| Greek Energy Market Report |

2022

HAEE HELLENIC ASSOCIATION for ENERGY ECONOMICS

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HAEE 2022

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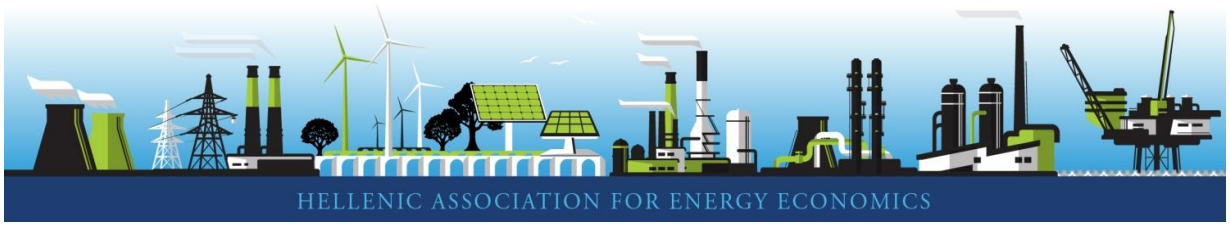


Hellenic Association for Energy Economics

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 €3.8 billion (including drawn facilities, LGs, LCs and excluding undrawn lines), maintaining its No1 position in financing renewable projects with a market share of 36%.

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

Prof. Dr. Spiros Papaefthimiou
Chairman HAEE

It is with great pleasure to introduce our Greek Energy Market Report, in partnership with NBG, for yet another year. Not only is the report HAEE's flagship project, but it has also become a reference point for Energy stakeholders – private sector, policy makers, government authorities, NGOs etc. – looking for direct and insightful information about the energy market in Greece and its position within an international context. Whilst not altering the successful and easily accessible format of the report, we have strived to enrich its content, make it even more relevant and follow key developments closely.

2021 was a year of remarkable growth, after pandemic-hit 2020, creating a context of opportunities and hope, but also significant challenges, contradictions and uncertainty. The year was characterized by landmark policy documents, such as EU's Fit-For-55, central support initiatives, such as the EU/National Recovery and Resilience Facility, but also inflated prices and significant supply chain issues across the energy sector and economic activity in general. By the moments of writing these lines, the world is shaken by the Russia-Ukraine war and its unprecedented repercussions on the energy market. HAEE is constantly collating, analyzing and distilling the energy market developments, aspiring to be an objective source of information and insights, supporting an open dialogue and informed decisions in the energy sector.

I would like to thank our strategic partner National Bank of Greece for its continuous support in this venture, and especially its CEO, Mr. Pavlos Mylonas, for endorsing the production of this report, Mr. Vassilis Karamouzis, Ms. Argyro Banila and Mr. Harry Vovos for our excellent collaboration. We are grateful also to our members, that span across the economic sector and help us not only with their material support, but also with allowing us the opportunity to have a direct connection with the market. Finally, I would like to thank our committed staff team of project managers, analysts and advisors that help us yield work of such high quality and impact and look forward to introducing an even more impressive piece of work next year.

Foreword

Prof. Dr. Kostas Andriosopoulos
Project Coordinator

2021 was undoubtedly a year of significant developments in the energy sector, both in Greece and internationally, characterized by positive and negative records. The RES and hydroelectric share in Greece's energy mix surpassed that of fossil fuels for the first time, with record RES contribution in May (63%) and record wind contribution in September (48%). At the same time, and even without considering the recent geopolitical turmoil, the mean electricity wholesale price skyrocketed to 240€/MWh during 2021, which, in combination with the high natural gas and CO2 prices, at 90€/MWh and 80€/tn respectively, created an entirely new reality in the sector, calling for targeted short- and long-term measures and actions.

Greece has a unique opportunity to expand its adoption and utilization of RES and accelerate its energy transition, through an abundance of financing tools (e.g., RRF, Just Transition, ESPA). Nevertheless, the broader transformation of the wholesale market and the expansion of Power Purchase Agreements (PPAs) is also critical for the development of the respective infrastructure. Investors' interest in RES is a given and in a trajectory of growth, expanding also to newer technologies, such as offshore wind and hydrogen. A prerequisite for the above interest to materialize, however, is the presence of a coherent and technology-specific regulatory framework, that would generate confidence to investors and minimize bureaucracy and licensing timeframes. Finally, one cannot overlook the recent dramatic consequences of the Russia-Ukraine war, and EU's impressively ambitious Repower EU plan, aiming at disengaging from Russian fuels by 2027 and accelerating its green energy transition. The commission proposes a goal of 45% RES mix (instead of 40%) and 13% energy efficiency target (instead of 9%) by 2030, and reduction of Russian natural gas imports by 1/3 within 2022.

There are, hence, great opportunities to pursue, but also significant hurdles to overcome. As energy poverty poses an imminent threat over the EU and Greece, concerted efforts on new investments and appropriate legislative/regulatory frameworks are required now more than ever before.

The Greek Energy Market Report 2022, through its continuity and systematic approach, attempts to capture all the key facts and figures of the energy market spectrum, stimulate and support discussions across the board and ultimately contribute to the advancement of the Energy Sector in Greece. I am very pleased to see all the hard work to come to fruition for one more year, and I am sure many more will follow, and even greater heights will be reached.

Foreword

Mr. Kostas Skrekas
Minister of the Environment and Energy

It is my pleasure to introduce for the 2nd consecutive year the "Greek Energy Market Report 2022" presented by the Hellenic Association for Energy Economics (HAEE) and supported by the National Bank of Greece (NBG). In a rapidly changing energy environment, 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, and illustrates a solid analysis of several sectors affecting the path of Greece towards the Energy Transition.

Greece installs Renewable Energy Sources at a faster pace even than the very ambitious European strategy goals for green transition. In 2020, 1.000 MW of RES were installed and another 1,153 MW in 2021, and it is estimated that about 1,750 MW will be connected to the grid in 2022.

The reduction of the average licensing time for new RES projects to 14 months from the current 5 years, the development of electricity storage projects with an installed capacity of at least 3.5 GW by 2030, and the increase of capacity in the electricity grid for the integration of more RES, are the main objectives of the draft bill for the simplification of the licensing process of RES. The strategic objective is to increase the RES total installed capacity from 8.62 GW today, to 25 GW by 2030. For the implementation of new RES investments with a total capacity of more than 12 GW, it is estimated that an investment of €10 billion is required.

Key national programs, such as the energy upgrade of the country's building stock, the promotion of electromobility, and the decarbonization of the islands through the GR-Eco Islands initiative, will decisively contribute to the energy transition of the country towards a climate-neutral economy. Regarding energy efficiency, in the last "Exoikonomo" program we had over 87,000 applications, more than any other time. The available budget, which had been initially allocated, is sufficient to cover 45,000 to 50,000 beneficiaries to upgrade their home's energy efficiency and thus reduce their electricity consumption, environmental footprint and ultimately their bill. Additionally, with the new program "Recycle, Change appliance", up to 300.000 households will be able to replace up to 3, old electric appliances, air conditioners, refrigerators and freezers, with new, more efficient devices. Therefore, they can reduce their energy consumption by up to 30% from their bill, achieving better efficiency.

Nowadays, Europe faces an unprecedented energy crisis. Russia's catastrophic invasion of Ukraine has created serious turbulence in the global economy and a crisis that threatens Europe's economy and social cohesion, fueling inflation and placing an unbearable burden on households and businesses. We are constantly looking for new interventions to support our most vulnerable citizens and tackle energy poverty. We were the first among the EU Member States to establish the Energy Transition Fund. Between last September and June, we made over €4 billion available in subsidies and rebates on electricity and gas bills to offset the burden borne by domestic and business consumers from the explosive increases.

Despite the wide measures we have taken, we understand that this crisis of unprecedented intensity requires even bolder interventions. We are fully aware of the anxiety and concern of citizens, who see that they are forced to spend an increasing part of their income to cover energy costs. For this reason and to drastically reduce the burden on consumers beyond the subsidies, we are adopting a model of drastic intervention in the Greek energy market that disconnects the retail price of electricity from the international exchange price of natural gas. From July onwards, we are implementing a mechanism in the wholesale electricity market to ensure the revenues of the production units reflect the actual operating costs, thus excluding the creation of future windfall profits for electricity producers.

Greece is emerging as a pillar of energy security for the whole of South-Eastern Europe. We are deepening regional cooperation by developing strategic infrastructure which will provide alternative sources of energy supply at a critical juncture. We are expanding the storage capacity of Revithoussa with a new floating tank, which will be completed by July. Also, the FSRU floating station in Alexandroupolis will significantly reduce the dependence of the countries of the wider region on Russian gas, unlocking an important export potential from Greece to the Balkans. We are shielding our country from imported energy crises by promoting electricity interconnections and by strengthening national energy security. We have taken all the necessary measures to ensure the country's energy adequacy to face even the most adverse scenarios.

It is imperative that we further strengthen our cooperation with the countries of the wider region, to achieve our goal of energy independence and competitiveness. A key priority of the Government to shield the country's energy sector is the electrical interconnection with Egypt. The two countries' electricity systems will be connected by an undersea cable that will carry green energy from North Africa to Europe. In addition, we are looking at strengthening our cooperation with neighboring countries in the Balkans.

It is obvious that the only realistic solution to overcome this crisis and shield the country from similar phenomena in the future, is the shift to clean energy using the sun and the wind, abundant in our country, implementing innovative RES projects such as green hydrogen and offshore wind. Greece has great potential in becoming a transit hub for green energy for the whole of South-Eastern Europe.

Foreword

Mr. Pavlos Mylonas
CEO, National Bank of Greece

I am proud to introduce for the fourth 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). The recent energy crisis amplifies the importance of this publication as a tool and source of information on the specifics of the Greek energy market for investors and market players. To this end, NBG continues to aspire to be viewed as the expert and market leader in financing Energy initiatives in Greece and Southeastern Europe, and recent developments confirm further progress to this goal.

With the Ukraine crisis raising further the importance of energy self-sufficiency under the Green Deal, the European Commission has recently unveiled an ambitious plan (called "REPowerEU"), raising the target for RES to 45% of total energy production by 2030. Under this plan, additional investments of c. €200 billion are estimated to be required to cover the phasing out of the imports of Russian fossil fuels, on top of the c. €600 billion for "Fit-for-55". Overall, EU's transition to a green economy should require energy investments of c. 3% of GDP per year up to 2050.

In line with EU objectives, Greece has set ambitious targets for RES penetration in electricity generation (50% in 2030 and 85% in 2050, from 35% in 2020), as well as for a significant increase in the economy's electrification (c. 45% in 2050, from 27% in 2020). In total, required investments for the next decade are estimated in the range of €55-60bn, in the context of a front-loaded plan in line with the "REPowerEU" strategy. While Greece is susceptible to rising energy prices in the short run, the re-drawing of the EU energy map provides Greece with the medium-term potential to develop from an energy importer to a green energy hub. Leveraging on its geographical position and natural advantages in terms of wind and solar conditions, Greece is already taking steps in this direction. Recent developments place Greece as a front-runner in the EU quest to balance the energy trilemma of decarbonization, affordability and security of supply.

NBG remains committed to lead Greece's energy transition, leveraging upon its financial strength, its human capital and its diverse products and services portfolio. Amid the ongoing global energy crisis, NBG continues to contribute significantly to the realization of high-profile investments that accelerate the energy autonomy of Europe overall. The latest milestone transaction includes the exclusive underwriting and coordination of a c. €300mn facility for the construction, development and operation of the 1st LNG FSRU terminal in Greece, located at Alexandroupolis, sponsored by Gastrade, a high-profile consortium of local and international sponsors. It should be noted that NBG is historically the market leader in Energy projects, with an associated total portfolio that currently exceeds €3.0 billion in drawn facilities, and almost €3.8 billion including drawn facilities, LGs, LCs and excluding undrawn linesoff-balance sheet exposures, achieving an aggregate growth rate of more than 20% over the past 2-years. Over the past year, we have additionally maintained our No.1 positioning in financing Renewable projects, with a market share of approximately 36%.

Reinforcing our role as the leading local bank for investments of the energy sector in Greece, we have expanded our energy offering to clients with innovative Global Markets hedging solutions for electricity, natural gas and emissions, while we aspire to play a pivotal role in the transition of the local energy market from a tariff-based approach to the emerging market regime of Corporate Power Purchase Agreement. Finally, NBG provides a full spectrum of clearing services, being the sole Greek bank, member of the European Commodity Clearing. All these contribute to NBG, being the Bank of first choice for all energy projects.

Coordinator

Prof. Dr. Kostas Andriosopoulos is the Director of the Research Centre for Energy Transition Sustainability at Audencia Business School. Kostas is a member in various professional and academic associations, including President of the Energy Committee of the American Hellenic Chamber of Commerce; founder and former Chairman of the Hellenic Association for Energy Economics; board member of the Global Gas Center - World Energy Council as a Gas and LNG markets expert; member of the board of the International Association for Energy Economics (IAEE); founding board member of the Financial Engineering and Banking Society. As of August 2018, he is the Country Manager of Akuo Energy in Greece.

Lead Researcher

Dr. Filippos Ioannidis holds a PhD from 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.

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.

Dr. Theodora Vataroglou is a Research Associate at HAEE. She holds a PhD in Invasive Ecology from the Nottingham Trent University, UK, an MSc in Environmental Management from the University of Nottingham, UK, a B.A. in Geography from the University of the Aegean, Mytilene, Greece and a Diploma in GIS. She has over six years' experience in engineering consultancies in the UK, involved in desktop and field studies for civil, transport and environmental design projects. Her expertise also includes GIS mapping and analysis, sustainability assessment and contaminated land management.

Dr. Dimitris Sarantaridis is a Chartered Mechanical Engineer and PRINCE2 practitioner, holding a PhD in Fuel Cell technology from Imperial College London. He has extensive R&D and professional experience, having worked in a number of leading institutions, such as University College London, the National Physical Laboratory (UK) Imperial College London and King's College London. He has over 7 years' experience in developing and managing research partnerships between industry and academia, has closed projects in excess of £20m and engaged with over 300 companies across the globe.

Nikos Georgiadis is a Research Associate at HAEE with a Bachelor's degree in Mechanical Engineering (University of Thessaly, Greece) and a Master's degree in Environmental & Energy Management (University of Twente, Netherlands). Nikos has undertaken assignments in projects relevant to Energy Systems Modelling, Water-Energy-Food nexus, Stakeholder Engagement at Deltares, University of Twente and KTH Royal Institute of Technology respectively.

Vasiliki Gemeni is a Geologist with an MSc in Applied Environmental Geology from the National and Kapodistrian University of Athens. Her main research fields are Carbon Capture Utilisation and Storage, low carbon technologies, sustainable mining and renewable energies focusing on geothermal energy. She has participated in many European and national research projects and published her work in many scientific journals and conferences. Since 2019, she participates in the COST Action CA18219 - Research network for including geothermal technologies into decarbonized heating and cooling grids (Geothermal-DHC), leading the Permanent Working Group (PWG) 2 "Outreach and Communication".

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.

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).

Executive Summary

The Greek Energy Market Report 2022, is a valuable tool for energy professionals, regulators, researchers, policymakers, students and those who wish to delve into the developments, advances and challenges regarding the energy market in Greece. It is also an asset for market participants and international or domestic companies, willing to invest in the Greek energy sector.

Aiming to capture today's picture, the Report consists of nine distinct chapters, covering most developments in the energy sector:

- **Chapter 1** covers the Country Profile of Greece by analyzing and providing its key demographic, macroeconomic, and energy statistics, in many cases compared with those of the EU's, accompanied by an examination of the impact of the recent energy crisis.

- **Chapter 2** provides an illustrative representation of the EU's and Greece's new strategies, policies and targets, while moving towards Energy Transition, with special reference to the role of Hydrogen as the new bridge fuel.

- **Chapter 3** focuses on the Electricity sector, highlighting various issues related to prices, generation, capacities, imports, exports, and RES share. Emphasis is given on the remarkable changes in electricity prices occurred in the Greek market.

- **Chapter 4** is a robust examination of the new formation, structure and role of the Hellenic Energy Exchange under the official operation of the Target Model. The volatility of spot prices and the market design of a fully operational Natural Gas Exchange are also presented.

- **Chapter 5** is dedicated to Natural Gas, in the light of the Russian invasion of Ukraine, and explores the EU's plan and Greece's strategy for reducing their dependence on Russian gas imports and diversifying their sources.

- **Chapter 6** focuses on the significant contribution of Renewable Energy Sources in the Greek energy system, by providing the latest available data for upcoming tenders, applications and connection procedures, market analysis, and updates regarding the share of RES penetration.

- **Chapter 7** covers the Oil and Refining market, which continues to play a crucial role in the country, as it is still linked with major parts of the economy.

- **Chapter 8** provides an extensive analysis of Energy Efficiency in Greece, highlighting the progress being made towards achieving all its energy-related goals. New economic, energy efficiency related measures and actions, such as the new "Exoikonomo" are also presented.

- **Chapter 9** describes the current Investment developments in Greece and internationally. The chapter covers clean energy technologies, R&D investment in RES and sustainable investments as these are presented in the ESG indices.

Given the green European legislative framework and the EU's ambitious, but realistic goals under the REPowerEU plan, the Fit-for-55 package and the EU "Green Deal", Greece has started undertaking political actions for the transformation of its energy sector from fossil-based to zero-carbon. Natural Gas along with Renewable Energy Sources are replacing lignite in the electricity generation mix, while during the last year, the carbon intensity of Greece's electricity sector has been significantly decreasing due to higher renewables and lower fossil fuels utilization.

The decarbonization process of the electricity generation in Greece continues, with the lignite energy technologies capacity share dropping at 12% in January 2022. Despite this drop, the lignite phase-out will be postponed from 2025 to 2028 as a measure to reduce dependency on natural gas imports. Significant progress is being made in the renewable energy sector despite the glitches observed in the connection terms and the number of applications waiting for the required electrical space to be opened for them to operate. Last year 1.5 GW of new green projects were added to the market, from the 7.7 GW that is the national target for the decade to 2030, meaning that 20% of it has already been covered. Moreover, until 2025, 3GW are planned to be added to the system investments in renewable projects and technologies are expected to thrive, and the NECP target of the share of RES will be significantly extended.

In 2021, strong volatility is noticed when comparing electricity prices between Q1 and Q4 in most European countries. Particularly, electricity prices in Greece recorded historical highs during the second half of 2021. Household natural gas prices followed the same trend and tripled during the period 2021-2022, reaching its highest at 11.08€/MWh in January 2022. It is expected that because of the ongoing Russia-Ukraine war, natural gas prices will further increase, mainly due to potential Russian sanctions and low storage levels. At the same time, following the REPowerEU guidelines, the EU prepares its energy future without Russian gas and turns to LNG, as the first alternative solution to diversify its energy sources and ensure its energy security.

The long-term Vision 2050 Energy pathway for Greece shows a 'clean' path to other forms of alternative fuels, such as hydrogen, while offshore wind stands out to be one of the most promising renewable technologies in the country. The transition to a climate-neutral economy requires high-RES integration, which results in high energy Storage demand. Hydrogen electrolysis market is expected to boom in the period 2022-2030. Multi-MW electrolysis plants are planned in the next decade. The past year, offshore wind sector worldwide presented the highest growth, increased by 48% compared to previous year. In this direction, Greece aims to put 2GW of offshore wind by 2030. The publication of the relevant regulatory framework is expected in the next few months.

Since the country's banking sector has started returning to pre-pandemic levels and has started providing fresh credit and support to the development of the economy, investments in the energy sector have started following an increasing trend. Major energy investments of €1,5bn have already been announced and planned, with operation scheduled till the end of 2030, including, but not limited to, Gas Distribution Networks, Island Interconnections, RES Development and New Power Plants. At the same time, in the light of Russian invasion of Ukraine and given the fact that Europe is trying to diversify its energy sources, Greece is expected to be transformed into an energy hub of the region and a strategic gateway for the entry of energy resources to Southeastern Europe as a whole. Thus, the last few months, various energy-related projects have been announced in Greece, while also a program to step up oil and gas exploration was announced by the Greek authorities in April.

Contents

"Everything that an investor needs to know about the Greek Energy Market in 2022"

1. Country Profile

Highlights

The Greek population was **reduced** by **0,37%** within a year (2020 – 2021). Greece faces a **demographic problem** of a declining and ageing population

Greece's **debt to GDP** reduction by **6,6%** was the highest in the EU. Currently at **206,7%** it is estimated that it will decline under the 200% threshold by 2026

In 2021 **consumer price inflation** increased only by **0,6%.** But early in 2022, it increased vastly by **6,3%** due to the rise in energy prices (February 2022)

Between 2009 – 2019, **GHG emissions** were reduced by **31%**, mainly associated with the decline in economic activity following the debt crisis

Even though the **unemployment rate** in Greece has been declining in the last 10 years, it is the **highest in the EU** at **14,8%** (2021)

An explosive increase of **7,6%** in **consumption expenditure** occurred in 2021, which far exceeded pre-pandemic levels.

Economic recovery was recorded in 20221 with a growth of **8,3%**,and **GDP** reaching pre-pandemic levels

Greek 10-year government bond yields have climbed over **2%,** due to high inflation and ECB's shift towards a tighter monetary policy

Between 2005 - 2019, **CO_2 emissions per capita** decreased at a faster rate than the EU average with an overall **decrease** of nearly **50%**

Overview

Greece, with a population estimated at 10.6 million individuals in 2021, faces a demographic problem described by a continuous decline in population, as well as, by significant ageing not only of the total population, but also of those over 65 years of age.

Besides, Greece, in the aftermath of the financial crisis of 2007 – 2008, faced a sovereign debt crisis with an extensive impact on its economy. Still recovering, Greek economy was again deeply affected by the economic implications the Covid-19 pandemic brought globally.

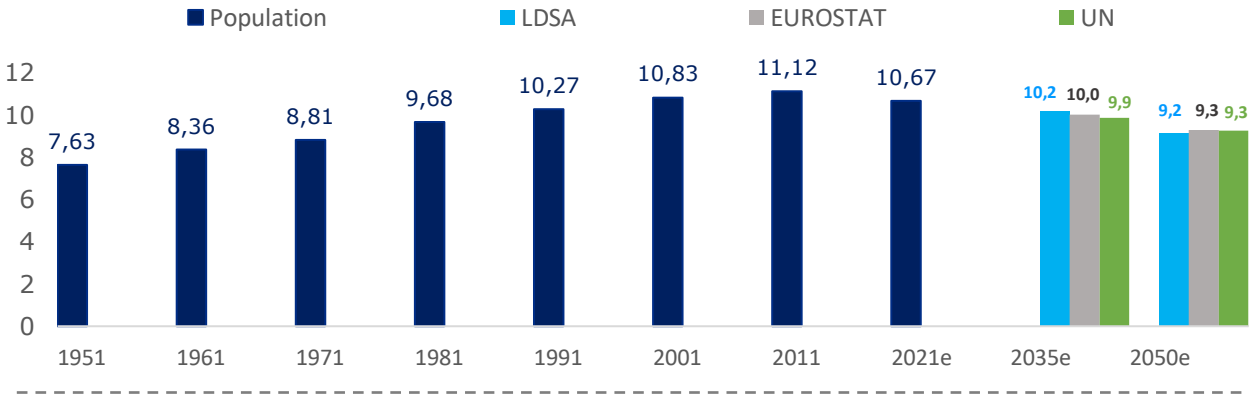
In 2021 however, and under a recovery mode once again, Greece exceeded all expectations with the economy bouncing back to pre-pandemic levels. Strong export performance (+40%), mainly from a stronger-than-expected summer tourist season, increase of private consumption (7.6%) and increase of gross fixed capital investments (+18.2%), contributed to an economic growth of 8.3%, (the highest in the eurozone) with the GDP reaching €183 billion. With the drive of the National Recovery and Resilience Plan, and while the government is to gradually withdraw the emergency fiscal support measures taken for tackling the impacts of the pandemic, recovery will be fostered with an expected further growth of 4.9% in 2022. However, the whole economic narrative can be negatively affected mainly by two factors: the prolongation and evolution of the pandemic and the energy crisis developments, especially with the Russia – Ukraine war being in progress.

The vast increase of energy prices during 2021, have resulted in consumer price inflation affecting Greece and the rest of the world. As electricity, gas and fuels prices are estimated to continue to rise in 2022, the remaining components of the consumption basket will be burdened even more with the higher energy costs mostly affecting low-income households. In February 2022, the inflation rate in the EU was 6,2%, the highest in its history prior to 2021, and for Greece 6,3%, the highest since 1997.

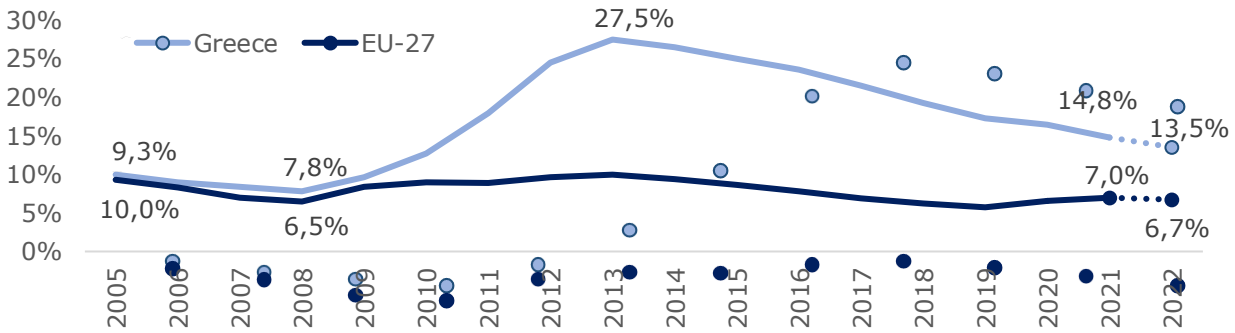
Tackling global warming is a global challenge that each country is called to address. Greece, in line with the EU's and other international agreements, has set itself targets to progressively reduce its GHG emissions by 2050 and become a climate-neutral economy. Greece's GHG emissions account for 2.4% of the EU's total. In 2020, Greece produced 58.2 MtCO2 emissions, reduced by 11% compared to 2019 levels. Although data for the rest of GHG constituents are not available for 2020, it is safely to assume that they also decreased substantially due to the lockdown restrictions and later increased with the economic growth of 2021. As per the 'Kaya Identity', data so far show that the main driver of total CO_2 emissions in Greece is GDP per capita.

Despite the predictions for a continuous decline of the Greek population, a further reduction in unemployment rates is expected next year

Total Population in Greece (millions), [1951 – 2021] and Projections for 2035 and 2050



Seasonally Adjusted Unemployment Rates (%) for Greece and EU-27*, [2005 - 2022]



* EU-28 until 2020

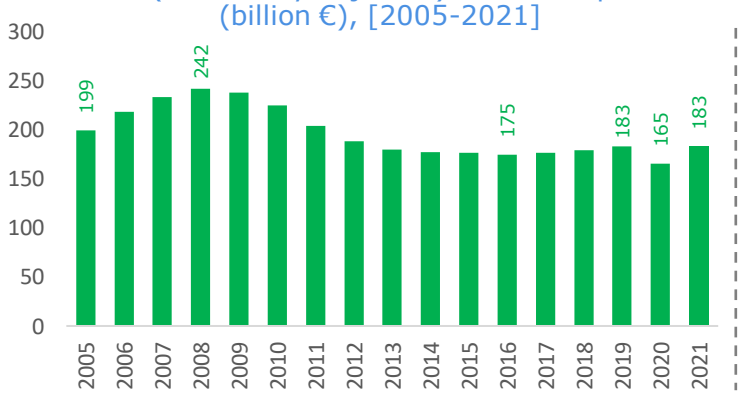
Source: LDSA, ELSTAT, European Economic Forecasts (2021) by European Commission, IOBE, United Nations, HAEE's analysis

Highlights

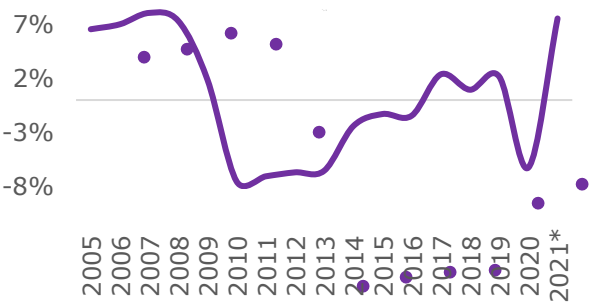
- The Greek population stood at ca. 10.67 million individuals in 2021, reduced by 0.37% compared to the corresponding population in 2020 (10.71 million individuals).
- The declining population of Greece is mainly attributed to the negative natural balance (births–deaths), low fertility rate, financial crisis, and aging population.
- According to LDSA, EUROSTAT and the UN, there will be a significant aging of the Greek population while it will continue to decline in the forthcoming decades.
- Unemployment in the EU over the last decade has been around 5.7% – 10%. In Greece, it peaked in 2013 (27.5%), but since then it has been gradually declining.
- In 2021, Greece and Spain had the highest unemployment rates in the EU (14.8% and 14.9% respectively). Unemployment rate is expected to further decline in 2022.

GDP recovered to pre-pandemic levels and further economic growth is predicted, supported by the Recovery and Resilience Plan

GDP (Seasonally Adjusted) in current prices (billion €), [2005-2021]

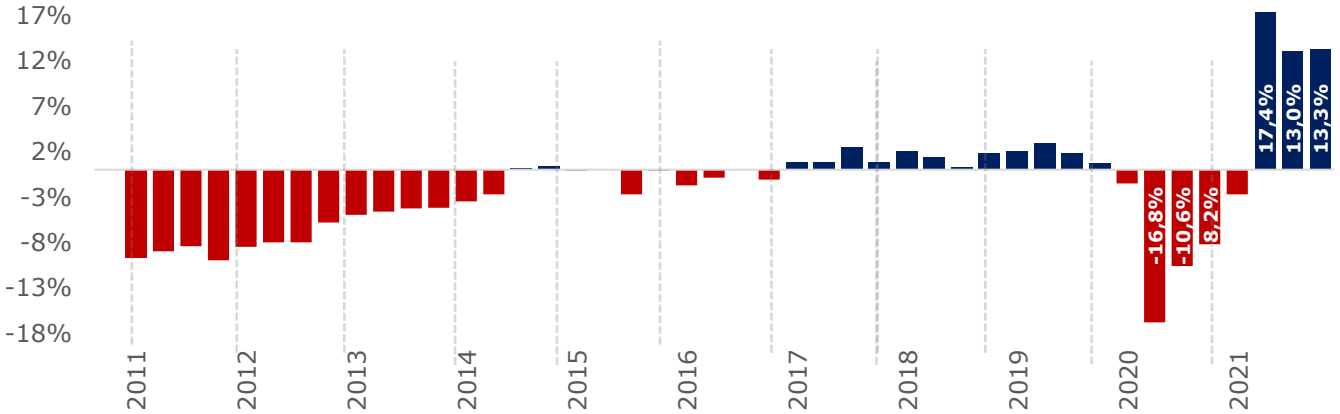


Final Consumption (% annual change), [2005-2021]



* Provisional data

GDP (Seasonally Adjusted) Growth Rate (% y-o-y quarterly change), [2006 – 2021]



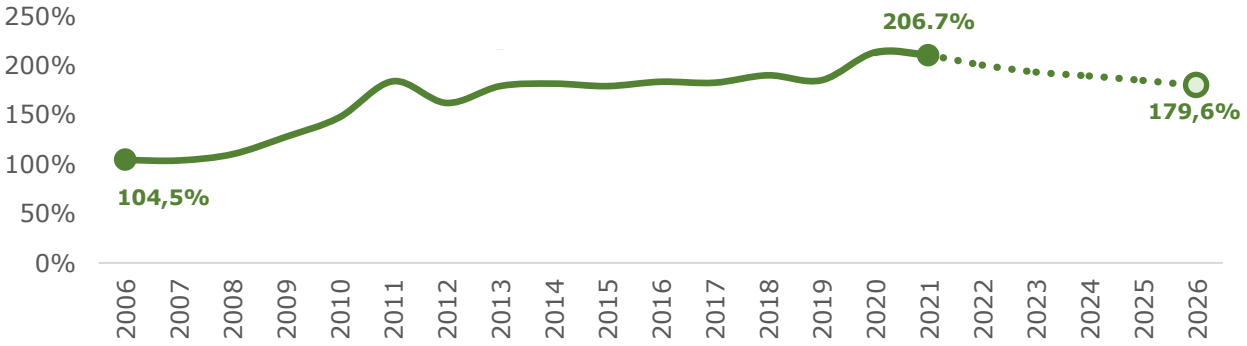
Highlights

Source: ELSTAT, EUROSTAT, HAEE's analysis

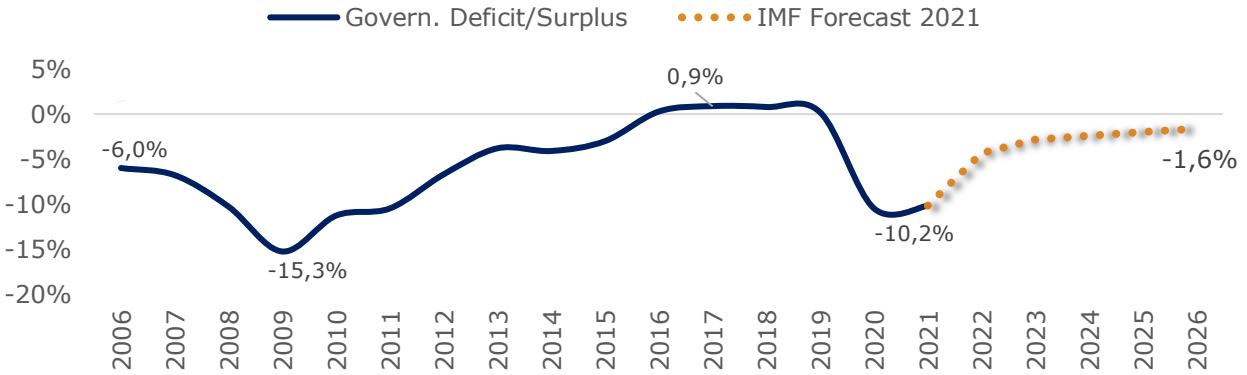
- The Greek economy shrunk by almost 11% during the pandemic (2020). In 2021 however, it bounced back with the GDP reaching pre-pandemic levels.
- A strong economic recovery was recorded in 2021 with a growth of 8.3%. This was mainly driven by strong export performance and an increase of private consumption.
- An explosive increase of 7.6% in Final Consumption Expenditure was observed in 2021 which far exceeded pre-pandemic levels.
- According to the European Commission, GDP is projected to grow by 4.9% in 2022, driven by investments supported by the impending Recovery and Resilience Plan.
- "Greece 2.0." is expected to positively contribute to the development of the country's further economic growth.

Greece holds the highest debt/GDP ratio in the EU; however, current strong growth performance forecasts an improvement in public accounts

General Government Gross Debt (% of GDP), [2006 - 2026]



Greek General Government Deficit/Surplus (% of GDP)
[2006 - 2020] and IMF Forecast [2021 - 2026]

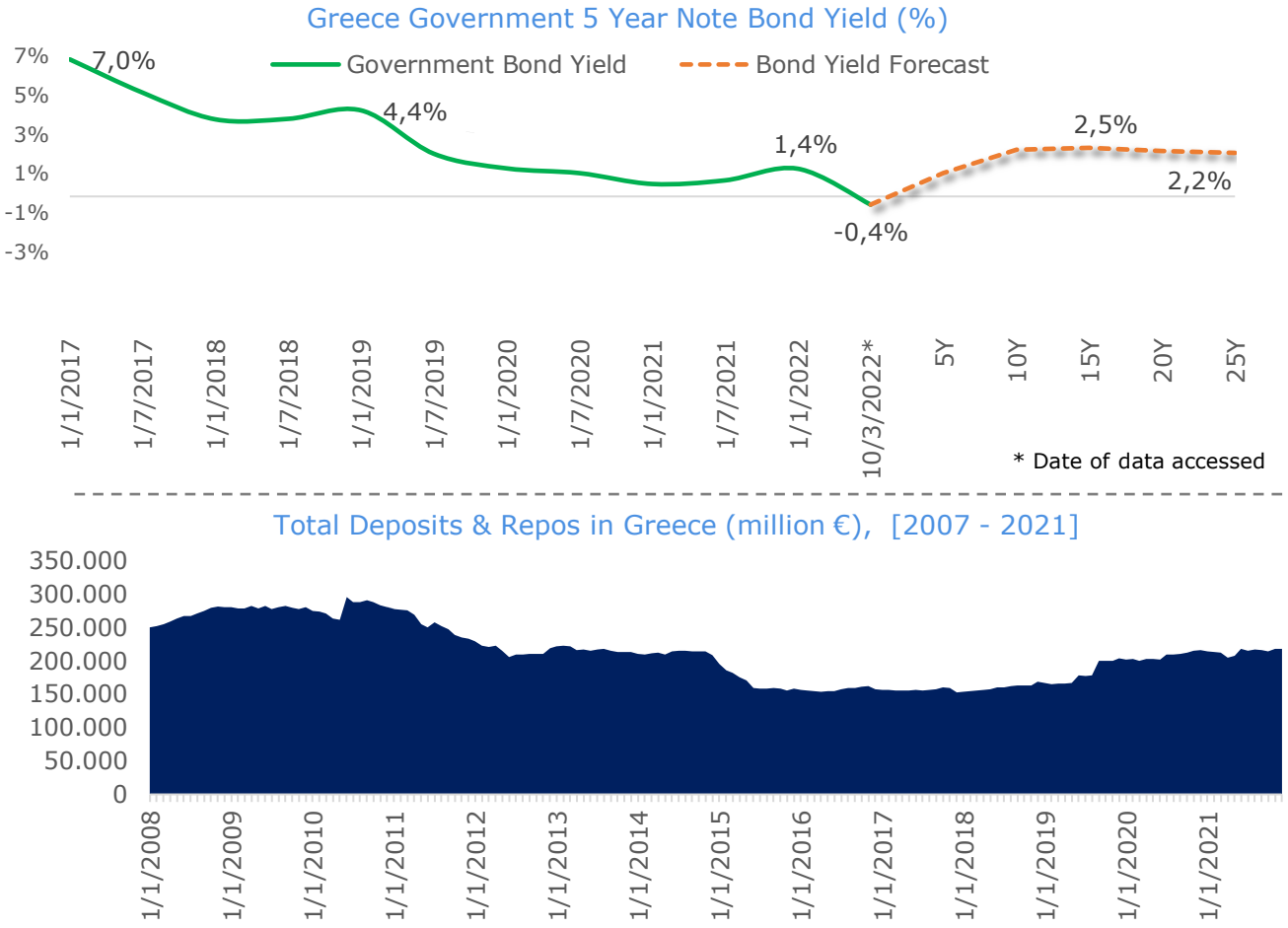


Source: IMF, HAEE's analysis

Highlights

- Currently, the Debt/GDP ratio for Italy, Portugal, Spain, France, Belgium and Cyprus is above the 100% threshold.
- Greece is the only country in the EU with a Debt/GDP ratio above the 200% mark. In 2021, Greece's public debt stood at 206.7% of GDP, compared to 213.1% in 2020.
- Greece's debt reduction in 2021 was the highest in the EU (6.6%). In absolute numbers, it increased further due to the follow-up pandemic associated measures.
- In 2021, Greece's current account deficit recorded a decrease of around 2 billion euros as net revenues exceeded expenditures.
- The Greek government estimates a further reduction in the primary deficit of GDP and consequently a further decline in the debt/GDP ratio under the 200% threshold.

Inflation and uncertainty in energy markets, have put a pressure on Greek government bonds expected to yield above 2%



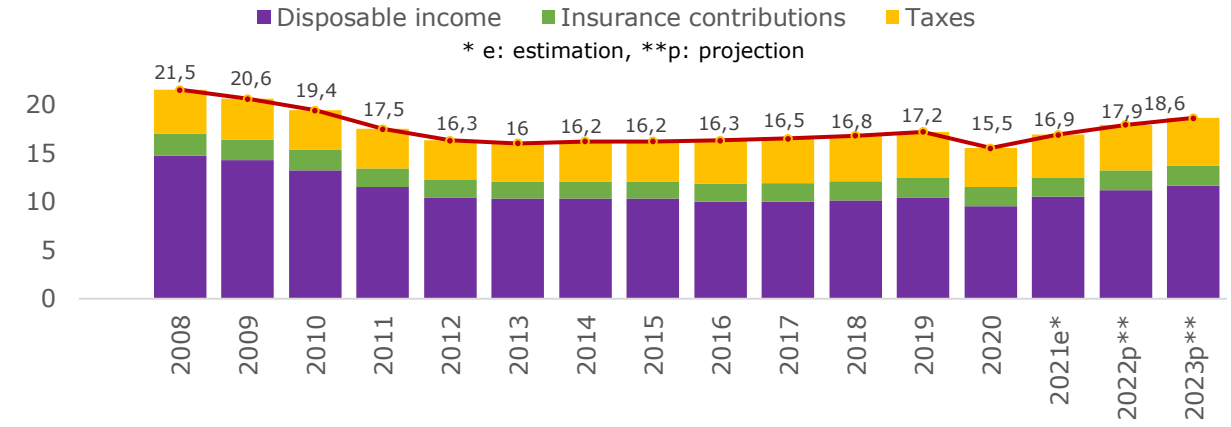
Source: Bank of Greece, HAEE's analysis

Highlights

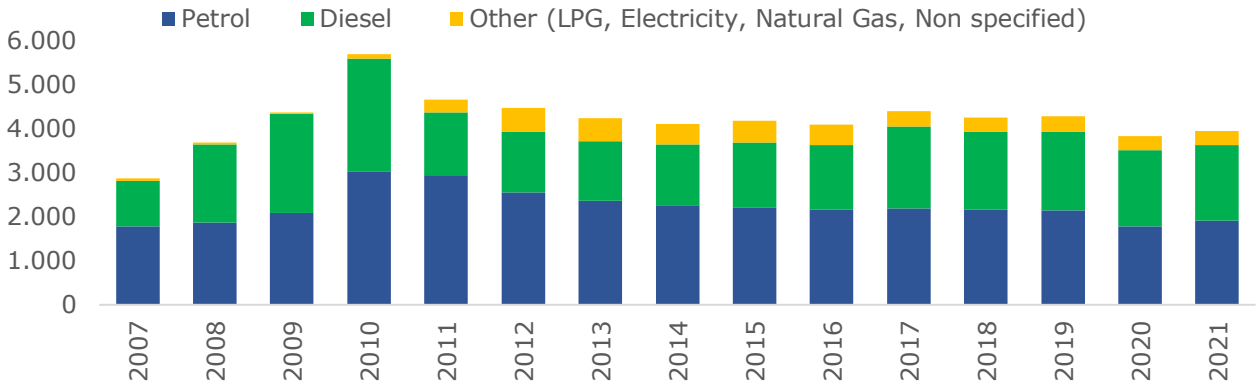
- The Covid-19 pandemic and the subsequent monetary and fiscal policy responses had a pronounced impact on the euro area sovereign bond yields.
- The Greek government bond yields declined during the pandemic but had an upward trend in 2021, affected by the ECB's shift towards a tighter monetary policy.
- High inflation and the expectation of a shift in interest rate policy for the eurozone, resulted in the Greek bond prices to fall and their 10-year yield to climb at 2.5%.
- As of March 2022, credit rating for Greece stands at BB (positive outlook) by S&P, BB (positive outlook) by Fitch, and BB high (stable outlook) by DBRS.
- At the end of 2021, deposits and repos increased only by €2 billion. This increase was strongly associated with the vast rise in consumption expenditure.

Disposable income and tax revenues were negatively affected by the pandemic - expected to gradually increase moving forward

Per Capita: Disposable Income, Taxes and Insurance Contributions and Projections (thousands euro, base year 2015), [2008 - 2023]



Revenues from Excise Duties on Energy Products (million €), [2007 – 2021]



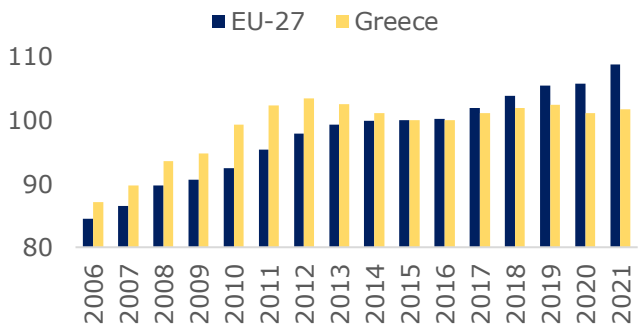
Highlights

Source: AADE, AMECO, IOBE, HAEE's analysis

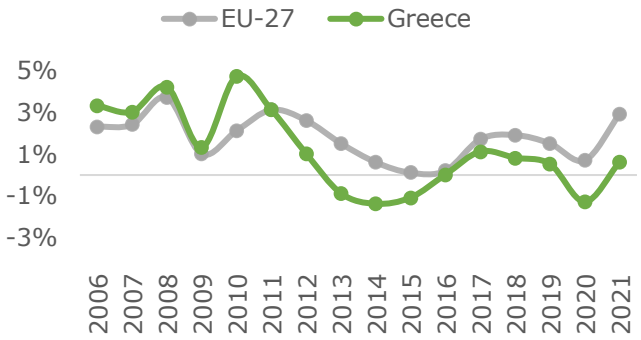
- Although disposable income was on recovery from the recession of 2009, it recorded a sudden reduction by 8% in 2020 due to the Covid-19 pandemic.
- According to an estimation by AMECO, in 2021, disposable income increased to pre-pandemic levels and will continue to increase in the next two years.
- Tax revenues were also affected by the pandemic. It is estimated that they rose by 10% in 2021 and will continue to rise, mainly due to the increase in fuel pricing.
- In 2021, Petrol accounted for the majority of the total tax revenues on energy products (48%).
- Tax revenues from energy products were widely affected during the pandemic. Yet, in 2021, taxes from Petrol rose by 6%.

Consumer price inflation is expected to increase due to the dramatic increase of electricity, gas and fuel prices

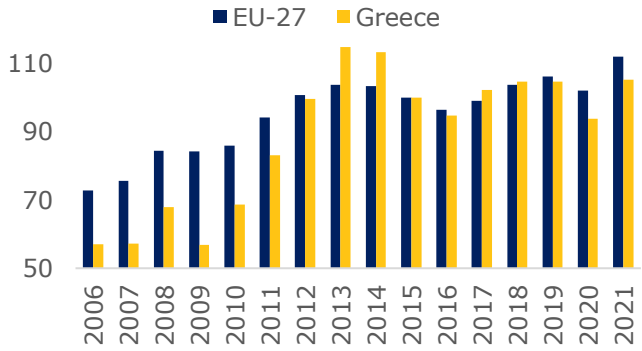
Annual Average of HICP* (Harmonized Index of Consumer Prices) in EU-27** and Greece [2006 - 2021]



Annual Rate of Change of HICP in EU-27** and Greece [2006 - 2021]

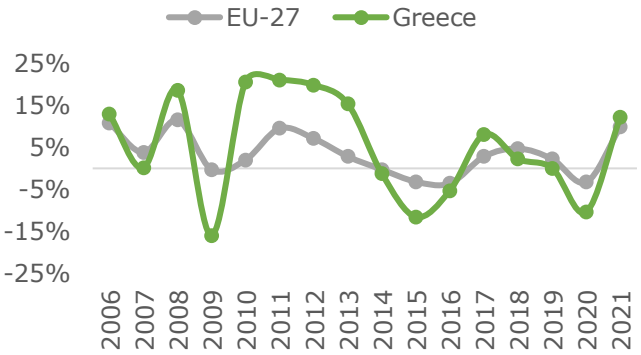


Annual Average of HICP* in EU-27** and Greece [2006 - 2021], for Electricity, Gas and other Fuels



*Index (2015=100), **EU-28 until 2020

Annual Rate of Change of HICP* in EU-27** and Greece [2006 - 2021], for Electricity, Gas and other fuels



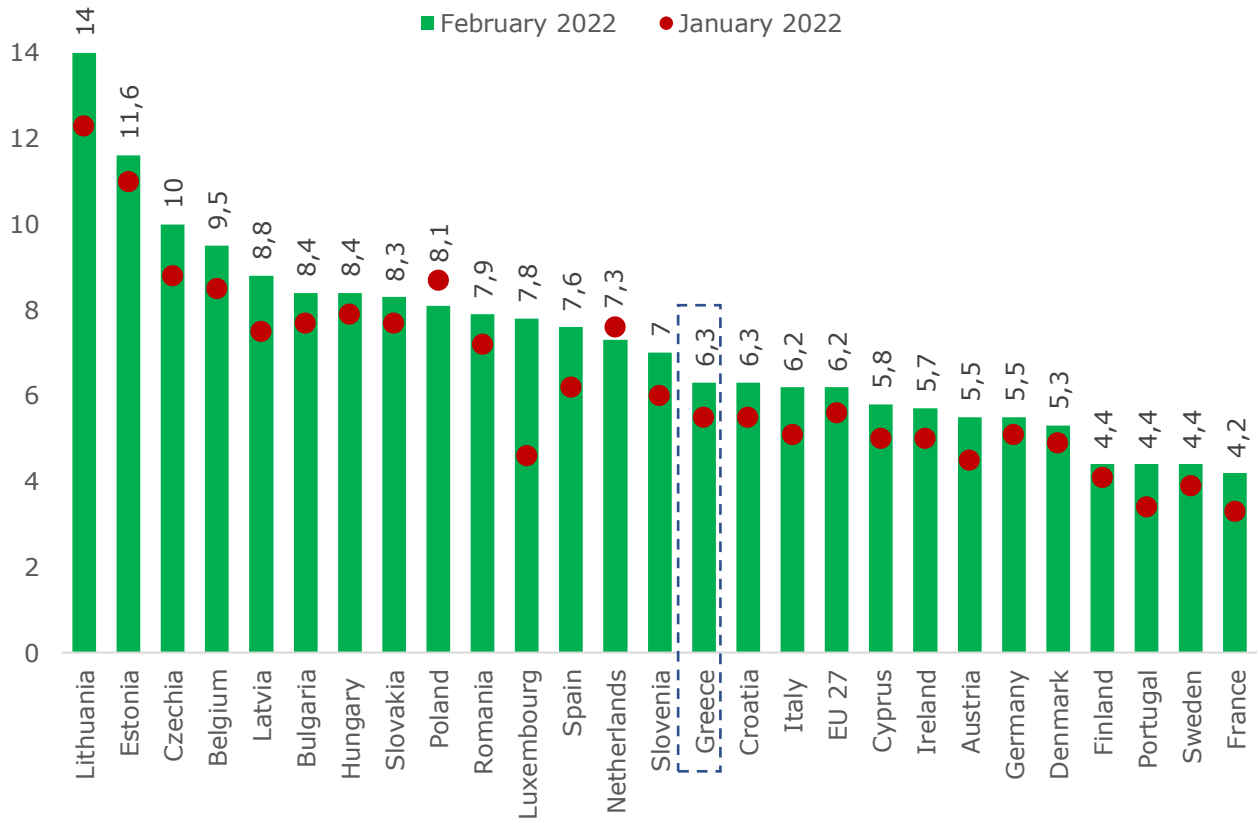
Source: EUROSTAT, HAEE's analysis

Highlights

- Until 2014, Greece had a much higher annual average of Harmonized Index of Consumer Prices than the EU. However, since then that trend has been reversed.
- The annual rate of change of HICP in Greece has historically followed the EU fluctuations but after 2011 it has been changing at much slower rates.
- The HICP decreased in Greece by 1.3% during the pandemic (2020) and increased only by 0.6% the following year.
- In 2021, consumer price inflation, driven mainly by energy prices, increased both in Greece and in the EU, following the staggering rise of electricity, gas and fuel prices.
- As energy prices are estimated to continue to rise in 2022, high energy costs are expected to subsequently pass-through to the consumption basket.

Inflation rates at the start of 2022, both in Greece and the EU, are of historical magnitude and mainly attributed to the vast increase of energy

Inflation Rate in EU 27 [January 2022 and February 2022]
(% change over same period of previous year)



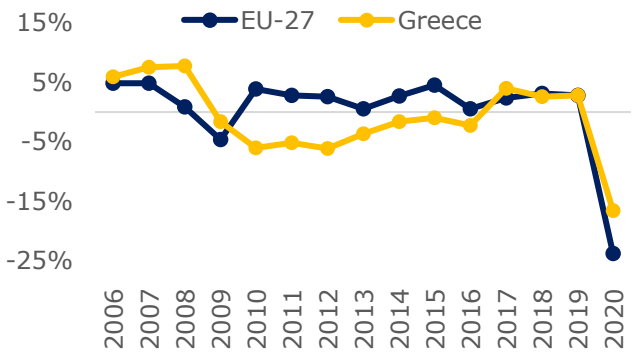
Source: EUROSTAT, HAEE's analysis

Highlights

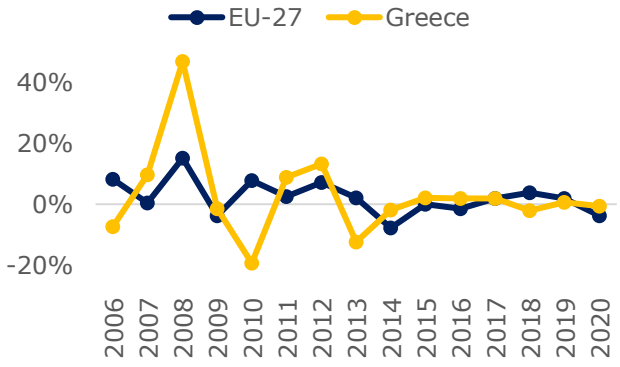
- Historically, the EU price rises were kept at relatively low levels. In general, inflation rates during the last decade remained below 3%.
- As of February 2022, the inflation rate in the EU was 6.2%, the highest rate in its history prior to 2021, apart from July 2008 with a recorded inflation rate of 4.5%.
- Among all EU members, in February 2022, prices rose faster in Lithuania with an inflation rate of 14%. On the contrary, France had the lowest at 4.2%.
- The same month, the inflation rate in Greece was 6.3%, the highest since January and February of 1997, which recorded a 6.7% and a 6.4% respectively.
- The vast increase of inflation rates are attributed to the rapid recovery of the EU economy and the energy cost increase, aggravated by the Russia – Ukraine conflict.

Greek household expenditures decreased vastly during the pandemic while energy products had the largest share in the consumer basket

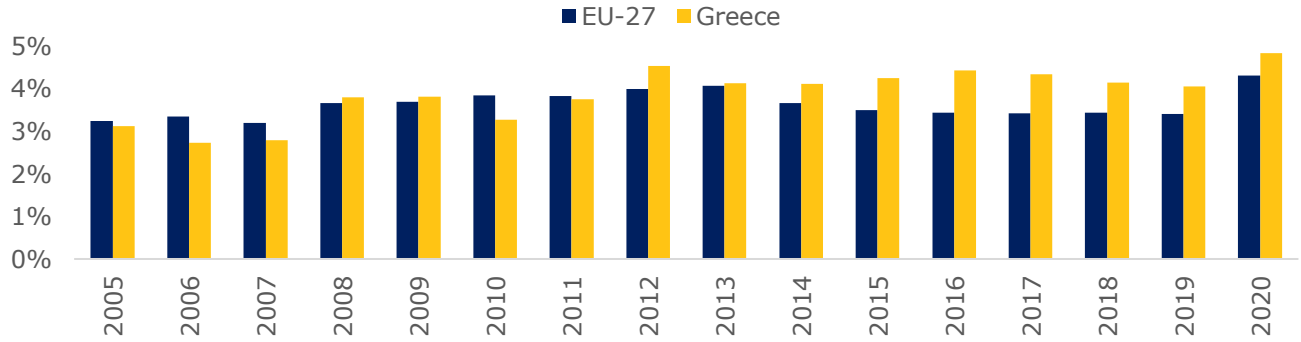
Final Consumption Expenditure of Households (% annual change) in Greece and EU-28, [2006 – 2020]



Household Final Consumption Expenditure (% annual change) on Electricity, Gas and other Fuels in Greece and EU-28, [2006 – 2020]



Share of Electricity, Gas and other Fuels in Household Total Expenditure, in Greece and EU-28, (%) [2006 – 2020]



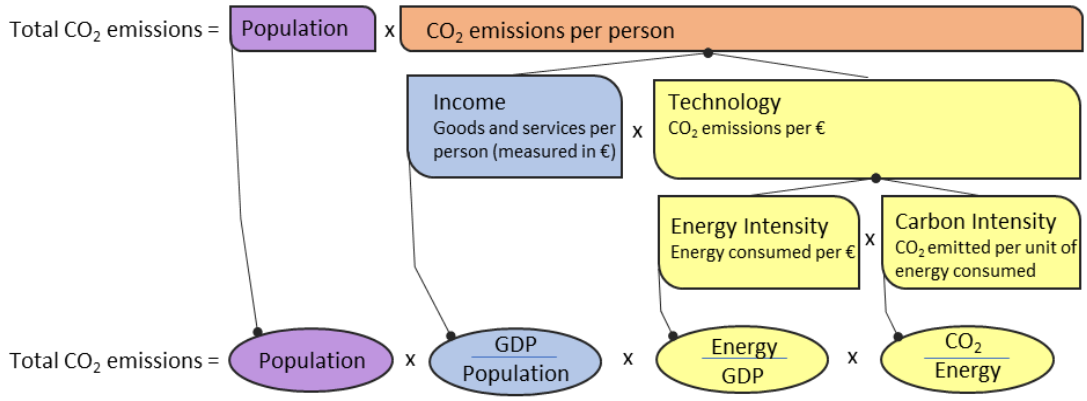
Source: EUROSTAT, HAEE's analysis

Highlights

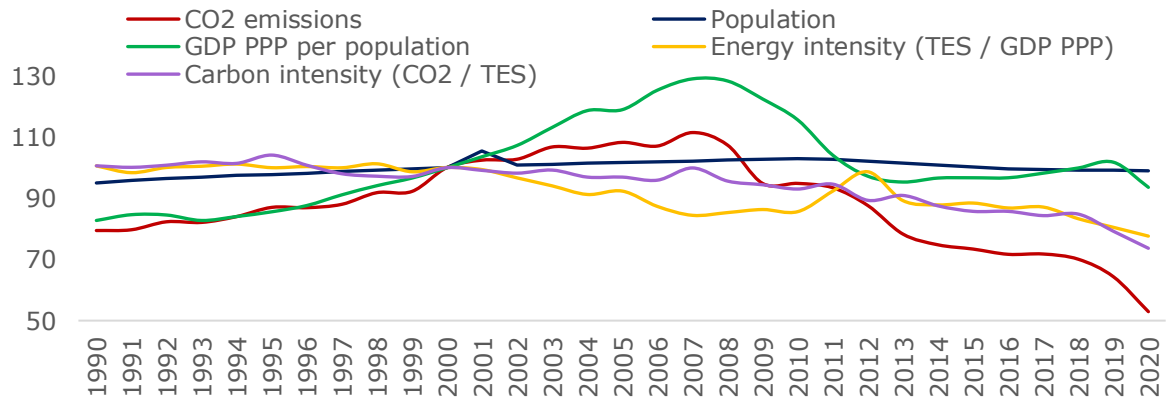
- Final consumption expenditure of households in Greece and the EU, was greatly reduced during the Covid-19 pandemic (16.5% and 23.8% respectively) in 2020.
- It is estimated that in 2021, Greek household consumption increased, reflecting the partial normalization of market operation related to the restrictions imposed in 2020.
- Household consumption expenditure for Electricity, Gas and other fuels during the pandemic was reduced only by 0.5% in Greece, while in the EU by 3.8%.
- After 2012, energy products have been having a larger share in the Greek household expenditure compared to that of the EU.
- It is estimated that in 2021, household expenditure on Electricity, Gas and other fuels was burdened substantially due to the vast increase in the respective prices.

Among the four determinants, as per the 'Kaya Identity', GDP per capita is the main driver of total CO_2 emissions in Greece

Determinants of Total CO_2 Emissions: the 'Kaya Identity'



CO_2 Emissions Drivers, Greece 1990-2020 Index [2000 = 100]



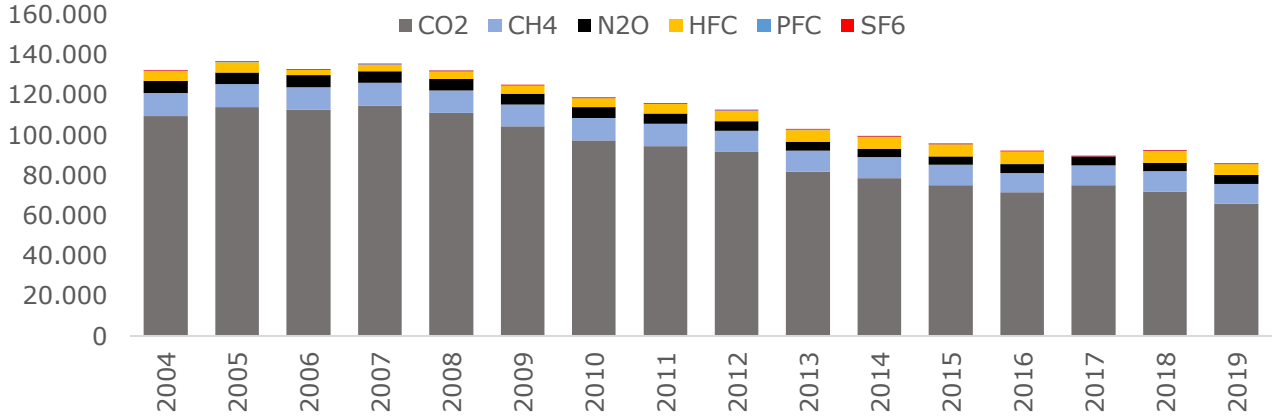
Highlights

Source: IEA Energy and Carbon Tracker 2020, HAEE's analysis

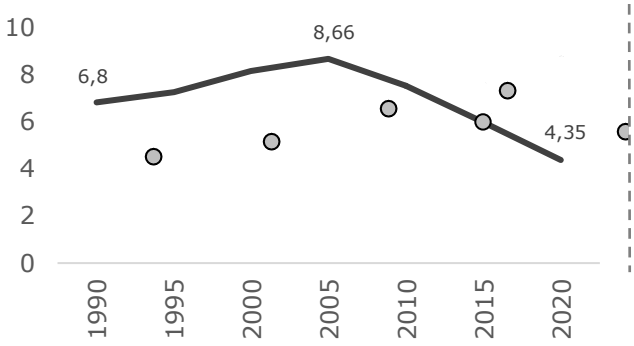
- According to the 'Kaya Identity' equation, total CO2 emissions are driven by four fundamental factors: Population, GDP per Capita, Energy and Carbon intensity.
- The equation is used in the development of future IPCC emissions scenarios, highlighting the elements of an economy one can act on to reduce emissions.
- It's common, in periods where GDP per capita is increased, CO2 emissions are also increased, supporting the notion that richer people tend to emit more CO2 emissions.
- In Greece until 2008 just before the economic recession, the continuous increase in GDP per capita was translated into a corresponding increase in CO2 emissions.
- Between 2000 and 2008, an increase in GDP was observed with an accompanied decrease in energy intensity.

CO_2e emissions have been reduced considerably in Greece during the last decade, mainly due to the reduction in GDP

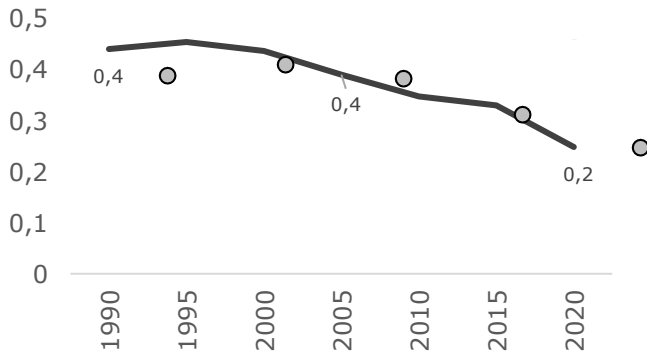
Total GHG Emissions in Greece (in kt CO2 eq) [2004-2019]



CO2** Emissions per Capita, Greece 1990-2020 [t CO2/capita]



CO2** Emissions per Unit of GDP, Greece 1990-2020 [kg CO2/2015 USD]



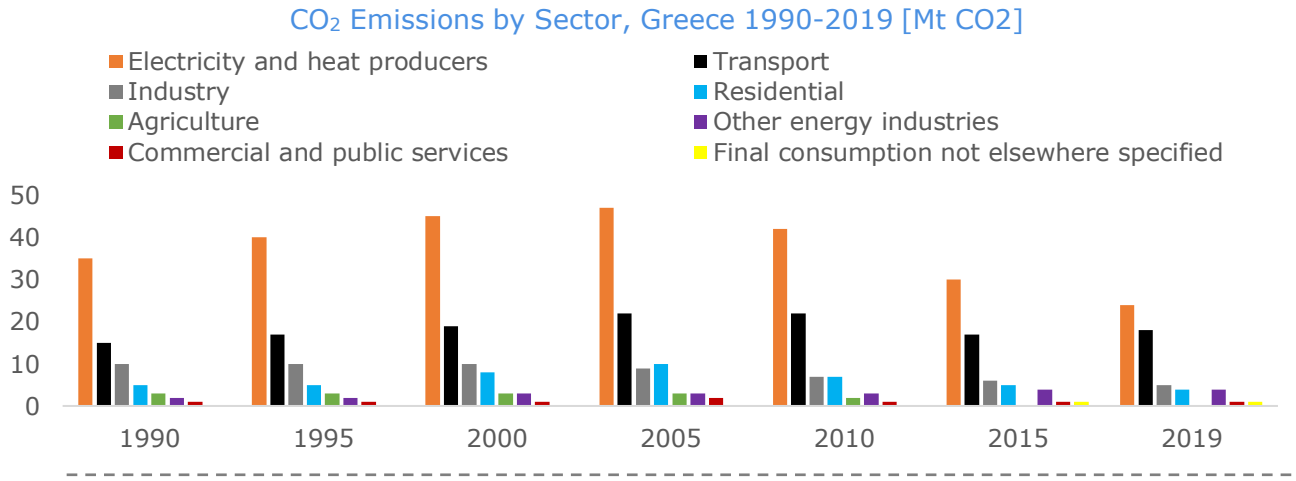
* Without LULUCF **From fuel combustion only

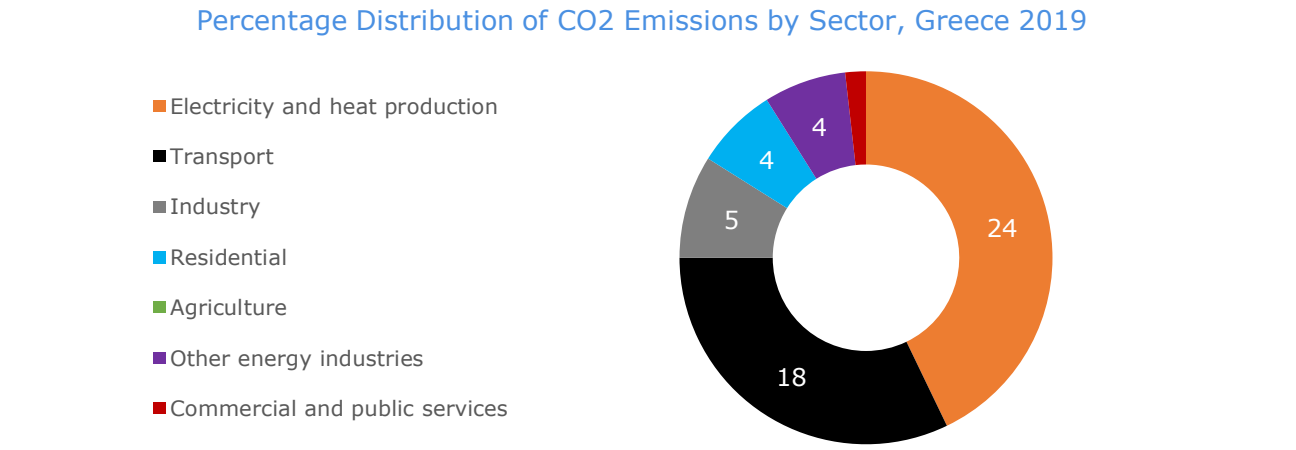
Source: : IEA Energy and Carbon Tracker 2020, Ministry of Environment, HAEE's analysis

Highlights

- Greece's GHG emissions account for 2.4% of the EU total. Between 2009 – 2019 the 'Kyoto Basket' was reduced by 31%, associated with the decline in economic activity.
- In 2019, CO2 and CH4 emissions accounted for 77% and 12% respectively of the total GHG emissions, with a corresponding reduction of 37% and 7% since 2009.
- In 2020, Greece produced 58.2 MtCO2 emissions, a nearly 25% reduction compared to 2019 levels due to lockdown restrictions.
- From 2005 to 2019, per capita emissions decreased at a faster rate than the EU average with an overall decrease of nearly 50%.
- The ratio CO2/GDP has been gradually reduced with an average five-year rate of 6.5% between 1995–2015, but with an outstanding 27% between 2015–2020.

Electricity, Heat production and Transport are the main contributors to CO_2 production in Greece during 2019





Source: : IEA Energy and Carbon Tracker 2020, HAEE's analysis

Highlights

- Total CO2 emissions produced from all economic sectors in Greece, peaked in 2005. Nevertheless until 2019 they vastly decreased by 40%.
- Electricity and heat production, and Transport have been the main contributors to the production of CO2 emissions in Greece.
- Between 2005 – 2019, CO2 emissions from Electricity were reduced by 48% but only 18% from Transport.
- In 2019, 43% of the total CO2 emitted in Greece was produced by Electricity and heat production, followed by Transport (32%), Industry (9%) and Residential (7%).
- Reductions in CO2 emissions recorded the last decade, are strongly associated with the decline in economic activity (decrease of GDP), after the recession of 2009.

2. Energy Transition

Highlights

Energy dependency rate amount to **84%** in Greece during 2020

Electricity generation by **lignite** in Greece planned to be completely **phased-out** by **2028**

44 Mt CO_2 could be stored in Prinos basin reservoirs with 1MTpa CO_2 injection

25.5% decrease in carbon intensity of the electricity sector during 2021 in Greece

BEV and PHEV new registrations for the year 2021, reached **7.067,** representing **6%** of total registrations

The first **CO_2** injection in Prinos is planned for **2025** and the pre-FEED is planned for **Q2 2022**

929% increase in Lithium prices in 2021, a critical metal for electric vehicles batteries

1.209 slow and fast publicly accessible chargers are in operation in 2021 in Greece

Overview

The EU is a frontrunner in the field of climate change and energy transition, implementing new strategies and policies. The EU's commitment to the European Green Deal has been proved in 2021 with the legislative proposals of the Fit-For-55 package, which revised the EU's 2030 plan for reducing emissions by 55%.

The package includes revisions of legislation, a review of renewable energy and energy efficiency targets, further exploitation of electromobility, and advances of low carbon technologies and renewable fuels. Fit-for-55 is planned to boost current energy transition projects and initiatives across Europe. The majority of Coal Power Plants in Europe will be phased out before 2030. There is currently a debate whether nuclear and natural gas could contribute to the future EU energy mix under certain provisions. France, Germany, Spain, and Sweden produce more than three quarters of the total energy generated by nuclear power plants in the EU-27. According to the new proposed Taxonomy new nuclear plants eligible to qualify as a sustainable investment would need to secure their construction permits by 2045.

The Greek Energy Sector is highly dependent and with an increasing rate on fossil fuels, most of which are imported. Greece's energy dependency is constantly increasing, in contrast to the EU-27 trend. In 2020, it reached the highest level since 2010. Greece is heavily reliant on imported natural gas, which continues to support the country's power production at a growing rate as a transition fuel. The massive investment in renewable energy improved energy efficiency, while the diversification of supply and the future interconnections of the Greek islands will be key factors in reducing energy imports in Greece.

RES and natural gas in Greece are replacing lignite in the electricity generation mix with a higher rate in the last three years. Annual CO_2 emissions from lignite power plants, were lower than those from natural gas plants, for the first time in history of Greece. The carbon intensity of Greece's electricity sector is significantly decreasing, due to higher renewables and lower fossil fuels utilization. In parallel, the electromobility market in Greece is growing rapidly, faster than NECP estimations, and is supported by several subsidies and policies.

Hydrogen and offshore wind are the most promising renewable technologies in Greece. Hydrogen electrolysis market will boom in the period 2022-2030. Multi-MW electrolysis plants are planned in the next decade. Hydrogen end uses in the next decade will focus on mobility and hard-to-abate sectors, such as the cement and steel industry. In 2021, offshore wind sector presented the highest growth worldwide, increased by 48% compared to the previous year. Greece aims to put 2GW of offshore wind by 2030. The publication of the relevant regulatory framework is expected to take place during 2022.

Reducing greenhouse gas emissions by at least 55% by 2030, requires higher shares of renewable energy in the energy mix

Fit-For-55 package

Renewables in the EU energy mix

19.7%
Current renewables share (in 2019)

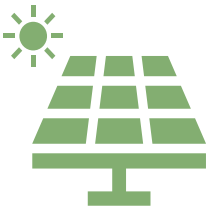
32%
Current EU 2030 target

40%
New EU 2030 target

- ✓ Annual binding increase of 1.1% renewables in heating and cooling at national level
- ✓ Indicative target of 2.1 % renewable energy and waste heat and cold in district heating and cooling
- ✓ New 13% greenhouse gas intensity target in transport
- ✓ New indicative target of a 1.1 % annual increase in renewable energy use in industry

- ✓ New benchmark to reach at least 49% renewable share in the energy used in buildings
- ✓ Measures to boost electrification, including a credit mechanism for transport
- ✓ Sub-targets and certification for renewable hydrogen

17.4%
Current energy efficiency savings for primary and final energy consumption (in 2019)



32.5%
Current EU 2030 non-binding target (relative to 2007 projections)

36-39%
New EU 2030 binding target for final and primary energy consumption

The NECP targets for the penetration of electric vehicles in Greece, have already surpassed the expectations for years 2020 **(90% greater)** and 2021 **(86% greater)**

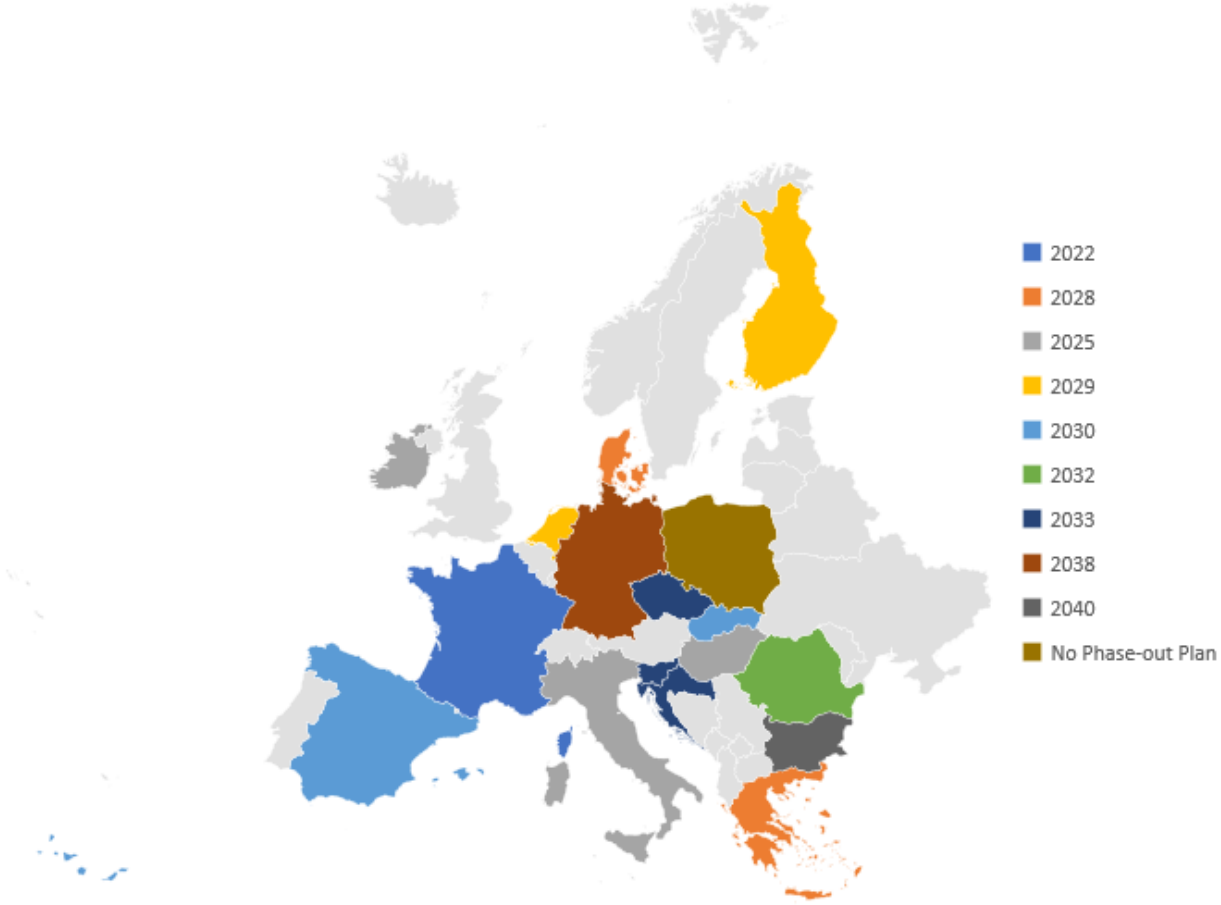
BEV and PHEV new registrations for the year 2021, reached 7.067, representing **6%** of the total registrations (in contrast with the NECP target of **2,8%).**

- ✓ Measures to facilitate renewable Power Purchase Agreements (PPAs)
- ✓ Accelerated permitting for renewable energy projects
- ✓ Promoting cross-border cooperation, including through the renewable energy financing mechanism

Source: European Commission, HAEE Analysis

The majority of Coal Power Plants in Europe will be phased out by 2030. The Russia-Ukraine crisis will likely affect the current planning

Coal Phase-Out Announcements in Europe [January 2022]

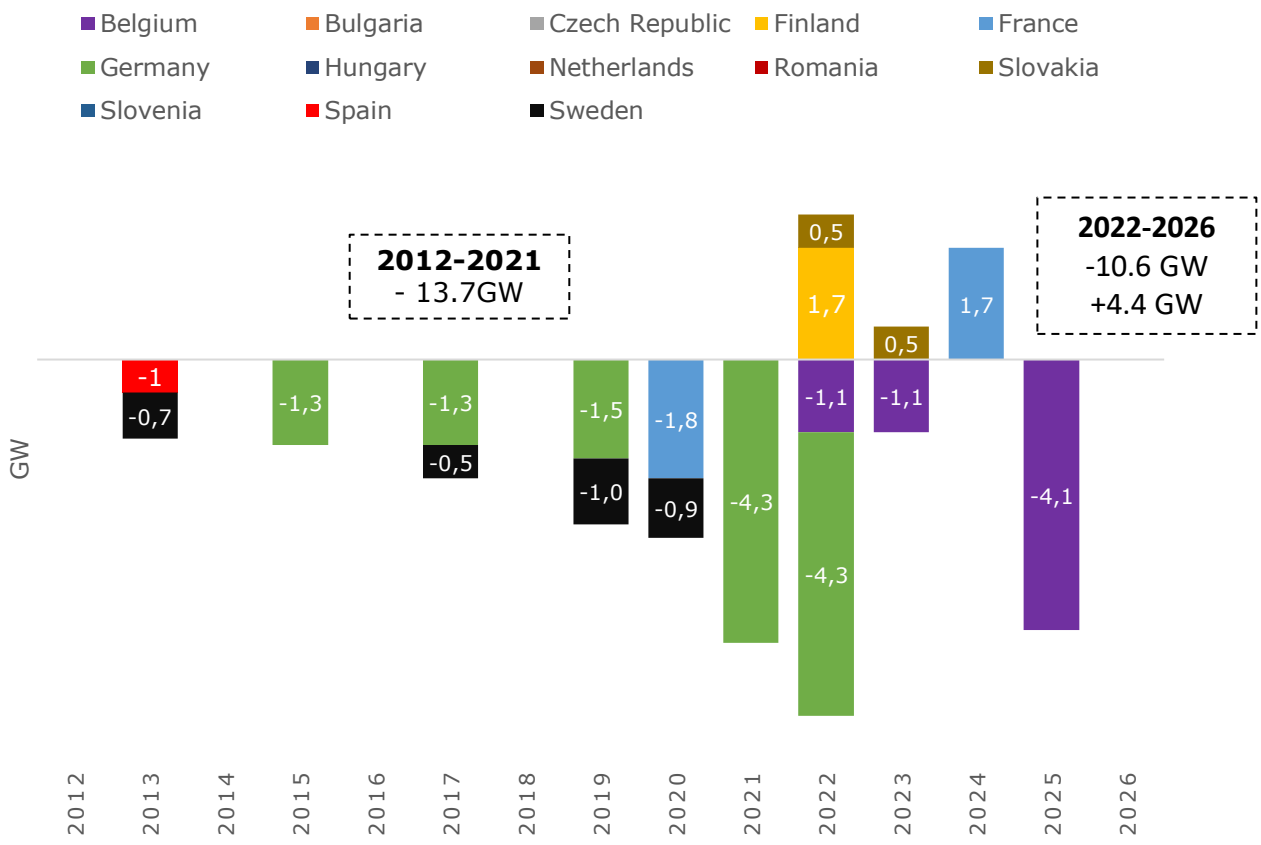


Highlights

- Poland with 44 coal plants, is the only country in the EU-27 that has not set a target for coal phase-out.
- In EU-27, there are 198 operating plants in total with a total capacity of 114 GW. In the coming years, 102 plants with a total capacity of 68GW will be phased out.
- Lignite and coal power plants had the largest contribution in the energy mix of Poland by 68%, Estonia by 65% and Bulgaria by 53%.
- Before 2030, 12 European countries will be coal phased-out and 7 countries will be coal free after 2030.
- The timeframe of coal phase-out plans is debatable due to the Ukraine crisis and the need for the elimination of domestic demand for Russian fuels.

There is currently a debate whether nuclear and natural gas could contribute to the future EU energy mix under certain provisions

Nuclear Power Plants Capacity Evolution in EU-27 (MW)



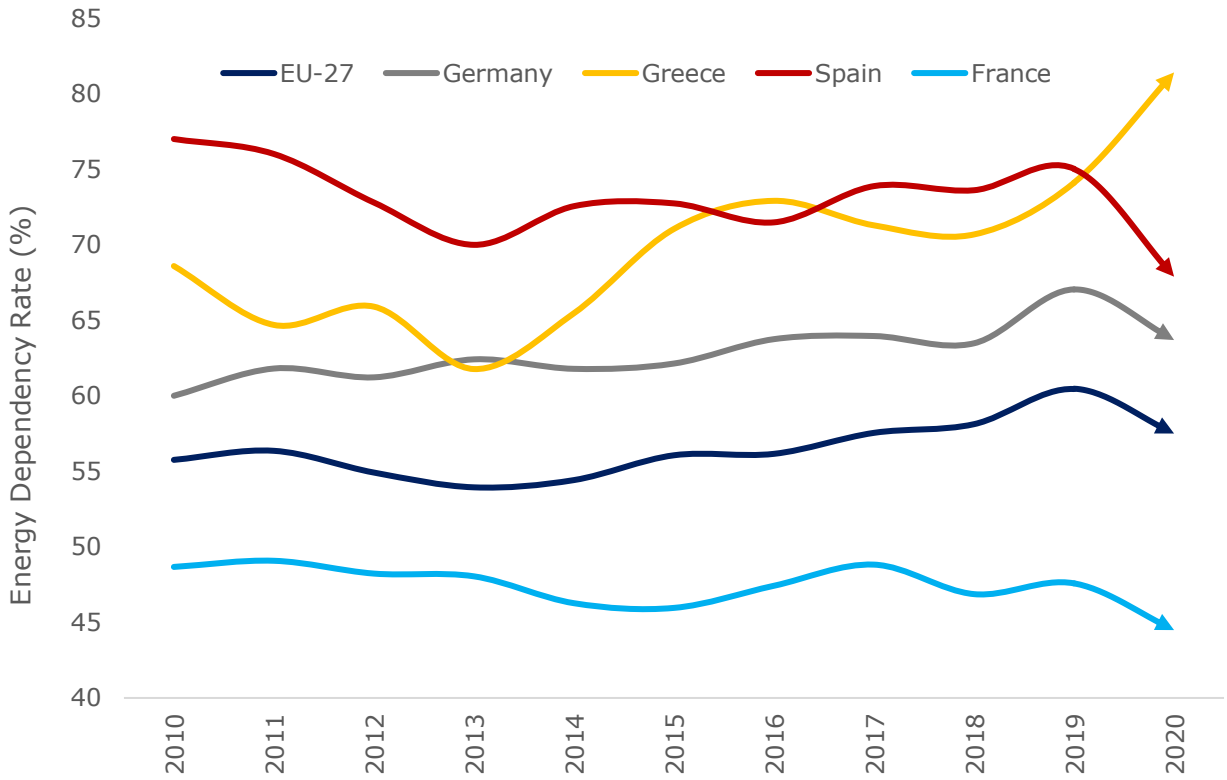
Source: EMBER, HAEE Analysis

Highlights

- Among the EU-27, the countries which had the highest share of Nuclear energy in their energy mix, were France (72%), Slovakia (57%) and Belgium (53%).
- France has the most active nuclear power plants in the EU, 56 plants with an average of 36.1 years of operation.
- France, Germany, Spain, and Sweden produce more than 75% of the total energy generated by nuclear power plants in the EU-27.
- According to the new proposed Taxonomy, new nuclear plants eligible to qualify as sustainable investments would need to secure their construction permits by 2045.
- France plans to build up to 14 new nuclear reactors to meet its climate targets. On the contrary, Germany plans to shut down all nuclear plants by 2022.

The Greek Energy Sector is highly dependent and with an increasing rate on fossil fuels, most of which are imported

Energy Dependency Rate in EU, Greece, Germany, Spain and France, (%), [2010-2020]



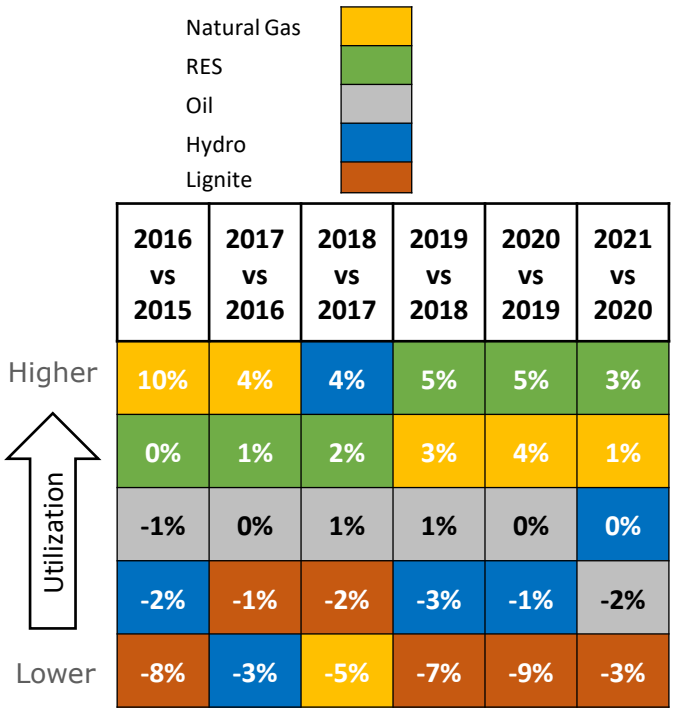
Source: EUROSTAT, HAEE's analysis

Highlights

- Greece's energy dependency is constantly increasing. In contrast to the EU's decreasing trend, it peaked in 2020, reaching the highest level since 2010.
- Greece is heavily reliant on imported natural gas, which continues to support the country's power production at a growing rate, as a transition fuel.
- In 2021, due to high natural gas prices, lignite power generation will be increased in the short-term, as lignite is a domestically produced fuel.
- In 2022, reflection the Ukraine crisis, a top-up of high energy costs is expected to further decrease the energy dependency rate, due to lower imported natural gas.
- Improvements in energy efficiency, large investments in renewable energy and diversification, will be key factors in reducing energy imports in Greece.

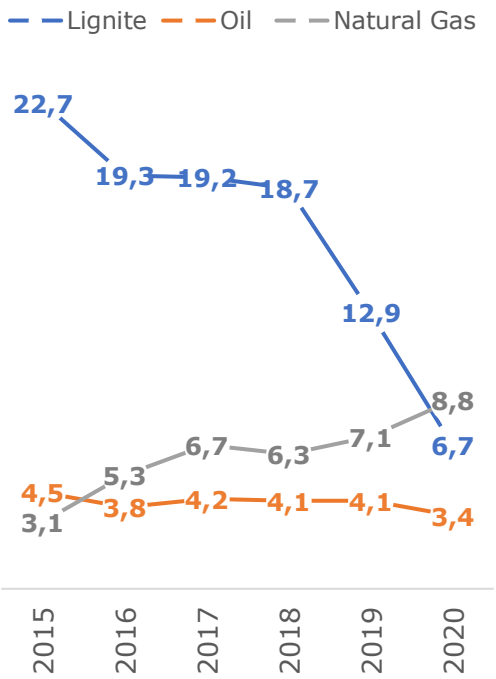
RES and natural gas in Greece, are replacing lignite in the electricity generation mix at a greater pace during the last three years

Yearly Change of Electricity Generation Fuel Share Mix in Greece (%)



2016 vs 2015	2017 vs 2016	2018 vs 2017	2019 vs 2018	2020 vs 2019	2021 vs 2020
10%	4%	4%	5%	5%	3%
0%	1%	2%	3%	4%	1%
-1%	0%	1%	1%	0%	0%
-2%	-1%	-2%	-3%	-1%	-2%
-8%	-3%	-5%	-7%	-9%	-3%

CO_2 Emissions in the Electricity Sector in Greece ($MtCO_2$) [2020]



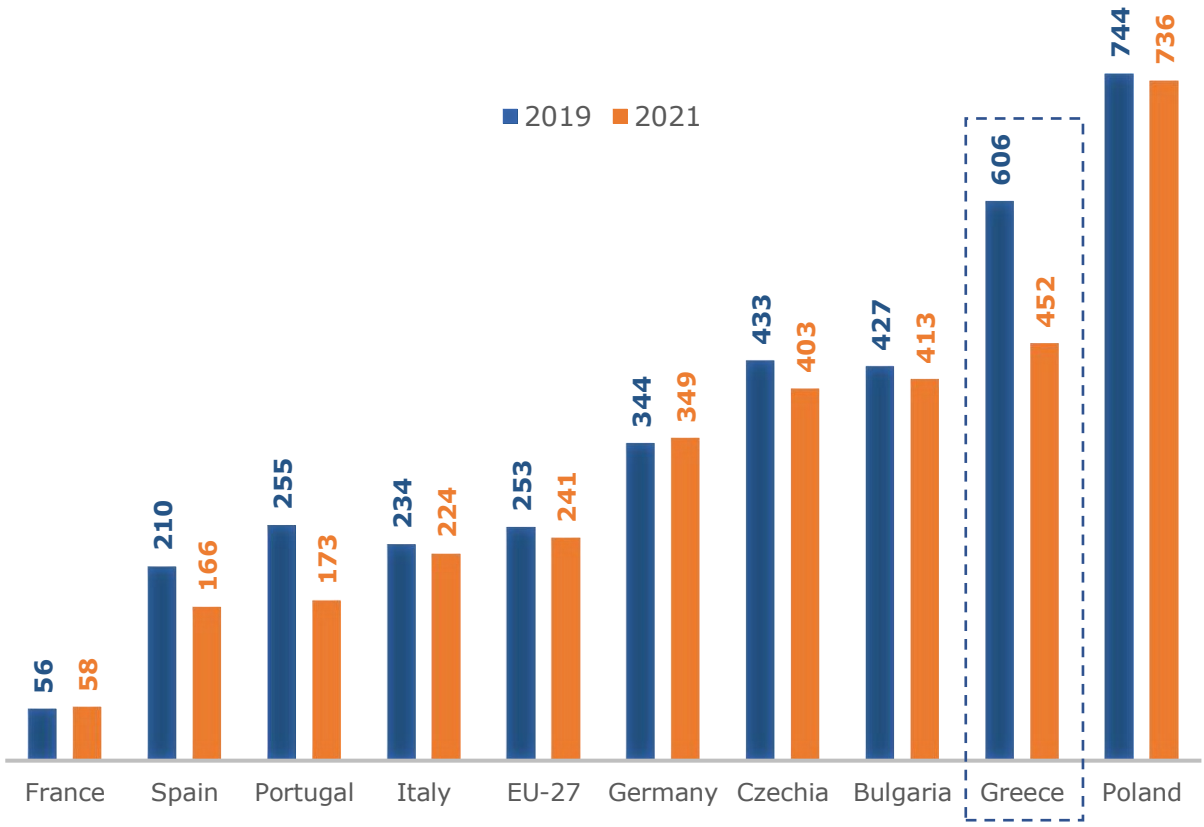
Source: IEA, EMBER, HAEE Analysis

Highlights

- Natural Gas together with Renewable Energy Sources, have been replacing lignite during the past years in the electricity generation mix in Greece.
- Annual CO2 emissions produced by lignite power plants, were lower than those from natural gas plants, for the first time in the history of Greece.
- In 2021, lignite share was reduced by 3% compared to 2020, at a much lower rate than previous years, due to high natural gas prices.
- In 2021, oil share in the electricity mix was reduced, mainly due to the interconnections of the islands, where oil is the dominant fuel for power generation.
- Due to high natural gas prices and the Ukraine crisis, it is expected that lignite will regain share as a fuel in the electricity mix in the short term.

The carbon intensity of Greece's electricity sector is significantly decreasing, due to higher renewables and lower fossil fuels utilization

Carbon Intensity of the Electricity Sector in Greece (grCO2/kWh), [2019-2021]

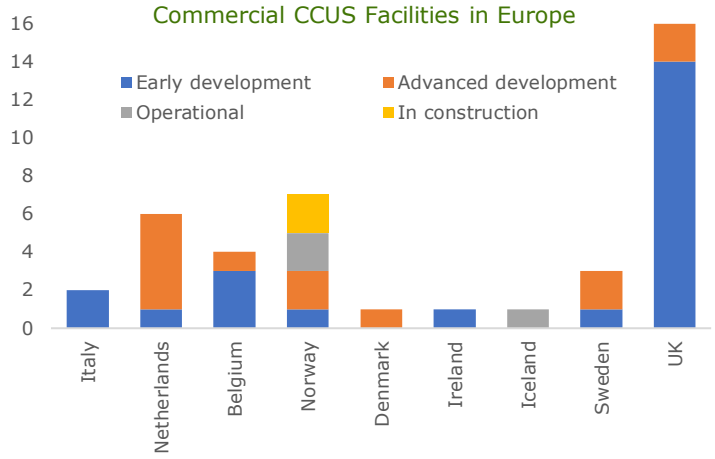


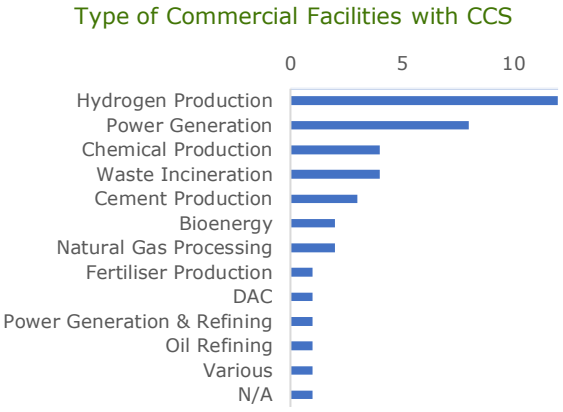
Source: EMBER, HAEE Analysis

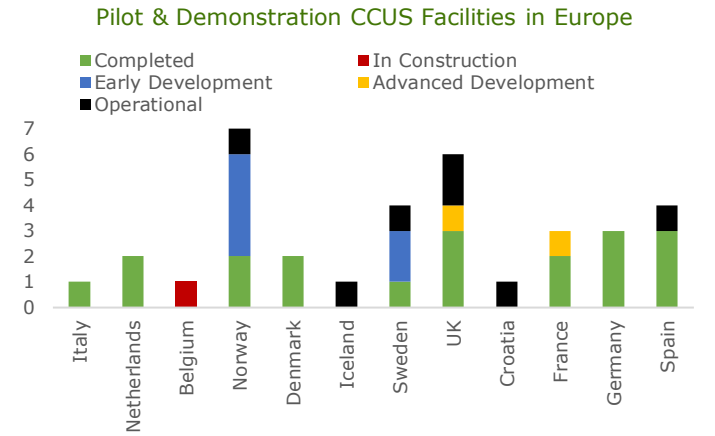
Highlights

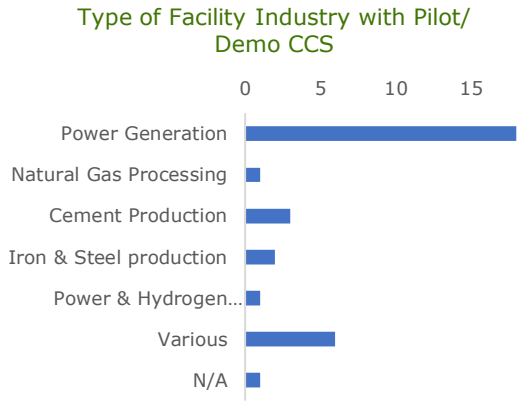
- Despite their reduction over the past two years, CO2 emissions produced from electricity generation in Greece are relatively high compared to other EU countries.
- Carbon intensity is expected to remain high, due to the reliance on natural gas power plants after the retirement of the lignite power plants.
- Decarbonizing the remaining natural gas power plants will be a challenging process, using carbon capture and storage technologies and hydrogen.
- According to the new taxonomy draft, investments in natural gas power plants would be deemed as green, if they produce emissions below 270 gCO2eq/KWh.
- To limit global warming to 1.5° C, advanced economies (including the EU) must reach zero emissions in the power sector by 2035.

Global climate goals cannot be met without the implementation of Carbon Capture Utilization and Storage (CCUS) Technologies









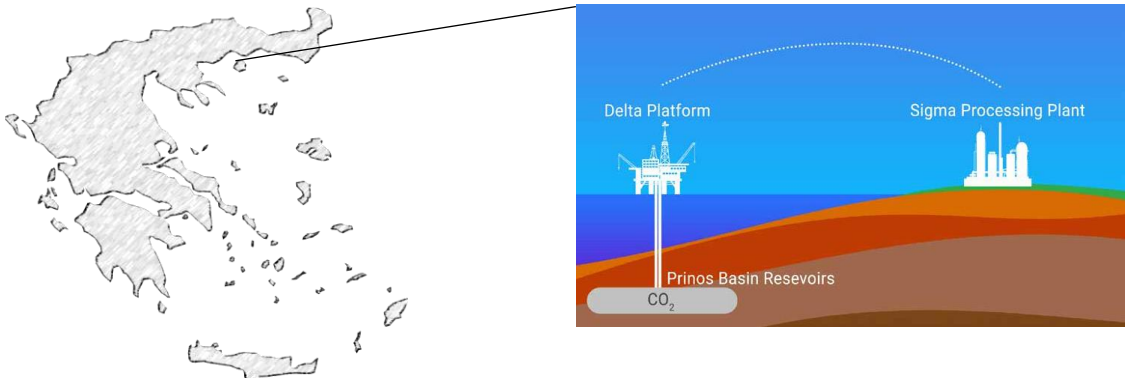
Source: Global CCS Institute, HAEE's analysis

Highlights

- Forty-one commercial CCUS facilities in different stages of development and 35 pilot & demonstration facilities are to develop and test the CCUS technologies.
- The implementation of CCUS technologies can deliver 15% reduction of the world's emissions reductions until 2050 (IEA Sustainable Development Scenario).
- Seven large scale projects were pre-selected for EU funding, 4 on CCS or related. The expected saved emissions, in their first 10 years of operation are 34.1 Mt of CO_2.
- CO_2 capture accounts for 80% of the total cost of CCS. The cost of CO_2 capture depends on the characteristics of the source, the size and the location of the facility.
- For processes producing "pure" or highly concentrated CO_2 streams CCS may cost \$15-25/t CO_2, while for cement production and power generation \$40-120/t CO_2.

Old Prinos oil field to be used as carbon dioxide storage facilities. Grant obtained under EU RRF (pre-FEED phase)

"Green Prinos"



Pre-FEED phase to be completed by Q2 2022

1st injection planned for 2025

1 Mtpa CO_2 injection

44 Mt CO_2 storage capacity

1 Eco-H_2 demo plant of 40 ton/day is planned

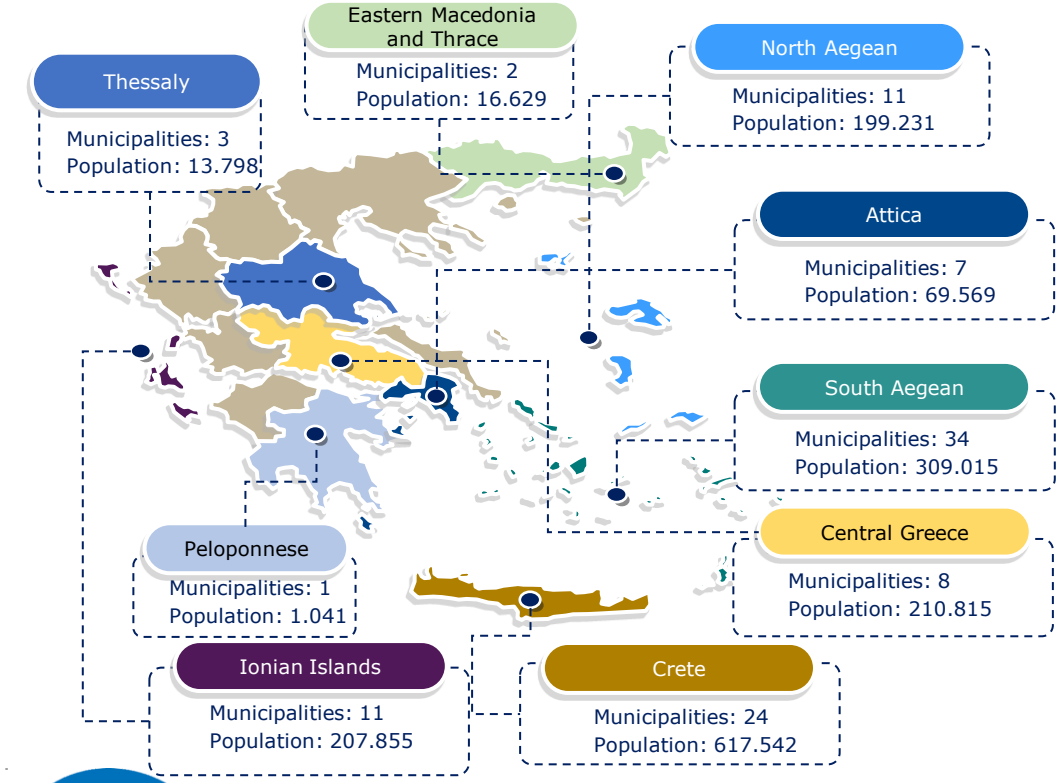
Source: ENERGEAN, HAEE Analysis

Highlights

- For the Eco-H2 demo plant, a grant was requested under the Important Projects of Common European Interest (IPCEI), in the hydrogen sector.
- The facility will be constructed in the Sigma onshore processing facility. Further expansion of the eco-hydrogen technologies coupled with CCUS is expected.
- The Green Prinos CCS project is expected to contribute to the decarbonization of the local Kavala area, under phase 1.
- A 32 km pipeline will transport the captured CO2 to the storage site. At a later stage, Prinos will store the CO2 from various site transported by ship.
- In Greece, another CO2 storage opportunity lays on the Mesohellenic Trough (Western Macedonia) with a potential storage capacity of 1,02 Gt CO2.

The energy transition of the Greek Islands is accelerating, and new initiatives and projects are in the pipeline

Insular Municipalities by Region, Eligible to be Included in the GR-ECO Islands Initiative



Number of insular Municipalities: 101
Number of permanent residents: 1.645.495

Source: HAEE analysis

Maximum utilization of Renewable Sources — hybrid power generation systems, energy storage, hydrogen production, energy efficiency and energy savings for buildings and all other sectors.

Electrification of transport — road and maritime transport, infrastructure for alternative fuels, modernization of the fleet of the coastal shipping network.

Circular economy — solid waste and wastewater management, and water resources management (desalination solutions).

Digital transformation & Telecommunications infrastructure — smart meters, smart grids, ultra fast broadband

The GR-Eco Island plan aims to make the islands independent of the national grid by providing them with renewable energy sources

GR-eco Islands

- Increased use of Renewable Energy Sources
- Creation of digital infrastructure
- Promotion of energy efficiency
- E-mobility and electrification of transport
- Green transformation of agriculture and tourism

Chalki Net-Zero Island

"Chalki becomes the first GR-eco island in Greece and becomes a model island for energy transition"

The actions on the island of Chalki:

- 1MWp PV system (Energy Community – Inhabitants - Virtual Net Metering)
- Six (6) EVs
- Public lighting & "Smart" Management Systems
- e-learning and 5G broadband networks.

Under the framework of Corporate Social Responsibility actions, the total amount of the donation to the island of Chalki was approximately 1,5 million euros

Multiple Benefits

Savings of **€180.000 – €250.000** per year

55% electricity bill reduction for residents, businesses and the Municipality of Chalki (concerns the competitive energy billing part of the provider)

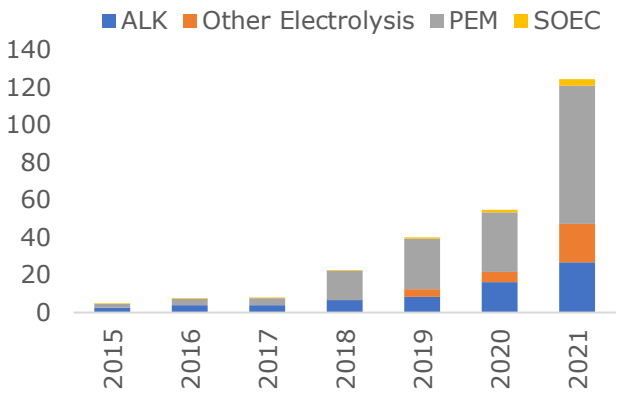
Savings of **1.800 tons of CO_2**

corresponding to **€120.000 per year** due to non-carbon emission (respectively cost = €60/ tn CO_2)

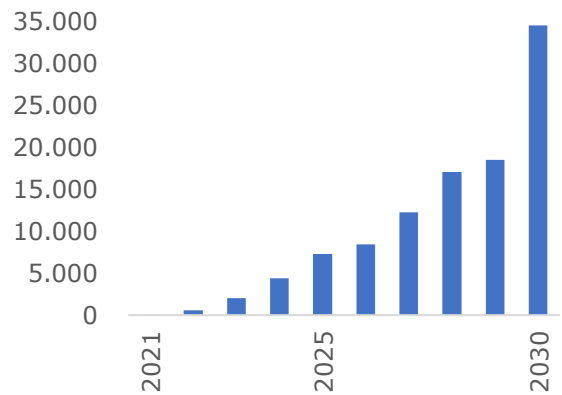
Savings of **€215.000 per year** for Services of General Interest due to the **replacement of thermal production units**

Hydrogen electrolysis market will boom in the period 2022-2030. Multi-MW electrolysis plants are planned in the next decade

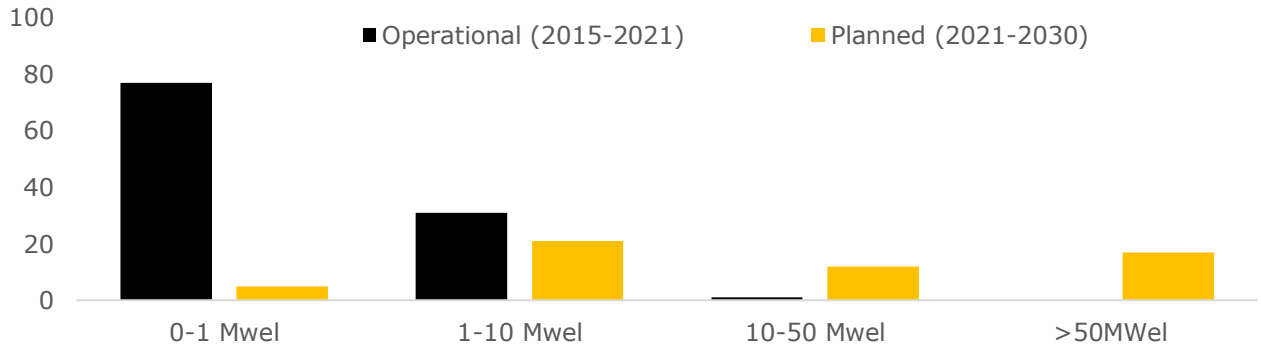
Operational Electrolysis Plants in EU-27 by Electrolyzer Type, [2015-2021] (MW)



New Electrlyzer Capacity in EU-27, [2022-2030] (MW)



Operational and Planned Electrolysis Plants in EU27 by Electrolyzer Size (MW)



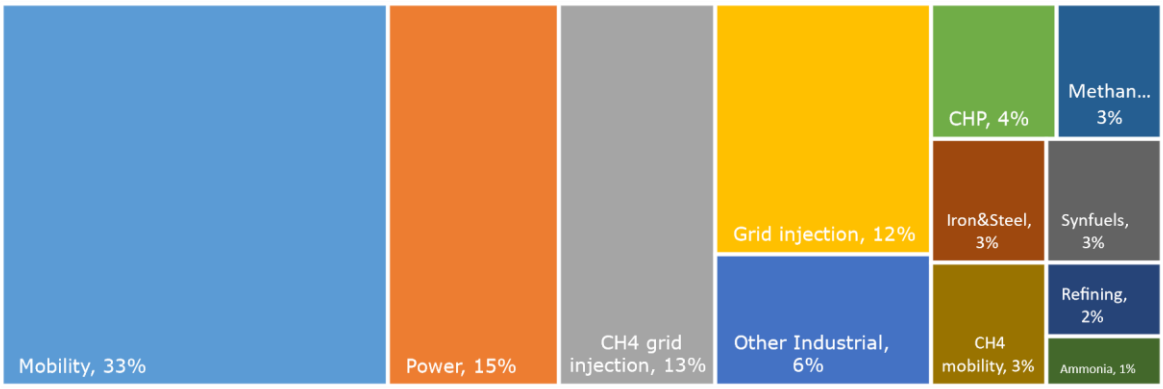
Source: IEA, HAEE Analysis

Highlights

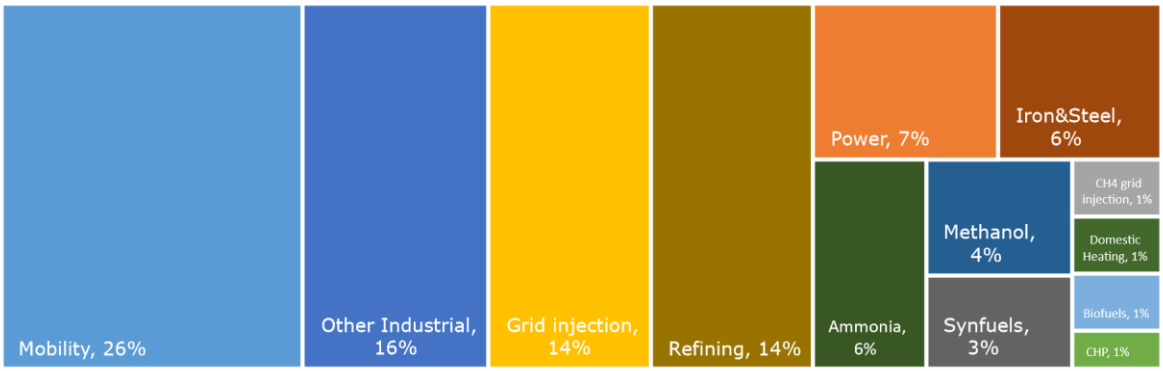
- For green hydrogen 2021 was a defining year, emerging as a viable solution for the decarbonization of hard-to-abate sectors and a key enabler of energy transition.
- In 2021, operational electrolysis plants have been doubled. PEM is the prevailing technology, followed by alkaline.
- The average capacity of an electrolyzer plant is at the range of 0-1MW and 1-10MW, while in the next decade it will be increased, exceeding 50 MW in some projects.
- The announced electrolysis projects are at the level of 35 GW by 2030, below the EU target of 40GW. Most projects have set 2030 as the completion date.
- The market share of alkaline electrolyzers will be increased. This technology is cheaper and better suited to large-scale projects, set to start construction in 2022.

Hydrogen end uses in the next decade will be focused on mobility and hard-to-abate sectors, such as cement and steel industry

Operational Electrolysis Plants in EU27 by End Use [2015-2021] (%)



Planned Electrolysis Plants in EU27 by End Use [2022-2030],(%)



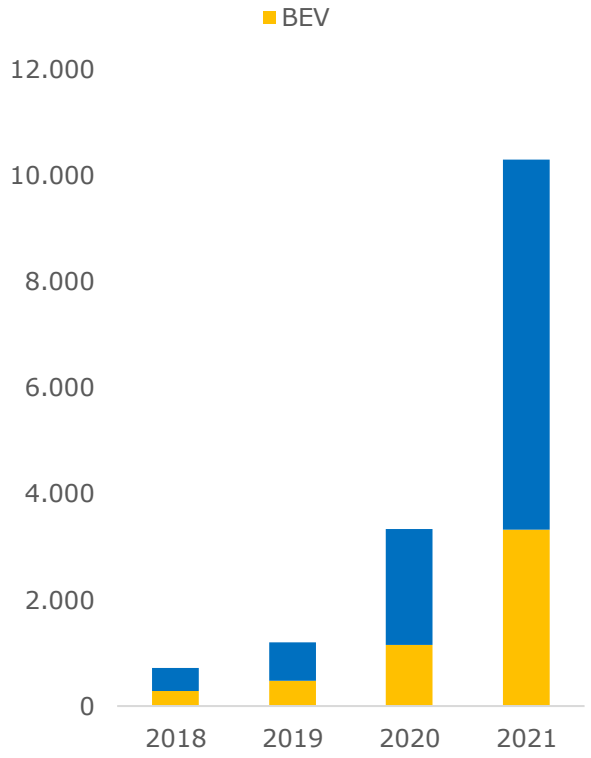
Source: IEA, HAEE Analysis

Highlights

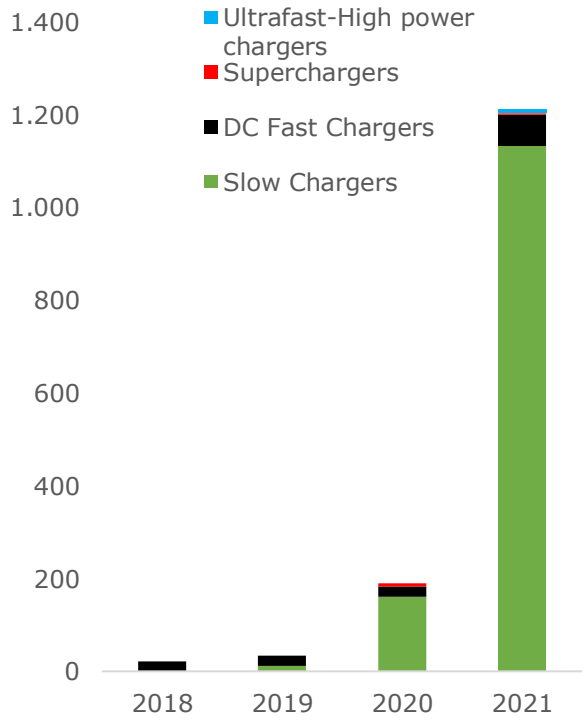
- Nowadays, mobility is the main end-use sector reaching 33% of the total electrolysis power plants use.
- Hard-to-abate sectors like steel, ammonia, chemicals and oil refining will dominate clean hydrogen demand.
- The number of countries with a hydrogen strategy doubled in 2021, from 13 to 26. In 2022, 22 more countries, Greece included, will follow.
- Targeted policies, funding instruments and economies of scale will be the key factors to spur a boom in the EU hydrogen market.
- Following the need for the EU's independence of Russian Natural Gas, the EU calls for higher green hydrogen capacity than the current targets.

The electromobility market in Greece is growing rapidly, higher than NECP estimations and supported by several subsidies and policies

Number of EV Passenger Cars in Greece [2014-2021]



Number of Publicly Accessible Chargers in Greece [2014-2021]

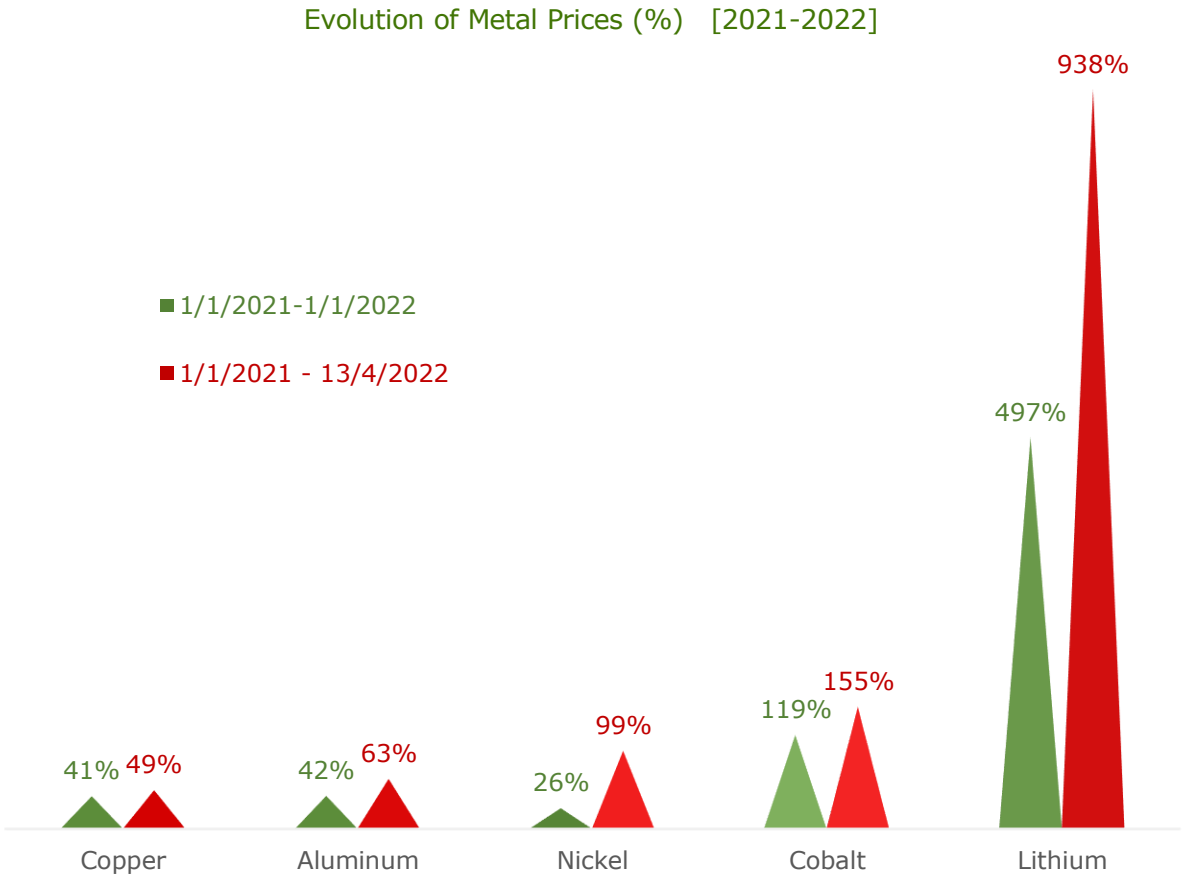


Source: YPEN, HAEE's analysis

Highlights

- The NECP targets for the penetration of electric vehicles in Greece, have already surpassed the expectations for years 2020 and 2021 by 90% and 86% respectively.
- BEV and PHEV new registrations for the year 2021, reached 7.067, representing 6% of the total registrations (in contrast with the NECP target of 2,8%).
- New electric vehicle registrations for 2020 were equal to 2.398, in contrast with the NECP target which has projected 1.265 new EVs for 2020 and 3.795 for 2021.
- For 2021, the number of charging infrastructures, both publicly accessible and private, skyrocketed to 1.344 charging points, a sixfold increase compared to 2020.
- Public Charging is expected to constitute the largest market segment until 2030, as the leading energy demand factor.

Extreme demand in the electromobility sector, supply chain disruption and high prices create a challenging environment



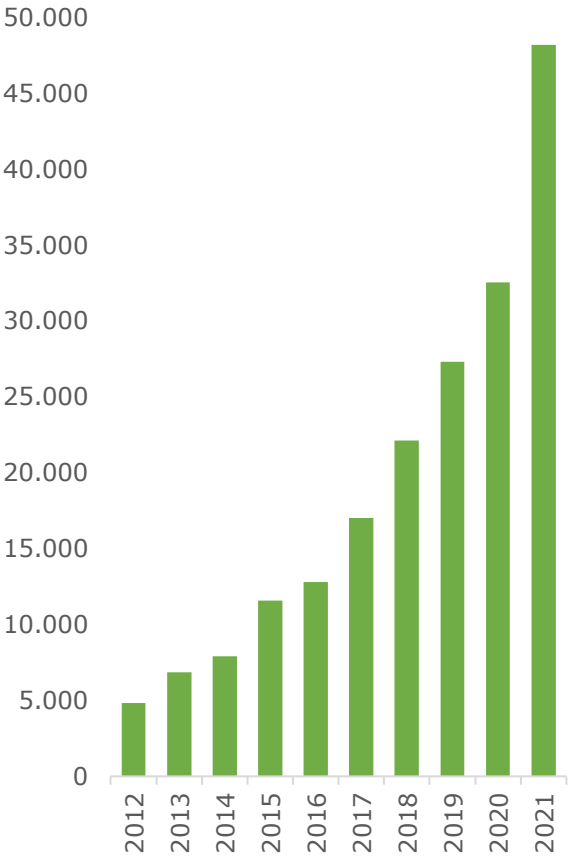
Source: Trading Economics, HAEE's analysis

Highlights

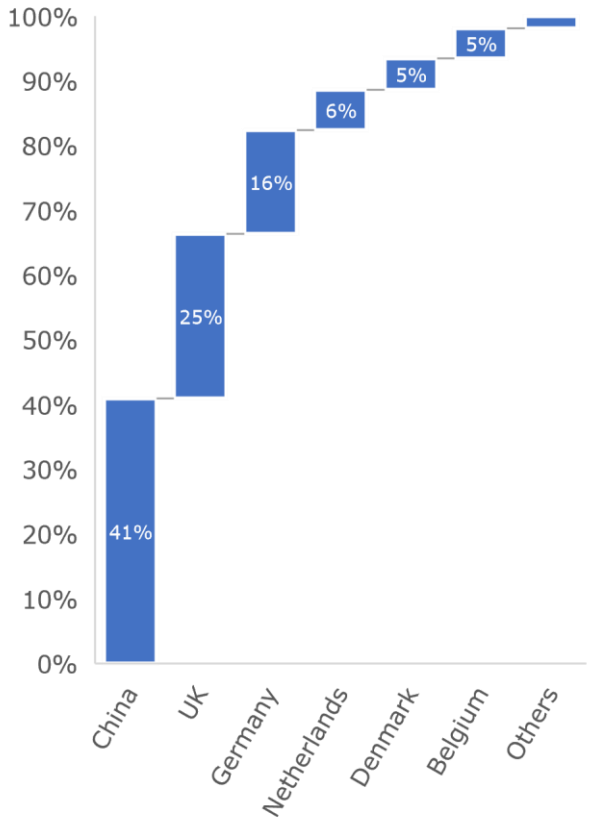
- Global growth of electric vehicles leads to increased demand for Lithium, Nickel, Cobalt and Copper, which are key metals for EV batteries.
- The supply chain disruption during the post-pandemic period fostered a significant price increase in these metals in 2021.
- The Ukraine conflict is ramping up the price of metals. The escalation of lithium cost resulted in a 938% increase during the last 15 months.
- Due to the high metal prices, the average transaction price for a new vehicle has risen 18% since 2021.
- In the coming years, the lithium and nickel market will face a turning point in terms of demand.

In 2021, offshore wind sector presented the highest growth, increased by 48% compared to previous year

Global Offshore Wind Parks in Operation [2021]



Location of Global Offshore Wind Parks in Operation [2021]



Source: WFOW, HAEE's Analysis

Highlights

- The offshore wind sector exceeded 15GW of new installations globally in 2021, which is tripled compared to the annual growth in the previous years.
- The majority of the operational offshore wind projects which started in 2021, are located in China.
- Greece aims to put 2GW of offshore wind by 2030. The publication of the relevant regulatory framework is expected within 2022.
- Greece envisages the definition of specific sea areas within which investors will be able to show interest in a specific zone commitment.
- An auction may follow for the projects to receive a "tariff" for the energy produced. ADMIE may be involved in the interconnection of the parks with the mainland.

3. Electricity

Highlights

Coal phase out will be extended from 2025 to **2028** as a measure to reduce dependence on natural gas imports

In 2021, fossil-based generation in Greece represented **58.5%**, followed by RES (incl. hydro) with **41.5%**

Despite the change in electricity mix, Greece continues to face one of the most **expensive** wholesale **electricity prices** throughout Europe

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

Electricity Prices in Greece skyrocketed to **338 €/MWh** in July 2022

The capacity of lignite energy technologies share dropped to **12%** in January 2022

A strong imbalance of **3655 GWh** between electricity imports vs exports was observed in 2021

Since 2018, carbon emission allowances increased by 1284%, climbing from around 7 €/ton to **97 €/ton** in Feb 2022

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

Overview

The electricity market is considered a key sector in Greece. Gross electricity generation in 2020 dropped to 48,2 TWh compared to 48,6 TWh in 2019, as a reflection of the Covid-19 impact on the way of daily life. In parallel, the decarbonization process of the electricity generation in Greece continues, with the lignite energy technologies capacity share dropping to 12% in January 2022. Despite this drop, the lignite phase-out will be extended from 2025 to 2028, as a measure to reduce dependency on natural gas imports.

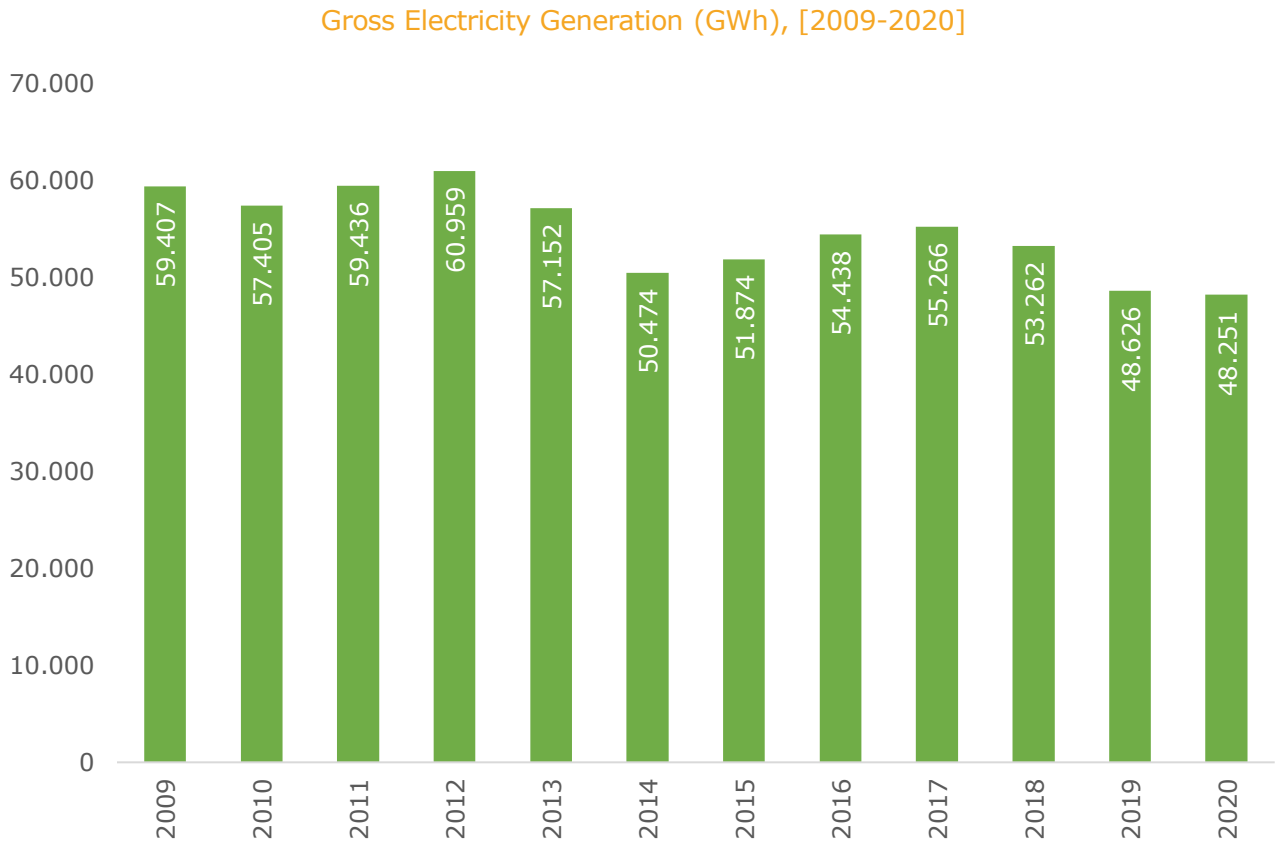
The share of installed RES capacity recorded a significant growth surpassing 8,5 GW and a 45% share compared to other energy technologies excluding hydro. The energy transition progress is depicted in the electricity mix of February 2021, when RES contributed more than 54%. RES contributed with more than 40% share in the electricity mix (including the non-interconnected system) for 6 months of the same year, indicating the strong shift towards decarbonization. Despite the increase of RES, the interconnected system is still dependent on electricity imports to cover its electricity demand. In 2021, the imbalance between exports and imports was equal to 3655 GWh.

The Public Power Cooperation (PPC), retained a dominant share in electricity generation. PPC's share in the retail market ranged between 63.4%-64.6% during October 2021 - February 2022, which reflects the downward trend from January 2016.

In 2021, remarkable changes in electricity prices occurred in the European countries. Strong volatility is evident when comparing electricity prices in Q1 and Q4 in most of the European countries. The most volatile electricity prices shifts were in Malta, Italy, Slovenia and Croatia (EU-27), while the Nordics (Sweden, Finland, Norway) experienced the lowest volatility. Electricity prices in Greece, list the country as one of the ten most volatile among the rest of the European countries (EU-27, UK, Switzerland, Serbia, Norway, Ukraine).

Besides, electricity prices in Greece recorded historical highs during the second half of 2021. From November 2021 onwards, the Market Clearing Price steadily exceeded 200 €/MWh while reaching 235 €/MWh in December 2021. The same month, the highest of the past 6 years hourly price was recorded at 542 €/MWh. For non-household consumers, only 51% of electricity prices is attributed to cover energy and supply costs. The rest is directed to cover taxes (31%), network costs (12%) and others (6%).

Gross electricity generation in 2020 remained at relatively similar levels compared to 2019 levels, dropping slightly to 48,2 TWh

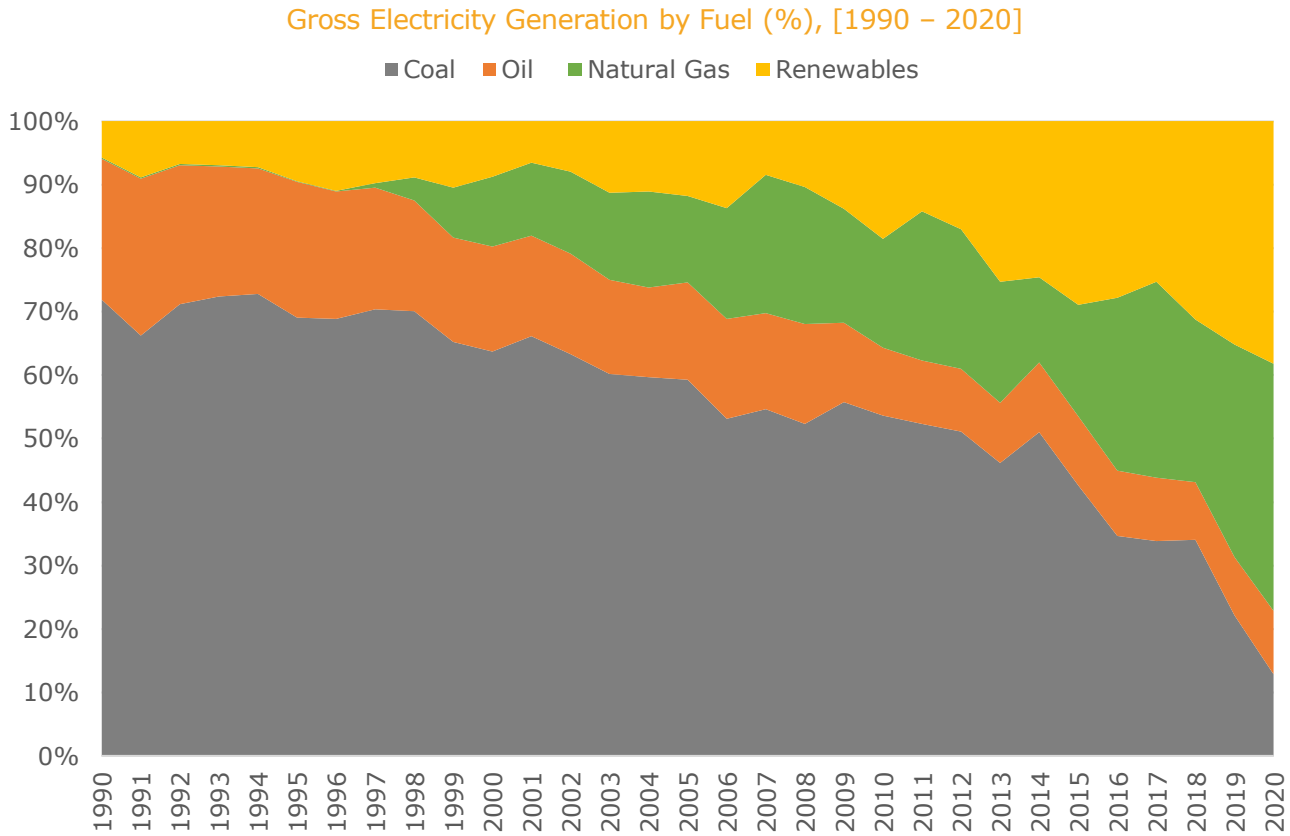


Source: Eurostat, HAEE's analysis

Highlights

- Between 2009 – 2014, the mean electricity generation was 574,72 TWh, while between 2015 – 2020 it dropped at 519,95 TWh.
- During 2009 - 2020, the gross electricity generation decreased by 18,7%, dropping from 59,4 TWh to 48,3 TWh.
- Since the beginning of the economic crisis, domestic generation has been declining, with relatively sharp fluctuations.
- In 2020, electricity generation dropped to the lowest level of the decade due to impact of the Covid-19 outbreak.
- Electricity generation in 2019 was only slightly higher than 2020 (0,77%), yet significantly lower compared to 2018 levels (-9,4%).

The decarbonization process of the electricity generation in Greece continues, with the lignite share dropping by 44.4% in 2020



Source: IEA, HAEE's analysis

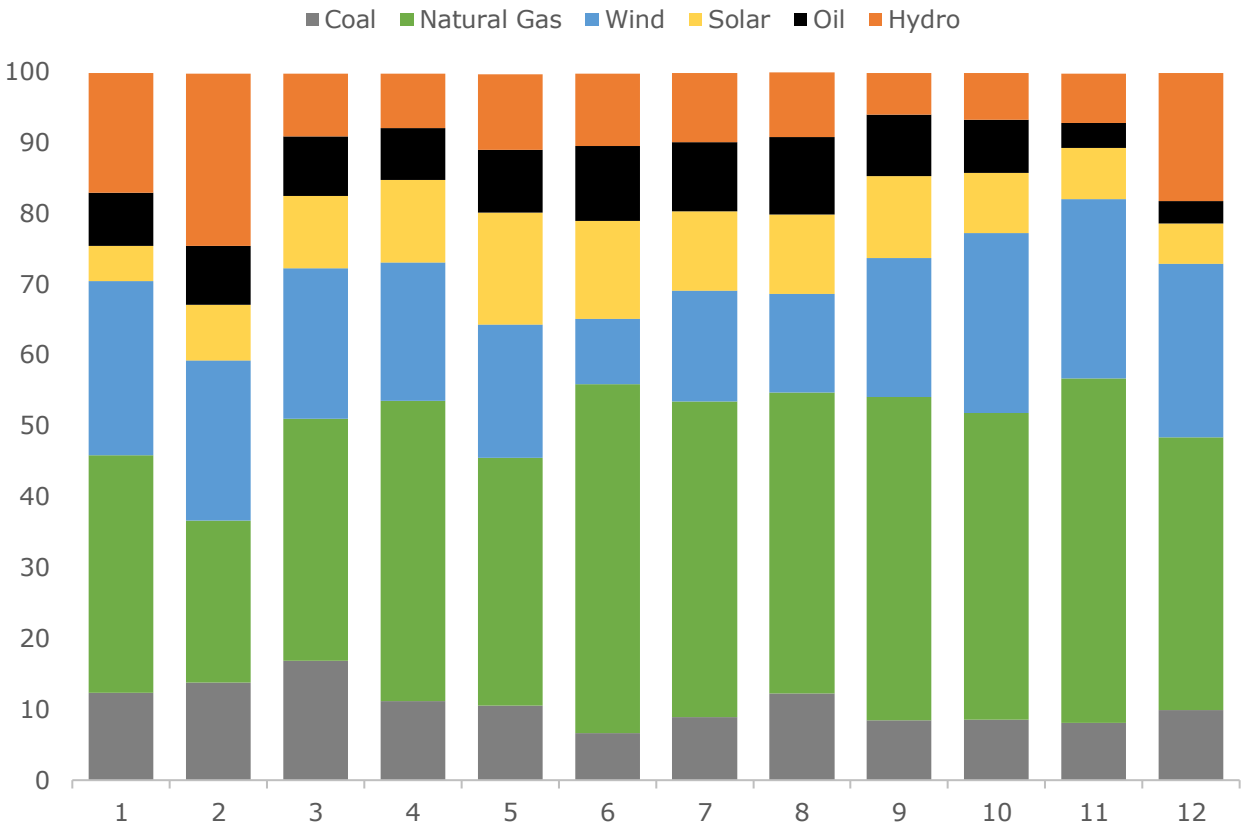
Highlights

- 2020 was the second consecutive year when natural gas-based electricity generation surpassed generation from lignite power plants.
- In 2020, natural gas increased its share by 4% and 13% compared to 2019 and 2018, respectively.
- Renewable Energy Sources share is the second largest in terms of electricity generation after natural gas.
- In 2020, Renewable Energy Sources share increased by 3%, 7% and 13% compared to 2019, 2018 and 2017, respectively.
- Both Renewable Energy Sources and natural gas dominate the electricity mix, with a cumulative share of 77%.

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

In 2021, RES contributed to Greece's energy mix with a minimum of 33,2% (June) and a maximum of 54,69% (February)

Gross Electricity Generation by Fuel (%), [January 2021 – December 2021]



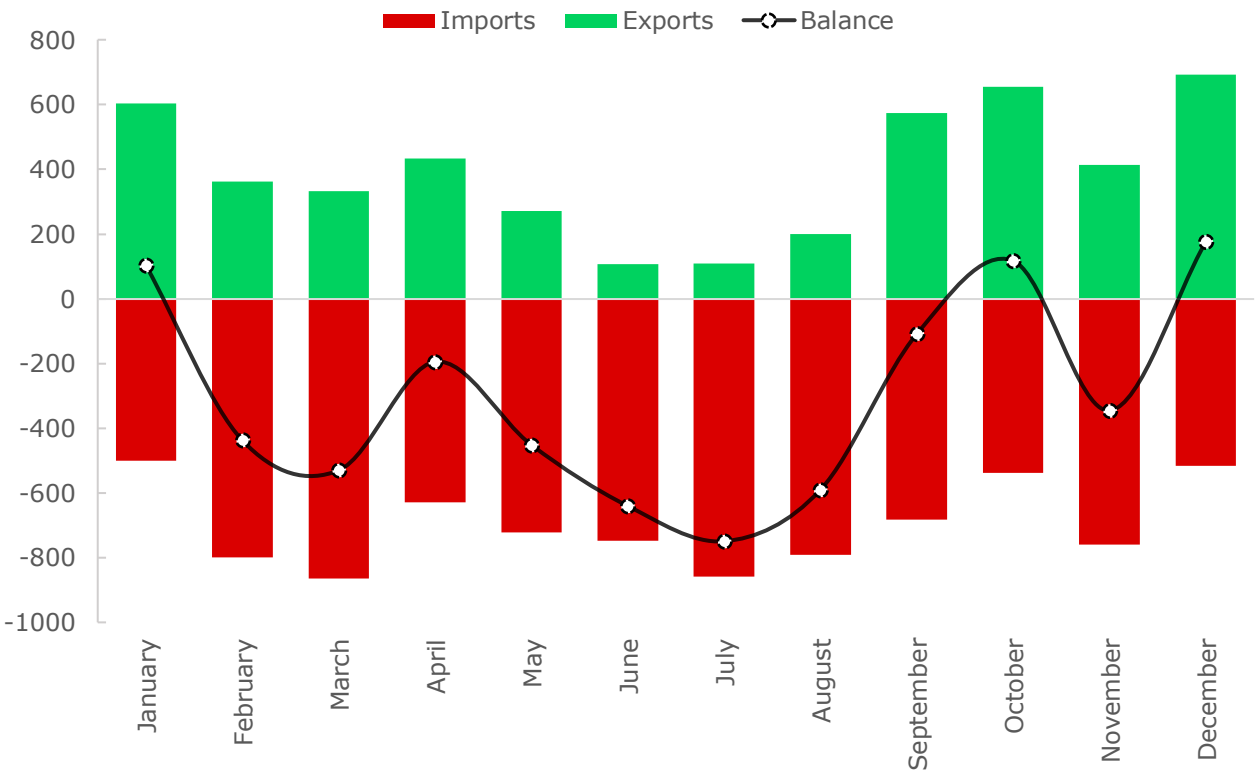
Source: IEA, HAEE's analysis

Highlights

- Renewable Energy Sources exhibited generation of electricity in February 2021 with a share larger than 54%.
- In 2021, RES contributed significantly to the electricity mix, surpassing a 40% share for 6 months of the year (Jan-Feb-Mar-May-Oct-Dec).
- Fossil-based generation peaked during the summer months indicating the high seasonal demand.
- It is evident that water resources play a key role in the decarbonization, with increasing shares during the winter months due to high rainfall and precipitation.
- Electricity generation from oil is primarily attributed to the diesel generators in the non-interconnected system.

Electricity imports for 2021 are steadily above 500 GWh per month, while exports present stronger variability

Monthly Electricity Imports, Exports and Balance (GWh) in the Interconnected System, [January 2021 - December 2021]



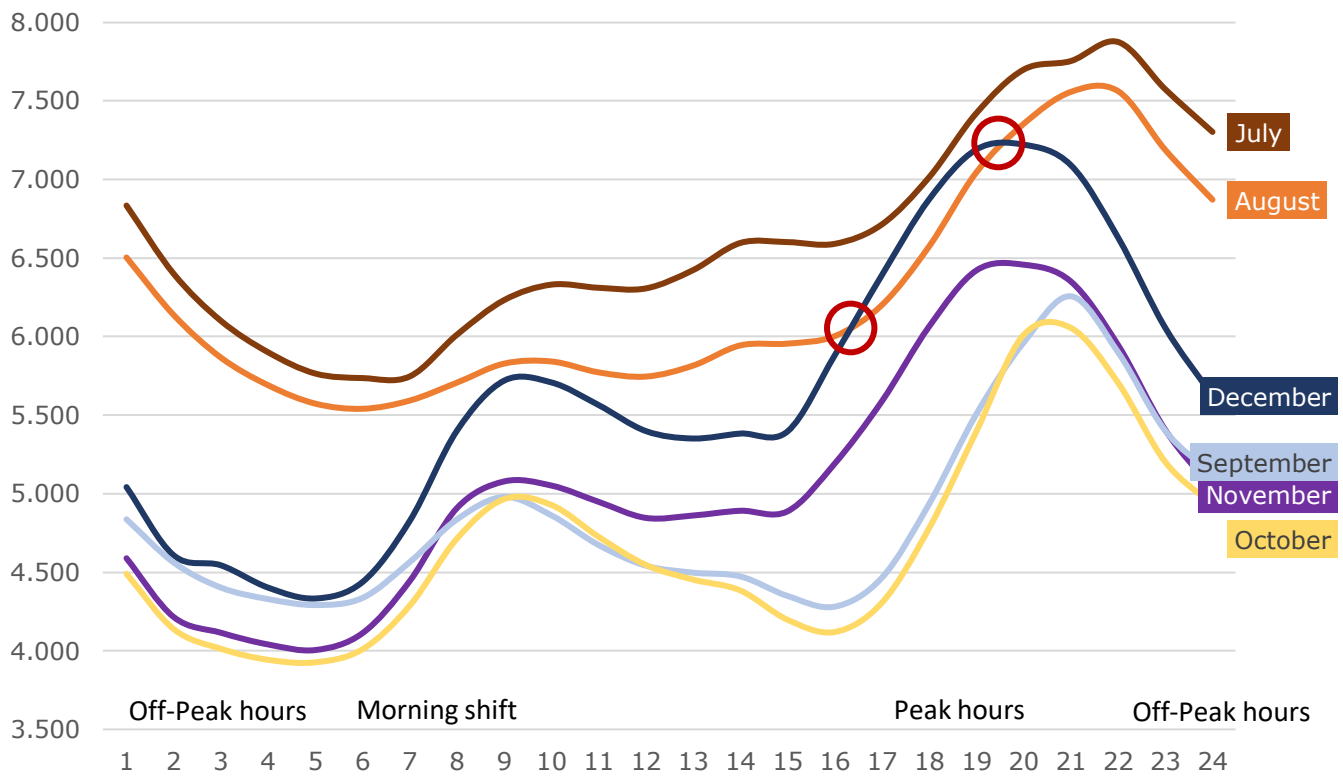
Source: ADMIE, HAEE's analysis

Highlights

- Duringg 2021, there was a strong imbalance between imports and exports in the interconnected system with the neighbouring countries.
- At the same year, electricity imports were above 500 GWh. In March electricity imports peaked, exceeding 863 GWh.
- The highest imbalance was noticed during the summer months of 2021 when more electricity imports were needed due to the increased summer demand.
- Electricity exports peaked during December and January which may be attributed to the increased domestic wind and hydro-electricity generation.
- The balance between exports and imports was positive only for three months: January, October and December 2021.

Strong seasonal variability was observed in the monthly average load curve between off-peak and peak hours

Monthly Average Load Profile in Greece (MWh), [July 2021 -December 2021]



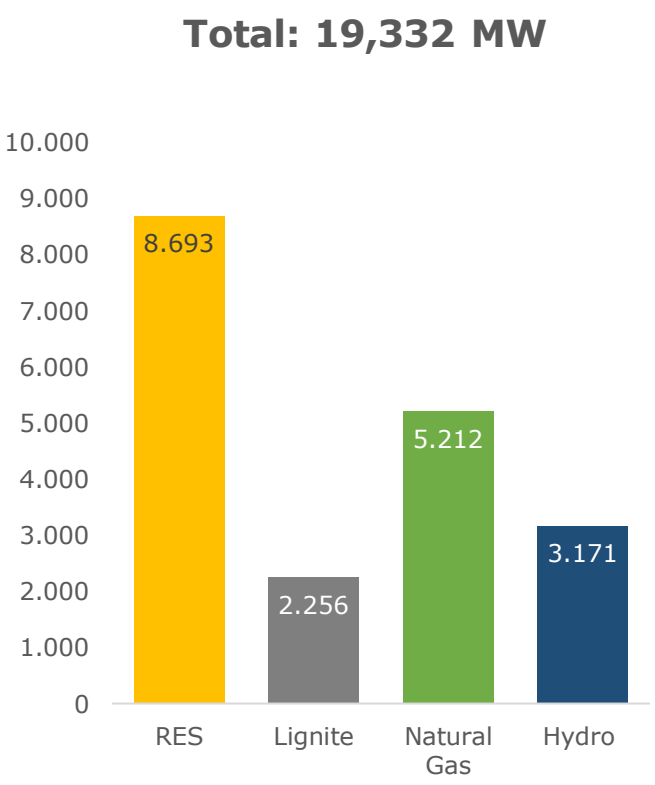
Source: ADMIE, HAEE's analysis

Highlights

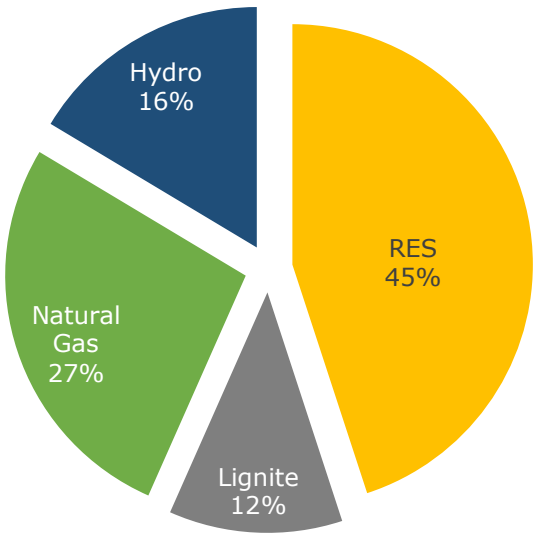
- The load variation between different times during the day, presents a common trend with minor differences.
- Accounting all months, peak hours start from 4pm-5pm until 9pm, while for July and August peak hours move 1 hour forward.
- December's load presents the strongest variability when compared to the last 6 months of the year, followed by November and October.
- It is observed that the load between morning shift and peak hours has an increasing trend for July and August, in contrast with the rest of the months.
- July and August are the two months with the most flattened load curve between 7am-3pm, which may be attributed to increased needs for cooling.

RES technologies have the highest installed capacity among energy technologies for January 2022 reaching a share of 45%

Total Electricity Capacity per Fuel (MW), [January 2022]



Total Electricity Capacity per Fuel (%), [January 2022]



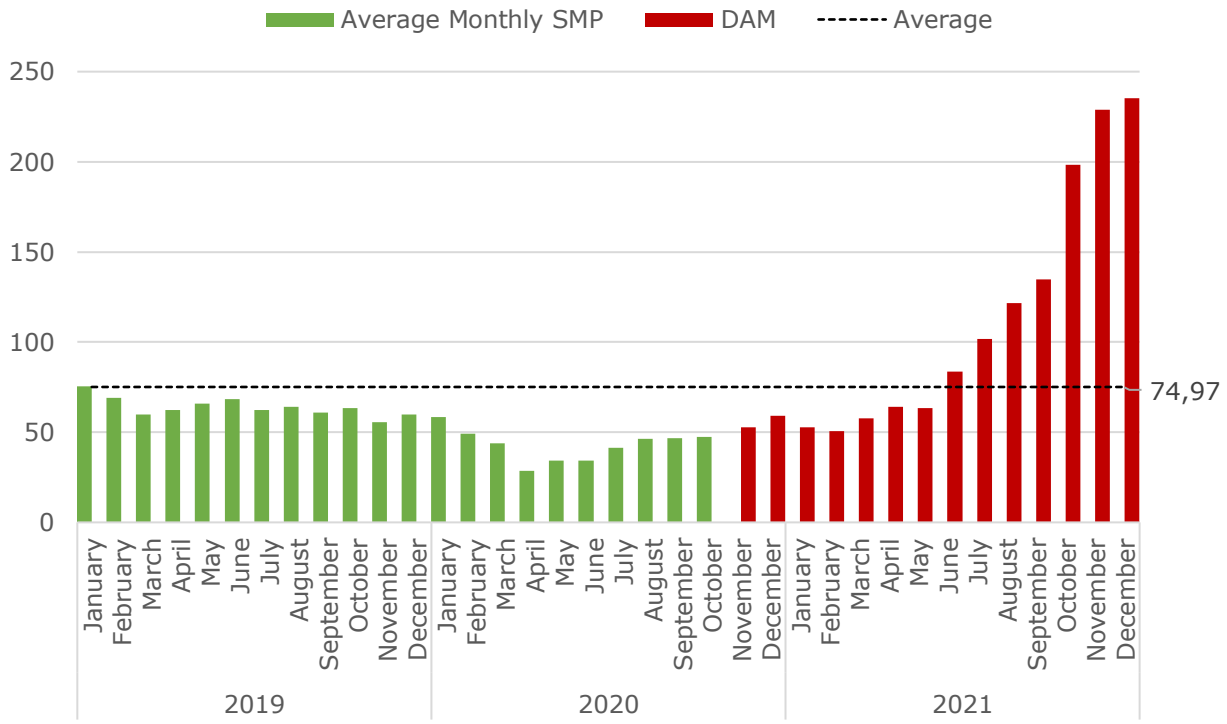
Source: ADMIE, DAPEEP and HAEE's analysis

Highlights

- In January 2022, RES accounted for the highest electricity capacity compared to any other energy technology reaching a share of 45%.
- Due to the decommissioning of the lignite-fired power plants, lignite installed capacity was reduced to 2,256 MW while reducing its share to 12%.
- The capacity of natural gas power plants and hydro remained in steady levels when compared to October 2020.
- Lignite, that used to be the main domestic fossil fuel in Greece, is gradually being replaced by Renewable Energy Sources and natural gas.
- RES comprise of 4,342 MW of Wind, 3,640 MW of PV, 250 MW of small scale-hydro, 109 MW of biogas/biomass and 352 MW of PV on rooftops.

From June 2021 and onwards, wholesale electricity prices exceeded 74,9 €/MWh which was the average price of the past three years

Monthly Wholesale Electricity Price in Greece (€/MWh), (January 2019 – December 2021]



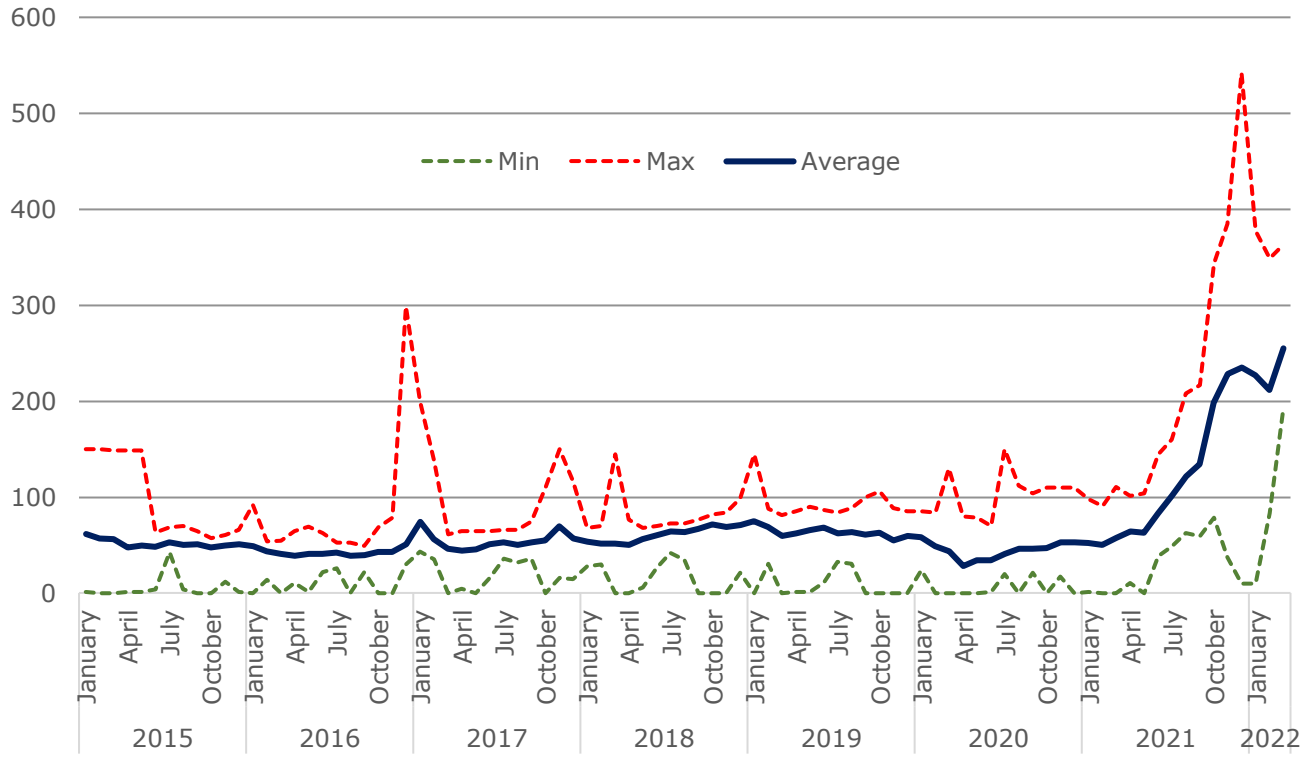
Source: HEnEx, HAEE's analysis

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.
- Since the implementation of the Target Model in Greece, the variability of the Market Clearing Price in the Day-Ahead Market is intense.
- Following May 2021, the Market Clearing Price reached new historical highs with prices ranging from 83.47 €/MWh (June '21) to 235.38 €/MWh (Dec '21).
- The most important price drivers are: the CO2 price, the cost of imported fuels and the availability and technical characteristics of thermal units and RES.
- The wholesale electricity price in December 2021 (235,3 €/MWh) accounted for approximately 44% of the annual cumulative price of 2020 (540,7 €/MWh).

Historical highs in the hourly Market Clearing Price were observed in the past months, with maximum prices exceeding 500 €/MWh

Monthly Wholesale Price on Hourly Basis (€/MWh), [January 2015- 1st March 2022]



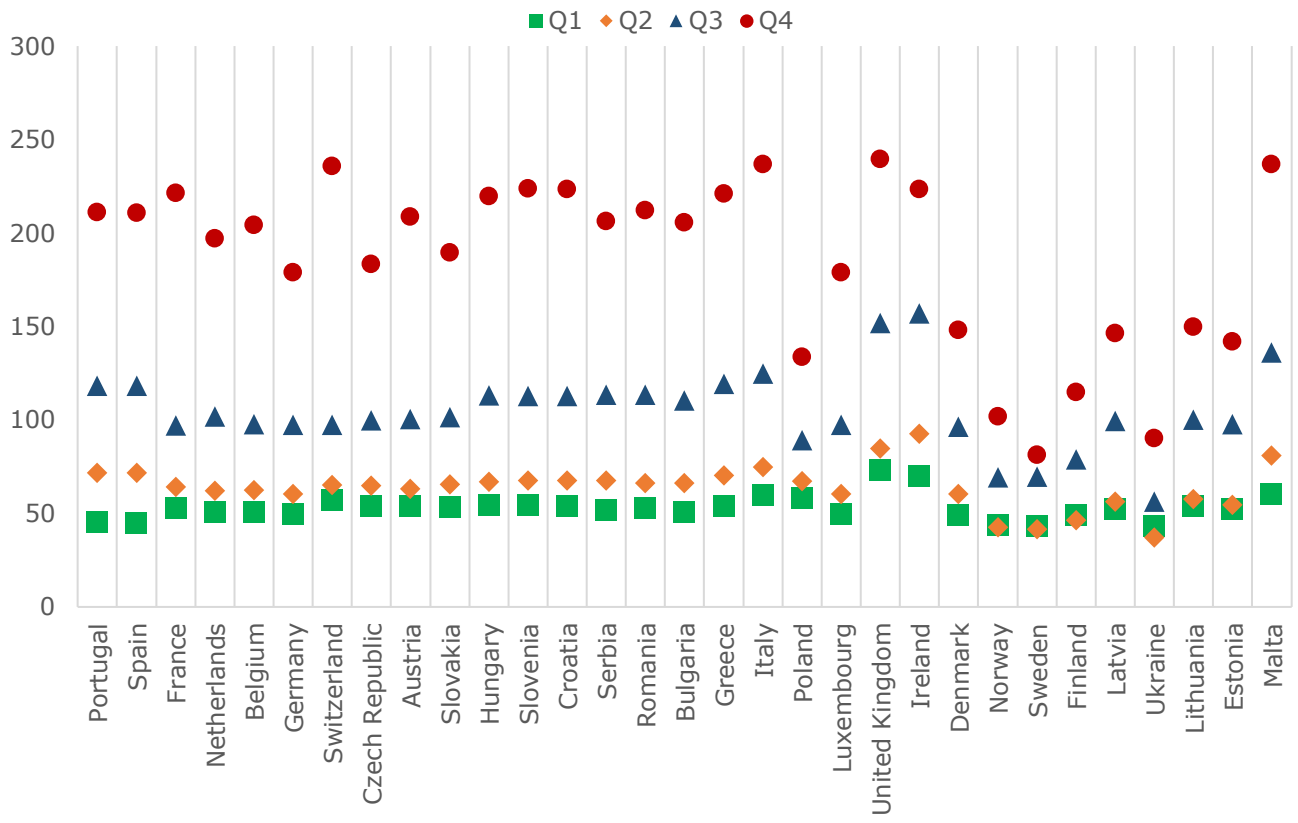
Source: HEnEx, HAEE's analysis

Highlights

- While the average hourly MCP did not exceed 100 €/MWh before July 2021, the maximum hourly MCP exceeded that price many times in the past 5 years.
- Maximum prices above 100 €/MWh, between 2015-2019, are spotted mainly during the winter months.
- For 2020, the maximum prices above 100 €/MWh were recorded during the summer, autumn and winter months.
- On the 12th of December 2016, wholesale price reached 299 €/MWh at 6,7 and 8 pm, for the 1st time in the wholesale electricity market of Greece.
- The highest hourly MCP was recorded during 22nd December 2021, when the price rocketed to 542,5 €/MWh at 5,6 and 7 pm.

Escalating volatility of wholesale electricity prices during 2021 was apparent almost in all European countries

Wholesale Baseload Electricity Prices in EU-27, UK, Serbia, Norway, Ukraine, Switzerland (€/MWh), [Q1, Q2, Q3, Q4 - 2021]



Source: European Commission, HAEE's analysis

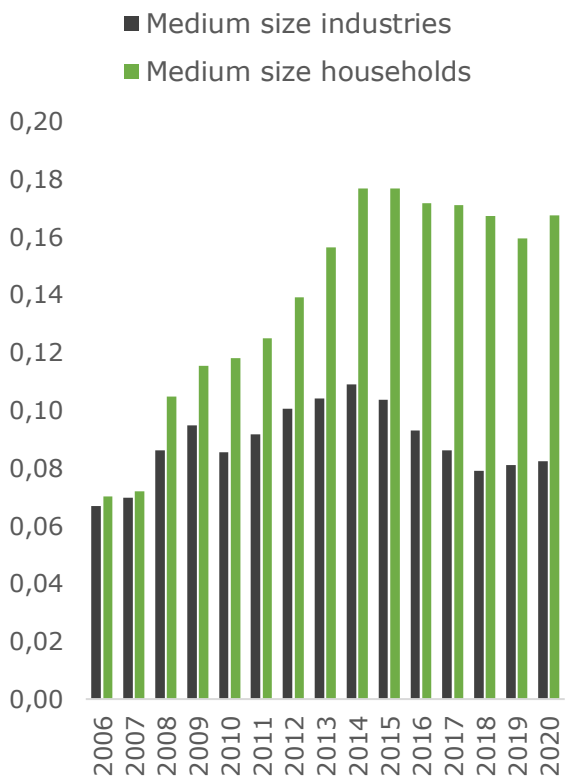
Highlights

- During the fourth quarter of 2021, the average wholesale baseload electricity price among European countries climbed at 194,3 €/MWh.
- During the fourth quarter of 2021, among the listed countries, the lowest prices were recorded in Sweden (81,2 €/MWh).
- The top 3 countries with the highest difference in max and min price are Switzerland (179 €/MWh), Italy (177,1 €/MWh) and Malta (176,2 €/MWh).
- The bottom 3 countries with the lowest difference in max and min prices are Sweden (39,8 €/MWh), Ukraine (53,2 €/MWh), and Norway (59,3 €/MWh).
- The price volatility in Greece was profound during 2021, fluctuating between 53,5 €/MWh in Q1, 70,3 €/MWh in Q2, 119,4 €/MWh in Q3 and 220,9 €/MWh in Q4.

CO_2 emission allowances directly affect electricity prices and contribute to emissions' reduction throughout Europe

CO_2 European Emission Allowances (€/ton), [2018-March 2022]

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



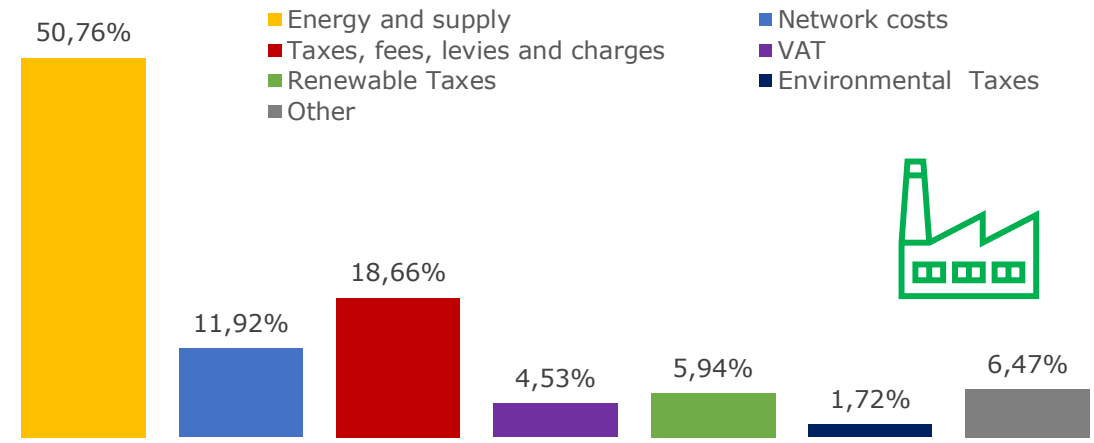
Source: Eurostat, HAEE's analysis

Highlights

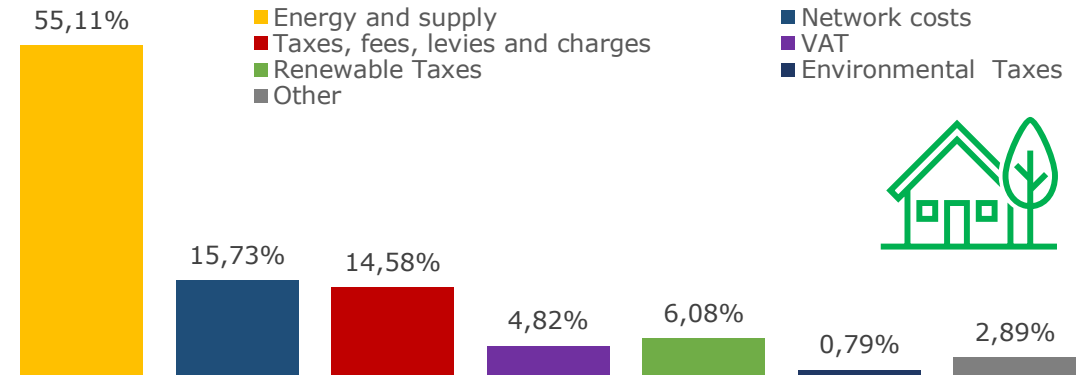
- Since 2018, carbon emission allowances increased by 1284%, climbing from around 7 €/ton to the historical peak of 96,7 €/ton in February 2022 (28 €/ton in 2019).
- CO2 price is estimated to reach a yearly average of 96.7 euros within 2022 and 91,71 euros in 2023 while for 2024 it is estimated to reach 94,11 euros.
- Accompanied by an increase in CO2 emission allowances pricing, the monthly average SMP in Greece encountered a steady surge following July 2021.
- In terms of electricity prices by type of user, medium size households experience a constant stable trend, with prices reaching 0,17 €/kWh in 2020.
- On the contrary, since 2017, prices in medium size industries are relatively steady at 0,08 €/kWh, decreased by 37% compared to the record high-year of 2014.

18.7% of the electricity price for non-household consumption in Greece was attributed to taxes, fees, levies and charges (2021)

Electricity Prices Components for Non-household Consumers (%), [2021]



Electricity Prices Components for Household Consumers (%), [2021]



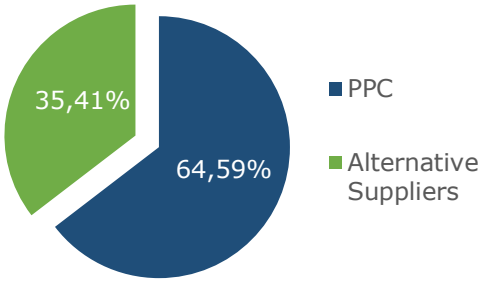
Source: Eurostat, HAEE's analysis

Highlights

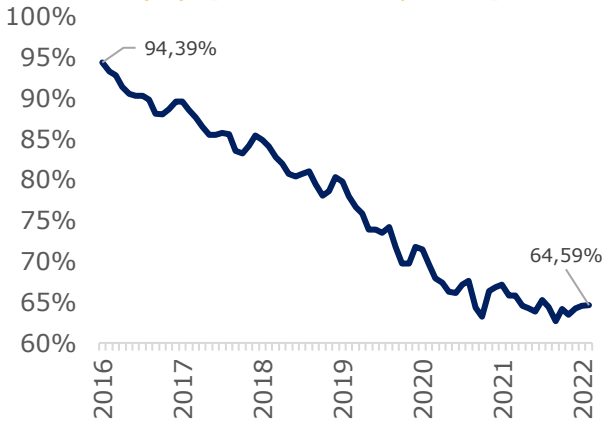
- In 2021, 50.7% of the electricity price for non-household consumption was attributed to energy and supply, 18.7% to taxes, levies and charges; and 4.5% to VAT.
- Compared to 2020, the price for energy and supply increased by approximately 10% in 2021.
- Cheaper electricity will be available to the tourism and agricultural sector through a reduced charge of ETMEAR which represents 7.4% of the total electricity cost.
- The reduced ETMEAR charges for farmers and businesses in the tourism sector will be applied retroactively from 1st January 2019 until 31st December 2021.
- For 2021, 55.11% of the electricity price for household consumption in Greece was attributed to energy and supply, 15.73% to network costs and 14.58% to taxes.

PPC's share in the retail market remains above 60% for 2021, while in February 2022 it reached 64.59%

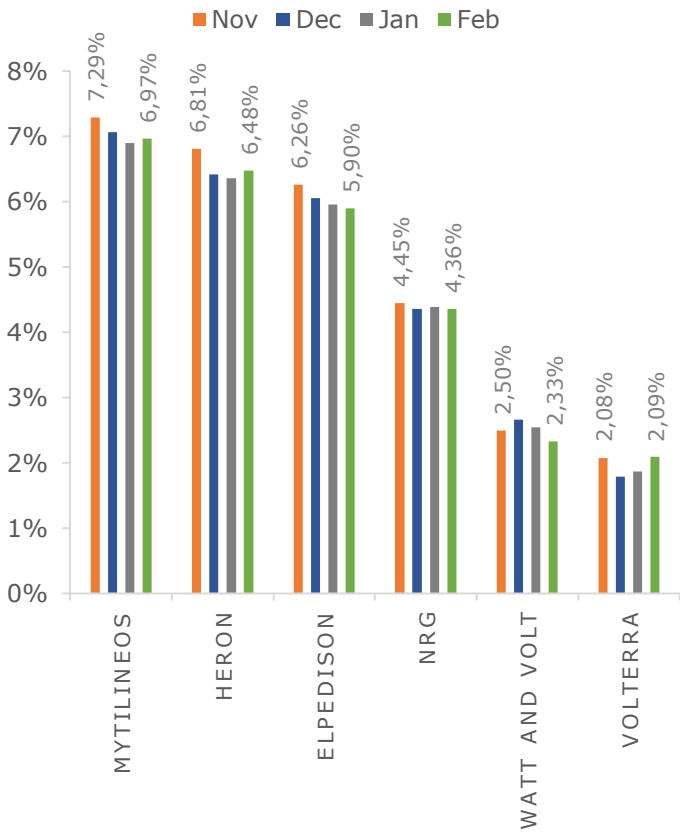
Retail Market Share (%), [February 2022]



PPC's Retail Market Share (%), [2016-February 2022]



Alternative Suppliers with Retail Market with Share > 2% (%), [Nov '21-Feb '22]



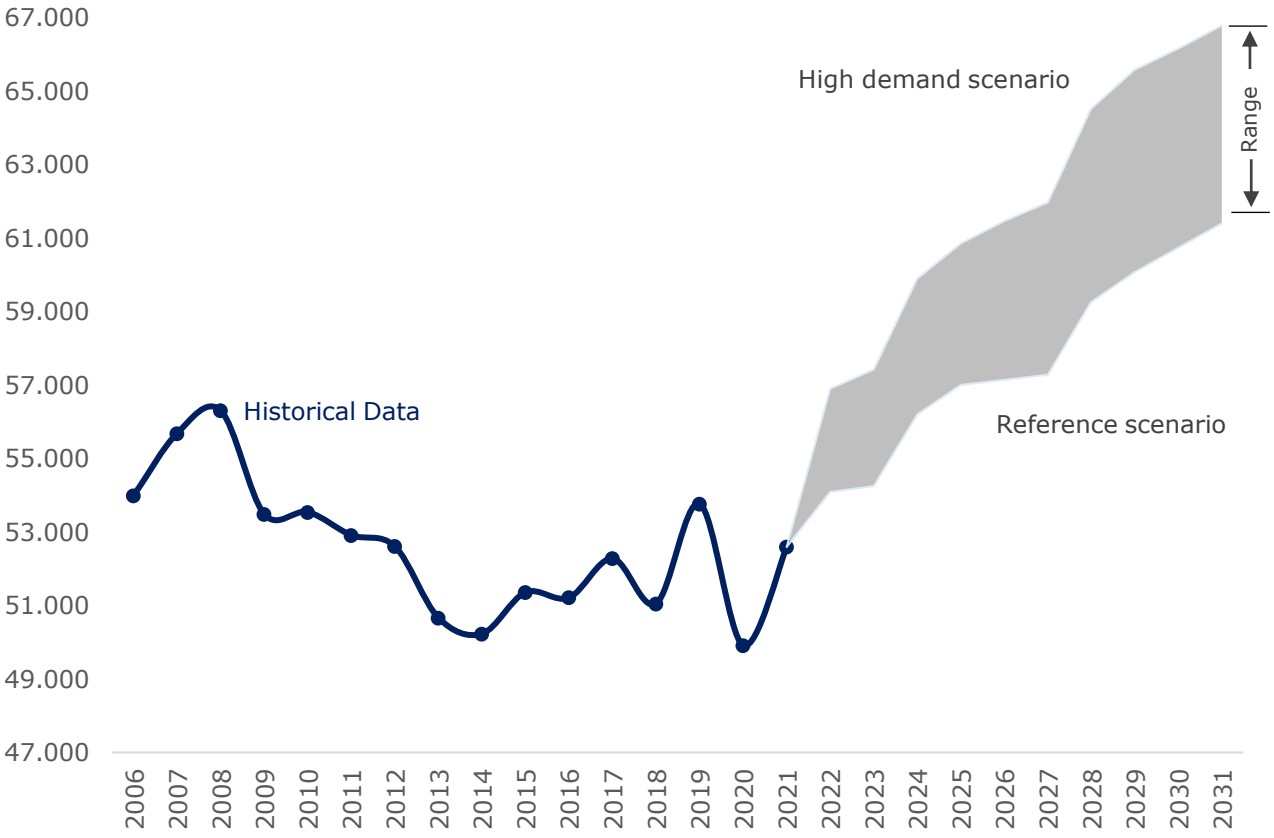
Source: HEnEx, HAEE's analysis

Highlights

- Market share in February 2022 was still dominated by PPC at 64.59%, while the remaining 35.41% was distributed among the rest of the suppliers.
- The largest part of the above share was attributed to 6 companies, which reached 28.13% in February 2021.
- In February 2022, the following shares are observed: Mytilineos 6.97%, Heron 6.48%, Elpedison 5.90%, NRG 4.36%, Watt and Volt 2.33% and Volterra 2.09%.
- The Derivatives Market, which officially started to operate in March 2020, aims to replace the gap created after the abolishment of NOME-type auctions.
- The Derivatives Market, launched simultaneously with the detrimental lockdown restrictions due to Covid-19, continues to face almost zero liquidity.

It is estimated that electricity demand will sharply increase during the next decade surpassing 60 TWh after 2028

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

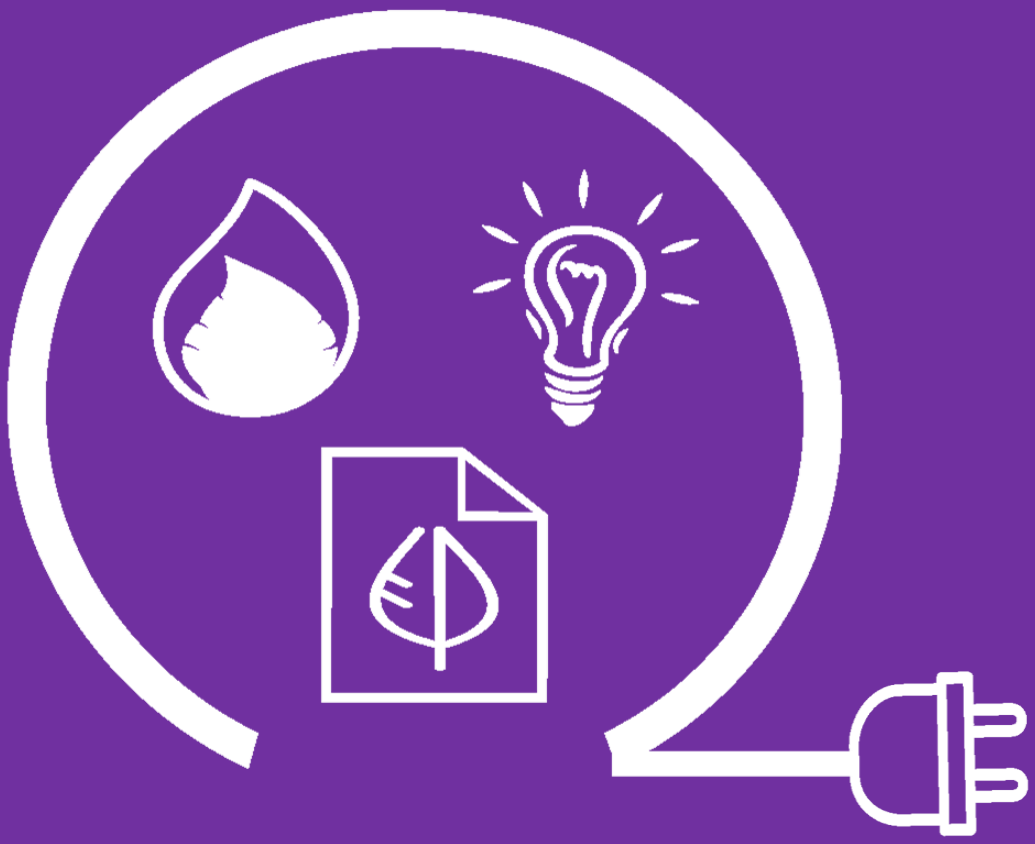


Source: ADMIE, HAEE's analysis

Highlights

- According to the projections of ADMIE, demand for electricity in the upcoming years will sharply increase.
- The Covid-19 impact 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.
- There is a significant rise in 2021, that may be attributed to the general recovery of the Greek economy after the Covid-19 restrictions.
- 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 that the total annual demand for electricity will reach 66,7 TWh in 2031. The Reference scenario projects demand of 61,4 TWh.

4. Hellenic Energy Exchange

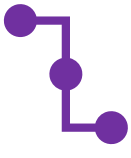


Highlights

Successful implementation of Complementary Regional Intraday Auctions (**CRIDAs**) between **Greece-Italy-Slovenia** in September 2021

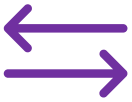
HEnEx's **Derivatives Market** offers trading on Futures with financial settlement of the transactions while Members can benefit from an optional physical settlement of their monthly contracts

Harmonised maximum clearing price for SDAC was set to **+4,000 EUR/MWh** from 10th of May 2022



Launch of the **hybrid model** for the operation of the small connected system (SCS) market of **Crete**

Day-Ahead Market Coupling of Greece with **Italy** and **Bulgaria** occurred in **2021**

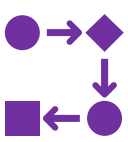


Natural Gas Trading Platform initiated in **March 2022** and will allow anonymous gas trading to the benefit of all market participants.

The Albanian Power Exchange (**ALPEX**) has signed an agreement with the Athens Stock Exchange (**ATHEX**), Hellenic Energy Exchange (**HEnEx**) on providing an electronic trading platform for its day-ahead and intraday markets.

Postponement of the **Core Flow-Based Market Coupling** project Go Live

97% of total trades in the HEnEx took place at **Day-Ahead Market** and only 3% at Intraday Market



Overview

Hellenic Energy Exchange, a Nominated Electricity Market Operator (NEMO) for the Greek Bidding Zone, provides the marketplace, trading venues, platforms and delivers efficient price formation, for a secure and reliable energy trading in the South-East Europe.

Trading services are based on high European regulatory standards, ensuring transparency of transactions, low transaction cost and elimination of counterparty risk through the clearing and risk management of a Central Counterparty.

Hellenic Energy Exchange operates the Energy Trading Spot System (ETSS) and Natural Gas Trading Platform powered by ATHEXGroup, offering web-based state-of-the art environments and Application Programming Interfaces (APIs) for customized individual trading management.

ETSS supports all the standard PCR products and Order Types used in Single Day-Ahead Coupling and is further extended and integrated for accommodating local and regional intraday auctions trading. The Natural Gas Trading Platform supports short-term Standardized Products and provides a market to all interested Participants, gas suppliers, traders and final consumers. The Hellenic Gas Transmission System Operator (DESFA) participates for the balancing needs of the National Natural Gas Transmission System.

The Natural Gas Trading Platform is an organized market operating in accordance with the Regulations EU BAL Network Code and REMIT, upgrading the operating framework of the existing wholesale gas market in Greece. Participants in the Natural Gas Trading Platform can be the Transmission Users and DESFA.

DESFA participates by trading in short-term Standardized Products for reasons of balancing the National Natural Gas Transmission System. The transactions that take place are anonymous while the quantities are automatically notified to DESFA.

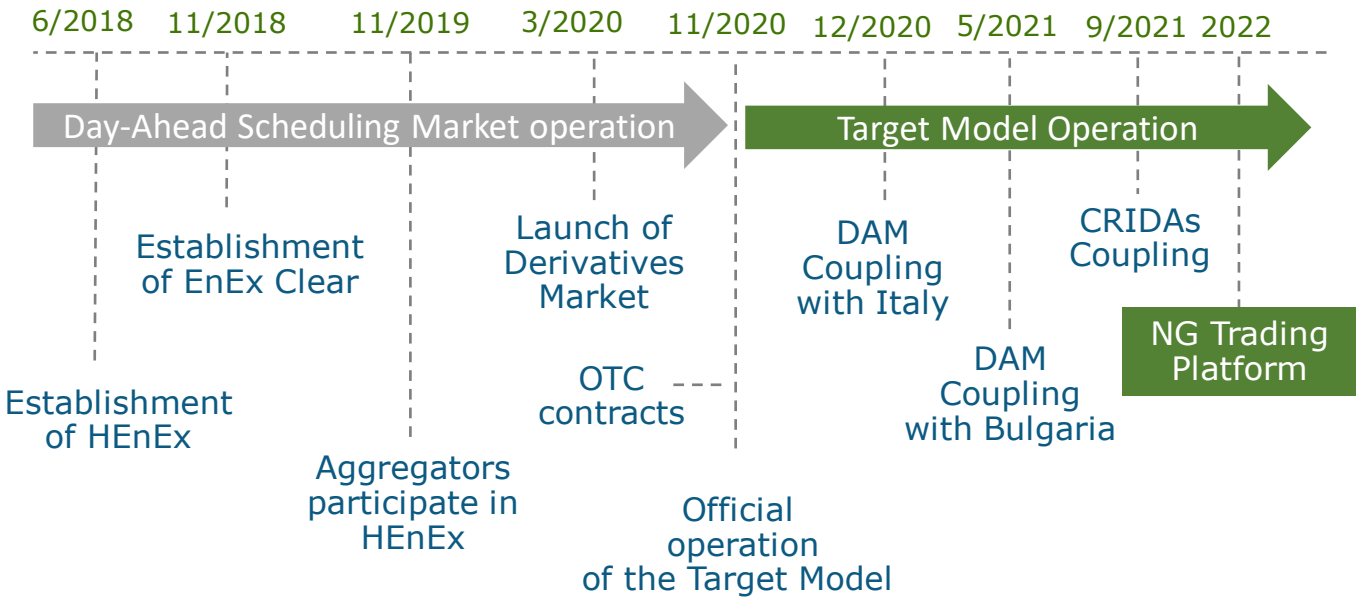
Based on the transactions made in the Natural Gas Trading Platform, HEnEx calculates and publishes a set of Prices, including Closing Prices, the Next Day Gas Index (HGSIDA) and the Intraday Gas Index (HGSIWD) as well as Buy and Sell Marginal Prices.

There are various advantages supporting the establishment of a new Trading Platform for Natural Gas within the HEnEx framework, since it functions as an additional tool for the portfolio optimization of all participants. In parallel, it fosters the evolution of the Greek Gas market and facilitates market participants to track price movements based on transparent, supervised and reliable exchange trades.

Finally, the availability and diversification of supply sources will support the development of the exchange considerably while improving the liquidity of the natural gas market in the wider region of South-East Europe.

The launch of the Natural Gas Trading Platform marks an important milestone for the Greek energy market

Timeline of Major Developments of the EnEx Group



Source: HAEE's analysis

Highlights

- The Platform is scheduled to start operating on 21st March 2022 and will allow anonymous gas trading to the benefit of all market stakeholders.
- The establishment of the Natural Gas Trading Platform is fully in-line with European provisions and supports the development of a regional energy hub in Greece.
- The new Platform is expected to increase the natural gas quantities traded and transited through Greece, while improving the liquidity of the natural gas market.
- The platform is designed to provide a complete exchange market for gas suppliers, traders and final consumers along with a robust set of reference prices & indices.
- The new Natural Gas Trading Platform levels-up the previous Greek market model at the standards of regulated markets abroad.

The existence of a competitive short-term wholesale market provides more flexibility regarding the diversification of gas supply

Previous Market Model

- Bilateral Contracts among Transmission Users
- Interim Measure for System Balancing (DESFA's Balancing Platform)

New Market Model

- Bilateral Contracts among Transmission Users

+

New

- Organized exchange market for Gas (NG Trading Platform)

Source: HEnEx & HAEE's analysis

Highlights

- The new market model is an actual organized Spot market with products on the VTP covering the current and the next 3 Gas Days.
- The platform offers Central Clearing by the Clearing House and incorporates system balancing, anonymity, Continuous Trading and Auctions.
- The Trading Platform required ten Regulatory Decisions since the beginning of 2022, while the Dry Runs period were implemented in parallel.
- Future products comprise different delivery horizons above month-ahead, such as quarterly, semi-annual, annual or seasonal products.
- The development of a futures' market requires the prior existence of a spot market with enough liquidity to give price signals and reference prices for future trading.

There are various advantages supporting the establishment of a new Trading Platform for Natural Gas within the HEnEx framework

7 Major Benefits of the new Natural Gas Platform

Portfolio Optimization

An additional tool for the portfolio optimization of all participants.

Spot Market Transparency

Fosters the evolution of the Greek Gas market where the price of gas will be determined by supply and demand in a transparent environment – facilitates price discovery.

Greek Market Evolution

The new Natural Gas Trading Platform levels-up the previous Greek market model at the standards of regulated markets abroad.

Establishment of Reference Prices

The introduction of indices specifically for the Greek Virtual Trading Point (VTP), will facilitate market participants to track price movements based on transparent, supervised and reliable exchange trades.

Smooth Market Transition

The market model provides for a smooth transition of the market from the current auction-based Balancing Platform that DESFA uses, to HEnEx's Trading Platform in order to procure or sell the required balancing quantities.

Central Clearing

Central clearing and risk management of transactions by EnExClear guarantees efficiency and security.

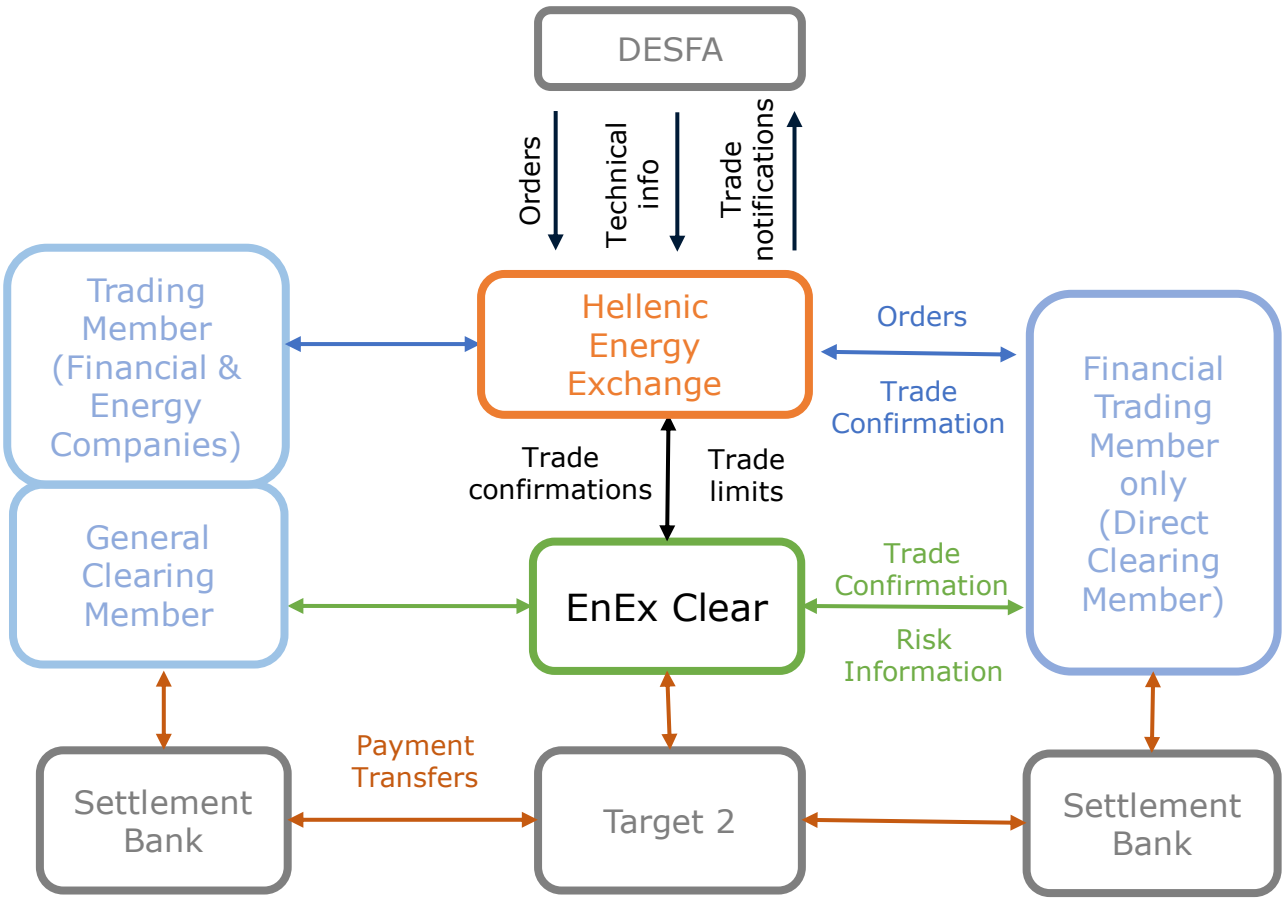
Synergies with Large Energy Projects

The availability and diversification of supply sources will support the development of the exchange considerably, while improving the liquidity of the natural gas market in the wider region of South-East Europe.

Source: HEnEx & HAEE's analysis

The Trading Platform for Natural Gas comprises a complex network that involves orders, trade limits, risk information and payments

Natural Gas Spot Market Architecture



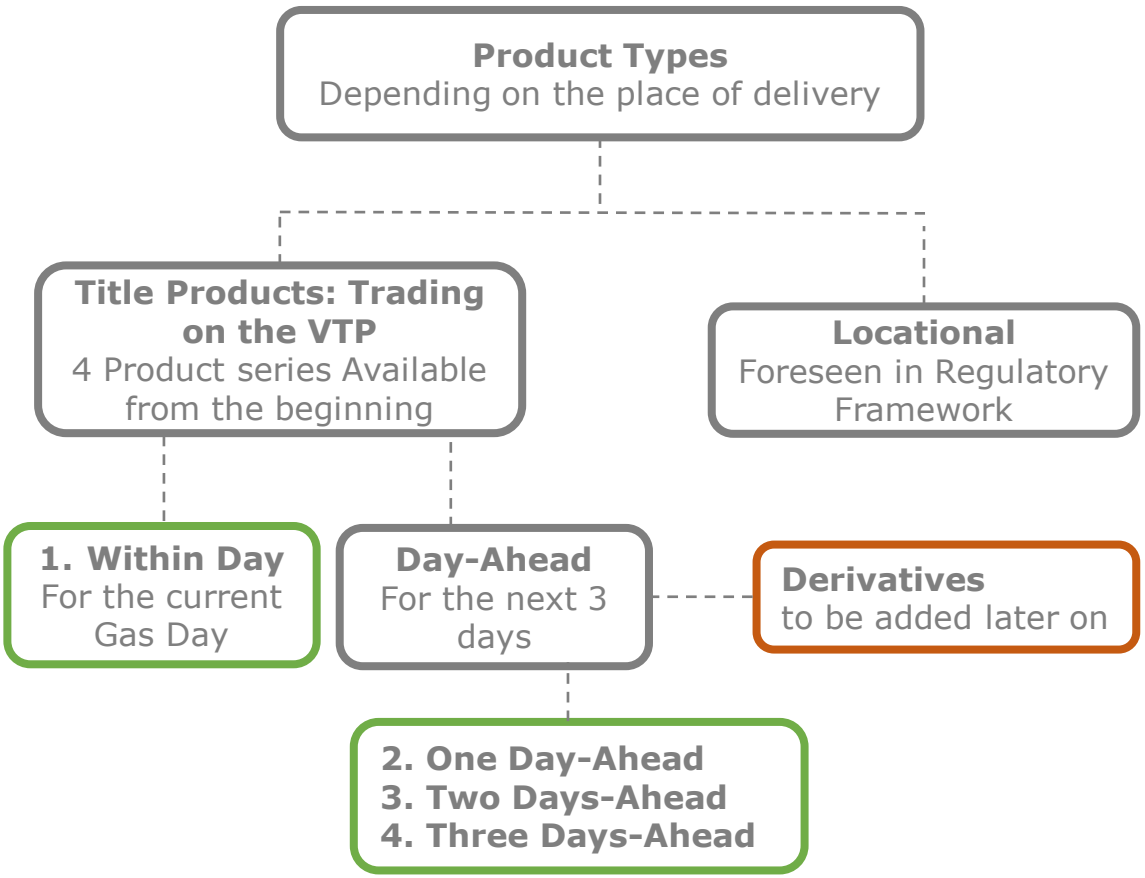
Source: HEnEx, HAEE's analysis

Highlights

- The Participant capacity is acquired after approval by the Hellenic Energy Exchange, in accordance with the terms of the Rulebook.
- Participants may act as Liquidity Providers after approval by HEnEx. The Participant capacity and Liquidity Provider capacity are non-transferable.
- Participants may act as Direct Clearing Members or assign the clearing of their transactions to a General Clearing Member.
- Natural Gas TSO plays an important role in the new Platform since DESFA is responsible for submitting orders and for the provision of technical information.
- For the purpose of undertaking balancing actions, the TSO trades in accordance with the terms and conditions applicable on the trading platform.

HEnEx calculates and publishes a set of Prices, including Closing Prices, the Next Day Gas Index and the Intraday Gas Index

Daily Traded Products on Hellenic Virtual Trading Platform



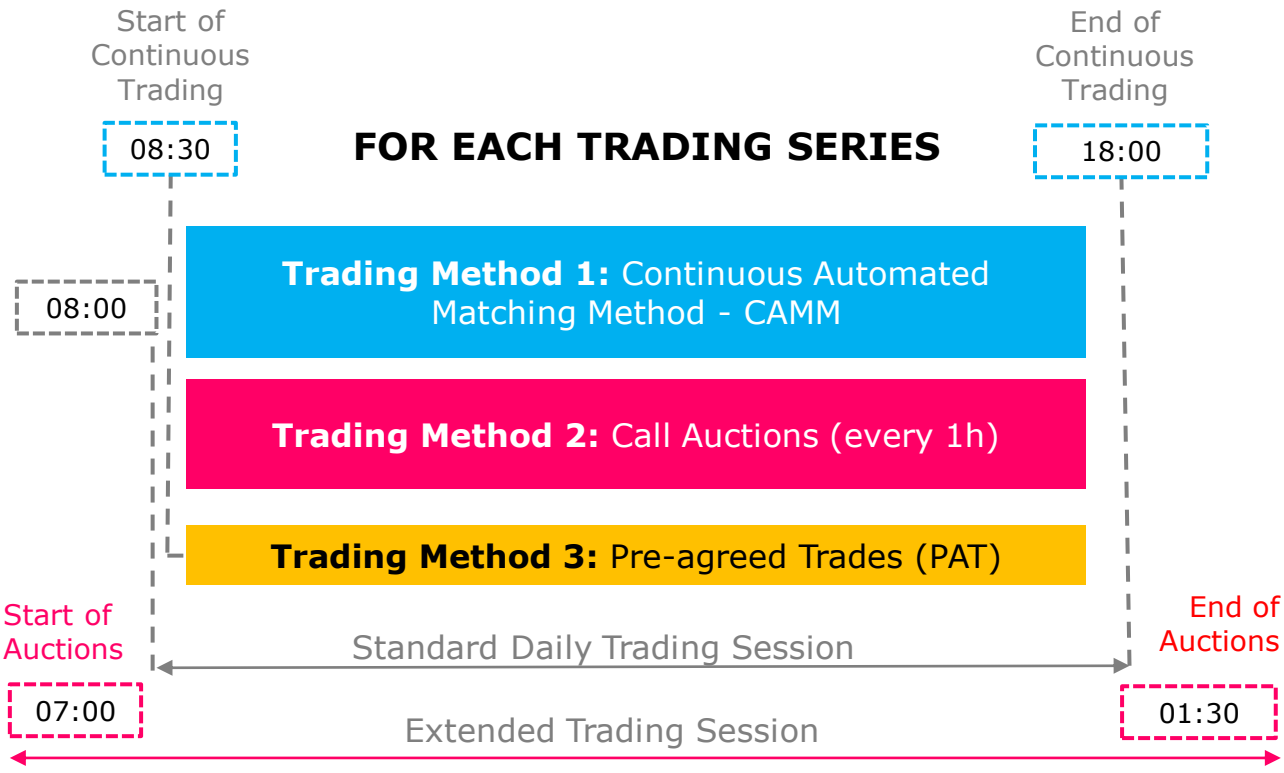
Highlights

Source: HEnEx, HAEE's analysis

- A typical Gas Day covers the period between 06:00 CET of day D and 06:00 CET of day D+1, while 4 product series are currently available in the Virtual Trading Point.
- The main characteristic of the new Trading Platform is that it features Continuous Trading and Call Auctions.
- In this framework, the main trading method is Continuous Trading; and is supported by ad-hoc auctions called by the TSO, for the TSO's balancing requirements.
- A smooth market transition was achieved from the previous auction-based Balancing Platform to the new Model, to procure or sell the required balancing quantities.
- Trade registration for clearing and settlement of pre-agreed trades between participants by the Clearing House is also supported.

Available products include Title Products with delivery day one Gas Day at the Virtual Trading Point of the Hellenic VTP

Market Schedule of the new Natural Gas Trading Platform: Central European Time from Monday-Sunday (including holidays)



Source: HEnEx

Highlights

- HEnEx publishes a set of Reference Prices that serve as indicators for monitoring the current gas prices in the Greek HTP.
- The following Reference Values are calculated: (a) Closing Prices: (i) Available daily at 01:45 CET, (ii) 4 Closing Prices are calculated daily, one for each Gas Day traded.
- (iii) Calculated as the volume-weighted average of last transactions covering 30% of the total volume for each Gas Day traded.
- (b) HGSIDA, available daily at 18:15 CET and is calculated as the volume-weighted average of transactions between 07:00-18:00 for the next Gas Day.
- (c) HGSIWD, available daily at 18:15 CET and is calculated as the volume-weighted average of transactions between 07: 00-18: 00 CET for the current Gas Day.

The role of the Liquidity Provider is to send orders to the marketplace at prices that reflect available information

Schedule & Active Period

	Monday	Tuesday	Wednesday	Thursday	Friday
Series	D+1 D	D+1 D	D+1 D	D+1 D	D+1 D+2 D+3 D

Source: HEnEx, HAEE's analysis

Highlights

- The main trading method is the Continuous Trading. Additionally, auctions may be held at the request of DESFA for the balancing needs of the Trading Platform.
- At the same time, the possibility of registration of pre-agreed trades (trade registration) in order to be cleared and settled by the Clearing House is supported.
- HEnEx calculates and publishes the evolution of the Buy and Sell Marginal Prices for the Gas Balancing Market, in accordance with Regulation (EU) 312/2014.
- The maximum quantity that can be traded by the liquidity provider is 100 MWh and is anticipated to increase up to 200 MWh after 9 months of operation.
- The maximum price spread is set at 1.6 €/MWh for D and 1.2 €/MWh for D+1/+2/+3. After 9 months the values will drop to 1.2 and 0.8 €/MWh, respectively.

EnExClear, operates as a Clearing House for the transactions concluded on the HEnEx's Natural Gas Trading Platform

Clearing House Main Tasks

CLEARING:

The process that takes place after the completion of transactions, when the financial obligations and rights for each Clearing Member are calculated.

Main Tasks:

- ✓ Receive and reconcile transactions from Trading System
- ✓ Calculate claims and obligations for participants (Settlement, fees, taxes)
- ✓ Management of Clearing procedures time schedule
- ✓ Invoicing

SETTLEMENT:

The process of the financial settlement of Clearing Members obligations and rights through settlement banks.

Main Tasks:

- ✓ Target 2 Ancillary System Management
- ✓ Settlement Instructions to Target 2

RISK MANAGEMENT:

The process of identifying and quantify credit risk in order to be covered by collaterals.

Main Tasks:

- ✓ Collateral Evaluation
- ✓ Margin Calculation
- ✓ Credit Limit Calculation & Management
- ✓ Default Fund Management

Source: HEnEx, HAEE's analysis

The clearing of Transactions on the Natural Gas Trading Platform of HEnEx is carried out between EnExClear and its Clearing Members

Daily Clearing - Clearing Days (C) are Only Working Days

Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed
Trade	Trade	Trade	Trade	Trade	Trade	Trade	Trade		
	Debit	Debit	Debit	Debit			Debit	Debit	
		Credit	Credit	Credit			Credit	Credit	Credit

Source: HEnEx, HAEE's analysis

Highlights

- Every Clearing Day, EnExClear on specific time T (14:00 CET) calculates for each Clearing Member and Clearing Account the net position (credit or debit).
- This position is derived from the transactions that have taken place and notified to EnExClear from the previous Clearing Day time T until current Clearing Day time T.
- Net debit is settled on the following working day (C+1) and net credit is settled one working day later (C+2).
- EnExClear provides detailed transaction information per Clearing Account and Participant and Invoices are issued on a daily basis.
- EnExClear sets specific financial, organizational, operational and technical requirements for Direct and General Clearing Members.

Despite the ongoing pandemic, accompanied by an unprecedented price surge and volatility shock, the PPA market in 2021 hit new records

PPA Benefits

Socio-economic benefits
- ✓ PPAs accelerate the transition to a zero-carbon economy
- ✓ PPAs reduce reliance on subsidies

For the producer
- ✓ PPAs offer long-term revenue predictability
- ✓ PPAs enable project financing

For the off-taker
- ✓ PPAs reduce the buyer's carbon footprint
- ✓ PPAs offer a hedge against market price volatility

Source: HAEE's analysis

Highlights

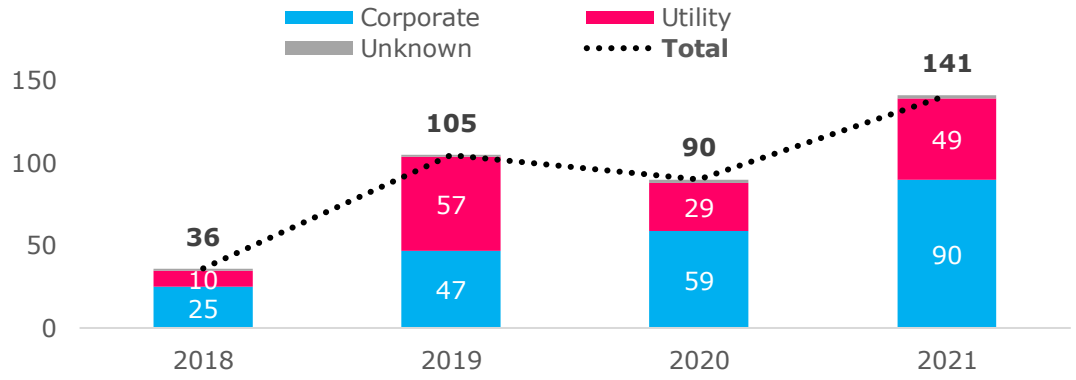
- The offtaker and producer need to negotiate the PPA to ensure that both parties are aware of, and can agree to comply with, their obligations.
- Power projects are large and expensive, tying up massive volumes of capital. A well drafted and balanced PPA is necessary to attract this level of financing.
- Given the nature of the power markets and power projects, there are often credit and liquidity concerns on both sides of the PPA.
- The above results in various requirements for credit support for the offtaker's obligations and credit support for the project company's obligations.
- The offtaker typically provides some form of credit support (letters of credit, comfort letters etc) to further secure its payment obligations under the PPA.

The European PPA market continued the growth trajectory in 2021, since market participants have learned to deal with the "new normal"

Main Types of PPAs

Off-taker	Form	Volume	Price
Corporate	Physical	As produced	Fixed
Industrial	Financial	Fixed profile	Indexed
Utility		Baseload	Floor, collar
			Combination

PPA Deal Count in Europe, (Number of Deals), [2018-2021]

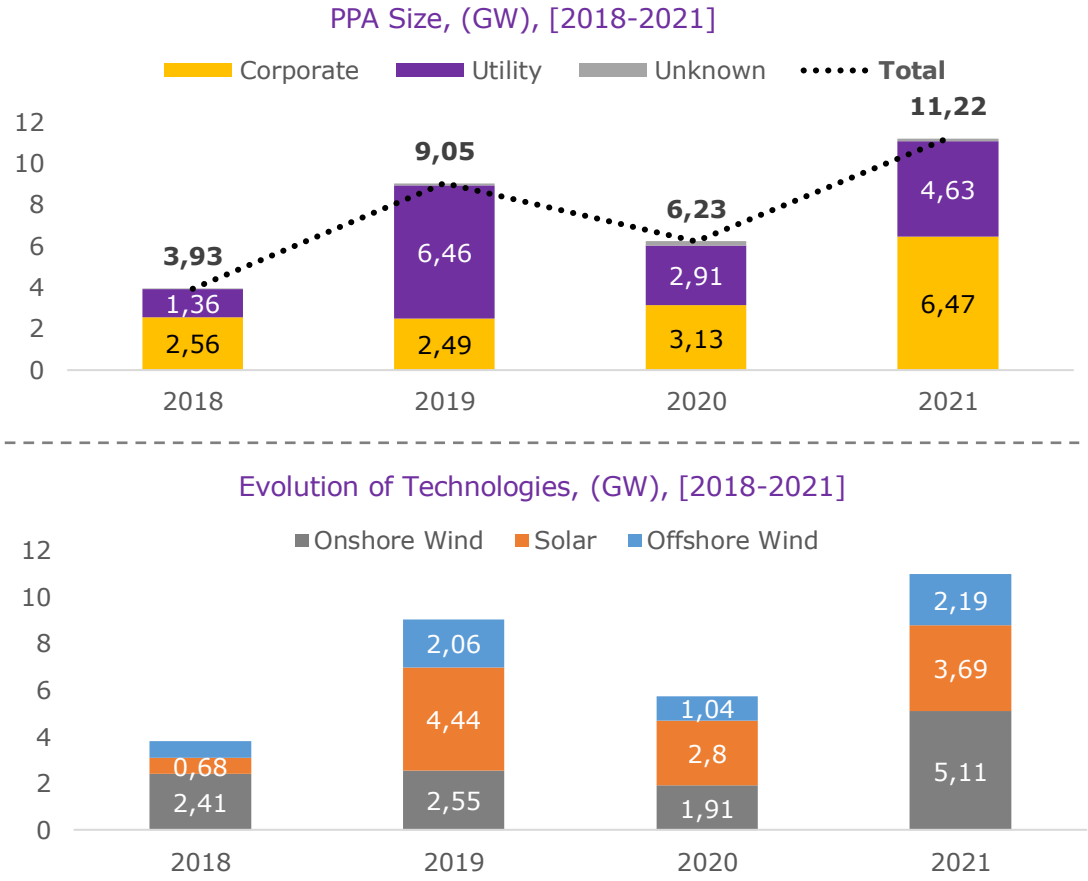


Source: PEXAPARK, HAEE's analysis

Highlights

- Feed in Tariff (FiT) support schemes were a price hedge that left no price risk with the producer and hence used to be the perfect hedging structure.
- Yet, in the open market, such "perfect hedges" are normally not available, since PPAs represent an investment and operation model shift.
- This new model requires the development of energy risk management skills and tools to manage open positions in a portfolio.
- PPA prices derive from forward curves which themselves are determined from traded forward contracts.
- The long-term impact of the price surge will be seen in the first half of 2022, since active and continuous deal flow flourishes when price changes are moderate.

Onshore Wind Power Purchase Agreements (PPAs) dominated deal flow by far – both in terms of contracted capacity and deal count



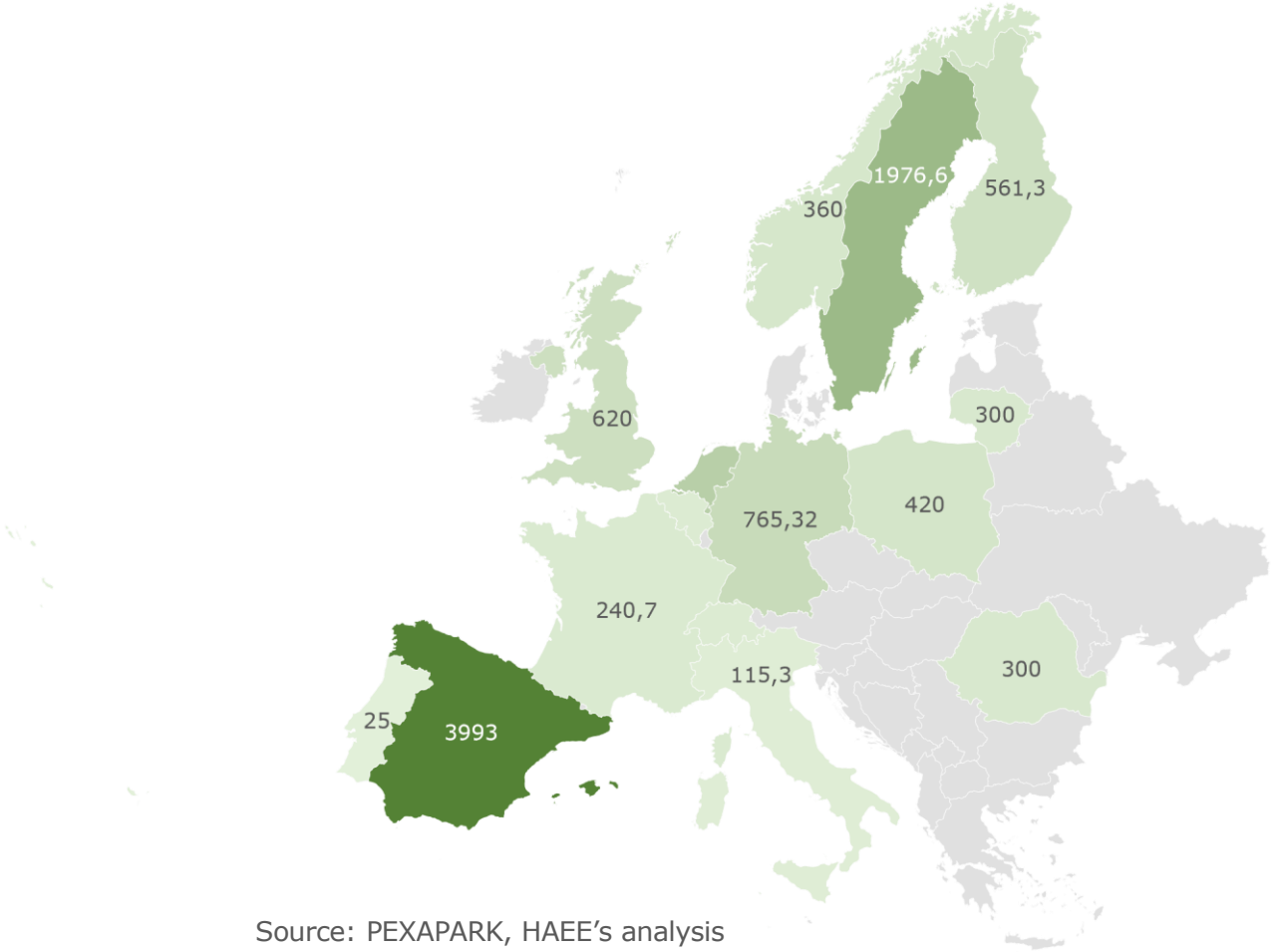
Source: PEXAPARK, HAEE's analysis

Highlights

- In terms of deal count, in 2021, a total of 141 deals have been identified supporting more than 11.2GW of new capacity to come online.
- For the European PPA market, 2019 was a clear milestone, the tipping point that defined where the industry was heading.
- In 2020, a global pandemic occurred and pushed prices to extremely low levels, making both sellers and buyers revaluate their long-term contracting appetite.
- From 2021 data, it is illustrated that PPA market has witnessed an impressive 58% annual growth in deal count since 2018, and a 42% growth in contracted capacity.
- The second half of 2021 was characterised by an energy crisis that led wholesale electricity prices and price volatility to unprecedented high levels across Europe.

Spain dominates deal flow for 2021, with a total of almost 4GW disclosed contracted capacity, followed by Sweden with almost 2 GW

Top European Countries by PPA Contracted Capacity (MW), [2021]



Source: PEXAPARK, HAEE's analysis

Highlights

- European industries are procuring their total European electricity needs in aggregate through financial PPAs, accepting significant levels of country spread risks.
- Secondly, noticeable qualitative differences exist between many industrial PPAs and utility PPAs.
- Many contracts concluded with industrial off-takers, contained price adjustment clauses to the benefit of the industrial off-taker.
- Nevertheless, such PPAs often entailed significantly lower credit risk protection compared to PPAs with utilities.
- A series of increases in energy-related commodities such as gas, coal and carbon credits, drove up electricity and therefore PPA prices to new highs.

5. Natural Gas

Highlights

Natural gas **import prices** in Greece skyrocketed in late 2021- early 2022, reaching **98€/MWh**, a **600% increase** compared to 2020

For 2021, the Sidirokastro gas entry (Russian gas) was responsible for **50% of the total natural gas imports** in Greece, showing the high dependency on Russian gas

Household natural gas prices in Greece **tripled** during the period 2021-2022, reaching **11.08€/MWh** in January 2022

The total annual gas demand in Greece is at around 6.5 Bcm and is expected to **exceed 8 bcm by 2030**. The development of new **distribution networks** in several areas in Greece will lead to added quantities of around **500 mcm of** natural gas in the next decade

50% of LNG imports originated from USA. In 2021, **35 LNG tankers** of a total of **24.51 TWh** were unloaded at Revithoussa

Greece has **no underground gas storage** capacity while gas storage covers around **30%** of the total gas consumed in the EU

All-time high natural gas in **power generation** in Greece represents **69% of the total natural gas consumption** in 2021, due to the partial phase out of lignite power plants

In the Attiki and Thessaloniki Region, households dominate the total gas consumption needs, accounting for **52% and 70%** respectively

A small-scale LNG in Revithoussa Terminal will kick-start in 2022, offering great potential for the next years

Overview

In view of the REPowerEU plan, the EU prepares its energy future without Russian gas. The average utilization rate of the EU LNG terminals increased from around 40% to 60% during Q1 2022, compared to Q1 2021.Two FSRU terminals are under construction, while sixteen FSRU terminals and five large onshore LNG terminals are planned. The annual regasification capacity of LNG terminals will increase by 17bcm/year (under construction-expansion) and an additional 105 bcm/year (as planned) by 2030. The EU imported 155 bcm of Russian gas in 2021, representing around 45% of its total gas demand, with most of it having been transferred through Gazprom pipelines.

Greece imports almost half of natural gas quantities of the total pipeline imports from Russia through Sidirokastro. Security of supply has been enhanced in 2021 with the operation of another entry point "New Mesimvria". During its first year of operation, a quantity of 13.61 TWh was imported, which corresponds to 17.5% of total imports. Last year, LNG off loadings at the Revithoussa Terminal amounted to approximately 24.51 TWh from 35 tankers compared to 33.40 TWh from 49 tankers in 2020. Due to competitive LNG import prices, the US remained the largest importer of LNG in Greece with 12.29 TWh (50.14%). In case of Russian gas supply disruption, a fourth floating tank is planned to be added in Revithoussa, increasing its current capacity by 100,000 bcm.

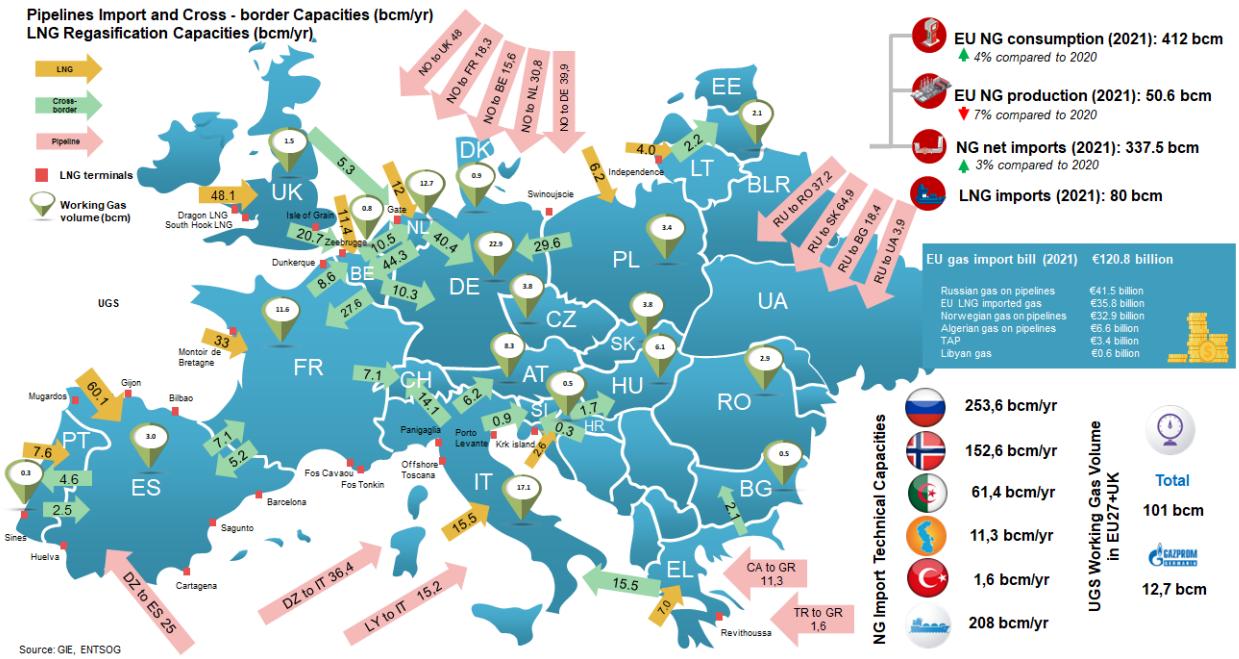
During the past years, natural gas consumption in Greece has been maximized, exceeding 6 bcm in 2021. For the same year, all-time high natural gas in power generation in Greece represents 69% of the total natural gas consumption, due to the partial phase out of lignite power plants. Following the Covid crisis and the disruption of supply chain, the natural gas import price in Greece presented a fivefold increase in Jan 2022, compared to Jan 2021.

Household natural gas prices in Greece have tripled during the period 2021-2022, reaching its highest 11.08 €/MWh in January 2022. The ongoing Russia-Ukraine war will cause further increase of the natural gas prices, due to possible Russian sanctions and low storage levels. The total annual gas demand in Greece is expected to exceed 8 bcm by 2030. Natural Gas demand in power generation is projected to increase by 13% during the period 2021-2025 due to the addition of new gas power plants in the electricity system. The development of new distribution networks in several areas in Greece will lead to added quantities of around 500 mcm natural gas during the decade. Large industries directly connected to high-pressure network will reach a peak in natural gas demand by 2025, reaching the level of 1160 mcm.

Small scale LNG services in Revithoussa will include a truck-loading station, starting in 2022 and a new jetty by late 2022. The new jetty will serve small ships to supply LNG in cruise ships, and RO-PAX and large ships to supply satellite storages and distribution stations. SSLNG demand is expected to grow during the period 2022-2031, by reaching 0.4 bcm in 2031, a 448% increase compared to 2022.

In view of the REPowerEU plan, the EU prepares its energy future without Russian gas, while physical bottlenecks must be resolved

LNG & Pipe Imports, Storage and Cross-Border Transmission Capacity



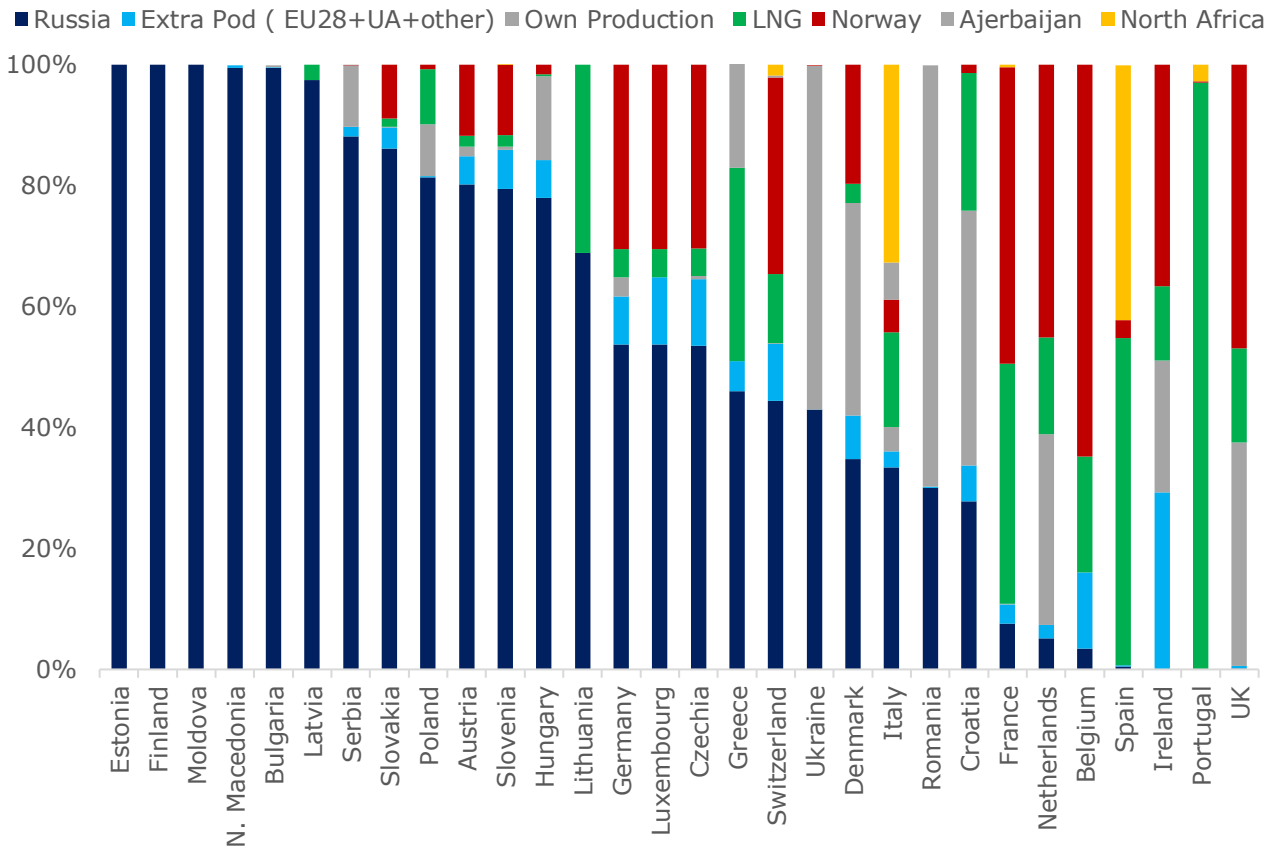
Source: GIE, ENTSOG, HAEE's analysis

Highlights

- LNG imports reached 80 bcm in the EU during 2021 and accounted for 23% of the total natural gas imports.
- Spain is the country with the most LNG terminals in the EU (60 bcm/yr.), having at the same time limited pipeline interconnection capacity with the rest of the EU.
- The average utilization rate of the EU LNG terminals increased from around 40% to 60% during the Q1 2022 compared to Q1 2021.
- There are 2 FSRU terminals under construction. Sixteen FSRU terminals and only five large onshore LNG terminals are planned.
- The annual regasification capacity of the LNG terminals will increase by 17 bcm/yr (under construction-expansion) and an additional 105 bcm/yr (as planned) by 2030.

Given the current Russia-Ukraine war, the EU needs to diversify its natural gas supply routes, which are mainly from Russia

Natural Gas Imports by Country of Origin in EU27, (%) [2021]



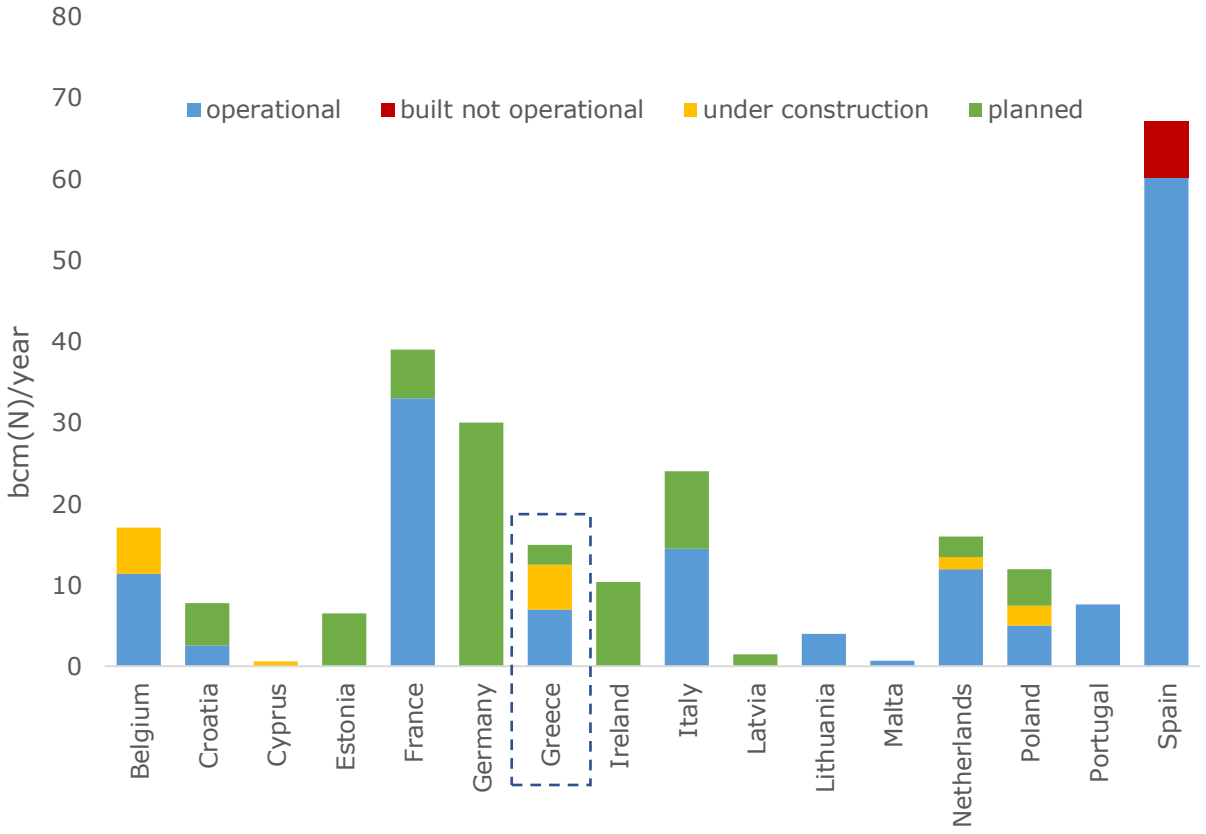
Source: IHS Markit, ACER, DESFA, Bruegel, HAEE's analysis

Highlights

- The EU imported 155 bcm of Russian gas in 2021, representing around 45% of its total gas demand, with the majority transferred through Gazprom pipelines.
- At least 19 EU countries are highly dependent on Russian gas, which represents at least 40% of their total natural gas imports.
- In the EU, the largest share of gas imports in the EU comes from Russia (41%), followed by Norway (24%), and Algeria (11%).
- Eastern European Countries rely almost exclusively on Russian gas. Netherlands, France and Belgium import low shares of Russian gas.
- High dependence on Russian gas, high NG prices, and low NG storage levels along with physical bottlenecks and long-term contracts are a difficult-to-solve equation.

LNG regasification capacity in the EU is located mainly in Spain and France, while new projects are under way in Germany, Italy and Greece

Annual Regasification Capacity of LNG Large Scale Import Terminals per Country



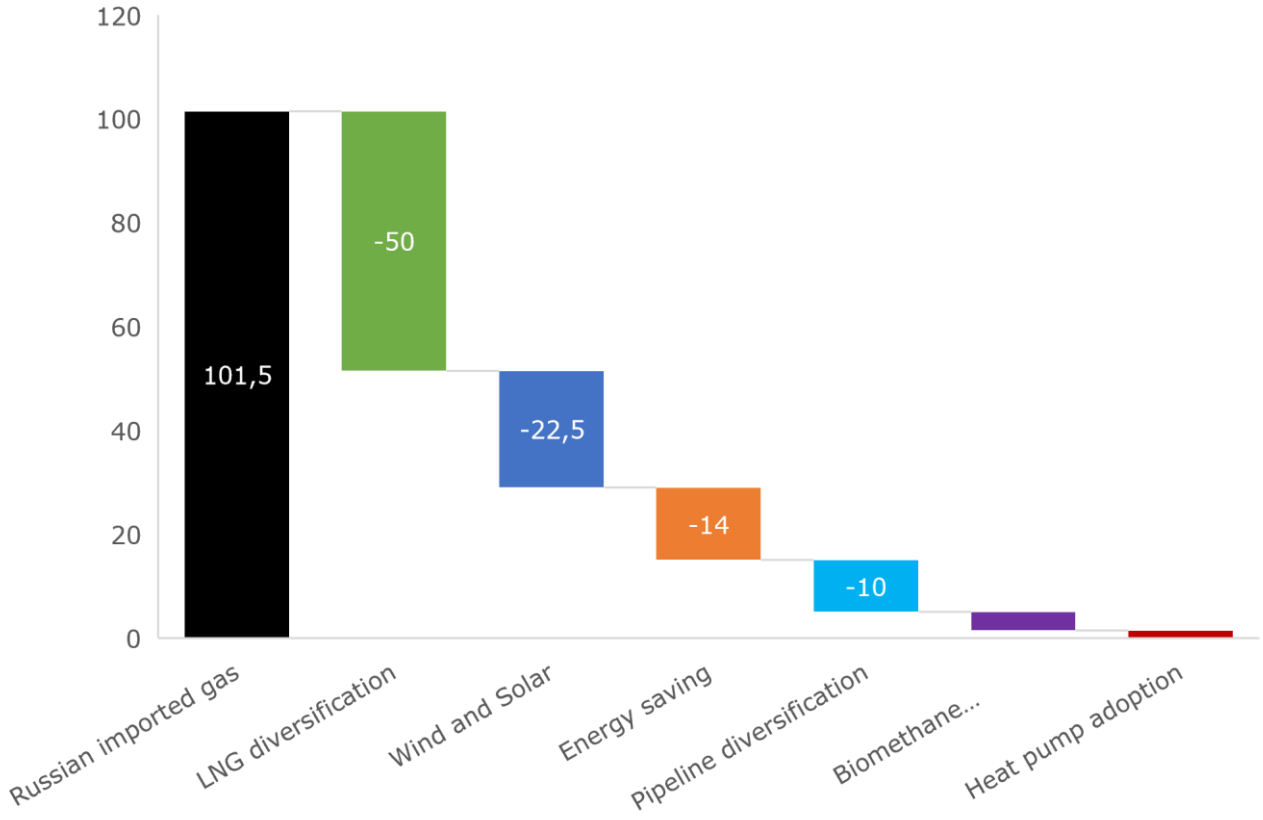
Source: EU Commission, HAEE's Analysis

Highlights

- Spain is the country with the most LNG terminals in Europe, accounting for almost one third of its LNG import capacity.
- Spain has only one pipeline connection to Europe - from Spain to France – and therefore its additional LNG capacity potential is restricted.
- Germany does not have its own regasification LNG terminals, but three FSRU terminals are planned to be developed with a capacity of total 27 bcm/yr.
- The new required LNG in Europe will be mostly covered by new FSRUS since land-based LNG terminals are costly and need at least five years to be constructed.
- Greece is planning to install an additional floating tanker with a total capacity of 150,000 cubic meters, increasing its capacity by 70%.

REPowerEU is a joint EU plan to make Europe independent from Russian imported gas by 2030, which will be replaced by sectoral targets

Russian Gas Imports to be Replaced by Sectoral Targets in 2022



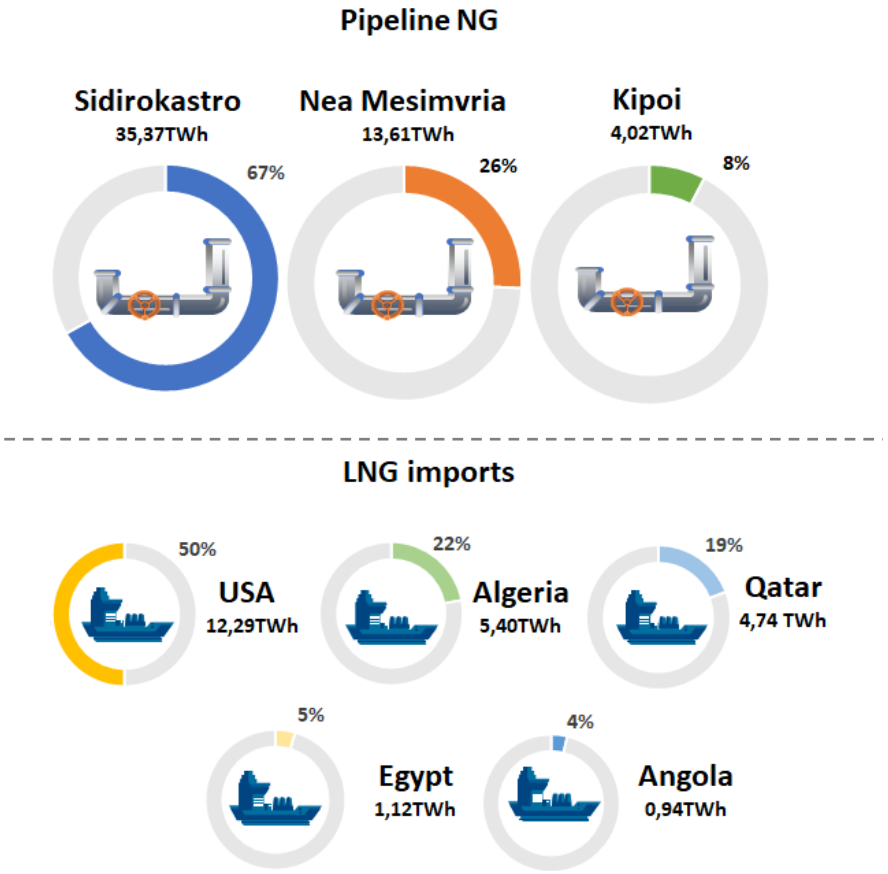
Source: EU Commission, HAEE's Analysis

Highlights

- It is evident that a possible disruption of Russian gas supply will affect a lot of EU countries and there will be a supply-demand deficit.
- The physical bottlenecks of the current NG network will complicate actions for NG sources' diversification.
- REPowerEU is the main EU initiative to cut off Russian imported gas. It is frontloaded, aiming to replace 101.5 bcm in 2022, 2/3 of the total gas imports.
- LNG and pipeline imports from other countries will be enhanced, reaching a total of 60 bcm until the end of 2022.
- The US has already committed to provide the European Union with an additional 15 bcm LNG imports within 2022.

At the end of December 2020, the entry point from TAP, Nea Mesimvria was put into commercial operation

Natural Gas and LNG Imports by Country of Origin in Greece (%) [2021]



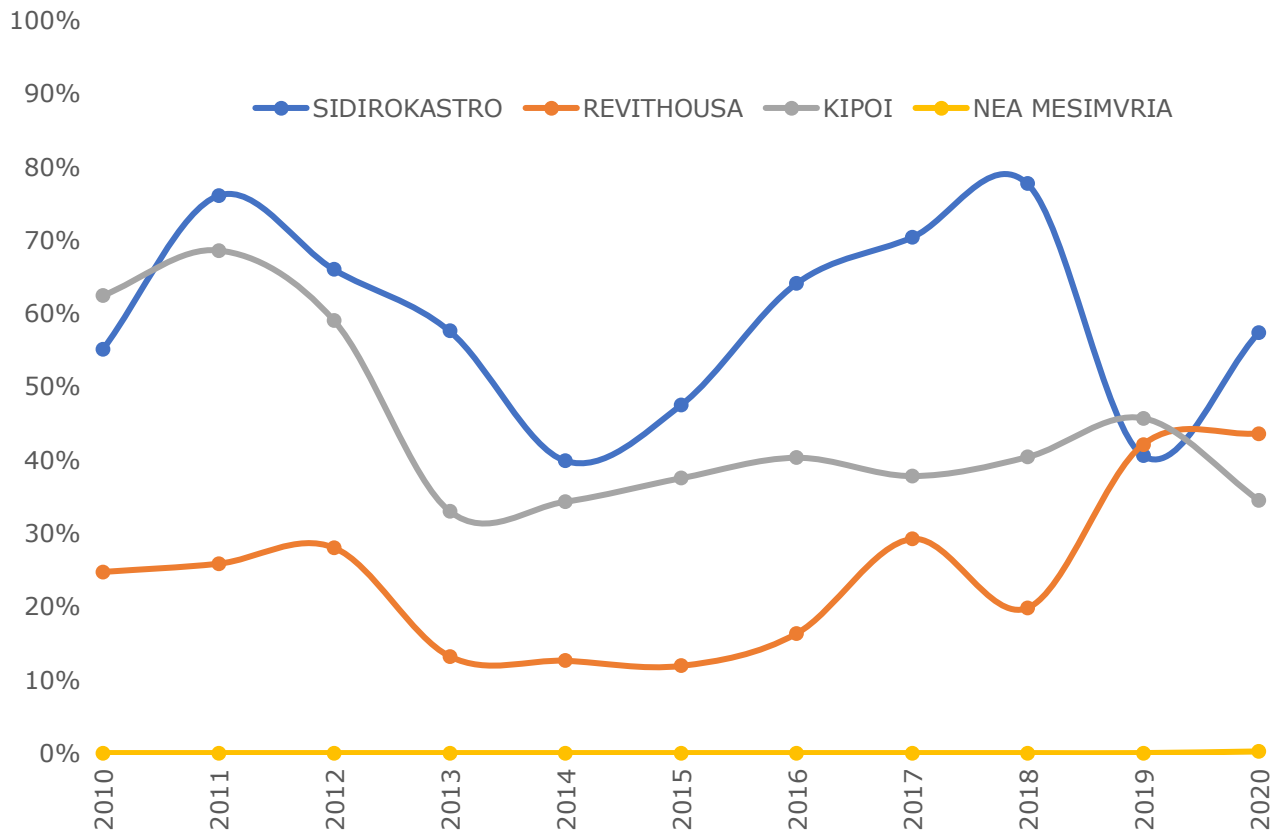
Source: DESFA, HAEE's analysis

Highlights

- Greece imported almost half NG quantities of the total pipeline imports from Russia through Sidirokastro in 2021 (10.4% increase compared to 2020).
- Security of supply was enhanced in 2021 with the operation of another entry point "New Mesimvria". This point is the entry point of TAP in the Greek NG system.
- In its first year of operation, a quantity of 13.61 TWh was imported through the new entry point at Nea Mesimvria, which corresponds to 17.5% of total imports.
- Last year, LNG off loadings at the Revithoussa Terminal amounted to approximately 24.51 TWh from 35 tankers compared to 33.40 TWh from 49 tankers in 2020.
- Due to the competitive LNG import prices, the US remained the largest importer of LNG in Greece with 12.29 TWh (50.14%).

Facing the Ukraine crisis, the utilization rate of Natural Gas infrastructure in Greece needs to be highly increased

Natural Gas and LNG Capacity Utilization Rate in Greece (%)

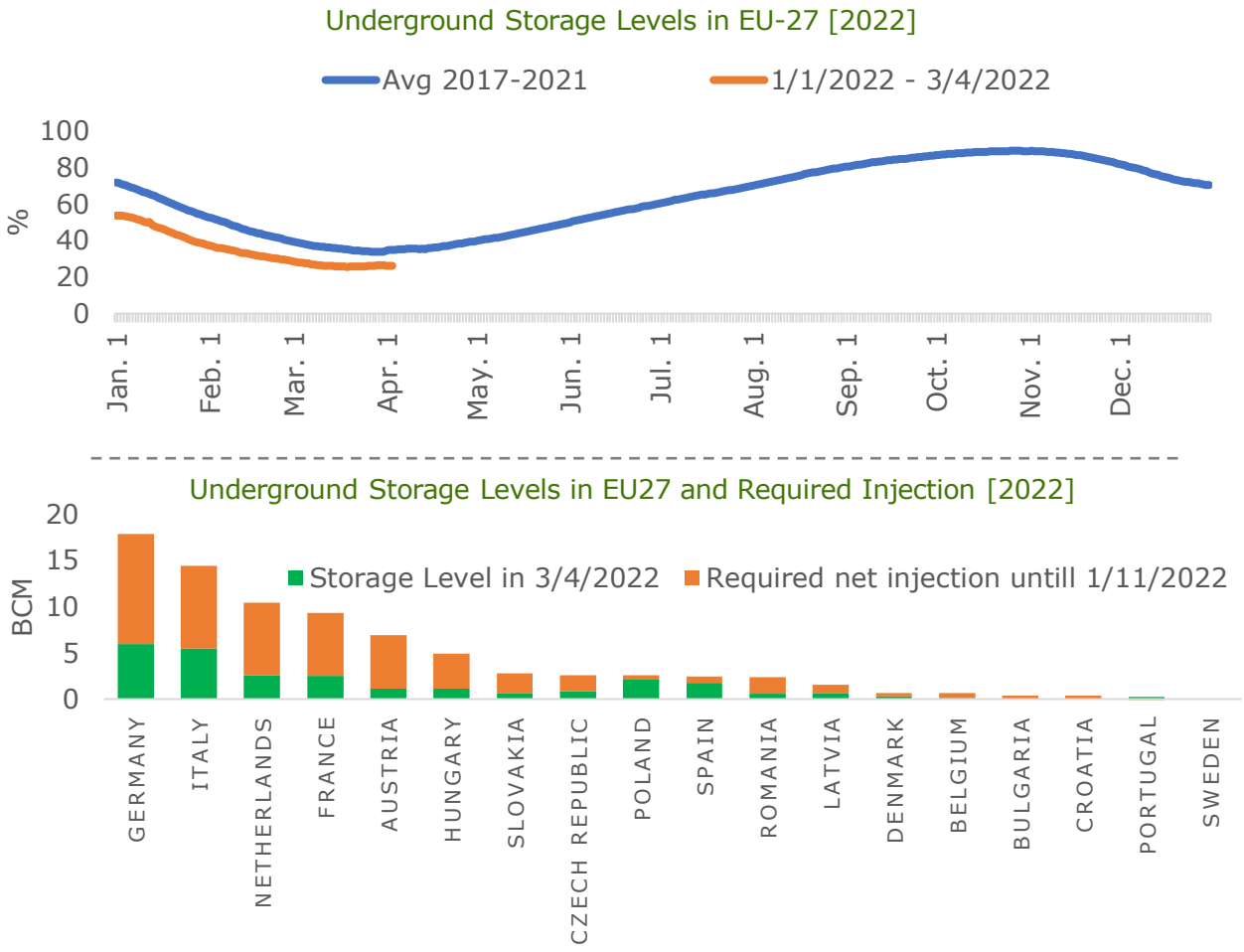


Source: ENTSOG and HAEE's analysis

Highlights

- Sidirokastro, the main import route for Russian Gas in Greece, has the highest utilization rate, which has been reduced during the past years.
- Revithoussa terminal is the only LNG import facility in Greece. In 2019 and 2020, the increased US LNG cargos doubled its utilization rate.
- It is expected that Revithousa will have a crucial role and increased utilization rate in 2022, due to the Russia-Ukraine crisis.
- In the case of Russian gas supply disruption, a fourth floating tank is planned to be added in Revithoussa, increasing its current capacity by 100,000 bcm.
- The time period that a supplier can utilize Revithoussa's storage capacity is planned to be increased from 21 days to 1.5 months.

Due to high dependency on Russian gas, possible sanctions could jeopardize the energy security due to currently low gas storage levels



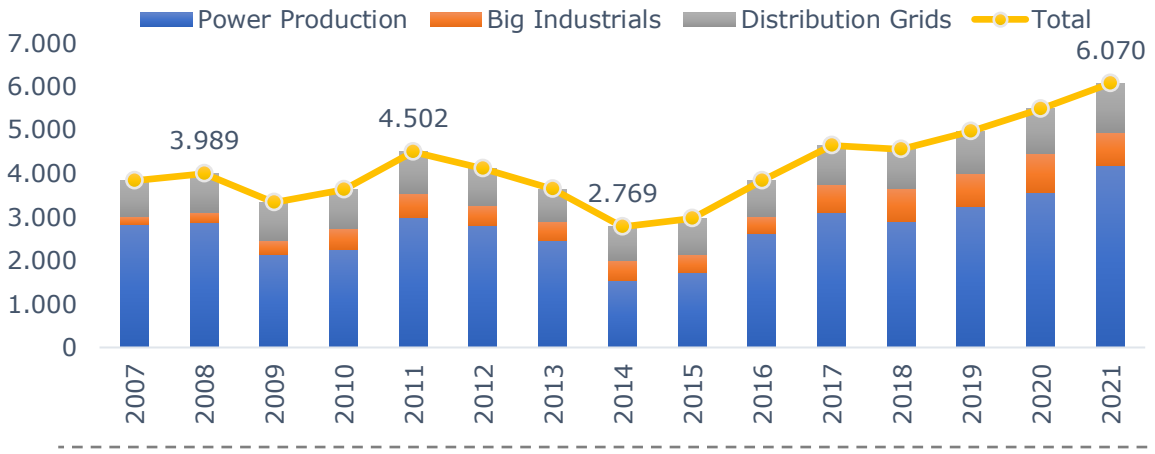
Source: ENTSOG, HAEE's analysis

Highlights

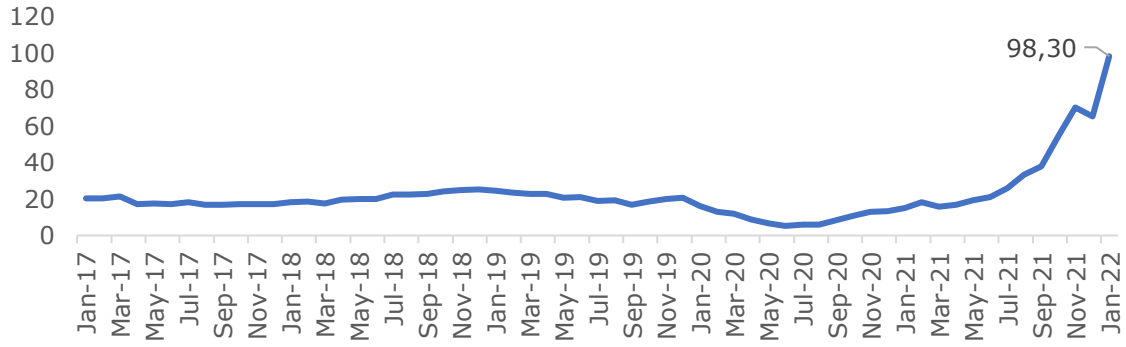
- The EU Member States must ensure 80% of their underground capacity to be filled up by 1 November 2022 and by 90% in the forthcoming years.
- Gas Storage covers 25-30% of the gas consumed across the EU. European Gas Stocks are now at 26.3%, far lower than the 5-year average.
- The net injections in Gas Storage facilities have started earlier than ever (mid-March 2022).
- By November 2022, 54.3 bcm will be added net to underground Gas Storage facilities to meet the target of 80%.
- Germany, Italy, Netherlands, and France should inject 35.5 bcm cumulatively, since they have the biggest underground storage capacity.

Record-high natural gas prices and demand, increase the total energy costs in Greece during 2021

Natural Gas Consumption in Greece (mil. Nm3), [2007-2021]



Natural Gas Weighted Average Import Price in Greece (€/MWh) [2015 – 1/2022]



Source: DESFA, RAE and HAEE's analysis

Highlights

- During the past years, Natural Gas consumption in Greece has been maximized, exceeding 6 bcm in 2021.
- All-time high natural gas in power generation in Greece represents 69% of the total natural gas consumption in 2021, due to the partial phase out of lignite power plants.
- Following the Covid crisis and the disruption of supply chains, the Natural Gas Import Price in Greece had a fivefold increase in Jan 2022 compared to Jan 2021.
- This increasing trend is expected to continue after Jan 2022 due to the Russian Gas crisis, which started in Feb 2022, skyrocketing Natural Gas prices.
- Europe plans to bulk buy strategic stocks of natural gas jointly to fill natural gas storage to 80% this year and 90% ahead of winter in the following years.

European gas hub prices presented record-highs in the fourth quarter of 2021 at the range of 91-96€/MWh

Comparison of EU Average Wholesale Gas Prices During the Fourth Quarter of 2021 (€/MWh)

Finland	*HUB*	80.92	**Italy**	*HUB*	95.84	**Belgium**	*HUB*	92.88
	LNG	65.34		*EBP2*	18.96		*EBP1*	75.47
				EBP3	19.95		*EBP4*	84.45
				EBP4	17.70		*LNG*	96.16
				EBP6	63.30			
				LNG	41.54			
Sweden	*EBP5*	27.82	**Romania**	*EBP2*	19.35	**Bulgaria**	*HUB*	52.83
	LNG	46.40					*EBP2*	54.36
							EBP2	19.90
Poland	*HUB*	98.75	**Denmark**	*HUB*	96.86	**Slovenia**	*EBP2*	21.11
Spain	*HUB*	96.57	**Czech Republic**	*HUB*	97.85	**Latvia**	*HUB*	79.24
	EBP3	26.09		*EBP2*	39.78		*EBP2*	68.63
	LNG	99.41						
France	*HUB*	93.41	**Portugal**	*LNG*	35.00	**Lithuania**	*HUB*	81.14
	LNG	99.41		*Other*	45.96		*EBP2*	65.39
							LNG	70.78
United Kingdom	*HUB*	91.15	**Hungary**	*HUB*	94.73	**Estonia**	*HUB*	79.24
	LNG	99.91		*EBP2*	57.74		*EBP2*	76.17
Netherlands	*HUB*	94.11	**Austria**	*HUB*	95.07	**Slovak Republic**	*EBP2*	67.96
	LNG	79.80						
Germany	*HUB*	94.56	**Greece**	*EBP2*	62.98			
	Other	46.69		*EBP6*	63.30			
				LNG	72.72			

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
EBP6 prices are estimations of border prices for gas from Azerbaijan

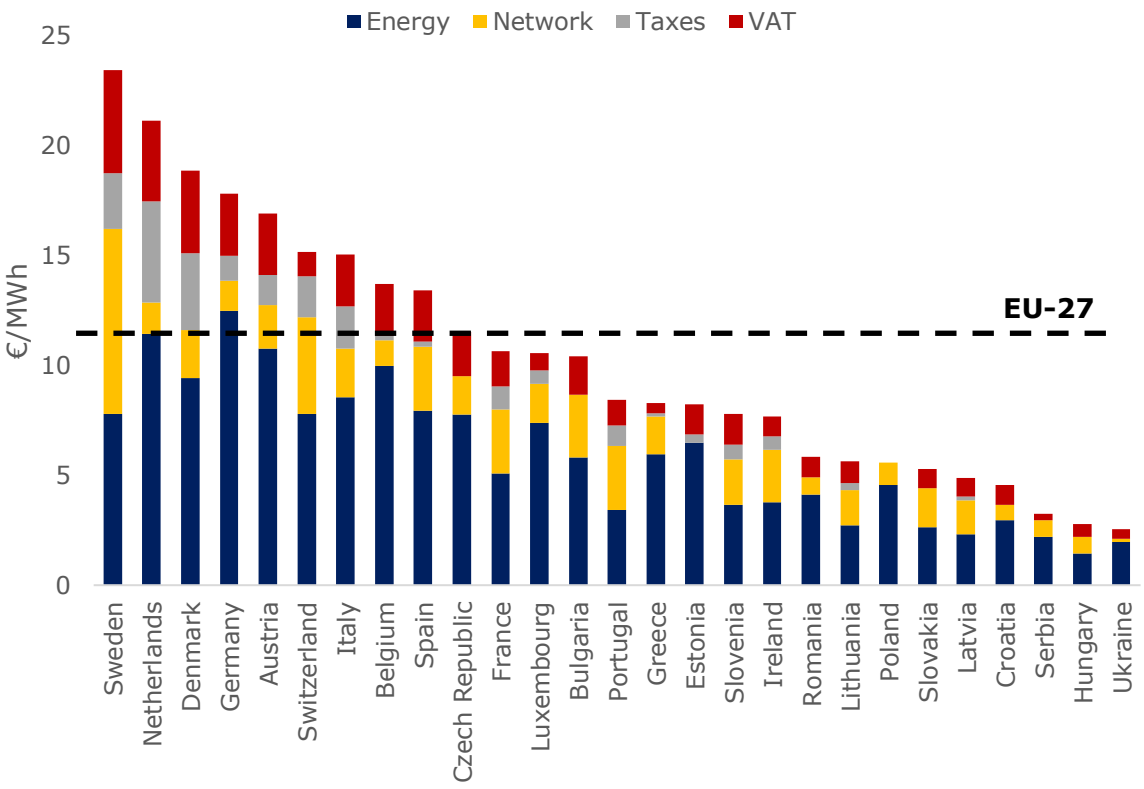
Source: EU Commission, HAEE's analysis

Highlights

- Gas hub prices between Q3 2021 (47-48€/MWh) and Q4 2021 (91-96€/MWh) were doubled.
- Compared with the 2020 data, gas hub prices in Q4 2021 in Europe, presented an increase of around 600%.
- This price spike is due to low storage filling levels at the beginning of the heating season and the general market tightness with low Russian inflows.
- Low Russian inflows, shut down of nuclear facilities in France, low wind availability and the Nord Stream 2 implications, led to further increase of NG hub prices.
- The ongoing Russia-Ukraine war will cause further increase of the natural gas prices, due to possible Russian sanctions and low storage levels.

Greece presents Natural Gas costs for household consumers below EU average, mainly due to moderate taxation

NG Retail Prices for Household Consumers in Greece, [January 2022]



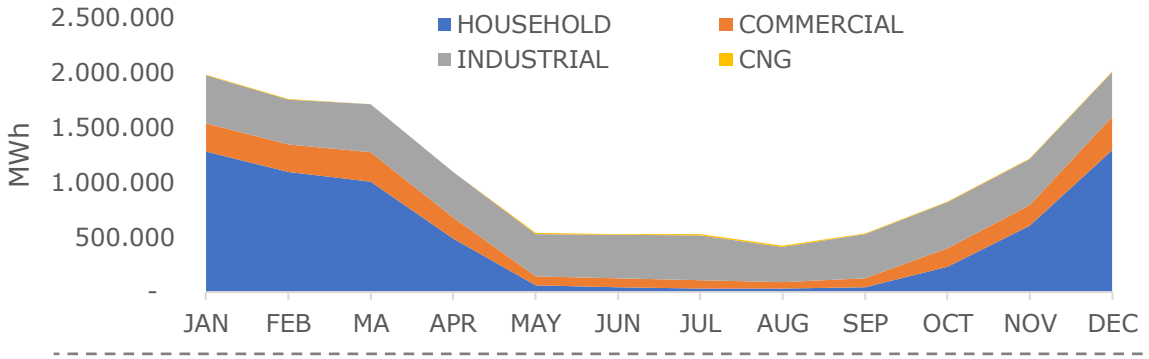
Source: Eurostat and HAEE's analysis

Highlights

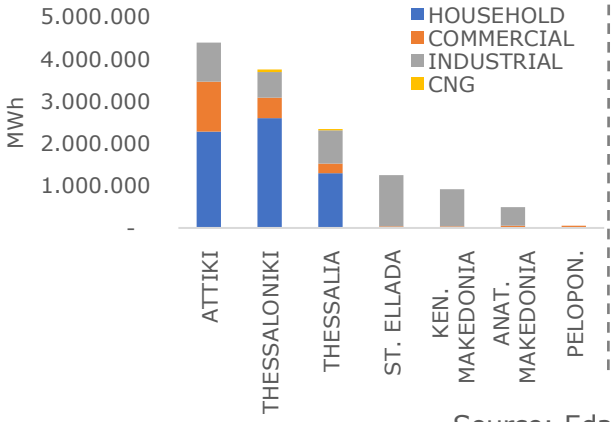
- The price of energy in the EU depends on import diversification, network costs, weather conditions, the geopolitical situation and the levels of excise and duties.
- The Natural Gas Price for household consumers in Greece recorded 8.28 €/MWh, 22% below than EU average, mainly due to moderate taxation.
- Netherlands and Denmark have the highest share of energy taxes and VAT, while Sweden presents the highest network costs.
- During the period 2015-2021, NG prices for household consumers in Greece were stable at the level of 6-7 €/MWh with an exception during the Covid period.
- Household natural gas prices in Greece have tripled during the period 2021-2022, reaching 11.08 €/MWh in January 2022.

The demand of natural gas in the distribution networks in Greece, is mainly in the household sector in winter and in industry in summer

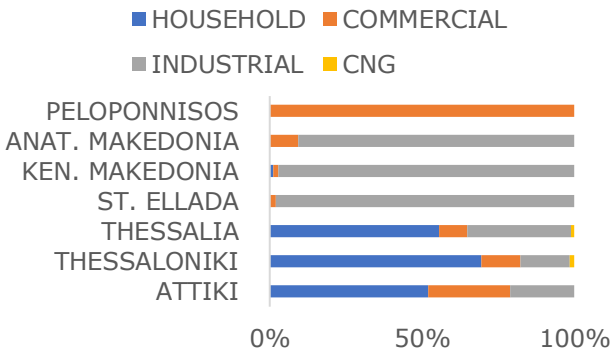
Monthly Medium Pressure and Low-Pressure Gas Demand per Consumer Type in Greece, [2021]



Yearly MP and LP Gas Demand per Region in Greece, [2021]



Yearly Share of MP and LP Gas Demand per Region in Greece, [2021]



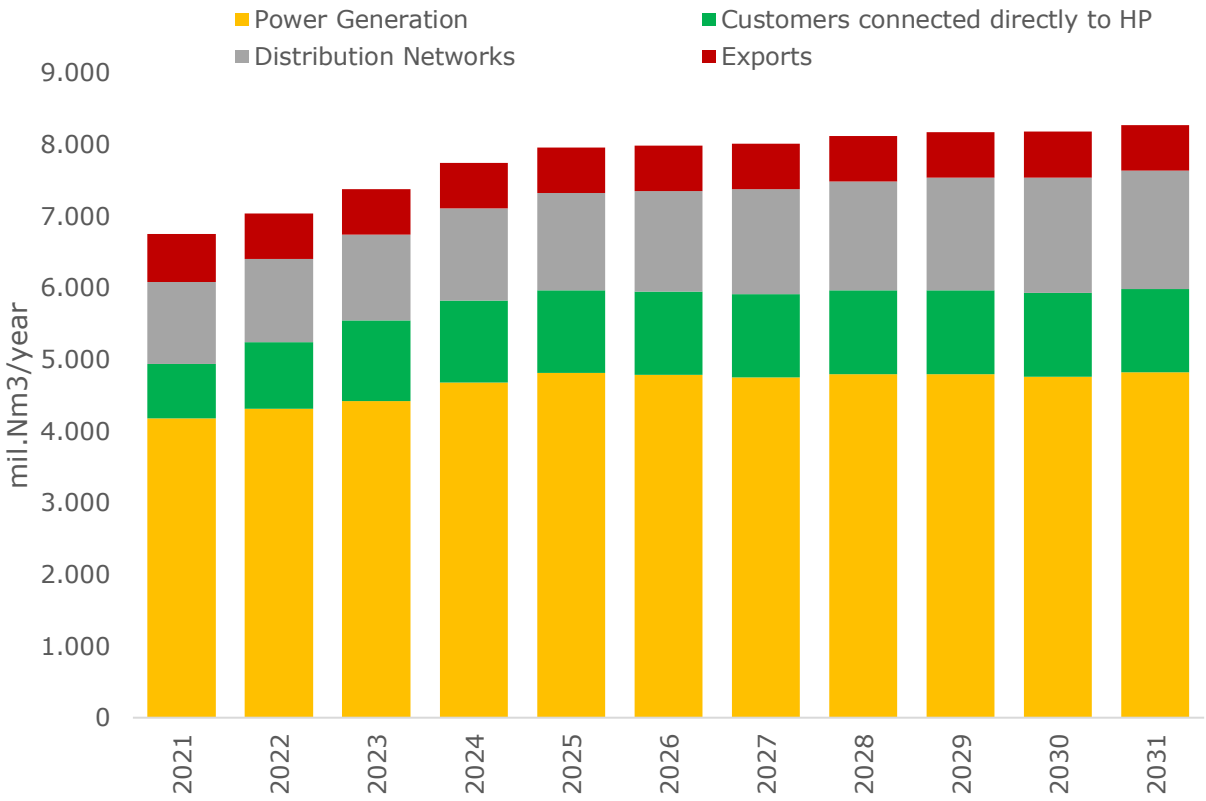
Source: Eda Attikis, Eda Thess, DEDA and HAEE's analysis

Highlights

- Natural gas is only available on the mainland in certain areas, where gas distribution companies are active.
- Household gas demand was directly linked to heating and hot water seasonal needs, hence significant consumption was observed during the November-April period.
- Newly added distribution networks in Kentriki Makedonia, Anatoliki Makedonia and Sterea Ellada, are currently relied on industrial needs.
- In the Attiki and Thessaloniki Region, household dominates the total gas consumption needs, accounting for 52% and 70% respectively.
- High Natural Gas prices in 2022 are expected to reduce its demand in all sectors in Greece, while gas distribution networks will continue to be developed.

Gas demand in Greece will be increased by 2030 following its higher utilization in power generation and distribution networks

Total Annual Gas Demand for Transmission Services in Greece [2021 -2031]



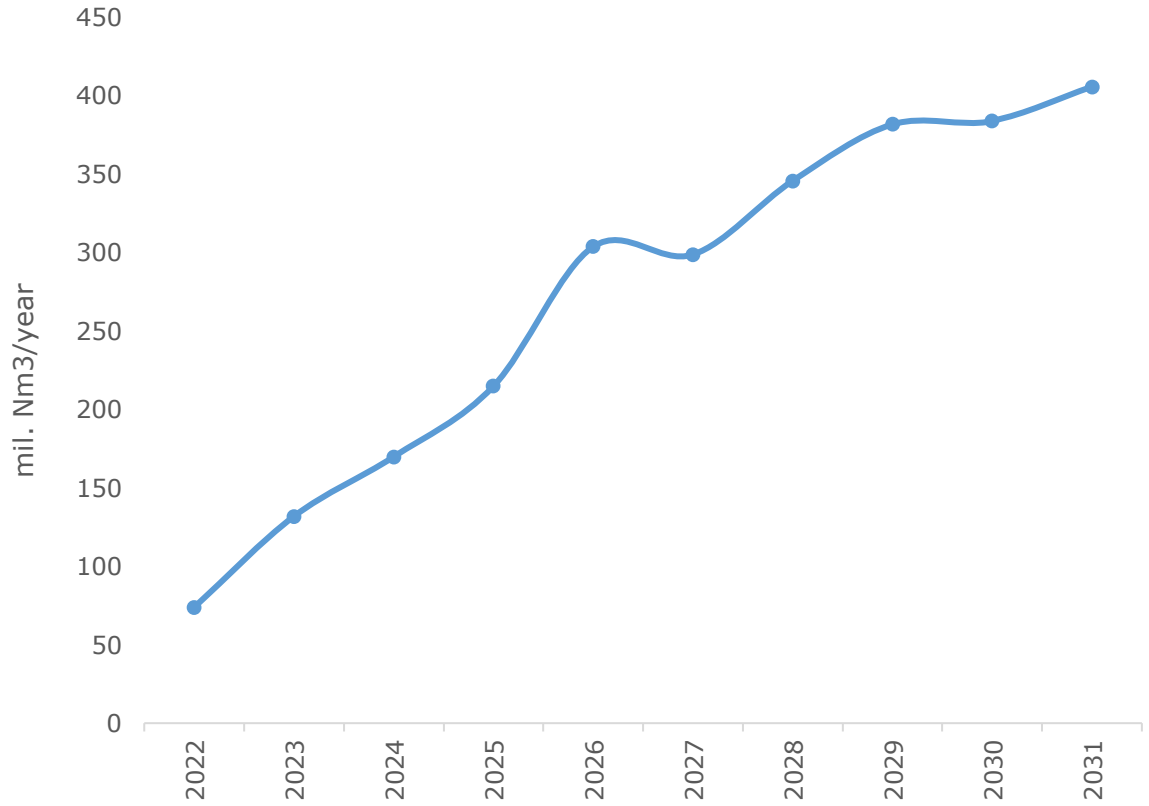
Source: DESFA, HAEE's analysis

Highlights

- Currently the total annual gas demand in Greece is at around 6.5 bcm and is expected to exceed 8 bcm by 2030.
- Natural Gas demand in Power Generation will be increased by 13% during the period 2021-2025, due to the addition of new gas power plants in the electricity system.
- The development of new distribution networks in several areas in Greece, will lead to added quantities of around 500 mcm natural gas the following decade.
- Large industries directly connected to the High-Pressure Network, will reach a peak in Natural Gas Demand by 2025, reaching 1160 mcm.
- It is expected that the estimates of DESFA to cover the natural gas demand in an effective and reliable way, will alter due to the Russia-Ukraine crisis.

Gas demand in Greece will be increased by 2030 following its higher utilization in power generation and distribution networks

Total Annual Gas Demand for SSLNG Services in Greece, [2022 -2031]

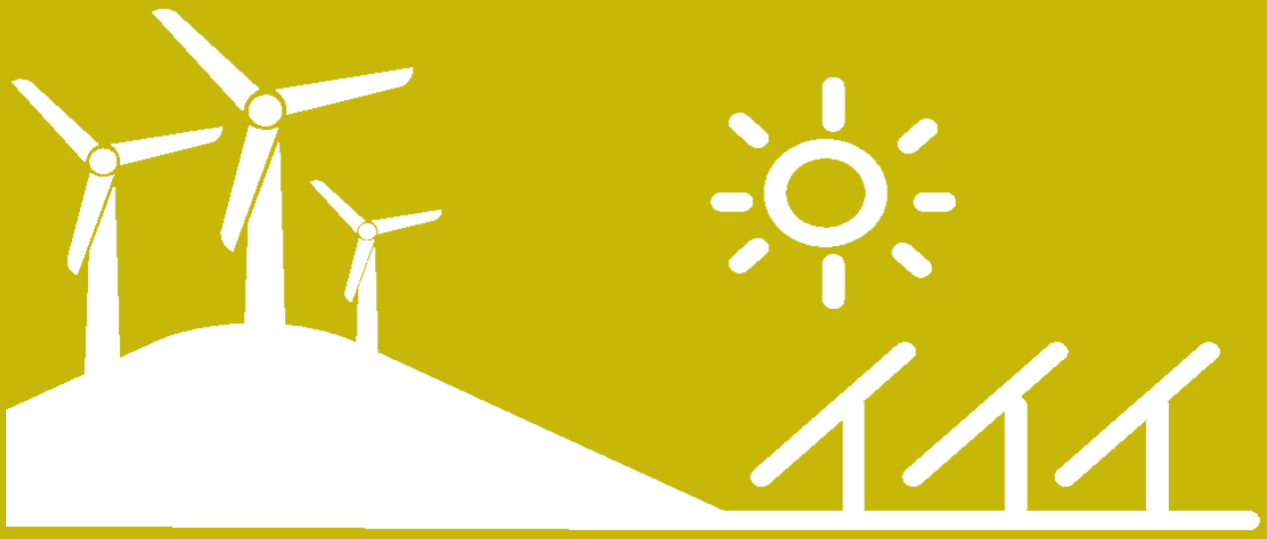


Source: DESFA and HAEE's analysis

Highlights

- Small scale LNG services in Revithoussa will include a truck-loading station, starting in 2022 and a new jetty by late 2022.
- The construction of a pilot truck loading station will give the possibility for the use of natural gas in off grid areas, where the transmission system is not developed yet.
- The new jetty will serve small ships to supply LNG in cruise ships and RO-PAX and large ships to supply satellite storages and distribution stations.
- The new jetty can accommodate small scale ships (1,000 m^3 – 30,000 m^3), while the truck-loading station will have a loading capacity of 100m^3/h and a bay for 50 m^3.
- SSLNG demand is expected to boom during the period 2022-2031, reaching 0.4 bcm in 2031, achieving a 448% increase compared to 2022.

6. Renewable Energy Sources



Highlights

The high participation of RES, which exceeded **80%** of the energy mix on the 10th of April 2021, led to the **electricity price close to zero, 0.09 €/MWh**

9,094 MW

In **2021,** the Greek RES capacity reached **9,094 MW**, increased by **15.3%** from the previous year, mainly due to the significant increase of Wind and Solar

The **solar capacity** seems to have its momentum, increasing its volume by **23.7%** the past year, while wind increased by **12.2%**

During December 2021, the **RMP** reached unprecedented levels, **increased by 420%** and reaching an **all-time high price** of **238.9€/MWh**

Wind remains the dominant RES in Greece, with more than **30%** of its capacity located in Central Greece, reaching almost **1.5 GW**

In **2021** additional wind projects were built, increasing the Installed Wind capacity to **4.4 GW**, exceeding the target of **4.2 GW** set for **2022**

In the **revised NECP** it is estimated that the number for total installed RES capacity by **2030**, will be updated to **25 GW**, instead of **18.9 GW** of the current plan

The amount of the **Letter of Guarantee** is set to **35k €/MW** acting as a "filter" for the financial solvency of the investors, being a prerequisite for the issuance of the Producer certificate

From June 2021 to December 2021, there was a total **addition of €655m to the RES Special Account**, a historic increase, in a 6 – months period

Overview

Significant progress is being made in the renewable energy sector despite the glitches observed in the terms of connection and the number of applications waiting for the required electrical space to be opened for them to operate. Last year 1.5 GW of new green projects was added to the market from the 7.7 GW that is the national target for the decade to 2030, which means that 20% has already been secured.

The wind farm portfolio also recorded a significant increase, with 29 new projects with a capacity of 340 MW and a total investment of EUR 350 million. The wind farm sector has 4.4 GW of projects and exceeds the target set for 2022, which was 4.2 GW. By 2025, there will be 8 tenders to add 3 GW to the system with different starting prices per technology.

Furthermore, there is growing concern about the long delays in the examination of applications for connection conditions, an issue on which the Energy Regulatory Authority has also taken the initiative. According to the Association of PV Energy Producers' data, in 2021, HEDNO rejected 80% of the requests for connection terms, while in 2018-2020 these did not exceed 40%.

The average time from the signing of the connection contract with the Hellenic Energy Regulatory Authority to the semi-loading of a unit, increased from 6.7 months in 2019, to 7.4 months in 2020 and to 8.8 months in 2021. However, the overall time from the final connection offer to the semi-loading, showed rather a stabilizing if not a decreasing trend: from 13.1 months in 2019, to 12 and 12.7 months in 2020 and 2021, respectively.

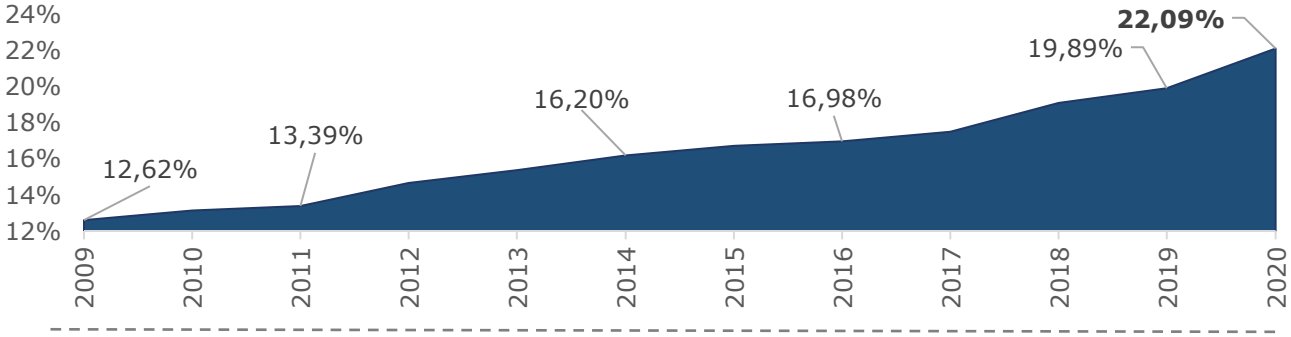
As it turns out, in 2021, connection offers were granted to 1,346 new RES generation plants with a total capacity of 3 GW, more than twice as many as in the previous year. At this pace, within the next four years it will be manageable to secure access to 12 GW of new RES projects, exceeding the NECP's target of an additional 10 GW of clean energy by 2030.

Investment interest on new RES projects remains huge, as TSO last year alone, received requests for connection offers exceeding 12 GW. The Operator notes that a decisive step towards achieving this objective is the establishment of fast-track licensing procedures for the new transmission projects of ADMIE, which are necessary for the expansion of the available electrical space.

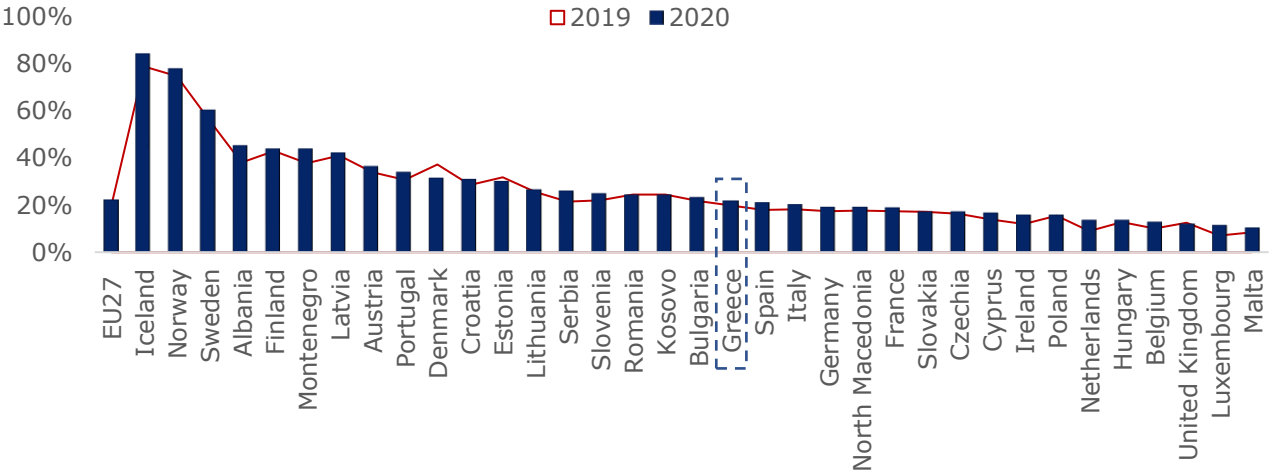
If the penetration of wind and photovoltaics was not at the current level, then the energy crisis as reflected through the highly increased natural gas supply prices, would hit the Greek wholesale electricity market to an even greater extent, with average monthly prices exceeding €310/MWh, and the turnover of the wholesale market for 2021 burdened by €2.5 billion.

The European Union member states, including Greece, continued to increase their energy share from RES in 2020

EU-27 RES Share Evolution (%), [2009-2020]



Share of Energy from Renewable Sources in the EU Member States (%), [2020]



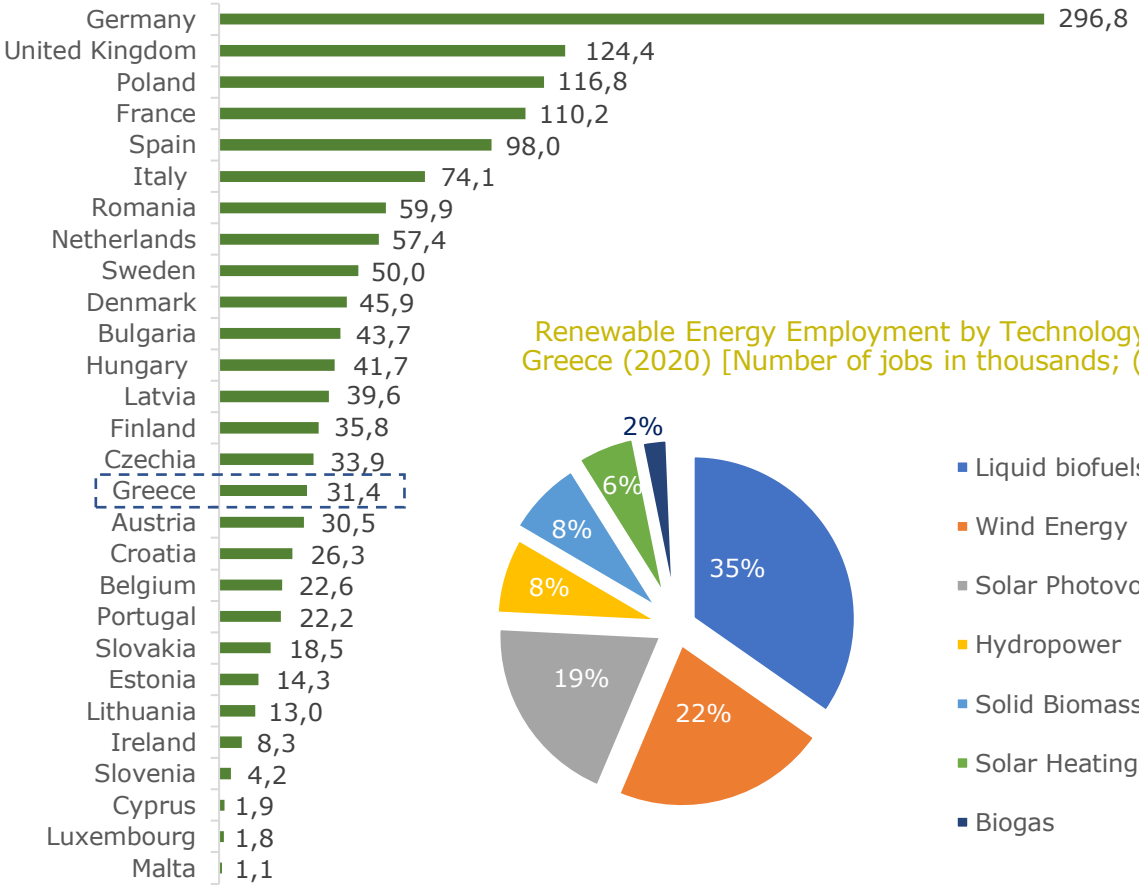
Source: Eurostat, HAEE' analysis

Highlights

- RES targets set by the EU, are to be met by its member states as they continue to progressively increase their RES share in their energy mix.
- In 2020, the average RES share in the energy mix of the EU-27 member states, increased by 9,98% and 13,55%, since 2019 and 2018 respectively.
- In 2020, 21,75% of the total energy produced in the EU was from RES, while in 2019 and 2018, the RES share was 19.7% and 17.9% respectively.
- The RES energy produced share for each EU-27 country in 2020, was higher than that of 2019, with Denmark and Estonia being the only exceptions.
- In the next 4 years in Greece, there will be secured access to 12 GW of RES projects, exceeding the target of the NECP, of 10GW of clean energy by 2030.

In 2020, Greece held the 16th position among EU members in RES energy employment, with 314,000 people in the sector

RES Employment in EU-28 (2020) [Number of jobs in thousands]



Renewable Energy Employment by Technology in Greece (2020) [Number of jobs in thousands; (%)]

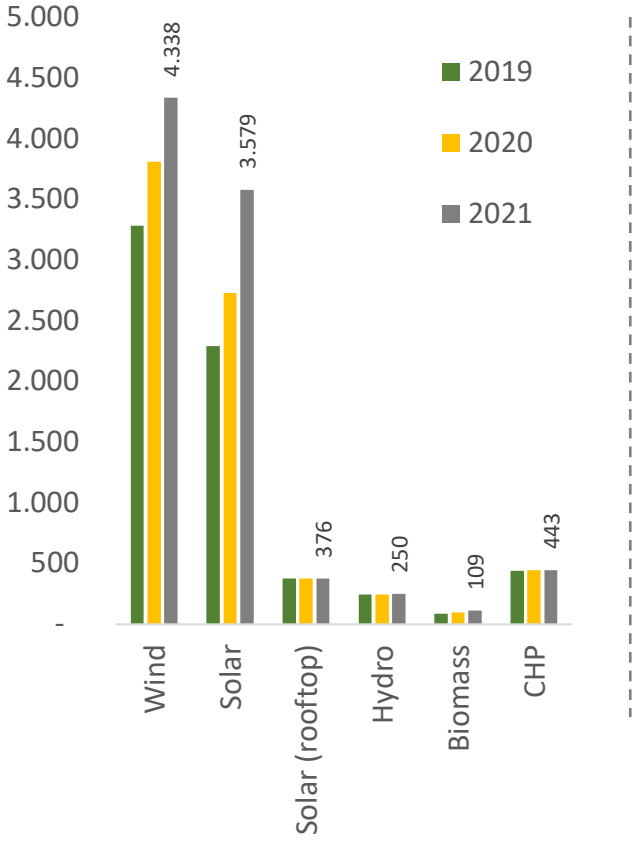
Highlights

Source: IRENA Jobs database 2021, HAEE's analysis

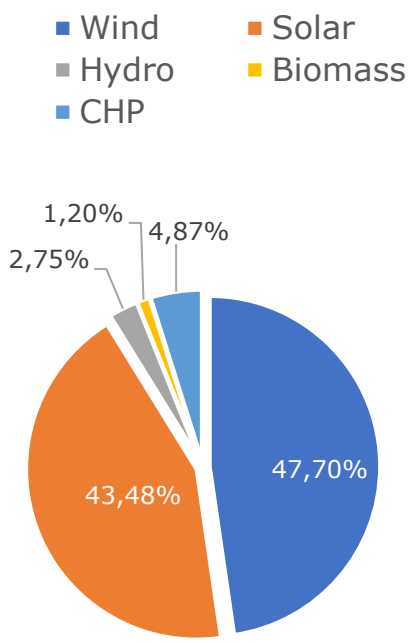
- In 2020, Germany had the highest employment rates in the EU with 2,968,000 employees in the RES sector among EU members, followed by the UK and Poland.
- Greece, in 2020, held the 16th position among the EU members in renewable energy employment (314,000 employees).
- Employment in Liquid biofuels has the largest share of the total RES energy employment in Greece (10.9%), followed by Wind (6.8%) and Solar (6.1%).
- According to IRENA, the renewable energy sector in 2020, employed globally 12 million people directly and indirectly; and increased by 64% since 2012.
- IRENA estimates that RES energy employment will increase between 19.8 – 37.8 million by 2030 and by 20.8 – 43.4 million by 2050, according to different scenarios.

In 2021, Greek RES capacity increased by 15.3% reaching 9GW compared to 2020, mainly due to the significant increase of Wind and Solar

Installed Capacity of RES by Type in Greece (MW), [2019 - 2021]



RES Share by Type in Greece (%) [2021]



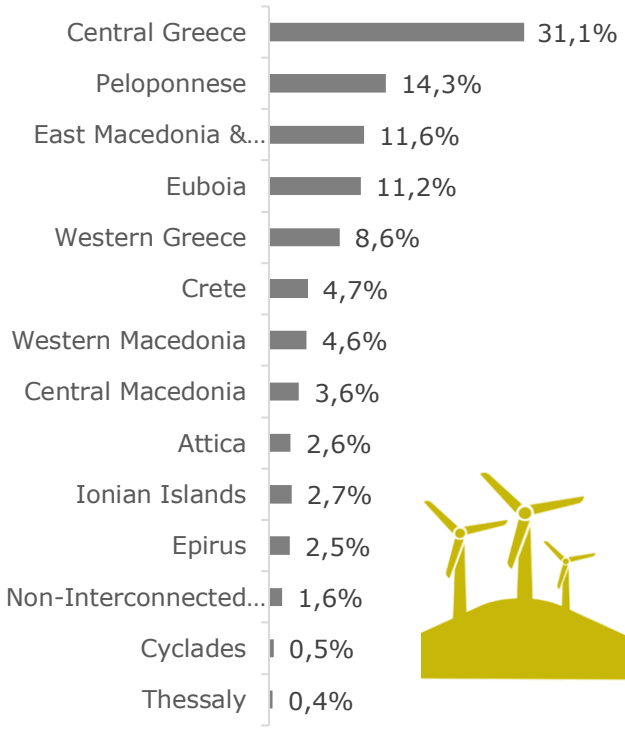
Source: DAPEEP, HAEE's analysis

Highlights

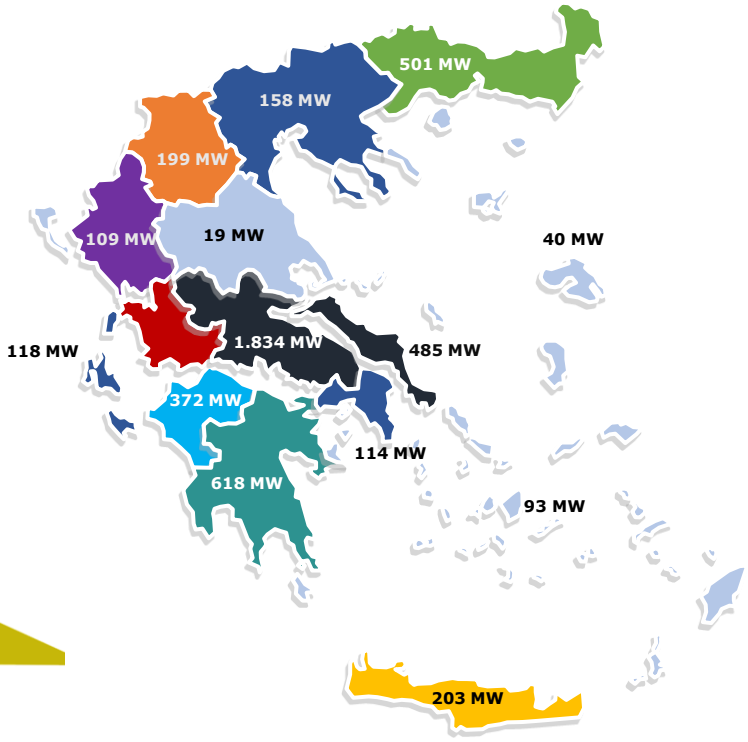
- Greek RES capacity in 2021, reached 9,094 MW (a 15.3% increase), while in 2020, it reached 7,697 MW.
- The past two years, wind capacity augmented. In 2021 it increased by 24%, reaching 4,338 MW, while in 2020 and 2019 it reached 3,810 MW and 3,283 MW, respectively.
- Solar capacity added almost 849MW to the Greek energy RES capacity, while Hydro, Biomass and CHP stations remained steady.
- The solar capacity seems to have the momentum, increasing its volume by 23.7% the past year, while wind increased by only 12.2%.
- The total RES capacity follows a significant increasing trend, as more and more RES projects are constructed. Since 2020, RES capacity increased by more than 2.2 GW.

Wind remains the dominant RES in Greece, with more than 30% of its capacity located in Central Greece, reaching almost 1.5 GW

Installed Wind Capacity by Region (%), [2021]



Installed Wind Capacity by Region [MW], [2021]



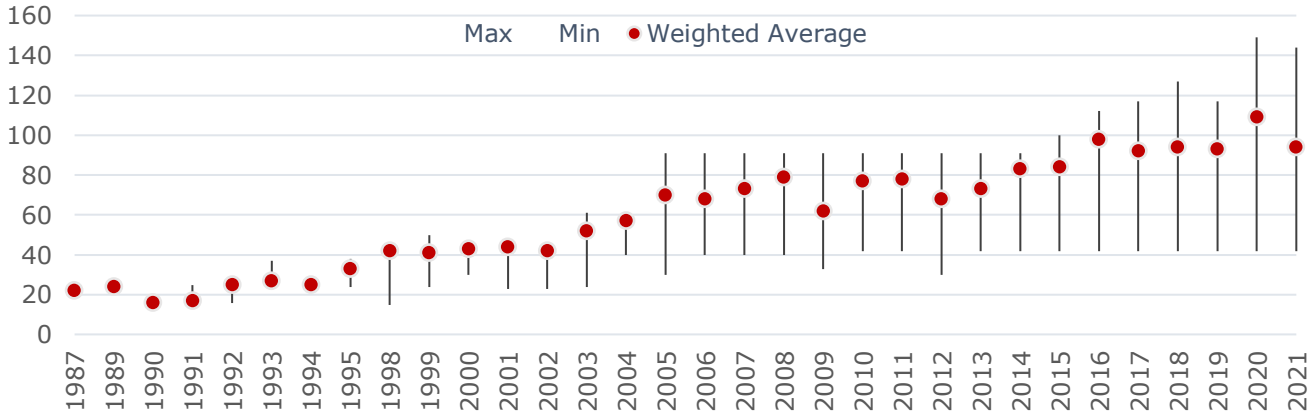
Source: DAPEEP, HAEE's analysis

Highlights

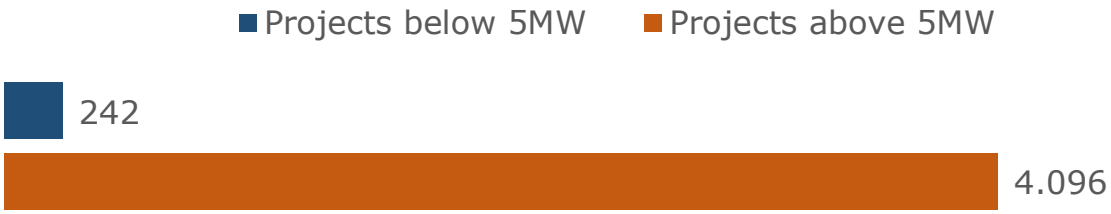
- In 2021 additional wind projects were built, increasing the Installed Wind capacity to 4.4 GW, exceeding the target set for 2022 of 4.2 GW.
- With the interconnection of Crete, there are 203 MW of additional wind capacity connected to the mainland, representing 4.7% of the total installed Greek capacity.
- 31.1% of wind capacity is located in Central Greece, while a significant amount is also installed in Peloponnese, reaching 14.3%.
- The capacity of the wind projects in Central Greece, Peloponnese and Euboea covers almost 60% of the total installed wind Greek capacity.
- Greece should develop the legal framework for offshore WTGs, as they produce much more power in a smaller area, allowing the decongestion of the mainland.

The Average Rotor Diameter of Wind Projects in Greece, is currently almost 100 meters, while the capacity per project is above 5MW

Rotor Diameter per Year Min/ Max/ Weighted Average
[1987 - 2021] [meters]



Installed Wind Capacity by Project Size (MW), [2021]



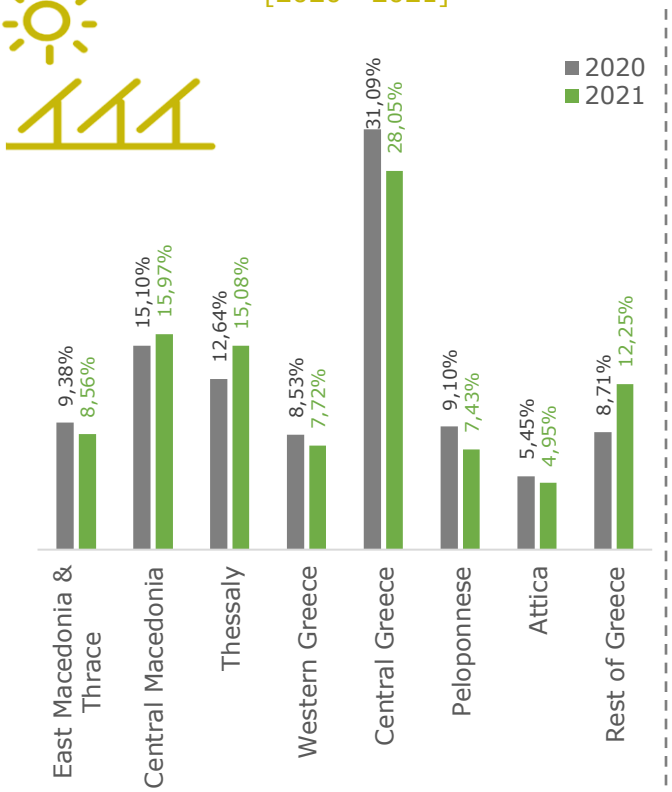
Source: ELATAEN, HAEE's analysis

Highlights

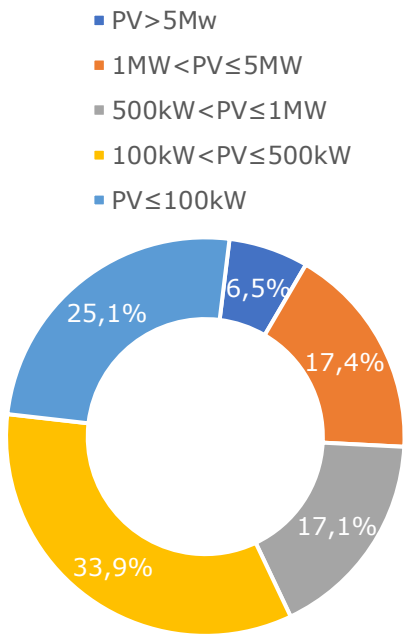
- Most of the installed capacity correspond to projects that have capacity of at least 5 MW, 4,096 MW or 94% out of the total 4,338 MW.
- There is a 65% increase of small-scale wind installations (below 5MW), reaching a total of 242 projects.
- The rotor diameter of an average WTG installed in 2021 in Greece is 4.2 times longer than the average rotor installed in 1987.
- The average rotor diameter installed in Greece in 2021 is 94m, while significant increase of 65% can be noticed to the rotor diameter comparing to WTGs of 2004.
- For a Wind installation 10 years ago, double the number of WTGs would be needed to produce an equal capacity project.

Solar capacity increased by 20% in 2021, with major activity in the Rest of Greece. Important increase in the PV projects above 5MW

Solar Capacity by Region (MW), [2020 - 2021]



Installed MW per PV Station Capacity (%), [2021]

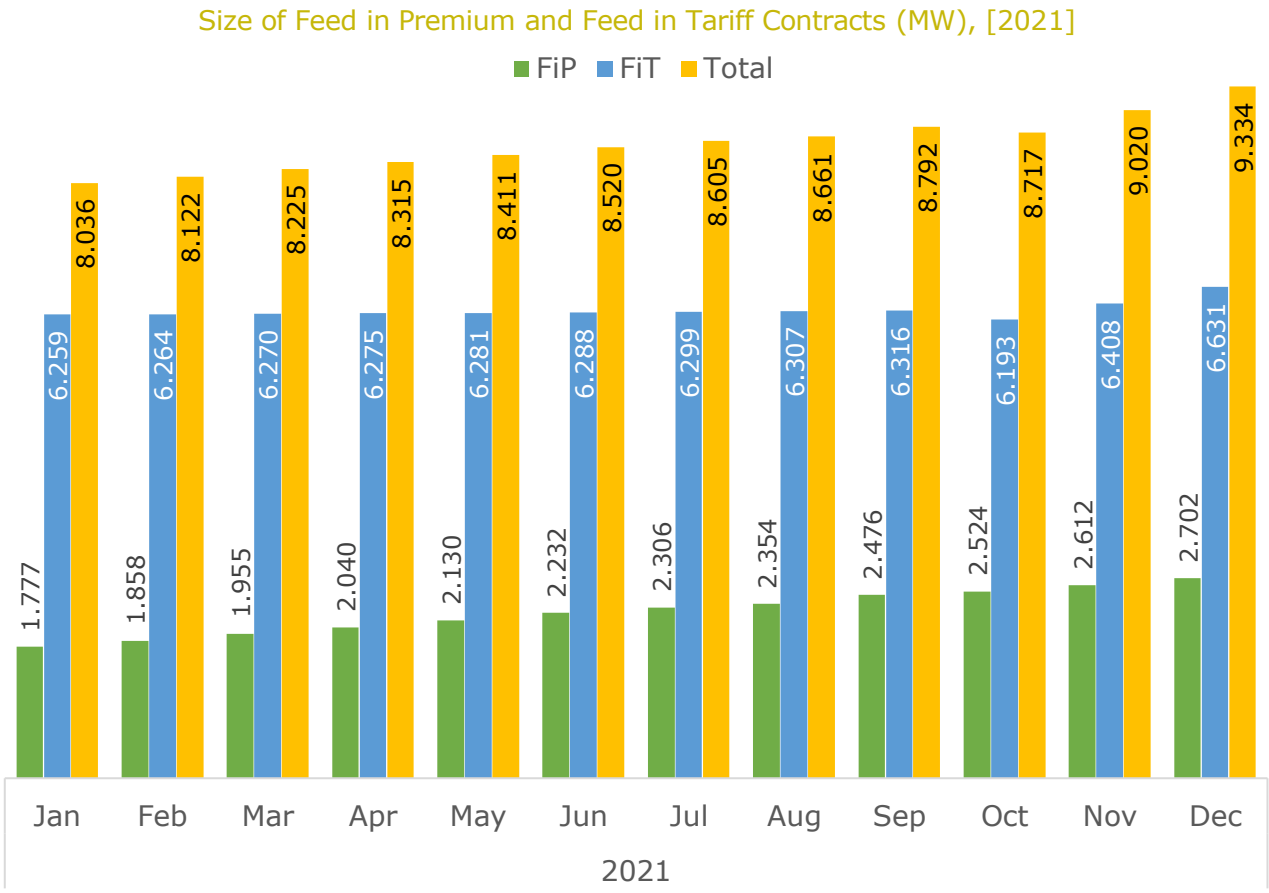


Source: DAPEEP, HAEE's analysis

Highlights

- By the end of 2021, the total installed solar capacity in Greece was 4,228 MW and 6.5% of this, was provided by large scale PVs (above 5 MW).
- PV installations are almost evenly dispersed across the mainland Greece, with Central Greece showing the largest concentration (28.05%).
- Next, Central Macedonia represents 15.97%, Thessaly 15.08%, Rest of Greece 12.25%, and East Macedonia & Thrace 8.56%.
- Most of the solar production is attributed to small PV installations PV≤100kW and 100kW<PV≤500kW), each holding a 59% of the total solar capacity.
- Large Scale PVs above 5MW, increased by 325% compared to 2020, as more and more investors' projects complete the Licensing process and are electrified.

The Feed-in Premium (FiP) has been increasing steadily since the adoption of the mechanism in 2016, supporting RES penetration



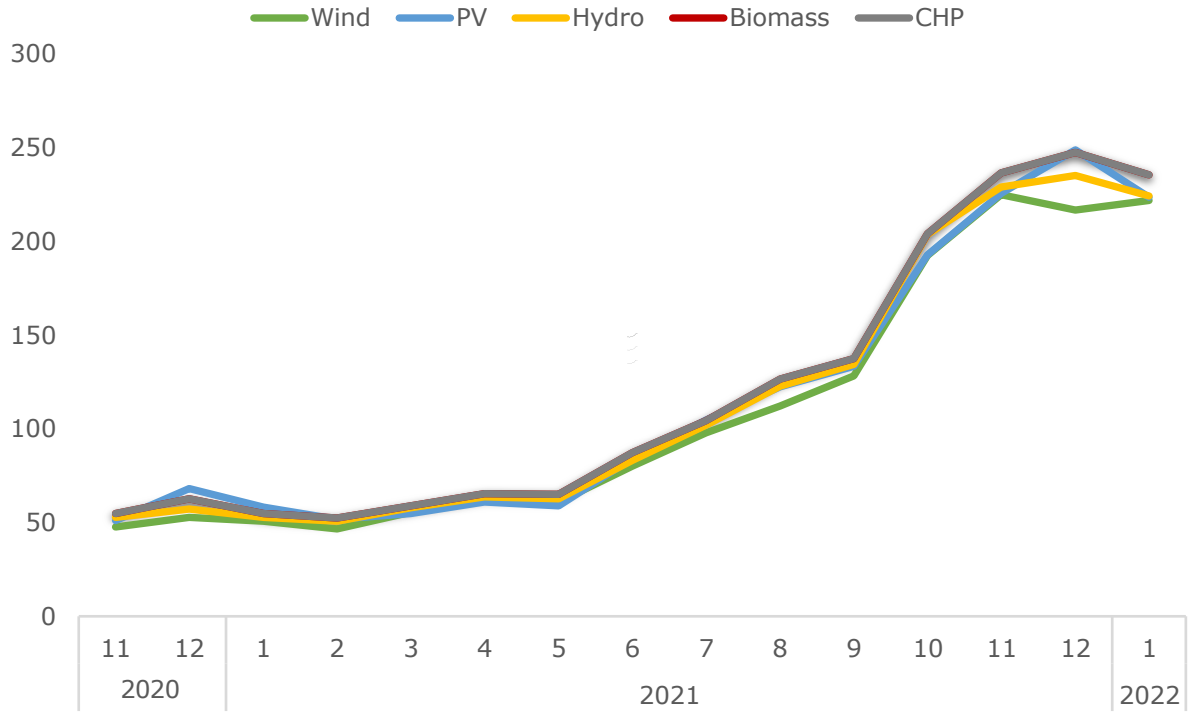
Source: HAEE's analysis

Highlights

- Most of the RES production in Greece is carried out under fixed price contracts (FiT/FiP) and as spot price is increasing, there is a vast revenue surplus to DAPEEP.
- The share of FiT increased to by only 5.6% during 2021, which is translated into a gradual movement towards less State-protection schemes in the RES market.
- The share of FiP increased by 34.2% in 2021, reaching from 1,777 MW in January, tp 2,702 MW in December 2021.
- RES projects under the FiP mechanism receive a premium, in the form of a variable (sliding) premium, on top of their revenues from the market.
- The total size of the FiP and FiT contracts in 2021, reached 9,334 MW in December, compared to 8,036 MW in January, an increase of 14% in a 12-moth period.

The Reference Market Price (or ETA) had a dramatic increase from January 2020 to January 2021, of approximately 420%

Historical Data of Reference Market Price by Month (€/MWh), [Nov 2020 – January 2022]



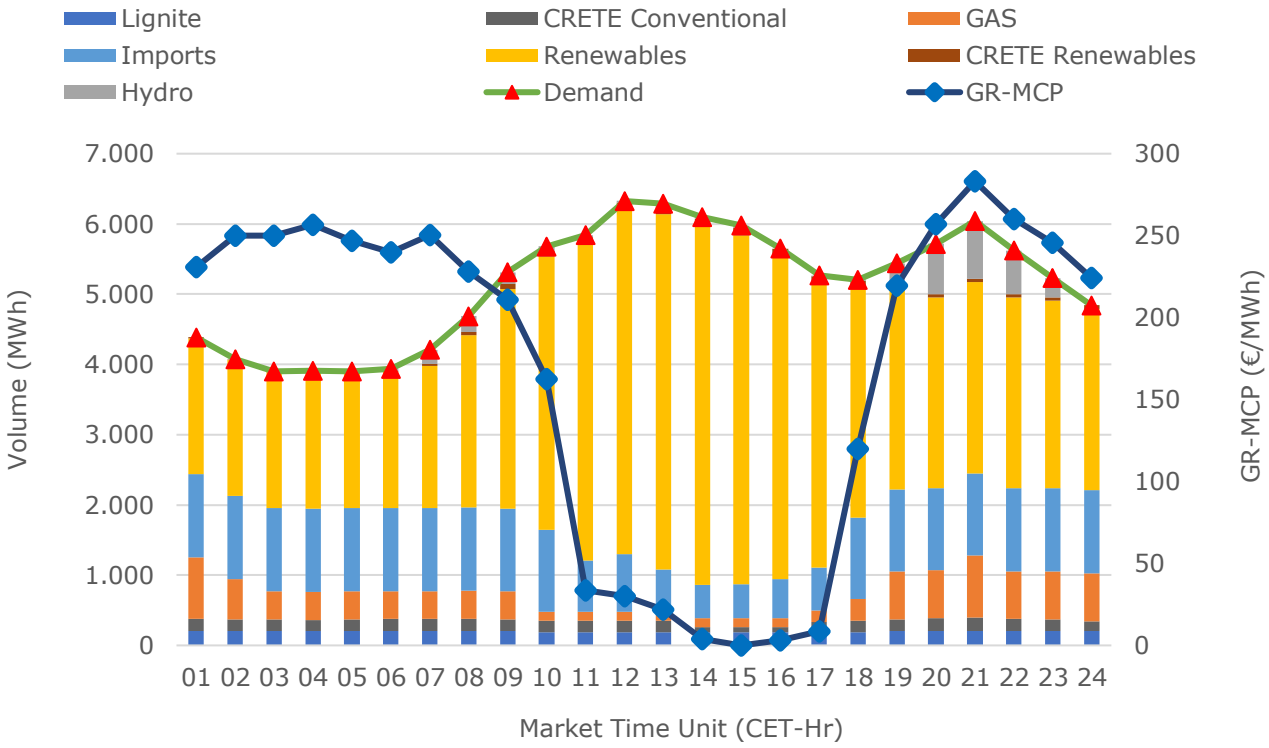
Source: HAEE's analysis

Highlights

- We observe a gradual escalation of the Reference Market Price from April 2021 to the explosive prices of December 2021.
- The monthly sliding premium is calculated based on the Reference Market Price and is identical for all producers of each RES technology.
- During December 2021, the RMP reached unprecedented levels, increasing by 420% and reaching an all-time high price of 238.9€/MWh.
- RES producers under the sliding FiP framework, receive a premium which is the difference between the Reference Price and the monthly RMP per technology.
- Due to the vast increase of the RMP, RES producers were requested to return to the RES Special Account, the difference between the ETA price and their Reference Price.

The electricity price in the Greek market reached almost zero levels during 9th April, for a limited time during the day, due to RES production

Electricity Demand, Production (MWh) and Prices per Hour (€/MWh), [10 April 2022]



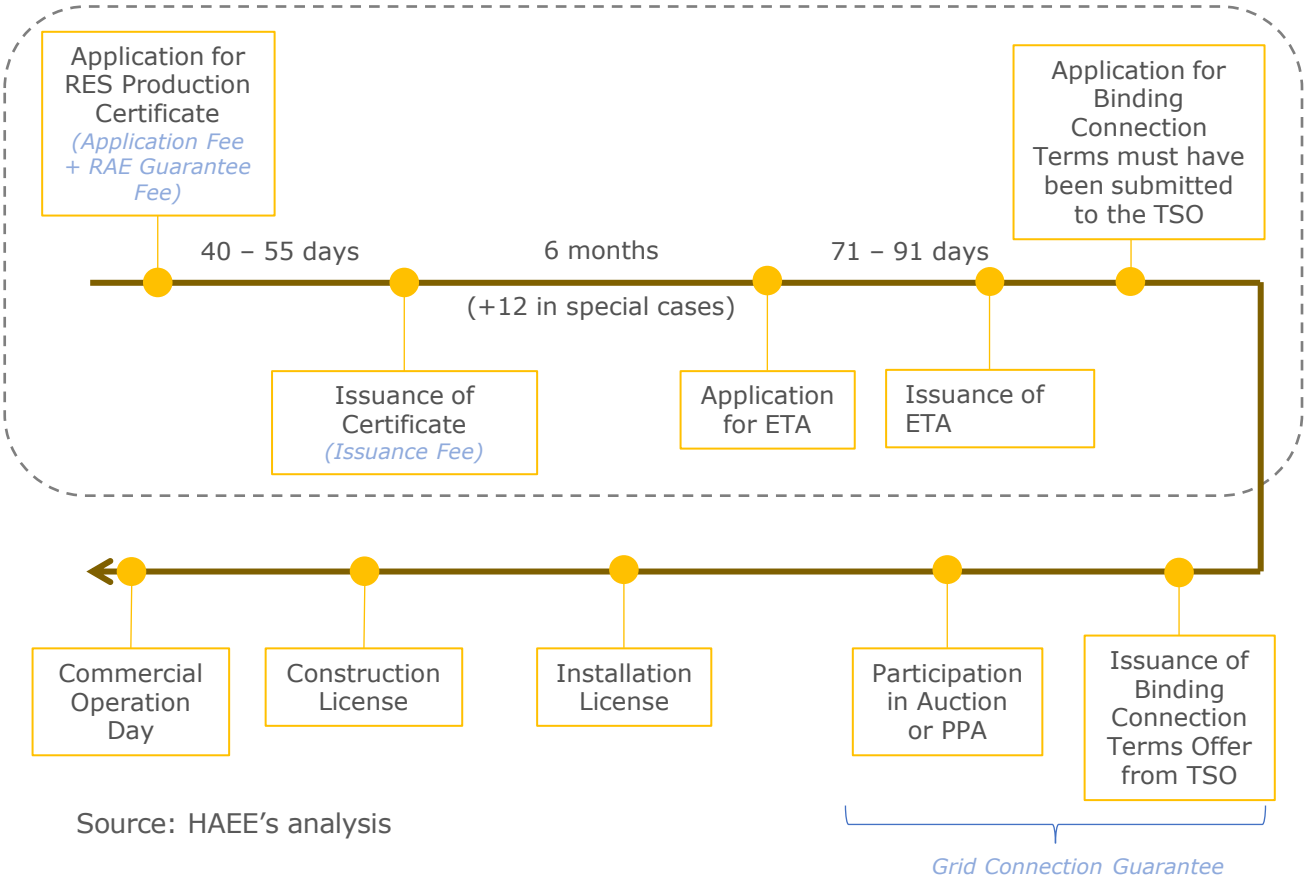
Source: HEnEx, HAEE's analysis

Highlights

- The increased RES supply and the limited demand on the 10th of April, pushed the expensive thermal units out of the merit order and the MCP dropped close to zero.
- The MCP reached these levels due to the participation (more than 80%) of RES in the energy mix and the low demand (6,000 MWh) from 14:00 – 16:00 on April the 10th.
- The outcome of MCP reaching low levels, resulted to the drop of CO_2 emissions by almost 90%, reaching 36g CO_2/kWh on average for this specific period of time.
- On 10th April night-time, with the RES participation decrease and the thermal units' coverage of the energy needed, the price increased from 0.09 to 283.12 €/MWh.
- Greek energy imports (500MW) do not affect the MCP, as the price for imports is declared on the market close to zero prices in order to ensure their absorption.

Fees and Guarantees of the Energy Law, accelerated the licensing process, and targets to reduce licensing time to less than two years

Chart Flow of the New RES Licensing Procedure



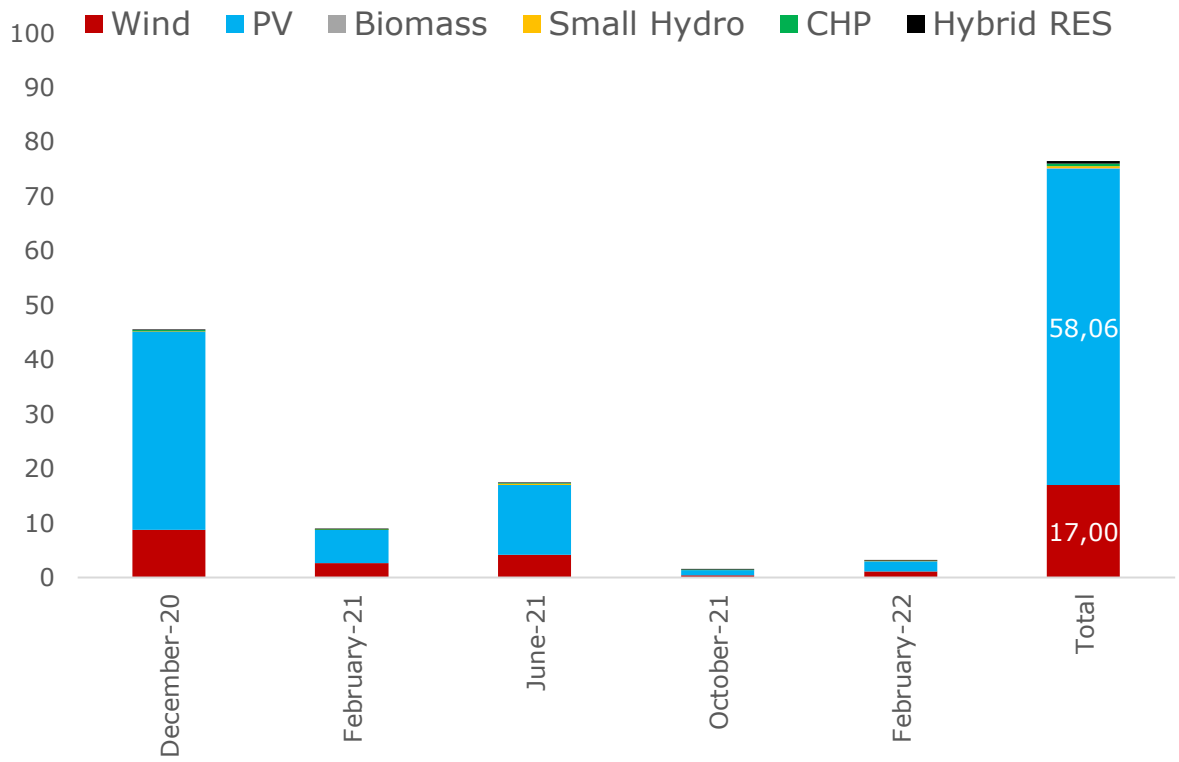
Source: HAEE's analysis

Highlights

- The required licensing stages are reduced from 7 to 5, while necessary documents are reduced from 91 to 54, supporting a process that can be handled digitally.
- The entire licensing process will now be carried out through the "Electronic Registry", acting as a link between the investor and the Licensing Authorities.
- 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.

From the Submission Cycle of Dec-20 to the one of Oct-21, there was a capacity drop of 97%, due to the updated enforcement of Guarantees

RES Project total Capacity (GW) during the Submission Cycle Applications [2020 – 2021]



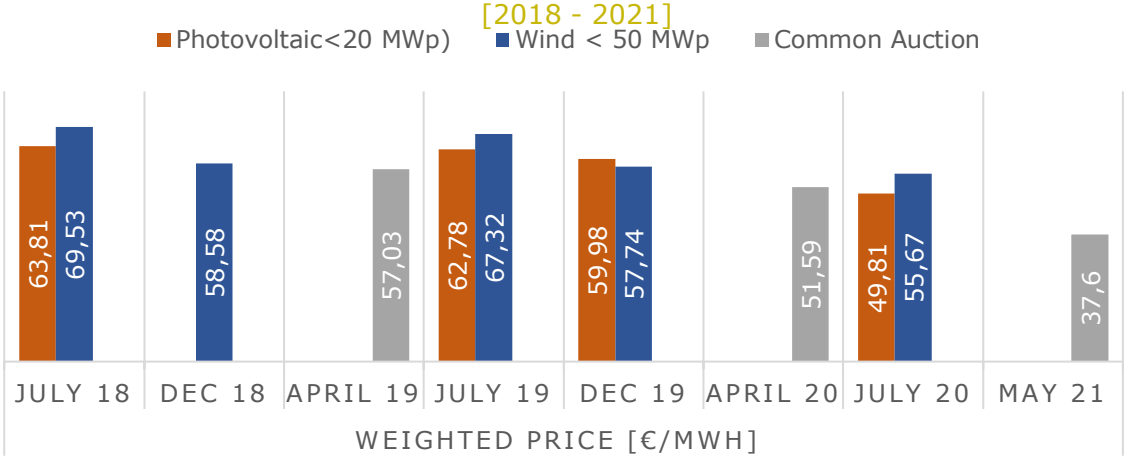
Source: HAEE's analysis

Highlights

- The Ministry of Environment and Energy promotes a clarification in the Production Certificates of RES, through the regulation of a letter of guarantee scheme.
- The amount of the Letter of Guarantee is set to 35k €/MW, a prerequisite for the issuance of the PC, acting as a "filter" for the financial solvency of the investors.
- There is a total of 76.43 GW of RES total capacity submitted during the cycles of 2020 and 2021, which express the enormous interest of RES investments in Greece.
- We notice that in October 2021, when the Application Fees and Guarantees were imposed to investors, their interest dropped by more than 90%.
- PV is the RES technology with the highest interest, representing 28.4% of the total capacity, followed by Wind with a 10.8% share.

Weighted Prices of RES Auctions in Greece are steadily declining, with the lowest observed at the Common Auction of May 2021 at €37.6/MWh

Weighted Prices (€/MWh) for Specific Technology and Common Auctions, [2018 - 2021]



Auctions Awarded Capacity (GW) for Specific Technology and Common Auctions, [2018 - 2021]

Auctions Awarded Capacity (MW)	2018	2019	2020	2021	
PV	169	248	142		
Wind	338	405	472		
Common Auction		438	503	350	
Total	**507**	**1,091**	**1,117**	**350**	**3,065**

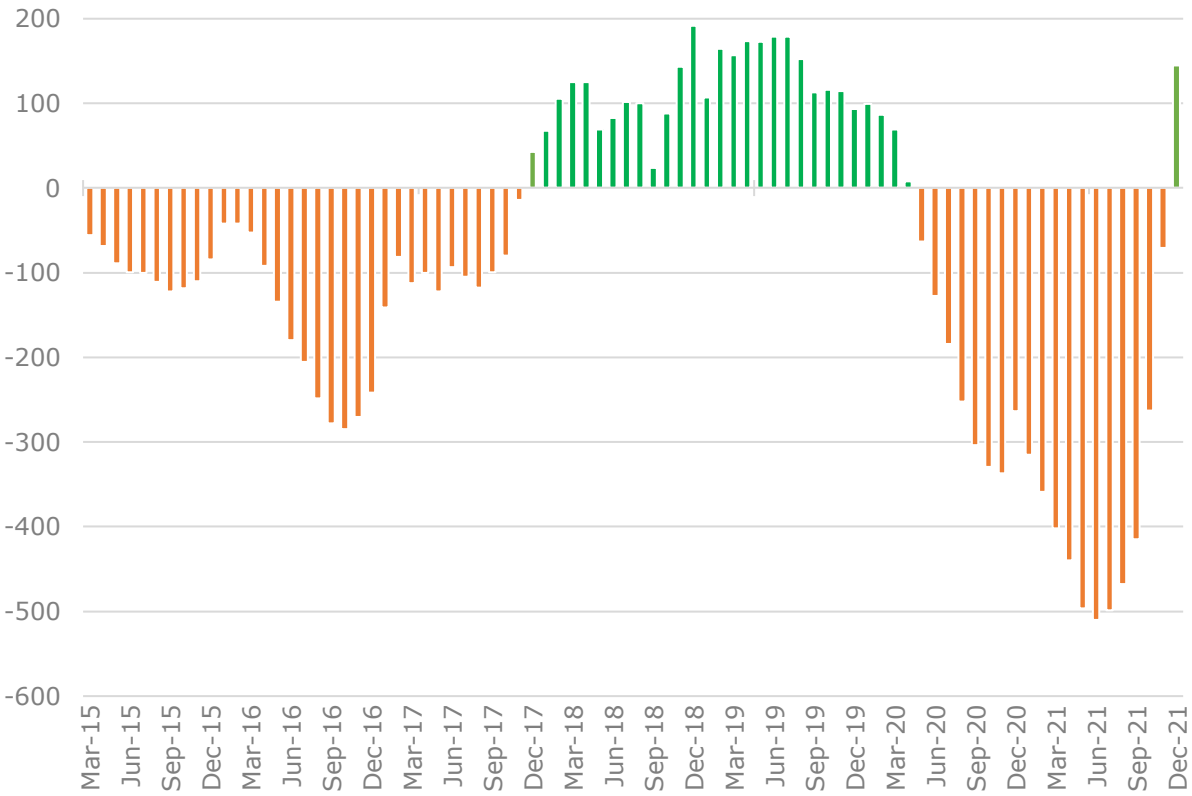
Source: RAE, HAEE's Analysis

Highlights

- Almost 3GW have been awarded in Auctions since 2018. In the 2021 common Auction, the capacity of 350MW was awarded only to PV projects.
- By 2025, there will be 8 tenders to add 3 GW to the system, with different starting prices per technology.
- In 2022, the new RES Framework on the licensing acceleration, storage and offshore wind will be on Public Consultation with a view to being voted during the year.
- There is general concern about the delays during the examination of applications to receive Connection Terms, an issue on which RAE has also taken initiative.
- The average time from the signing of the contract with HEDNO to electrification, increased from 6.7 months in 2019 to 7.4 in 2020, and to 8.8 in 2021.

RES Special Account recorded a surplus of €29.7 million during Dec 2021, achieving for the first time, positive values since June 2020

Evolution of Deficits and Surpluses of RES Special Account
(Million €), [December 2013 – December 2021]



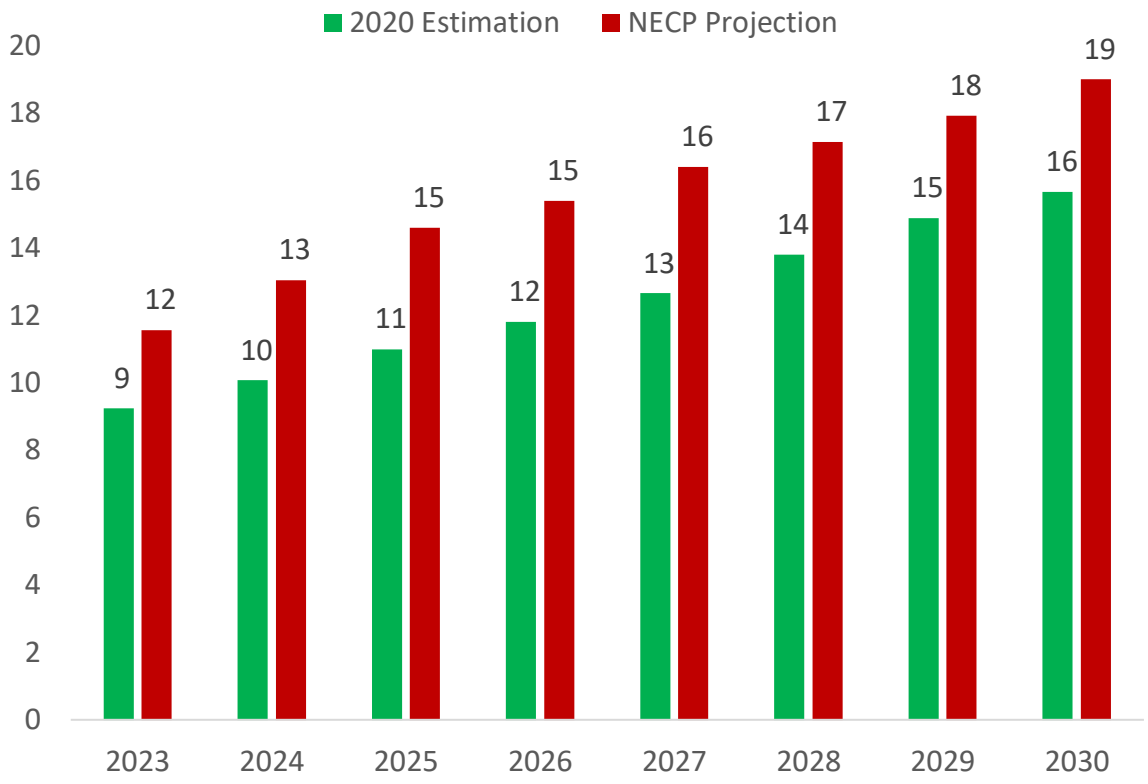
Source: DAPEEP, HAEE's analysis

Highlights

- €144m was the surplus for 2021. From the profits, €70m were given to the special security reserve, €108m to the green fee on diesel, and €55m for the special PC fee.
- The past year, there was a total addition of €655m to the RES Special Account, a historic increase in a 12 – month period.
- This account is the main contributor to the Energy Transition Fund, through which Greek society is being supported during the energy crisis of the past few months.
- As the Greek RES capacity and the Reference Price are increasing simultaneously, the total revenues for the RES Special Account are increasing exponentially.
- A sub-account dedicated to storage units, will be created in RES Special Account, and the compensation mechanism will be based on the FiP scheme, replicating RES.

During 2021, 1.5 GW of new RES projects were added to the grid, a 20% of the total 7.7 GW which is the National Target to reach by 2030

NECP Projection for RES capacities by 2030 [GW]



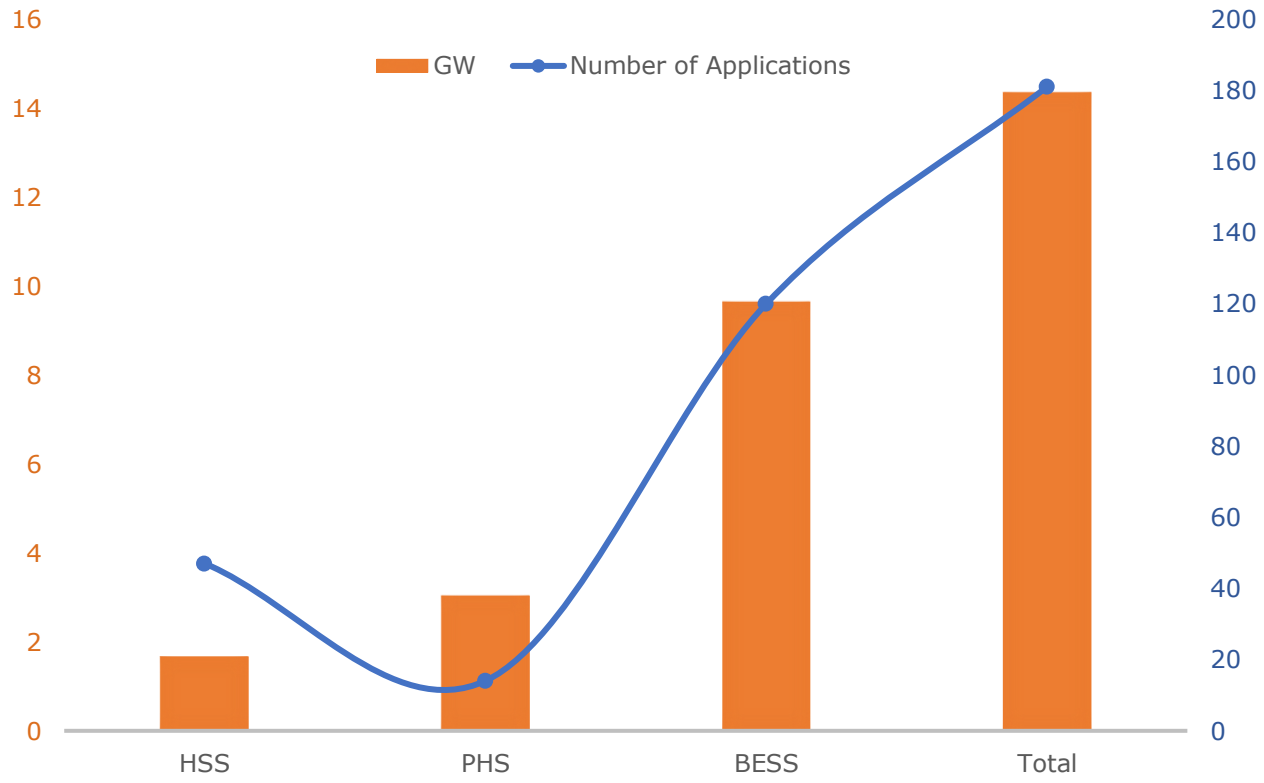
Source: NECP, HAEE's analysis

Highlights

- In 2021, 1.5 GW of RES covered a part of the total of 7.7 GW needed by the end of the decade, about 20% of the NECP target.
- The wind farm sector has 4.4 GW of projects and exceeds the target of 4.2 GW, set for 2022.
- The first tender for RES under the new support scheme for the period 2021-2025, will be in 2022.
- Under this new scheme, 3 GW of capacity for Wind and PV will be put out to tender, including special tenders for specific categories, such as congested areas.
- In the upcoming NECP, the number of total installed RES capacity by 2030, is expected to be increased from 18.9 GW to 25 GW.

Greece targets to achieve the installation and operation of 1.5GW of Storage Systems by 2030, with the support of the new legal framework

Storage Capacity (GW) and number of Applications until December 2021



Source: HAEE's analysis

Highlights

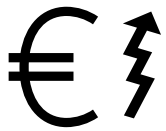
- Greece is among the first countries in the EU to implement an aid scheme for storage plants, as currently the market does not ensure their economic viability.
- Through the Recovery Fund, €200 million will be invested to secure 700MW Battery Storage Tenders by S2 2022, as investors' interest has increased the past year.
- RAE has granted 181 Production Licenses for 14.3GW, 120 applications (9.64GW) for storage power plants and the remaining 47 (4.66GW) for hybrid power plants.
- The Ministry of Energy and Climate Change targets for around 700MW of pumped storage and 800MW of batteries.
- In Q3 2022, the first tender for Storage and Hybrid units of a total capacity of around 400-450 MW will be announced.

7. Oil & Refining

Highlights

Oil production in **EU-27** has been **decreasing** steadily in recent years, whereas production in **Greece** in **2021**, was as low as in **2015**

Crude oil prices exhibited a sharp rise during **2021** and early **2022**



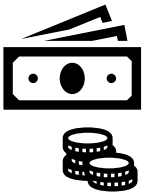
Russia was the World's second largest Crude oil producer in **2020** and the EU's top respective source

Greece's total refinery output has been dropping in recent years, though **gas/diesel oil** production exhibited an increase in **2020**, despite the pandemic

The **transport sector** represents more than half of the Oil final consumption both in the EU (**59%**) and in Greece (**63%**)

The main source of crude oil for Greece remains **Iraq** (**36%**), but **Russia** is also included in the mix **(18%)**

The **average EU** unleaded 95 price approached **2€/litre** in early 2022, almost **100%** higher than at the start of the pandemic



Global oil demand is expected to increase in the next five years, but the **EU's to level by 2026**

Greece has the second highest taxation on unleaded 95 in EU-27 (after Malta), as of March **2022**

Overview

Oil demand/consumption is subject to several external, and at times, opposing forces. On one hand there is the political realization and efforts for implementing decarbonization strategies as a matter of high priority, and on the other hand there are events of significant global impact, such as the pandemic and the Russia-Ukraine conflict, that can affect government, consumer and industry behaviors in unforeseen ways.

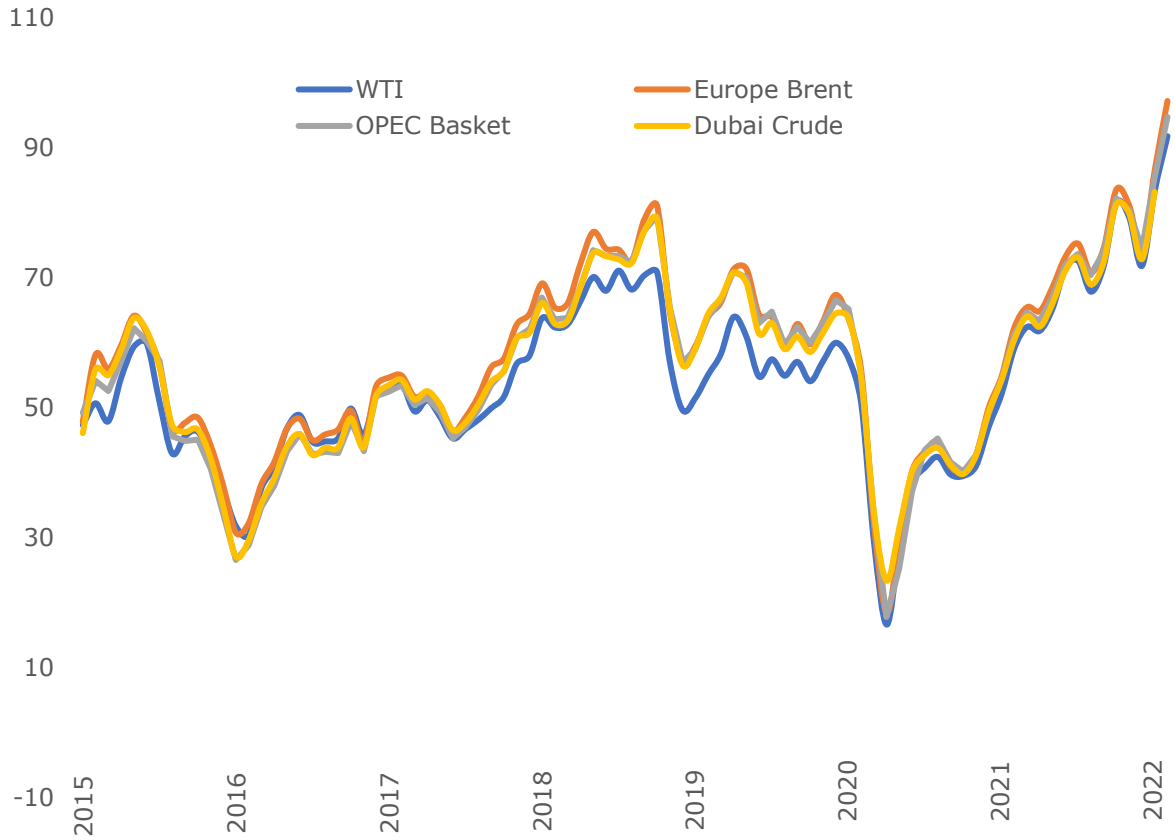
As the pandemic's adversary effects started easing during 2021, crude oil prices climbed up, and not only did they recover all the 'lost' ground, but they also exceeded the $100 per barrel mark in Q1 2022, for the first time since 2014. New interest has been drawn lately into geopolitical energy interdependencies, highlighting the critical role of Russia in the supply of Oil globally (being only second to the USA) and at EU level (by far EU's top source of oil imports).

At national level, Greece's declining oil production in recent years is likely to be seen in a new light, given its notable dependence on Russian oil (ca. 20% imports). Refining output, although also declining in 2020, did not appear to be as highly affected by the pandemic as the EU total. The transport sector continues to represent more than half of the oil final consumption in Greece (in line with EU), and the recent very high motor fuel prices, exacerbated also by Greece's respective high taxation, create a mix of potential strong economical pressures to most aspects of everyday life in the country.

Projections of Oil demand/production have traditionally been a central part of the Energy debate, and estimates drawn from relatively recent studies are also presented herein. However, taking into account the unprecedented rate of new developments and events of global impact, said figures should be considered in the appropriate context and assuming significant levels of uncertainty.

After the collapse in 2020, a sharp rise in Crude Oil spot prices was observed, also exacerbated by geopolitical developments

Crude Oil Spot prices, ($ per barrel), [2015-2021]



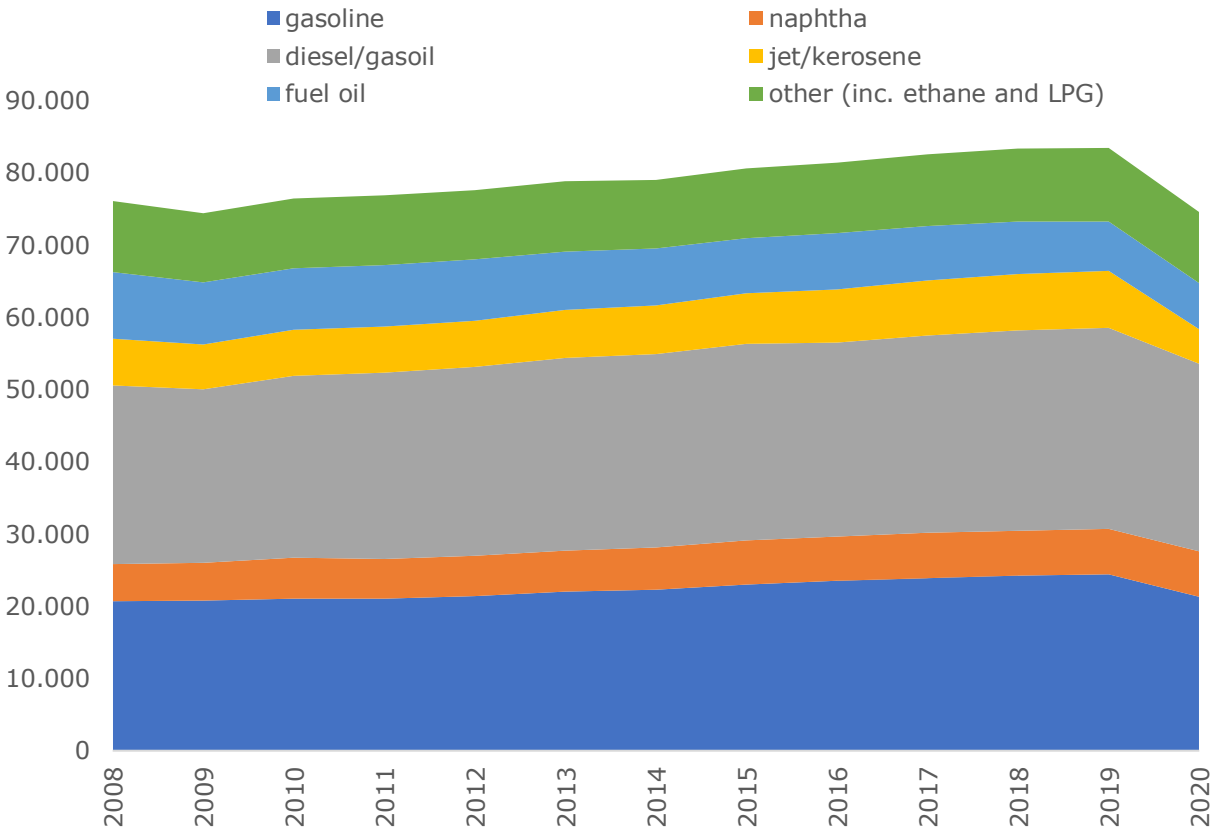
Source: EIA, HAEE's Analysis

Highlights

- The volatility of the Oil sector is yet again being confirmed with the sharp dip in 2020, having been followed by an equally remarkable recovery.
- The bounce-back of global demand following the ease of the pandemic, as well as Russia's invasion of Ukraine, were the main factors for the rise in prices.
- For the first time since 2014, Crude Oil spot prices exceeded $100 per barrel in early 2022.
- It is worth noting that all Crude Oil indices appear to be much more aligned after the pandemic recovery.
- Forecasting Crude Oil spot prices for the immediate future, is considered particularly difficult due to the dramatic geopolitical developments (Russia-Ukraine conflict).

The upwards global oil consumption since 2009 was followed by a sharp drop in 2020, mainly driven by the breakout of the pandemic

Oil Products Consumption Globally (thousand barrels), [2008-2020]



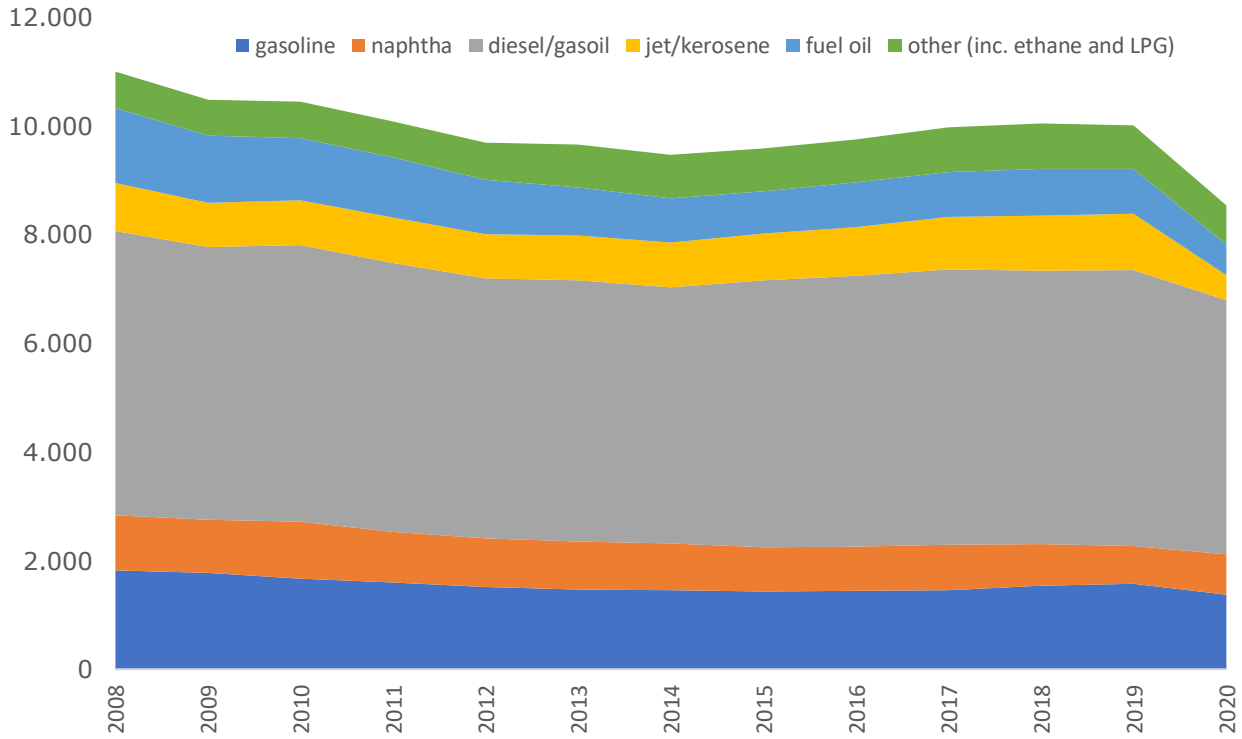
Source: BP, HAEE's analysis

Highlights

- Historically, worldwide oil products' consumption has been dominated by diesel/gasoil, gasoline and fuel oil.
- It is evident that the 2008 economic crisis had had less of a dramatic effect on oil consumption than the recent Covid-19 pandemic.
- The total consumption in 2020 decreased by more than 9% compared to the consumption in 2019.
- All product consumption was affected, but none as much as the jet/kerosene consumption (-40%), because of the airplane fleet grounding.
- Given the sharp rise in crude oil prices in 2021, the respective oil products consumption values are expected to have also increased significantly in 2021.

Oil consumption in the European Union declined as well, and at an even greater rate than the global total

Oil Products Consumption in the EU 28 (thousand barrels), [2008-2020]



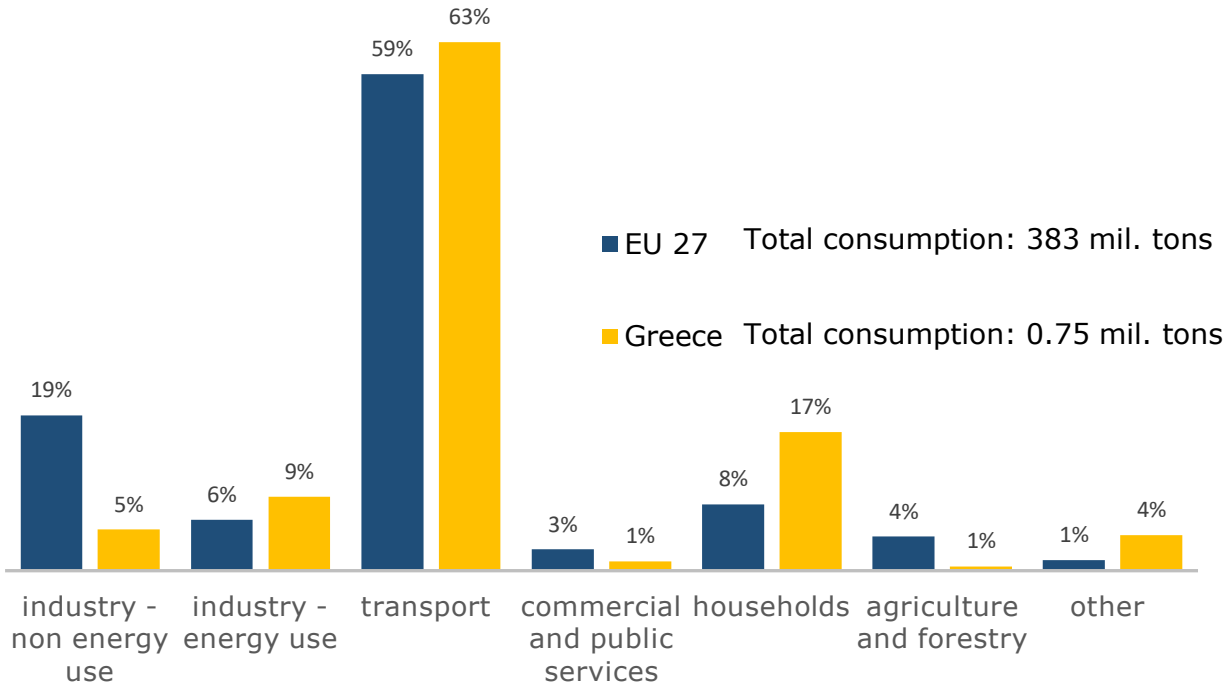
Source: BP, HAEE's Analysis

Highlights

- EU oil consumption has been fluctuating in the last decade, with both upward and downward trends observed.
- The 2020 pandemic caused a dramatic drop of 13.5% in total consumption compared to 2019.
- Jet/kerosene consumption decline was even greater in the EU-28 (-55%) in 2020, than the World average, highlighting the level of aviation crisis in EU.
- Interestingly, naphtha consumption appeared not to be affected much by the pandemic.
- Given the observed sharp rise in crude oil prices in 2021, the respective oil products consumption values are expected to have also increased significantly.

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

Oil Consumption % by Sector in EU 27 and Greece, [2020]



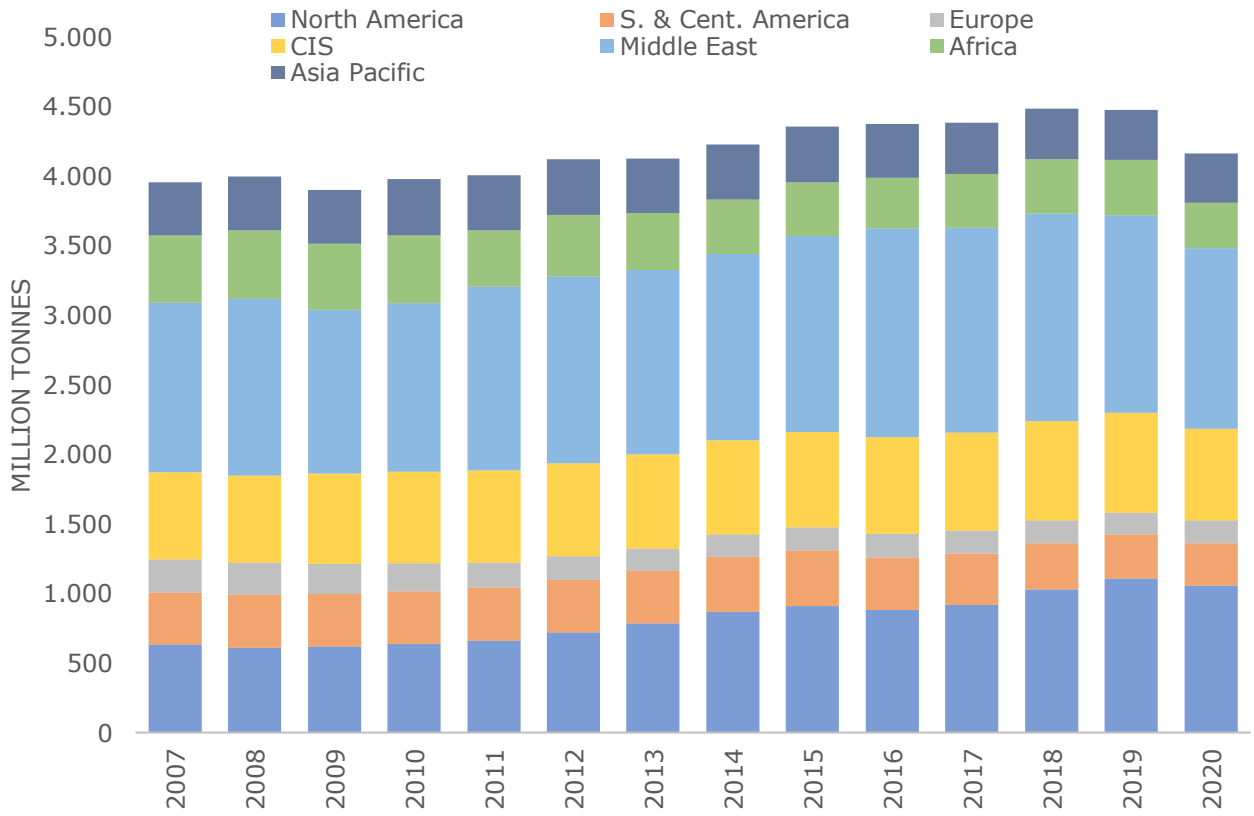
Source: Eurostat, HAEE's analysis

Highlights

- The widely recognized contribution of transport to GHG emissions is easily illustrated in this figure, with the sector dominating oil consumption in EU/Greece.
- Therefore, de-carbonizing Transport, via e-mobility and other initiatives, can be a positively impactful policy priority.
- Household oil consumption is more pronounced in Greece (17%) than in the EU (8%), allowing a lot of room for improvement in the respective end-use.
- Worth noting that a large part of the total EU oil consumption (19%) relates to non-energy use in industry, an activity that is much less prevalent in Greece (5%).
- On the other hand, oil consumption for industrial energy use has the third largest share in Greece, at 9%.

The generally upward trend in oil production since 2010, was followed by a significant drop of 7% in 2020, compared to 2019 levels

Oil Production Across the World (mil. tons), [2007-2020]



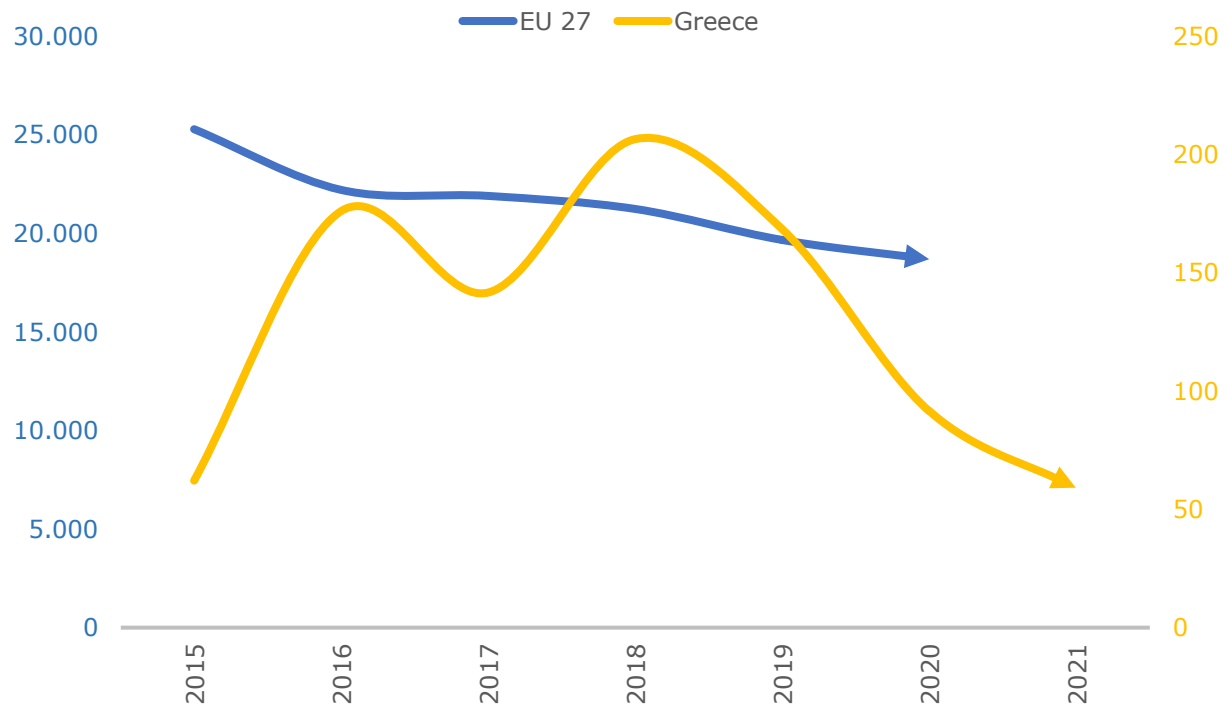
Source: BP, HAEE's analysis

Highlights

- As oil consumption and production are closely linked, the latter showed a significant decline in 2020 due to the pandemic.
- The Middle East has been the geographic region with the largest oil production in recent history. However, there are top oil-producing countries outside this region.
- North America, on the other hand, has been increasing its oil production at a higher rate that any other region since 2010.
- Africa was the region with the highest drop in oil production (-19%) in 2020, compared to 2019.
- Europe's oil production amounts to only 4% of the world's total, being roughly constant in the last 5 years.

During 2015-2021, the EU-27 Crude Oil production follows a steady decline, whereas Greece's has been more turbulent

Indigenous Crude Oil Production in EU27 and Greece (thousand tons), [2015-2021]



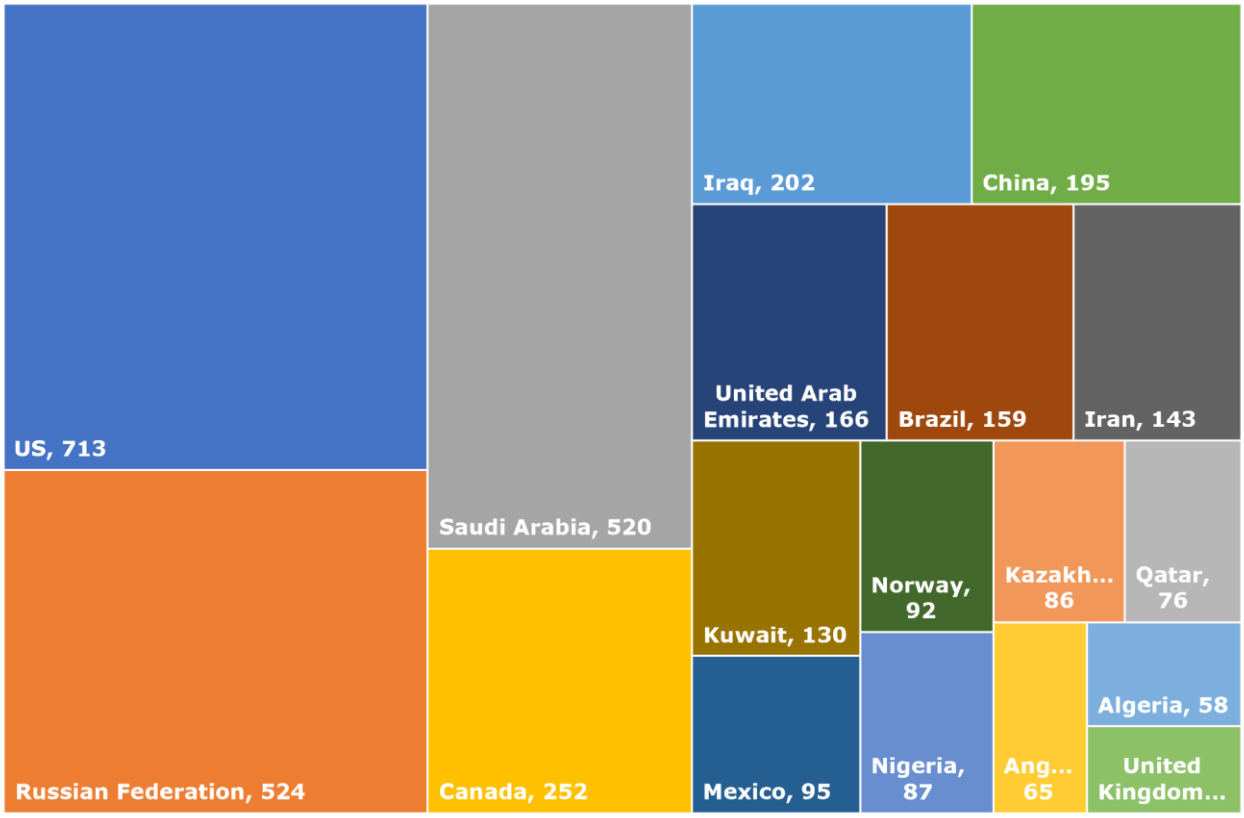
Source: Eurostat, IEA, HAEE's analysis

Highlights

- Oil production has been gradually decreasing in the EU, as a result of energy policies as well as depletion of oil reserves.
- EU's crude oil production in 2020 (18.7 mil tons) was just above Libya's (18.3 mil tons) and under Australia's (19.7 mil tons).
- Greece's crude oil production returned to 2015's levels in 2021 (50 thousand tons), having peaked at 200 thousand tons in 2018.
- To put things in perspective, Greece's total crude oil production in 2021 amounted to roughly filling one medium range tanker.
- The recent geopolitical developments (Russia-Ukraine) make predictions particularly hard – it may well be that EU/Greece decide to rump up indigenous production again.

Russia was the second largest oil producer in 2020, with USA having increased its leading margin, as compared to previous years

Top Oil-Producing Countries (mil. tons), [2020]



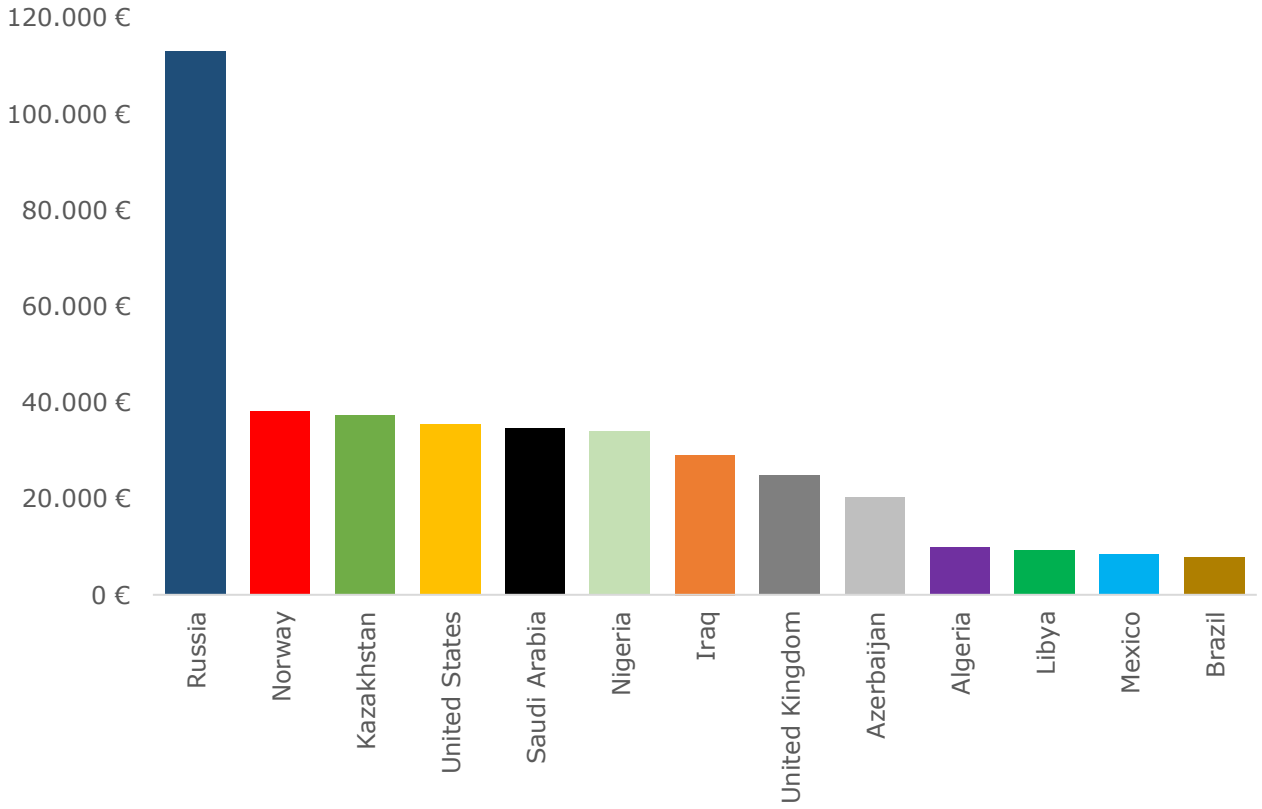
Source: BP, EIA, HAEE's analysis

Highlights

- The top 5 oil producing countries are USA, Russia, Saudi Arabia, Canada and Iraq, with China following closely in the sixth place.
- With Russia being the second largest oil producer, it is natural its involvement in geopolitical conflicts to cause significant turmoil in the markets (Oil or other).
- USA has more than doubled its oil output since 2008 (from 300 mil tons to 700 mil tons), becoming a net oil exporter in 2020 for the first time since at least 1949.
- Norway was one of the very few countries globally that increased its oil production in 2020 (by 17%).
- UK is the only other European country featuring in the top 20 of oil producing countries in 2020.

Russia was, by a very large margin, the EU's top source of crude oil in 2020, followed by Norway, Kazakhstan and the US

Crude Oil Imports in EU27 per Country (thousand ton), [2020]



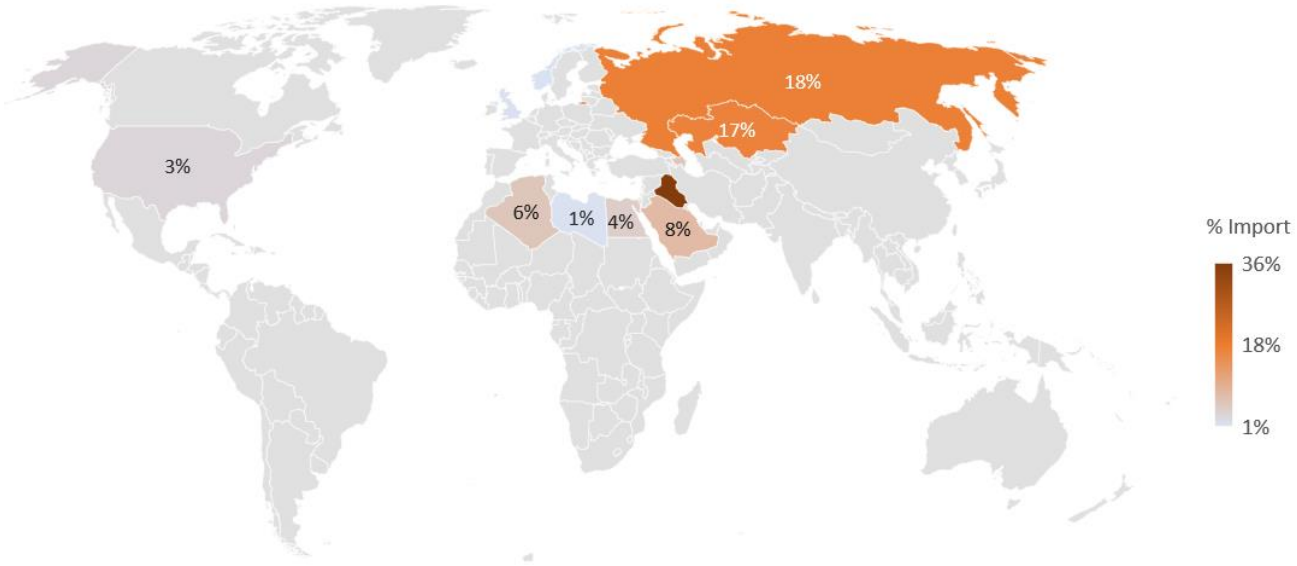
Source: Eurostat, HAEE's analysis

Highlights

- The EU's evident energy dependence on Russia (also regarding oil and not just gas imports) is seen in a new light given the recent geopolitical developments.
- Except for Russia, there is quite a wide spread of countries, mitigating dependence risks to some extend.
- Import sources include countries from America, Asia and Africa, as well as from Europe.
- It is worth noting the strategic importance of Norway's oil imports, because of its proximity to the EU, as well as reduced geopolitical risks.
- It would be interesting to see whether Brexit will have a significant effect on oil trade between the UK and the EU-27 moving forward.

Greece has developed trade relations with several countries to fulfil its crude Oil import needs – Iraq being traditionally its top source

Crude Oil Imports in Greece per Country (%), [2020]



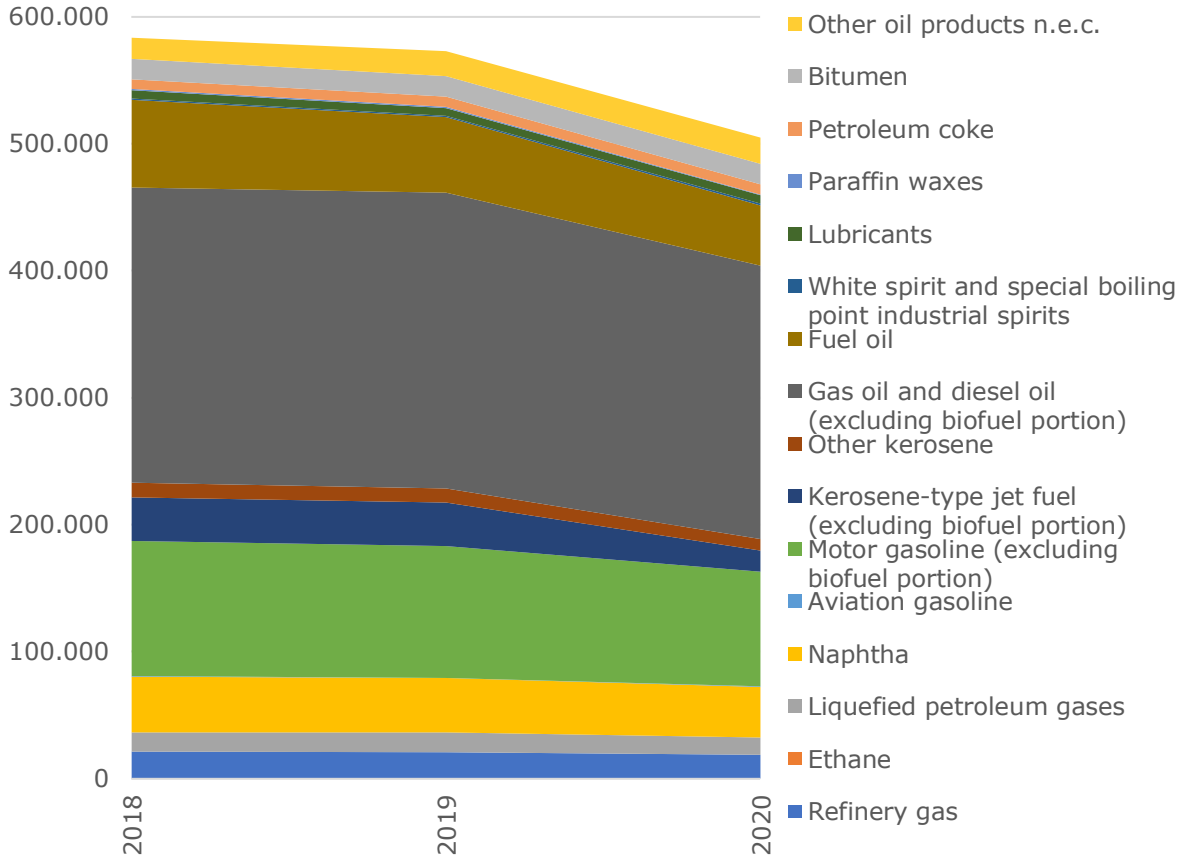
Source: Eurostat, HAEE's analysis

Highlights

- Greece imports Crude Oil from a number of countries across the world, since its indigenous production is low.
- Iraq continued to have the top place in crude oil import volumes, but its contribution to the mix has dropped from 50% in 2019, to 36% in 2020.
- It appears that this was counterbalanced by an increase in imports from Russia (totaling 18% in 2020 as compared to 10% in 2019).
- The recent geopolitical developments involving Russia, are expected to have significant repercussions on the EU's and Greece's oil import mix moving forward.
- The other countries Greece imported Crude Oil from in 2020, were Kazakhstan, Saudi Arabia, Algeria, Azerbaijan, Egypt, USA, UK, Libya, Albania, Tunisia and Turkmenistan.

The refinery output at European Union level exhibited a sharp decrease in 2020, continuing the declining trend

Oil Refining Products in EU 27 (thousand tons), [2018-2020]



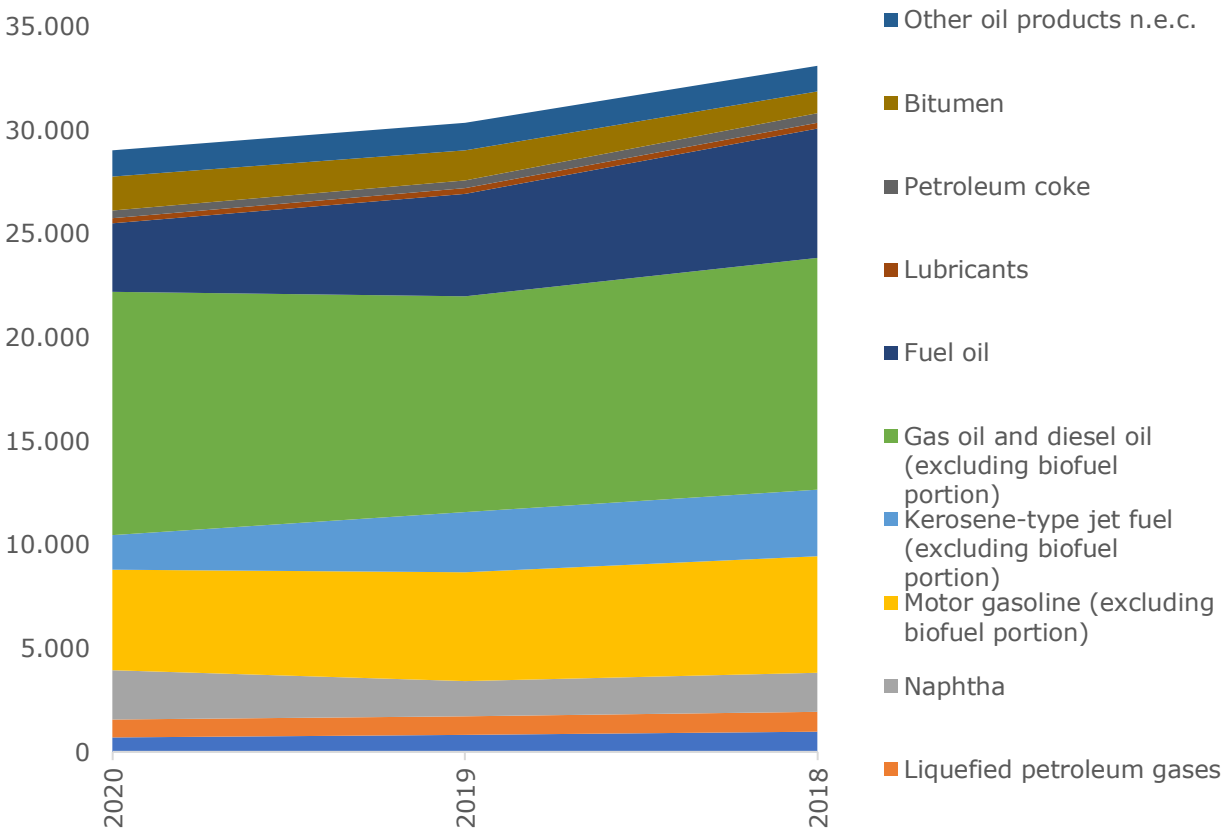
Source: Eurostat, HAEE's analysis

Highlights

- In line with the observed drop in oil production and consumption, EU refinery output decreased significantly in 2020 (by 12%).
- Gasoil and diesel consistently dominate the refinery mix (43%), followed by motor gasoline (18%) and fuel oil (9%).
- On the other hand, production of refinery gas, liquified petroleum gases and naphtha, appear to have been largely unaffected by the pandemic crisis.
- Europe has 93 refineries in 23 different countries of total capacity 667 mil tons pa. (EU-27 capacity is 505 mil tons pa.).
- Considering refining products, motor gasoline and fuel oil constitute net export products for the European Union-27.

Greece's refining output continued to drop in 2020, although at a lower rate than the previous year

Oil Refining Products in Greece (thousand tons), [2018-2020]



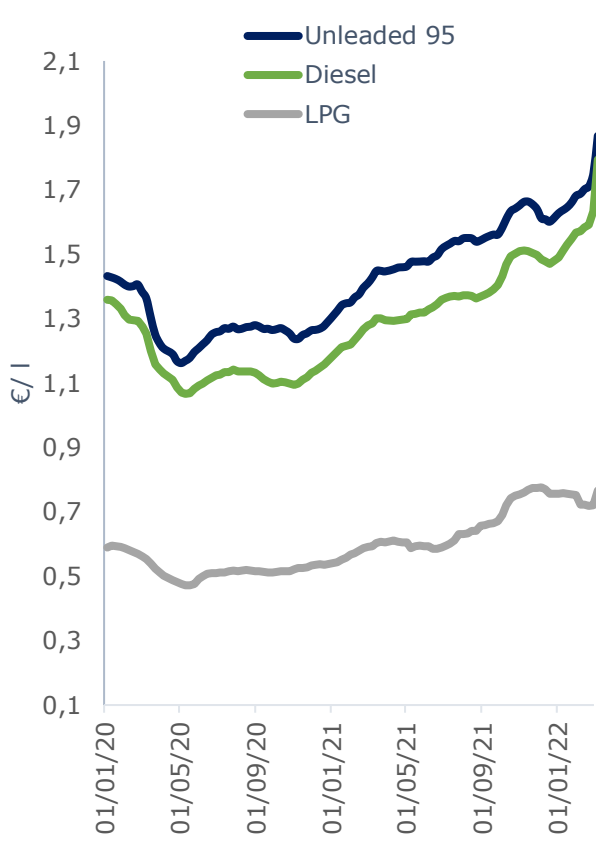
Source: Eurostat, HAEE's analysis

Highlights

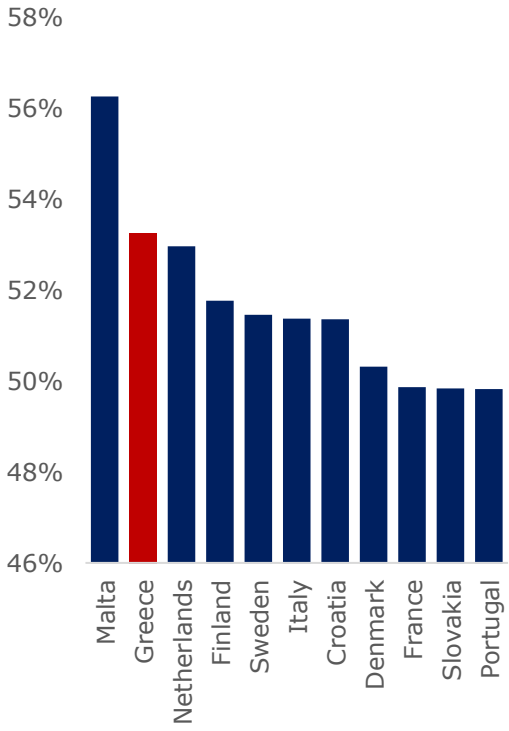
- Refinery output dropped in 2020, but at a much lower degree (4%) compared to the EU total.
- It was already in decline in 2019 before the pandemic outbreak, hence why its reduction was not very pronounced.
- There was, however, an increase in the output of Gas/Diesel oil, as well as that of Naphtha and Bitumen, in 2020 compared to 2019.
- Gas/Diesel oil and motor gasoline are Greece's major refinery products, while Greece does not exhibit any net exports in its refinery products.
- Road diesel production stood at 7 million tons approximately, accounting for the highest share, with 23% of the country's refining capacity.

Retail prices of motor fuel have been following an upward trend, after a short-lived dip at the beginning of the pandemic in 2020

Retail Prices of Motor Fuel Products, EU 27 Weighted Average (€/litre), [2020-2021]



EU 27 Countries with Highest % Taxes on Unleaded 95 price, [14/3/22 snapshot]



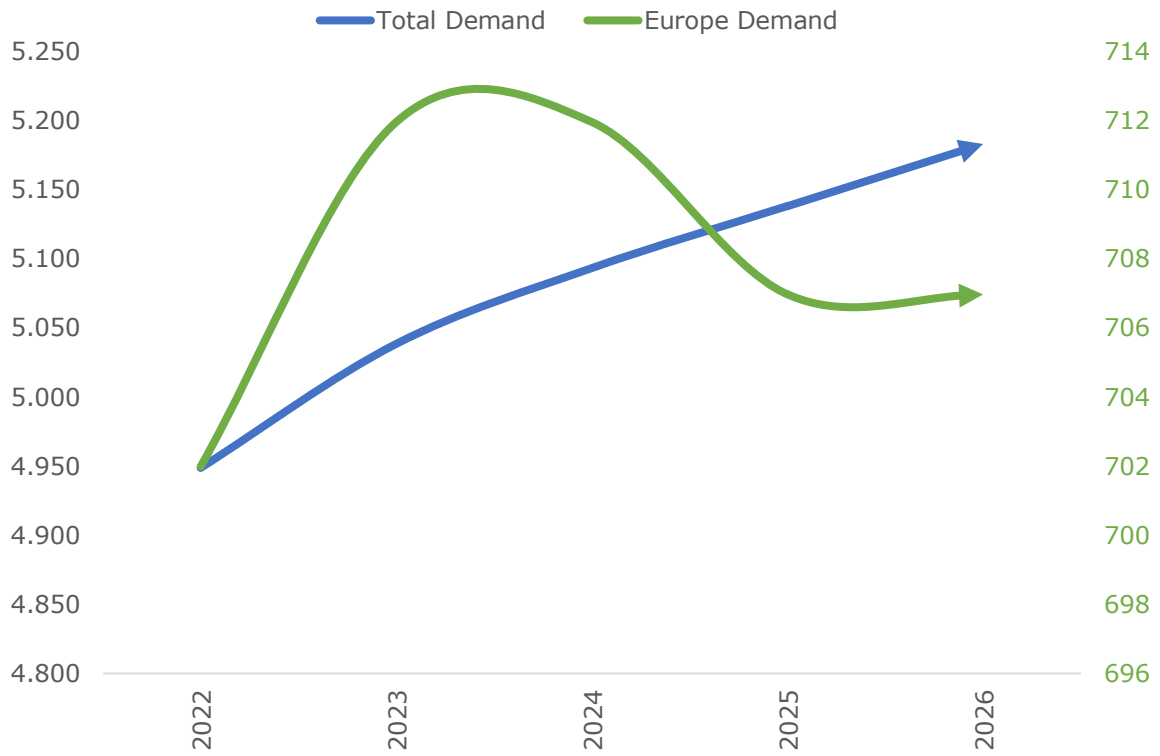
Source: European Commission, HAEE's analysis

Highlights

- Motor oil retail prices have been increasing steadily since the first wave of the pandemic.
- A dramatic upshoot is observed in early 2022, driven by the Russia-Ukraine conflict and respective geopolitical developments.
- Greece is in the top 5 European Union countries with the highest retail prices on motor fuels.
- This is mainly a consequence of its respective high taxation, 53% in Unleaded 95 which is the second highest in the EU.
- LPG follows a lower rate of increase, compared to the other fuels, and its generally much lower price is likely to influence consumer habits/choices in the short term.

Total World demand for oil is projected to increase in the next few years, whereas Europe's demand is largely expected to stabilize

Projected Oil Demand, World Total and Europe (mil tons), [2022-2026]



Source: IEA, HAEE's analysis

Highlights

- IEA's study forecasts a steady increase in oil demand in the medium term reflecting the world's heavy dependance on oil products.
- It is apparent that current policies and energy transition initiatives have only a marginal impact on oil demand up to 2026.
- The predicted oil demand trajectory is much higher than what is required for a net-zero emissions scenario for 2050.
- Strong policy initiatives and dramatic behavioral changes would need to be implemented soon for global oil demand to peak in 2026.
- Things look more optimistic in the case of Europe regarding oil demand, as it is expected to stabilize in the medium term.

8. Energy Efficiency

Highlights

Oil consumption in the **household** sector was increased by **12%** in 2020

Natural gas was significantly increased by **7%** in 2020 , reaching **20%** of the total final consumption in the **industry sector**

The total number of beneficiaries in the new energy efficiency program "**Exoikonomo "** is **50,000**, **38%** higher than the previous program

The total **cost of interventions** in new "Exoikonomo" is estimated at around **630** million Euros

Final **energy consumption** decreased by **12%** during 2011-2015 and by **15**% during 2016-2020 in Greece

Electricity is responsible for almost **40%** of the final consumption in the **industry sector** in 2020

Renewables in the industry sector are in the range of **6%** of the total final consumption in 2020, which remained **almost steady** since 2013

17.1% of the Greek population in 2020, was **unable to keep their home adequately warm**, double than the EU average (8,2%)

New "Exoikonomo" will save energy of around **2 TWh**

Overview

The pandemic crisis caused a large drop in the final energy consumption in the EU-27 and Greece, just within a year, contrary to the slight increase during the previous years. Compared to the EU, final energy consumption in Greece has been decreasing at a higher rate, mainly due to the economic recession and the longer lock-downs.

Due to the economic growth, final energy consumption is expected to be increased in EU and Greece, despite the implementation of energy efficiency measures. Final energy consumption per sector in Greece in 2020, dropped at the lowest level since 2011, apart from households. Compared to 2019, in 2020, final consumption in the household sector increased due to the lock-downs, teleworking, and longer stays at home.

The Industry sector's final consumption significantly decreased in 2020 since 2011, reaching the all-time low level of 2,500 ktoe. The industry sector in Greece is dominated by the use of electricity and natural gas, constantly replacing oil consumption.

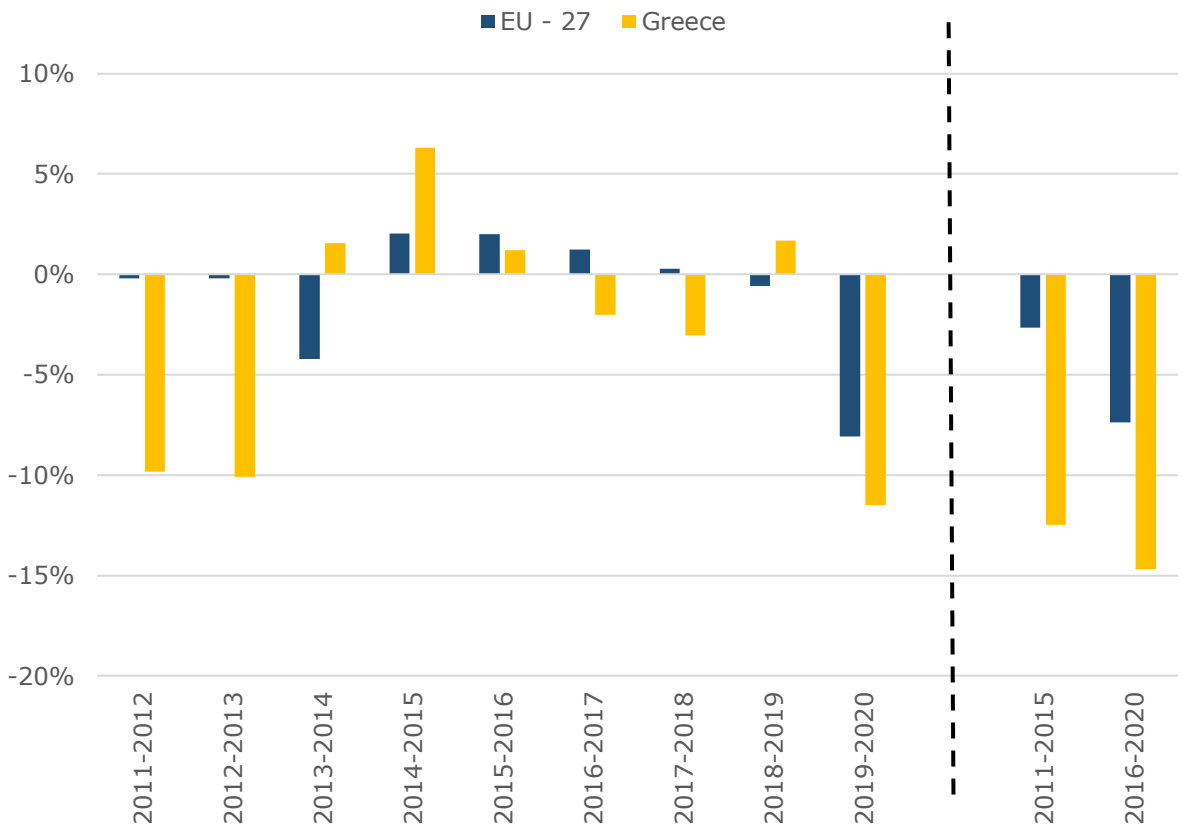
Energy poverty, is a rising problem among the EU and thus Greece, affected by increasing energy prices, recession impacts and energy inefficient housing. In 2020, 17,1% of the Greek population, was unable to keep their home adequately warm, double than the EU average (8,2%). Energy poverty in Greece became worse during the years following the economic recession but after 2014 it started to improve reaching almost pre-recession levels. Due to the recent rising energy prices, the recessionary impact on economies and poor energy efficient homes, energy poverty is an increasingly recognized problem across the EU members.

Most buildings in Greece were constructed between 1961-2000. The potential in energy saving is high. The majority of buildings, which have an energy performance certificate, are in the Category H, which is the least energy-efficient category. The energy performance of an existing building that undergoes major renovation can become of an energy class B or better.

Energy saving is an important pillar for Greece's energy transition, since it contributes to the reduction of final consumption, energy demand and use of conventional power. The implementation of new economic measures and actions, such as the new "Exoikonomo ", could tackle energy poverty. The total number of beneficiaries in the latter efficiency program are 50,000, 38% higher than the previous program. The total cost of its interventions is estimated at around 630 million Euros and the relevant energy savings at around 2 TWh.

The pandemic crisis caused a large drop in final energy consumption in the European Union-27 and Greece

Final Energy Consumption Compared to Previous year (y-on-y) (%) [2011-2020]



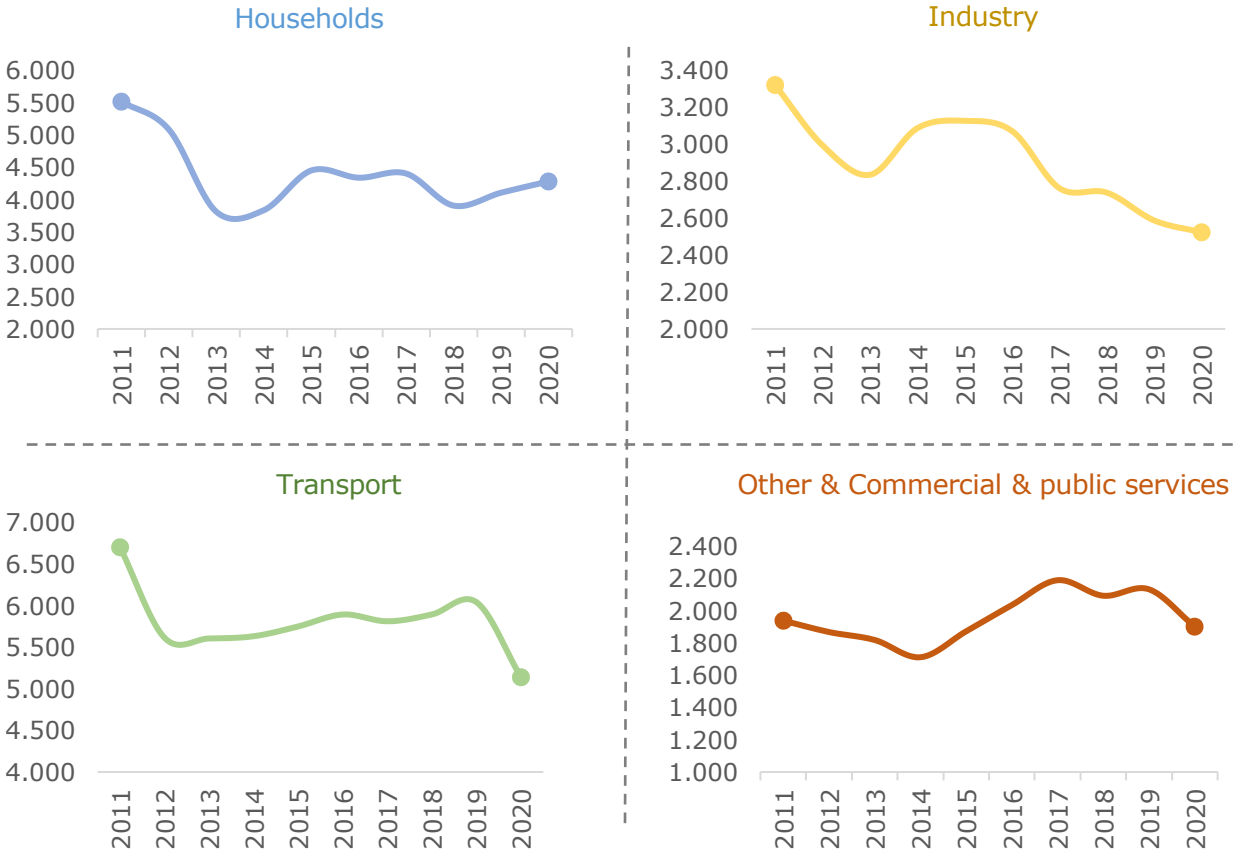
Source: Eurostat, HAEE's analysis

Highlights

- Final energy consumption decreased by 3% during 2011-2015 and 7% during 2016-2020 in the EU, and 12% and 15% in Greece respectively.
- The pandemic crisis caused a large drop in final energy consumption within one year, contrary to the slight increase during the previous years in both the EU and Greece.
- The measures taken to improve energy efficiency and combined with the economic recession, led to a reduction of final energy consumption in Greece (2011-2013).
- Compared to the EU, final energy consumption has been decreasing at a higher rate than EU, mainly due to the economic recession and the longer lock-downs in Greece.
- Due to the economic growth, final energy consumption in the EU and Greece is expected to increase, despite the implementation of energy efficiency measures.

Final energy consumption per sector in Greece in 2020, dropped at the lowest level since 2011, apart from households

Final Energy Consumption per Sector (ktoe), [2011-2020]



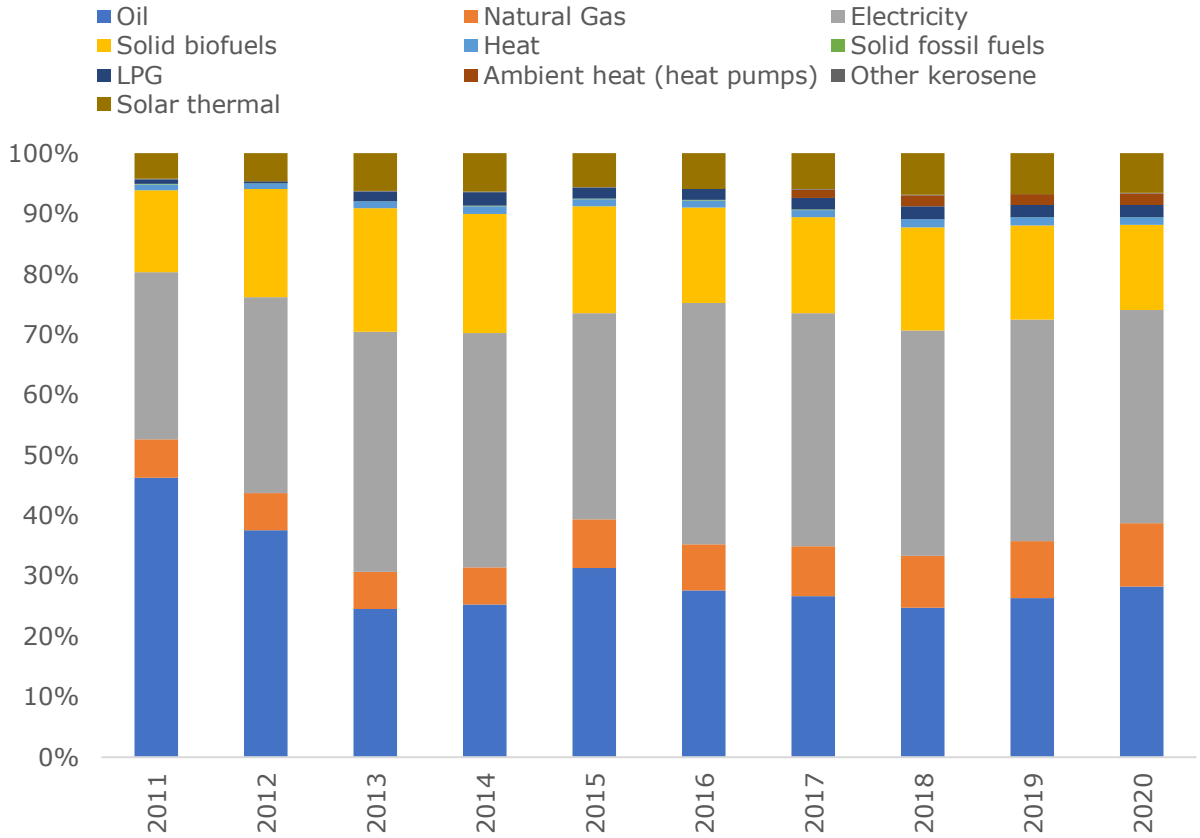
Source: Eurostat, HAEE's analysis

Highlights

- The pandemic crisis had a great impact across all end-use sectors in Greece at different levels and rates.
- Compared to 2019, in 2020 final consumption in the household sector increased due to the lock-downs, teleworking, and longer stays at home.
- In 2020, the Transport sector had the greatest impact on the final energy consumption, which decreased by 15% compared to 2019.
- The Industry sector's final consumption, decreased significantly in 2020 compared to 2011, reaching an all-time low level of 2,500 ktoe.
- In 2020, other services' final consumption, which increased since 2014, returned to 2011 levels (1900 ktoe).

Final energy consumption in the household sector in Greece, is based mainly on electricity and an increased share of fossil fuels

Final Energy Consumption for Households by Fuel (ktoe), [2011-2020]



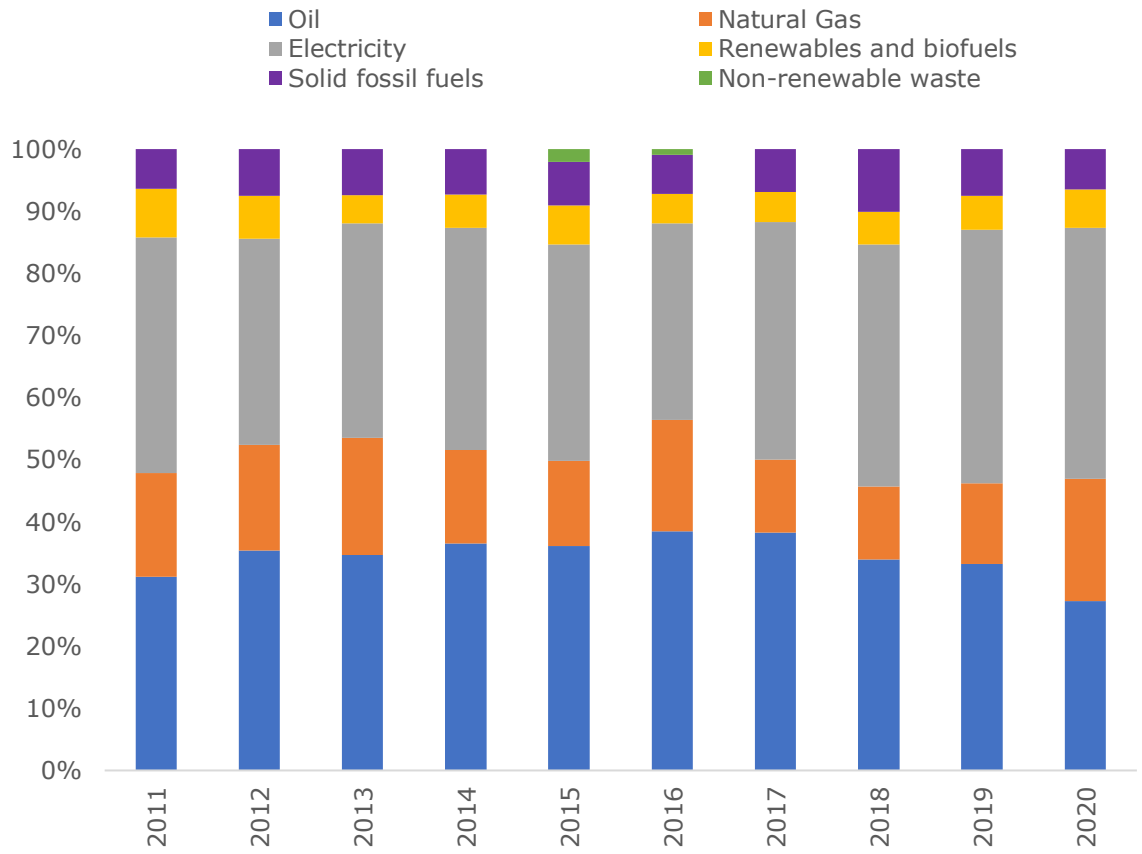
Source: Eurostat, HAEE's analysis

Highlights

- Oil consumption in the household sector increased by 12% in 2020, the year of the pandemic crisis.
- Natural gas has been constantly increasing during the past years, driven by the development of new natural gas distribution networks and competitive prices.
- In 2020, heat pumps gained a small, but significant share of the total final energy consumption since 2017.
- The share of electricity in the final consumption in the household sector was at 38% in 2020, which was mainly due to the extended use of air-conditioning.
- Fossil fuel and especially natural gas consumption is believed to have decreased in 2021 and 2022, due to high prices.

The industry sector in Greece is dominated by the use of electricity and natural gas and is constantly replacing oil consumption

Final Energy Consumption for Industry by Fuel (ktoe), [2011-2020]



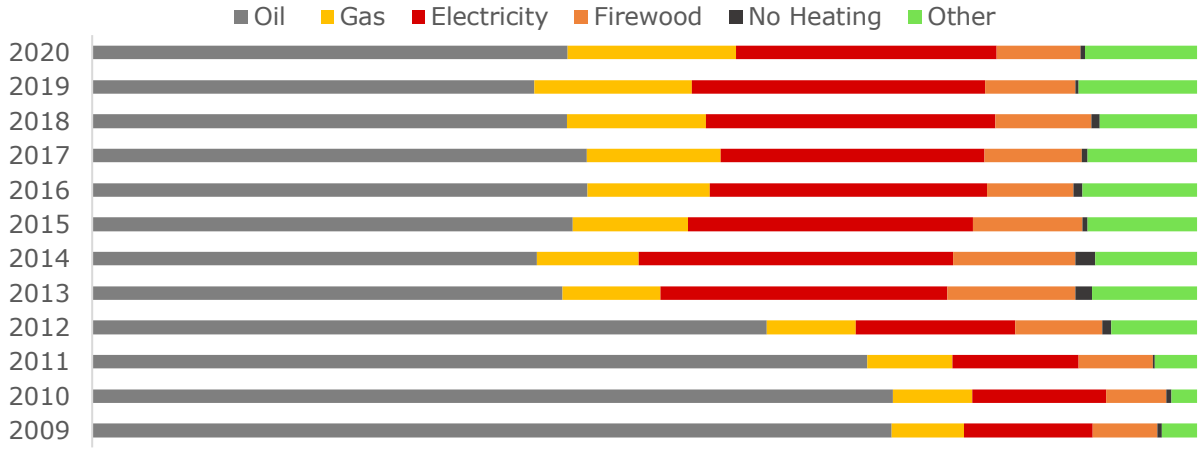
Source: Eurostat, HAEE's analysis

Highlights

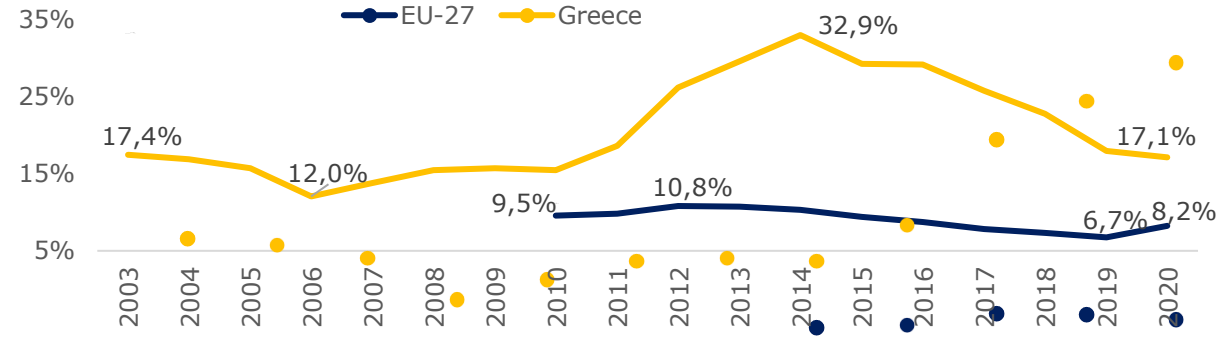
- In 2020, electricity was responsible for almost 40% of the final consumption in the industry sector.
- Natural gas significantly increased by 7% in 2020, reaching 20% of the total final consumption.
- In 2020, Renewables' share was in the range of 6% of the total final consumption, an almost steady percentage since 2013.
- Oil's consumption share, which has been decreasing since 2017, was around 27% in 2020, the lowest percentage during the past ten years.
- Industry is an energy intensive sector, which must have been significantly affected by the high energy prices in 2021 and 2022.

Energy poverty, is a rising problem among the EU due to increasing energy prices, recession impacts and energy inefficient homes

Percentage Distribution of Households by Type of Fuel Used for Heating in Greece [2009 - 2020]



Population (%) Unable to Keep Home Adequately Warm in Greece and EU-28 [2003 – 2020]



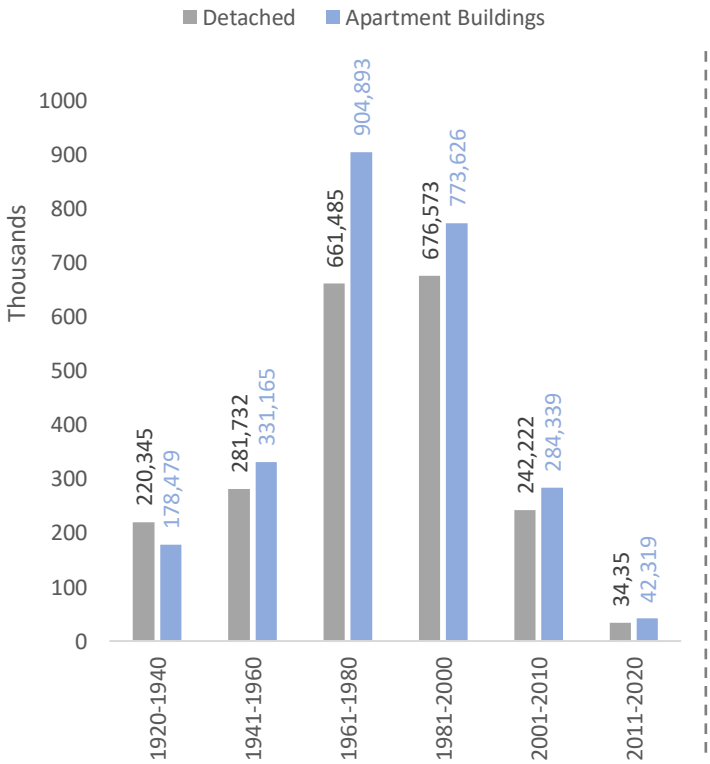
Source: ELSTAT, EUROSTAT, HAEE's analysis

Highlights

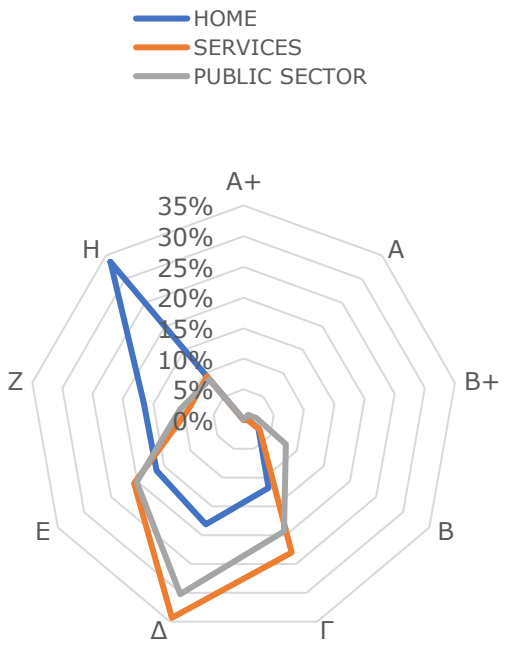
- Between 2009-2020, households using oil decreased by 40% while those using electricity and gas increased by 100% and 130% respectively.
- In 2020, 17,1% of the Greek population, was unable to keep their home adequately warm, double than the EU average (8.2%).
- Bulgaria, Greece, Cyprus, Lithuania and Portugal have the highest rates of energy poverty among the rest of the EU members (above 15% in 2020).
- Energy poverty in Greece became worse during the years following the economic recession but after 2014 it started to improve reaching almost pre-recession levels.
- Due to rising energy prices, recessionary impacts on economies and energy inefficient homes, energy poverty has become an increasing problem across the EU.

Low Energy efficiency ratings in the Energy Efficiency certificates dominate the residential sector

Construction Period of Residential Buildings in Greece



Buildings Efficiency with Efficiency Certificate[2011-2019]



Source: Ministry of Energy, HAEE's analysis

Highlights

- Most buildings in Greece were constructed between 1961-2000. The potential for energy savings is high.
- The majority of buildings, which have an energy performance certificate, are in the Category H, which is the least energy-efficient category.
- Energy saving is an important pillar for the Greek energy transition, as it can contribute to the reduction of final consumption and energy demand.
- The implementation of new economic measures and actions, such as the new 'Exoikonomo', could mitigate energy poverty.
- The energy performance of an existing building that undergoes major renovation should become an energy class B or better.

The implementation of the latest Regulation on the Energy Performance in Buildings could save significant amounts of energy per type of use

Percentage of Energy savings (%) per Building Type If KENAK is being applied

Building Types	Climatic zones in Greece			
#	A	B	C	D
Commercial	47.90	47.59	51.18	54.95
Health	36.80	38.59	39.47	39.38
Education	40.95	40.29	48.85	53.92
Public	41.02	40.82	44.20	45.87
Prisons	42.74	38.69	25.81	58.58
Offices	45.40	43.19	45.24	48.15
Temporary residences	45.14	46.69	44.61	53.76
Residencial buildings	62.25	61.42	60.75	63.55
Apartments	58.17	59.37	57.32	59.34
Detached houses	68.45	69.83	70.95	71.26
Apartment building	61.50	64.36	64.38	64.60

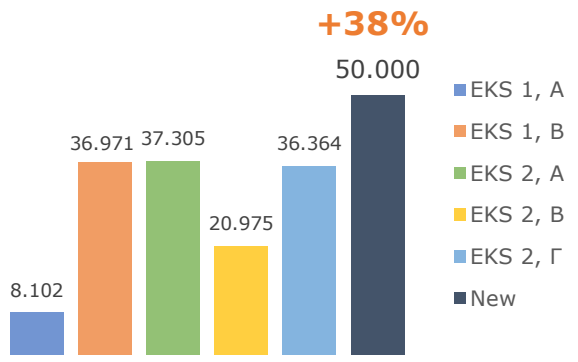
Source: Ministry of Energy, HAEE's analysis

Highlights

- Each building type in Greece could reach a different amount of energy savings depending on their location and the relevant climatic zone.
- The largest energy savings potential is observed in detached houses in the climate zone D, mainly in Northern Greece, reaching 71%.
- In the climatic zone A (southern Greece and islands) the energy savings could reach 37-69% depending on the building type.
- Residential buildings and Offices have a higher energy savings potential in Central Greece than in Northern Greece.
- Residence buildings, Apartments, Detached houses and Apartment buildings are the most promising building types in terms of energy savings potential.

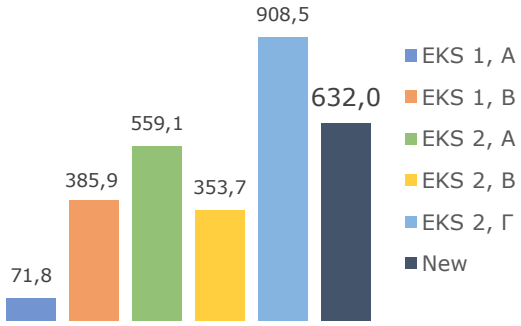
The "Exoikonomo – Aftonomo" was the most ambitious energy efficiency program during the last decade

Total Number of Beneficiaries



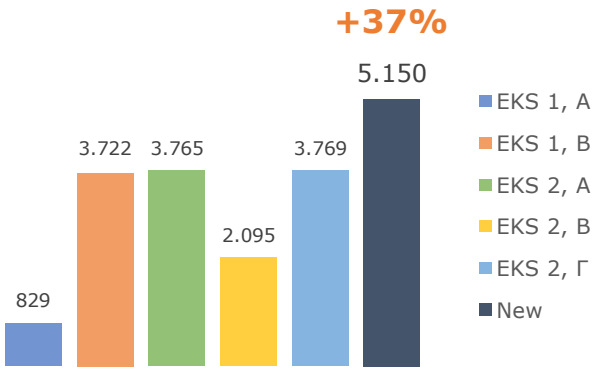
Total Cost of Interventions

in mil. €.



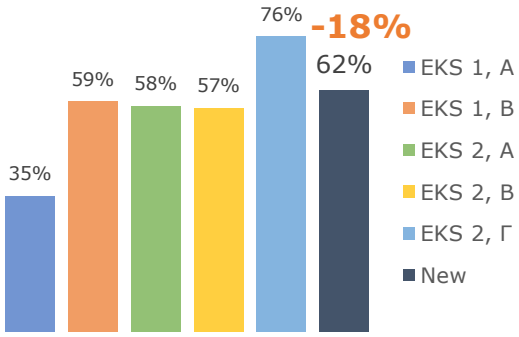
Total Number of Usable Areas

in 000 m²



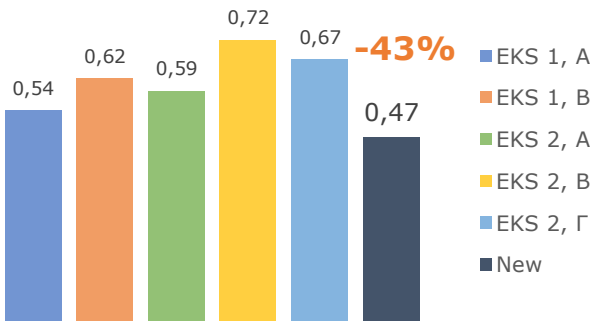
Average Subsidy

in% of total measures



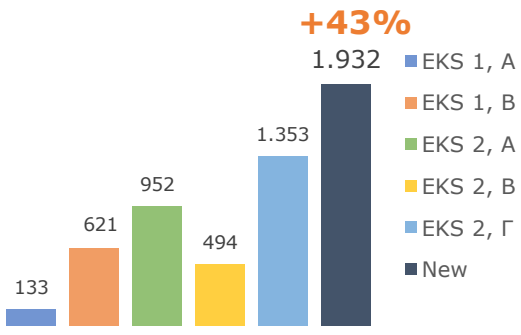
Total Cost

in € per Kwh Savings



Total Energy Savings

in mil. Kwh

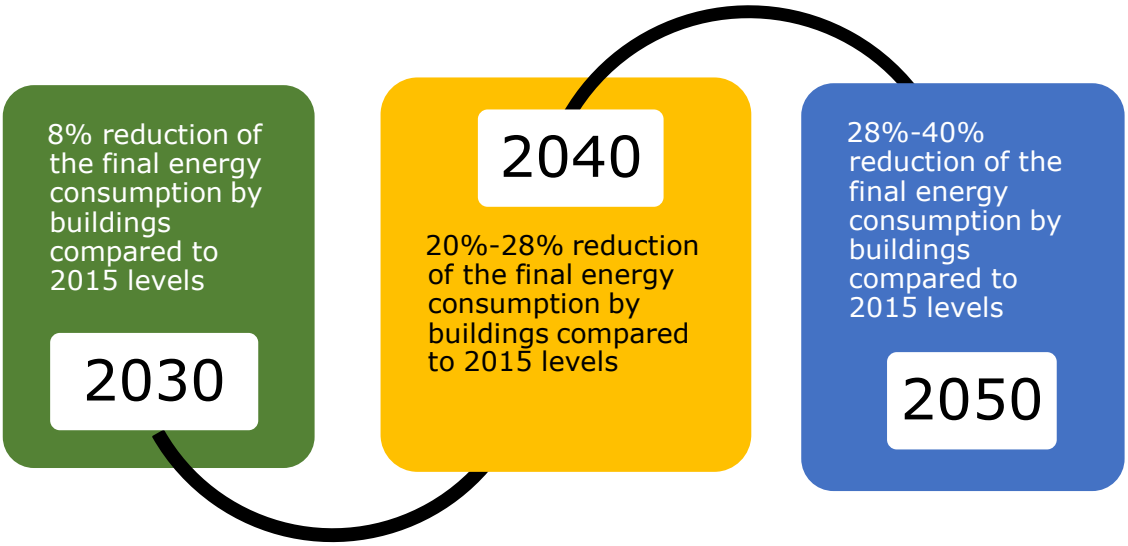


Eks 1 A: 2011 - B: 2012
Eks 2 A: 2018 - B: 2019 – Γ: 2020
New Exoikonomo: 2021

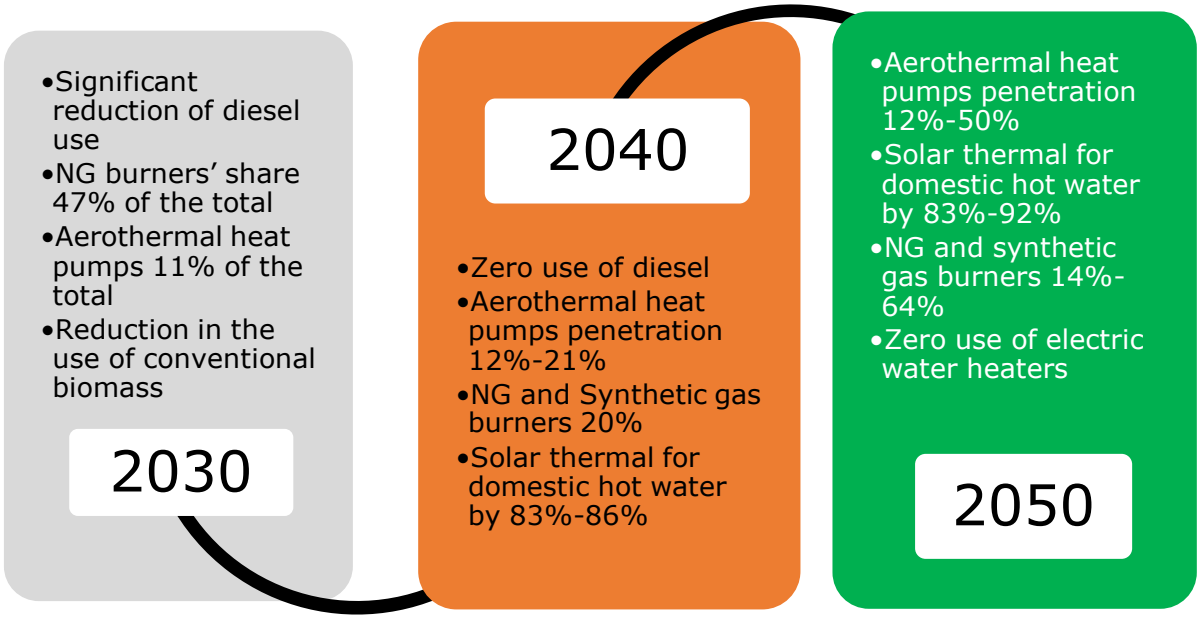
Source: Ministry of Energy, HAEE's analysis

Energy Savings Long-term Roadmap

Targets for the Reduction of Final Energy Consumption in the Residential sector, [2030-2050]



Targets for Energy Systems Transformation in the Residential Sector, [2030-2050]



Source: PRIMES, HAEE's analysis

9. Investments

Highlights

In **2021,** investment decisions in electricity reached **$823 billion**

In **2021**, Bloomberg Goldman Sachs Clean Energy Index, achieved a significant **increase of 13%**

Major **energy investments** of **€1,5bn** have already been announced and planned for starting their operations until the end of the current decade

According to 'Greece 2.0', **6.1 billion euros** of the available funding will be used for **green transition investments**

In **2021, energy investments** increased to **$1.85 trillion** compared to 2020, an **increase of 9.5%**, reflecting a gradual return to the pre-Covid period

In 2020, Europe spent **$8,5 billion** in **energy R&D**

In **H1 2021,** the **non-performing exposure of the energy sector**, was reduced by **1,7%**, continuing its declining path

New **RES projects** of approx. **12 GW** will be shortly connected with the target of CO_2 emissions' decrease **by 55% by 2030**

Over the five-year period, the average **ESG score of the Greek companies** has increased by about 9 points, **from 42.09 to 51.93**

Overview

In 2021, global investment decisions in electricity reached $823 billion and investing initiatives in the fuel supply sector have started bouncing back at 2019 levels. The biggest share corresponds to renewable energy-related projects. It is a fact that bolder decisions and stronger initiatives have already gained ground, to make the energy system more sustainable. Energy transition, which is estimated to be fully achieved by 2050, will be mainly driven by low-cost energy sources such as wind and solar. The latter are anticipated to represent almost 56% of the world's electricity in 2050.

Additionally, in 2021, clean energy technologies worldwide, including CCUS, low-carbon fuels, electrified transport, electrified heat and renewable energy and battery storage attracted approximately 750 billion dollars. Research and Development is important to drive down the technological costs and step up the pace for the availability of new energy technologies, accelerating the energy transition and the economies' decarbonization.

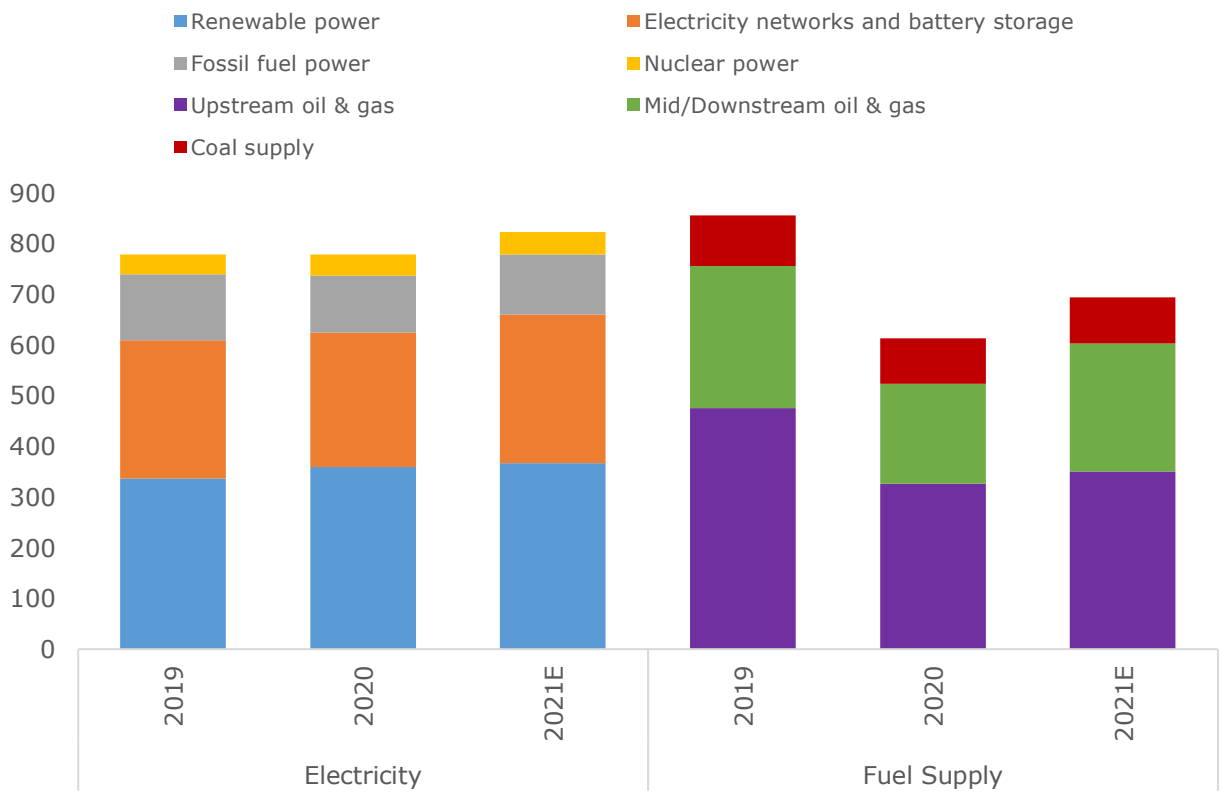
Considering the case of Greece, major energy investments of €17.5bn have already been announced and planned for being in operation till the end of the current decade, including, but not limited to Gas Distribution Networks, Islands Interconnections, RES Development and New Power Plants. According to 'Greece 2.0', 6.194 billion euros of the available funding will be used for green transition investments. The Plan includes 48 Projects, including investments in green technologies, biodiversity, energy efficiency, building renovation, preservation of energy security, circular economy and sustainable development.

The country's banking sector has started a return to pre-pandemic levels and to be able to provide fresh credit and support for the development of the economy. The Greek banking system provides even more loans to the growing Greek Energy sector, reaching 5.939 in 2021. With 1.7% performance, the energy sector is at the bottom of the list of non-performing exposures of the different sectors in the Greek banking system and continues outperforming in terms of both reliability and credibility. Moreover, since 2017, the non-performing exposure of the energy sector, has steadily been dropping by approximately 0.6% annually.

The Russia – Ukraine conflict has resulted in a fundamental change in the geopolitical balance of power and in the European energy policy. Within the next few months, the map of Europe may be re-defined, while European end-users are already being called upon to change the way they source and consume their energy. Thus, Greece is being quickly transformed into an energy hub of the region, but at the same time, a strategic gateway for the entry of energy resources to Southeastern Europe. In the past few months, various energy-related projects have been announced in Greece, while also a program to step up oil and gas exploration was revealed by the Greek authorities in April.

In 2021, investment decisions in electricity reached $823 billion, while investment in the fuel supply sector reached almost 2019 levels

Global Energy Investment in Electricity and Fuel Supply (billion $), [2019 - 2021]



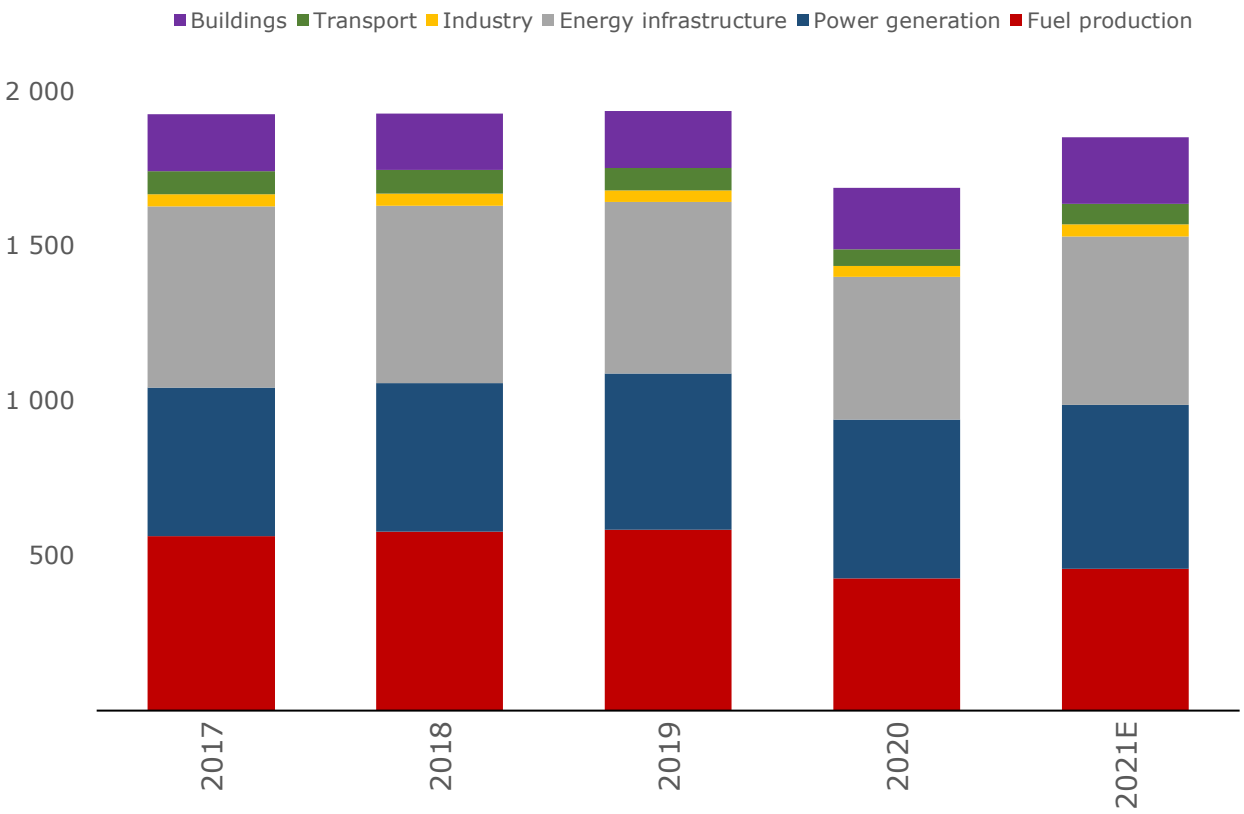
Source: IEA, HAEE analysis

Highlights

- In 2021, energy investments in the electricity sector increased to $1.51 trillion, and by 8.5% compared to 2019, reflecting a possible return to the pre-Covid period.
- The share of investments in RES that were directed to the electricity system increased by 2.2% in 2021, compared to 2020.
- Investments in the fuel supply sector increased from $613 billion in 2020 to $694 billion in 2021, while power sector investments also increased by 5.6%.
- Investment decisions for coal power were down by 80% in the last decade, but the number continued to grow in developing countries.
- Despite the pandemic, spending in R&D moderately rose in 2020, since most the countries are not spending their economic output on improving energy efficiency.

In 2021, most investment decisions concerned mainly energy infrastructure and power generation

Global Energy Investment by Sector (billion $), [2017 - 2021]



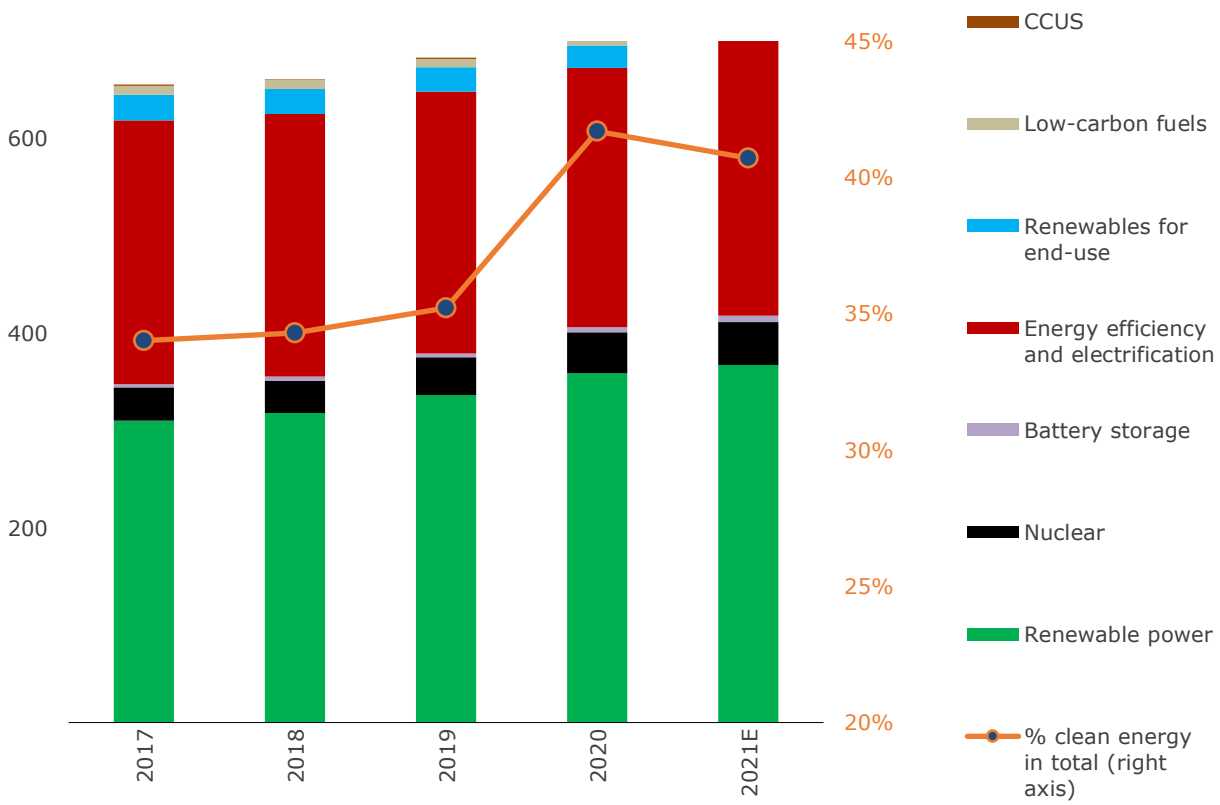
Source: IEA, HAEE analysis

Highlights

- In 2021, energy investments increased to $1.85 trillion, and by 9.5% compared to 2020, and started bouncing back to pre-pandemic levels.
- Approximately 60% of energy investments were directed to energy infrastructure and power generation for 2021.
- Investments in projects on fuel production increased by 7.5% between 2020 and 2021.
- Global energy investments in 2021 slightly dropped compared to previous years, mainly as an aftermath of the global pandemic.
- A notable decrease of investments directed to fuel production, by 27% and 22%, was observed in 2020 and 2021 respectively, compared to 2019 levels.

In 2021, clean energy technologies and energy efficiency attracted approximately 750 billion dollars worldwide

Investment in Clean Energy and Energy Efficiency Worldwide (billion $), [2017-2021]



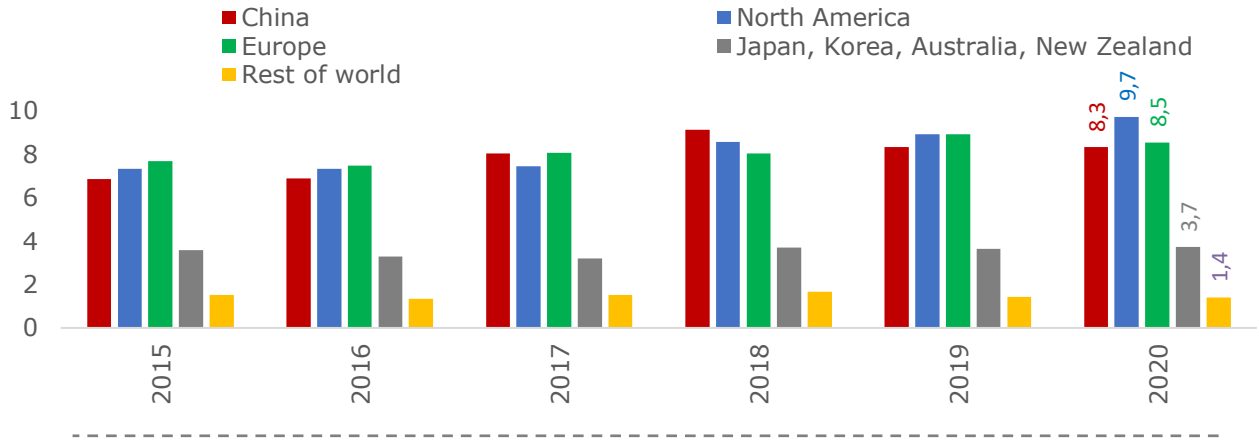
Source: Bloomberg NEF, IEA, HAEE analysis

Highlights

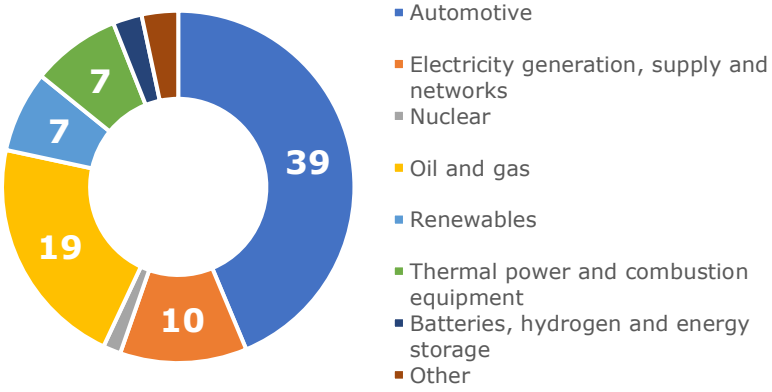
- Energy transition spending includes investments in hydrogen technologies, CCS, energy storage, electrified transport, electrified heat and renewable energy.
- The total number of investments slightly increased in 2021, compared to 2020. From these investments, $367 billion corresponded to RES capacity.
- Between 2017 and 2021, energy transition investments have shifted upwards by approximately 9%.
- The increase in annual investments in RES and innovative sectors can be attributed to the national net –zero policies' targets and the Covid recovery programs.
- Battery and Storage received investments of $7.1 billion and $5.5 billion, in 2021 and 2020 respectively, indicating the need for flexibility of the energy system.

North America and Europe lead investments in energy R&D. Renewables cover 7% of energy R&D spending by globally listed companies

Investments in Energy R&D by National Governments by Region (billion $), [2015-2020]



Investments on Energy R&D by Listed Companies, by Sector of Activity (billion $), [2020]



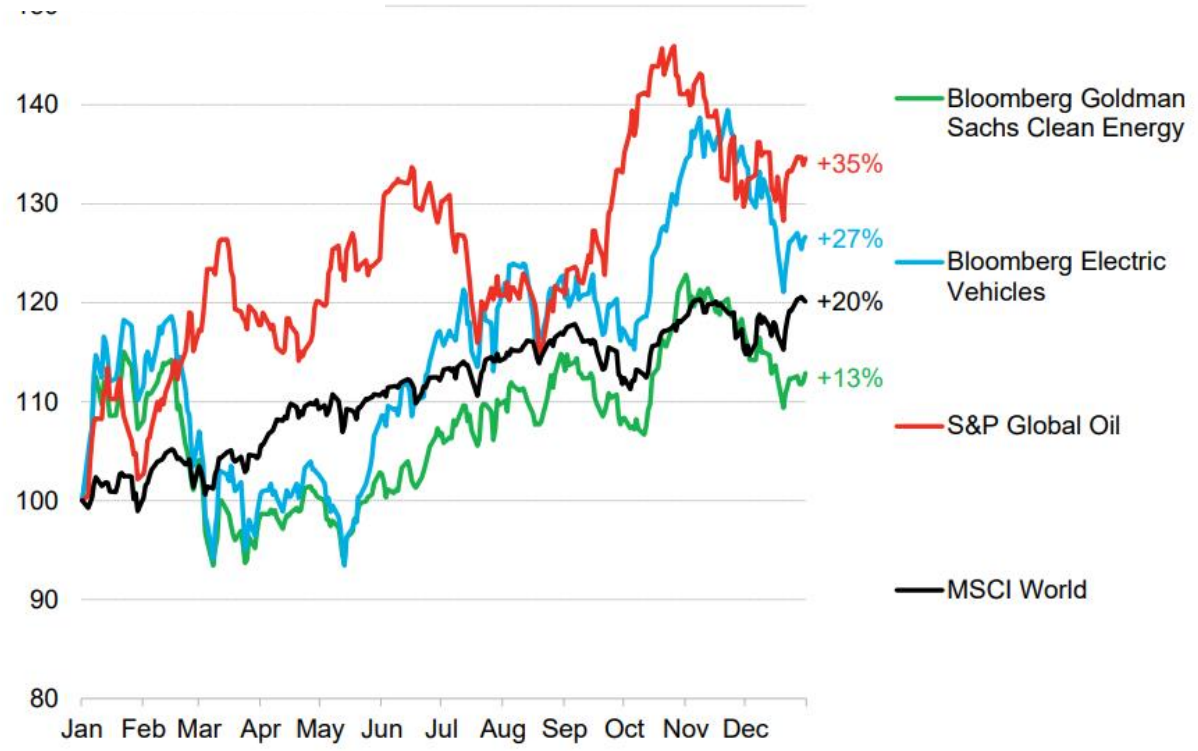
Source: IEA, HAEE analysis

Highlights

- Between 2015 and 2020, China built up its R&D programs and increased investments on clean energy innovation. China's investments in R&D peaked in 2018.
- In 2020, North America spent $9,7 billion on energy R&D, Europe $8,5 billion, China $8,3 billion, while Japan, Korea, Australia and New Zealand $3,7 billion in total.
- European research initiatives such as the Horizon Europe, LIFE, Interreg, and the European Battery Alliance, aim to create new value chains of energy investments.
- Research & Development is important for reducing technological costs and for accelerating the development of new energy technologies.
- Thirty-nine percent of firms' spending on R&D, concern investments in Renewables, 19% in Oil and Gas, and 10% in electricity generation, supply and networks.

Bloomberg Clean Energy Index represented a 13% gain in 2021, while S&P Global Oil Index outperformed due to surge of oil and gas prices

Performance of Energy and Equity Indexes, [2021]



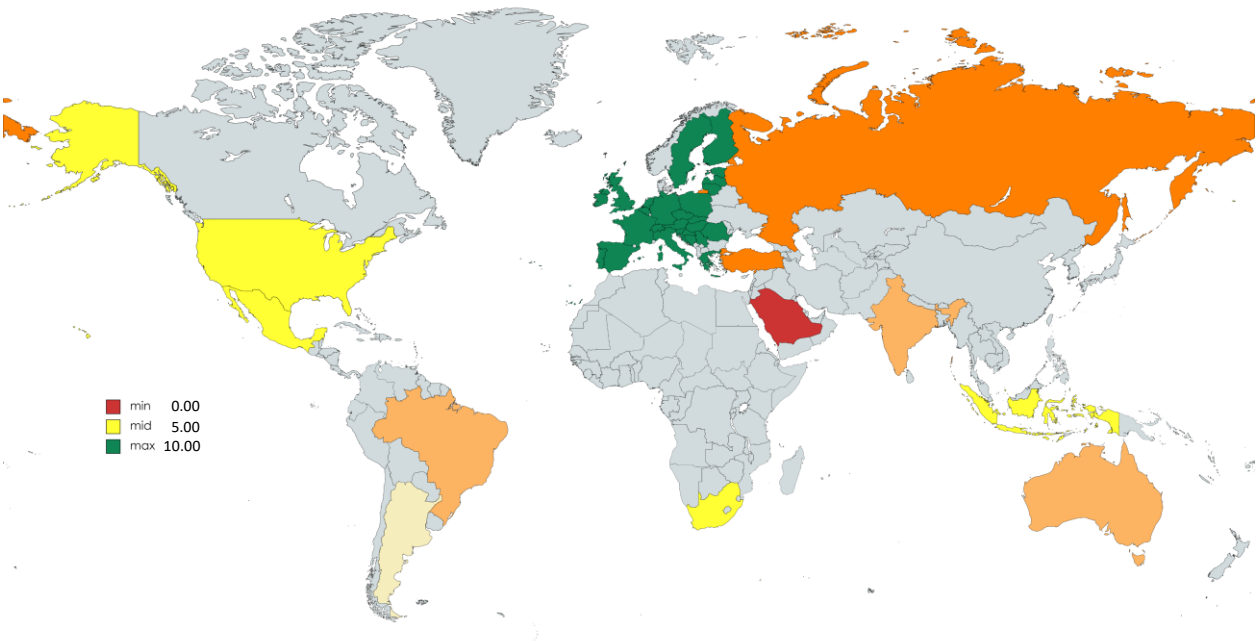
Source: Bloomberg NEF, HAEE's analysis

Highlights

- In 2021, Bloomberg Clean Energy Index, increased its performance by 13%. It peaked in October and recovered the most of its pandemic-era losses.
- In 2021, the MSCI World Index had a 20% gain compared to 2020, continuing its steady upward path which started in January.
- The S&P Global Oil Index, which monitors the largest upstream oil & gas companies, outperformed both the Clean Energy and Electric Vehicles stock.
- Because of the vast increase in oil and gas prices, the S&P Global Oil performed better by 35% in 2021.
- Global Clean Energy and Low-Carbon Investment hit $755 billion in 2021, recording an increase of 27% compared to 2020.

The average score of sustainable finance and ESG implementation policies worldwide was 6.57 during 2021

Countries Score for Sustainable Finance and ESG disclosure [2021]



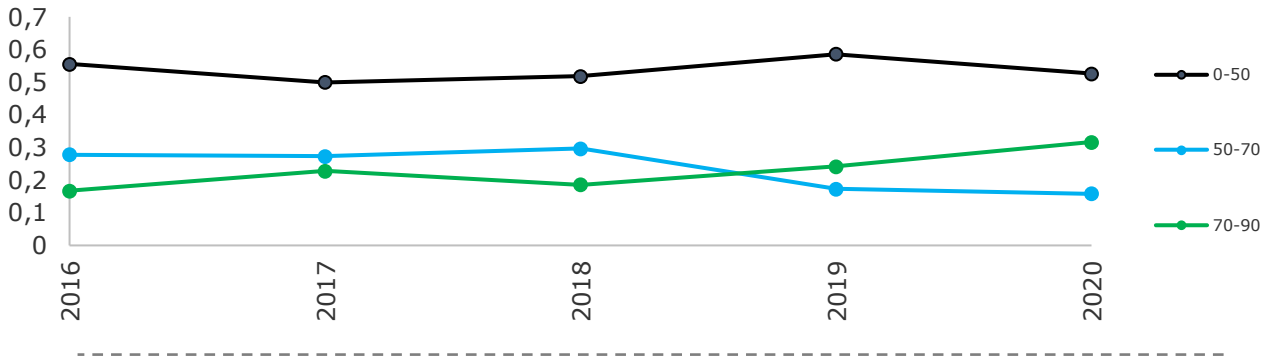
Source: Bloomberg NEF, HAEE analysis

Highlights

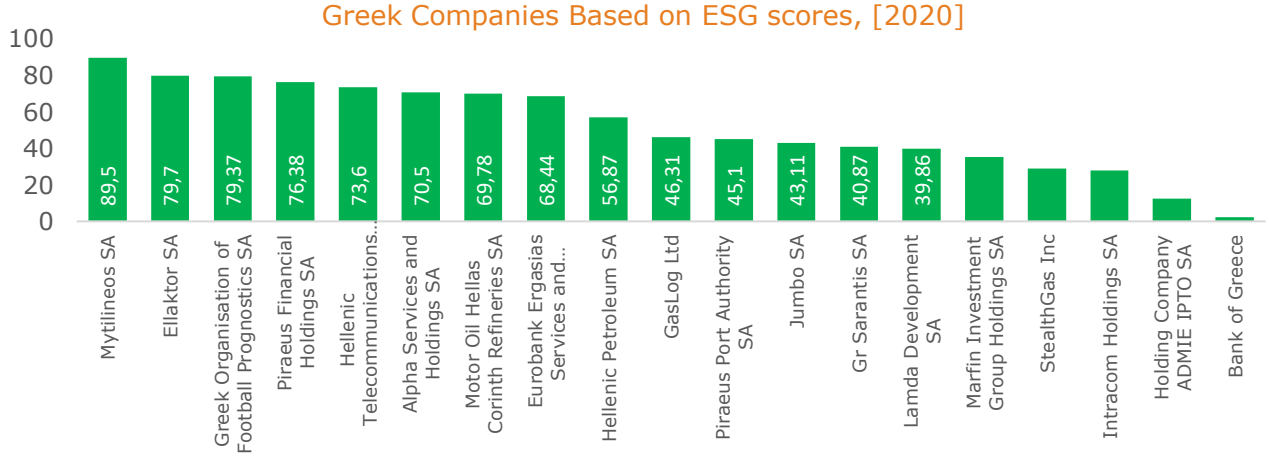
- European countries pave the way for sustainable finance and ESG disclosure, given the strict national climate policies and the EU Directives.
- The average score of ESG disclosure and sustainability policies of all countries across the globe is at 6.57/10.
- The economic superpowers, U.S., China and Russia are rated with 4.85/10, 5.71/10, and 2.6/10 respectively.
- Saudi Arabia, Russia, and Turkey are among the lagging markets and their policies need to be updated to incorporate ESG criteria.
- In 2021 flows of investments in ESG exchange-traded funds accounted for $96 billion, an increase of 25% from 2020.

Regarding ESG, Greece ranks low in environmental indicators, satisfactorily in social indicators, while there are significant shortcomings in governance

Score Distribution of Greek Companies Based on their ESG Performance (%) [2016 - 2020]



Greek Companies Based on ESG scores, [2020]



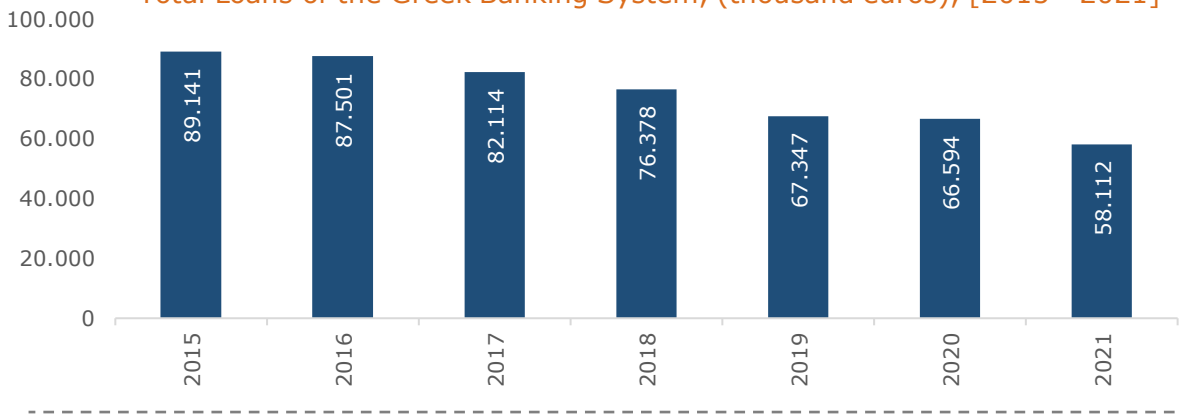
Highlights

Source: Refinitiv, HAEE analysis

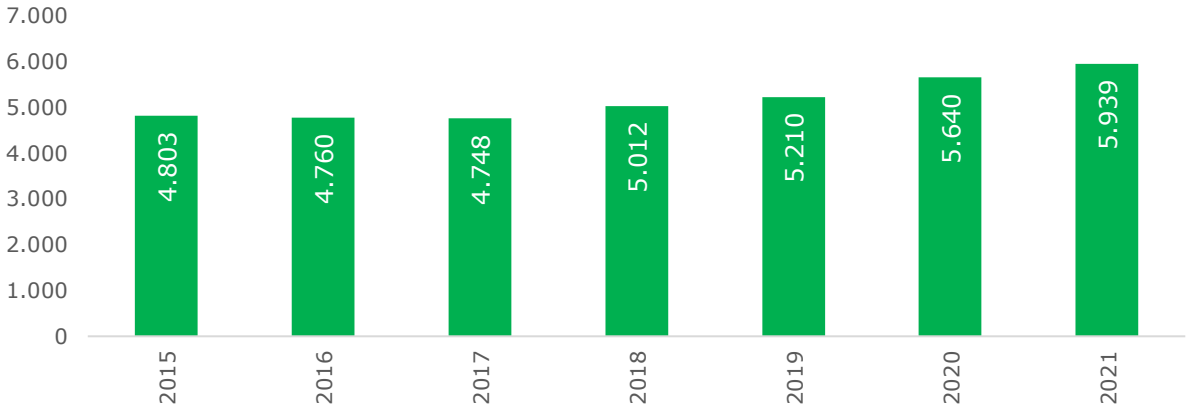
- In 2020 only 19 Greek companies reported their ESG performance. However, only 9 of them achieved a medium to high sustainability performance.
- Over the five-year period, the average ESG score of the Greek companies has increased, from 42.09 to 51.93, but well below the global and European averages.
- Although, there is a relative increase in the number of companies using and publishing ESG data, the rate of this increase remains low.
- In 2020, there has been an increase in the percentage of high ESG performing companies. For the very first time, more companies scored between 70-90%.
- Mytilineos, Ellactor and OPAP with scores 89.5, 79.7 and 79.3 respectively, have the highest scores, regarding their ESG performance.

The Greek banking system provides more and more loans to the growing Energy sector, reaching 5,939 in 2021

Total Loans of the Greek Banking System, (thousand euros), [2015 - 2021]



Loans to the Greek Energy Sector, (thousand euros), [2015 - 2021]



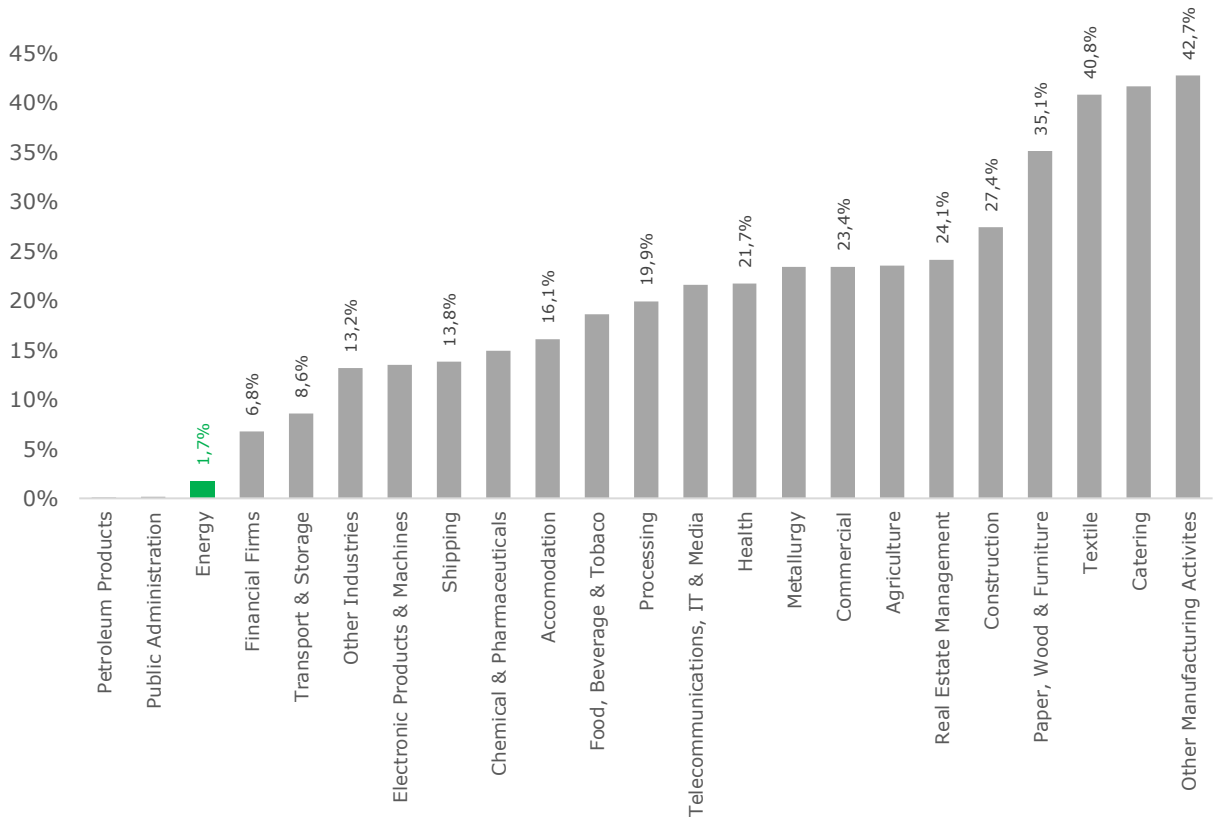
Source: Bank of Greece

Highlights

- Loans provided by the Greek banking sector declined from 66,594 in 2020 to 58,112 in 2021.
- The average non-performing exposure of all 23 sectors for 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 once again remain the most unreliable borrowers.
- The loans to the Greek energy sector continued outperforming and reached 5.939 loans in 2021, an increase of 5% between 2021 and 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 energy sector is at the bottom of the list of non-performing exposures of the different sectors in the Greek banking system

Non-performing Exposure by Sector in Greece (%), [H1 2021]



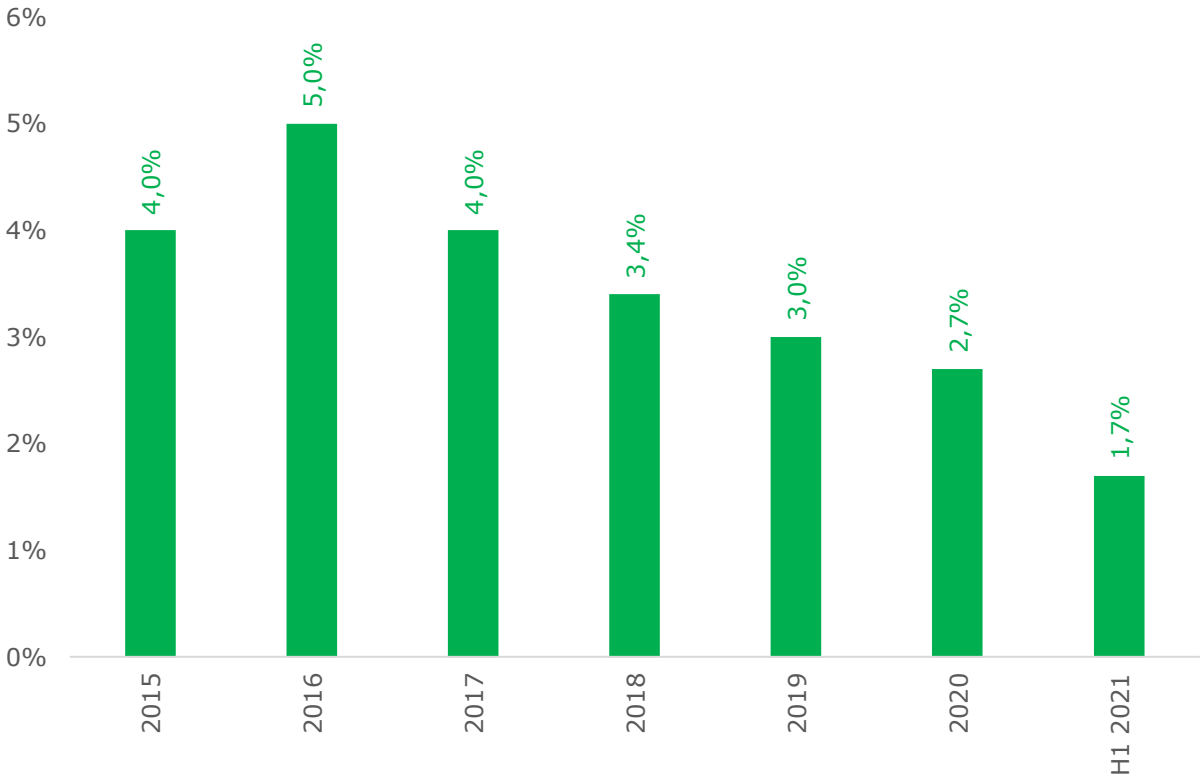
Source: Bank of Greece

Highlights

- The number of non-performing loans (NPLs)/ exposures (NPEs) in Greece is considered as one of the highest in Europe.
- The average non-performing exposure of all 23 sectors for H1 2021 is 19.7%, with petroleum products being the most creditworthy sector at 0.1%.
- Manufacturing Activities, Catering, Textile, and Paper, remained the most unreliable borrowers with a rate of 42.7%, 41.6%, and 40.8% respectively.
- The energy sector continued to outperform in terms of both reliability and credibility, shaping its annual rate of non-performing loans at 1.7% for H1 2020.
- Despite the Covid-19 pandemic, the average non-performing exposure of all 23 sectors was reduced from 28.7% in 2020 to approximately 20% in 2021.

Since 2017, the non-performing exposure of the energy sector, has steadily been dropping by approximately 0.6% annually

Non-performing Exposure of the Greek Energy Sector(%), [2015-2021]



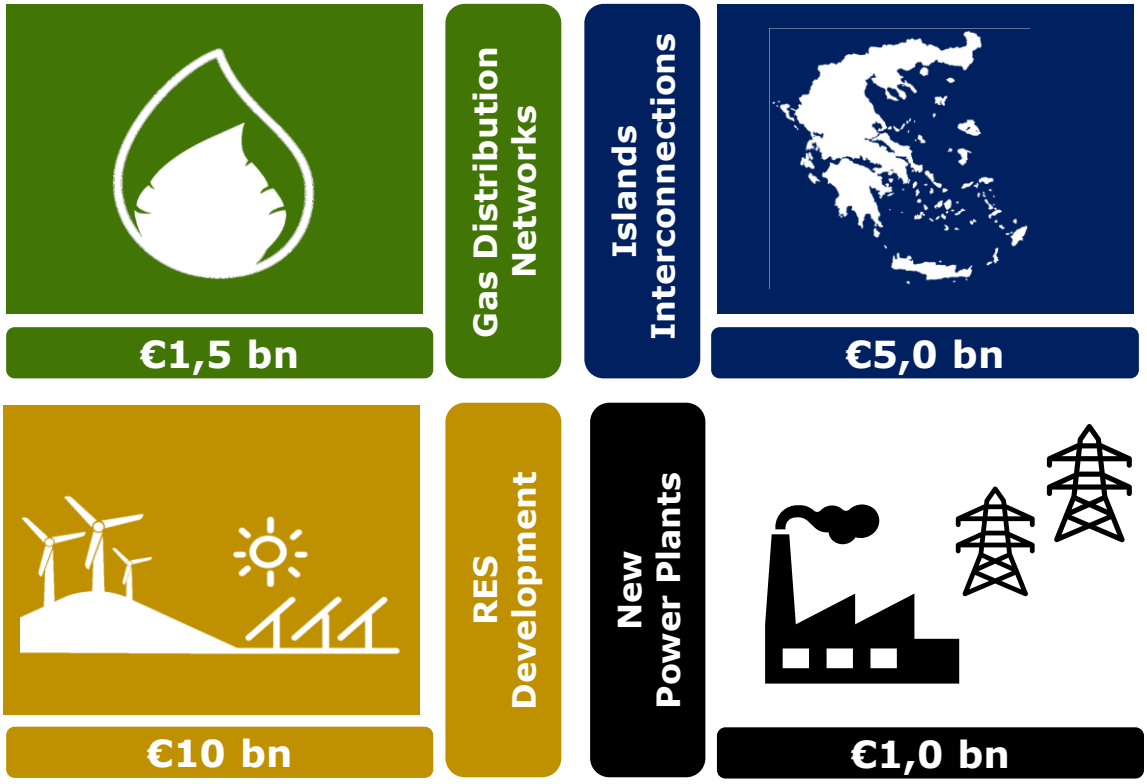
Source: Bank of Greece

Highlights

- Since 2017, the non-performing exposure of the energy sector, has steadily been dropping by approximately 0.6% annually. In H1 2021 it declined to 1.7%.
- Between 2015 and 2021 the CAGR of the non-performing exposure of the Greek energy sector was 3%.
- The highest record of 5% non-performing exposure of the Greek energy sector was noted in 2016, while in 2020 there was a record-low of 2.3%.
- The outstanding loans in the energy sector stood at 3.2 billion euros in H1 2021, while in 2021 the number of loans accounted for 7.2 billion euros.
- The banking sector supports overtime investments in RES, as these are considered vital for the country's economic growth and for reaching its climate goals.

Major energy investments of €17,5bn have already been announced and planned for being in operation until 2030

Projections for Major Energy Investments in Greece until 2030 (bn euros)



Source: Bank of Greece, HAEE analysis

Highlights

- The announced and planned major energy projects by large energy Groups and Companies seem to be probably correlated with current EU's energy policy.
- Gas networks, islands interconnections and RES are the most preferable investments due to the predetermined tariffs.
- RES development is highly correlated with the Greek islands' interconnections since their location is preferable, especially for the development of wind parks.
- New RES projects of approx. 12 GW will be highly connected with the target of CO2 emissions' decrease by 55% by 2030.
- The investment in these new power plants is mainly driven by the gradual decarbonization of energy production.

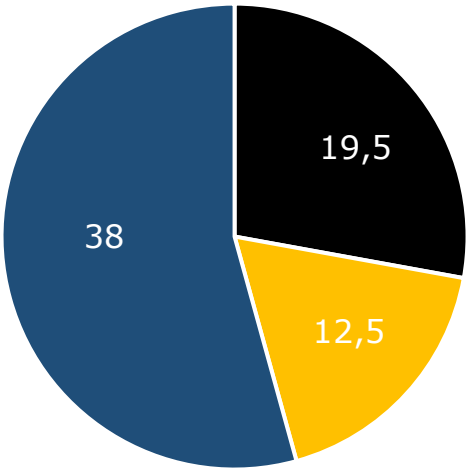
According to 'Greece 2.0', 6,194 million euros of the available funding will be used for green transition investments

Green Transition	RRF Budget (in €M)	Mobilized Investment Resources (in €M)
Power Up	1,200	2,348
Renovate	2,711	5,225
Recharge and refuel	520	1,305
Sustainable use of resources	1,763	2,726
Total Resources	**6,194**	**11,604**

Source: Greece 2.0, HAEE analysis

Available financial sources for Greece [2021 – 2027]

- RRF Grants
- RRF Loans
- Multiannual financial framework



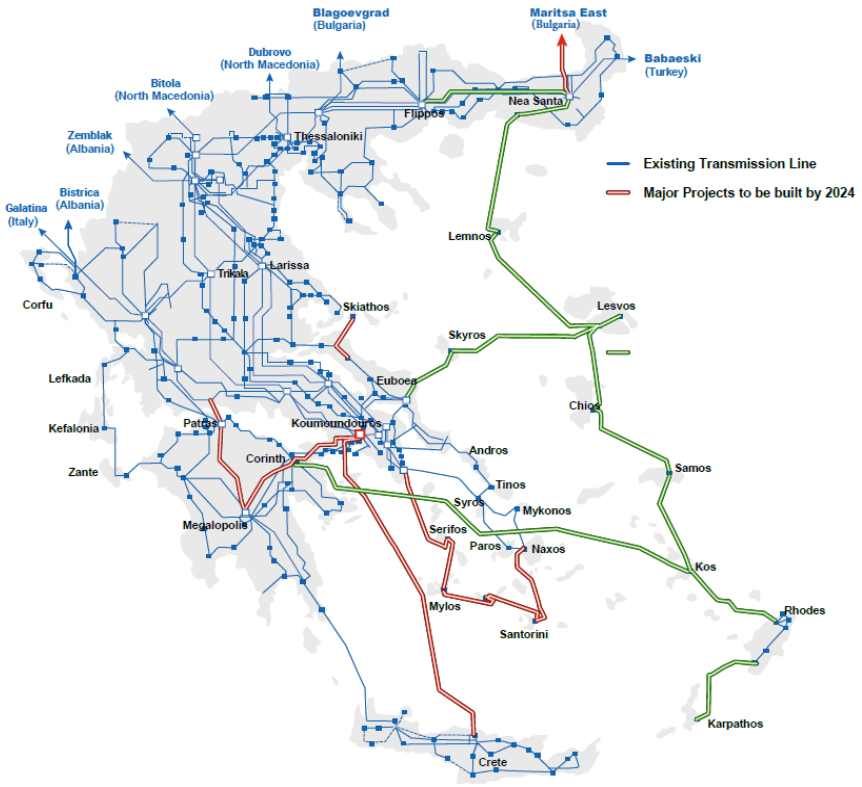
Environment and Climate Change Energy

- National Reforestation Plan 248 M€
- Flood protection projects 39 M€
- Flood protection projects using water for irrigation purposes 130 M€

4th Phase of Cyclades Interconnection
164.5 M€

The ADMIE's Development Program includes the completion of the Cyclades and the Dodecanese islands Interconnection

ADMIE's Ten-Year Development Program for Islands' Interconnections [2022 – 2031]

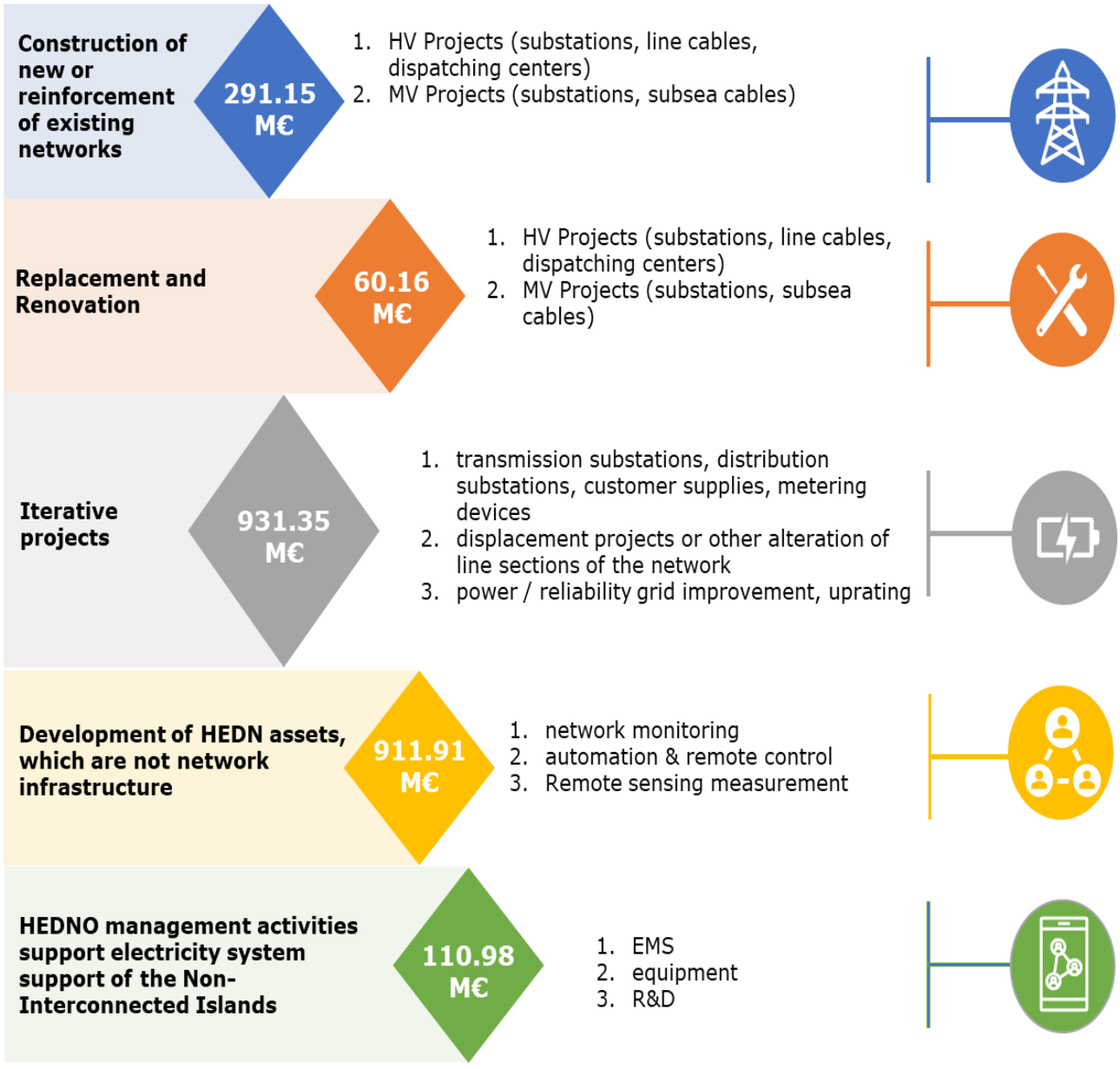


Project	Description	Construction Date	Completion Date
	Crete interconnection		
2nd Phase		2022	2025
	Cyclades Interconnection		
4th Phase	Thira - Naxos Interconnection	2021	2023
	Thira - Folegandros - Milos - Serifos Interconnection - Lavrio wire ropes	2022	2024
	Dodecanese Interconnection		
1st Phase	Interconnection of Corinth High Voltage Center – Kos and Kos-Rhodes	2025	2027
2nd Phase	Interconnection of Rhodes - Karpathos	2026	2028
	Interconnection of Rhodes - Samos		
	Northeast Aegean islands Interconnection		
1st Phase	Interconnection Santas High Voltage Center – Lemnos and Lemnos - Lesbos	2025	2027
2nd Phase	Interconnection of Aliveri High Voltage Center - Skyros, Lesbos- Chios and Kos - Samos	2026	2028
3rd Phase	Interconnection of Lesbos - Skyros and Chios - Samos	2028	2029

Source: ADMIE's Ten-Year Development Program (under consultation), HAEE's analysis

HEDNO's Network Development Plan for 2021 and 2025, include Investments of approximate 2 billion euros

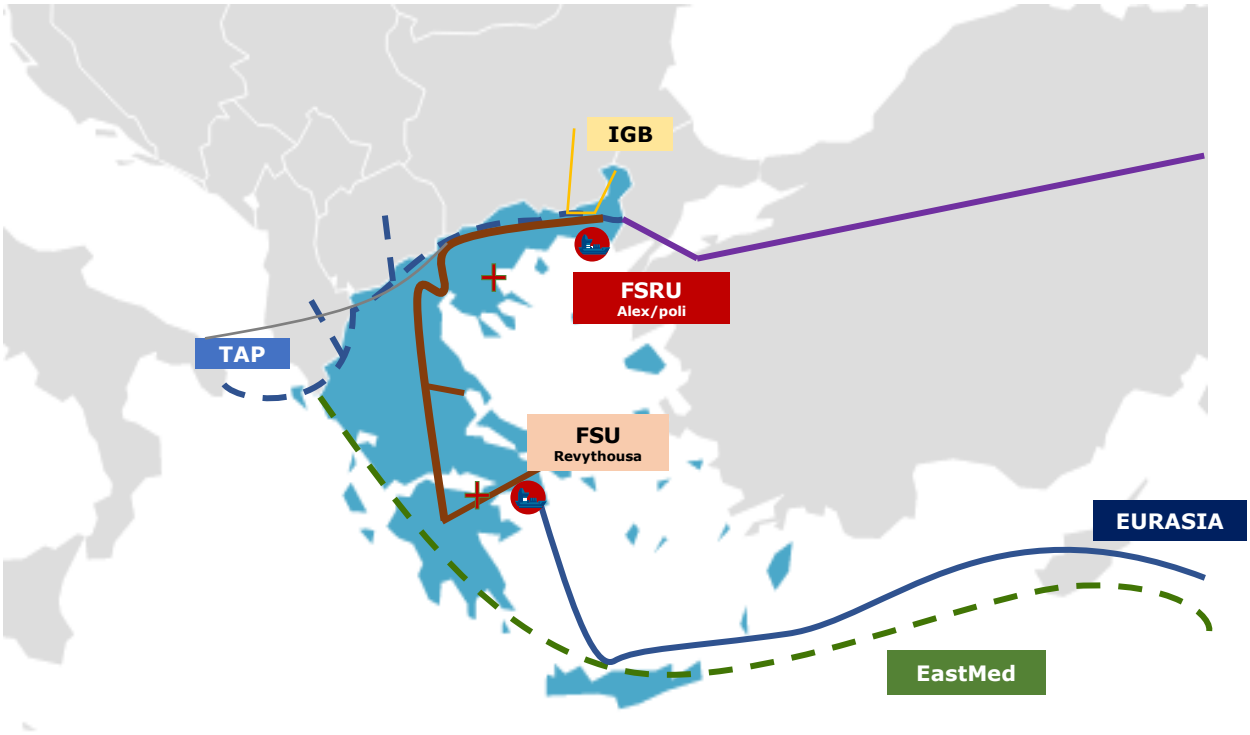
HEDNO Network Development Plan [2021 – 2025]



Source: HEDNO Network Development Plan, HAEE's analysis

Greece quickly transforms into an energy hub of the region and a strategic gateway for the entry of energy resources in SE Europe

Map of Greece with Key Energy Projects



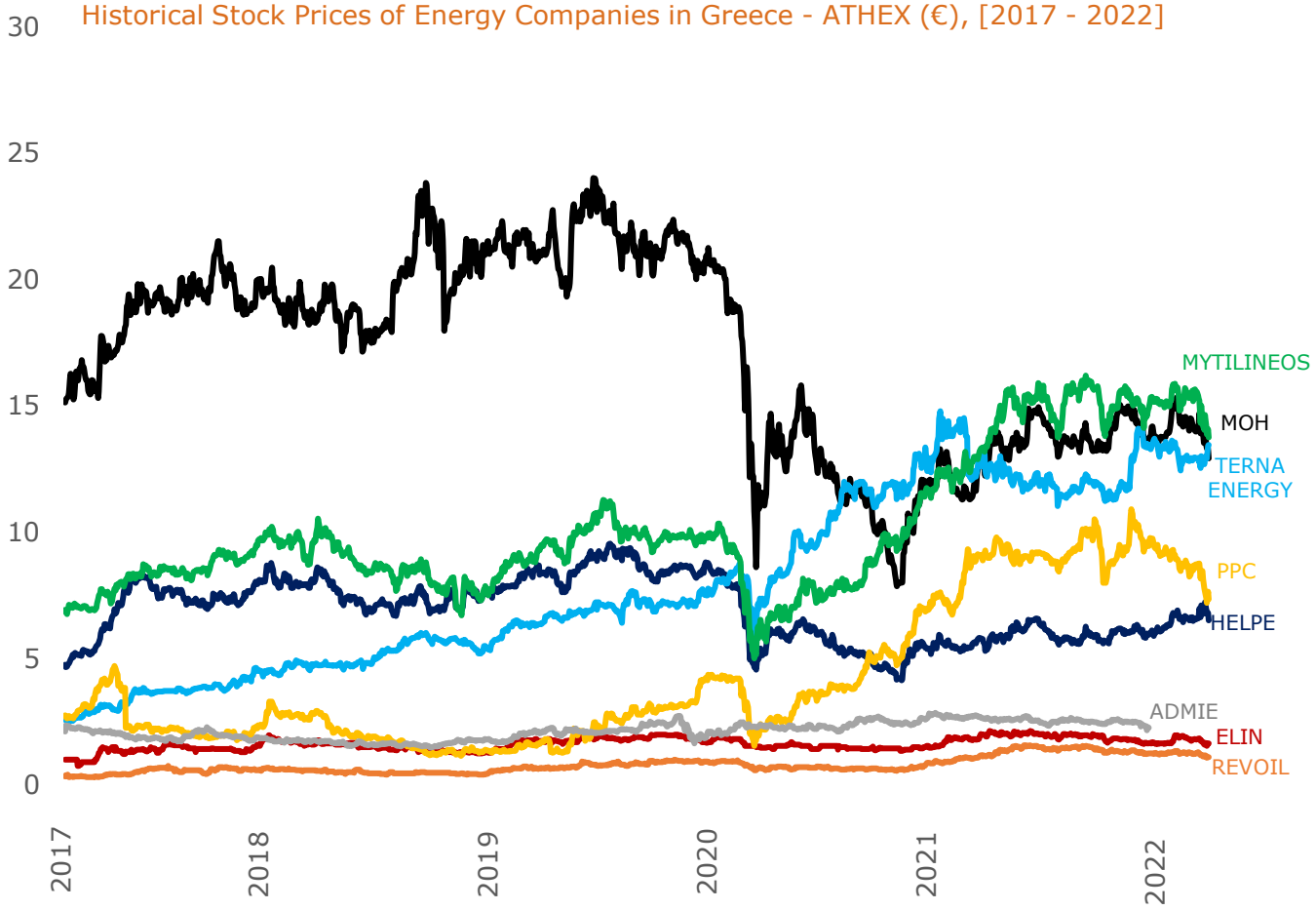
Source: HAEE's analysis

Highlights

- In May 2022, the Greek government announced the construction of the Floating Storage and Gasification Unit (FSRU) in Alexandroupolis by Gastrade S.A.
- The FSRU will connect with and transmit gas into other gas transmission systems (e.g. TAP), and will be transported to Greece, Bulgaria, and the wider Balkan region.
- Given the current geopolitical uncertainties, a new round of negotiations concerning the construction and the utilization of EastMed have already started.
- At the end of the year, the construction of Motor Oil's "Dioriga FSRU" is expected to begin.
- In mid-April Elpedison applied to RAE for a license to develop the "Thessaloniki FSRU" which is expected to be operational by 2025.

During turbulent economic periods, financial products in the energy sector follow irregular curves

Historical Stock Prices of Energy Companies in Greece - ATHEX (€), [2017 - 2022]



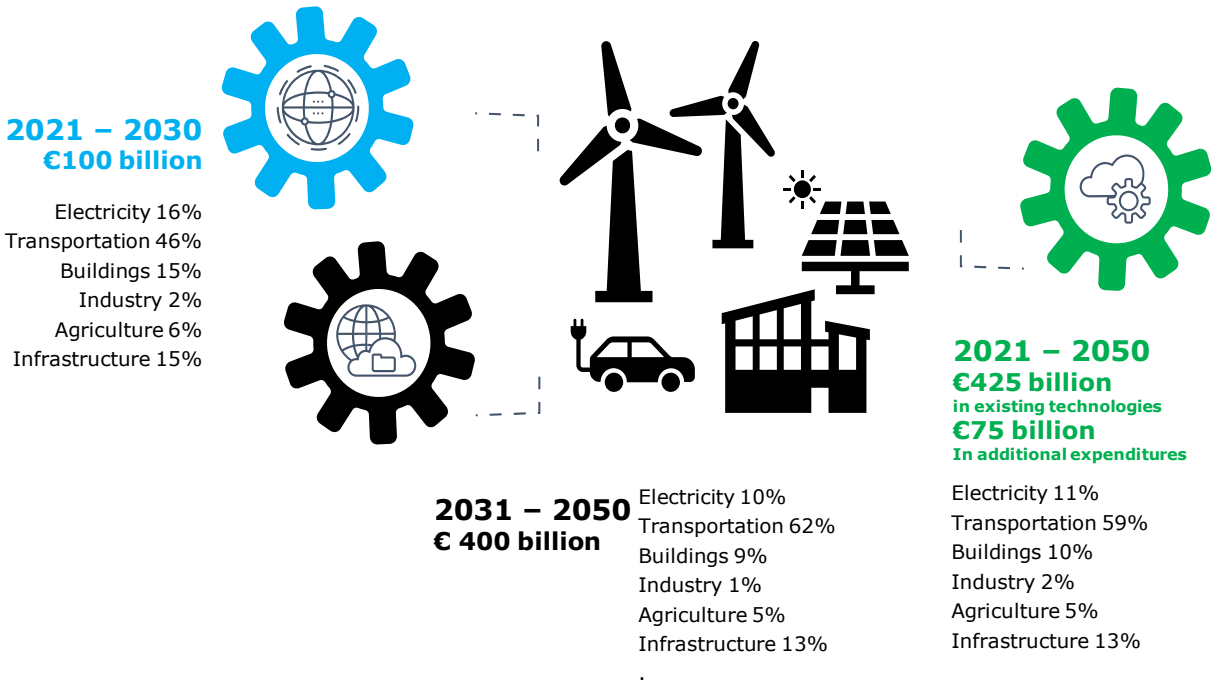
Highlights

Source: NECP, HAEE's analysis

- From 2020 onwards the majority of energy companies' stocks follow an upward trend, illustrating Greece's opening up to new investment opportunities.
- Mytilineos, Motor Oil and Terna Energy are the highest-priced stocks among the energy companies' stocks in ATHEX.
- The price of refining industry depends on crude oil prices, refining margins, exchange rate, domestic demand and impact of fiscal and monetary policy measures.
- The Financial markets' stability is fundamental factor for firms' growth and their stock prices.
- In periods with high market volatilities, stock prices suffer from anomalies and follow irregular curves.

€500 billion of investments are needed to reach zero-emission goals, while 6 technologies can contribute to 80% of CO_2 reduction

Investment Opportunities for Energy Transition Acceleration in Greece (€), [2031 - 2050]



Source: Net-zero Greece McKinsey, HAEE analysis

Highlights

- Investments of approximate €500 billion in electricity, transport, buildings, industry, agriculture and infrastructure, are required for reaching net-zero emissions by 2050.
- To achieve transition, priority must be given to energy production from RES and the introduction of green hydrogen in sectors such as industry and heavy transport.
- Strategic investments are essential in new technologies such as CCUS, generation and exploitation of green hydrogen and biofuels.
- The government's investment priorities include the development of a Mediterranean offshore wind hub, while the relevant regulatory framework is under development.
- In achieving Greece’s energy goals, political decisions and further actions are needed to speed up licensing procedures and provide incentives in the R&D sector.

Data Sources

ΑΑΔΕ Ανεξάρτητη Αρχή Δημοσίων Εσόδων	ΑΔΜΗΕ Ανεξάρτητος Διαχειριστής Μεταφοράς Ηλεκτρικής Ενέργειας	bruegel
https://www.aade.gr	http://www.admie.gr/	http://www.bruegel.org/
bp	ΔΑΠΕΕΠ	ΔΕΔΑ, διανομή αερίου αττικής, EDATHESS
https://www.bp.com	https://ape.dapeep.gr	https://deda.gr https://edaattikis.gr https://edathess.gr
DESFA Hellenic Gas Transmission System Operator S.A.	eia Independent Statistics & Analysis U.S. Energy Information Administration	ΕΛΕΤΑΕΝ
http://www.desfa.gr/	https://www.eia.gov/	http://eletaen.gr/en
Hellenic Statistical Authority Digital Library (ELSTAT)	EMBER COAL TO CLEAN ENERGY POLICY	ENERGEAN
http://www.statistics.gr/	http://ember-climate.org/	http://www.energean.com
entsog european network of transmission system operators for gas; gie Gas Infrastructure Europe	EUROPE BEYOND COAL	eurostat
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http://www.un.org

Acronyms and abbreviations

CCS	Carbon Capture and Sequestration/Storage CRES
CCUS	Carbon Capture, Utilisation & Storage
ESG	Environmental, Social and Governance
EV	Electric Vehicle
FiP	Feed-in Premium
FiT	Feed-in Tariff
FSRU	Floating Storage and Regasification Unit
FSU	Floating Storage Unit
GDP	Gross Domestic Product
GHG	Greenhouse Gases
HICP	Harmonised Index of Consumer Prices
HV	High Voltage
LNG	Liquiefied Natural Gas
MCP	Market Clearing Price
MV	Medium Voltage
NECP	National and Climate Energy Plan
NOME	Nouvelle Organisation du Marché de l'Electricité
NPEs	Non-Performing Exposures
NPLs	Non-Performing Loans
PPA	Power Purchase Agreement
PV	Photovoltaic
RMP	Reference Market Price
RO-PAX	Roll-on/roll-off passenger
SMP	System Marginal Price
SSLNG	Small Scale LNG
TAP	Trans Adriatic Pipeline
WTG	Wind Turbine Generator

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

Conversion of units

Source: BP Approximate conversion factors – Statistical Review of World Energy
Updated July 2021

Natural gas and LNG	To convert						
	Billion cubic metres NG	Billion cubic feet NG	Petajoules NG	Million tonnes oil equivalent	Million tonnes LNG	Trillion British thermal units	Million barrels oil equivalent
From	Multiply by						
1 billion cubic metres NG	1.000	35.315	36.000	0.860	0.735	34.121	5.883
1 billion cubic feet NG	0.028	1.000	1.019	0.024	0.021	0.966	0.167
1 petajoule NG	0.028	0.981	1.000	0.024	0.021	0.952	0.164
1 million tonnes oil equivalent	1.163	41.071	41.868	1.000	0.855	39.683	6.842
1 million tonnes LNG	1.360	48.028	48.747	1.169	1.000	46.405	8.001
1 trillion British thermal units	0.029	1.035	1.050	0.025	0.022	1.000	0.172
1 million barrels oil equivalent	0.170	6.003	6.093	0.146	0.125	5.800	1.000

Units		
1 metric tonne	= 2204.62 lb	= 1.1023 short tons
1 kilolitre	= 6.2898 barrels	
1 kilolitre	= 1 cubic metre	
1 kilocalorie (kcal)	= 4.1868 kJ	= 3.968 Btu
1 kilojoule (kJ)	= 0.239 kcal	= 0.948 Btu
1 petajoule (Pj)	= 1 quadrillion joules (1×10^{15})	

Crude oil*	To convert				
	Tonnes (metric)	Kilolitres	Barrels	US gallons	Tonnes/year
From	Multiply by				
Tonnes (metric)	1	1.165	7.33	307.86	–
Kilolitres	0.8581	1	6.2898	264.17	–
Barrels	0.1364	0.159	1	42	–
US gallons	0.00325	0.0038	0.0238	1	–
Barrels/day	–	–	–	–	49.8

*Based on the worldwide average gravity

Products	To convert					
	Barrels to tonnes	Tonnes to barrels	Kilolitres to tonnes	Tonnes to kilolitres	Tonnes to gigajoules	Tonnes to barrels oil equivalent
From	Multiply by					
Ethane	0.059	16.850	0.373	2.679	49.400	8.073
Liquified petroleum gas (LPG)	0.086	11.600	0.541	1.849	46.150	7.542
Gasoline	0.120	8.350	0.753	1.328	44.750	7.313
Kerosene	0.127	7.880	0.798	1.253	43.920	7.177
Gas oil/diesel	0.134	7.460	0.843	1.186	43.380	7.089
Residual fuel oil	0.157	6.350	0.991	1.010	41.570	6.793
Product basket	0.124	8.058	0.781	1.281	43.076	7.039

Units			
1 exajoule (EJ)	= 1 quintillion joules (1×10^{18})		
1 British thermal unit (Btu)	= 0.252 kcal	= 1.055 kJ	
1 tonne of oil equivalent (toe)	= 39.683 million Btu	= 41.868 million kJ	
1 barrel of oil equivalent (boe)	= 5.8 million Btu	= 6.119 million kJ	
1 kilowatt–hour (kWh)	= 860 kcal	= 3412 Btu	= 3600 kJ

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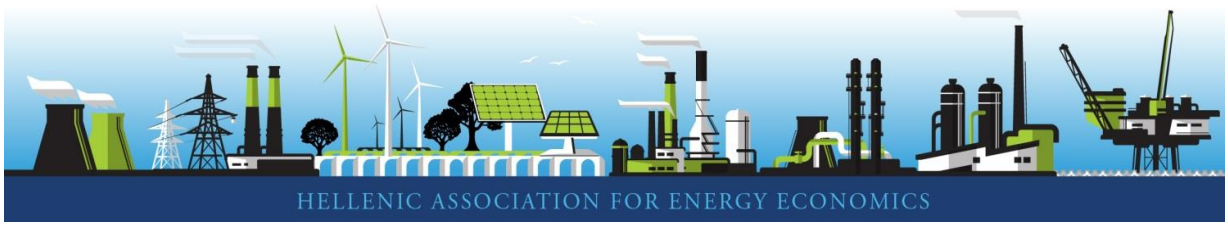

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