in the active phase while the progress continues despite the globally challenging situation.
- The Energy Ministers of Greece, Israel, and Cyprus signed the final agreement for the East-Med pipeline project in January 2020 (estimations of 10 bcm of natural gas).
- The Alexandroupolis FSRU will have a regasification capacity of 6.1 bcma and is planned to connect with the IGB interconnector in the upcoming period.

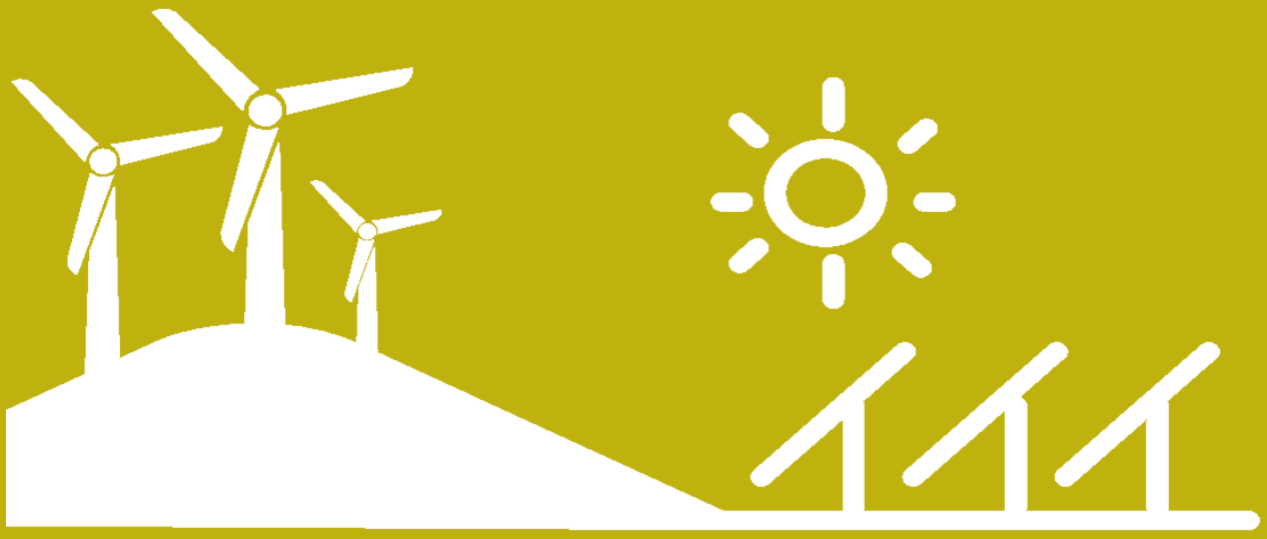
The implementation of infrastructure projects by 2026 will significantly increase the penetration of natural gas in Greece

Natural Gas infrastructure development projects in Greece that are part of ENTSO-E's Ten-Year Network Development Plan [2020]

	Project	Year
1	Interconnector Greece-Bulgaria (IGB)	2025
2	Compressor Station Kipi	2024
3	LNG terminal in northern Greece / Alexandroupolis	2022
4	Metering and Regulating Station at Alexandroupolis	2022
5	Trans Adriatic Pipeline	2020
6	Metering and Regulating station at Nea Mesimvria	2020
7	Compressor station at Nea Mesimvria (3rd unit)	2022
8	Compressor station at Nea Messimvria	2023
9	EastMed Pipeline	2025
10	Metering and Regulating station at Megalopoli	2025
11	Poseidon Pipeline	2025
12	Nea Mesimvria to Evzoni/Gevgelija pipeline (IGNM)	2022
13	South Kavala Underground Gas Storage facility	2023
14	TAP Expansion	2025
15	Komotini-Thesprotia pipeline	2024
16	Compressor Station Kipi Increment	2023
17	Metering and Regulating Station at UGS South Kavala	2023
18	Compressor station at Ambelia	2023
19	South Kavala Underground Gas Storage facility	2023
20	Interconnection North Macedonia-Greece – Nea Mesimvria to Evzoni/Gevgelija pipeline (IGNM)	2022
21	Greece - Italy interconnection	2025

Source: Eurostat, IOBE and HAEE's analysis

6. Renewable Energy Sources



Highlights

The weighted average price of May 2021 auction was **37.6 €/MWh.** The price, decreased by more than **30%** compared to the initial auction price.

3,591 MW

At the end of **2020**, **3,591 MW** of the total RES installed capacity is attributed to Wind stations

Another **1.092 MW** of RES capacity submitted to participate in the auction of May **2021**

During the Auction of **May 2021**, **none** of the **Wind parks** achieved to acquire a **tariff,** which also results in their direct participation to the wholesale market.

In **2021**, the installed RES capacity increased by **14.5%** compared to 2020 levels, reaching a total of **7,441 MW** by the end of the year.

The total **Capacity** of applications in the last two submission cycles during December 2020 and February 2021, reached **54,36** GW, surpassing NECP goal by **611%.**

During December 2020, **1,864** applications for projects with total capacity of **45.5 GW** submitted for Producer Certificates

Most of the **Wind** capacity is in **Central Greece** with a share equal to **24.9%,** while **Central Macedonia** accounts for **16.8%** of **PV** installations

The Ministry of Environment and Energy set up a **special Committee** responsible to review the licensing and regulatory framework of **storage** to be published this **June**.

Overview

European Union member states, as well as Greece, continued to increase their energy share generating from RES in 2020. RES installed capacity in Greece holds 38.3% of the energy mix, while Wind hold the biggest share. At the beginning of 2021, this grow peaked at 7,441 MW of RES installed capacity. 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.

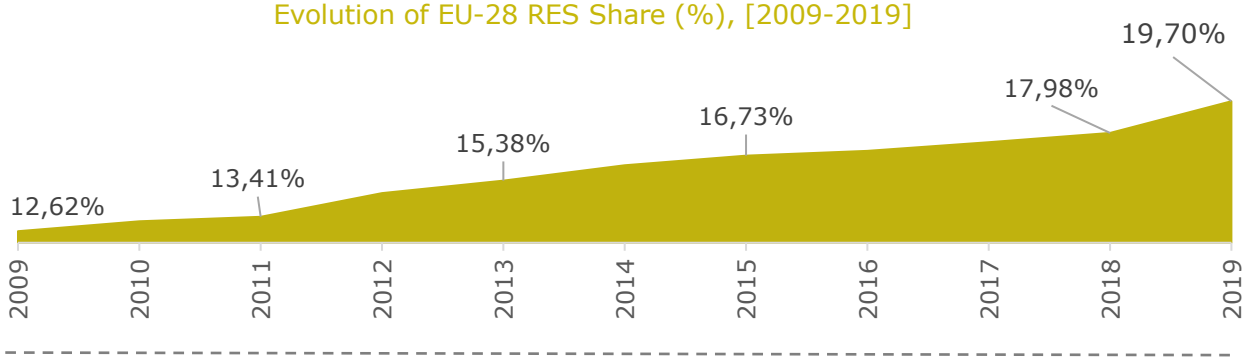
Wind remains the dominant RES in Greece, with most of the capacity located in Central Greece, while Solar production follows at the second place and compared to Wind production, shows more dispersion around the various regions in Greece. The share of FiT slightly increased during 2020, which is translated into a gradual movement towards less State-protection schemes in the RES market. The significant and constantly growing share of FiP as share of the total RES installed capacity, highlights the importance of the RES Aggregators in the wholesale market.

RES proved to be resilient to the pandemic as they increased within 2020. The growing acceptance of the need to tackle the climate crisis by reducing carbon emissions, has made renewable energy increasingly attractive to investors, constantly seeking to exploit new possibilities, such as Offshore Wind Parks and storage technologies. During 2020, new projects faced minor delays related to the progress of the construction phase. For the first time in the 20-year history of the Regulatory Authority for Energy (RAE), the largest number of applications was submitted in December Auction, both in number and in force: 1,864 new applications for projects with a total capacity of 45,5GW. The full-scale implementation of the Target Model is anticipated to take place in the first quarter of 2021, while the upcoming scheme includes significant operating costs such as, clearance charges, deviations charges and non-compliance charges

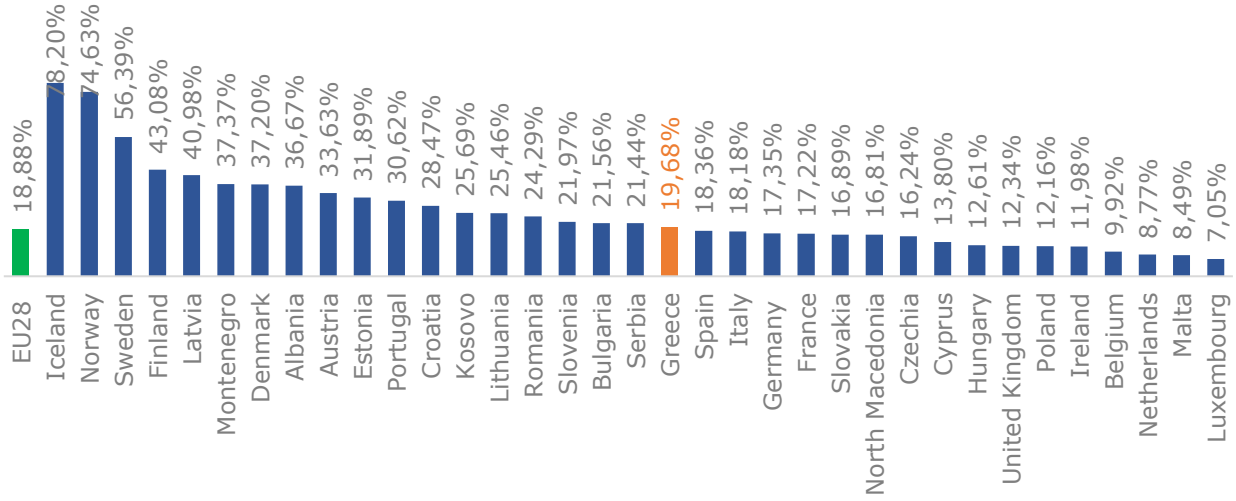
Since 2018, five auctions for Renewable Energy Projects per technology have been held by RAE. Except from the auctions per technology, three common auctions (technology neutral) have been held in 2019, 2020 and 2021. During December 2020 auction process, most of the applications considered PV projects with 1.286 applications, followed by Wind projects accounting for 423 applications. Significant amount of the applications referred to projects up to 3 MW and projects from 500 MW and above. The Ministry of Environment and Energy established a special Committee to review the relevant new licensing and regulatory framework. Their final proposal is expected by June 2021.

European Union member states, as well as Greece, continued to increase their energy share from RES in 2019

Evolution of EU-28 RES Share (%), [2009-2019]



Share of Energy from Renewable Sources in the EU Member States (%), [2019]



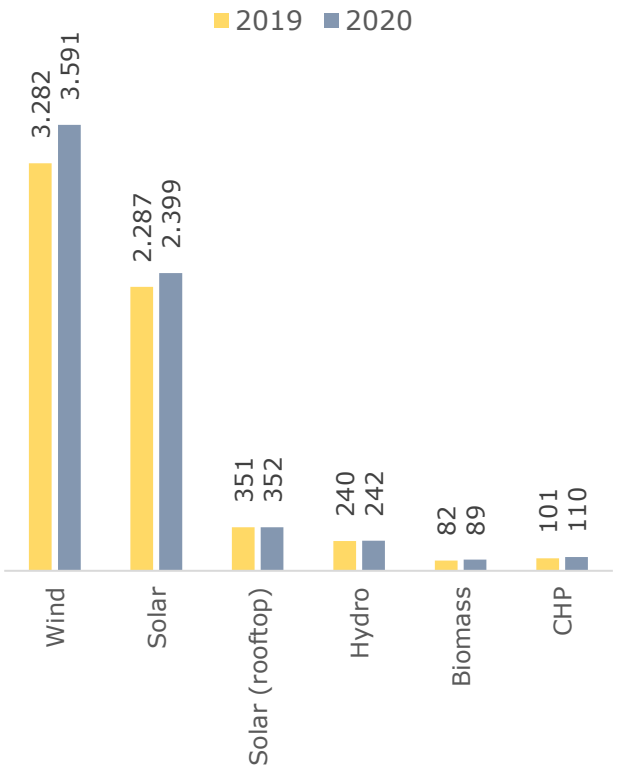
Source: Eurostat, HAEE' analysis

Highlights

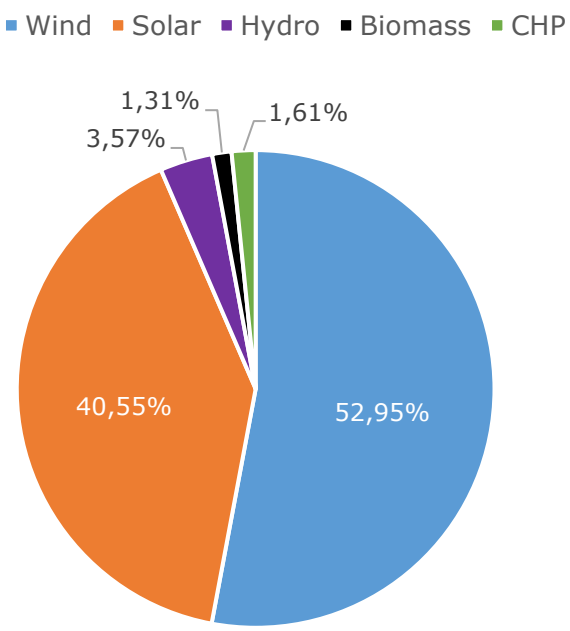
- Following the medium and long-term goals set by EU, Member States continued to increase their share of energy from RES.
- The average RES share of the EU 28 Member States has steadily been increased during the last years, from 12.6% in 2009 to 18.8% in 2019.
- Most of the EU Members have achieved their 2019 goals, nevertheless, some countries still have not reached their targets and additional efforts should be made.
- The share of energy generated from RES in Greece was 16.9% in 2017, 17.9% in 2018 and increased even more during 2019, reaching the level of 19.7%.
- According to the New National Energy and Climate Plan, by 2030, it is estimated that the total RES capacity in Greece will grow by 61-61%.

In 2020, RES capacity increased by 6.5% compared to 2019, mainly due to the significant increase of Wind capacity

Installed Capacity of RES by Type in Greece (MW), [2019 - 2020]



RES Share by Type in Greece (%) [2020]



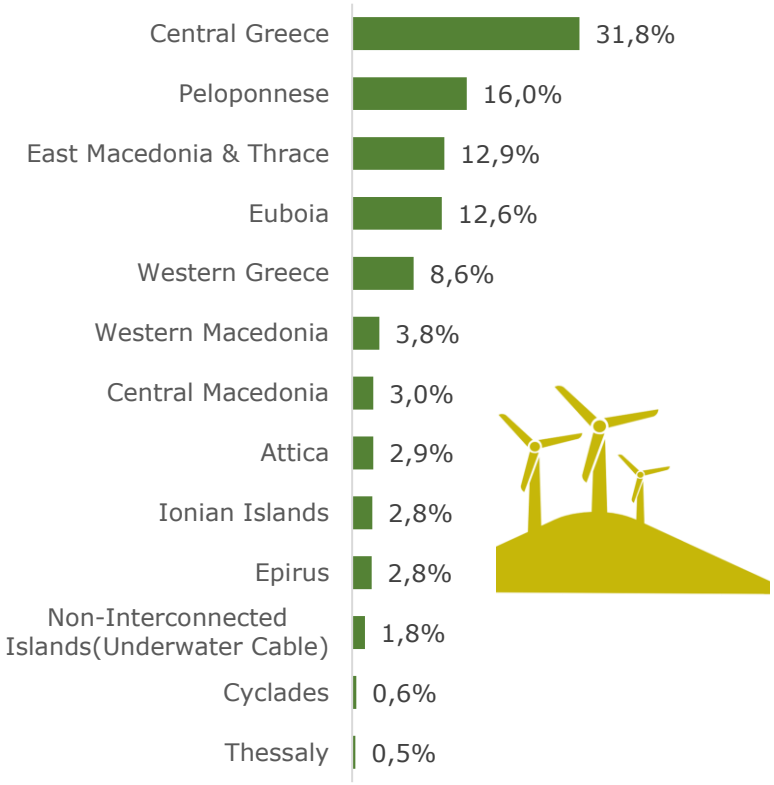
Source: DAPEEP, HAEE's analysis

Highlights

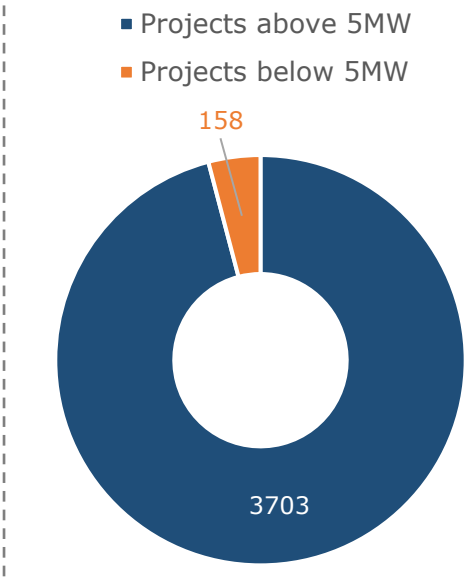
- The increase of RES capacity continued in 2019, with an annual increase of 16%, from 5,469 MW in 2018 to 6,355 MW in 2019.
- Renewable Energy Sources capacity now holds a 34.6% or 18,329 MW of the total installed capacity in the country.
- Wind capacity showed the most significant increase, from 2,555 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 at steady 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 greatest share of its capacity located in Central Greece

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



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



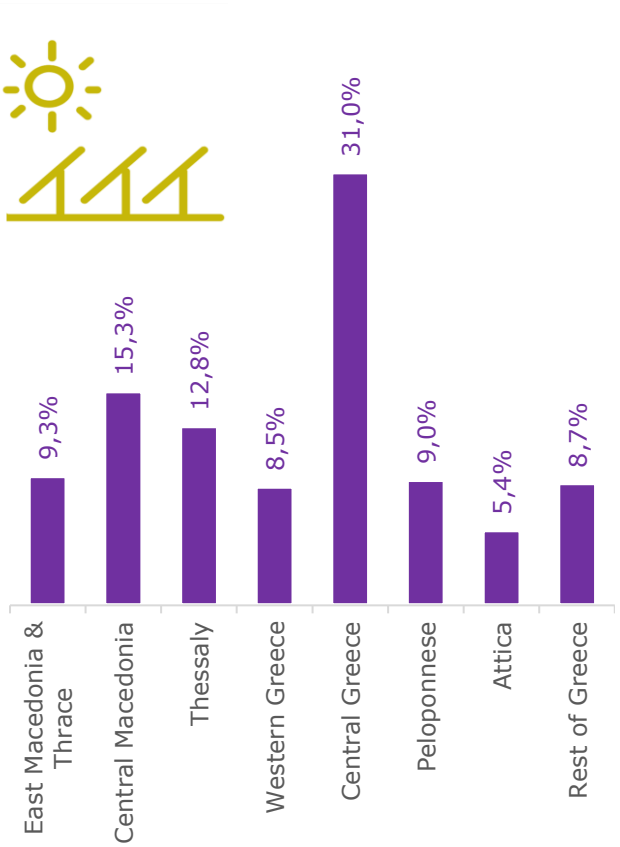
Source: DAPEEP, HAEE's analysis

Highlights

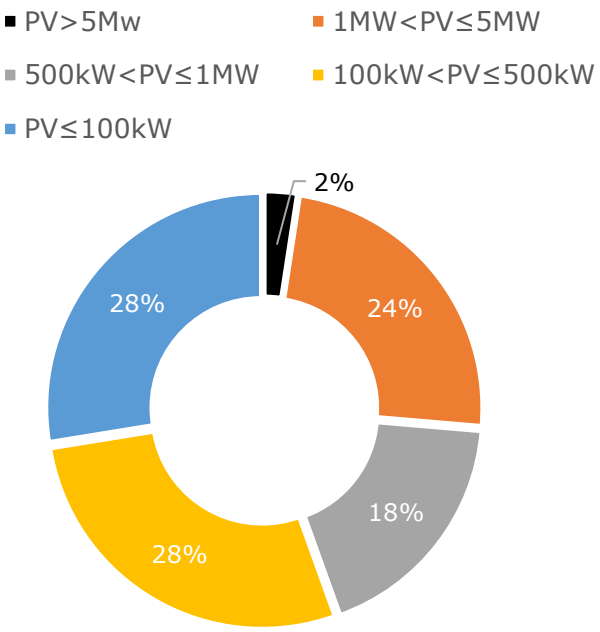
- In January 2021, the total installed Wind capacity in Greece was 3,860 MW, while many projects are now on a pending list for the Issuance of "Production Certificate".
- 31.8% of the wind capacity is located at Central Greece, while a significant amount is also installed in Peloponnese, reaching the level of 16%.
- Euboea represent 12.6%, East Macedonia and Thrace 12.9%, Western Greece 8.6% and the remaining 18.2% met at the rest of Greece.
- Most of the installed capacity concerns Projects that have capacity of at least 5 MW, 3,703 MW or 96% out of the total 3,860 MW.
- 58 MW of the total capacity correspond to small-scale Wind installations (below 5 MW). Nevertheless, compared to 2019, those projects show a significant increase.

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

Solar Capacity by Region (MW), [2020]



Installed MW per PV Station Capacity (%), [2020]



Source: HEDNO, ELETAEN, HAEE's analysis

Highlights

- PV installations are nearly evenly dispersed across the mainland Greece, with Central Greece showing the biggest concentration (31%).
- Next, Central Macedonia represents 15.3%, Thessaly 12.8%, Peloponnese 9%, Rest of Greece 8.7% and Western Greece 10.5%.
- By the end of 2020, the total installed solar capacity in Greece was 3,452 MW and only 2% of this amount was provided by large scale PVs (above 5 MW).
- Most of the solar production is attributed to small PV installations PV≤100kW and 100kW<PV≤500kW), holding a 27,8% of the total solar capacity each.
- 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.

Electricity Wholesale Market Clearing Price reached the lowest levels during April 2020, but today seems to stabilize to pre-COVID-19 prices

Evolution of Electricity Wholesale Market Clearing Price (€/MWh), [2018 – March 2021]

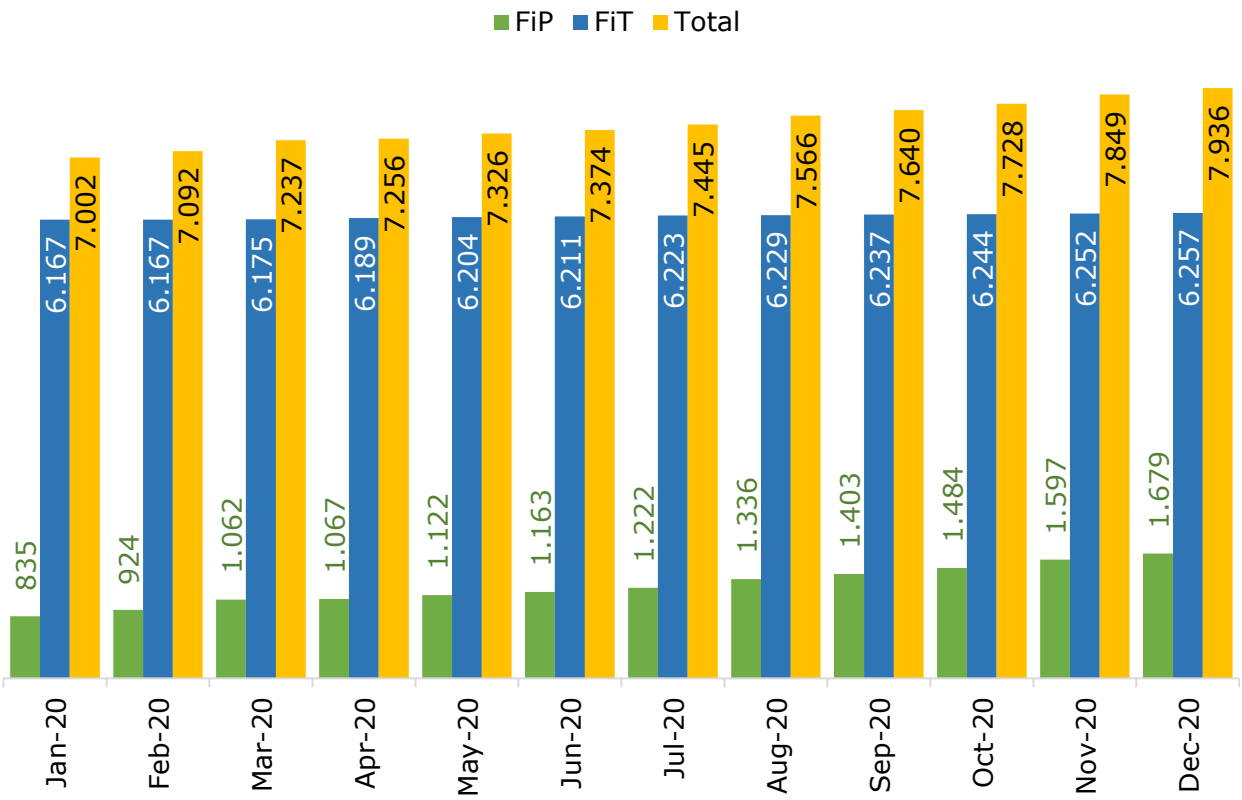
Source: HEnEx, HAEE's analysis

Highlights

- Wholesale price is calculated based on a combination of quantity and price bids offered by the producers and hourly load demand determined by the consumers.
- Market Clearing Price is the actual price that each electricity producer is being paid and each consumer pays for each Market Time Unit of the year.
- Due to the Covid-19 effect, the average electricity price for 2020 was equal to 45.06 €/MWh, decreased by 18.77 €/MWh compared to 2019 levels.
- The lowest price was recorder in April 2018 (28.5 €/MWh), while the highest price was recorded in January 2019 (75.2 €/MWh).
- The deviation between lowest and highest electricity prices was significant in 2019 and 2020 due to the pandemic, but it lately seems to return to prior levels.

The Feed-in Premium (FiP) mechanism which significantly supports RES penetration has been adopted in Greece since 2016

Size of Feed in Premium and Feed in Tariff Contracts (MW), [2020]



Source: DAPEEP, HAEE's analysis

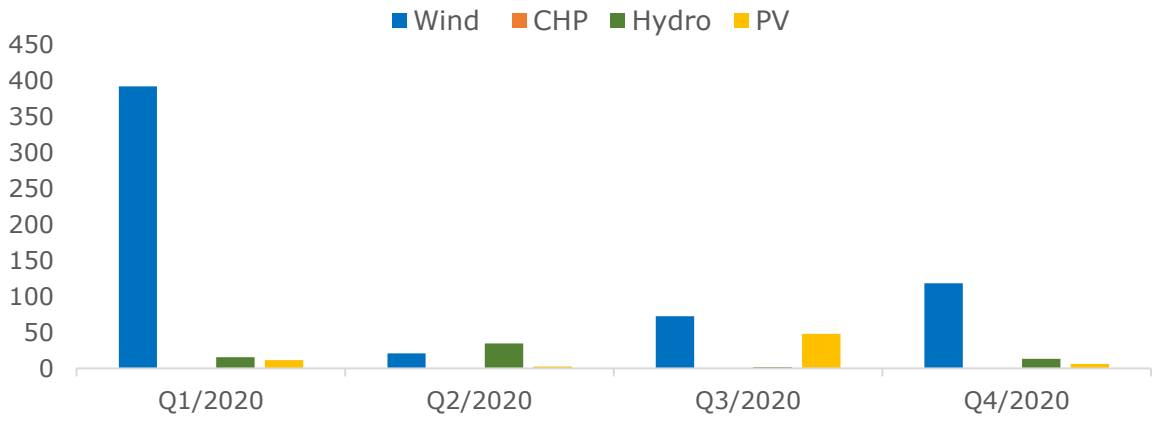
Highlights

- RES projects under the FiP mechanism 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).
- The share of FiT slightly increased during 2020, which is translated into a gradual movement towards less State-protection schemes in the RES market.
- The significant and constantly growing share of FiP as share of the total RES installed capacity, highlights the importance of the RES Aggregators in the wholesale market.
- During the Auction of May 2021, none of the Wind parks achieved to acquire a Tariff which also results in their direct participation on the wholesale market.

According to RES & GO Managing Body (DAPEEP), 739 MW correspond to the total amount of Guarantees of Origin for 2020

Guarantees of Origin Registry in Greece (MW), [2020]

	Wind	CHP	Hydro	PV	Total
Q1/2020	392,32	0	15,51	11,66	419,49
Q2/2020	20,9	0	35,02	2,98	58,90
Q3/2020	72,6	0	1,99	48,23	122,82
Q4/2020	118,45	0	13,4	6,20	138,05
TOTAL	604,27	0	65,92	69,09	**739,28**



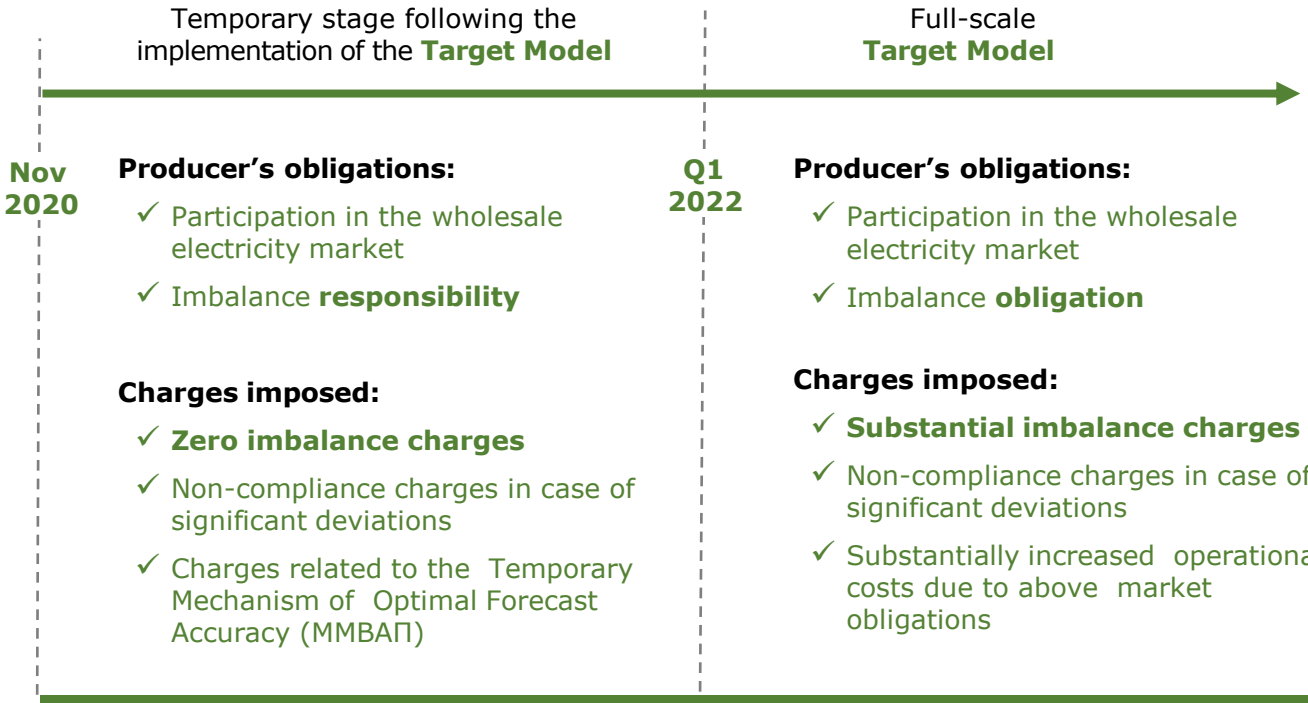
Source: DAPEEP, HAEE's analysis

Highlights

- The purpose of the Guarantees of Origin is to promote RES to the consumer, through the receipt on behalf of its supplier of the origin of the electricity which consumes.
- In Greece, the Guarantee of Origin system, is operated by RAE and DAPEEP as the issuing body, has taken the necessary steps for the international recognition.
- The new registrations reached 157 units, of which 102 PV, 37 Wind and 18 small hydroelectric, representing a total of 739 MW.
- Wind had the highest numbers, reaching to almost 400 MW for the first quarter of 2020, followed by small scale Hydro and PVs.
- The Guarantees of Origin Registry in Greece has been operating since 2010, and the total amount until May 2021, was recorded at 9.516.699 MWh.

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

New RES Framework



Full-Scale Target Model obligations and charges:

- Already in place during the current stage, for **subsidy-free** RES projects
- Following Q1 2022, will be the same for all RES projects, regardless of being subsidized or not.

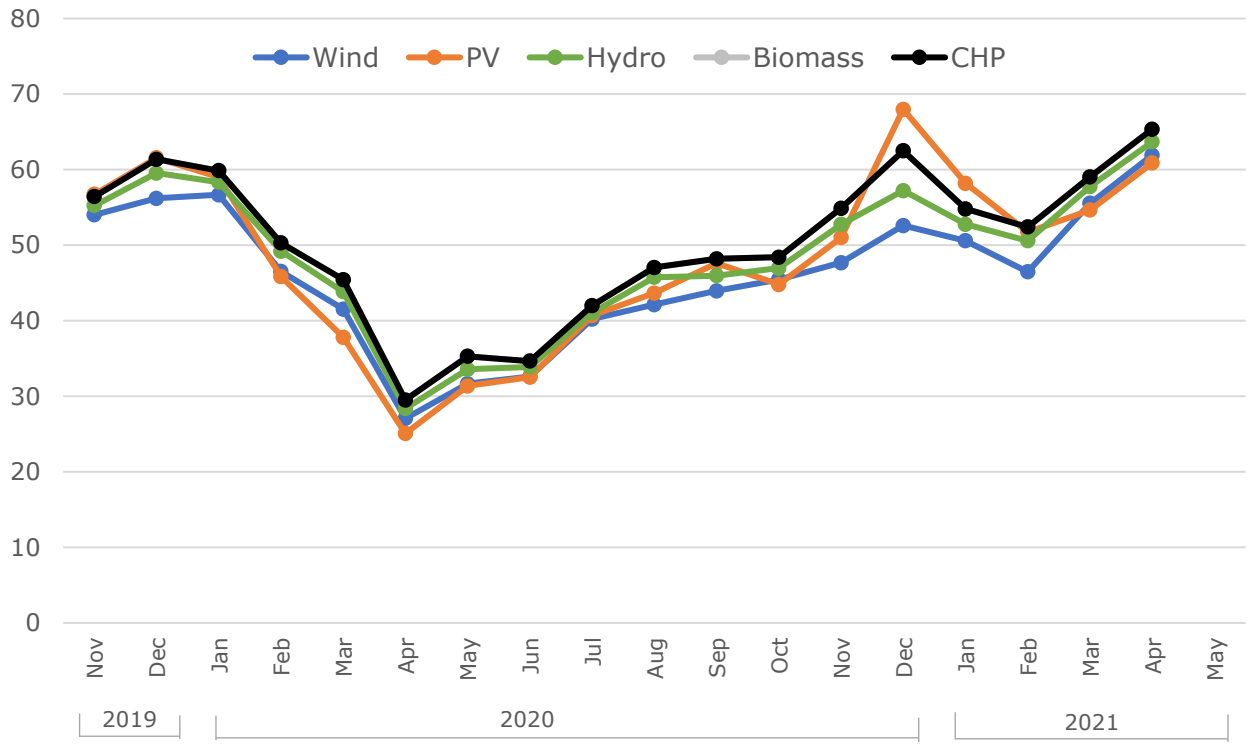
Source: HAEE's analysis

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 complete 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 Temporary Mechanism of Optimal Forecast Accuracy (ΜΜΒΑΠ) that equals 12.98 €/MWh for 2021.
- In overall, RES producers under the Sliding FiP framework, receive a premium which is the difference between the Reference Price with the monthly RMP per technology.

Reference Market Price (or ETA) is based on the hourly production of energy corresponding to the specific RES technology

Historical Data of Reference Market Price by Month (€/MWh), [Nov 2019 – May 2021]



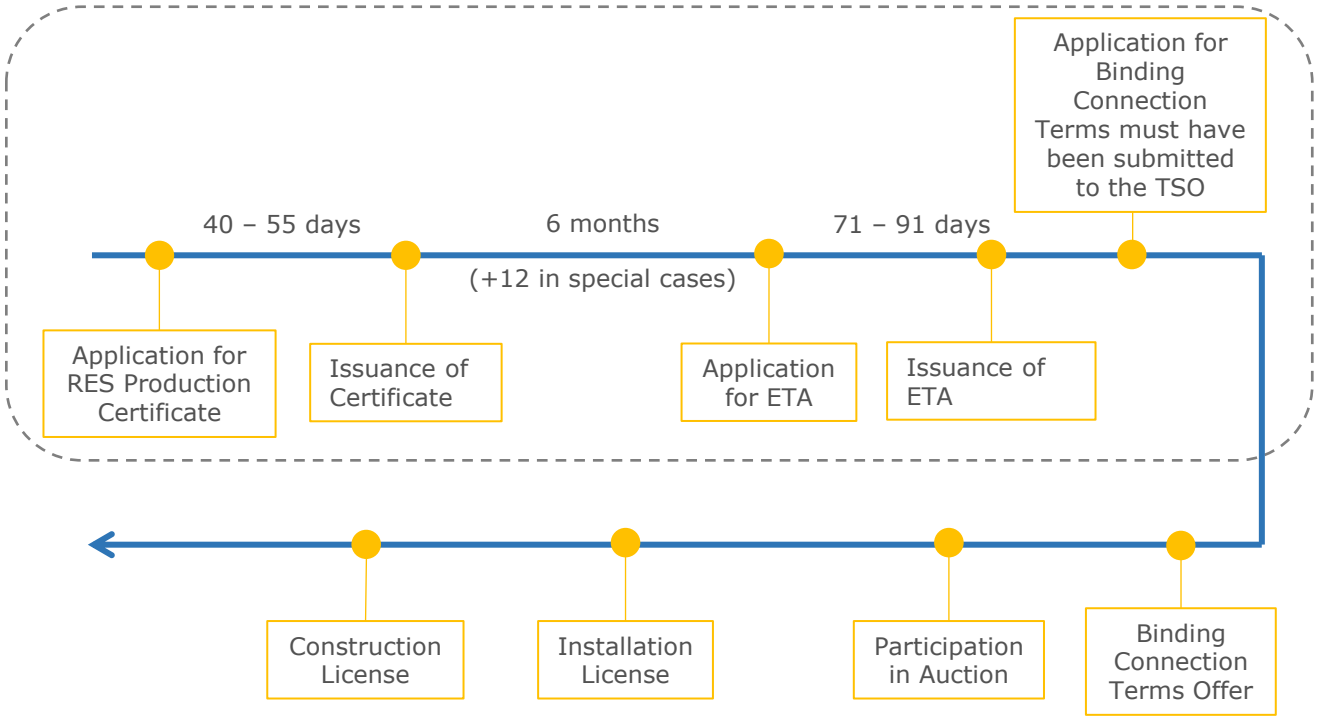
Source: HAEE's analysis

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 the Reference Market Price 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 their participation in the wholesale electricity market.

The new Energy Law accelerated the licensing procedure and invited huge investment interest providing stricter deadlines

Chart Flow of the New RES Licensing Procedure



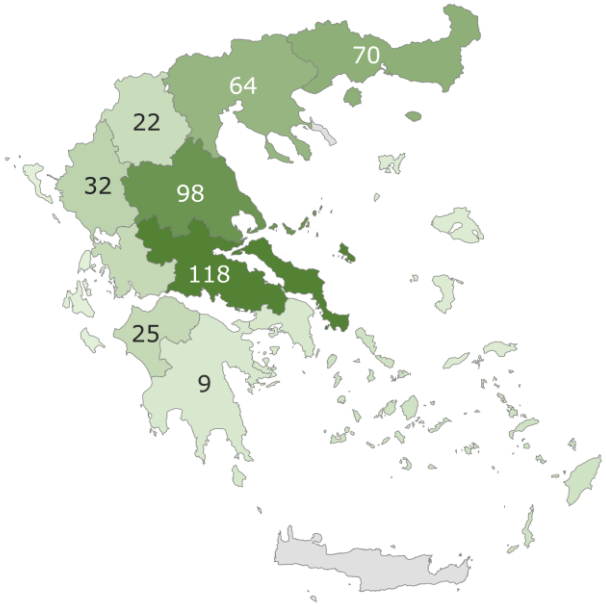
Source: HAEE's analysis

Highlights

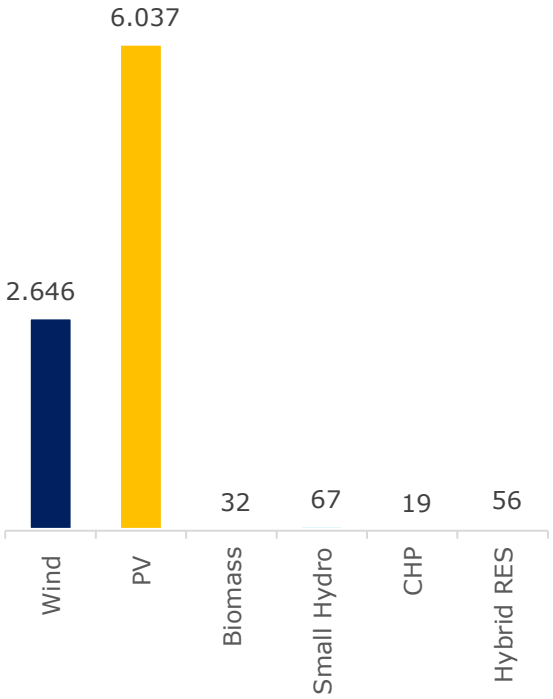
- Within 36 months after the issuance of the Certificate, the applicant must have applied for Binding Connection Terms.
- Within 6 months (+12 in special cases) after the issuance of the Certificate, the applicant must apply for ETA.
- In order to participate in the Auction, a Binding Connection Terms Offer must have been accepted.
- The detailed time obligations to reach COD status is defined by RAE in each Auction declaration.
- For the common auction of April 2020, the obligation for PVs>20MW & Wind>50MW was to reach COD within 36 months.

Great interest for RES projects remain high in Greece as delivered from the 1st submission cycle of the year of 54,36 GW

Number of RES Project Applications by Region during the Submission Cycle of February 2021



Capacity per Technology (MW), [February 2021 Submission Cycle]



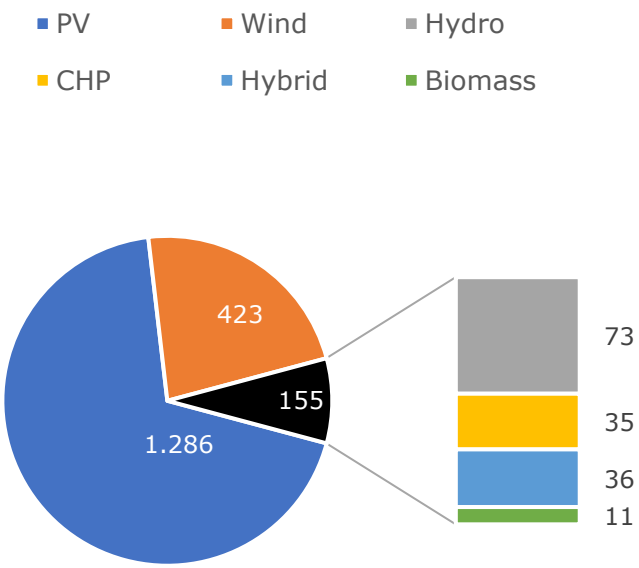
Source: DAPEEP, HAEE's analysis

Highlights

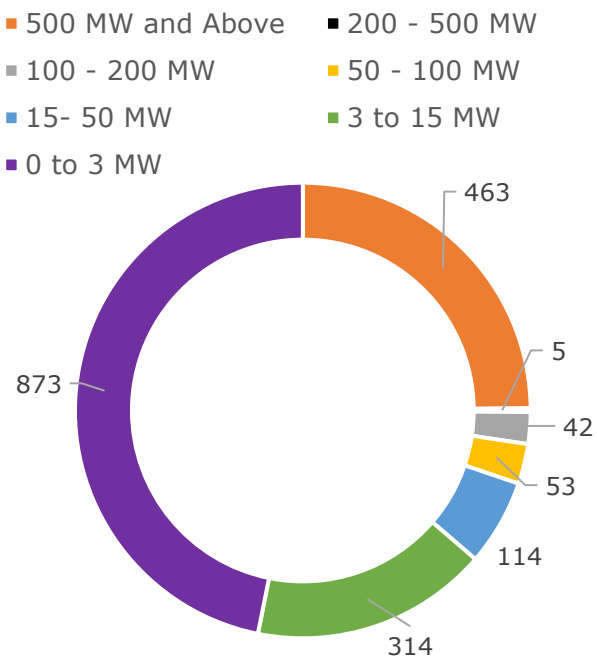
- The total Capacity of applications in the last two submission cycles during December 2020 and February 2021, reached 54,36 GW, surpassing NECP goal by 611%.
- Total applications for Production Certificate in RAE in February 2021 reached 8,86 GW, with the 68% of those accounting for PV projects.
- RES project applications are split all around Greece, with most of them being placed in Central Greece and Thessaly.
- No changes are expected to the structure of the Greek auction system, with six RES auctions (Wind and PV) by 2024 (350-MW capacity on offer at each auction).
- In effort to ensure a balance in Wind and PV project opportunities at each auction, each technology will secure no less than 30% of the total tariff agreements.

During December 2020, applications submission for the issuance of Producer Certificate was the highest in the 20-year history of RAE

Number of RES Project Applications by Region during the Submission Cycle of December 2020



Distribution of Applications (MW) during the Submission Cycle of December 2020

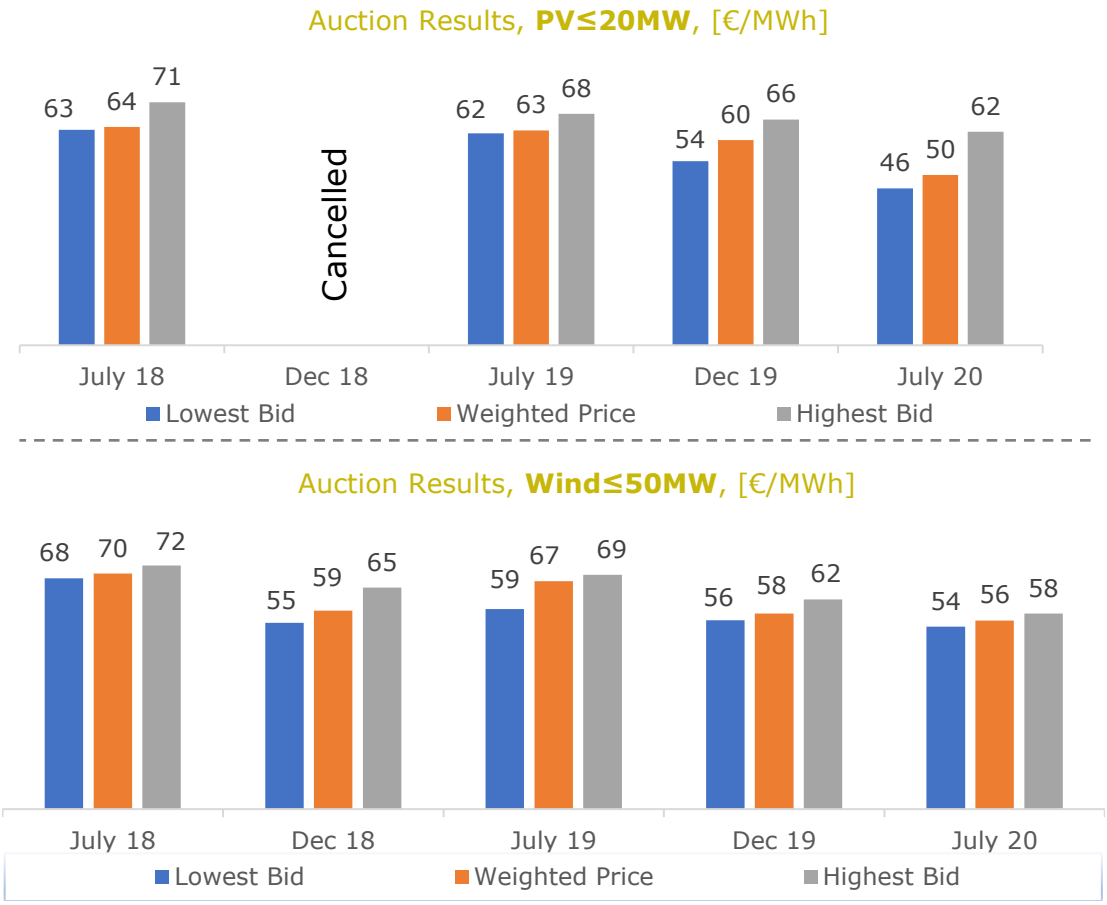


Source: HAEE's analysis

Highlights

- During December 2020, 1.864 applications were submitted for Producer Certificates considering projects with total capacity of 45,5 GW
- During the first cycle of its implementation (December 2020), the new innovative RES Information System proved to be completely secure, transparent and reliable.
- The issuance of a unique Payment Code for each application and the automatic update to RAE, eliminated bureaucracy and time required for audits.
- Most of the applications considered PV projects with 1.286 applications, followed by Wind projects accounting for 423 applications.
- At the same time, significant amount of the applications referred to projects up to 3 MW and projects from 500 MW and above.

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



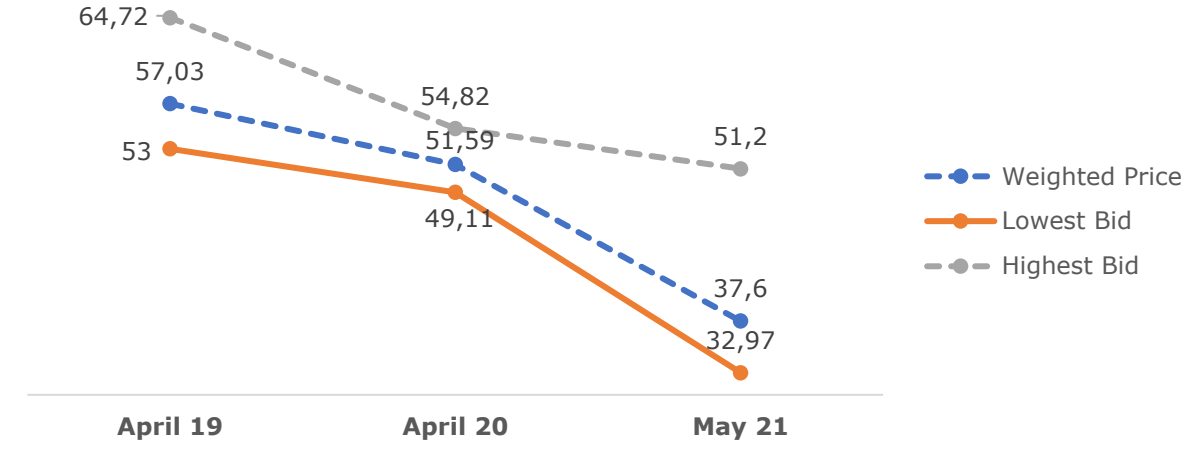
Source: RAE, HAEE's Analysis

Highlights

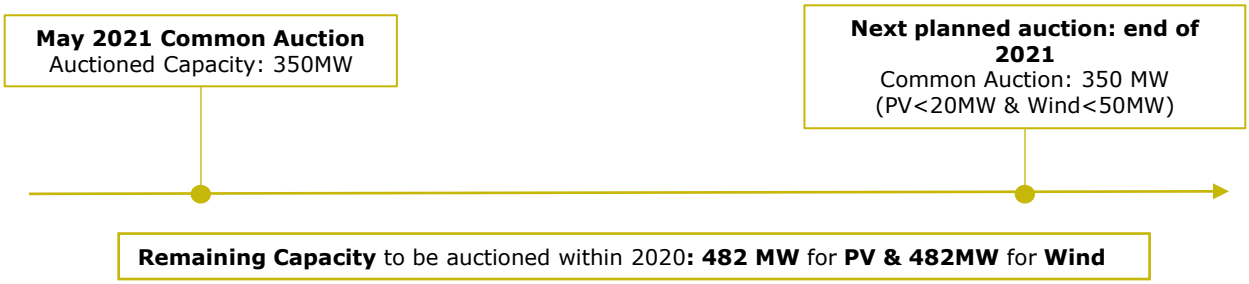
- Small PV plants (PV<1MW) are unified with the 1MW≤PV≤20MW category, creating the Category PV≤20MW which is still the case until today.
- There is only one category for Wind under auction, (Wind≤50MW) since the auction of July 2019 with a total of 1234.2 MW auctioned up to today.
- In total, 141.93 MW of solar capacity auctioned during the PV≤20 category, while 471.82MW of Wind projects auctioned during the July 2020.
- Overall, the weighted price of PVs seems to be steadily decreasing, from the 63.81 €/MWh in July 2018 to 49.81 €/MWh in July 2020.
- In the wind projects case, the price is also decreasing to 55.67 €/MWh despite the unexpected increase in the price occurred in the July 2019 auction.

Beyond auctions per technology, three common auctions (technology neutral) have been held in 2019, 2020 and 2021

Common Auction (Technology Neutral) Results, **PV≥20MW** & **Wind≥50MW** (€/MWh), [2019, 2020, 2021]



2020 Auction Timeline



Source: RAE, HAEE's Analysis

Highlights

- The common auctions for 2019 and 2020 concern Solar and Wind projects of PV≥20MW and Wind≥50MW, while in 2021 PV<20MW and Wind<50MW.
- During the May 2021 auction, the weighted average price dropped at the level of 37.6 €/MWh, which is a significant decrease of 30.2% from the starting price.
- The Reference Prices ranged from 32.97 €/MWh to 51.2 €/MWh. A total of 126 projects participated and a total of 2.188 bids were submitted.
- The prices in this category are steadily decreasing, while during the latest auction, the price dropped dramatically, with no wind park acquiring a tariff.
- The projection for the 2nd Common Auction in 2021 is that weighted average price will shrink further going close to 30-32 €/MWh

By October 2021, the institutional framework for storage will be ready, thus supporting even further investments in the energy market

Production Licenses and Applications Under Evaluation [2021]

	Pump Storage Units	Production & Storage Units	Storage Units
Number Existing Units	5	7	4
Capacity (MW)	1,487.3	261	800
Number of Applications under evaluation	8	-	69
Production License (Capacity - MW)	1,632.2	-	3,794.66
TOTAL	**3,119.5**	**261**	**4,594.66**

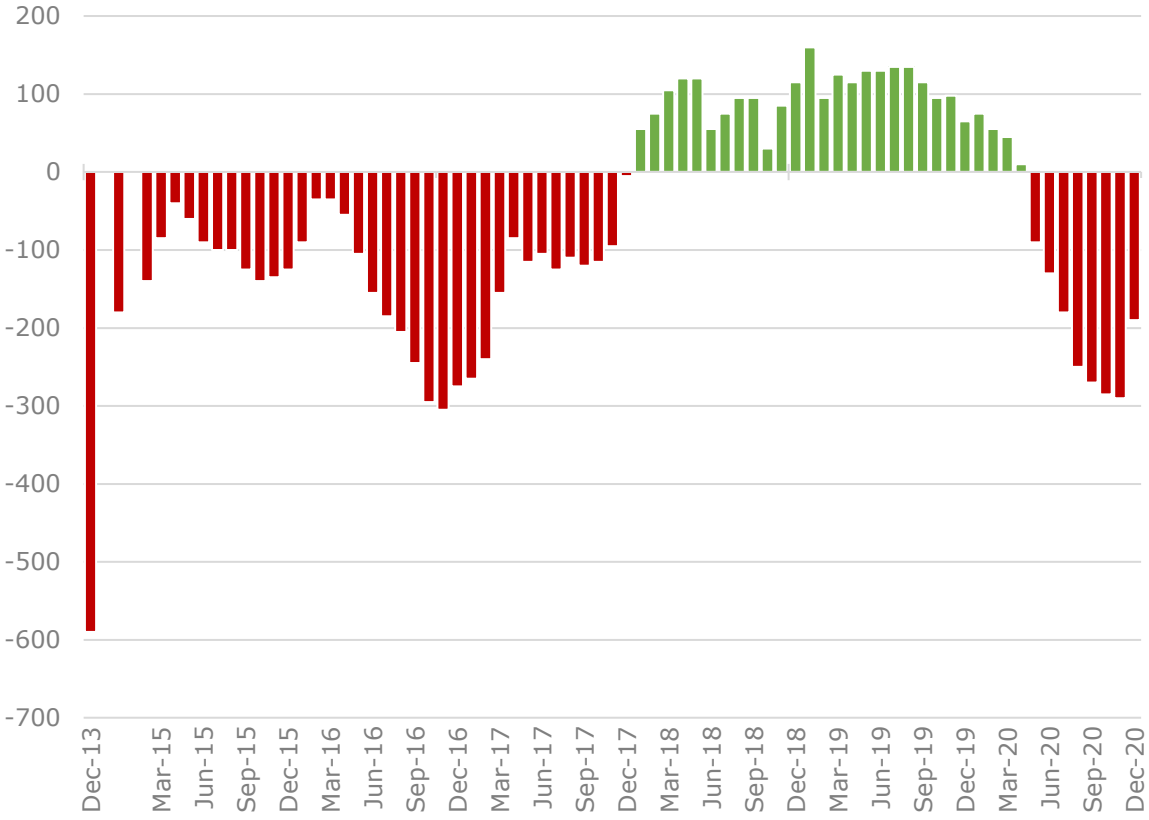
Source: HAEE's analysis

Highlights

- It is of crucial importance to include storage units in the System, hence ensuring the security of supply under the vast penetration of Renewable Energy Sources.
- The Ministry of Environment and Energy set up a special Committee responsible to review the licensing and regulatory framework of storage.
- According to the National Energy and Climate Plan, the future of RES in the electroproduction system will be built on the technology of Off-shore Wind parks.
- The development of the Off-shore Wind parks is associated to the long-term development planning of the islands' interconnections.
- RAE's proposal recommends the interconnection of all the islands with the mainland except for five islands (Erikousa, Othonoi, Kastelorizo, Gavdos and Ai-Stratis).

After many years of deficits, RES Special Account recorded a surplus of €42.4 million, and retained positive values until March 2020

Evolution of Deficits and Surpluses of RES Special Account
(Million €), [December 2013 – December 2020]



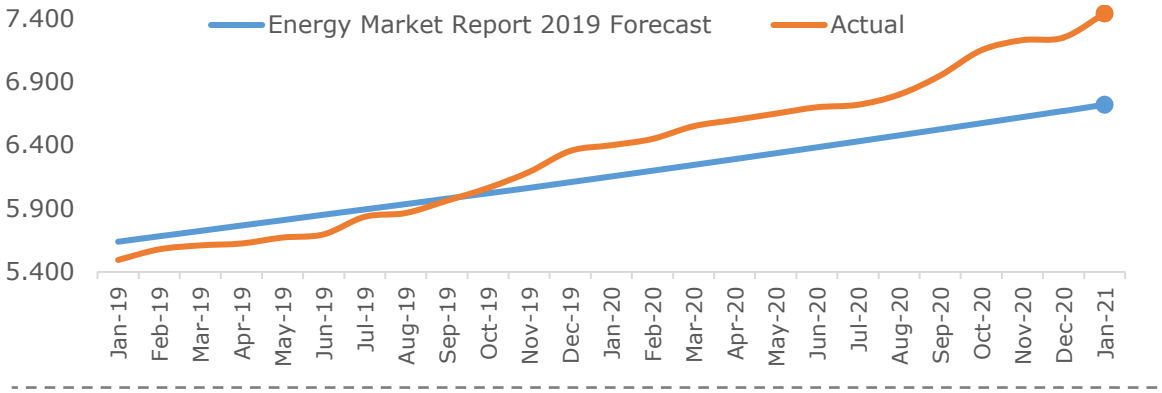
Source: DAPEEP, HAEE's analysis

Highlights

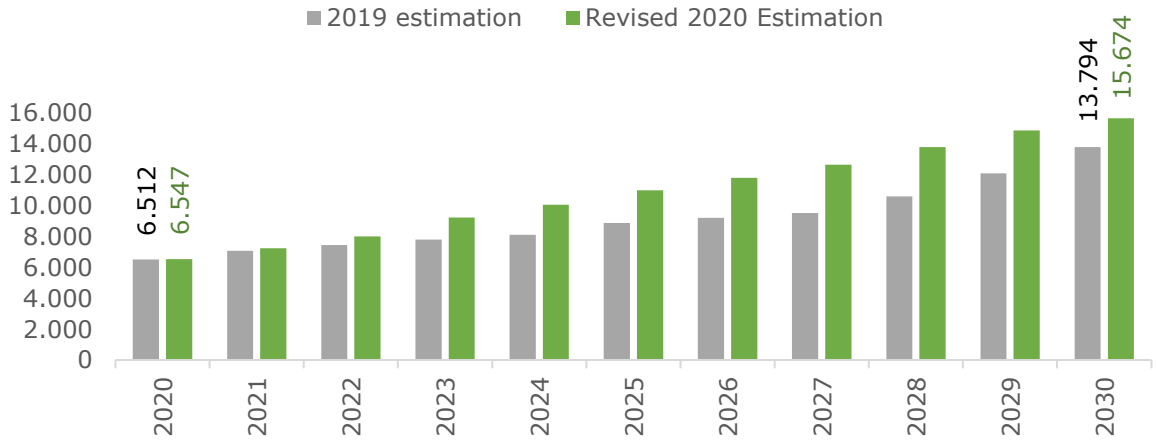
- RES Special Account is the main tool to support RES power generation, both under the past framework, but also under the new context that came into force in 2016.
- RES projects that are supported at fixed prices are reimbursed based on the relevant reference price and these payments are considered as an outflow from ELAPE.
- ELAPE ceased to be in deficit on December 2017, when the cumulative balance recorded a surplus € 42.49 million.
- On one hand, the fall of wholesale electricity prices due to dropping demand, and on the other hand the decline in natural gas prices brought ELAPE at deficits again.
- At the end of 2020, the deficit of RES Special Account was estimated at € 217.6 million cumulatively.

The levels of actual RES Installed Capacity in Greece is way above the forecasted numbers of 2019, reaching to 7,441MW in January 2021

Forecast and Actual RES Installed Capacity in Greece (MW), [2020 - 2021]



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 7,441 MW in January 2021.
- Projections presented in 2019 Greek Energy Market Report, forecasted 6,720 MW of RES installed capacity for January 2021, which is 10% 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 by 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.

7. Oil & Refining

Highlights

Diesel fuel has overtaken **unleaded gasoline** as the most consumed oil product over the past years, representing almost **37%** of the total consumption

In 2020, **aviation** and **shipping sales** have faced a **64%** decrease, being the sectors, which have been affected the most from the **pandemic**

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

During **April 2021**, oil exports recorded a quick **rebound**, given that the annual growth was equal to **134%** (from € 331.2 mil to € 775.1 mil)

As a result of the pandemic, retail prices of oil products have collapsed in **March, April and May of 2020**

The added value of the **refining sector** in the **national economy of Greece** is of great importance, accounting for the **28%** of country's exports

The sector accounting for the major part in **final oil consumption** is **transportation** both at European level - **77%,** and in Greece - **70.7%**

The average unleaded price until **May 2021** in Greece is **1.5 €/litre**, when the average price in 2009 was less than **1 €/litre**

The **tax burden** for unleaded for **2021** in Greece is close to **66%** of the final retail price while at EU level is at **60%**

Overview

The upward trend of global Oil demand continued over the last decades, yet the pandemic cease that uptrend trajectory for the first time in the last 30 years. In 2020 the global oil demand decreased by almost 8 mb/day and the projection for 2021 is to reach 96 mb/day showing slight recovery signs from Covid-19.

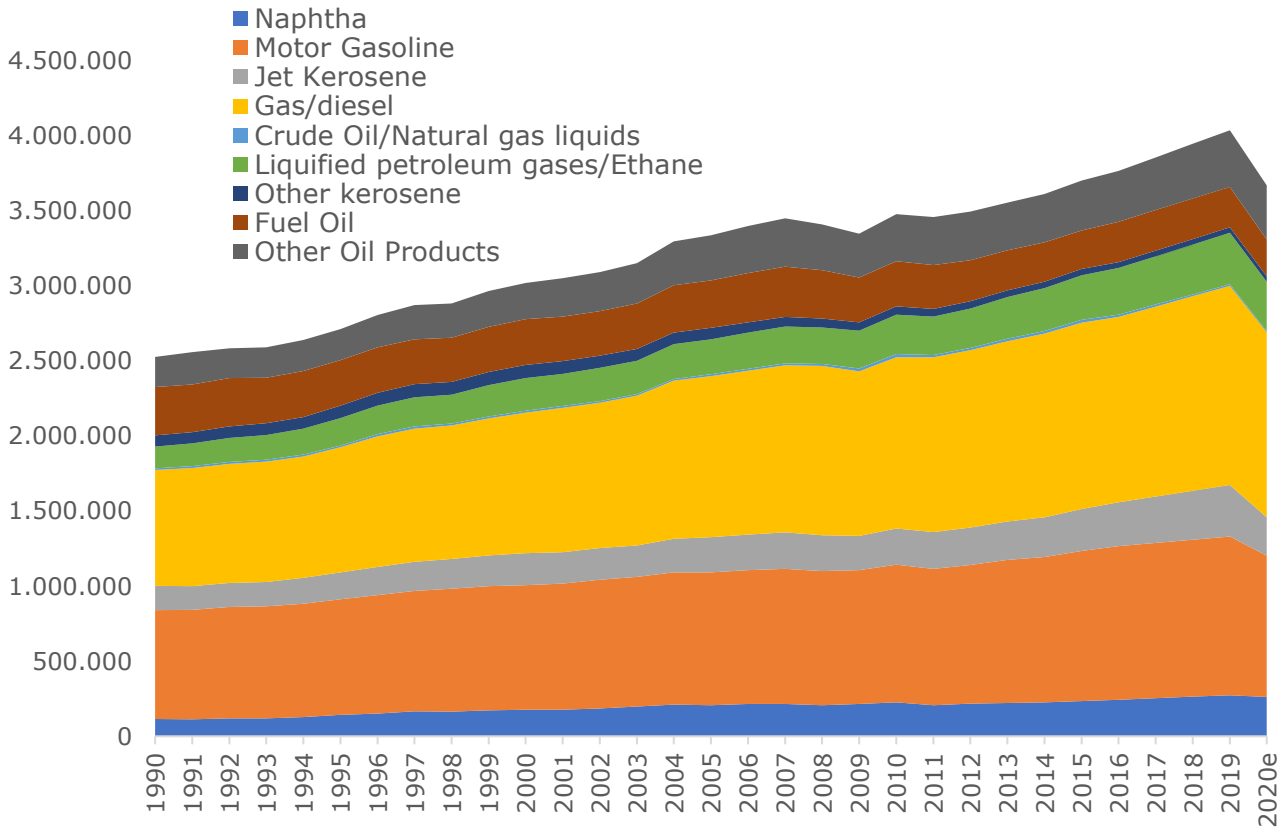
Regarding the case of Greece, Oil consumption is showing a downward tendency, after a steep rise that has been observed for the first time following the economic crisis. This downward trend is due to the Covid-19 restrictions which have affected a variety of market sectors. Moreover, the impact of Covid–19 is evident, on the aviation and shipping sector since oil sales decreased by almost 2/3 compared to 2019 levels. The Greek domestic Oil market consists of three different sectors and is dominated by two refining companies. Greece's Oil production is low, yet its refining capacity is substantial, adding extra value to the country's economy. Refining accounts for more than 28% of the total exports of the country. 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 70% in average of the Oil final consumption both at European and national level. Greece has developed trade relations with several countries to meet its crude Oil import needs.

Although the energy transition is ongoing, the country's dependency on imports of crude Oil and petroleum products remains high, as the 86.5% of energy imports is related to Oil. In this framework, retail prices of unleaded and diesel Oil are burdened by significant taxes both in Greece and at European level. Retail prices of Oil products in March, April and May 2020 reduced by almost 30%. That sharp drop brought uncertainty to the upstream Oil investments, where major investors considered to withdraw their interest.

Until May 2021, the retail prices for the two major oil products (Oil & Diesel) have increased by 20% and prices seem to face a rebound from the troubles that pandemic had brought. Finally, over the following years, refining sector is expected to adopt new low-carbon technologies, mitigating climate change. Thus, future refineries are expected to become hubs for the production and distribution of low-emission products and raw material.

Global oil consumption dropped by 9% in 2020, mainly driven by the implemented restrictions following the breakout of the pandemic

Oil Products Consumption Globally (thousand tons), [1990-2020]



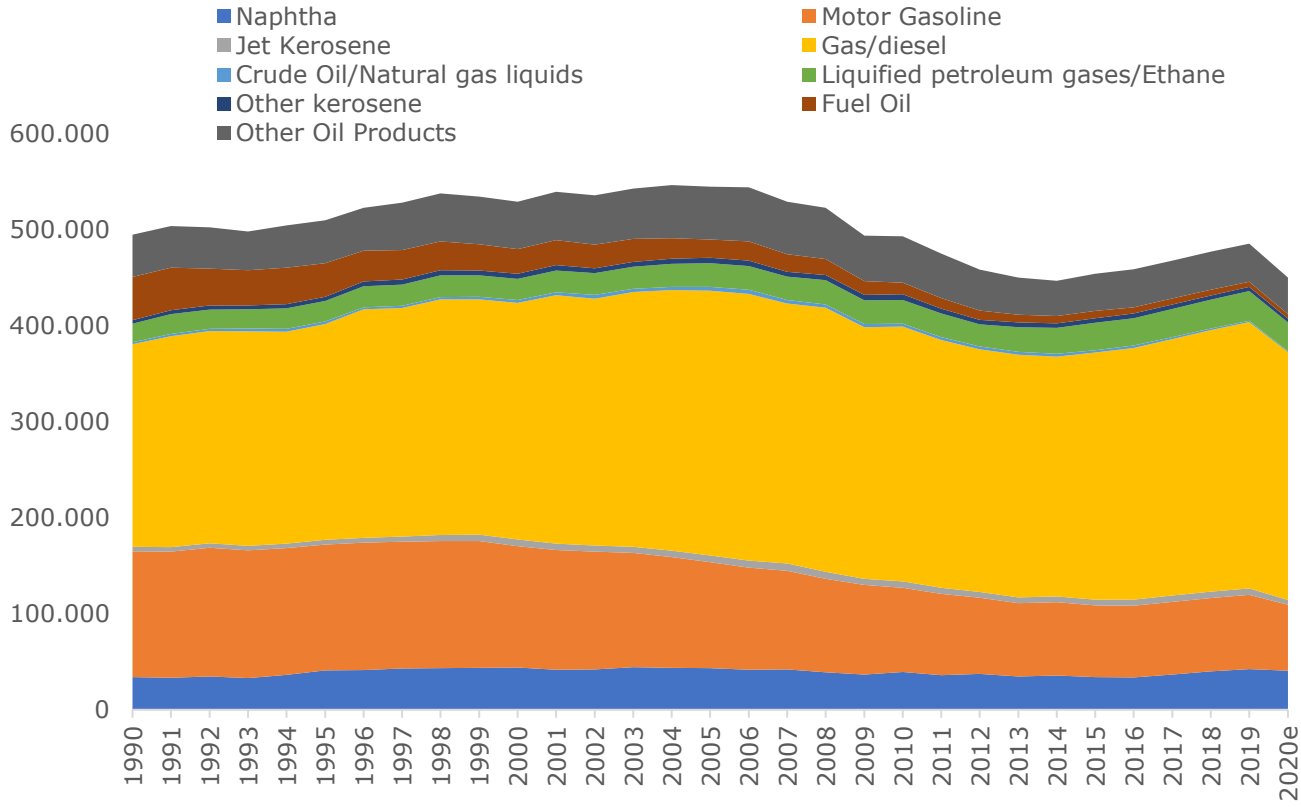
Source: IEA, HAEE's analysis

Highlights

- Worldwide Oil products consumption since 1990 is heavily dominated by gas/diesel motor gasoline and fuel oil.
- The upward trend in the global oil products consumption has been stopped for the first time in the past 30 years, as a result of the pandemic.
- Covid-19 has negatively affected the global Oil demand, since consumption was almost 8 mb/d lower in 2020 compared to 2019 levels.
- As result of the pandemic the West Texas Intermediate (WTI) recorded negative prices for the first time in history.
- Given that, Oil producers are paying buyers to take the commodity off their hands over fears that storage capacity could run out.

Oil consumption in the European Union declined as well, with gas oil and diesel oil representing almost 50% of the total consumption

Oil Products Consumption in the EU 28 (thousand tons), [1990-2020]



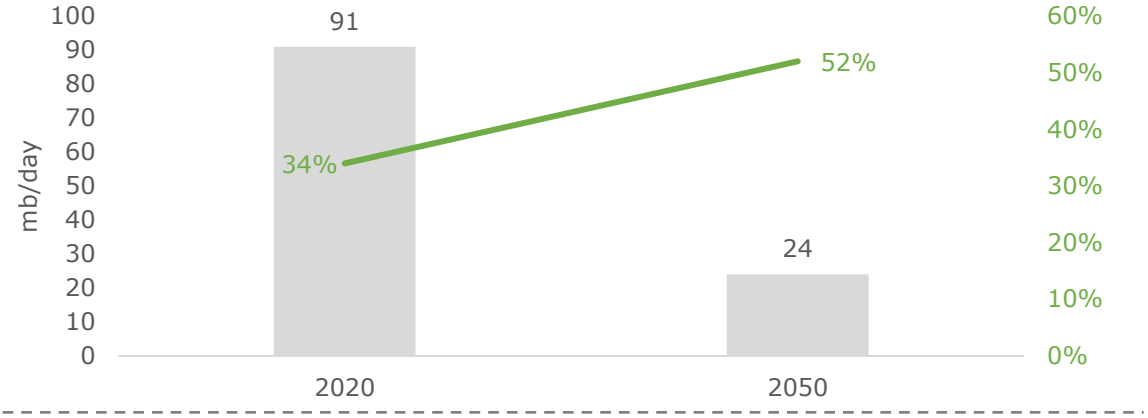
Source: IEA, HAEE's Analysis

Highlights

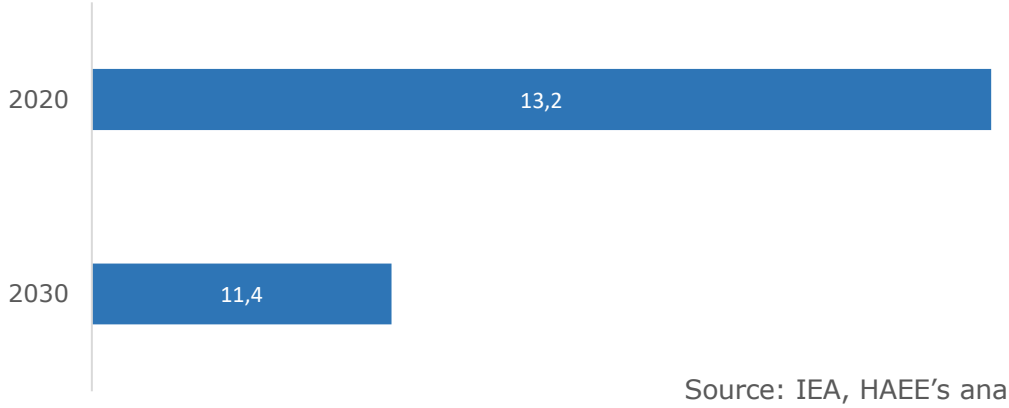
- For decades, crude Oil and petroleum products accounted for the largest share in gross energy consumption in the EU-28.
- Despite decreasing production and consumption in the EU over recent years, crude Oil and its derived products remain the largest contributors to energy consumption.
- Historically, the major oil imports in Europe come from Russia, Norway, Iraq, Kazakhstan and Saudi Arabia.
- The aviation sector has struggled the most during the pandemic, with almost 25% decrease of the demand compared to 2019 levels.
- In 2020, motor gasoline and gas/diesel consumption decreased by almost 11% and 7%, respectively.

The Net Zero Pathway towards 2050, will affect dramatically the Oil sector, where Global Oil supply is expected to decline by 75%

Global Oil Supply (mb/day) & OPEC Share (%), [2020-2050]



Oil sector jobs in the net zero pathway (million jobs), [2020-2030]

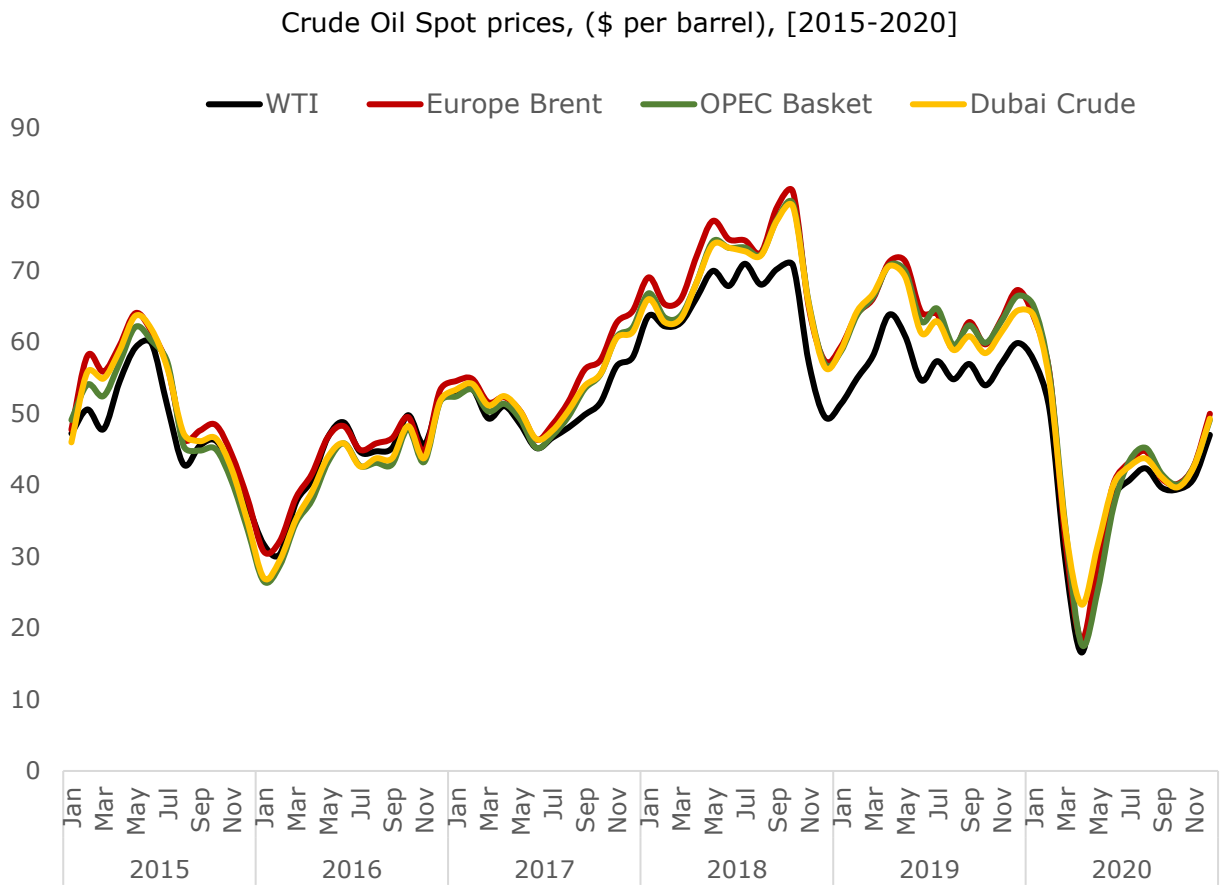


Source: IEA, HAEE's analysis

Highlights

- Global Oil supply is expected to shrink at around 24 mb/day in 2050, causing permanent loss of several job positions.
- Specifically, oil sector is anticipated to lose 1.8 million jobs until 2030, as new developments are expected to come to a halt.
- Given the majority of these jobs are well paid, structural changes can cause shocks for the local communities.
- Moreover, the OPEC Oil supply share is expected to be increased by 18% globally in 2050, reaching 52%, an all-time high share.
- Due to the competitiveness of the Oil supply of OPEC countries as supply will become increasingly concentrated in a small number of low-cost producers.

As a result of the pandemic, Crude Oil spot prices collapsed in April 2020, reaching historical-low levels



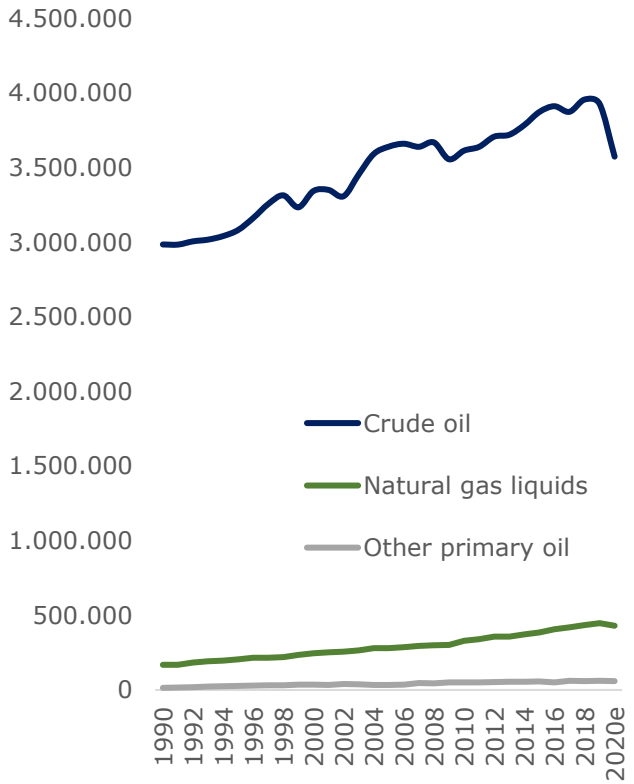
Source: EIA, HAEE's Analysis

Highlights

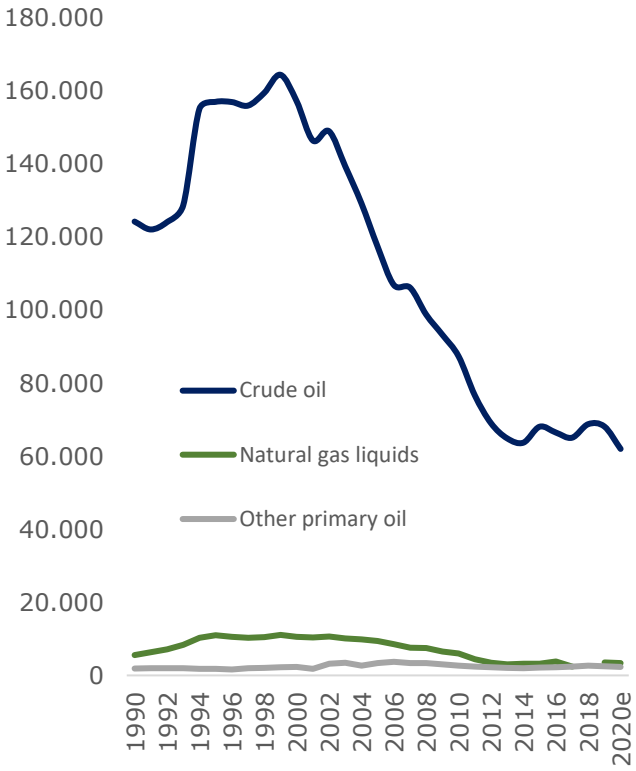
- The Oil sector faced an unprecedented blow during 2020, mainly hitting oil-exporting countries, where the fossil fuel industry is facing a process of structural decline
- From January 2020 to April 2020, as reflected by the 4th major crude oil indices, crude Oil spot prices sharply decreased, from $60 to $20 per barrel, on average.
- During the following months, the sharp increase in prices support the projection of quick rebound that may bring prices close to 2018 levels.
- Considering, 2021 the projections for crude futures have settled the Brent at 68 $/bbl and 65 $/bbl for WTI.
- With Covid-19, an already volatile market has reached a breaking point, highlighting the drawbacks of high dependence on non-renewable resources.

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), [1990-2020]



Oil Production - Crude and Other Products in the EU 28 (thousand tons), [1990-2020]



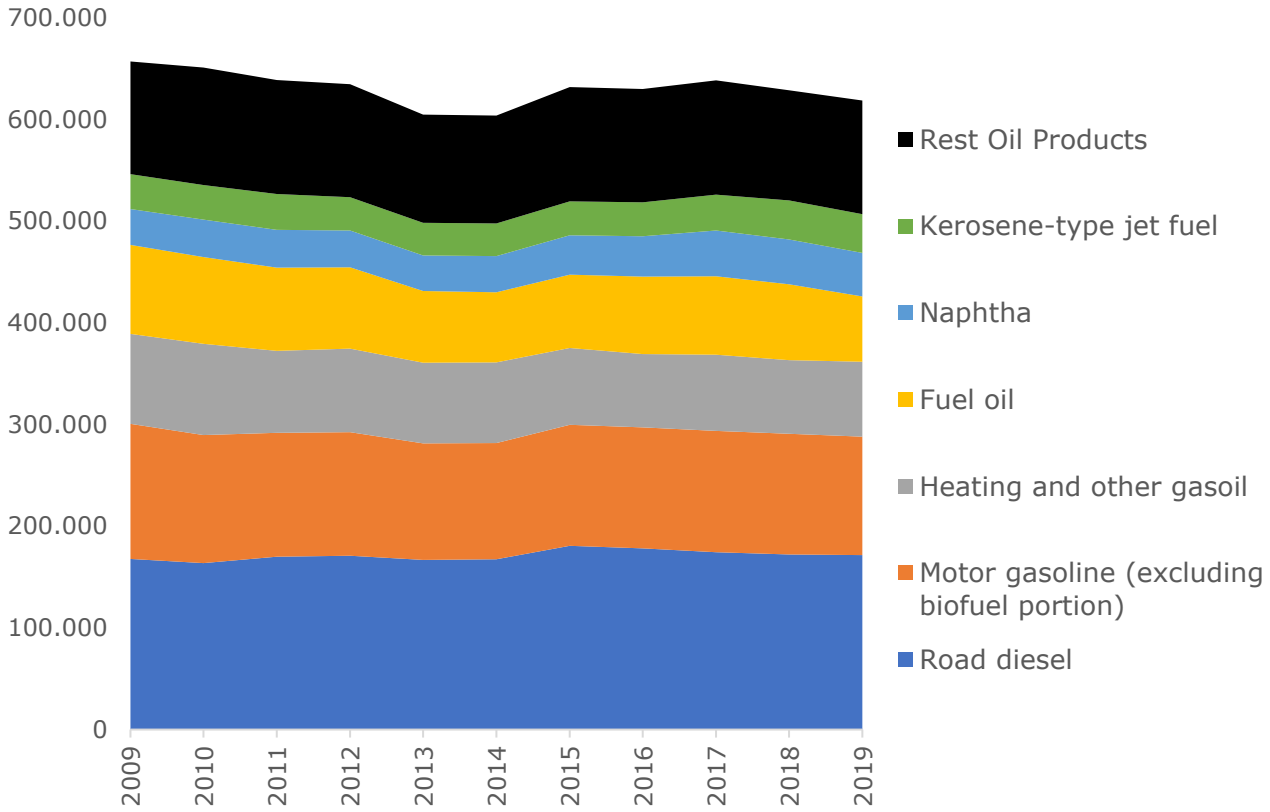
Source: IEA, HAEE's analysis

Highlights

- The Global Oil production was expected to rise in 2020 but due to the pandemic and according to recent estimations, the decrease was equal to 8.0 mb/day.
- In May 2020, the OPEC+ countries along with the United States have agreed to reduce oil production by 12 mb/d.
- International Energy Agency, estimates an increase in production by 5 mb/d, compared to 2020 levels.
- The production of crude Oil at EU level has been decreasing steadily since 2000, to reach less than 62 million tons in 2020.
- 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), [2009-2019]



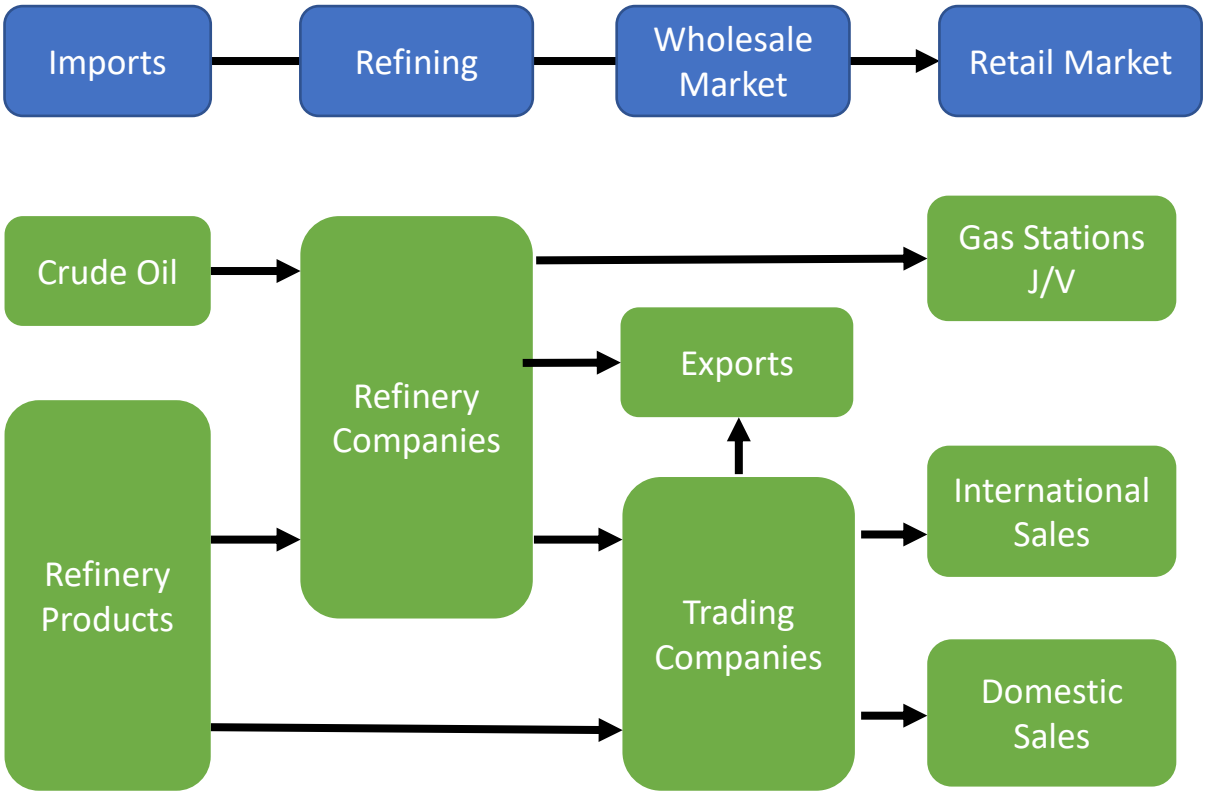
Source: Eurostat, HAEE's analysis

Highlights

- 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 618 million tons of oil products in 2019, observing a slight decrease of 3% compared to 2017.
- The main output of the European Union refineries for 2019 is road diesel, with a production of 172 million tons.
- Motor gasoline is the second major output from the refineries, representing 19% of the total production while fuel oil production was more than 10% of the total.
- Heating oil, Naphtha, and Jet-fuel kerosene production was 72 million tons, 44 million tons and 38 million tons, respectively.

Refining sector has an unquestioned beneficiary role to the Greek economy, contributing with 28% of country's exports

Domestic Petroleum Products Market Structure



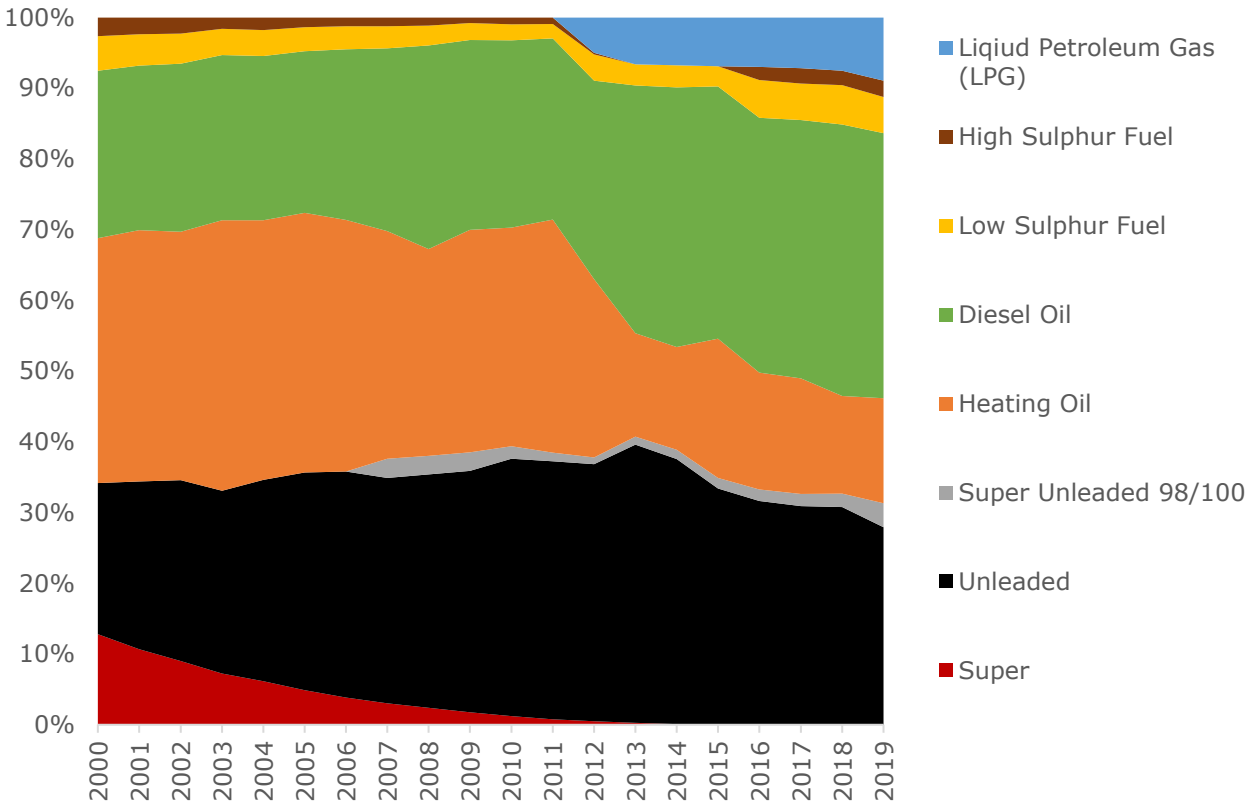
Source: IOBE, HAEE's analysis

Highlights

- The Greek petroleum products market is divided to three main sections: Main Refining Companies, wholesale market companies and retailers.
- Refining sector consists of four refineries, which are owned by two companies, HELPE and Motor Oil.
- The added value of the refining sector in the national economy of Greece is of great importance, accounting for the 28% of country's exports.
- Despite the economic crisis, since 2010, the petroleum products exports have been doubled, reaching €9.1 bn in 2019.
- During April 2021, oil exports recorded a quick rebound, given that the annual growth was equal to 134% (from € 331.2 mil to € 775.1 mil).

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 (%), [2000-2019]



Source: Elstat, HAEE's analysis

Highlights

- The financial crisis has totally changed the shape of the oil consumption in Greece, with a decline of 35% from 2009 to 2013.
- The consumption is picking up the last years to reach slightly more than 7.2 billion tons in 2019.
- Diesel has overcome 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 sector of petroleum products in Greece is highly dependent to crude oil imports reaching 24.1 million toe

Greek Energy Balance of Petroleum Products (Million toe), [2018]

	Crude Oil	Gasoline	Diesel	Fuel Oil	Other
Primary Production	0.2	:	:	:	0
Imports	24.1	0.4	1	1.6	6.5
Exports	0.2	4.7	7.7	3.7	4.1
Gross Available Energy	24.1	-4.2	-6.7	-1.9	2.3
Maritime Sales	:	0	0.3	1.8	0
Gross Domestic Consumption	24.1	-4.2	-7	-3.7	2.3
Aviation Sales	0	0	0	0	1.1
Total Energy Supply	24.1	-4.2	-7	-3.7	1.2
Electricity Production	0	0	0.3	0.8	0.2
Final Energy Consumption	0	2.4	3.8	0.5	1.3
Final Non-Energy Consumption	0	0	0	0	0.4

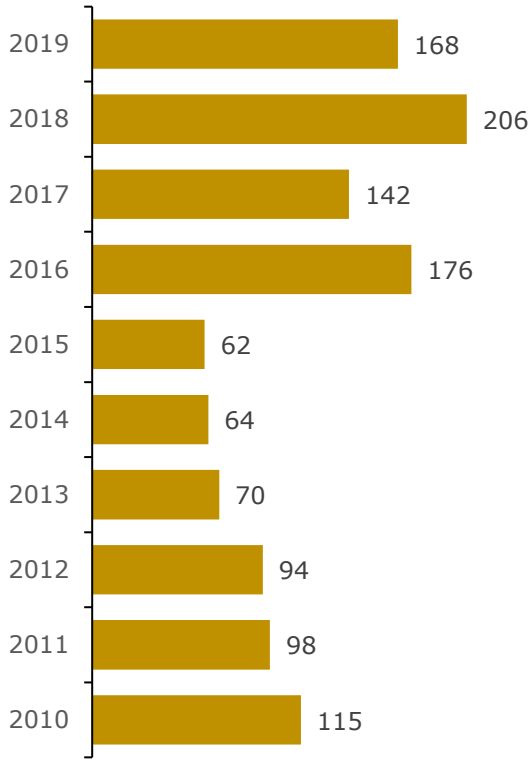
Source: IOBE, HAEE's analysis

Highlights

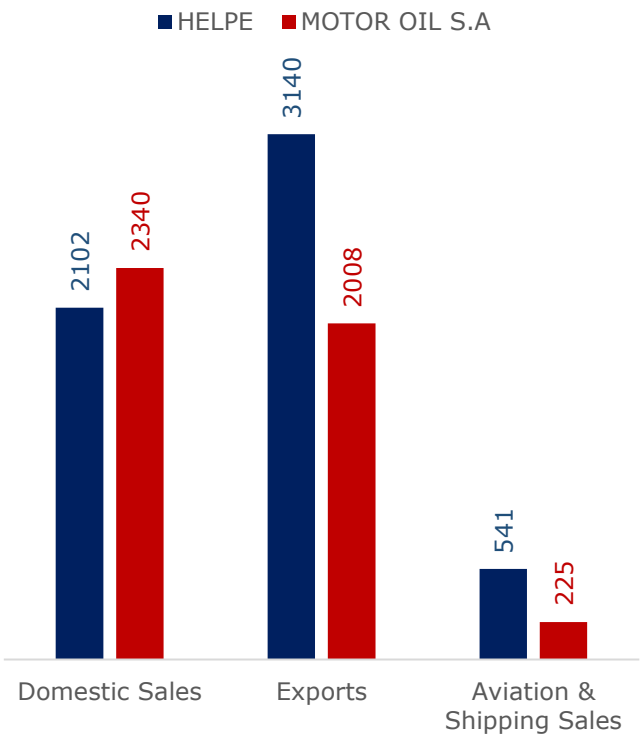
- Crude Oil accounts for the 71.5% of the total petroleum products imports, while diesel oil accounts for 38% of the total petroleum products exports.
- Petroleum products share for electricity production is quite low reaching 1.3 million toe since those are mainly used in non-interconnected islands.
- Petroleum refineries is an industry that over the years, has been plagued with challenges such as high cost of crude oil supply, lower margins and lower demand.
- As a result, revenues have been declining over the years, with manufacturing operations expected to be defunct in the medium term.
- Another reason for the industry's decline is the EU's intension to stop funding all oil, gas and coal projects by the end of 2021.

In 2020, aviation and shipping sales have faced a 64% decrease, being the sectors, which have been affected the most from the pandemic

Crude Oil Production Greece (thousand tons), [2010-2019]



Total Refining Sales, (million €), [2020]



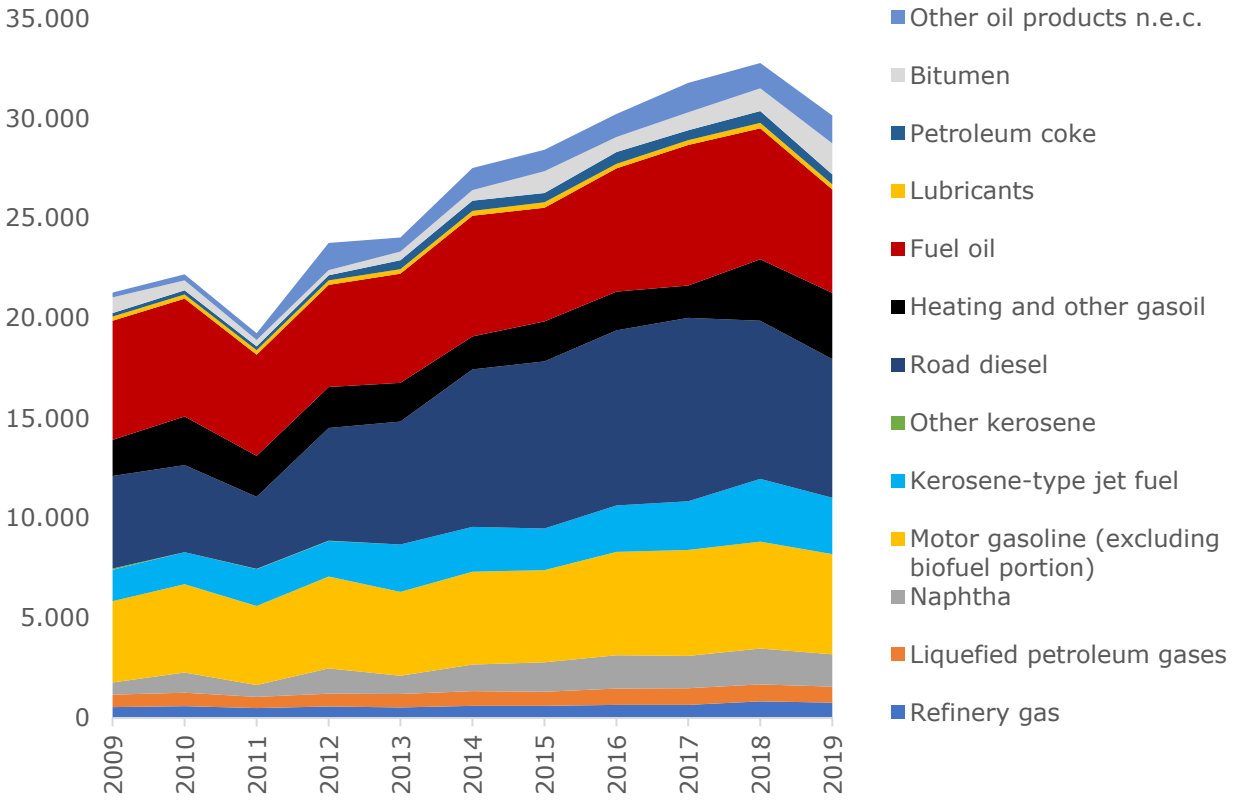
Source: Eurostat ,HELPE, Motor Oil, HAEE's analysis

Highlights

- Private company Energean Oil & Gas SA is the country's current only crude oil producer. The offshore fields, are located in the North Aegean Sea.
- Aviation & Shipping sales have affected the most due COVID-19 with a total sales decrease of 64% compared to 2019.
- Three refineries are owned by HELPE and are located in Aspropyrgos, Elefsina, and Thesalloniki. 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 Theothoroi, near Korinthos.
- The Greek refineries offer a wide range of products serving domestic and international market with sales of over € 10.2 billion in 2020.

Greece's refining output had declined by almost 8% from 2018 to 2019, unlike the upward trend observed over the past decade

Oil refining products in Greece (thousand tons), [2009-2019]



Source: Eurostat, HAEE's analysis

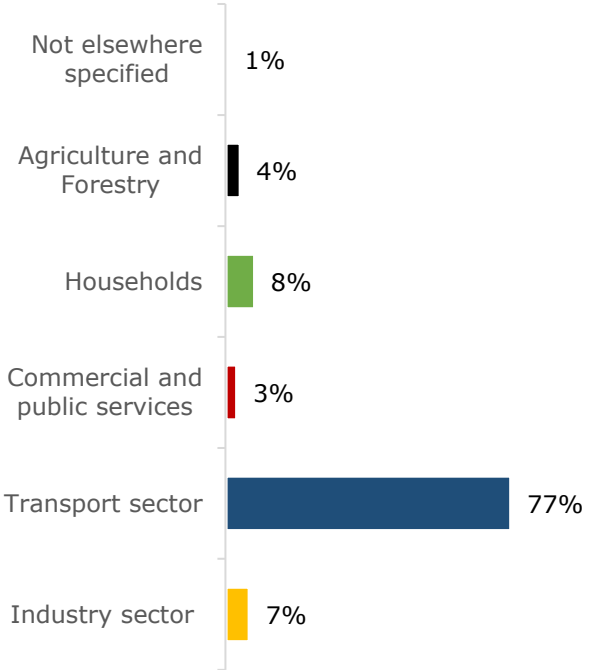
Highlights

- The Greek refining groups have made significant investments over the past decade in order to upsurge the refining output, increasing it by 50% at 32 million tons in 2018.
- In 2019, however, the total refining output was around 30 million tons, reduced by 8% compared to previous year's production.
- Fuel Oil and motor gasoline consists of 17.2% and 16.6% of the refined products in Greece for 2019.
- Jet fuel kerosene and heating oil production stood at 2.8 and 3.3 million tons respectively, representing 20.3% of the refining capacity.
- Road diesel production stood at 7 million tons approximately, accounting for the highest share, with 23% of the country's refining capacity.

The transport sector represents more than 2/3 of the Oil final consumption both in the EU (77%) and in Greece (71%)

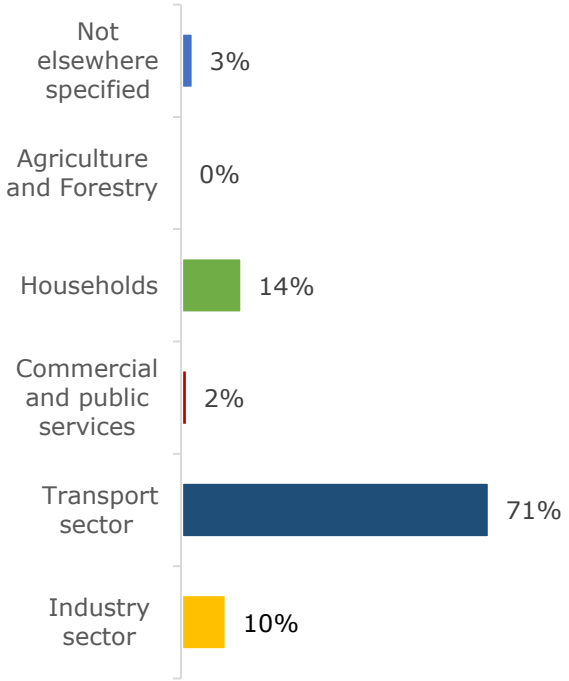
Final Consumption of Oil and Products by Sector in EU 28 (%), [2019]

Final Consumption: 535 mil. tons



Final Consumption of Oil and Products by Sector in Greece (%), [2019]

Final Consumption: 10 mil. tons



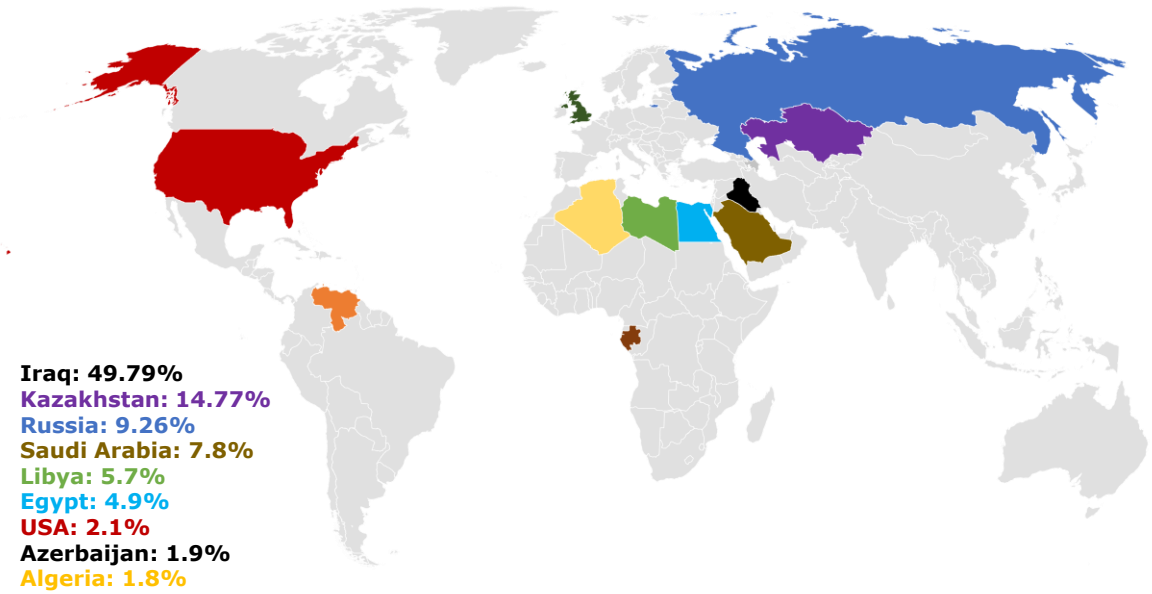
Source Eurostat, HAEE's analysis

Highlights

- The sector with the highest Oil and Oil products final consumption is the transport sector both at European level (77%) and in Greece (70.7%).
- In the EU, 535 million tons of Oil and products were consumed as total in 2019, while in Greece this is equals to 10 million tons.
- The second largest final consumer is the household sector which consumed 31.4 million tons in the EU and 1.2 million tons in Greece in 2019.
- At EU level the rest 16% of the consumption is divided among industry (7%), agriculture and forestry (4%) and commercial and other uses.
- Industry represent 10.4% of the final consumption due to the use of Oil for heating and manufacturing. The rest 4.8% is consumed by commercial and agriculture.

Greece has developed trade relations with several countries worldwide to fulfil its crude Oil import needs

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



Iraq: 49.79%
Kazakhstan: 14.77%
Russia: 9.26%
Saudi Arabia: 7.8%
Libya: 5.7%
Egypt: 4.9%
USA: 2.1%
Azerbaijan: 1.9%
Algeria: 1.8%
United Kingdom:0.3%
Gabon:0.3%
Venezuela:0.2%

Crude Oil Imports 2019: 166 mbbls

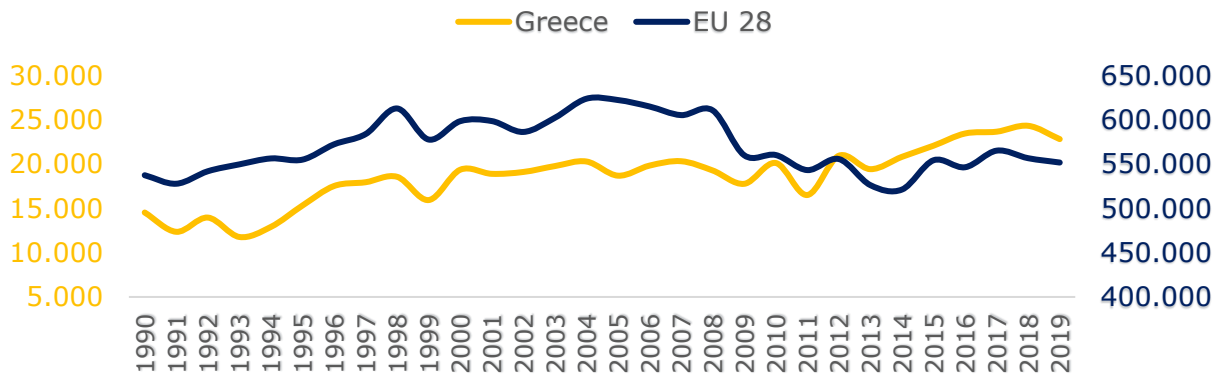
Source: European Commission, HAEE's analysis

Highlights

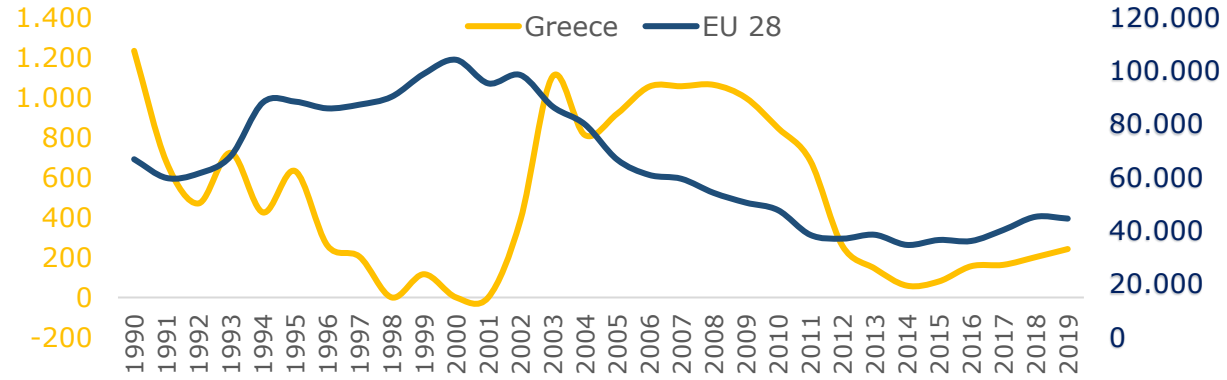
- Greece imports crude Oil from different sources from all over the world, to cover the needs of its refining sector, since crude production is low.
- The main source of crude Oil in 2019 was Iraq, representing almost 50% of the imports, with imports of 82 million barrels of crude oil.
- Another 25% 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 million barrels from Saudi Arabia, 10 million barrels from Libya and 8 million barrels from Egypt.

Although the implementation of the European Green Deal is underway, dependency on imports of crude Oil and petroleum products remains high

Crude Oil Imports (thousand tons), [1990-2019]



Crude Oil Exports (thousand tons), [1990-2019]



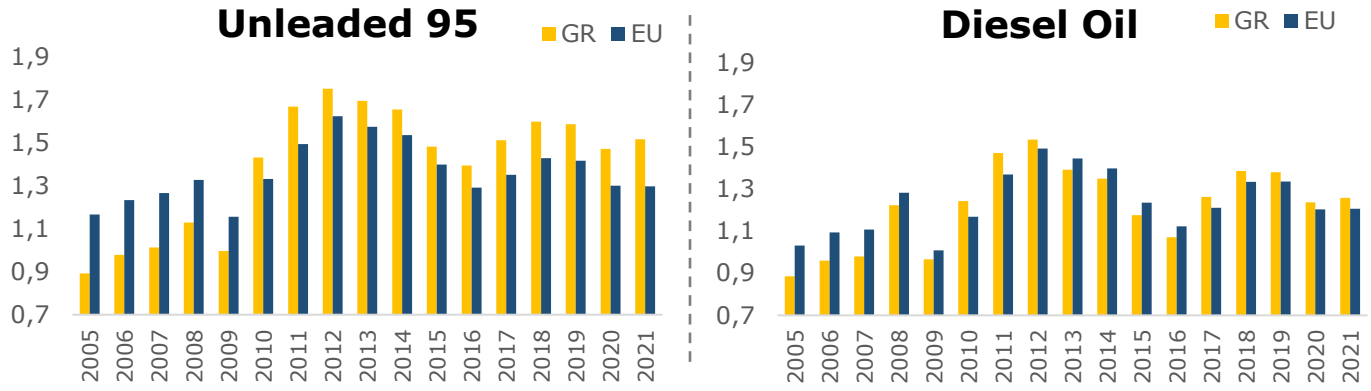
Source: Eurostat, HAEE's analysis

Highlights

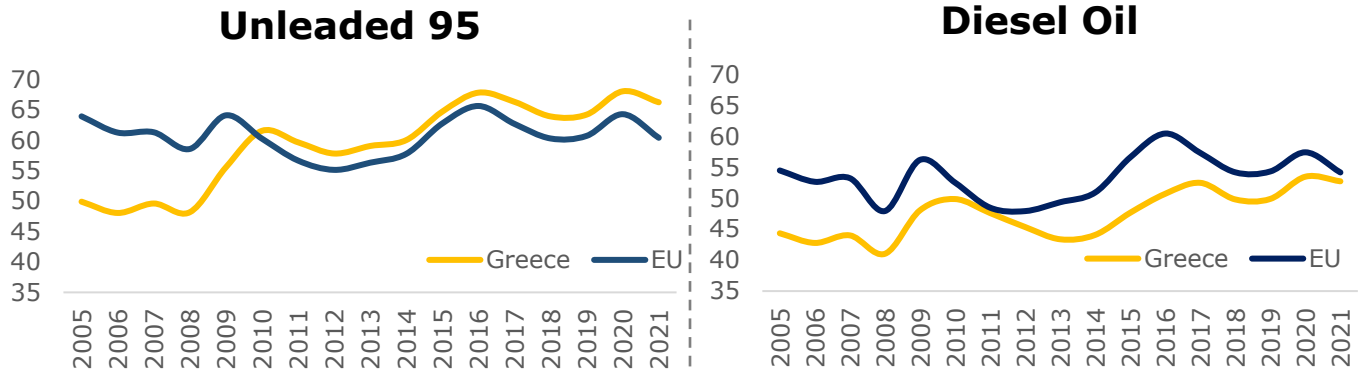
- Crude oil exports are declining at EU level since 2000, reaching in 2019 45.5 million tons, a slight increase from 34.6 million tons in 2014.
- In Greece, a similar trend is observed with an increase of crude oil exports from 2013, only to reach 230 thousand tons of crude oil exports in 2019.
- The EU crude oil imports are also in a downward trend since the mid-00s, standing at 552 billion tons in 2019, while fifteen years ago the volume was 610 billion tons.
- On the contrary crude oil imports in Greece have risen by 20% since 2011 to reach almost 23 million tons in 2019.
- Russian petroleum oil exports to Europe declined by 1.4%, reaching 26.4% in the first half of 2020.

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), [2005-2021]



Taxes as Share of the Final Price (%), [2005-2021]



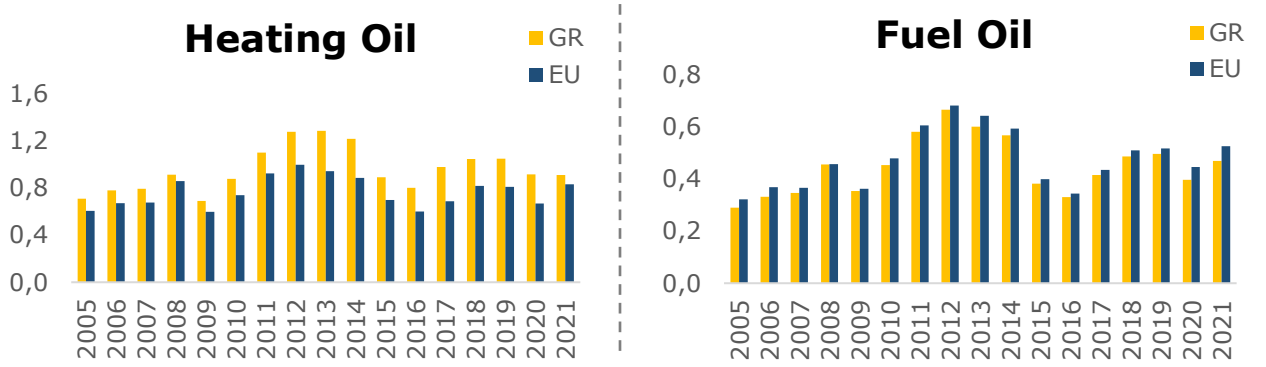
Source: European Commission, HAEE's analysis

Highlights

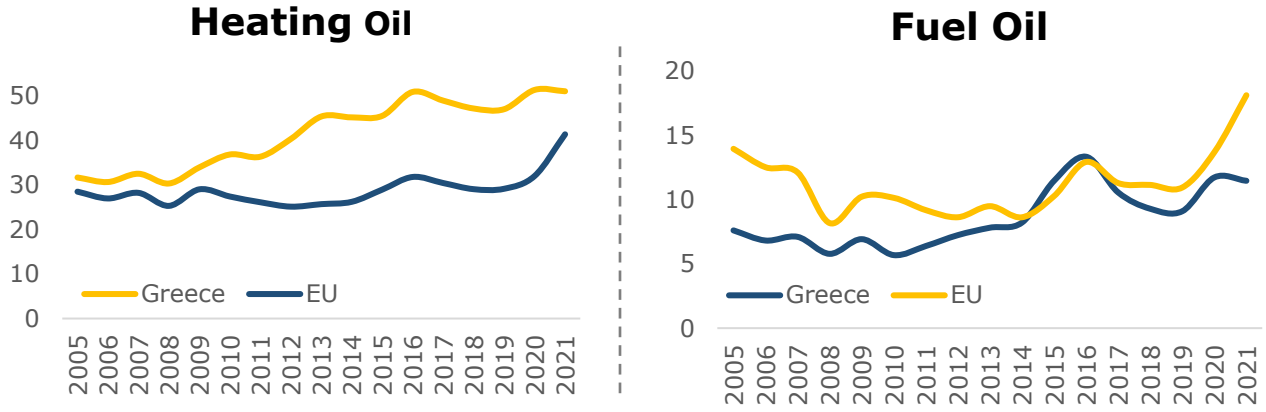
- Since 2010 the retail price of Unleaded in Greece is higher than the average EU price, as a result of a tax increase due to the financial crisis of 2009.
- The unleaded average price for 2021 in Greece is 1,516 €/litre, when the corresponding price in EU is 1,296 €/litre.
- The tax burden for unleaded in Greece in 2021 is close to 66% of the final retail price while at EU level it stood lower at 60%.
- As far as diesel oil concerns the average price in Greece and the EU are quite close, with the price in Greece settling at 1,258 €/litre and 1,206 €/litre in the EU.
- Taxes on diesel consumption are a bit higher in the EU than Greece, representing 55% for the EU price and 53% for the Greek price in 2021.

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), [2005-2021]



Taxes as Share of the Final Price (%), [2005-2021]



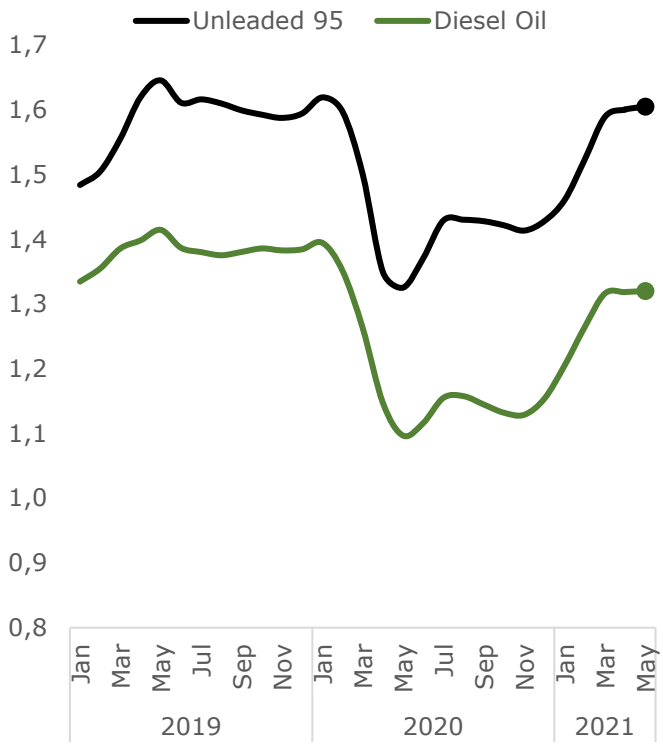
Source: European Commission, HAEE's analysis

Highlights

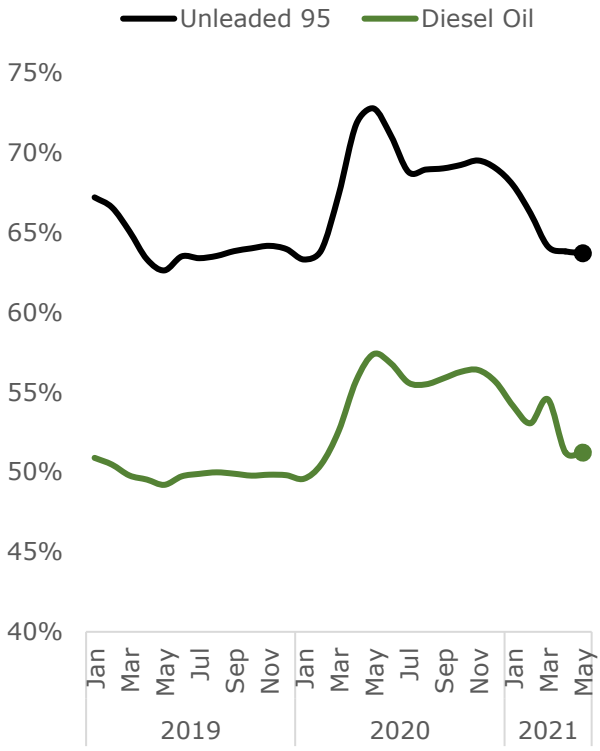
- Heating oil prices discrepancy between the EU average and Greece is a result of the increased taxes imposed by the Greek Governments due to the 2009 crisis.
- Greek consumers paid on average 15% more for Heating Oil than the EU average. The price in Greece for Heating Oil was around 0.91 €/litre in 2021.
- The taxes imposed in Greece for the consumption of Heating Oil are 23.3% higher than the EU average for 2021.
- Fuel Oil prices are lower in Greece than EU average by almost 11%, settling at 0,469 €/litre in March 2021 while the EU prices was 0,525 €/litre.
- Taxes on Fuel Oil in Greece and the European Union are equal to 11.5% and 18% of the final price, respectively.

The impact of COVID–19 seems to mitigate in 2021, as there is an increase of 20% compared to May 2020 in the retail prices of oil

Retail Prices of Petroleum Products in Greece (€/litre), [2019-2021]



Share of Taxes in Retail Prices of Petroleum Products in Greece (%), [2019-2021]



Source: European Commission, HAEE's analysis

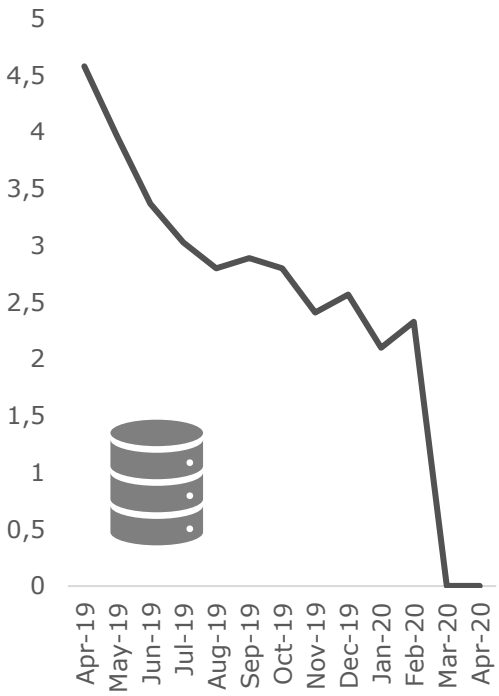
Highlights

- 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.
- In 2021, diesel and unleaded retail prices seem to face a rebound slowly recovering from the negative effect of the pandemic.
- In 2021, the average retail price for unleaded 95 shaped at 1.545 €/litre, while for diesel at 1.277 €/litre.
- An increase equal to 20.5% for both unleaded 95 and diesel prices is apparent, compared to the collapsed retail prices in May 2020.

Global Oil plummeted prices in 2020, led petroleum group Repsol to withdraw its interest from an exploitation license in Greece

Exploration and Discovery, [November 2020]

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



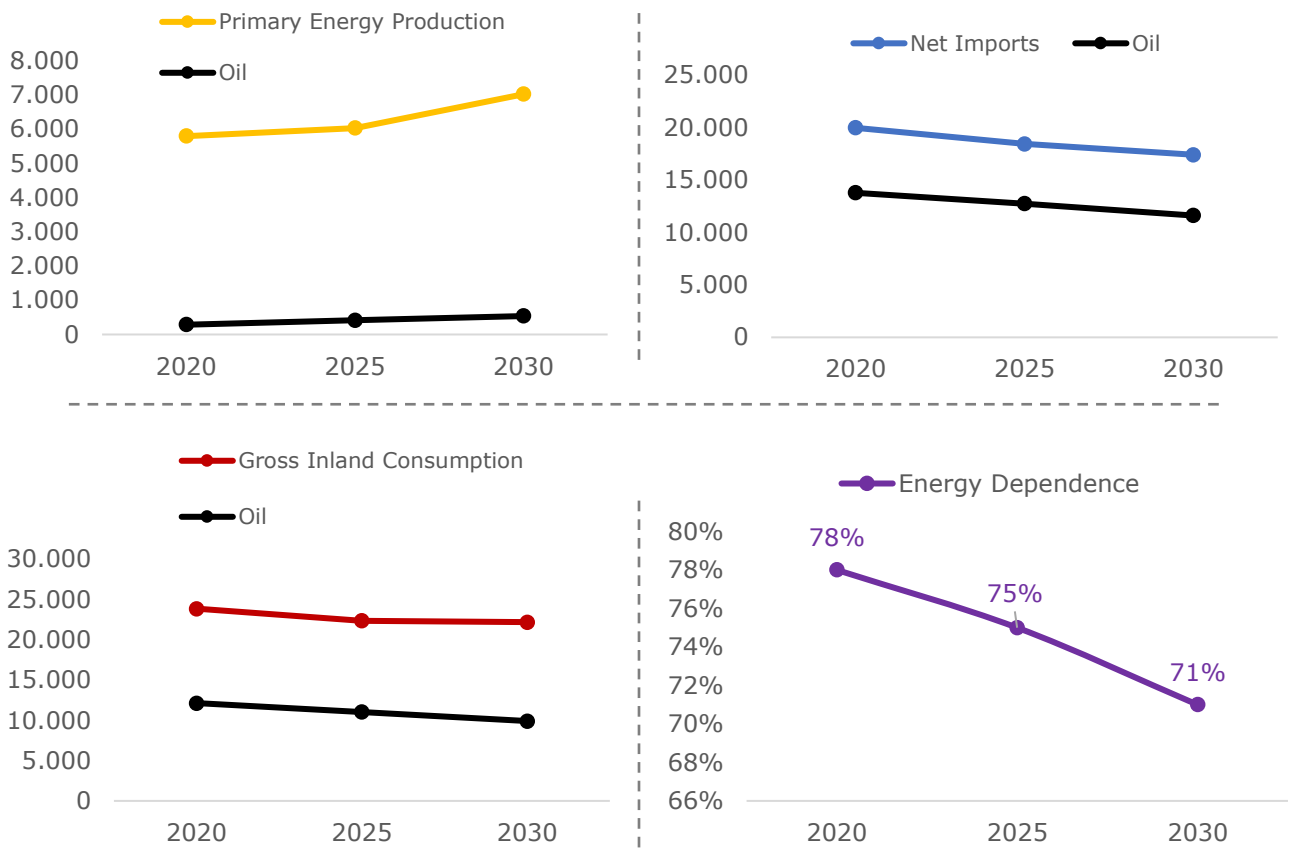
Source: HHRM, HAEE's analysis

Highlights

- The Prinos oil output 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, as it cannot continue to keep operating at a loss.
- This led Greece to announce a financial support scheme of €90.5 million as a state-guaranteed commercial loan for the company.
- Besides, the Spanish petroleum group Repsol withdrawn from its interests from two onshore licenses in the Aitoloakarnania and Ioannina and in Northwestern Greece.
- The sharp drop in oil prices has made upstream investments not feasible, while Repsol examine to withdraw from an offshore block in the Ionian Sea, as well.

According to recent projections, oil products will continue to play an important role in the future energy demand in Greece

Greek Energy Balance estimated projections (ktoe), [2020-2030]



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

Highlights

- According to NECP's projection, net imports of crude oil are expecting to decrease by 16% in 2030.
- By 2030, most of the NIIs will be interconnected with the continental electricity system, thus reducing even more oil imports for electricity generation purposes.
- Nevertheless, gross consumption will decrease, as energy efficiency and decarbonization are expected to lead the Energy Transition.
- The total primary energy production will raise up to 7.000 ktoe in 2030, from which less than 10% will come from oil or natural gas.
- In parallel, energy dependence is expected to decrease by 7%, as a result of the Energy Efficiency measures and the reduced oil use for electricity generation.

8. Energy Efficiency

Highlights

European Energy Efficiency **target** for **2030** will be **revised** after Brexit

Energy productivity in Greece is **20%** less compared to the average levels of EU-27

Oil represents **53%** of the total **energy consumption** in Greece

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

41% of **industry's** energy consumption stems from **electricity**

RES and biofuels are used **36% more today** compared to the previous decade

Households' energy consumption has **decreased** by **24%** over the last years

50% is the energy efficiency **index** in terms of **transportation ranking**

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

Overview

Energy efficiency is expected to play a vital role in the mitigation of CO_2 emissions, while ensuring energy security by decreasing energy imports and boosting countries' economy by creating new jobs. In this direction, Europe introduced specific targets for energy efficiency to mitigate climate change and ensure efficiency in energy markets. 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. According to the recent National Energy and Climate Plan(NECP), the country aims to improve that target by at least 32.5% by 2030, compared to 1990 levels. The two main "tools" towards to that direction are expected to be the electrification of the transport sector which is responsible for most of the energy consumption and the energy upgrade of the buildings through a huge subsidy program of €1.0 bn where 60.000 households are going to increase their energy efficiency rating.

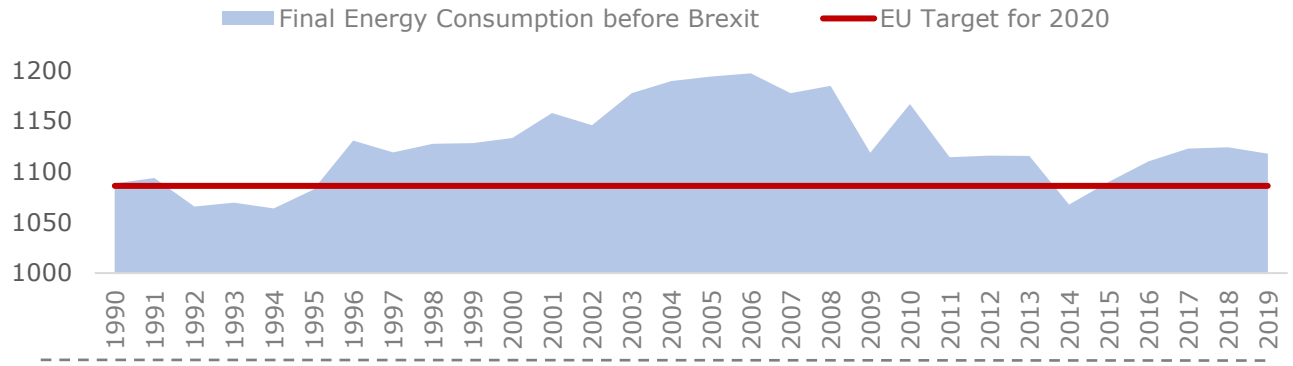
Decomposing the Greek economy into sectors, transportation constitutes the most energy-consuming sector, which is responsible for 39% of the overall energy consumption. Industry accounts for 17%, households for 27% and services for 17%. In terms of fuels, the Greek economy is based solely on oil & petroleum 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 is responsible for 41%, while 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.

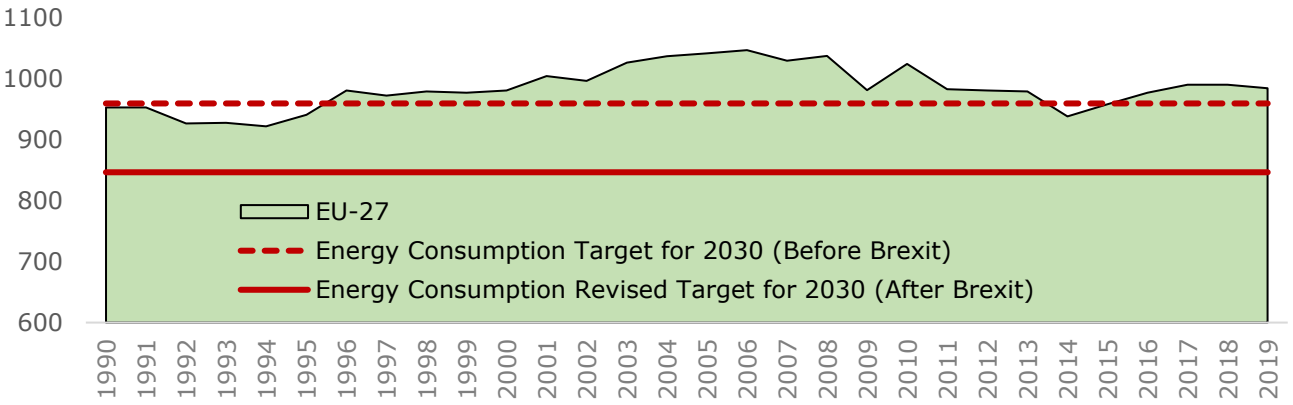
Finally, Covid-19 has triggered a severe world recession which is expected to stress the ability of Greece to immediately respond to it, in a national level, which means that shortly energy efficiency may be considered as a secondary issue. However, climate change remains a priority and we need to cope with it. Covid-19 has brought opportunities as well, that could boost the implementation of Energy Transition, where energy efficiency is expected to have a crucial role.

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), [1990-2019]



Final Energy Consumption for EU-27 and the Corresponding Target for 2030 (Mtoe), [1990-2019]



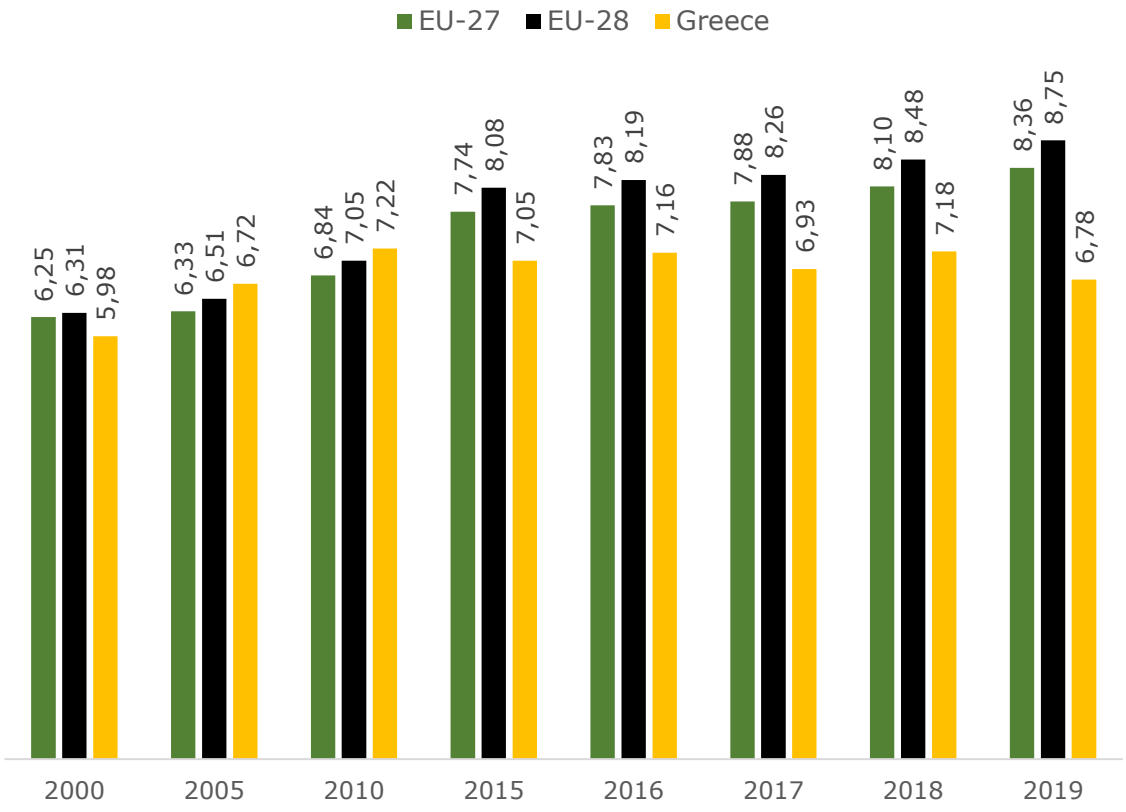
Source: Eurostat, HAEE's analysis

Highlights

- The EU-28 has introduced a maximum bound for final energy consumption at 1.086 Mtoe for 2020, known as the 20% efficiency target.
- The corresponding efficiency target for 2020 adjusted downward following the Brexit, at 959 Mtoe for 2020 and at 846 Mtoe for 2030.
- 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 the 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), [2000-2019]



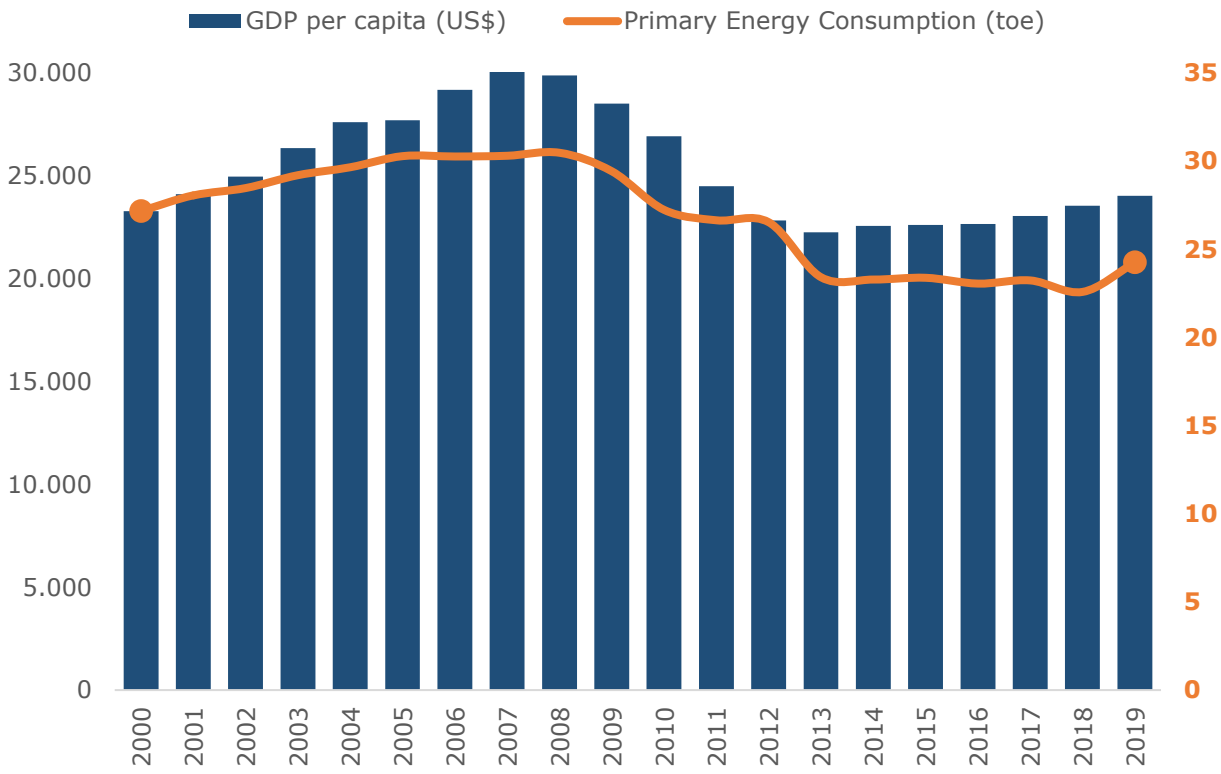
Source: Eurostat, HAEE's analysis

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.
- During the previous decades, energy productivity improved by 13.4% in Greece, but thenceforth Greek productivity is inferior to the European Union's average.
- EU-28 and EU-27 have increased energy productivity by 39% and 34% in 2019, reaching 8.75 and 8.36 €/Mtoe, respectively.
- Despite the sanitary and financial measures against Covid-19, it has already caused another lasting crisis, highlighting the essential role of energy productivity.

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, [2000-2019]



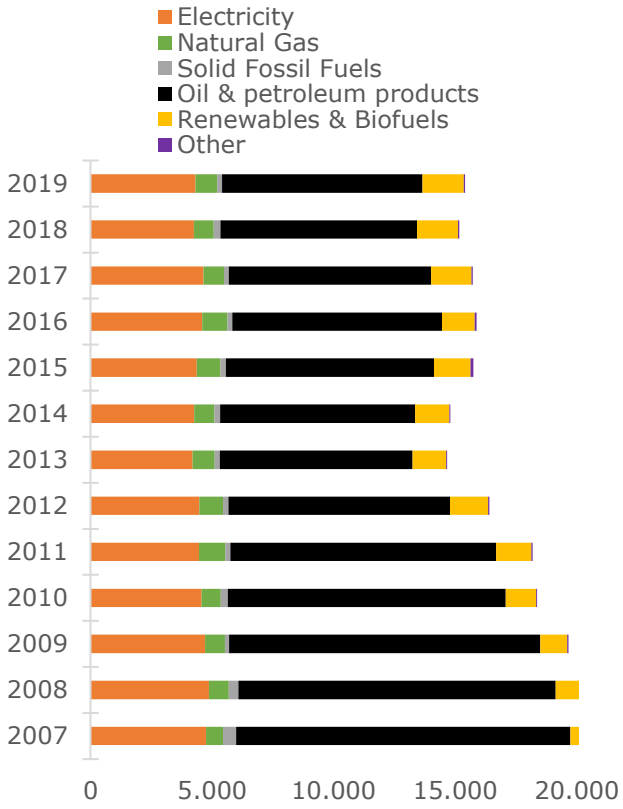
Source: World Bank, Eurostat, HAEE's analysis

Highlights

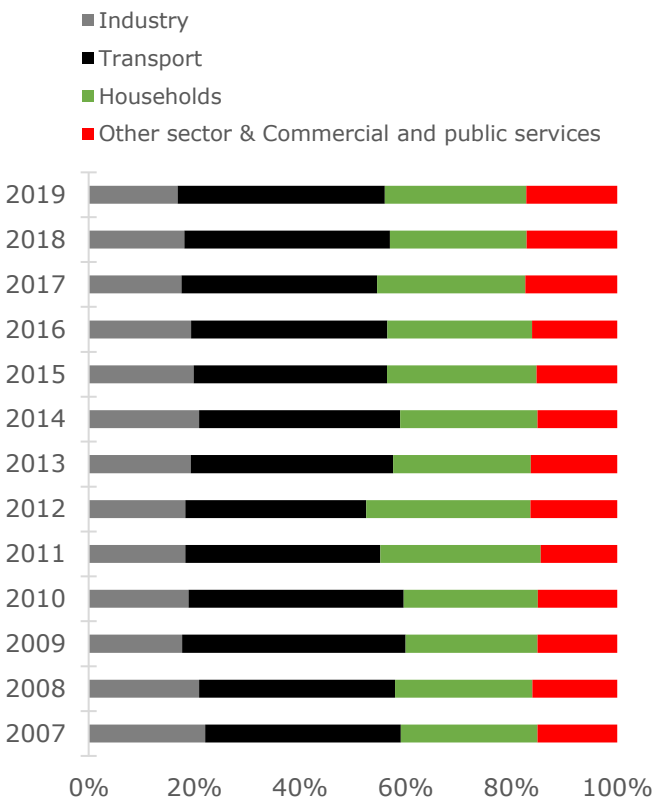
- Energy efficiency analysis can be decomposed into the trends of GDP per capita and final (or primary) energy consumption.
- GDP per capita continues to follow an upward trend in the Greek economy reaching 24.024 US$ in 2019 (constant 2010) whereas energy consumption contracts.
- From 2013 to 2019, GDP increased by 8% while primary energy consumption increased by 4%, indicating the need for more targeted initiatives
- Hence, 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 considers the diversification of fuels that contribute to Greek energy consumption and additionally, the peculiarities of the Greek market.

Oil and Petroleum products dominate in terms of energy consumption, while the transport sector is driving the energy demand

Final Energy Consumption by Fuel (toe), [2007-2019]



Final Energy Consumption by Sector (%), [2007-2019]



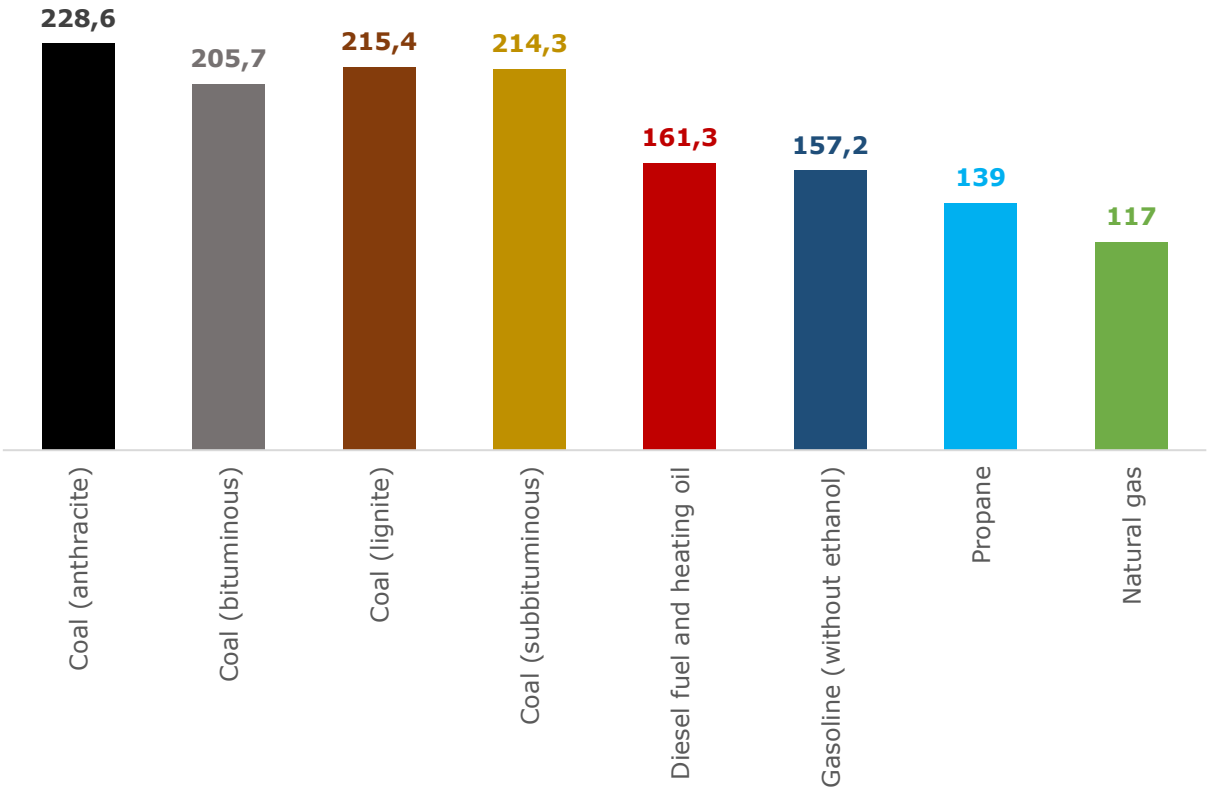
Source: Eurostat, HAEE's analysis

Highlights

- The percentage of oil and petroleum products on Greek energy consumption has decreased over the last decade, yet it remains the fuel with the highest share.
- The share of electricity is approximately constant (28% in 2019), while the exploitation of renewables and biofuels has been enlarged (11% in 2019).
- The role of Natural Gas is crucial for the energy transition and cannot be neglected, albeit it has been decreased by 14.4% from 2016 to 2019.
- Throughout this decade, in terms of economic activity, the shares of the various sectors remained almost steady, while transportation is leading energy consumption.
- Industry utilizes 19% of the national energy, while the shares of transportation, households and other sector and services are 38%, 28% and 16%, respectively.

Different fuels emit different amounts of carbon dioxide (CO2) in relation to the energy they produce when burned

Pounds of CO2 Emitted per Million British Thermal Units (Btu) of Energy for Various Fuels



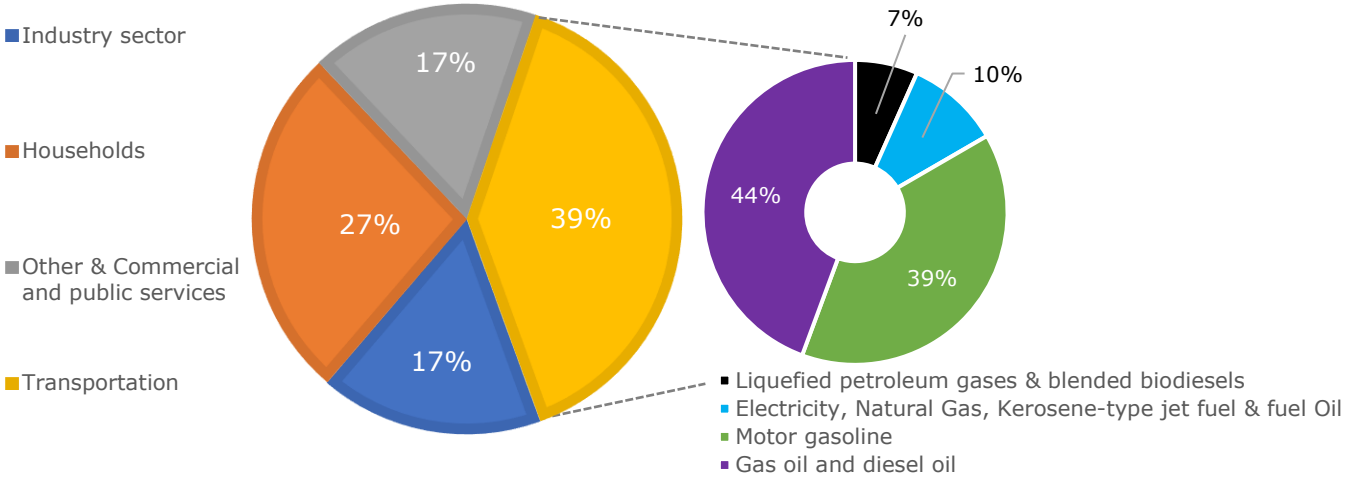
Source: EIA, HAEE's analysis

Highlights

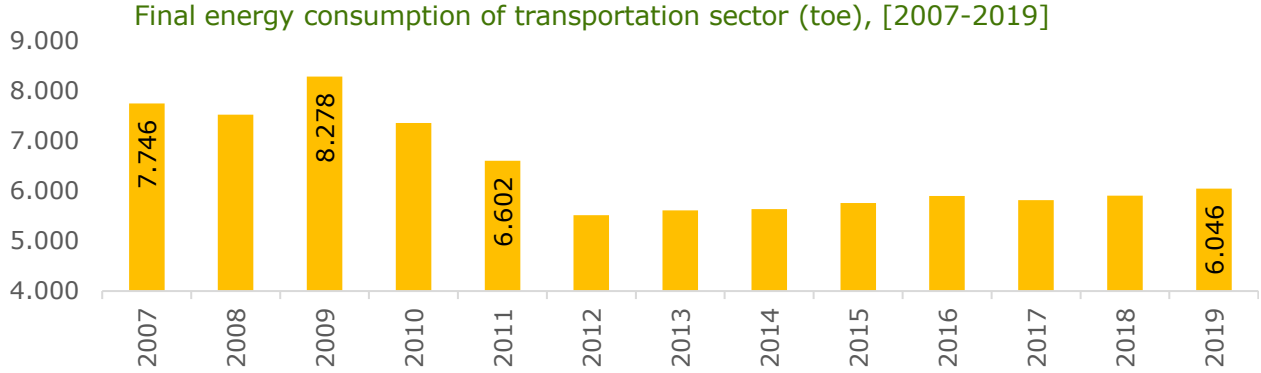
- To analyze emissions across fuels, EIA compare the amount of CO2 emitted per unit of energy output or heat content.
- The amount of CO2 produced when a fuel is burned is a function of the carbon content of the fuel.
- The heat content, or the amount of energy produced when a fuel is burned, is mainly determined by the carbon (C) and hydrogen (H) content of the fuel.
- Coal (anthracite) is the most polluted fuel, since it emits 228,6 pounds of CO2 emissions when used, while Coal (lignite) is ranked 3rd (215,4 p. of CO2 emissions)
- Natural gas is ranked 8th in the above classification since it emits 117 pounds of CO2 emissions when used, which crucially affect the operating cost of CCGT units.

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 (%), [2019]



Final energy consumption of transportation sector (toe), [2007-2019]



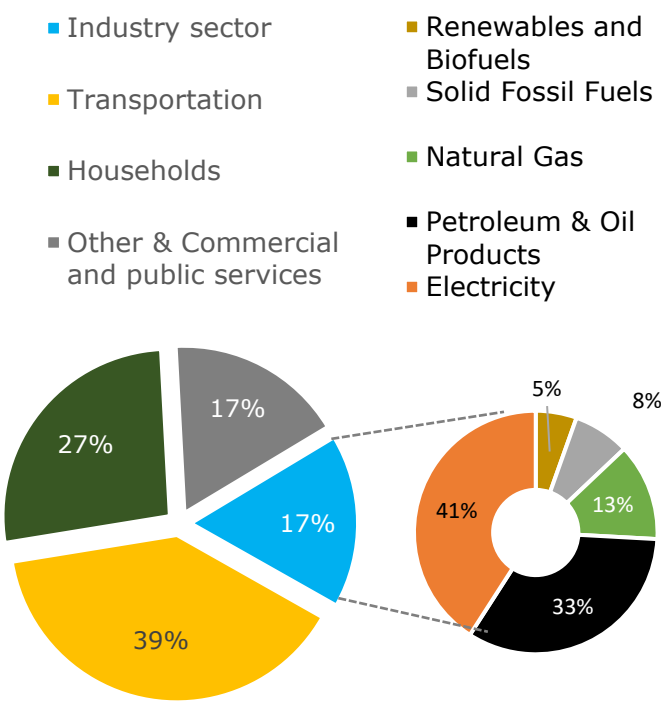
Source: Eurostat, HAEE's analysis

Highlights

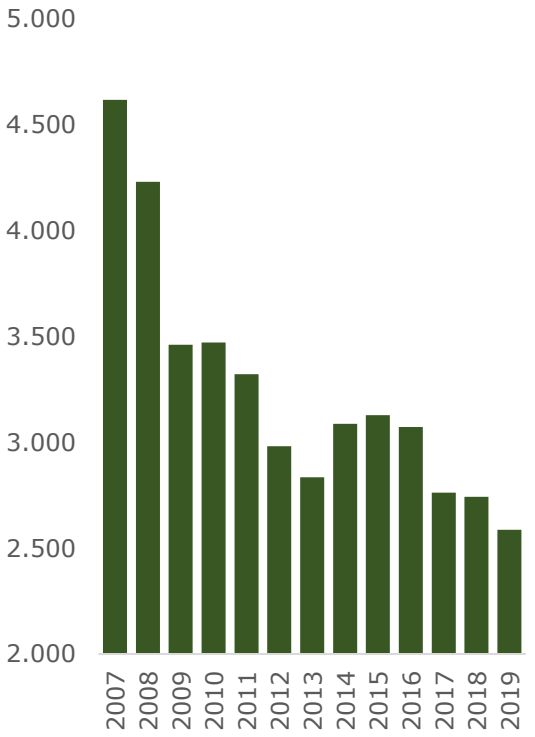
- The final energy consumption of transport was 6.046 toe in 2019 (39%), but different fuels contribute disproportionately to the total amount.
- Gas oil and diesel oil used in transportation account for 44% of the transport energy consumption and 17% of the total energy utilized, which translates to 2.670 toe.
- Another principal fuel utilized in transportation is the motor gasoline which is responsible for 15% of the entire energy consumption.
- The notable shares of those fuels highlight the need of E-mobility since those are primarily used in road transportation.
- The Greek crisis of 2009-2012 led to a 33% decrease in energy used in transportation, while hereafter a slightly increasing trend is evident.

Electricity, Petroleum and Oil Products dominate the fuels market while energy consumption of industrial sector has shrunk by 44% since 2007

Fuels Contribution to the Final Energy Consumption of Industry (%), [2019]



Final Energy Consumption of Industry Sector (toe), [2007-2019]



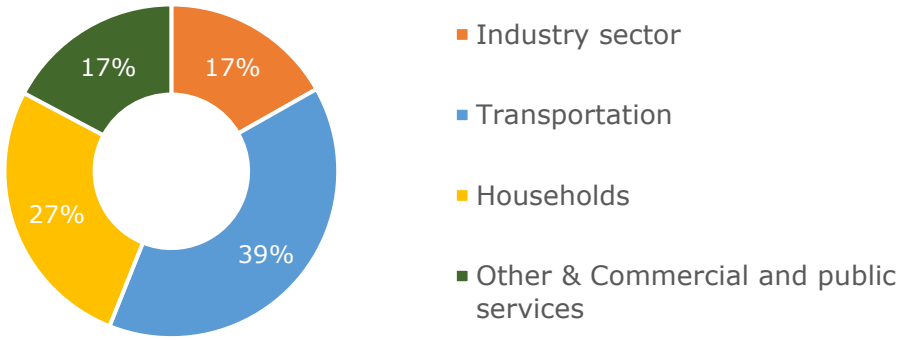
Source: Eurostat, HAEE's analysis

Highlights

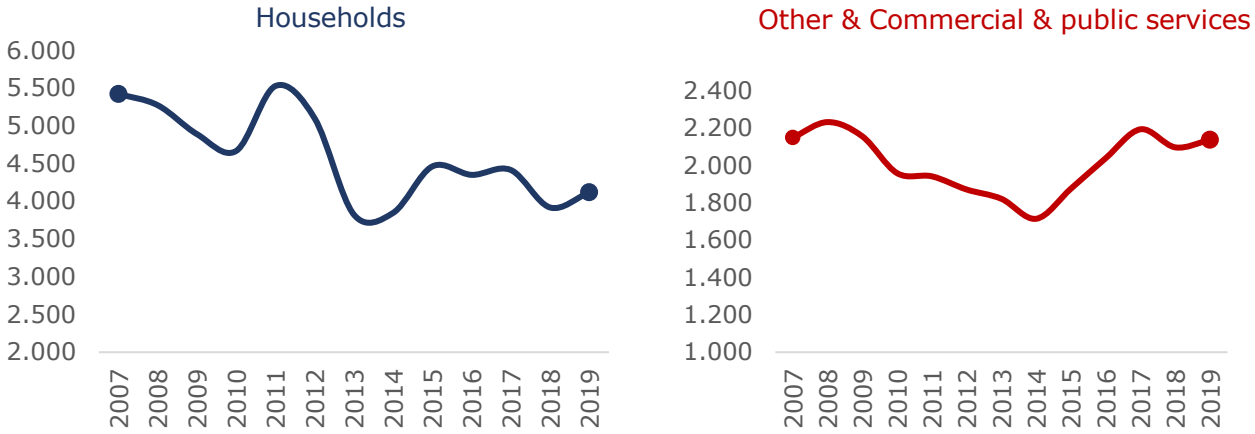
- Some fuels prevail in terms of industrial energy consumption, namely petroleum products and electricity constitute the dominant energy sources.
- Specifically, electricity is responsible for 41% of the energy utilized in the industry sector and 7% of the total energy consumption, which is equivalent to 1.058 toe.
- Natural Gas, solid fossil fuels, Renewables and biofuels are crucial sources of energy consumption of the industry sector.
- Since the Greek crisis in 2008 and onwards, the final energy used in the industrial sector follows a downward trend.
- The outbreak of Covid-19 along with the heavy restrictions imposed in the overall economy, crucially affected final energy consumption of the industrial sector,

Households, commercial and public services are responsible for almost 44% of the overall energy consumption

Final Consumption of Energy by Sector in Greece (%) [2019]



Energy Consumption for Households and Commercial & Public Services (toe), [2007-2019]



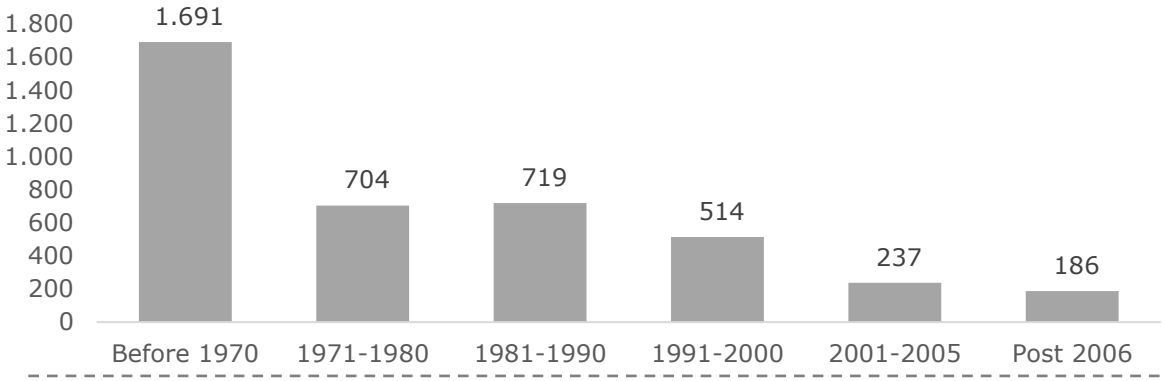
Source: Eurostat, IEA, HAEE's analysis

Highlights

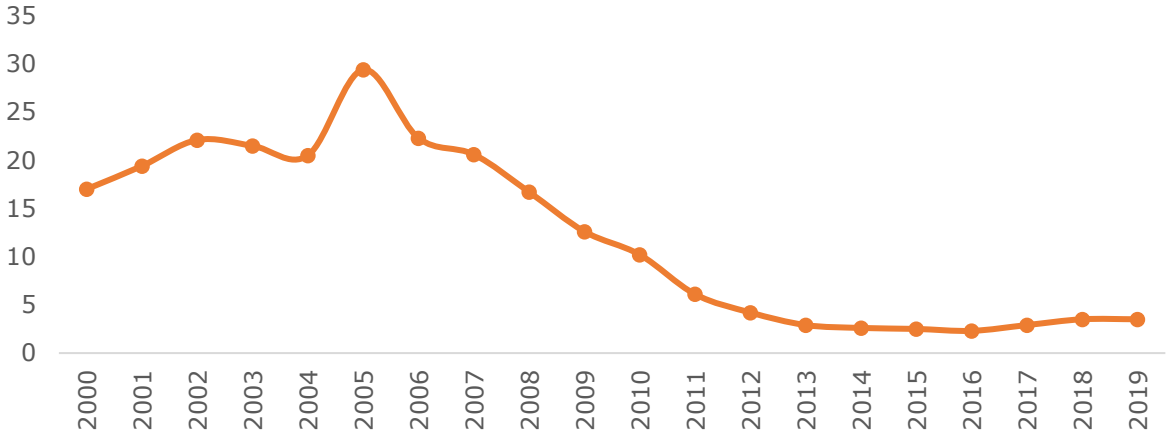
- Although most emphasis is given to transport and industrial sectors, households and services are crucial sectors that can drastically improve the overall energy efficiency.
- The final energy consumption of services sector is largely dependent on electricity, while renewables & biofuels, natural gas and oil play a significant role as well.
- The share of electricity is also crucial in households' consumption (1.494 toe), as well the gas & diesel oil (1070 toe) and the primary solid biofuels (634 toe).
- The final energy consumption of households has experienced a substantial decrease by 24% during the period 2007-2019.
- The energy consumption of services sectors mirrored the recovery of the Greek GDP, and hence the energy consumption remained considerably high at 2.135 toe.

42% of the total building stock in Greece, constructed before 1970, consequently, having a poor energy performance

Buildings' Construction Date Distribution (thousands),[2020]



New Buildings Construction Surface (million m^2), [2000-2019]



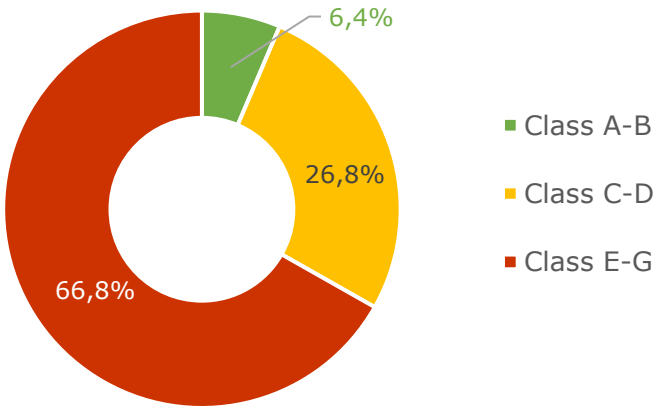
Source: HSA, HAEE's analysis

Highlights

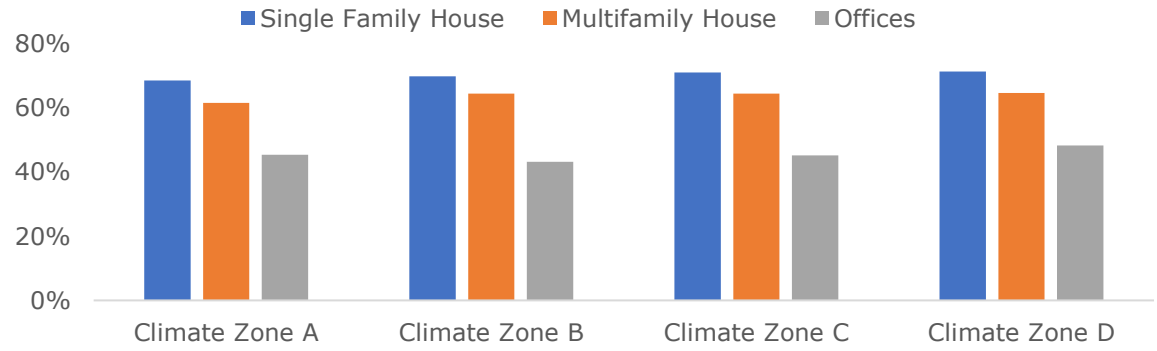
- The building sector is responsible for 41% of the final energy consumption, proving crucial towards the route of the energy transition.
- The poor energy performance of the building stock, the majority of which have been constructed before the official Energy Codes, negatively affect energy efficiency.
- Specifically, in Greece the 42% of the building stock have constructed before 1970, presenting a poor energy performance.
- On the other hand, the new buildings construction surface have dropped significantly (88%) from 2005.
- This points out the urgent need for the energy upgrade of the existing building stock, to achieve the energy and climate goals the country has set.

Households in Greece present poor Energy Performance with almost 67% the households classified in the lowest categories

Households Energy Performance (%), [2015-2019]



Average Savings Potential per category (%), [2017]



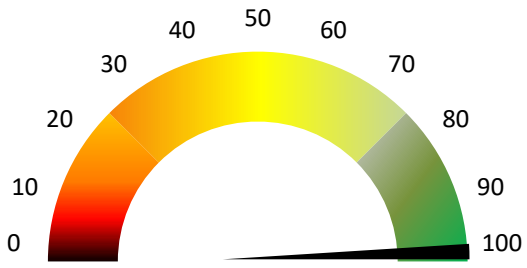
Source: Ministry of Environment and Energy, HAEE's analysis

Highlights

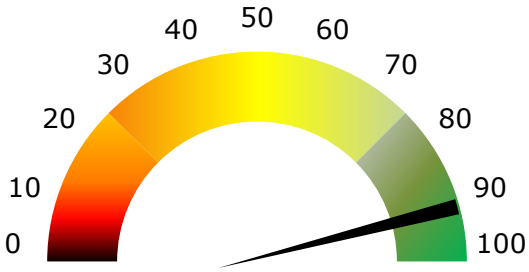
- According to statistics of the Ministry of Energy and Environment, during the last 5 years, the 67% of Greek households' present poor energy performance
- Greece is classified in four main climate zones according to annual Heating Degree Days (HDD), where climate zone A defines the zone with the less need for heating.
- On the other hand, climate zone D defines the zone with greatest need for heating. Data reveal a significant energy saving potential for dwellings.
- For Single Family Houses in all climate zones there is an average saving potential of 70%, while for Multifamily houses varies between 61-65%.
- For commercial offices, the potential energy saving varies, between 43-48%. (max - Climate Zone D: 48.2% and mic Climate Zone B: 43.2%)

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

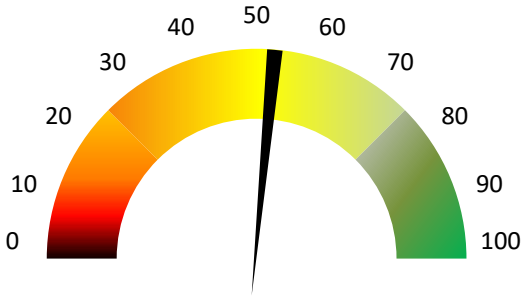
Energy Efficiency Indicators for Greece (%), [2020]



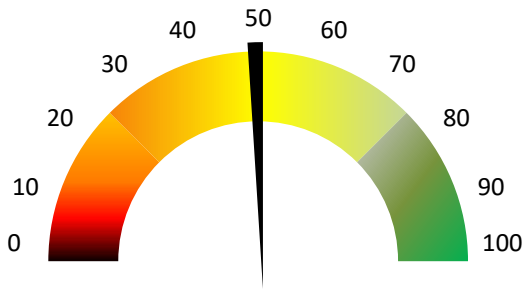
Carbon Pricing & Monitoring (%)



Building Energy Codes (%)



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.
- Greece has made excellent performance in building Energy Codes, concerning the legal framework and efficiency obligations for residential and commercial buildings.
- There is room for improvement in "Energy Labeling Systems" which could have also included industrial electric motors, other industrial equipment and vehicles.
- Transport indicator has improved substantially from 17% the previous year to 50% in 2020, mainly due to incentives for electric vehicles implemented in Greece .
- Overall, the Greek economy has achieved a sufficient level of energy efficiency, yet more policies needed in national level to meet the current targets.

9. Investments

Highlights

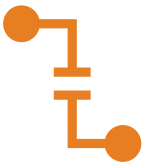
In 2020, investment decisions in Wind increased by **6%**, while the projections from 2021 reflect a further **growth of 3%**

Covid-19 pandemic affected investment decisions, especially in **fuel supply sector,** while utility-scale **renewable** power has been more resilient

Global energy investment in **2021** is expected to reach **$1.83 trillion**, **growing by 11%** compared to 2020

Wind and solar is estimated to produce **48% of world electricity in 2050**

Energy transition investments hit **$500 billion in 2020**



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

Greece will receive **32.1 billion euros** from Relief and Recovery Fund, **6.2 billion euros** will be used for **green investments**

On May 9th, 2021, **63% of electricity consumption** was covered by **clean sources**, breaking last autumn's historic record of 51%

According to the revised National Climate and Energy Plan, **€11 billion** will be used for **Energy Efficiency** until 2030

Overview

Covid-19 pandemic directly affected global investment decisions, especially in fuels sector, which decreased from $846 billion in 2019 to $578 billion in 2020, while the power sector investment also followed a declining trend of 5%. Thus, bolder decisions are needed to make the energy system more sustainable. The energy transition, which is estimated to be fully achieved by 2050 will be mainly driven by clean energy sources such as wind and solar. The last ones are anticipated to represent almost 56% of world electricity in 2050.

Additionally, energy transition spending, which include investment in hydrogen technologies, CCS, energy storage, electrified transport, electrified heat and renewable energy, hit for the very first time $500 billion in 2020, growing by 86% compared to a decade ago in 2009. China paves the way for energy transition investments, with $135 billion spending in the sector, while the European Union is leading the way of RES penetration and is actively promoting Europe's evolution to net-zero and facilitates the implementation of the European Climate Law.

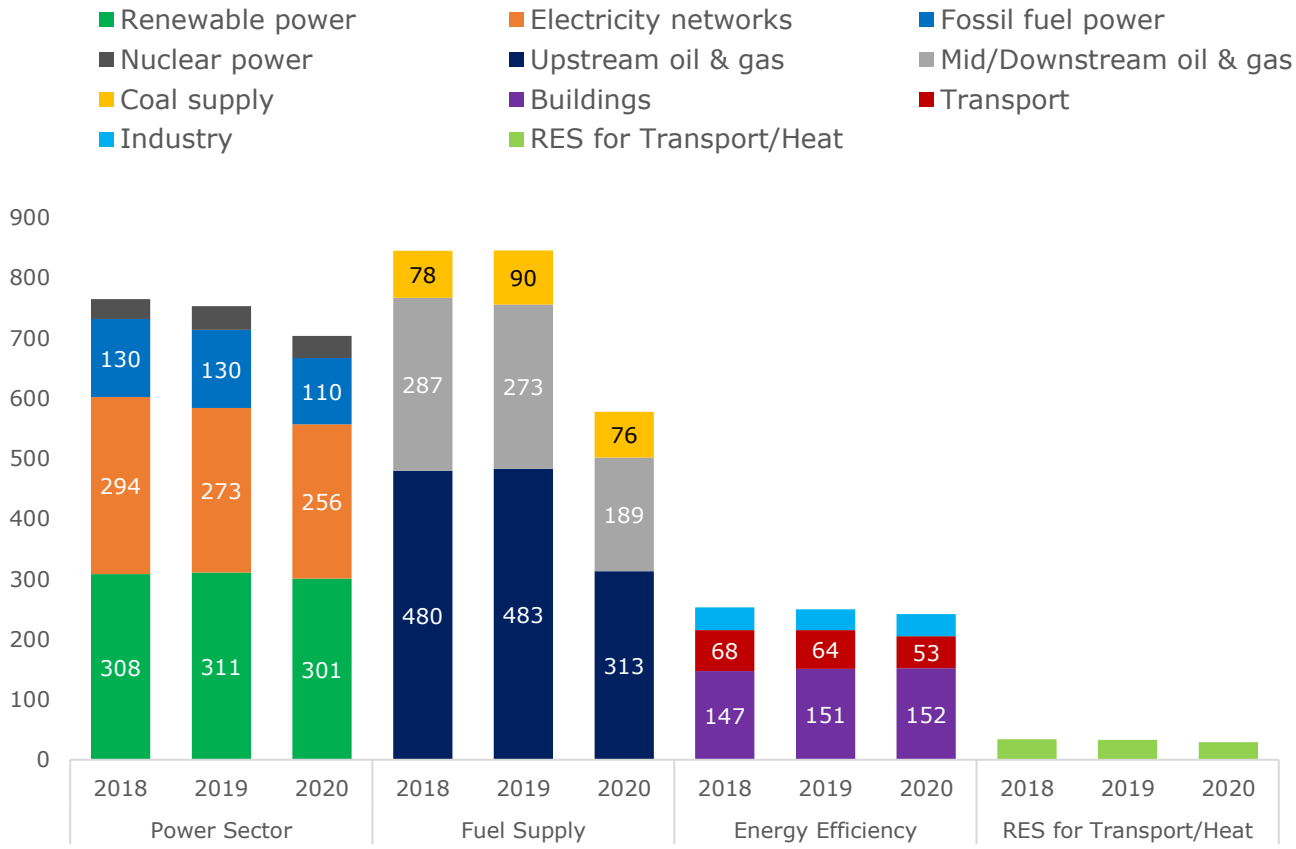
Greece follows the EU "Green Deal" directions and has set its own ambitious goals for climate change, which lead to a radical transformation of the country's energy sector away from its strong lignite dependency. In parallel, despite the Covid-19 pandemic, the average non-performing exposure of all 23 sectors was reduced from 36.2% in 2019, to 28.7% in 2020, while the Greek banking system overall provides more loans to the growing Energy sector, since its NPL percentage keeps on declining. The next day for the 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 remains the basic source of funding.

The National Energy and Climate Plan (NECP) will offer 44 billion euros in energy investments by 2030 and RES will mainly benefit from it, since with RES and Energy Efficiency representing almost 46% of the total new investments. In 2020 the Master Plan of the lignite phase-out procedure was launched, paving the way for country's independency from lignite. The Master Plan prepared by the Ministry of Environment and Energy envisages utilization of resources approaching 4 billion euros, especially used in Western Macedonia region and Megalopolis.

Greece is, also, expected to receive 32.1 billion euros from Relief and Recovery Fund, shaped as loans and grants. Out of them, €6.2 billion will be used for green transition investments, including investments in power-up, renovate, recharge and refuel and sustainable use of resources.

The outbreak of Covid-19 pandemic, negatively affected investment decisions, especially in fuel supply sector

Global Energy Investment by Sector (billion $), [2018 - 2020]



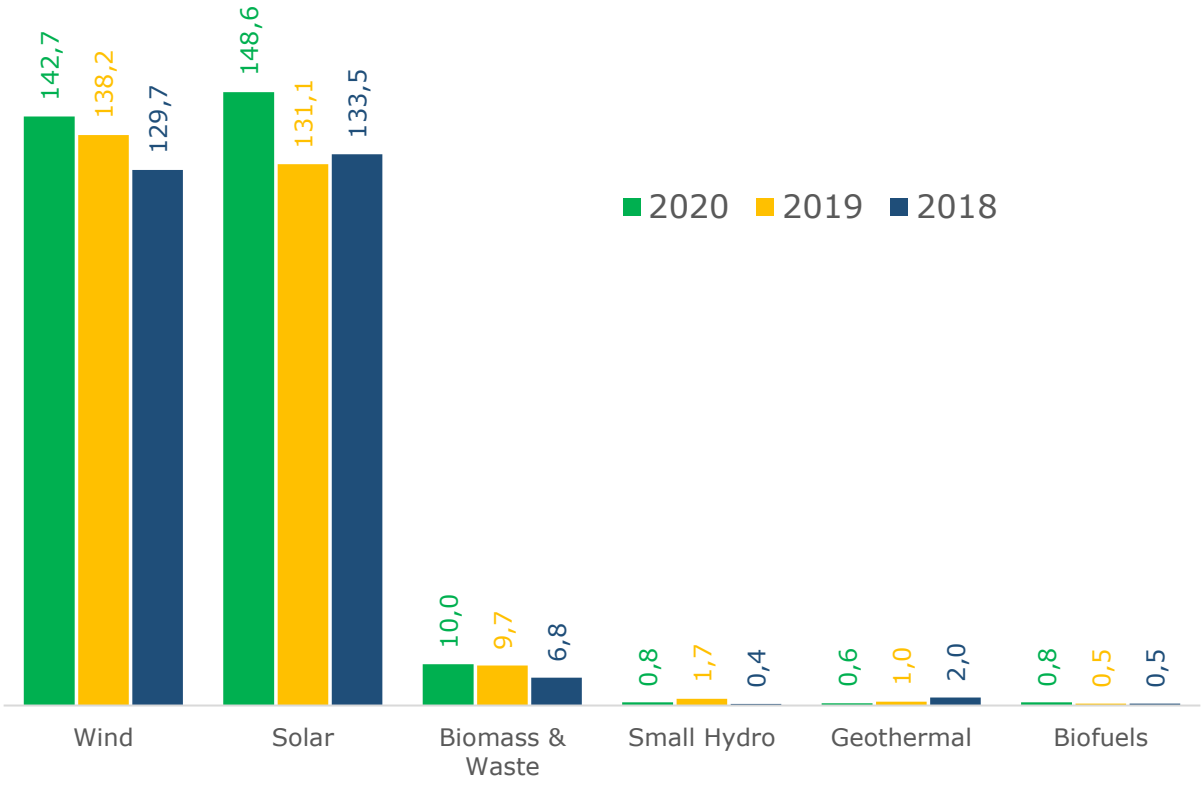
Source: IEA, HAEE's analysis

Highlights

- In 2020 energy investment declined to $1.57 trillion compared to 2019, presenting a decrease of 15%, following the instability and the insecurity of Covid-19 pandemic.
- The share of investment in Renewable Energy Sources, both in power sector and in transport and heat slightly declined from 2019.
- Fuel supply decreased from $846 billion in 2019 to $578 billion in 2020, while power sector investment also followed a declining trend of 5%.
- Investment decisions for coal power are down by 80% this decade, but the sector continued to grow in developing countries.
- Despite the pandemic, spending in R&D moderately rose in 2020, since most of the countries are trying to improve energy efficiency and limit energy losses.

Investments in RES, especially in Solar and Wind are expected to be strengthened to accelerate the pace of global Energy Transition

Global Investment in RES Capacity by Technology (billion $), [2018 - 2020]



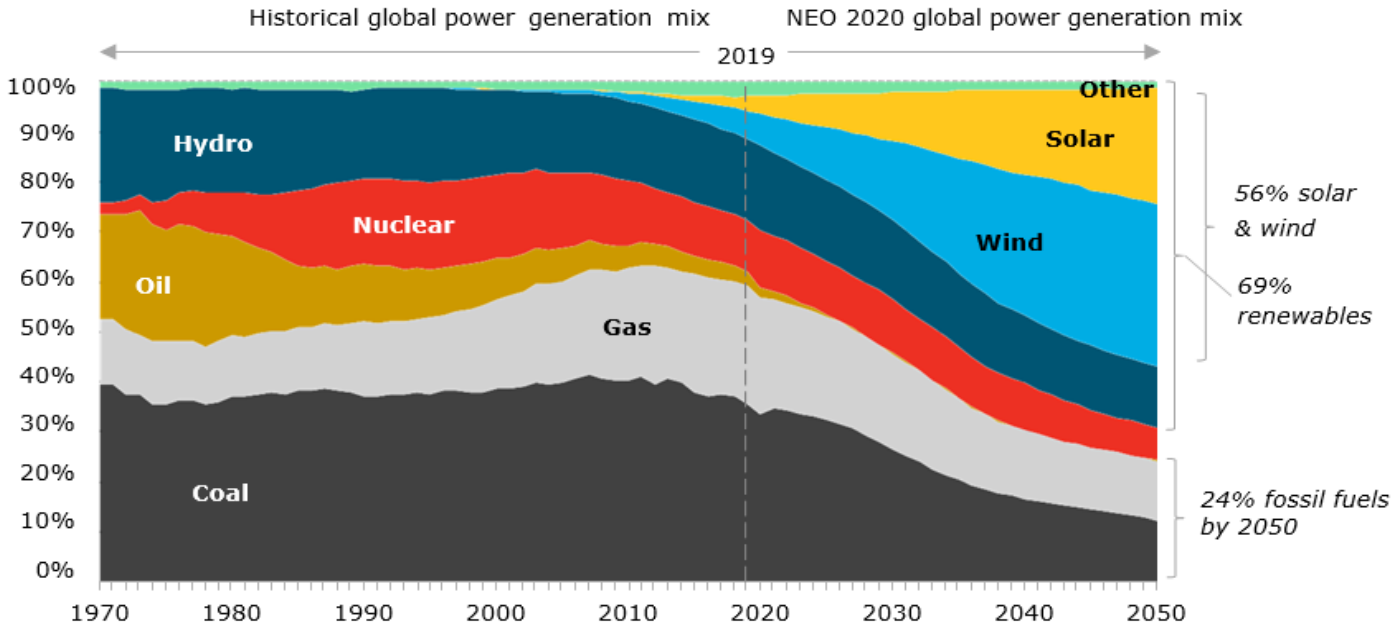
Source: IEA, HAEE's analysis

Highlights

- Investments in RES edged down, as net additions to capacity were flat and costs fell in some technologies but was also supported by plants under development.
- In 2020 and despite the impact of the pandemic investment decisions in Wind increased by 6%, while the projections from 2021 reflect a further growth of 3%.
- Global Solar investments are expected to reach approximately $148.6 billion during the year, forming the most attractive Renewable Source for the investors.
- Compared to 2018 levels, investments in Biomass and Waste are expected to reach $10 billion.
- Estimations for 2021 show that investment spending in small Hydro will decline from $1.7 to $0.8 billion, since the available hydro sources have already been exploited.

Wind and Solar is estimated to produce 48% of global electricity demand by 2050, overtaking the dominance of fossil fuels

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



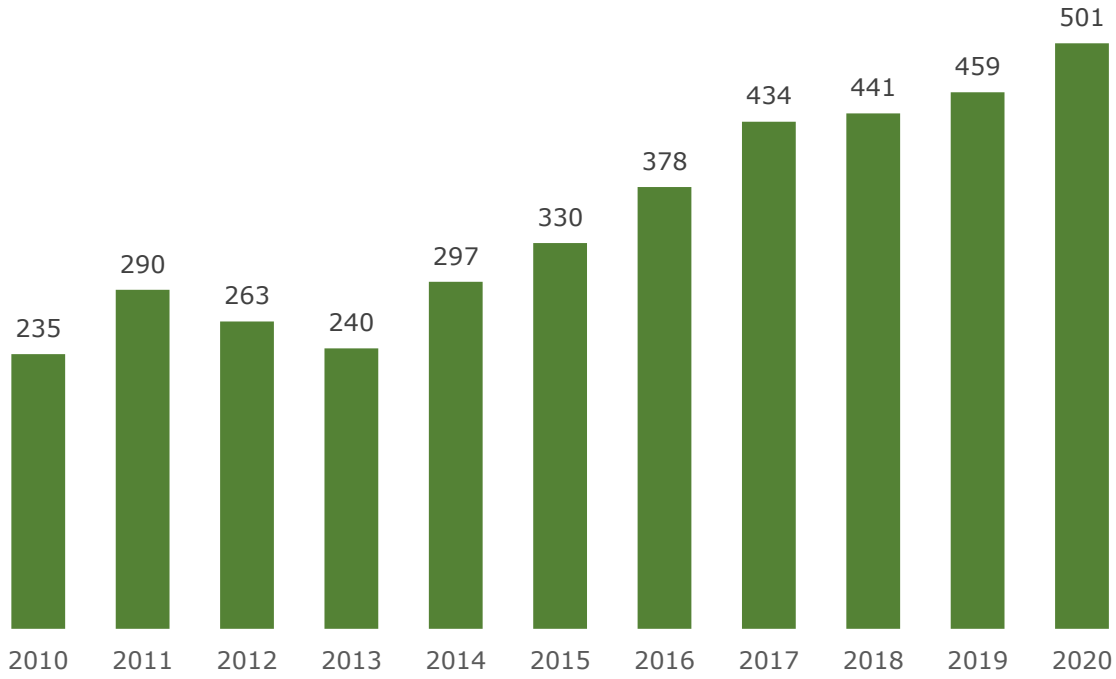
Source: Bloomberg NEF, HAEE's analysis

Highlights

- The energy transition, which is estimated to be fully achieved by 2050, is mainly driven by cheap energy sources such as Wind and Solar.
- As costs continue to fall, a significant increase of new Wind and PVs is expected. These technologies are expected to overtake existing fossil-fuel power plants.
- By 2050 69% of the global power generation mix will be covered by Renewables and only 24% by fossil fuels, a downfall of 62% from current levels.
- In 2050, Wind and PV is estimated to supply 56% of world electricity, while nuclear, hydro and other Renewable Sources, represent the rest 20%.
- Combined Cycle Gas Turbines (CCGT) plants are anticipated to become even more flexible and operate during high-value hours instead of baseload.

For the very first-time the total amount of global investments supporting the Energy Transition hit $500 billion in 2020

Global Energy Transition Investments
(billion $), [2010-2020]



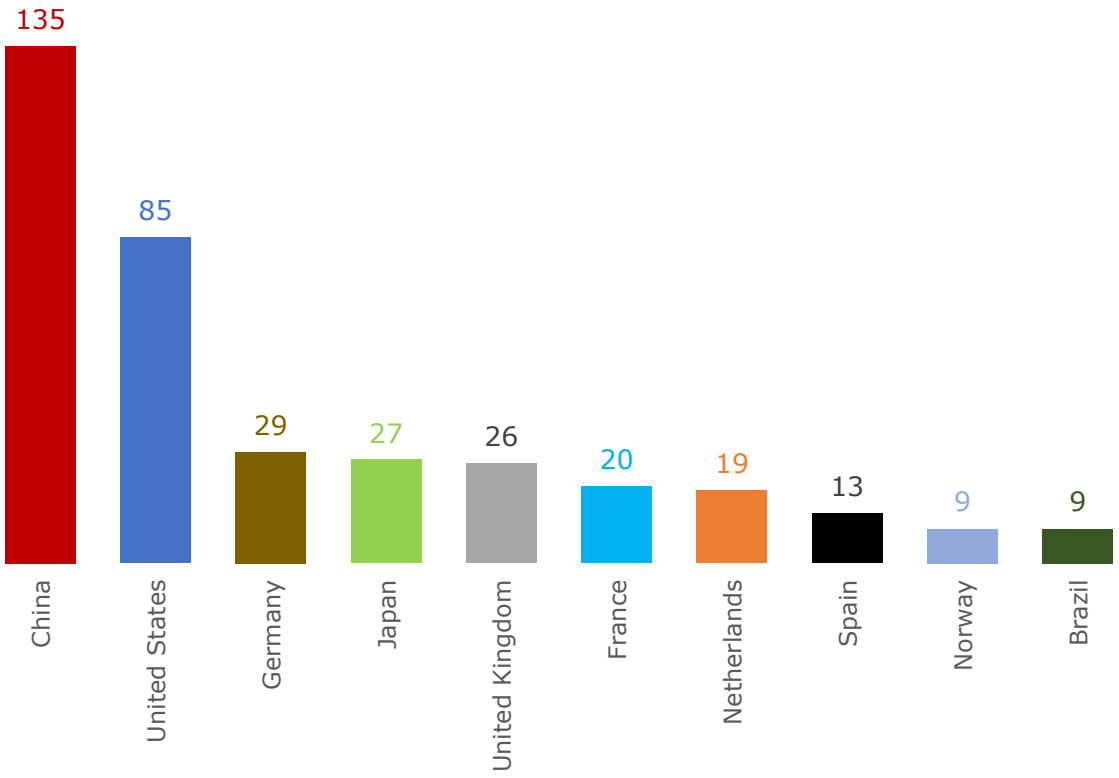
Source: Bloomberg NEF, HAEE's analysis

Highlights

- Energy Transition spending includes investment in Hydrogen technologies, CCS, Energy Storage, Electrified Transport, Electrified Heat and Renewable Energy.
- The total number of the investments increased by 9% in 2020, compared to 2019. $303.5 billion out of the total amount correspond to investments in RES.
- As more countries' commit to net- zero goals, Energy Transition investments doubled between 2010 and 2020, reaching $501 billion in 2020.
- Green stimulus programs aiming to support the quick recovery from the pandemic, have been imposed by the majority of the advanced and emerging economies.
- In 2020, hydrogen and CCS, received investment of $1.5 billion and $3 billion respectively, proving high growth potentials.

China paves the way for Energy Transition investments, with $135 billion spending in the sector during 2020

Global Investment in Energy Transition by Country (billion $), [2020]

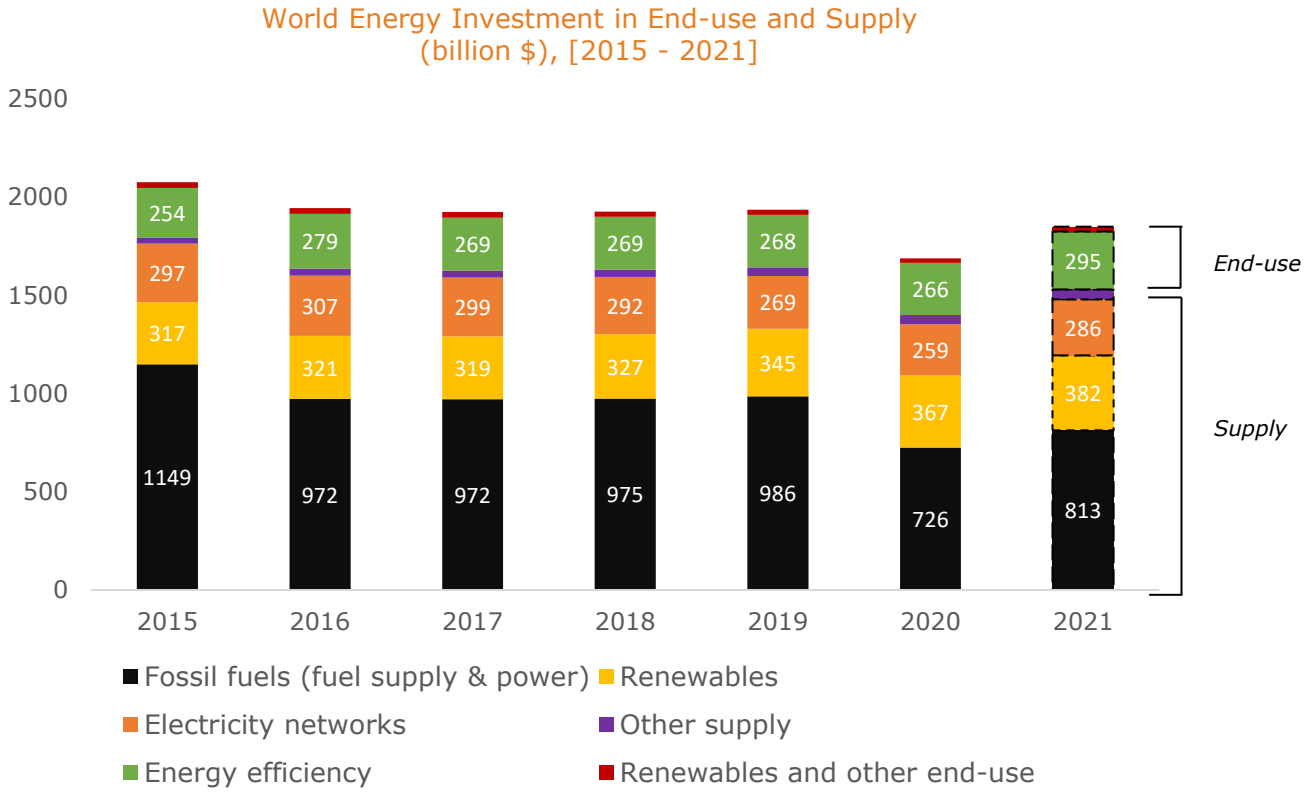


Source: Bloomberg NEF, HAEE's analysis

Highlights

- $83.6 billion of China's investments correspond to RES capacity investments and $45.3 billion to electromobility sector, which faces a growing trend.
- China leaded the road of Wind power investments with country's capital spending in power sector overcoming those for Oil and Gas supply.
- United States invested more than $85 billion in green projects, lower than expected by 11%, in comparison to 2019 levels.
- Developed countries attract lenders and financial institutions, since they are seeking to support secure and sustainable projects, especially during Covid-19 pandemic.
- European countries followed the global trend and increased their Energy Transition investments by 67% compared to 2019, reaching $166 billion.

Global energy investment is projected to rebound by 10% in 2021, escalating from $1.6 billion in 2020 to $1.8 billion



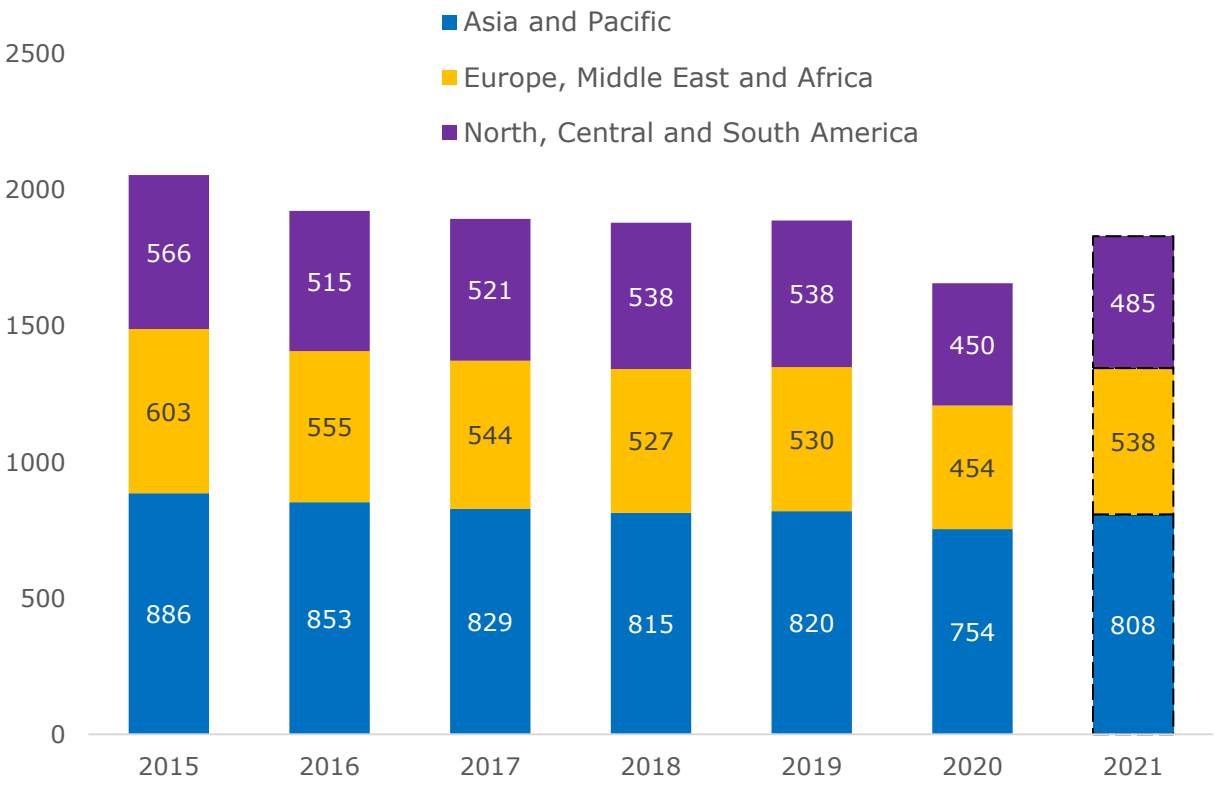
Source: Bloomberg NEF, HAEE's analysis

Highlights

- In 2021 total volume of investment is expected to return to pre-crisis levels. RES attract the main investors interest.
- The investments in traditional fuel production declined from $986 billion in 2019 to $813 in 2021.
- The anticipated increase in energy investments in 2021, will be supported by huge capital flows towards cleaner technologies.
- Most of the countries invest in infrastructure and Energy Efficiency technologies. Spending on efficiency and other end-use technologies improved by nearly 11%.
- The total investments in end-use applications reached $320 billion, the greatest increase since 2016.

Global energy investment in 2021 is expected to reach $1.83 trillion, growing by 11% compared to 2020

Global Energy Investment by Region (billion $), [2015-2021]



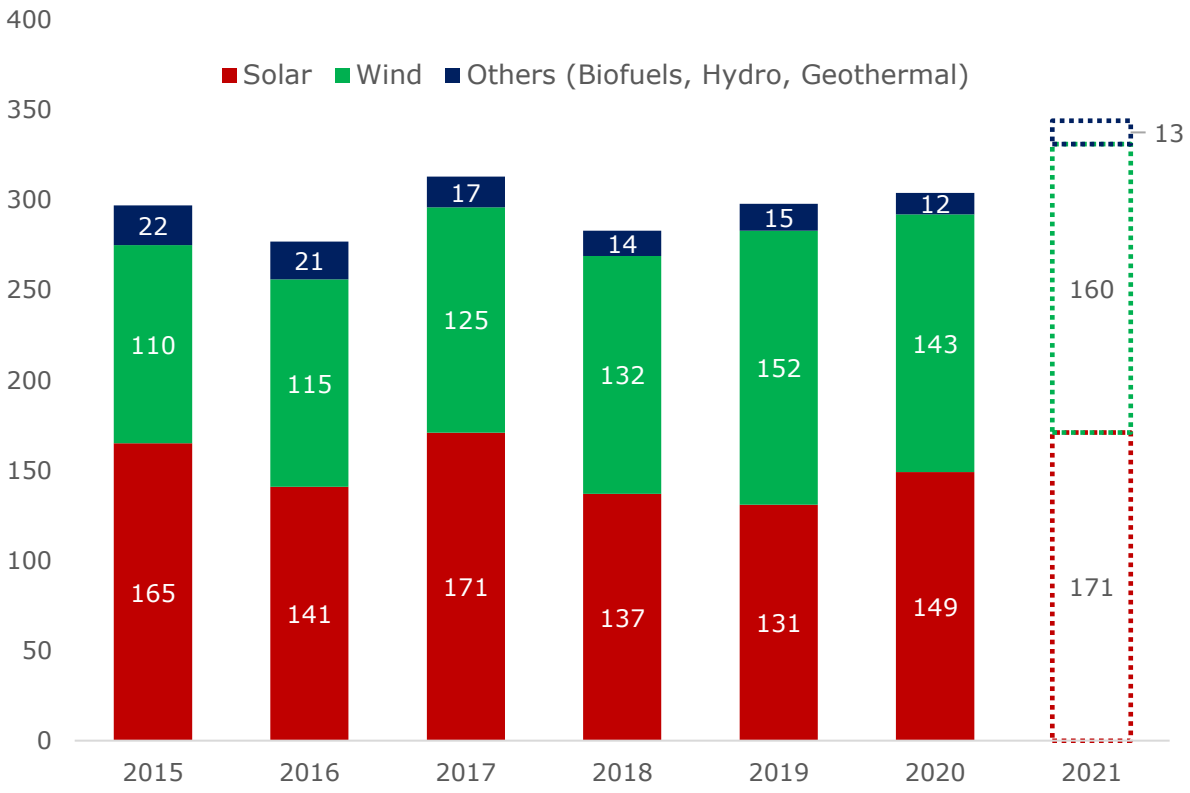
Source: IEA, HAEE's analysis

Highlights

- Global energy investment in 2021 is expected to reach $1.83 trillion, growing by 11% compared to 2020.
- Asia and Pacific countries are the biggest investors in the energy sector. The estimations for 2021 show an important increase of 7% compared to 2020.
- Expectations for total investment decisions in Europe, Middle East and Africa for 2021 stand for $538 billion, covering 29% total energy investment.
- New investments in energy globally stood at $1.88 trillion in 2019, and $1.83 in 2021, proving that the pandemic losses tend to be fully recovered.
- On the other hand, the latest data coming from North, Central & South America reveal a substantial increase, from $450 billion in 2018 to $485 billion in 2021.

Significant annual growth in global new clean energy investment is projected in 2021, reaching $344 billion

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

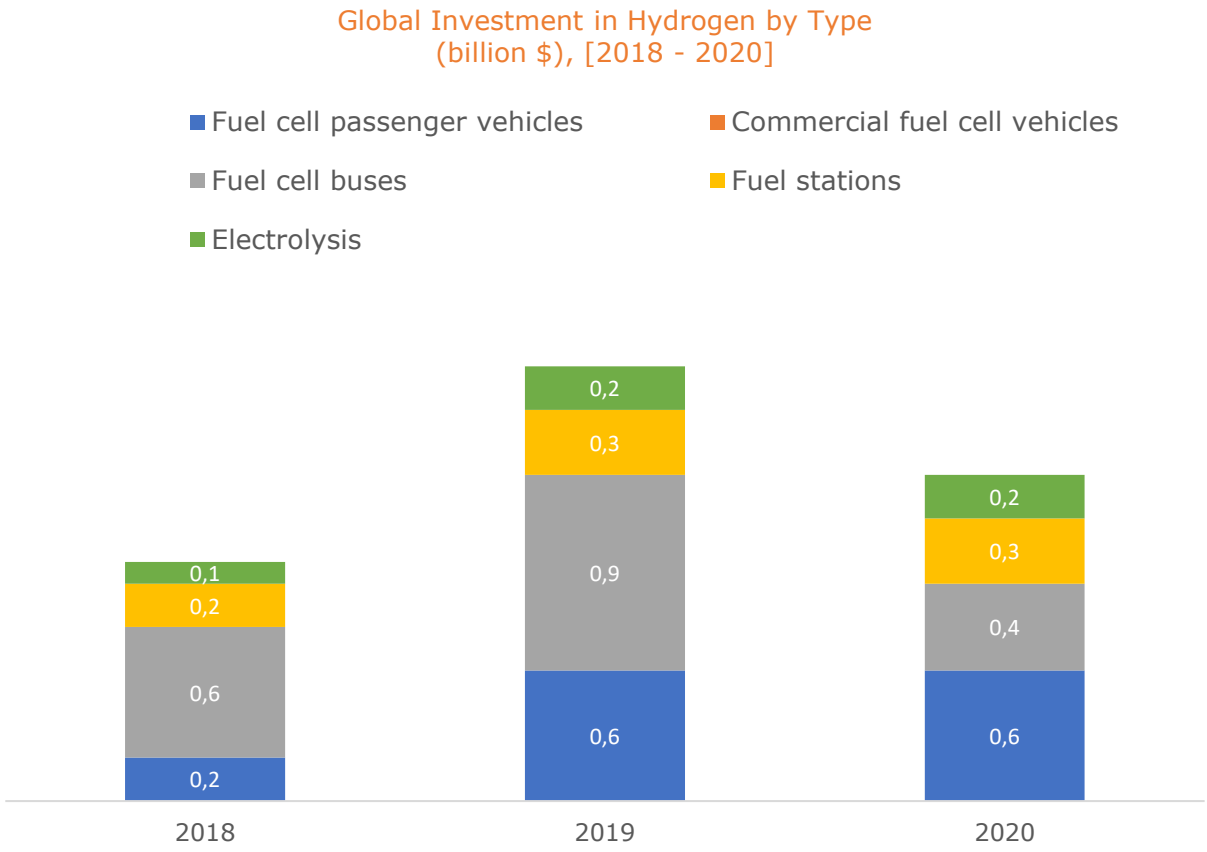


Source: Bloomberg NEF, HAEE's analysis

Highlights

- Significant annual growth in global new clean energy investment is projected, reaching $344 billion.
- Investments in solar accounted for $131 billion in 2019, increasing in $149 billion in 2020.
- According to recent estimations, in 2021 solar investment will reach $171 billion, the highest amount after 2017.
- Interestingly, hydro, biofuel and geothermal maintain a share of 3% on average over the examined period.
- Due to the Covid-19 crisis, wind investments fell by 17% between 2019 and 2020. However, in 2021 investments will reach $160 billion.

Despite hydrogen's exponential increase from 2018 to 2019, hydrogen investments fell to $1.5 billion in 2020



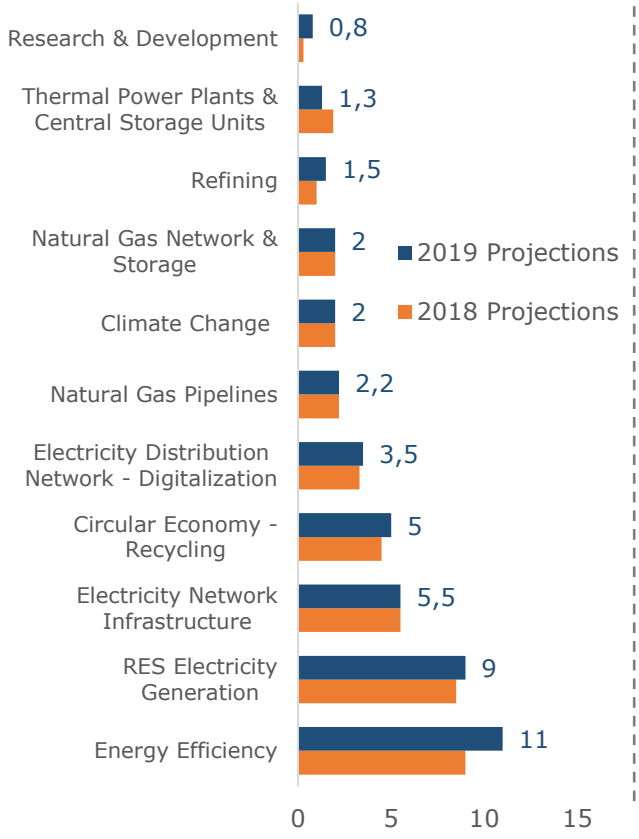
Source: Bloomberg NEF, HAEE's analysis

Highlights

- Hydrogen projects received approximately $1.5 billion in investments in 2020 with a decrease of 21% compared to 2019 levels.
- Spending in fuel cell passenger vehicles remained on a steady level, while fuel cell buses decreased from $865 million in 2019 to $400 million in 2020.
- Investment in Hydrogen refueling stations slightly increased from $268 million in 2019 to $272 million in 2020.
- Investment decisions in electrolysis sector grew by 7%, given the increasing interest in blue and green hydrogen production and strong governmental support.
- The market of commercial fuel cell vehicles is anticipated to receive strong investment interest over the following years.

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

Estimation of Investments in Key Sectors of National Energy and Climate Plan (billion €), [2020 - 2030]



EV Funding Opportunities in Greece

Relief and Recovery Fund (RRF):

- €80 million for "Fortizo Pantou" Program
- "Kinoume Ilketrika" funding program: €100 millions
- "Antonis Tritsis" Greek funding program: €130 millions

Just Transition Fund for E-mobility industry in lignite areas: €200 million in Western Macedonia (Industrial Park)

Electromobility Market funding potential is €510 million in total, which could raise investments of approximately €1.2 billion (according to RRF multiplier factor).

Smart Cities Funding Opportunities in Greece

Smart Cities:
- RRF: €73 millions
- "Antonis Tritsis" Greek funding program:€120 millions

Smart Meters
- HEDNO tender (September 2021): €800 millions

Smart Infrastructure (RRF)
- Environment and Culture: €174 millions
- Smart bridges: €81 millions
- Smart water pumping management: €200 millions
- Smart hydrometers: €200 millions

Energy Storage(RRF)
- Pumped-storage – Batteries (RES development) : €450 millions

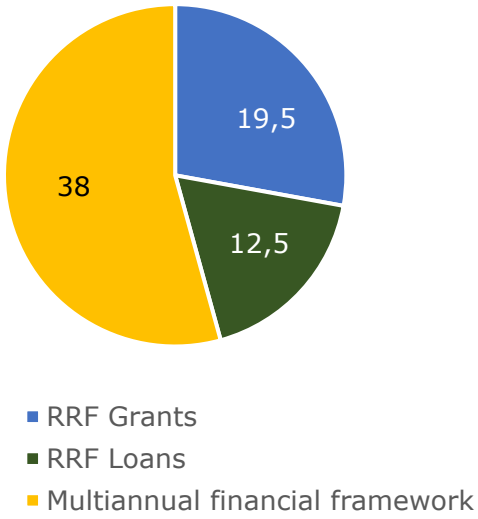
Source: NECP 2019, HAEE's analysis

Highlights

- The NECP following the European Green Deal and 2030 UN Agenda has set very ambitious goals for 2030 and 2050 country's long-term strategy.
- Compared to 2018 projections, the revised National Energy Plan of 2019, grew by 33% and added 11.1 more billion euros.
- Estimations on Energy Efficiency, RES electricity generation, R&D, Circular Economy, Climate Change and Refining further expanded in the revised NECP.
- 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.
- According to National Energy and Climate Plan $44 billion is designed to end for investments in the energy sector.

Greece is expected to receive €32.1 billion from Relief and Recovery Fund and € 6.2 out of the total amount will be used for green investments

Available Financial Sources for Greece for 2021-2027, (billion €)



Estimated potential funding of Greece for the period 2021-2027 is expected to exceed € 70 billion

€ 32 billion come from emergency recovery measures

The costs of RRF will be based on goals and progress milestones

RRF payments will be due to 2026

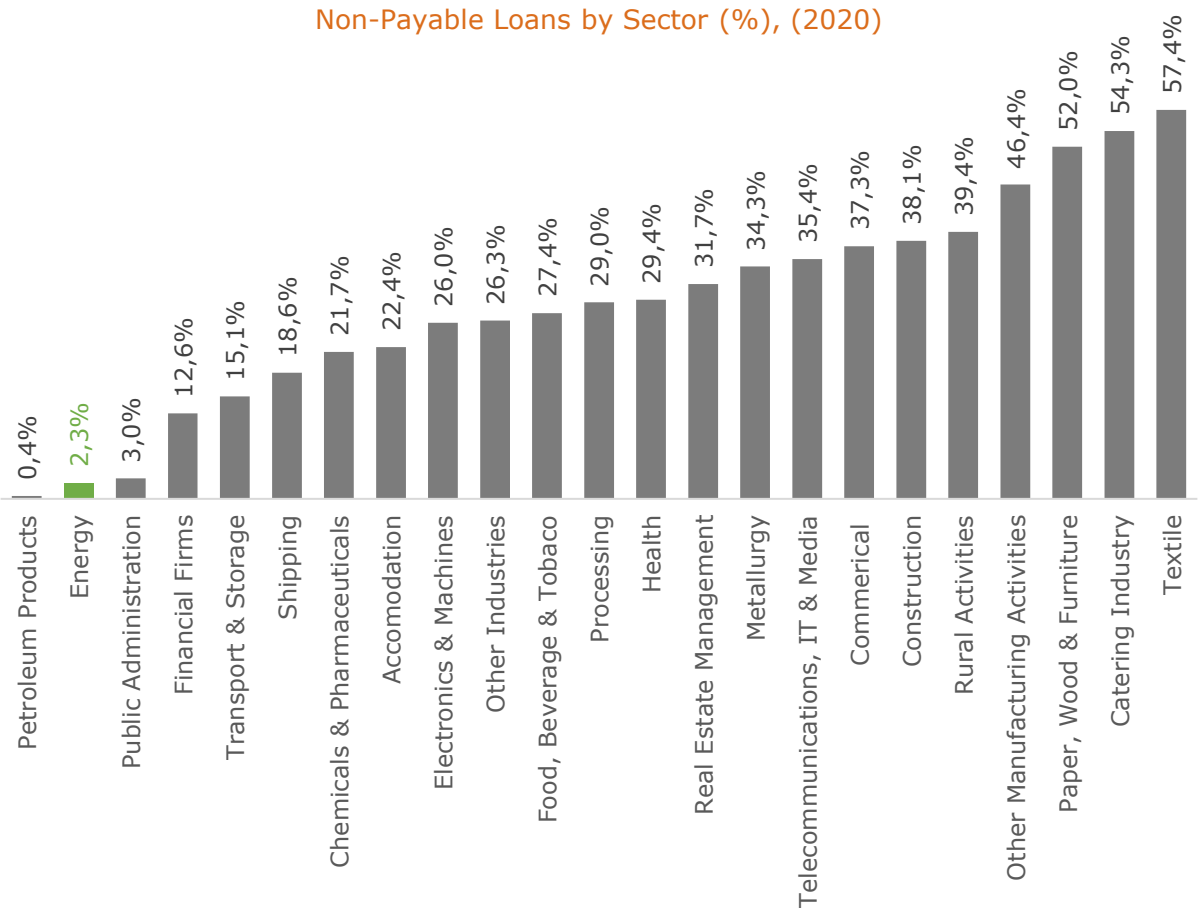
Source: IOBE, HAEE's analysis

RRF Pillars	RRF Budget (in €bn)	Mobilized Investment Resources (in €bn)
Green Transition	6.2	11.6
Digital Transformation	2.2	2.4
Employment, Skills, Social Cohesion	5.2	5.3
Private investment and transformation of the economy	4.9	8.8
Sum of Grants	**18.4**	**28.0**
Loans	**12.7**	**31.8**
Total Investment Resources	**31.2**	**59.8**

Green Transition	RRF Budget (in €M)	Mobilized Investment Resources (in €M)
Power Up	1.200	2.348
Renovate	2.689	5.203
Recharge and refuel	520	1.305
Sustainable use of resources	1.763	2.726
Total Resources	**6.172**	**11.582**

Source: National Recovery and Resilience Plan, HAEE's analysis

The Greek banking system provides increased number of loans to the growing Energy sector, since its NPL percentage keeps on declining



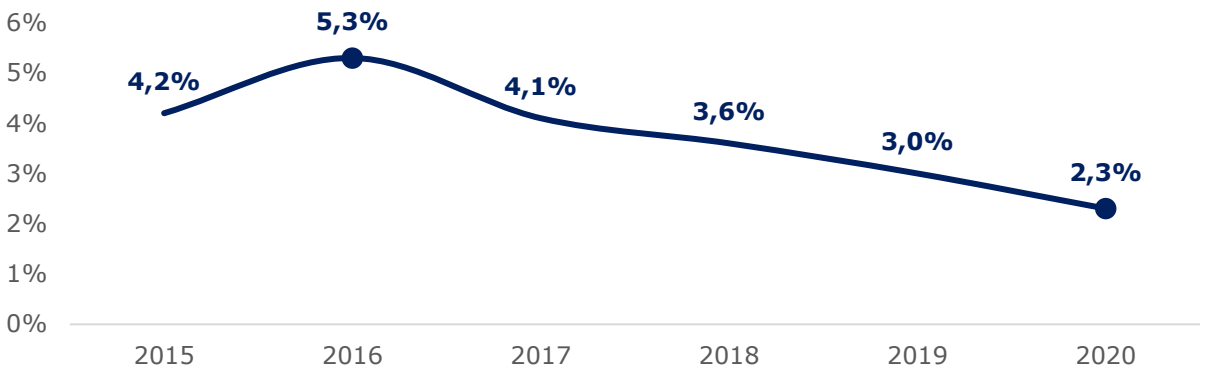
Source: Bank of Greece

Highlights

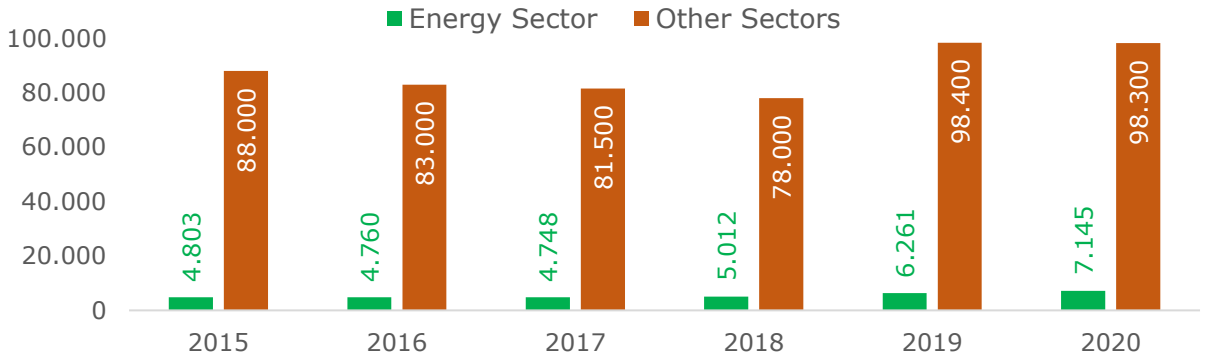
- Loans provided by the banking sector to businesses rose from €121.4 bn. euros in 2019, to €123 bn. in 2020.
- The average non-performing exposure of all 23 sectors during 2020 is 28.7%, with petroleum products being the most creditworthy sector at 0.4%.
- However, sectors like Textile, Catering, as well as Paper, Wood & Furniture remain the most unreliable borrowers.
- The energy sector continues outperforming in terms of both reliability and credibility, dropping its annual rate of non-performing loans from 3% in 2019, to 2.3% in 2020.
- Despite the Covid-19 pandemic, the average non-performing exposure of all 23 sectors was reduced from 36.2% in 2019, to 28.7% in 2020.

The constantly increasing reliability towards the Energy sector led to more than 1 billion euros of new lending from the banking system

Non-Performing Exposure of the Energy Sector (%), [2015 - 2020]



Outstanding Loans of All Industrial Sectors (million €), [2015 - 2020]



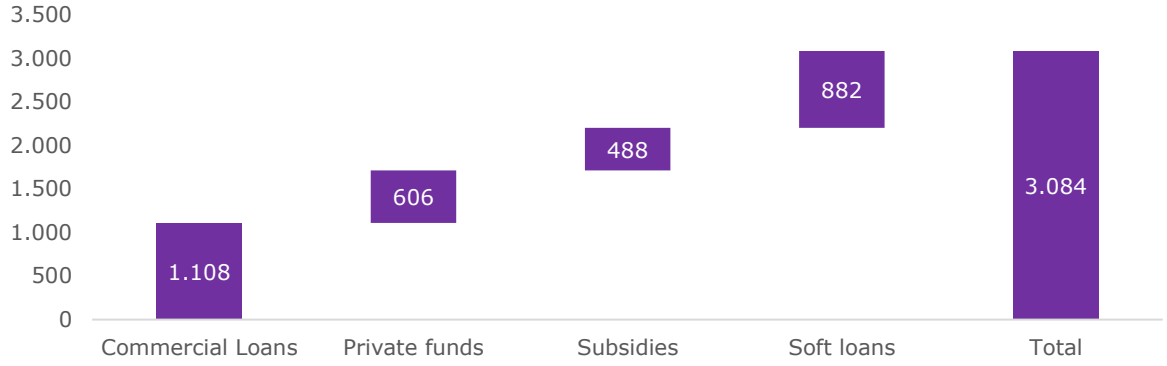
Source: Bank of Greece

Highlights

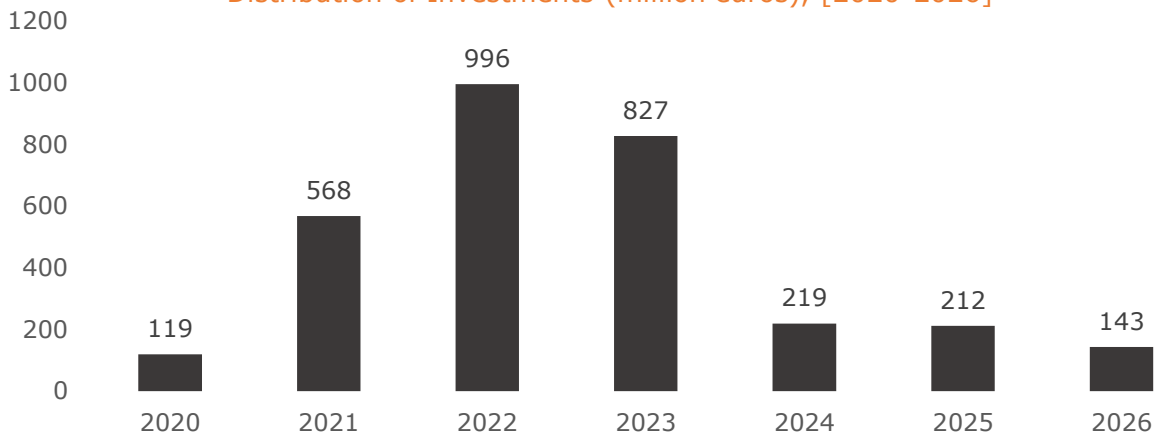
- Since 2017, the non-performing exposure of the energy sector, has steadily been dropping by approximately 0.6% annually, reaching a record-low of 2.3% in 2020.
- This led to a vote of confidence from the banking system, which has provided the sector with over 2 billion euros in the past 2 years.
- The outstanding loans in the energy sector stood at 7.2 billion euros in 2020, an increase of 2.5 billion euros since 2015.
- After 4 years of consecutive decline, the outstanding loans in all other economic sectors recorded a spectacular increase of 20 billion euros in 2019.
- The banking sector strongly supports investments in RES, since they are considered vital for the economic growth and sustainability of both Greece and the EU.

Frontloaded investments of €3 billion, coming from European and national sources will be exploited for the lignite phase-out scheme

Funding Sources for Financing the Transition Procedure in Lignite Areas (million euros)



Distribution of Investments (million euros), [2020-2026]



Source: Master Plan, HAEE's analysis

Financing sources

Just Transition Fund
- Allocation of resources through grants for productive investments
- Economic transformation of affected areas

Invest EU Scheme
- Wider eligibility and leverage of private resources
- Covering the subsidies for investments gap

Public sector credit facility
- Possibility of additional investments in infrastructure

Domestic and international financial institutions
- Raising funds from the financial system
- Possibility of optimal risk allocation

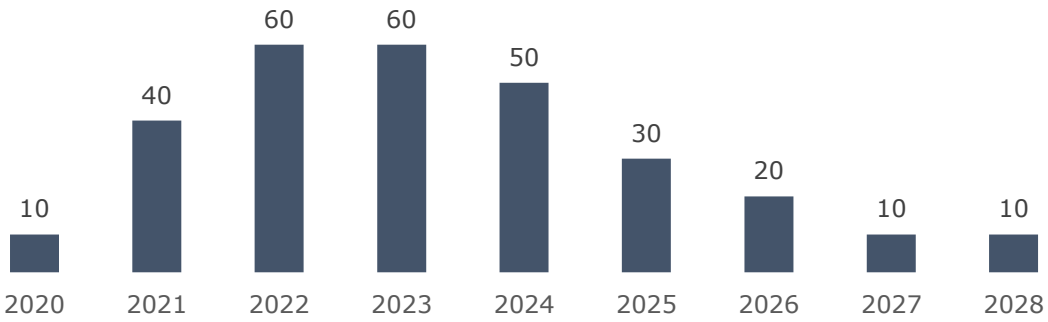
Private funds
- Increased mobilization of individuals' participation

Other European funding mechanisms
- Utilization of other sources of financing (NSRF)

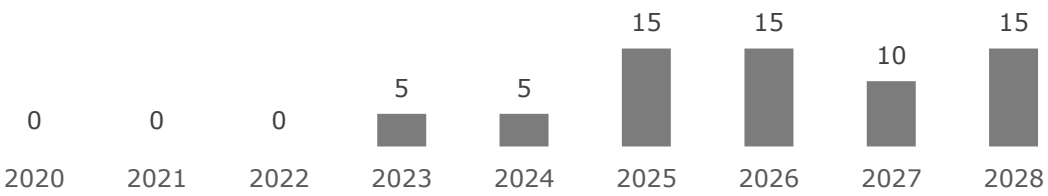
Source: HAEE's analysis

More than €355 million will be directed according to PPC's estimation for land recovery in the areas affected by lignite-units phase-out

Total Cost of Land Recovery in Western Macedonia (million euros), [2020 - 2028]



Total Cost of Land Recovery in Megalopolis(million euros), [2020 - 2028]



New Investments in Areas Affected by the Lignite-units Phase-out

Western Macedonia

- **€1.2 bn** for solar parks - total install capacity of 2GW
- **€50-60M** for the development of an energy R&D center
- **€200M** for the establishment of an electromobility center
- **€100M** for a 40MW CHP Unit
- **€20-25M** for the development of Enotourism
- **€50-60M** for the construction of a rehabilitation center

Megalopolis

- **€350M** for solar parks - total install capacity of 550MW
- **€90M** for the construction of a pharmaceutical production Unit
- **€30-40M** for innovative cattle farms
- **€40-40M** for an amusement park

The **Just Transition Factor** favors the acceleration and implementation of investment in affected areas:

- Increases the subsidy rate of "Eksoikonomo – Autonomo" per **10%** in the affected areas **(~€100M)**
- Creates incentives for the development of electromobility in the country (Reduction of tax rates and employer contributions, increase in depreciation rates, issuance of installation and operating licenses)
- Accelerates licensing and implementation in RES projects

Source: Master Plan, HAEE's analysis

2021 WORLD ENERGY ISSUES MONITOR

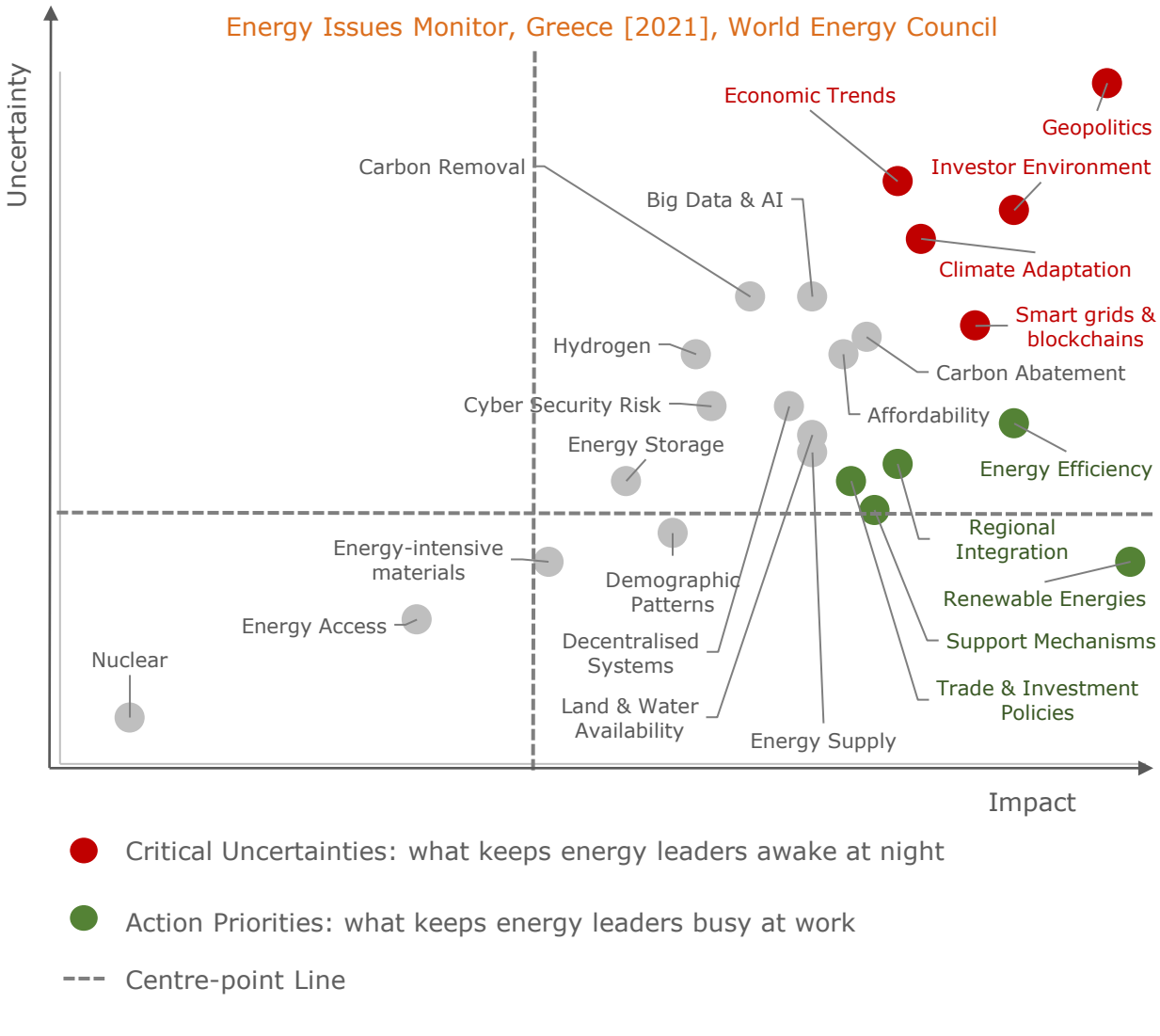
WORLD ENERGY COUNCIL

Energy Issues Monitor, Greece

According to World Energy Council, Greek energy markets are advancing towards liberalization and integration into the European Union (EU) Internal Energy Market. The pandemic has resulted in significantly lower oil consumption, lower electricity demand, and stable gas consumption. However, the recent crisis dramatically changed trends and Greece has experienced a severe decline in GDP during 2020. The expectation for 2021 is encouraging, since economic growth of more than 3% is projected, supported by reviving private and capital spending, and funding by the EU Recovery and Resilience Facility.

Moreover, the gradual easing of Covid-19 restrictions is considered to give a strong push to the crucial energy market. Although the investor environment in Greece has seen positive developments over the past years, investors worry about the impact of the Covid-19 pandemic on the country's economy. According to UNCTAD's World Investment Report 2020, Foreign Direct Investments (FDI) flows reached $ 4,6 billion in 2019, their highest level since 2009, but experienced a huge drop in 2020.

Considering the recent developments in the energy sector, new electricity markets were launched in late 2020, and a Day-Ahead electricity market coupling with Italy and Bulgaria have also been established. Renewable Energy Sources maintain their high impact and low uncertainty position and are broadly considered as a key priority. In line with decarbonization commitments and the phase-out of all operating lignite-fired units by 2023, the Greek government is putting forward ambitious plans and incentives for private investments in Wind, Solar and Biomass/Biogas. Due to these efforts and despite the limitations, Greece has already surpassed its EU 2020 renewables targets.



The launch of the new electricity markets in Greece in November 2020 aims to integrate the Greek market into the EU internal energy market, mainly through market coupling. Greece has successfully partnered with Bulgaria for the IGB gas pipeline. Additionally, local and foreign investors plan to build a liquefied natural gas (LNG) terminal in Alexandroupolis. The investment plans for an LNG facility at the Corinth refinery and the plans for the EastMed undersea pipeline underline Greece's important role in the eastern Mediterranean and its pivotal position as an energy transmission-hub while improving energy security.

Despite recent efforts, energy efficiency in Greece continues to require further action. Curbing energy consumption is a priority in achieving climate and energy security objectives. Improving efficiency in private and public buildings, with strong state, EU and private support, is also essential to alleviate energy poverty. Greek energy policy is committed to the EU's overall goal for climate neutrality by 2050 and plans to reach a 62%-65% renewables share in the electricity energy mix by 2030. The Greek Electric Vehicles market has been rather immature, although from 2019 onwards an increasing trend has been recorded. More specifically, sales rocketed right after the launch of "E-Moving" incentive, reaching 10% of new monthly registrations in December 2020. The Greek government announced a package of economic incentives, tax reduction, exemptions and funding-tools, supporting the promotion and the deployment of electric cars and charging stations.

Finally, the Greek banking system continued to provide loans to the growing Energy sector, since its Non-Performing Loan percentage keeps on declining to reach 2.3% in 2020. The National Energy and Climate Plan (NECP) foresees 44 billion euros in energy investments by 2030. In 2020 the Lignite phase-out procedure was launched, paving the way for country's independence from lignite. Greece is, also, expected to receive 32.1 billion euros from Relief and Recovery Fund, shaped as loans and grants, out of them, €6.2 billion will be used for green transition investments.

Data Sources

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http://iobe.gr/

http://www.statistics.gr/

https://www.greekhydrocarbons.gr/

Useful links

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

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
https://www.hradf.com/en/fund

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
CO2	carbon dioxide
GJ	gigajoule
GW	gigawatt
kL	kilolitre
km	kilometre
ktoe	thousand tonnes of oil equivalent
kW	kilowatt
kWh	kilowatt hour
m3	cubic meter
mcm	million cubic metres
Mt	million tonnes
MtCO2	million tonnes of carbon dioxide
MtCO2-eq	million tonnes of carbon dioxide equivalent
Mtoe	million tonnes of oil equivalent
MW	megawatt
MWh	megawatt hour
tCO2	tonne of carbon dioxide
toe	tonne of oil equivalent
TWh	terawatt hour

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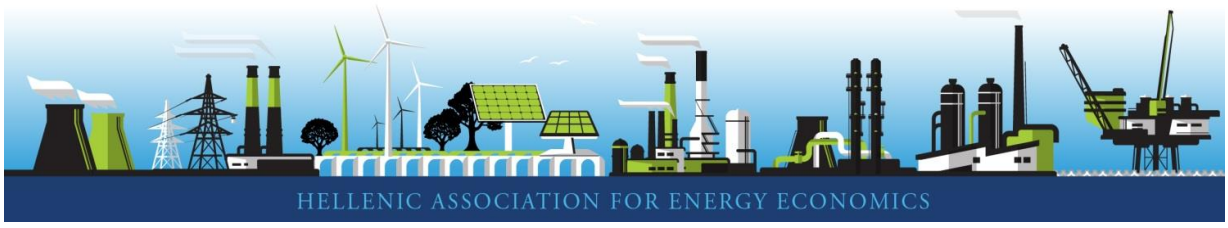
The Hellenic Association for Energy Economics (HAEE - www.HAEE.gr) is a non-profit research and professional organization acting as an interdisciplinary forum for the exchange of ideas and experiences among energy experts. It acts as an independent consulting body for national and international organizations 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)



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