Greek Renewable Energy Market Outlook 2023-2024

WATTCROP

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> Wattcrop is leading the way in sustainable development and ethical principles.

Ypatios Moysiadis

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About Wattcrop

Wattcrop was incorporated in 2019 aiming to develop best-in-class renewable energy and energy storage projects mainly in South-East Europe and the UK.

Who we are

Wattcrop's vision is to create the most ethical and innovative company in renewable energy project development. By following strict ESG criteria, and embracing best practices and technological advancements in the sector, the company's aim is to provide long-term tangible benefits for society the environment and its shareholders.

Wattcrop has a substantial portfolio of projects in excess of 950 MW of power generation and 700MW of storage under development and is a major player in the Greek renewables market.

A sustainable future for all

To achieve that we are capitalising on local talent by establishing local teams on the jurisdictions we operate. In addition to greenfield development, we aim to expand our portfolios through licencing acquisition and strategic partnerships.

Our goal is to drive Carbon Zero energy generation, support local communities, protect, and enhance ecosystem biodiversity, envisioning a better more sustainable future for all.

A sustainable future for all

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2019

Wattcrop is incorporated by international investors with the aim to be a major developer in Greece.

2020

We exceed our initial development target of 250MWp in Renewable projects.

2021

Cero Generation / Macquaire GIG become a majority partner after successfully concluding the transaction.

2022

First projects with draft PPAs submitted to IPTO for grid connection offer.

2023

Solar Project pipeline circa 904.98MW. New technologies are being explored including Wind and Floating Solar.

Company Milestones

What we do

We have created services that address the development and operational cycle of renewable energy projects. Primarily focusing on Solar PV, Onshore Wind and Battery Storage we start from greenfield development all the way to asset management and ancillary services for operational plants.

The writing and creative team of this guide

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Foreword

2023 marked a historic milestone in Greece's clean energy production taking another step towards the energy transition!

However, it was overshadowed by a lack of transparency and beyond reasonable procedural delays. The need for a deep reform is evident!

Despite its achievements in terms of additional renewable energy capacity added, the indecisiveness and the constant changes that the government is making in the energy sector are preventing the substantial acceleration of green energy development. Recently the International Energy Agency called for a tripling of renewable energy capacity by 2030 to meet climate goals, but progress is not as rapid. Delays in the transition to sustainable energy sources are exacerbating the impacts of climate change, as evidenced by record temperatures and extreme weather events in 2023. Immediate and decisive action is vital to accelerate the transition to renewable energy and mitigate these escalating environmental threats.

On the bright side, in 2023, Greece achieved a historic milestone in clean energy production, with 57% of its electricity mix being supplied by Renewable Energy Sources Additionally, lignite's share in Greece's domestic energy mix further declined to a historic low of 10.1%. This reduction underscores the significant strides made in the country's lignite phase-out program.

Continued advances in renewable energy technologies and the acceleration of electrification in the transport and heating sectors are driving a transformational change in the energy landscape. New provisions for energy storage and the recent tenders held in July and December 2023 aim to enhance grid stability and efficiency by further integrating renewables into the mix. These developments pave the way for a dynamic and robust market. However, the introduction of Battery Energy Storage Systems (BESS) is both delayed and far from optimal.

The framework relies on a complex auction system and subsidies, enabling participants to use these auctions as a means to gain access to the grid, which has become the most valuable asset in the Greek market environment. Consequently, this method not only complicates the deployment of BESS but also detracts from their potential effectiveness in enhancing grid stability and promoting renewable energy integration, hindering the development of a full merchant market for energy storage, which is essential to fostering competition and efficient market dynamics.

Greece is once again at a crossroads. The pressing question is whether the country will continue to be a viable investment destination for renewable energy and adopt best practices by paying attention to the market insights, or if it will implode and become a cautionary tale to avoid. At Wattcrop, we are committed to playing a key role in driving the transition to green energy. Our mission is to promote sustainable development that respects the environment and aligns with the interests of local communities.

This report presents our comprehensive analysis of the market, highlighting key information and data which will allow the readers to reach their own conclusions on the opportunities and challenges within the market. Drawing on a wide range of data and insights from multiple, authoritative sources, we aim to provide an in-depth and impartial view of the current and future state of the Greek renewable energy market. Our analysis seeks to decode market trends, offering a detailed snapshot of the current situation and a forward-looking perspective on potential developments.

We recognize the critical importance of this transition and are committed to contributing to a sustainable energy future. By sharing our research and findings, we hope to inform and inspire stakeholders across the industry to join us in realising the country’s full potential of green energy.

Ypatios Moysiadis
Managing Partner

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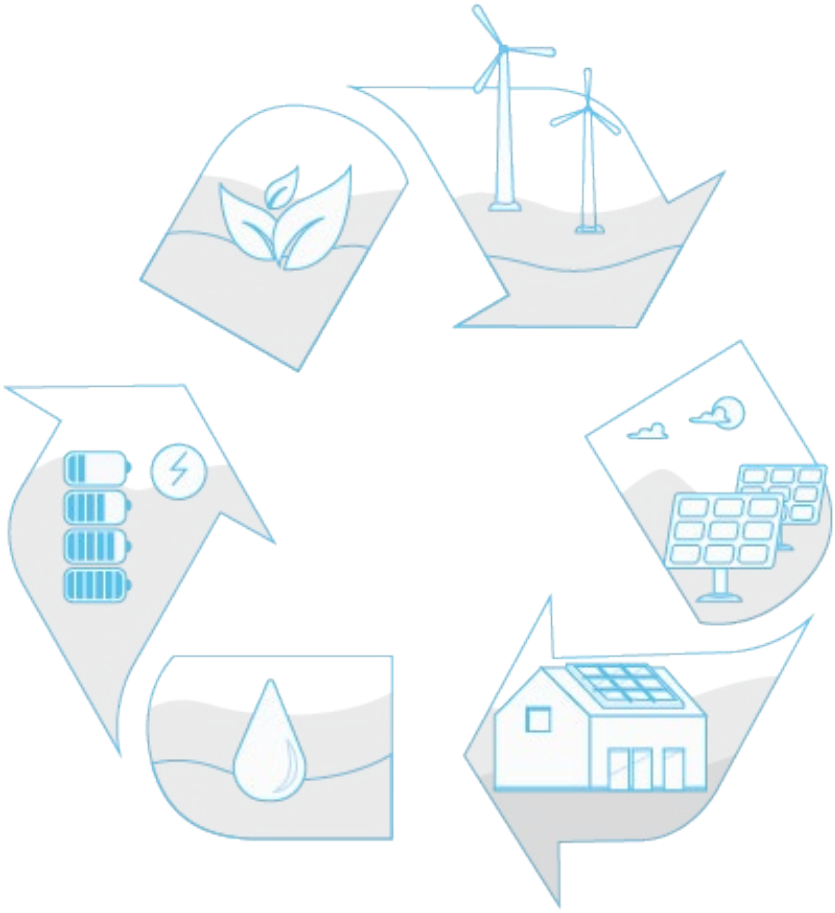

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Executive Summary

Since 2018 Greece has been following through with the European Plan to mitigate the climate crisis. Despite its relative small market size, the country has achieved and in cases surpassed its targets related to renewable energy generation. All state stakeholders acknowledge the urgent need to address this transition to more sustainable sources of energy.

Consequently, for the last 5 years there has been a substantial political backing from both the government and most of the parties in the opposition, aligning with EU policies and international initiatives. This support mainly in the form of subsidies is aimed at advancing the deployment of renewables and enhancing energy efficiency.

Greece is a small country with particular geographical and seasonal characteristics. The country is witnessing a decline in population mainly because of migration, ageing of the population and the low rate of births due to the economic crisis that the country has faced. In the long run this can be a real issue. On the brighter side and despite the slowdown due to COVID-19 the unemployment is steadily decreasing, and the fiscal outlook is improving.

The country has some unique advantages for renewables. It is well suited both for wind and solar installations and plans new national /international interconnectors that can significantly increase the potential to become a key net exporter of green power within the EU.

In terms of electricity the country is a net importer, and this is projected to change through the several country-level interconnections that are being designed but their connection timeline is further down the line which means the import/export balance of the country is projected to not shift much in the near future.

In 2023, Greece achieved a significant milestone in clean energy production, with Renewable Energy Sources (wind and solar) and hydroelectric power supplying 57% of the energy mix. This is a substantial increase from the 50.12% share in 2022. The rapid growth of Renewable Energy Sources in recent years is evident with the annual green energy production in 2023 reflecting a 147% increase compared to the 2014 production as announced by the IPTO.

Overall with the current pipeline of RES projects that Greece has, the country seems to be able to exceed its own targets outlined in the NECP 2023. Despite the congestion on the grid and the slow response times of the grid operators, officials are ambitious that 2030 figures will be exceeding the 2030 targets in installed RES capacity.

However, in the last few months we see increased curtailments, phenomena of negative pricing which is a strong indication that there is an imbalance between supply and demand. Greece is very late in adopting energy storage and introducing the necessary market structure reforms in order to capitilise on the oversupply of cheap green energy. Cases of protectionism and oligopoly should be carefully examined as the country has on average one of the highest retail electricity rates in the EU.

Nonetheless, due to the anticipated slow rise in demand, largely driven by the electrification of transport and heating sectors, as well as the electrification of production processes in major industrial sectors demand for additional renewable energy projects is expected to continue increasing in the coming years.

Additionally, the liberalization of the energy market, the gradual phase-out of fossil fuels, and the potential for power-to-gas-to-power projects using green hydrogen highlight a promising outlook for increased demand for renewable energy projects. However, the most imminent challenge across Europe, remains the grid infrastructure. The current upgrade and expansion plans by many countries are underestimated and will not be sufficient to meet the demand for new generation connections. While private investments are also going to support the grid upgrades in order to connect projects faster, ultimately the Grid operator is the one driving this conversation and unless the projections are reevaluated the new infrastructure will still not be enough to facilitate all the new RES project connections.

Furthermore, there is a pressing need and expectation within the industry for immediate improvements in how operators manage the licensing process and especially increased transparency and simplification.

Greece is slowly yet steadily heading towards an unsubsidized market where merchant contracts and corporate PPAs are expected to play a significant role. Key criteria for corporate PPAs will be market price expectations, risk management on both size (the developer and the off-taker) and quality of projects (strong expectation for PPAs to comply with ESG standards). The industry is still pending further clarifications with the country's legal framework to further enable sleeved (virtual) PPAs.

It is worth highlighting that the market is still not mature in this aspect, however, the legislators are slowly introducing PPAs and providing incentive for future producers to enter these bilateral agreements and get more acquainted with a full merchant market scenario compared to the subsided one. Contracts and products are not expected to fall outside the European norms starting with buy-as-produce contracts which will eventually be transformed into fixed volume PPAs (either on baseload or fixed time period).

In addition, the introduction and shaping of BESS legislation is underway which shows the eagerness of the country to keep up with the global market trends. Having said that the progress on this is quite slow and the pace at which the framework for BESS is set will need to be ramped up for the country to meet its National Energy Plan ambitious targets.

Greece has transformed into a very attractive area for the development of renewables with significant foreign investments taking place. However, many investors are exiting the market while projects that are actually reaching financial close and the construction phase are mainly owned by local energy conglomerates or partnerships of local and foreign companies.

Within the next 2 years we will see the construction of large scale SolarPV assets and a few standalone BESS assets as well as a first round of consolidation of operating assets and development portfolios.

On the residential and C&I sectors the legislators failed to adopt the proposals of the industry and also did not follow best practice examples from more mature markets. The sector depended heavily on CAPEX subsidies and a net metering model, which as soon as it changed to net-billing led to a massive slow-down in the market.

The country has also put effort into attracting investments in green hydrogen production, however, the legal framework is not in place yet to foster large and robust investments even if these come through a subsidized environment. Therefore, the largely politically driven hydrogen revolution is yet to be realized or have any serious traction in Greece.

We hope that by producing this Outlook you will be able to navigate the current market environment and make better and more informed decisions regarding the Greek Renewables Market.

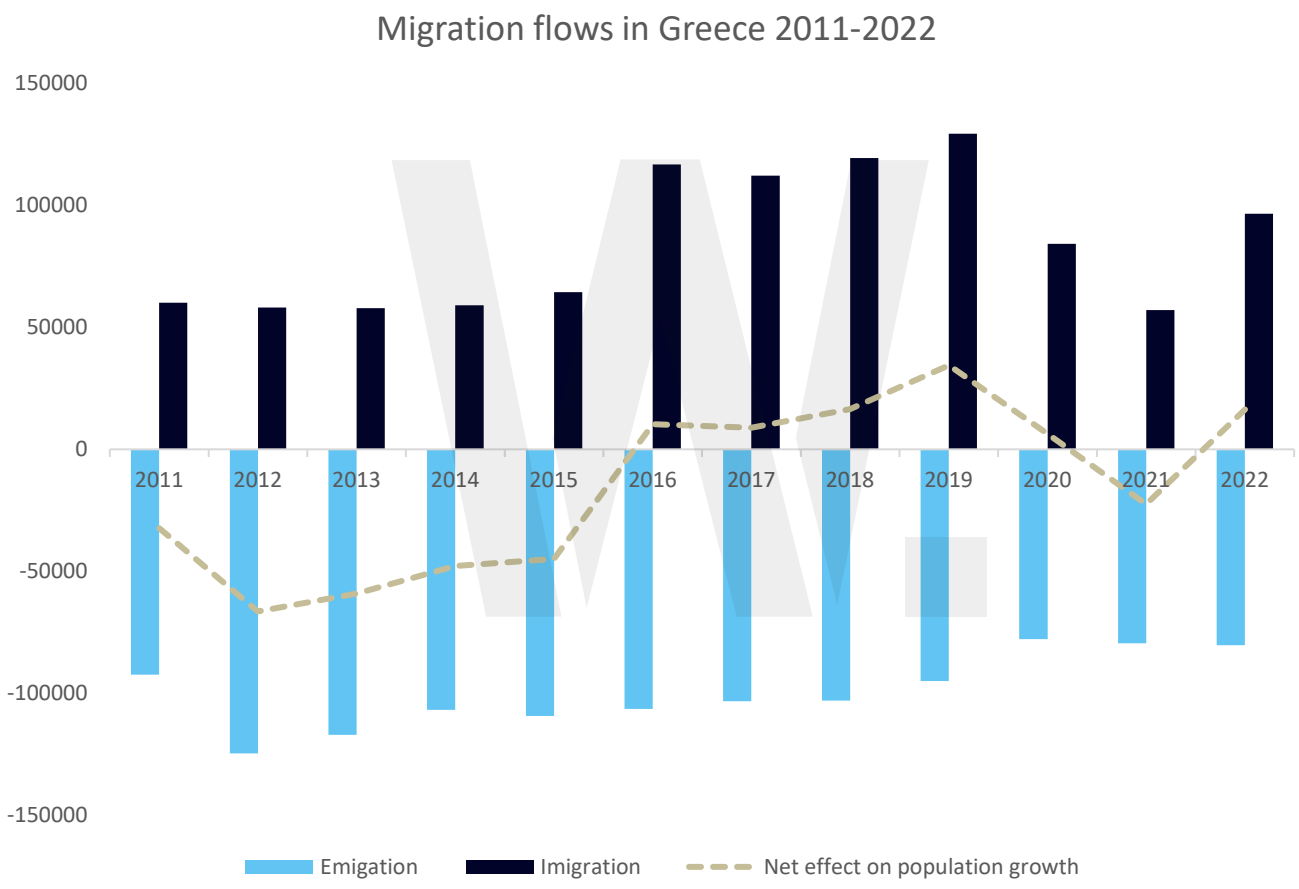
1

Demographics

Demographics

Since 2005, Greece has experienced a sharp population decline, dropping from 11.23 million people to 10.42 million in just 15 years. This is closely associated to the brain drain; According to research, approximately 500.000 people moved abroad, mainly in Europe, during the financial crisis.

Coupled with the aging population and low birth rate, the most recent projections show a continuation of this trend, resulting in a population of 9.03 million by 2050 and 6.61 million by 2099. Greece's population aged 25-49 years is slowly declining whereas the proportion of population aged 65-79 years is increasing.



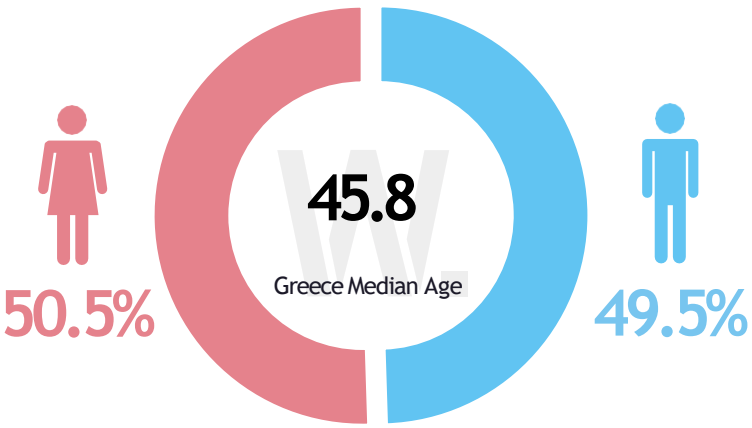
Migration Flows

The most significant emigration flows in Greece are observed in 2012, at the peak of the financial crisis. Between 2011 and 2016, there was a net outflow of people, which then leveled, not due to the decrease of emigration but due to the refugee crisis that affected Europe from 2016 onwards.

Source **ELSTAT, 2023**

Demographics 2023

Adults:10,341,277



Annual Salary

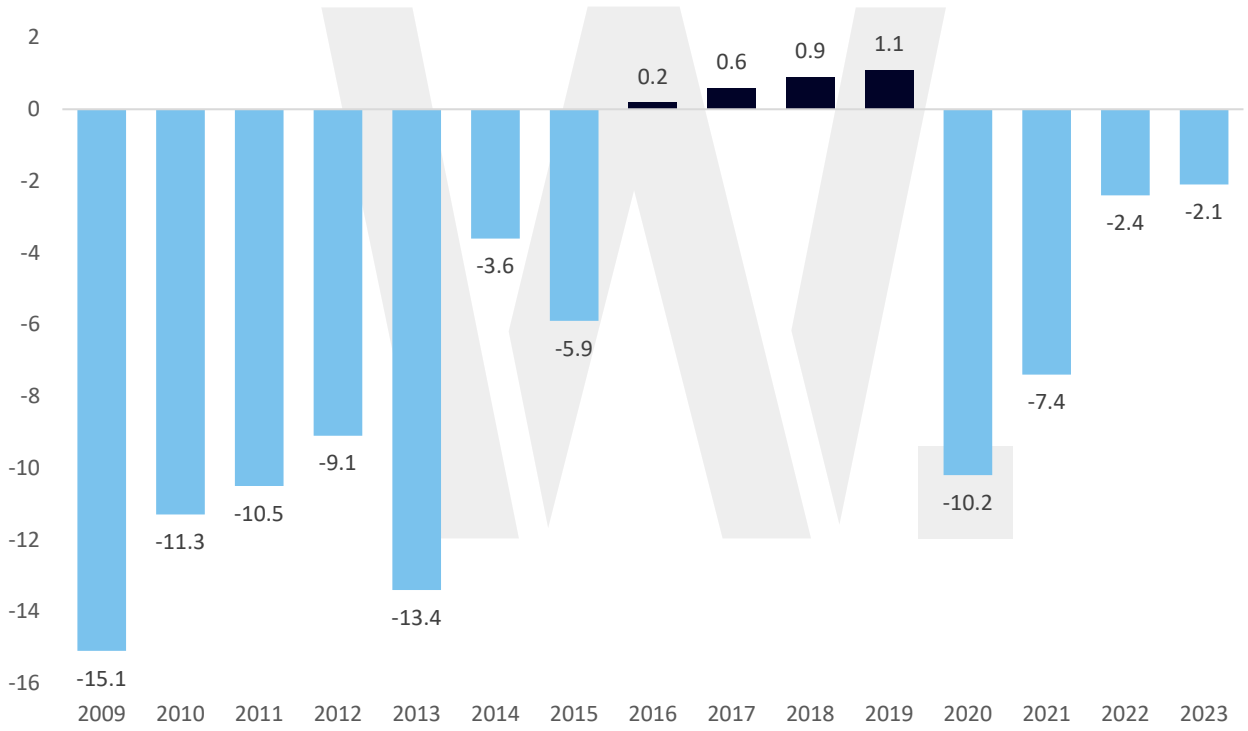
$27.207

average annual salary, compared to the OECD average of $33.604 a year.

26.3%

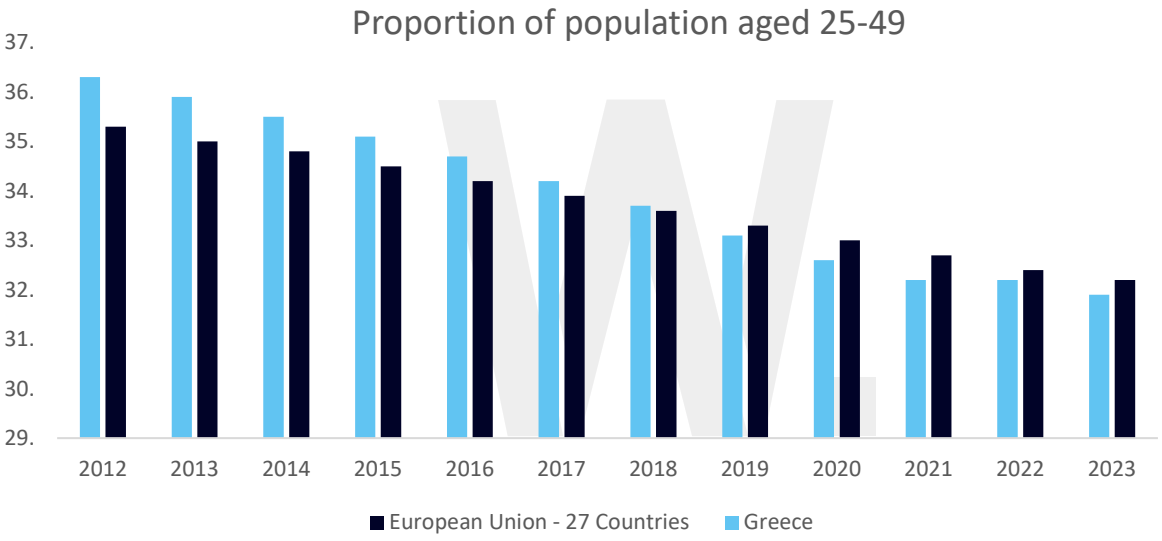
would be at risk of falling into poverty if they had to forgo 3 months of their income.

Government Budget (% of deficit and surplus) 2009-2023



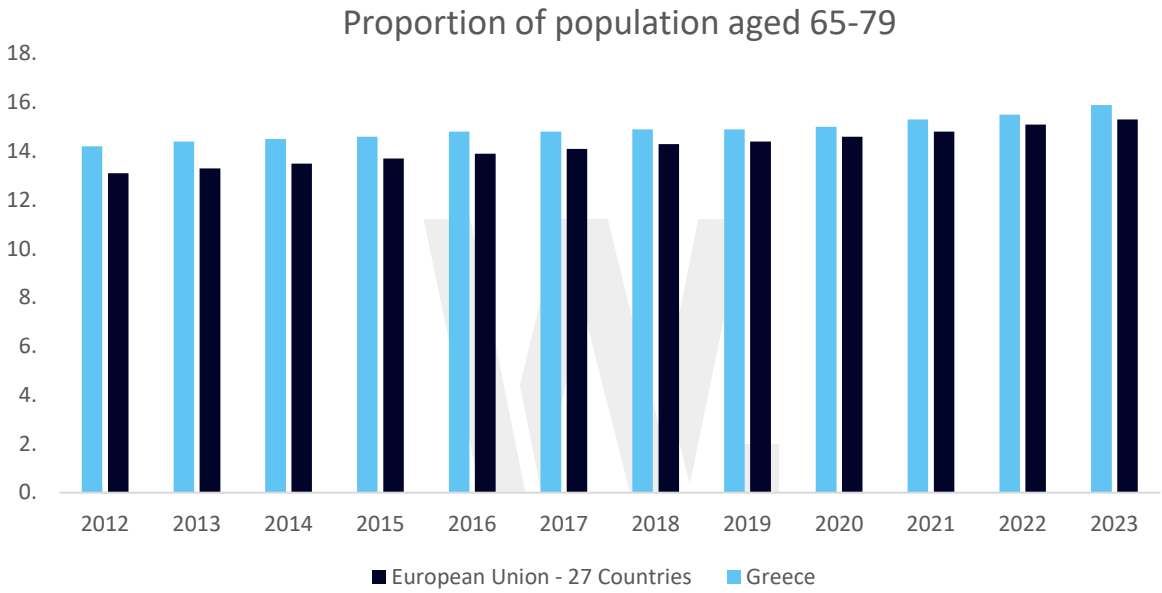
Source ELSTAT, 2023

Greece has a rapidly aging population



The graph provided illustrates a significant decline in Greece's young population since 2012. Unlike the broader EU-27 trend, Greece's young population has fallen below the European average since 2019.

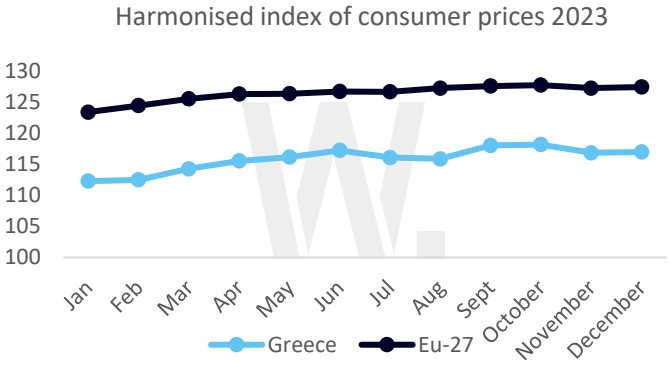
This consistent downward trend highlights a demographic challenge for Greece, contrasting sharply with the relatively stable youth population in the EU-27.



This graph complements the previous one by highlighting the steadily increasing aging population in Greece since 2012.

Source: Eurostat, 2023

One Million households in Greece are energy-poor.



Energy poverty in Greece has become a significant issue, exacerbated by the economic challenges and rising energy costs. The COVID-19 pandemic further intensified this problem, with many households experiencing reduced incomes and increased energy demands due to lockdowns and prolonged stays in energy-inefficient homes.

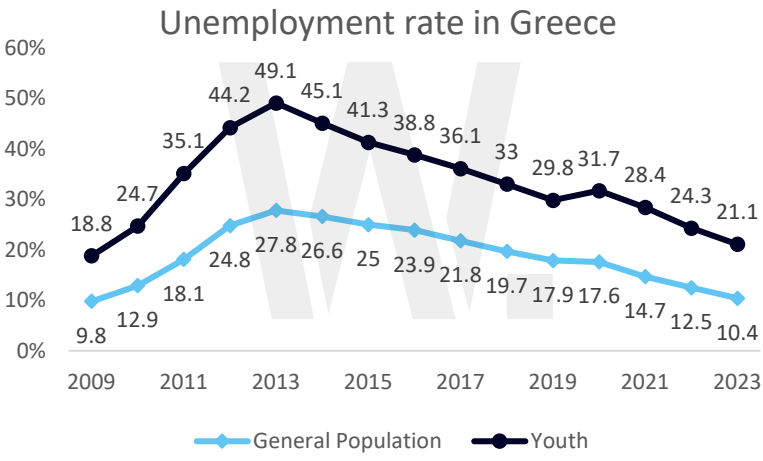
In 2021, Greece saw an average increase in energy bills by 42%, and by 2022, one in three households had to cut back on basic needs to afford energy costs. Greece's reliance on fossil gas for 40% of its electricity and market dynamics have left consumers particularly vulnerable.

The chart on the left shows the significant increase in the harmonised index of consumer prices for housing, water, gas electricity and other fuels in Greek households from January to December 2023. Prices for housing and consumers' energy needs spiked in April and May, following a downward trend and then plateauing during summer. However, the decline was short-lived, as Greece is now following the same trend as the EU-27 average, with prices rising significantly in September. Under the objective expenditure-based method, 58% of Greek households are energy poor. Among households under the poverty threshold, the energy poverty rate exceeds 90%

According to the data of the Action Plan to Combat Energy Poverty 2021 - 2030, there is a target to reduce energy poverty index by 50% by 2025 and 75% by 2030.

Efforts to combat energy poverty include government subsidies and the promotion of energy communities. However, the complexity of the institutional framework and limited access to the energy distribution network have hindered the effective implementation of these.

Average annual unemployment rate in Greece



The unemployment rate in Greece surged during the financial crisis, especially in 2013 when it peaked. In recent years, there has been a significant decline, though this progress was slowed by the COVID-19 pandemic in early 2020.

As seen in the graph, the unemployment rate shows a declining trend until 2023.
In 2023, the overall unemployment rate was 10.4%, with the youth unemployment rate significantly higher at 21.1%.

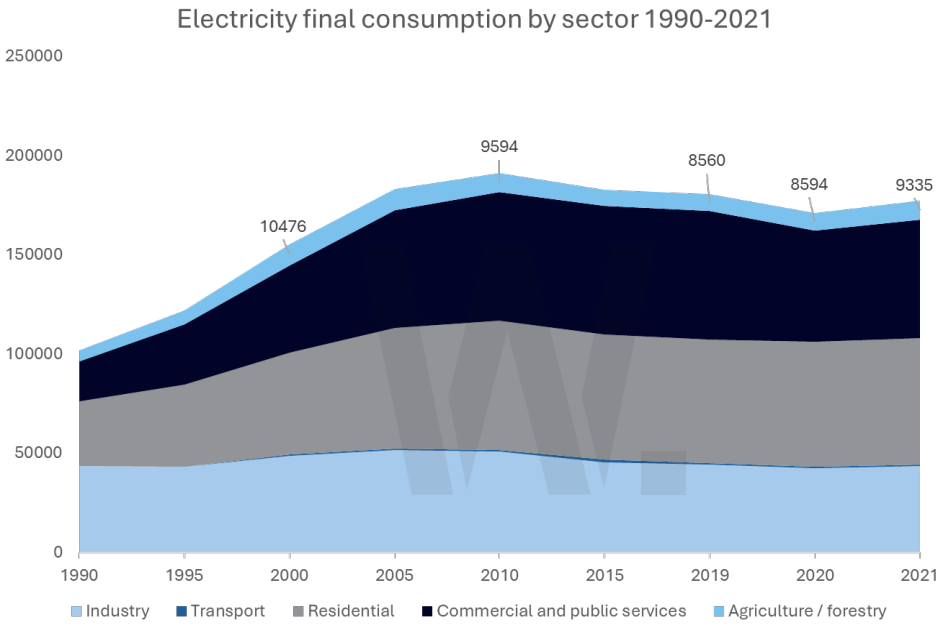
Greece ranks 2nd in the EU in terms of the unemployment rate.

Source: Springer

2

Energy Mix and Electricity

Greek Energy Consumption Profile



Source: IEA

Electricity Consumption

62,559 TJ in 2019 residential consumption

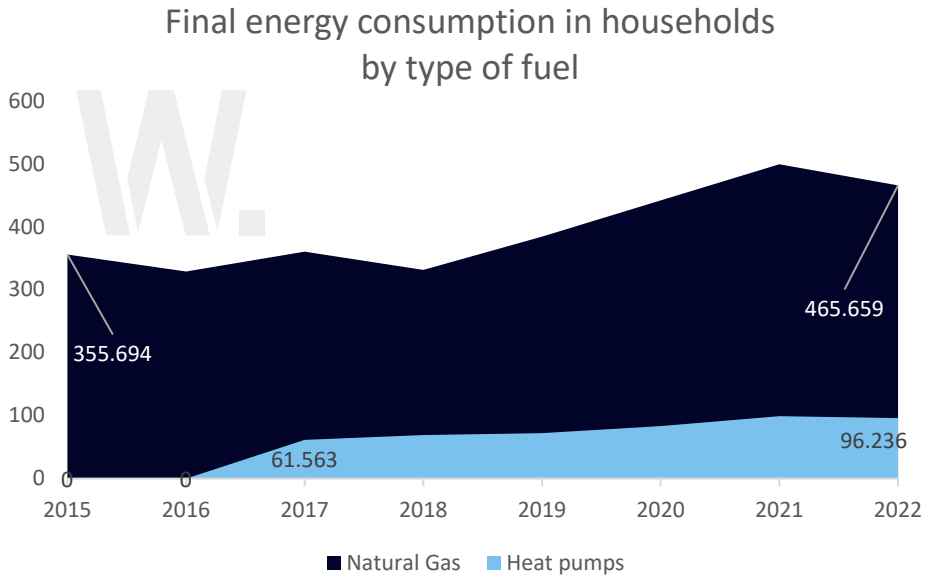
64,493 TJ in 2019 Commercial and public services consumption

Air Source Heat Pumps penetration

Increased market penetration since 2017. 58% increase between 2017 and 2022

Heat Pumps VS Natural Gas

Both show upwards trends, but the share of heat pumps is increasing more rapidly compared to natural gas. Increase of 31% of natural gas between 2015 and 2022



Electricity Demand Trends

Electricity demand in Greece has been shaped by a combination of economic factors, demographic changes, and evolving energy policies. As of recent data, Greece's electricity consumption has shown variability influenced by economic conditions and seasonal factors.

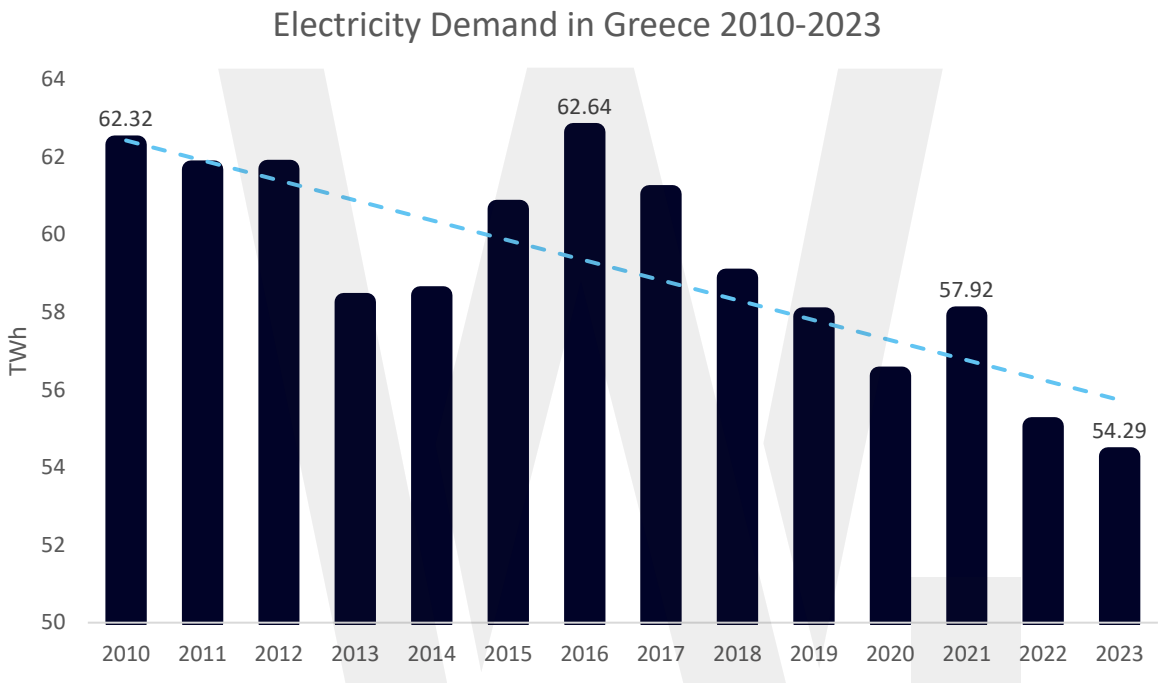
The country's economic recovery post-2008 financial crisis and the impact of the COVID-19 pandemic have played significant roles in shaping electricity demand. In 2021, the total electricity consumption was around 53 terawatt-hours (TWh), reflecting a moderate increase compared to previous years as economic activities resumed and industries ramped up production.

Electricity demand in Greece exhibits strong seasonal fluctuations, peaking during the summer months due to the extensive use of air conditioning and cooling systems. The tourism sector, a significant contributor to the Greek economy, also drives up electricity demand during these months. Conversely, winter months see increased consumption for heating, particularly in northern regions.

To support the growing demand and the integration of renewable energy, Greece is investing in modernizing its grid infrastructure.

The country faces several challenges in managing its electricity demand and supply. The aging infrastructure, the need for grid modernization, and the intermittency of renewable energy sources are critical issues. However, these challenges also present opportunities for innovation and investment. The deployment of smart grids, energy storage systems, and enhanced interconnections with neighboring countries are areas with significant potential.

The demand for electricity in Greece is on an upward trajectory, driven by economic recovery, demographic trends, and policy shifts towards sustainability. The transition to a cleaner energy mix, coupled with investments in infrastructure and technology, positions Greece to meet future electricity demands while advancing its climate goals.



In 2023, Greece's electricity demand was 54.3 terawatt-hours, following a steady decline over the past few years. From 2010 to date, figures peaked in 2013 at 62,64 terawatt-hours.

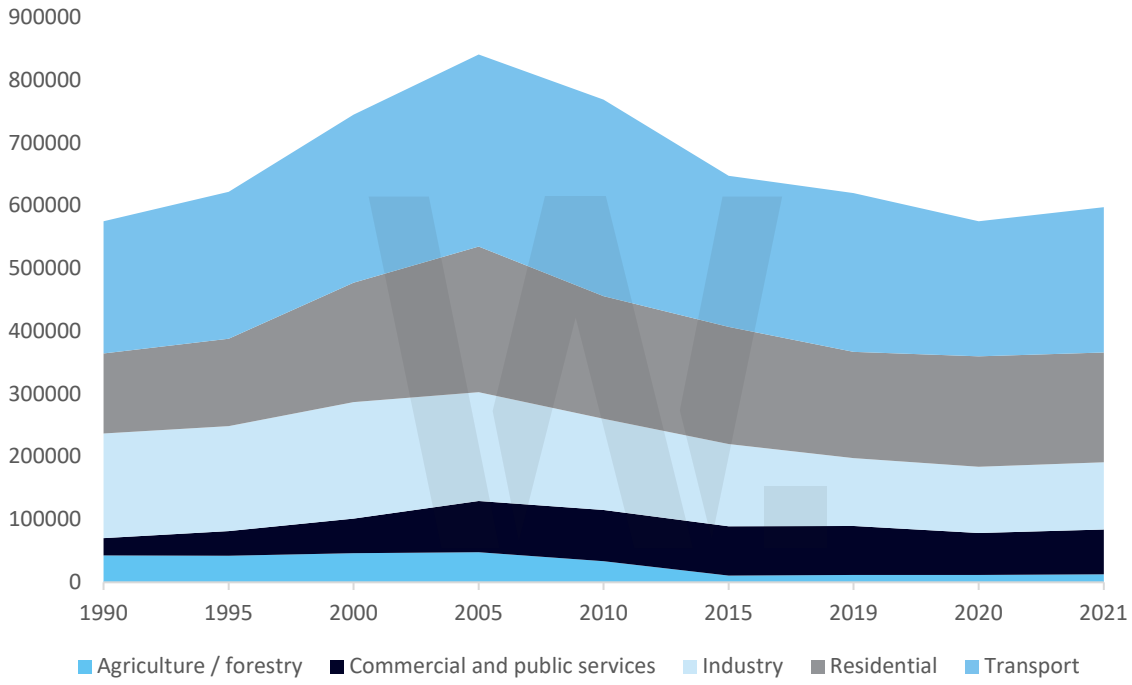
Electricity Demand Trends

Electricity demand based on the available data will be on an upwards trend given further electrification needs. The main drivers for that will be the electrification of transport and the increased requirements of EV chargers predominantly in cities and urban environment, along with the ongoing decarbonisation initiative and reduction of fossil fuel energy sources.

As presented the roll out of Air Source Heat Pumps and use of electricity for heating purposes in commercial and residential sectors will further increase the electricity consumption in specific regions with bigger cities and increased population.

This has the capacity to change the grid requirements and projections of electricity consumption in the coming decades.

Energy efficiency indicators per sector - Energy Intensity in Greece



The general trend across all sectors apart form services is that operations are becoming more energy efficient. This is driven partly because of general public expectations (modern and energy efficient buildings and commercial/office space) but also as a result of the introduction of various Government Schemes over the past decades which subsidize improvements to existing buildings, EV charging and eclectic car uptake, domestic solar and storage installation and general overall green initiatives.

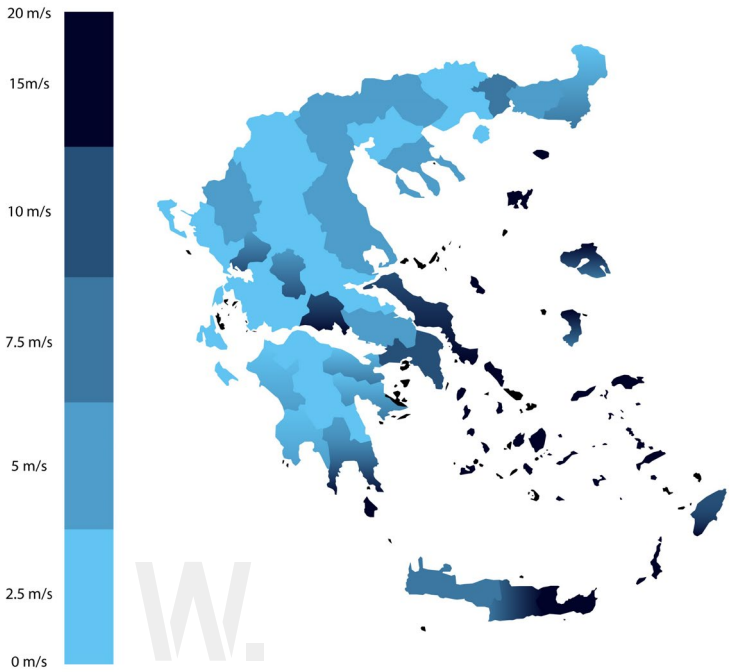
The government initiatives which are predominantly focused on minimizing the use of fossil fuels along with an increasing trend of increased energy requirements in bigger cities and urban landscape, will have an impact not only in higher electricity demand but also on where the demand is required.

Grid expansion along with energy storage strategy will have to align with where the main energy requirements are geographically to increase both capacity and efficiency. We believe that due to the above factors ESEK targets will need to be revised to reflect different demands.

3

Renewable Energy in Greece & EU

The Country's Wind Potential



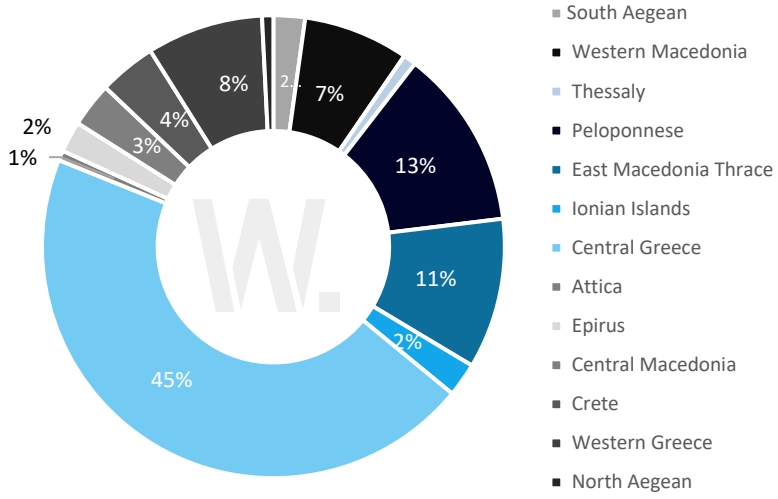
Source: RAE

The strong wind potential of the country is mainly concentrated in the Greek islands (Crete, Aegean, Evia, etc) as indicated on the map, while areas in Northern and Western Greece are also suitable for wind project development.

Further exploitation of wind power, in combination with technological improvements in the sector and modernization of current licensing legislation is expected to play a key role, enabling wind energy to make significant contributions towards sustainable development.

The lengthy licensing process for wind projects coupled with frequent interventions by the local communities, bureaucracy, and lack of a stable legal framework prevents many projects from reaching construction. According to the Hellenic Association of Wind Energy, it is evident that less than 13% of projects with a grid connection offer (or pending receipt of one) concern wind farms, while a whopping 85% corresponds to solar.

Percentage of wind projects Installed by region (2023)



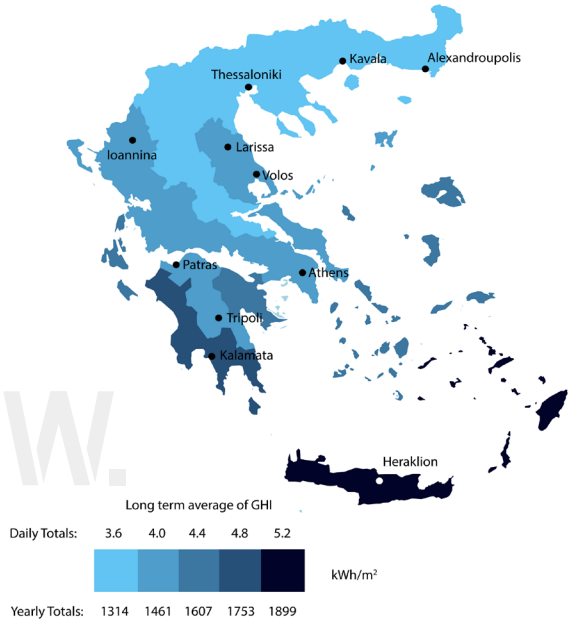
Source: Eletaen

Most of the country's installed wind capacity is currently located in the areas of Central Greece (2293MW), Peloponnese (639MW) and Eastern Macedonia and Thrace (534 MW).

The wind dynamics of the regions in Greece are expected to change once legislation for offshore wind is in place.

The Greek Ministry of Energy along with legislators, professional bodies and other stakeholders have taken important steps in this direction, but to date, despite the country's significant sea fronts and high wind potential, Greece lags behind other EU coastal countries that are already realizing the benefits of major offshore wind projects.

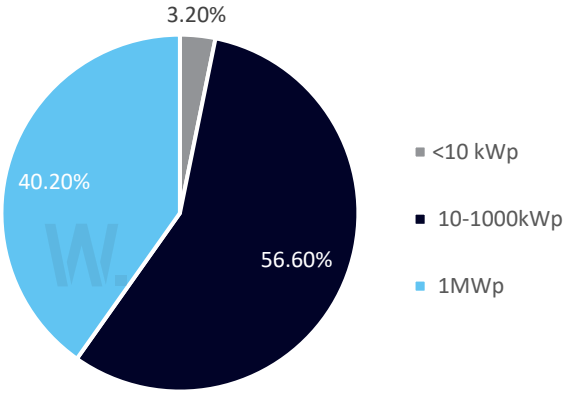
The Country's Solar Potential



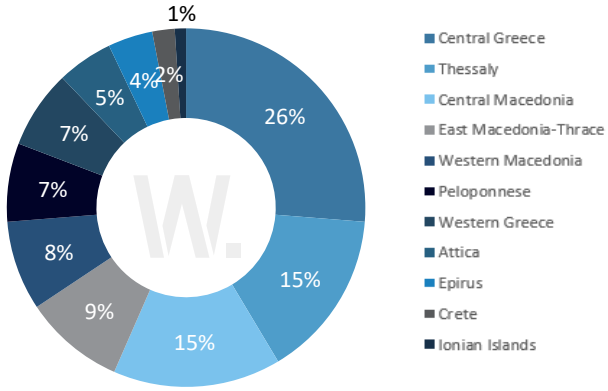
The prevailing conditions in Greece favour the development of solar PV mainly due to the high horizontal irradiation, which ranges between 1400-1800 kWh/m2 per year, depending on the latitude and topography of each region. This is evident on the solar resource map, where Peloponnese, Crete and Dodecanese islands benefit from the highest insolation, however, the whole country offers lucrative conditions for solar PV development, boasting one of the highest irradiation levels in Europe.

The steady, year-round sunlight that peaks during the summer months, conveniently coincides with the significant incoming tourism activity during the same period offering a significant seasonal correlation between energy demand and PV power generation.

Market share by size 2023



Percentage of solar projects installed by region 2022



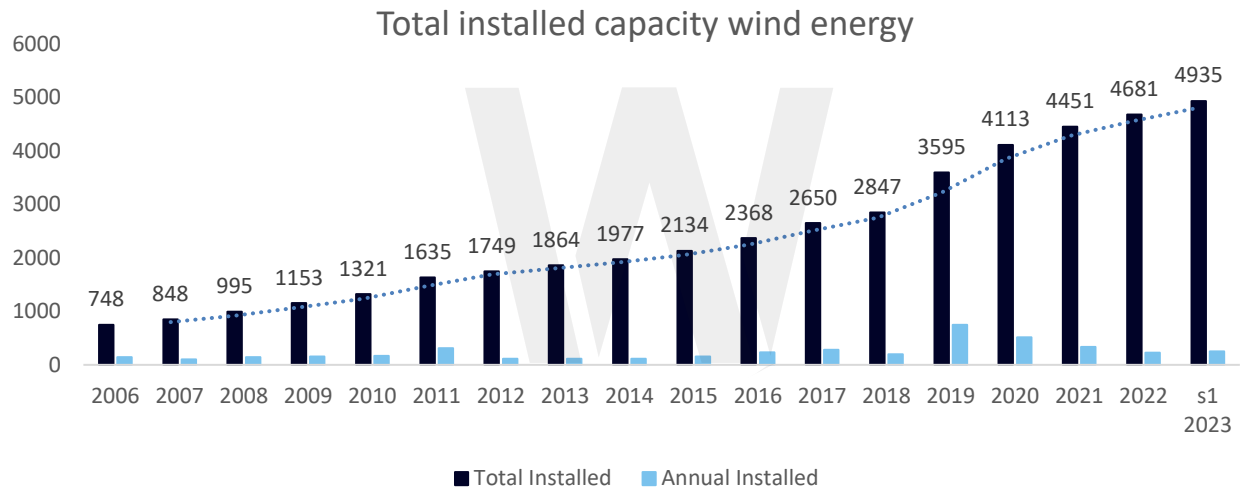
The majority of the solar production comes from small PV installations (P<1000kWp), holding a 67.6 % of the total solar capacity. However, this has significantly changed in 2023, with the percentage of the solar pv stations > 1MWp reaching 26% of the country's installed capacity.

This trend will change even further, as there is a shift toward utility-scale projects, due to technology advancements, large foreign investors entering the Greek market and congestion of Medium Voltage lines.

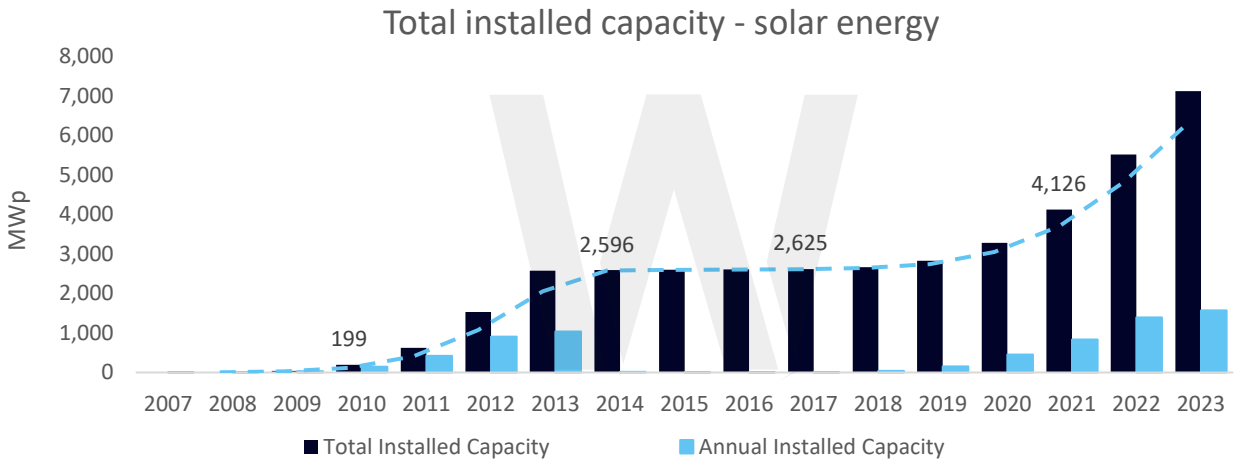
PV installations are nearly evenly dispersed across mainland Greece, with the largest concentration of projects in Central Macedonia and Thessaly. At the end of 2019, the total installed solar capacity in Greece was 2,288 MW and only 7.6% of this amount was provided by large scale PVs (above 5 MW).

Source: Helapco, Statista

Annual Wind & Solar Installed Capacity Growth (MW)



The growth of installed capacity for wind projects is linear, with the total installed capacity almost quadripling during the period of 2011-2023. The capacity added each year ranges from 100MW to 500MW, with the exception of 2018 to 2020 when the new annual capacity added reached a cumulative record high of over 1400 MW.

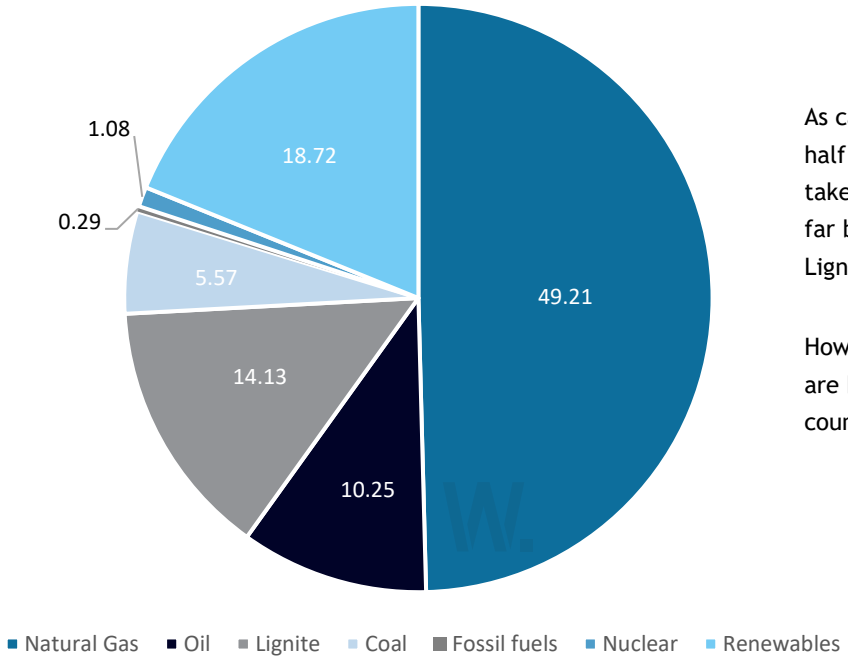


The Greek solar industry has experienced unprecedented growth over the last decade, with the total installed capacity of Solar PV projects growing almost at an equal amount in 22/23 compared to 2021 levels. The upward trend is set to continue over the next few years, as a large number of utility-scale projects is currently under construction or at a Ready to Build stage.

Source: Helapco, Eletaen

Greek Energy and Electricity Mix 2023

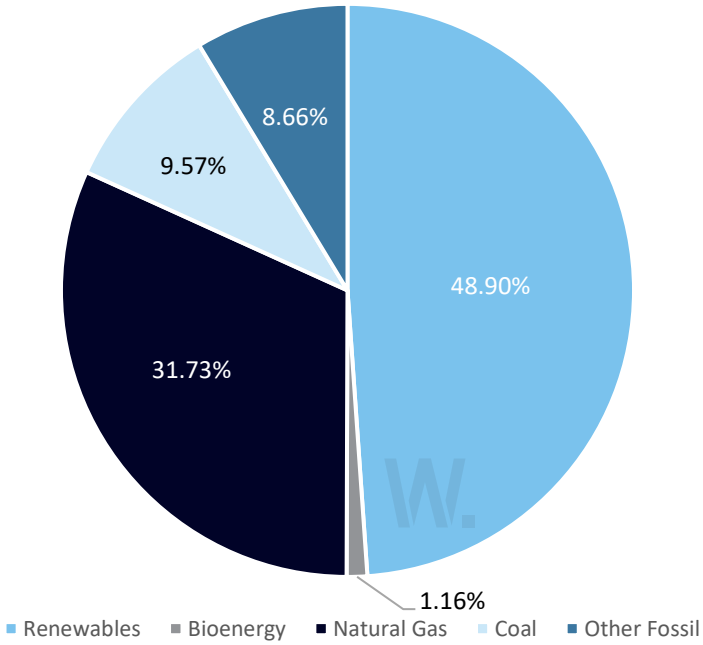
Greek Energy Mix (2023)



As can be seen in this chart almost half of the energy mix in Greece is taken over by Natural Gas. Lagging far behind are Renewables and Lignite closely follows.

However, lignite fired power plants are being phased out across the country by 2028.

Greek Electricity Generation Sources 2023



It is evident that Natural Gas still plays a big part in electricity production in Greece, however, in 2023 renewables surpassed natural gas in electricity generation in line with the NECP of the country.

Source: DG ENER and Eurostat

Renewable Energy in the European Union

The year 2023 was a landmark period for the renewable energy market, signaling significant advancements and a notable shift away from fossil fuel dependence. During this year, CO2 emissions, along with coal and gas consumption, plummeted to some of their lowest levels in recent history.

According to a comprehensive report by Ember, fossil fuels' contribution to the European Union's electricity mix experienced a remarkable 19% decline. For the first time ever, the share of fossil fuels fell below one-third of the total energy mix. This reduction is equivalent to a decrease of 157 million tones of carbon dioxide emissions. Notably, this achievement surpasses the 13% annual drop recorded during the 2020 pandemic year, underscoring the substantial progress made in just three years.

19% Decline in contribution of fossil fuels to the electricity mix

CO_2 -157 tonnes

A decline in the contribution of fossil fuels to the electricity mix

46% Decline in power sector emissions

43% Wind & solar in the energy mix

Since the peak in power sector emissions in 2007, there has been a remarkable 46% decline, marking a significant achievement in the transition towards cleaner energy. Coal generation experienced a dramatic 26% drop, now constituting just 12% of the EU's electricity mix. Similarly, gas generation followed suit with a 15% decline, representing the largest annual reduction since 1990. Gas now accounts for only 17% of the total EU electricity generation.

The overall reduction in emissions was further supported by a 3.4% decrease in electricity demand in 2023. A key driver of this positive trend has been the substantial rise in wind and solar generation, which contributed 43% to the energy mix. This increase accounted for 90 TWh of the fall in fossil fuel generation, underscoring the critical role of renewable energy in reducing dependency on fossil fuels

Source: Solar Power Europe, European Commission

Renewable Energy in the European Union

Renewable energy surged to a 44% share in the EU electricity mix, surpassing the 40% mark for the first time. Solar and wind were the main contributors accounting for 27% to EU electricity production, up from 23% in 2022. Wind and solar generation reached a peak increase of 90 TWh, and installed capacity growing by 73 GW. It is worth mentioning that solar showed exceptional growth, adding 56 GW of capacity in 2023, compared to 41 GW in 2022.

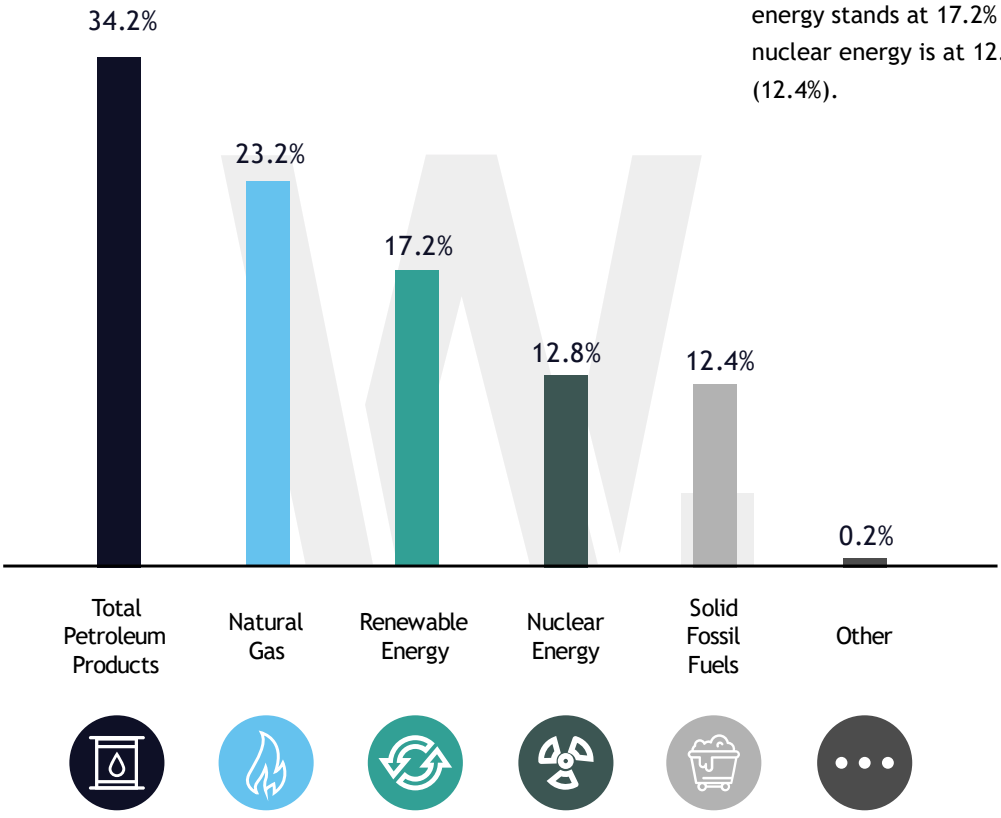
In addition to the aforementioned positive changes, in the market a significant portion (21 GW) of the EU's coal fleet is expected to close in 2024 and 2025. This includes the shutdown of 10 GW of coal power plants in Germany, primarily scheduled for April 2024. In 2025, several coal plants in Italy, Poland, and Greece will also cease operations, and Spain plans to close its remaining coal power plants as well. These closures will enhance the EU's position in terms of phasing out fossil fuels and committing to renewable energy source production.

44% Share of renewables in the EU electricity mix

20GW+ EU coal plants to be decommissioned by 2030

Energy mix for the European Union

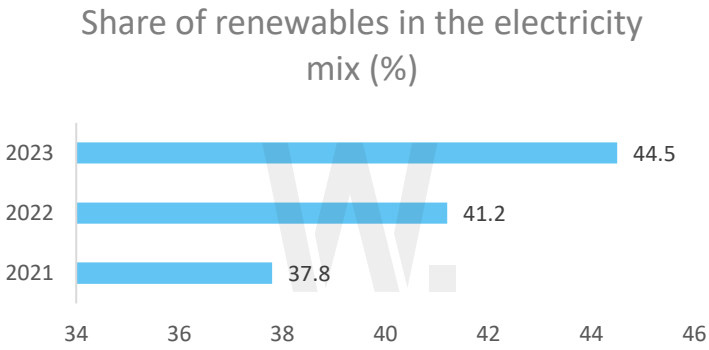
Petroleum products accounted for the highest share of energy production in the European Union in 2021 at 34%, followed by natural gas at 23.2%. Renewable energy stands at 17.2% of the EU energy mix, while nuclear energy is at 12.8% followed by solid fuels (12.4%).

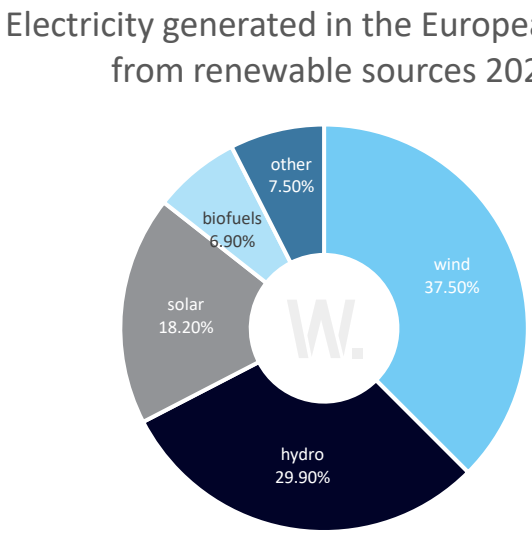


Source: Solar Power Europe, European Commission

European Electricity & Energy Mix

In 2022, renewable energy sources made up 41.2% of gross electricity consumption in the EU, 3.4 percentage points more than in 2021 (37.8%) and well ahead of other electricity-generation sources such as nuclear (less than 22%), gas (less than 20%) or coal (less than 17%). In total, renewable energy sources increased by 5.7% from 2021 to 2022.

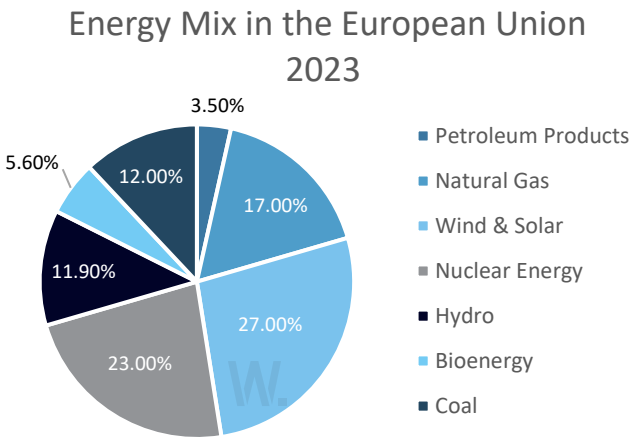




Wind and hydropower accounted for over two-thirds of the total electricity generated from renewable sources (37.5% and 29.9%, respectively). The remaining one-third of electricity came from solar (18.2%), solid biofuels (6.9%) and other renewable sources (7.5%). Solar power is the fastest-growing source; in 2008 it only accounted for 1% of the electricity consumed in the EU.

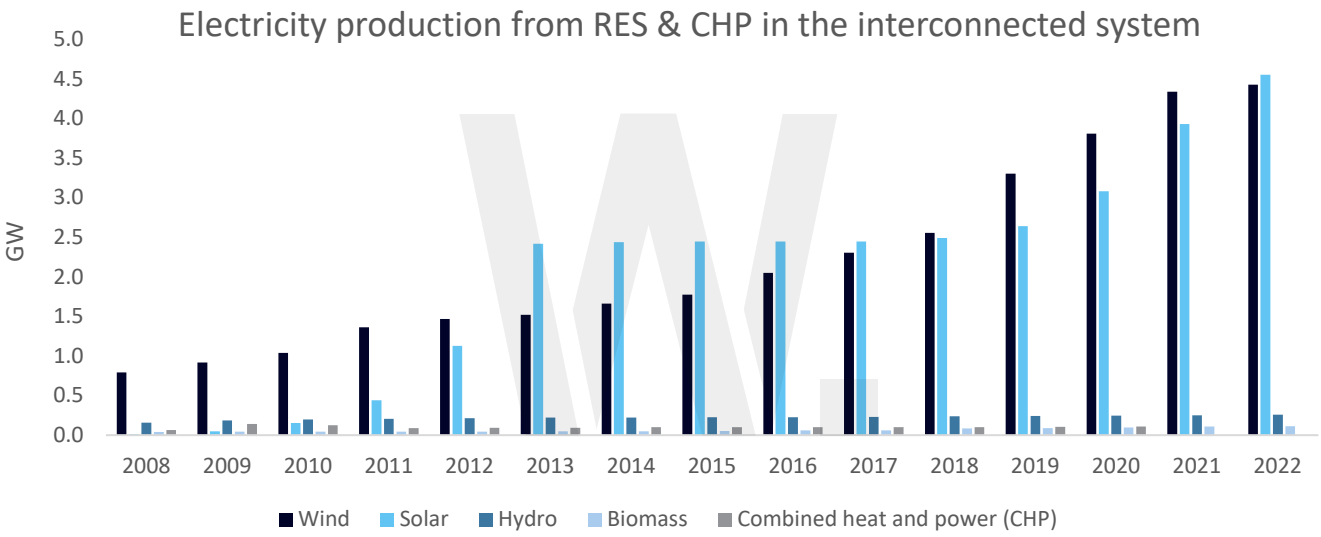
In 2023, the EU electricity mix hit a new record of more than two-thirds of electricity produced was from clean sources. Wind and solar combined produced 27% of total EU electricity generation more than nuclear at 23% and hydro at 12%.

Bioenergy and other renewables contributed a further 5.9%. The share of fossil generation fell to its lowest ever to 33% of total generation, from 39% in 2022. Gas remained the largest source of fossil generation at 17% in 2023, while coal generation only made up 12%.



Source: Eurostat, Ember

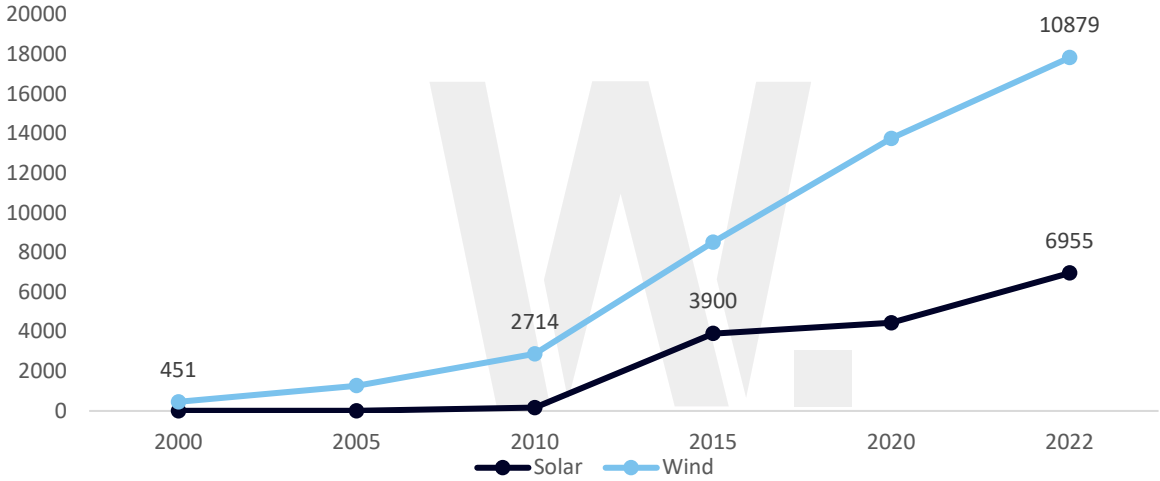
Share of total installed capacity (GW) and electricity generation (GWh) by technology in the Greek interconnected system (2008 - 2022)



RES penetration to the Greek market follows an upwards trajectory during the period 2018 to 2022. Hydro, biomass and CHP are relatively steady throughout the period under consideration.

Wind capacity growth is relatively steady since 2013 with projects picking up during 2018-2022. Solar is also steadily growing, with more projects coming on line during 2019 and 2022 after a relatively static period from 2013 to 2018.

Evolution of renewable electricity generation by source in Greece since 2000



4

Electricity Prices in Europe & Greece

Electricity prices Europe

In the third quarter of 2023 the European Market wholesale electricity prices were at a low level. The European Power Benchmark averaged 85 €/MWh in Q3 2023- 74% lower than in the third quarter of the previous year.

For the duration of the year all EU countries experienced a decline in prices on their wholesale electricity markets (ranging from -80% to -33%). The largest declines were registered in Finland and France (-80%), and Denmark (-77%).

The lowest quarterly average prices during Q3 2023 were recorded in Sweden and Finland, at 29 €/MWh and 44 €/MWh, respectively. In contrast, the highest prices were recorded in Malta and Italy (116 and 113 €/MWh), but still lower than in the third quarter of the previous year.

74% YoY electricity prices Reduction in Europe

Lowest average prices – Q3 2023

Sweden **29€ / MWh**

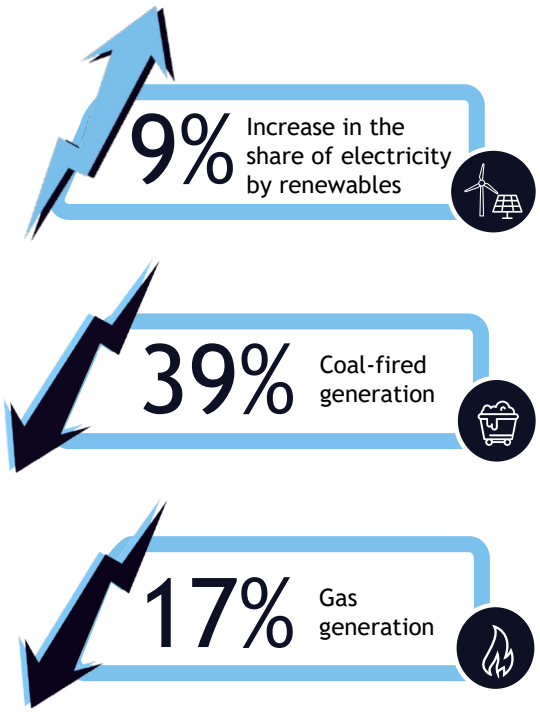
Finland **44€ / MWh**

Highest average prices – Q3 2023

Malta **116€ / MWh**

Italy **113€ / MWh**

The share of electricity in the 3d quarter 2023



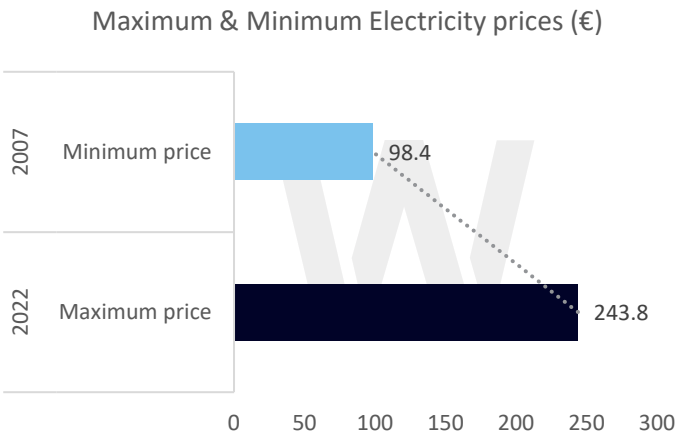
The share of electricity generated by renewables increased for the third consecutive quarter to 46% in the third quarter 2023 a significant increase of 9%, while the share of fossil fuels-fired electricity fell by 9%. Solar generation surged by 23% and onshore wind output rose by 21%.

Coal-fired generation fell by 39%, whereas less CO2-intensive gas generation dropped by 17%. Overall, fossil fuel generation fell by 23% in the third quarter of 2023, supported by lower demand and sustained renewables generation. Nuclear generation recovered in the third quarter of 2023 rising by 7% when compared with the quarter of the previous year.

The EU's electricity consumption in the third quarter in 2023 fell by 4% for another quarter compared with last year's levels. Electricity consumption was lower than the same quarterly figure in 2020, which was historically low due to the impact of COVID.

Source: Eurostat

Electricity prices EU & Greece



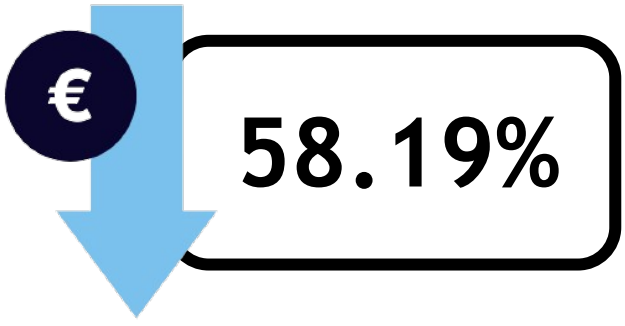
After a significant increase in prices that started before the Russian invasion of Ukraine, but skyrocketed through the second semester of 2022, electricity and gas prices stabilized. The prices of energy rose due to an increase in the price of natural gas, which is considered the marginal fuel. This happened because the imports from Russia decreased, and other importers were sought. The energy market is priced after the marginal fuel, which means that the price of natural gas affects the prices of the electricity market. Mechanisms were constructed to alleviate the burden on consumers, and one of these were subsidies.

Electricity prices rose in 22 EU countries in the first half of 2023. The largest increase (86%) was reported in the Netherlands. This increase is related to several factors: tax relief measures from 2022 were not continued in 2023 and at the same time, energy taxes on electricity doubled for households

Average household electricity prices in the first half of 2023 were lowest in Bulgaria (€11.4 per 100 kWh), Hungary (€11.6), and Malta (€12.6) and highest in the Netherlands (€47.5), Belgium (€43.5), Romania (€42.0), and Germany (€41.3).

The price without taxes on electricity and natural gas is decreasing. The countries slowly withdraw their support measures. As a result, the final customer prices with taxes are slightly higher than the previous reference period. Compared with the first half of 2022, in the first half of 2023 the share of taxes in electricity bills dropped from 23% to 19% and in the gas bill from 27% to 19%, with all EU countries having in place governmental allowances and subsidies or reducing taxes and levies to mitigate high-energy costs.

The average price of electricity in Greece, in December of 2023, was **230.9€/MWh**. Electricity price has decreased by € 18 MWh, 0.77% less than the previous semester. Meanwhile, the average price of electricity without taxes in Greece in that period was € 190.5/MWh, compared to € 187.6/MWh in the previous semester. The price of electricity excluding taxes increased by 1.55%. Overall, the price of electricity in Greece compared to the previous year has fallen by 58.19%. The maximum price of electricity reached was € 243.8 MWh, in December of 2022. Its minimum price was €98.4 MWh, December of 2007.



Reduction of the price of electricity in Greece compared to the previous year

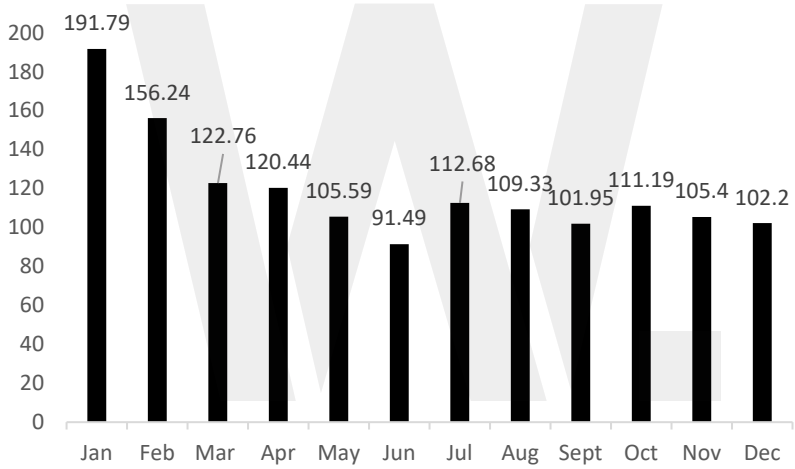
Source: Eurostat

Electricity Prices Greece & EU

In Greece, consumers received compensations in their electricity bills as a support measure for the energy crisis. For household consumers, the compensation ranged from 40€ to 330€, with the highest amount recorded in January 2022. For non-household consumers, the maximum amount was 134€, provided only for January and February.

There were no support measures for natural gas consumption during the reference period. Natural gas used for electricity production was exempt from subsidies. The level of the subsidy varied for the two categories of consumers and for each month. In the second semester of 2022, only non-household consumers, excluding electricity production, received a subsidy for the period July-October 2022.

Monthly average electricity baseload price in the day-ahead market (DAM) in Greece in 2023



In 2023, electricity prices in Greece remained among the highest in Europe

For households, the price in September 2023 was approximately €0.246 per kWh, while for businesses, it was around €0.277 per kWh.

Throughout the year, Greece had some of the highest wholesale electricity prices in the EU, with early January prices exceeding €218 per MWh. This was much higher than in other EU countries like Germany and Denmark, where prices were about €59 per MWh. This high cost is partly due to Greece's energy market structure and reliance on natural gas.

Additionally, electricity prices for households saw a significant increase in the second half of 2023 compared to the previous year, reflecting a broader trend across the EU due to factors like changes in fuel costs and market regulations.

The graph shows the monthly average electricity baseload price in the day-ahead market in Greece from January 2023 to December 2023, where the impact of the disruptions due to gas shortage is evident, with a peak in January at 191.79€.

In January 2023, the monthly average electricity baseload price in Greece's day-ahead market (DAM) reached a peak of 191.79 euros per megawatt-hour. Prices began to decline in Q2 of 2023 and started to increase again towards the end of the year. However, as of the end of 2023, they had not yet returned to pre-pandemic levels.

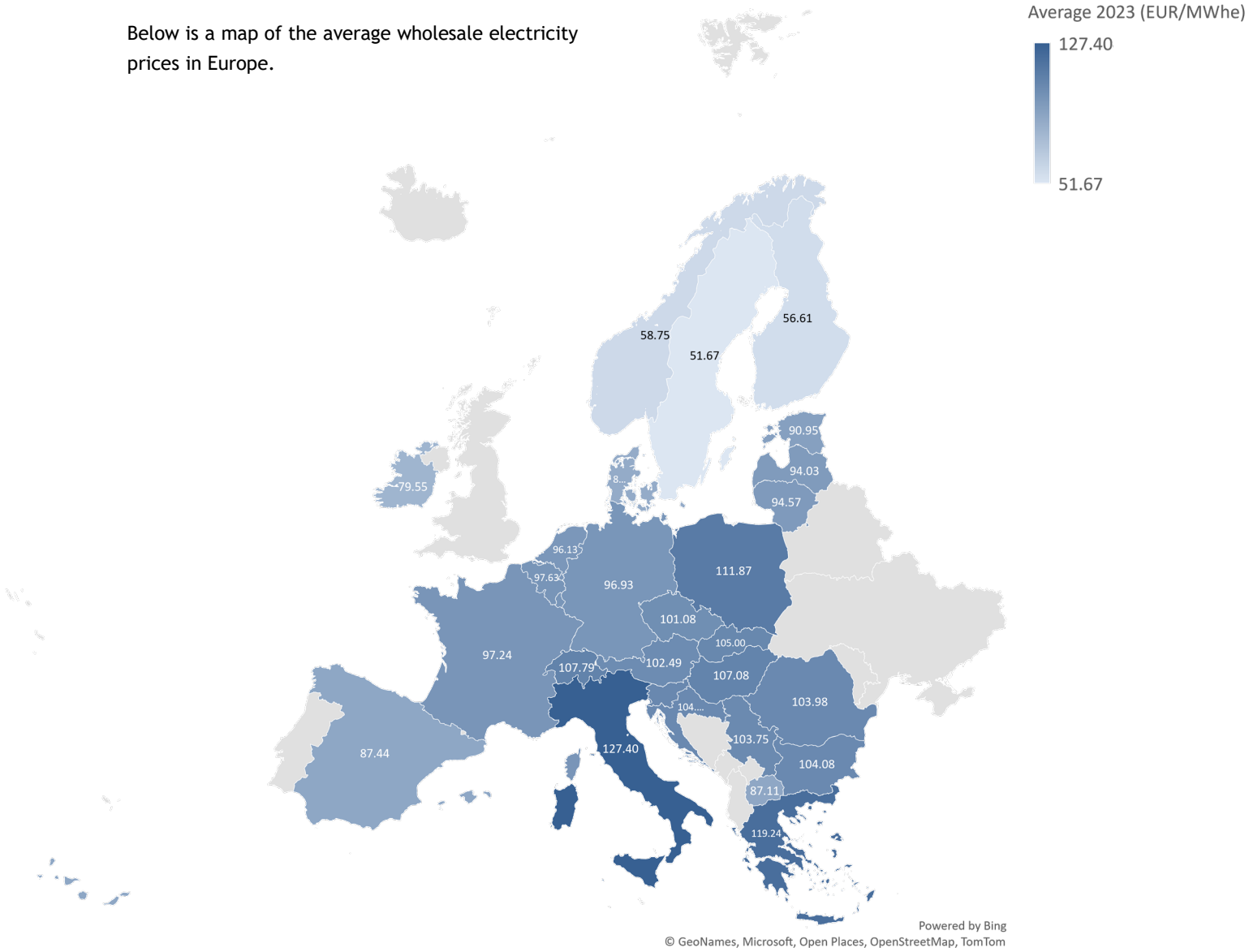
Source: Eurostat, Global Petrol Prices

Average Wholesale Prices in Europe (Up to 2022)

The Wholesale Electricity prices in Greece in the first quarter of 2023 were one of the highest in Europe along with Italy, reporting quarterly average prices of 157 and 158 € /MWh respectively.

Figures that were 34% and 37% lower than in Q1 2022. The European Benchmark marked an average of 122 €/MWh in Q1 2023 which was significantly lower compared to Q4 2022.

Below is a map of the average wholesale electricity prices in Europe.

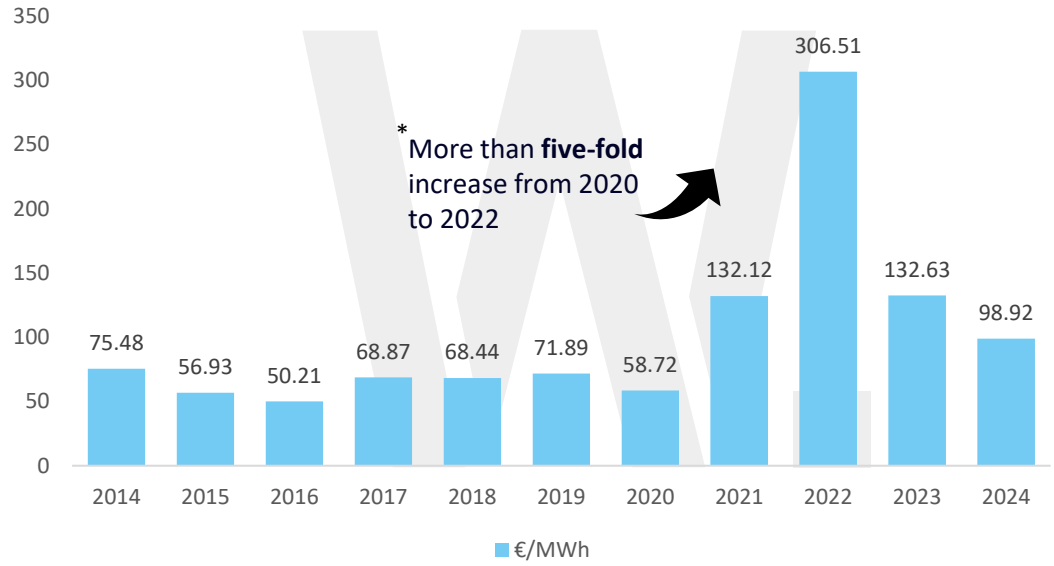


Only regions with data are displayed.

The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Wattcrop Hellas M IKE concerning the legal status of any country, territory, city or area or concerning the delimitation of its frontiers or boundaries.

Source: ENTSOe, GME

Weighted Average Price of Electricity Market in Greece in the Interconnected System 2014-2024



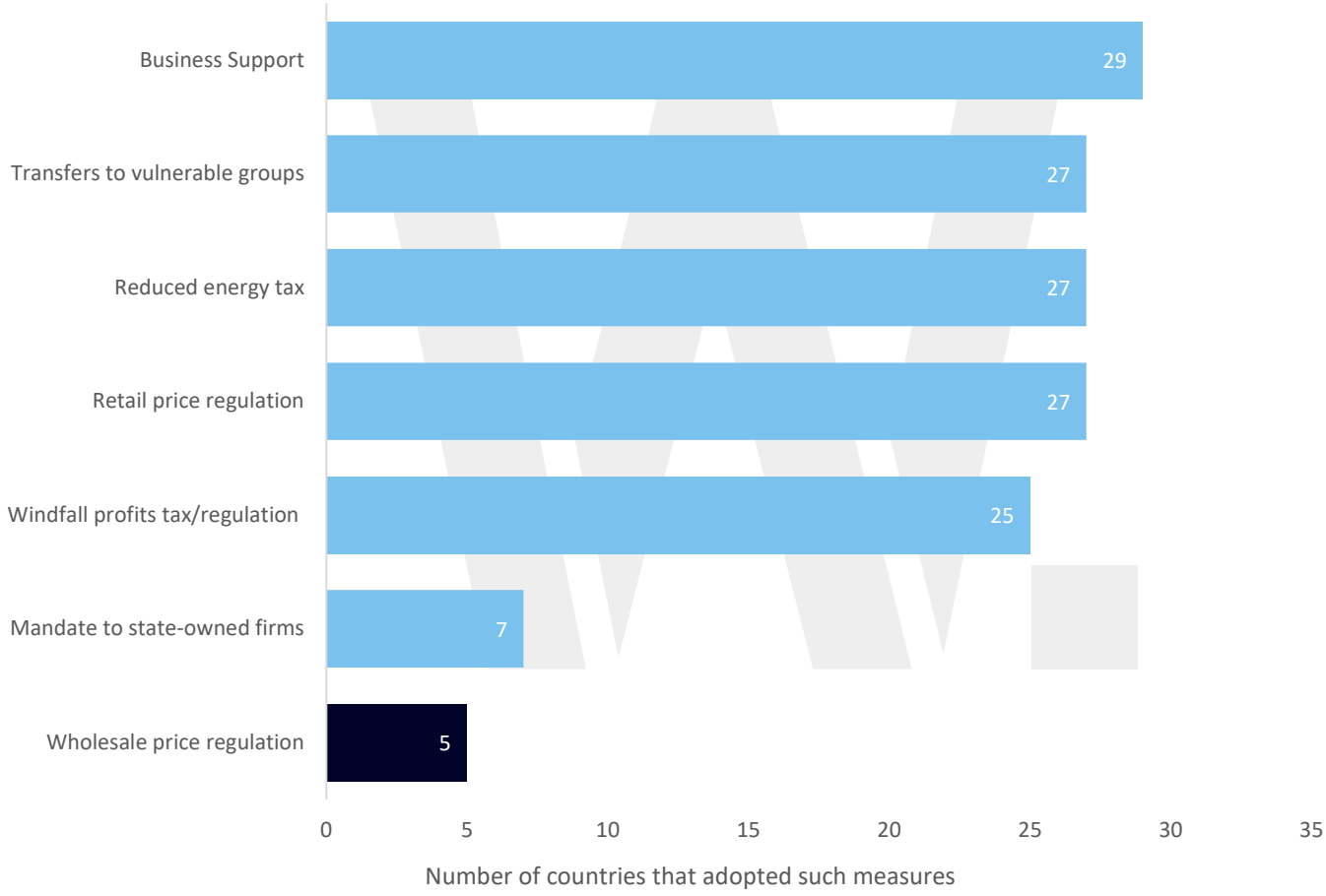
The first signs of a potential energy crisis in Europe emerged in 2021, with gas prices rising exponentially. The TTF day-ahead[1] went up by a whopping 585% within a year, from December 2020 to December 2021.

In Greece, prices reached an all-time high in August 2022, with an average price of 455.49€/MWh. This unprecedented surge in gas and subsequently energy prices has been caused by a combination of factors, as laid out below:

Source: European Union Institute for Security Studies (EUISS)

*1. TTF Day-Ahead means the arithmetic average of the bid and offer prices of the TTF Price Assessment Day-Ahead or Weekend, as published in the ICIS European Spot Gas Markets report, in Euro/MWh; Source: Lawinsider

Government measures to support households and businesses amid the energy crisis in Europe (Sep 2021 - Jan 2023)



Measures adopted by the Greek Government

Measures **not** adopted by the Greek Government

* Note: The data include all EU countries, the United Kingdom and Norway

Source: www.bruegel.org

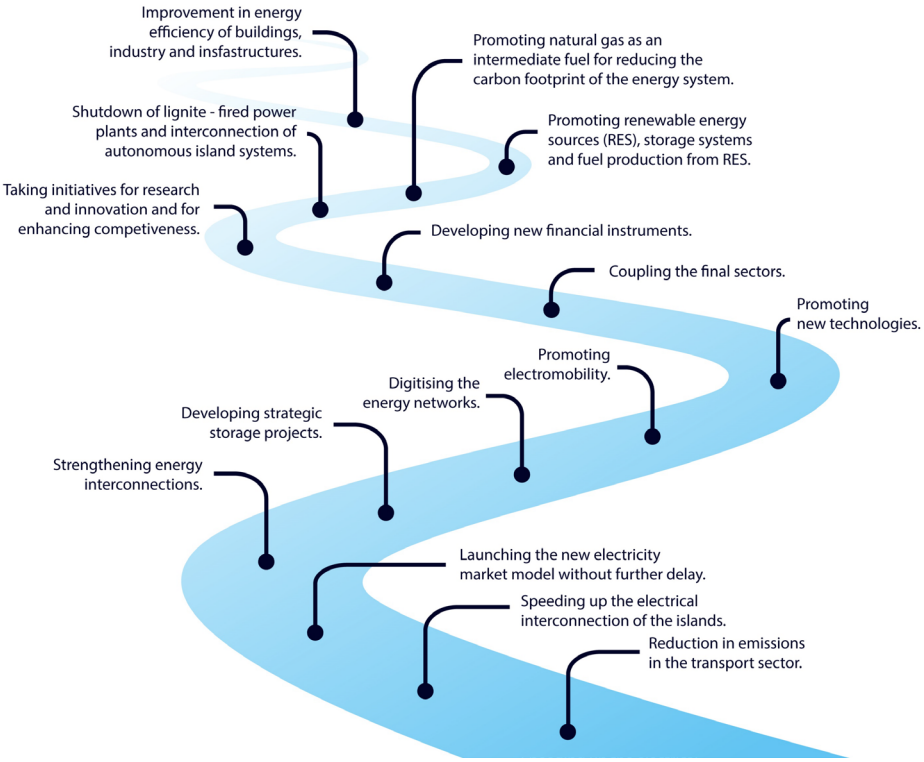
5

National Energy & Climate Plan

The National Energy & Climate Plan, Draft Apr 2023

The NECP provides a roadmap for a substantial reduction in greenhouse gas emissions (GHG). The core objective is set for 40% reduction in GHG emissions in 2030 compared to 1990, or more than 55% compared to 2005 levels.

Some of the main policy measures outlined in the roadmap are described:



Actions to be undertaken for the implementation of the NEC Plan

Security of Energy Supply

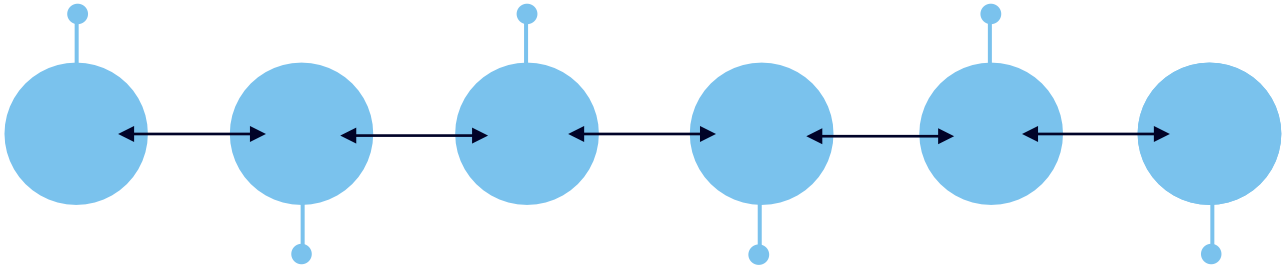
Through diversification, ensuring uninterrupted and reliable coverage of domestic and regional energy needs.

Low-carbon economy

By integrating RES in the electricity market in a competitive manner.

Bioclimatic town and urban planning

To realize energy savings while improving the quality of life.



Completion of a sustainable energy market

Through restructuring, innovation and strengthened competition.

Physical Planning

By rethinking the structure and functionality of modern cities improving their energy and climate footprint.

Energy efficiency

Covering the entire scope of policies and all fields of consumption.

Key Drivers for Renewables

Enhancing Energy Efficiency

Final energy consumption not to exceed 15-4 Mtoe, and primary energy 19.1 Mtoe in 2030.
To achieve an improvement in energy efficiency by 49%

Reducing GHG emissions and environmental objectives

Total GHG emissions to be reduced by 54% compared to 1990.

Shut down lignite power plants by 2028

Increasing the RES share in energy consumption

- The RES share in gross final energy consumption to reach at least 42%
- RES share in gross final electricity consumption to reach at least 79%
- RES share in covering heating and cooling needs to exceed 46%
- RES share in the transport sector to exceed 29%

Simplification of the licensing process.

To cut down on project implementation times, to accelerate investment in this sector and eventually to strengthen investor confidence and thus attract new investment.

01

02

Combination of RES and storage.

This combination opens up new prospects for participation in additional energy markets, such as the balancing market and the long-term capacity compensation scheme.

Licensing and framework for offshore wind and floating solar.

Through a special regulatory (licensing and support scheme) and physical planning framework.

03

04

Promotion of electromobility.

Through an efficient package of measures and policies to facilitate the increase in the number of electric vehicles, while simultaneously building the necessary infrastructure and network.

Promotion of new technologies.

Promotion of new technologies and coupling of energy sectors with a focus on making maximum use of domestic renewable energy potential.

05

06

Development of energy networks.

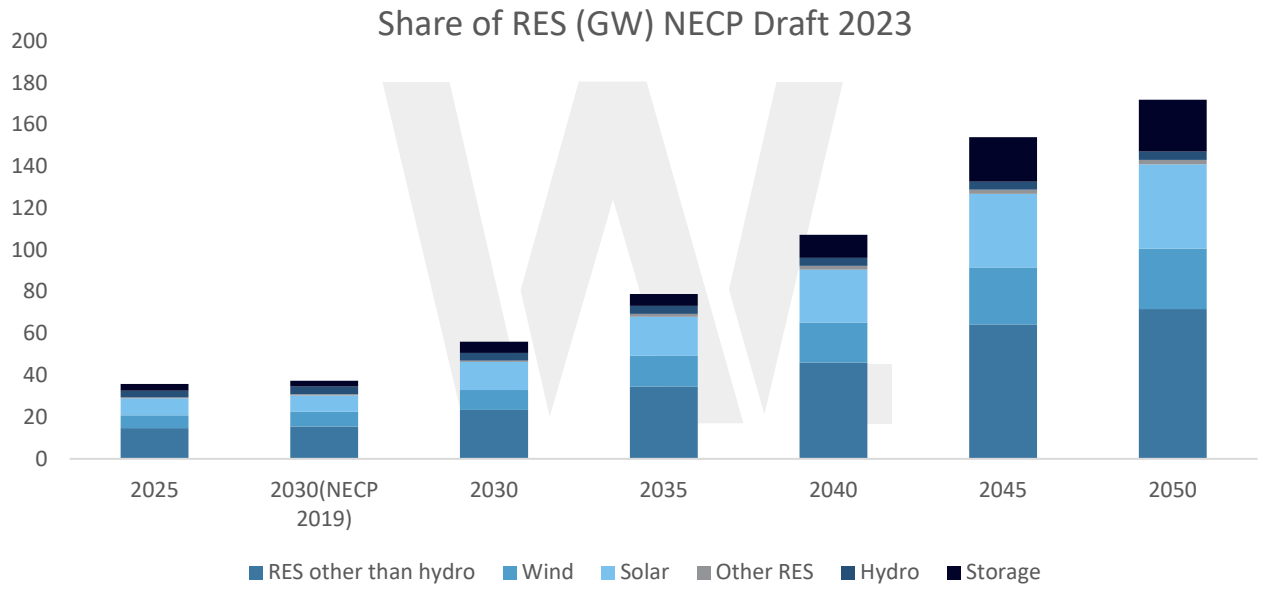
Development and strengthening of energy networks and optimal integration and operation of RES plants - energy storage.

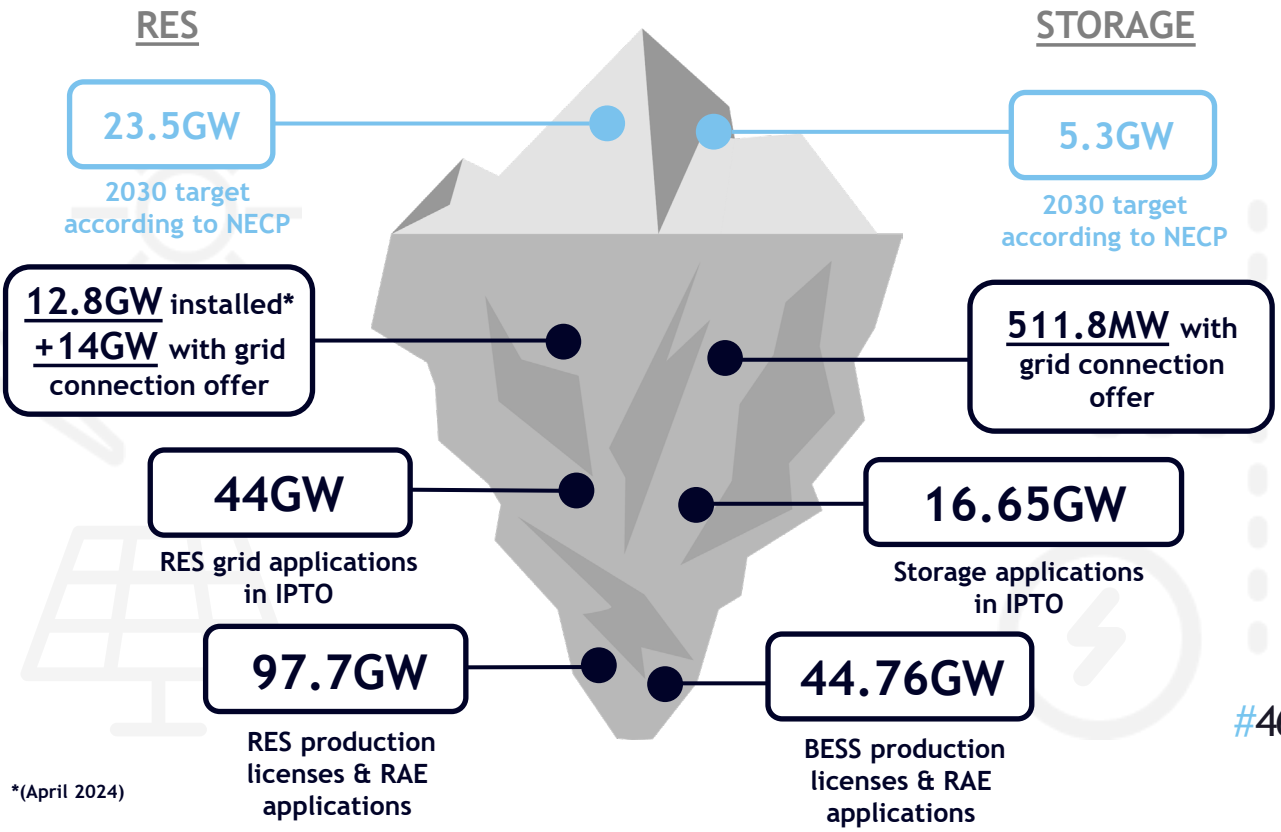
Source: EC.Europa *https://energy.ec.europa.eu/system/files/2020-03/el_final_necp_main_en_0.pdf

Renewable Energy Penetration 2020-2030 (NECP)

As presented in the National Energy and Climate Plan, as an obligation of the European Union, the scenarios, although optimistic when drafted, seems rather pessimistic nowadays, especially if we consider the RES investments so far. Considering the grid upgrades IPTO has planned for the next decade, and the forthcoming enhancement in PV modules technology, the RES penetration seems to move forward faster than previously planned. Finally, if we take into account the framework planned for Battery Energy Storage Systems, which will help RES Integration, new targets might have to be set by the state.

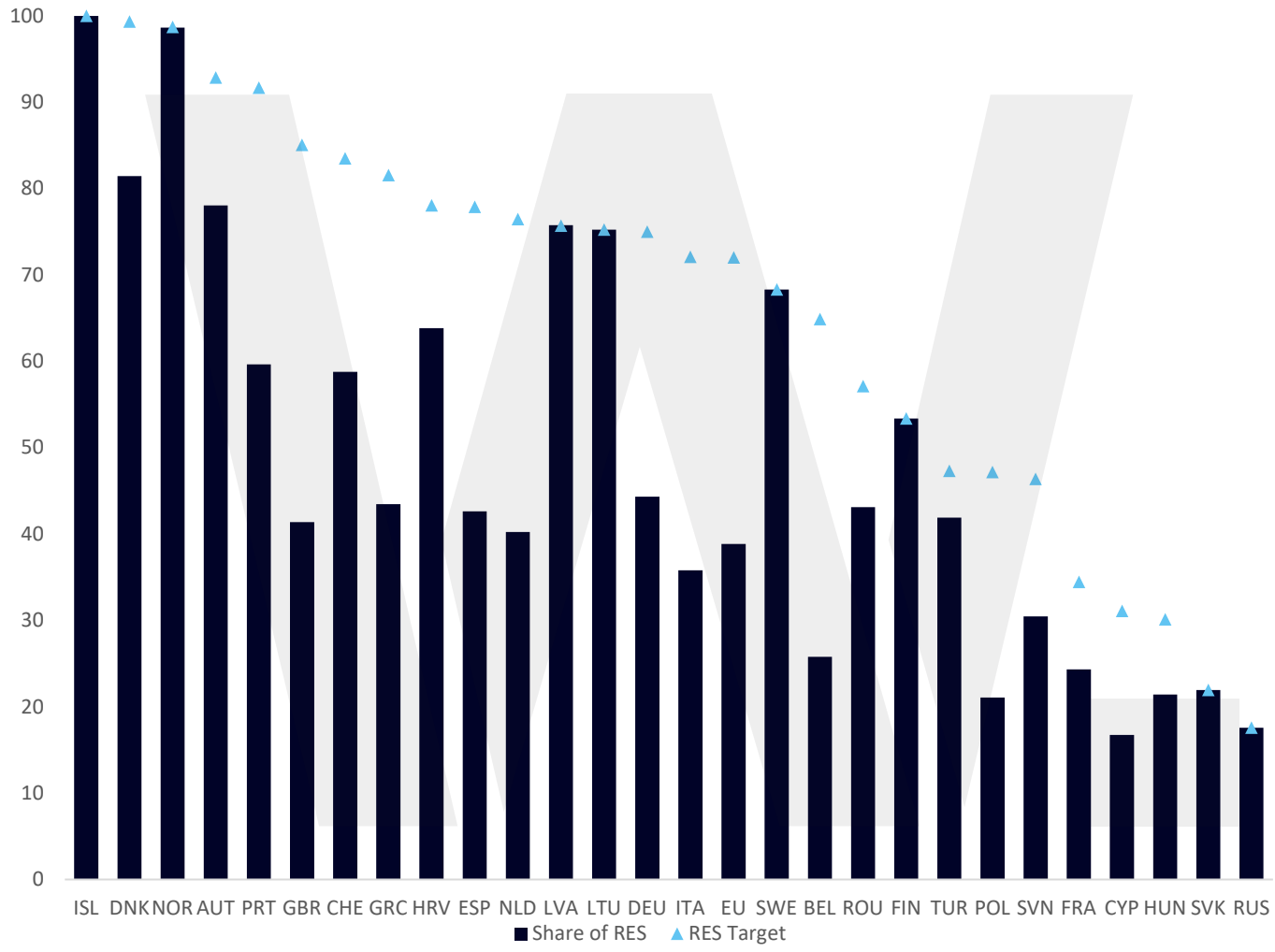
The gradual interconnection of Crete, Cyclades, North Aegean and Dodecanese with the mainland and the electrification of transport and heating/cooling will increase the electricity demand up to 61 TWh by 2030.





*(April 2024)

Share of total electricity generated by renewables: current (2022) and target (2030)



It is worth noting that Greece announced a revised NECP released as a draft in November 2023. This might change slightly the current percentage in comparison to the NECP 2019 initial targets.

However, Greece in 2023 was standing at approximately 50% of renewables in the electricity generation, according to the Deputy Minister of Environment and Energy.

Source: Ember, eKathimerini

6

The Greek Energy Market

Timeline of the liberalization process in the Greek energy market

The licensing process in Greece for Renewable Energy Projects

Regulatory Authority for Energy in Greece. Only projects >1MW submitted for receipt of a production license.

Digital Environmental Registry. Environmental Impact Assesments in Greece are required only for projects a certain threshold.

RAE → LICENSING → EIA

Submission of application to competent authorities such as archaeology, planning office, agricultural office etc.

To date Wattcrop has not participated in any of the auctions, choosing to enter into corporate PPAs with domestic off-takers.

GRID → PPA/AUCTION → INSTALLATION

Independent Power Transmission Operator. Grants grid connection offers for projects >8MW.

Installation Permit is received after successful completion of all the previous steps.

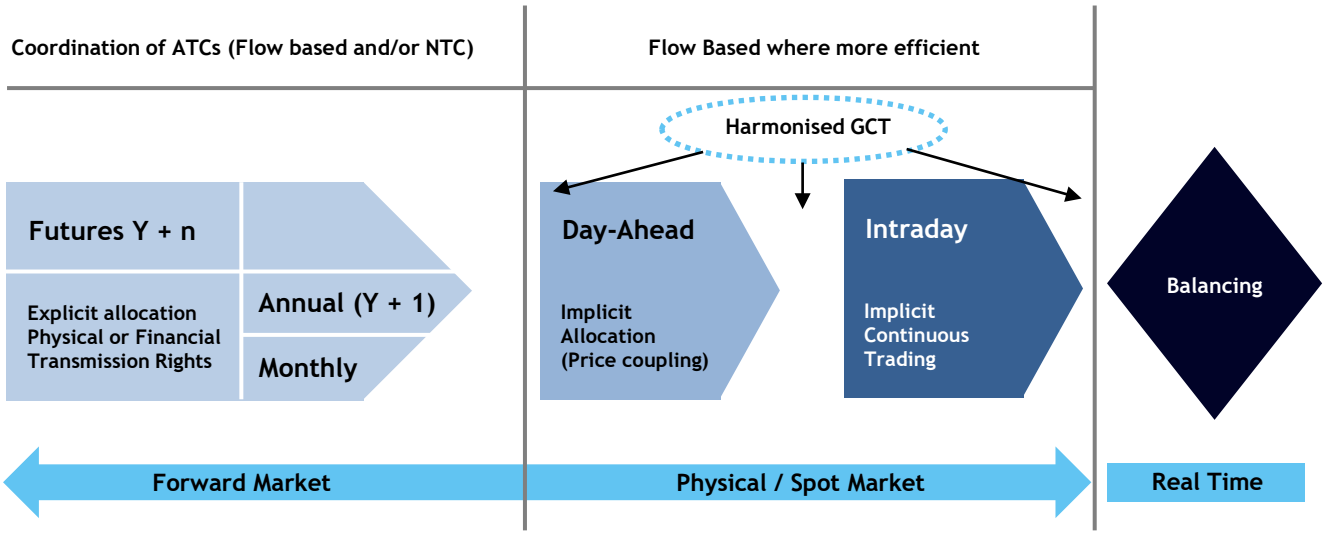
European Target Model & Electricity Markets in SEE

Greece, among seven other countries in the Southeast Europe region, has liberalized wholesale electricity markets, operating established internal spot electricity markets.

The European Target Model includes both the explicit allocation of transmission capacities in the form of annual and monthly transmission rights (derivatives market) as well as the implicit allocation in the day-ahead and Intraday markets (spot market).

The adoption of the Target Model is expected to promote competition, increase transparency, enhance system operation through the efficient use of interconnections and allow for increased possibility of transactions (including exports) of electricity from RES.

The implementation of the target model replaces the day-ahead scheduling and replaces it with the day-ahead market, intraday market and balancing market as per schematic below.



ATC - Available Transmission Capacity | NTC - Net Transfer Capacity | GTC - Gate Closure Time

Aggregators - Offtakers

The Greek Renewable Energy Market has been evolving and maturing for the past 10 years with big projects being developed across the country and international investors expressing active interest in the market. However, the market is still taking shape and form and therefore it is lagging in some areas such as the lack of, until recently, aggregators in the market which would ensure a more stable renewable energy supply and support the energy prices on the producer's side as well as on the consumers.

The European Union set out the framework concerning the internal electricity market of each member state which set the framework for the liberalization of the electricity markets in the EU in 1996 with its latest revision in 2009 which introduced the concept of the aggregators. In Greece, this framework was introduced as law4001/2011 which was released in 2011.

The Agency for the Cooperation of Energy Regulators - ACER, has suggested the "Target Model" whose goal is to achieve the optimization of the use of the Transmission System's capacity through coordinated practices of the System Operators, which in turn will lead to reliable prices and liquidity in the allocation of the interconnection capacity for the day- ahead market and the efficient planning of intraday markets for the allocation of the interconnection capacity.

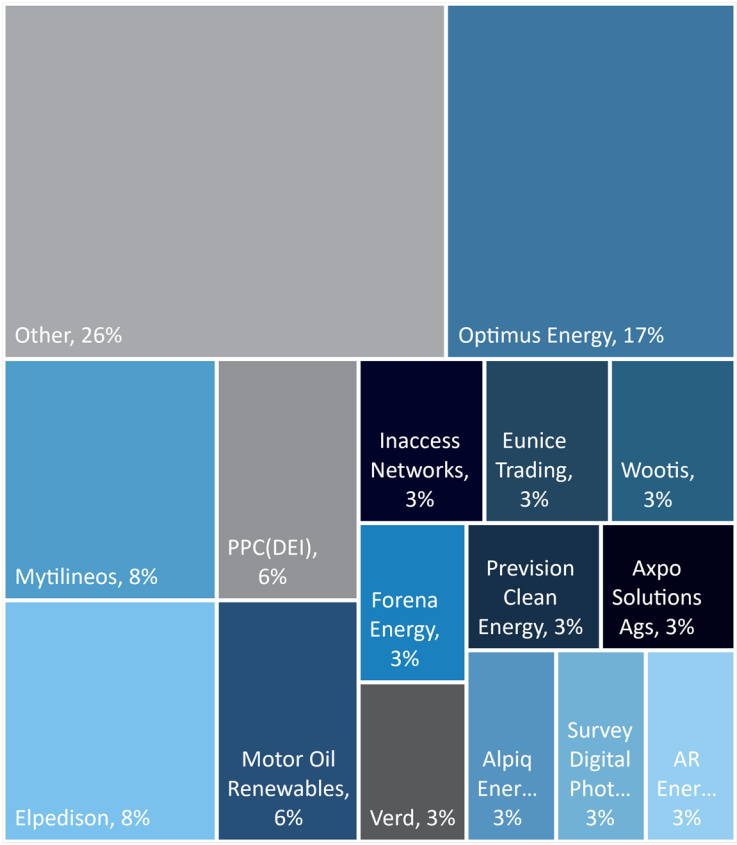
The Target Model framework transfers the responsibility of balancing from the IPTO to RES producers, meaning that asset owners will be fully responsible for the deviations between the declared and injected energy to the Day-Ahead Scheduling.

The aggregator's function is to pool electricity supply and/or demand and sell this capacity in the electricity markets. Renewable energy aggregation can foster the integration of intermittent electricity sources and decrease the reliance on renewable energy support schemes.

FoSE reduce the discrepancy between forecasted and actual production and consequently, the variability of the production of RES stations, hence, avoiding discrepancies between the energy produced and the energy sold. The aggregator would buy the production of the plant on pre-agreed terms and there after sell to end costumers and consumers or trade in on the stock exchange. This is an effective way of minimizing the effects of price volatility for both the producer and the end consumer.

Therefore, due to the highly complicated process and high costs involved in forecasting, the commercial management of green units will be undertaken by the Market Aggregators (FoSE). This volatility and uncertainty will be further reduced in the future when energy storage systems fully integrated in the renewable energy system.

Main Market Aggregators in the Greek Market in 2023%



Source: Enexgroup

7

Power Purchase Agreements & RES Tenders

Evolution of the Greek PPA Market

Until recently, the PPA market in Greece was at its infancy, even though large domestic and international players are showing growing interest. Municipalities, small and large industrial consumers, large commercial enterprises and companies with high energy costs could be potential candidates for PPAs. As pointed out by the Greek Minister of Energy & Environment in May 2021, the government's goal is for Green PPAs to cover 20% of demand in energy-intensive industries.

The lack of a regulatory framework for PPAs, coupled with the heavy reliance on subsidies, did not create fruitful conditions for the corporate PPA market to flourish. Up to the first half of 2022, the only PPAs signed in Greece were from vertically integrated energy groups, between their subsidiaries. PPA contracts have many advantages for both sides: renewable energy producers or developers and large consumers (off-takers):

1. they enhance the predictability of revenue for the seller and energy costs for the buyer by reducing their exposure to energy market price fluctuations;
2. they ensure affordable prices, as they exploit the strong cost reduction in RES, and
3. implement the companies' environmental commitments for climate-neutral activities, with reflection on the general public and investors.

PPAs Enhance:

Predictability

Affordability

ESG Commitments

The Market is Maturing

The situation is now rapidly changing, as **PPAs in Greece start to gain momentum.** In June 2022, the Greek energy exchange (HENEX) launched a pre-feasibility study for a non-mandatory auction platform, which suggests that HENEX is investigating the possibility of implementing Corporate PPAs. In July Cero Generation announced what is quoted as «the first private PPA-backed utility-scale solar project» for a 100MW solar project in Northern Greece.

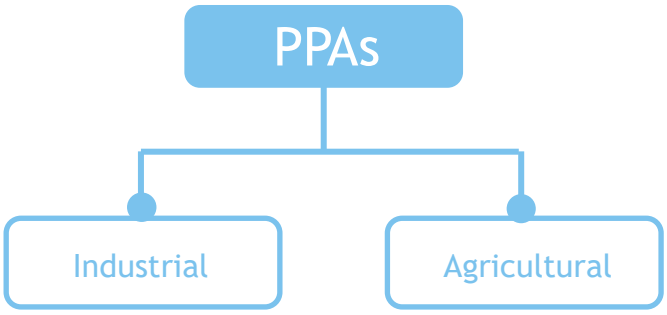
In August2 022, The Ministry of Environment and Energy issued a decree concerning the criteria for grid connection priority. Projects with a draft PPA in place, where the off-taker is a domestic industrial consumer, will be prioritised over those aiming to secure tariffs through auctions.

Therefore, a lot key players in the market have started structuring PPAs with their subsidiary companies. In April 2024 it was announced that renewable electricity projects that have power purchase agreements signed with energy-intensive industrial consumers can skip the line for final connection offers from the Independent Power Transmission Operator.

Following this directive developers applied for a total of 3.8GW of projects to get grid priority. Due to the volume of the application and capacity of the projects the government is looking into the possibility of lowering the capacity of each project by 20% so that more projects can get connected.

Evolution of the Greek PPA Market

Following the introduction of the PPAs in the Greek Market and to mitigate the concerns over the rising costs of electricity the government has introduced two types of PPAS : industrial and agricultural.



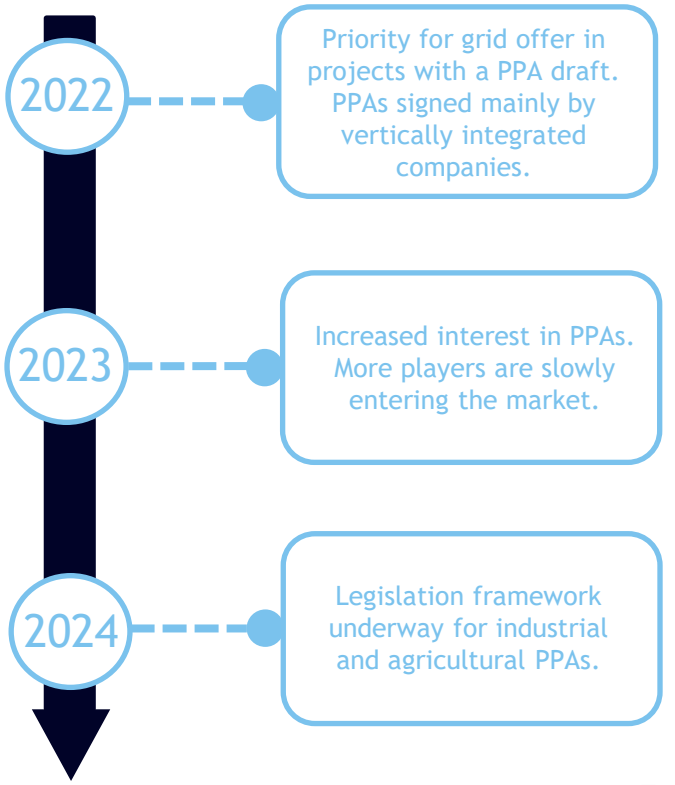
Renewable Energy Industrial Power Purchase Agreements (PPAs) are gaining traction as a significant mechanism for businesses to secure sustainable, cost-effective, and reliable energy. These agreements are pivotal in the global transition towards greener energy and play a crucial role in meeting corporate sustainability goals.

Industrial Power Purchase Agreements (PPAs) are long-term contracts between electricity producers and industrial consumers for the supply of power. These agreements play a crucial role in the energy market, particularly for renewable energy projects, by providing financial stability and ensuring a reliable power supply. The contracts typically span from 8-15 years providing longer term stability for both the producer and the consumer.

The agreed-upon price for electricity is usually fixed, protecting industrial consumers from fluctuating energy prices and enabling better financial planning. Industrial PPAs can be customized to meet the specific needs of the industrial consumer, including the amount of power, delivery schedule, and pricing structure. By locking in a fixed price for electricity, companies can hedge against future price volatility, leading to significant cost savings over the contract's duration. Securing a consistent energy supply ensures operational stability and reduces the risk of power outages.

Agricultural PPAs were introduced by the Greek government in Q2 2024 in order to provide agricultural consumers with a lower electricity costs as well as clearing the debt of the previously government owner energy supplier (DEH). An Agricultural PPA is a contract between an agricultural entity and a renewable energy provider. Under this agreement, the agricultural business commits to purchasing a certain amount of energy from a renewable source—such as solar, wind over a specified period for 2 + 8 years.

Offering a higher tariff for the first 2 years and a lower one for the remaining term. At the same time, the producers that will enter such an agreement will have to take own and pay out all the outstanding payments that farmers have towards DEH as part of the deal.



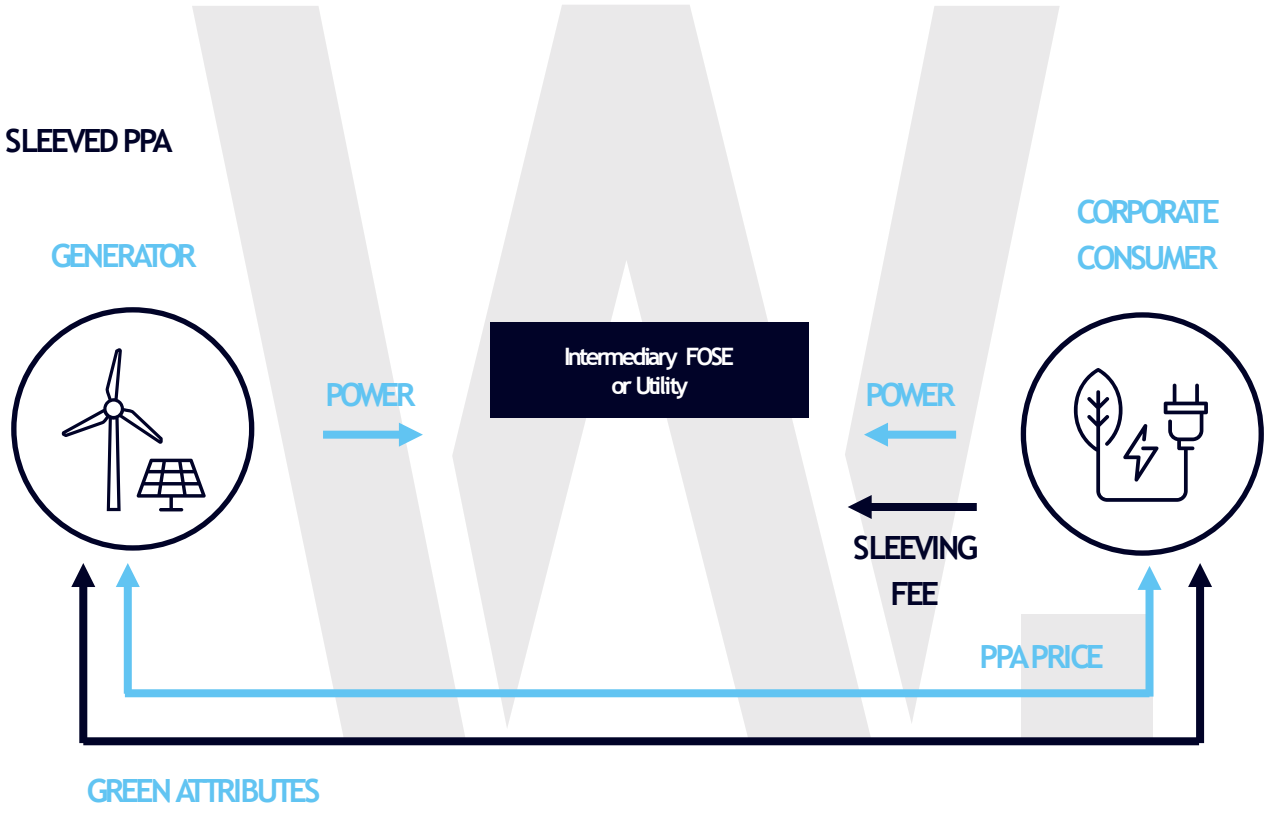
Following the latest amendments in the regulation regarding PPAs in Greece the market is slowly evolving, and we expect an upward trajectory to a subsidy free renewable energy market.

PPA models in the Greek Market

The dominant model of PPAs in Greece will be the sleeved PPA (as is already the case in Europe), ie a "tripartite scheme" consisting of the producer, an intermediary (supplier or FOSE) and the final consumer.

According to this model, an "intermediary" of the RES producer and the consumer either an energy supplier or a FOSE (Cumulative Representation Body), enters the agreement, to guarantee uninterrupted supply when there is a shortage from the producer/generator.

The Aggregator (FOSE) meets demand either by purchasing energy from the wholesale market or from other assets of its own portfolio. For this service (availability service) the supplier receives a fee from the final consumer.



Market forces enhance PPA deployment

Supply

In terms of supply, developers and investors are focusing on PPAs as the next growth engine due to increasingly competitive renewable auctions, especially for solar projects. The 2030 NECP targets for Greece can't be met solely through subsidized projects, making merchant projects with PPAs crucial.

Another aspect of the changes in the revenue models adopted by suppliers is the change in the risk profile that the financiers and lenders are willing to accept. Both suppliers and lenders are willing to engage in discussions and leverage the high energy prices by allocating part of their production in the merchant market. Therefore, new models allow 70% - 80% of the annual yield to be secured under a PPA (until now we see that there is a requirement for a minimum 10-year tenure) and the remaining to be openly traded in the day ahead markets.

However, the asset can borrow and is underwritten only against the secure PPA revenue value. The potential merchant revenue is disregarded in the financial structuring but can bring a significant upside to knowledgeable asset owners.

Demand

Due to the sharp increase in power prices, medium and large industrial consumers are facing significant challenges, making long-term PPAs more attractive; it also indicates the market's growing interest, **given that ESG criteria are increasingly becoming a part of organizations' "day-to-day operations".**
The major issue amongst industrial consumers is the cost of energy. Therefore, PPAs with bankable producers that uphold ESG and HSE criteria are very high on everyone's agenda.

Between 2022 and 2023, Europe's corporate PPA volumes grew 74% to 15.4 GW, the largest growth of any region.

As supply chains eased and gas balances normalized after the 2022 energy crisis, corporate PPA prices dropped faster than power prices. According to the International Renewable Energy Agency (IRENA), the global capacity of renewable energy PPAs reached over 23.7 GW in 2020 and is expected to continue growing as more companies recognize the benefits of securing renewable energy sources.

Main drivers:

Demand

1. Consumer protection by electricity price volatility
2. Drop in PPA prices
3. ESG compliance

Supply

1. More competitive auctions lead to a downward pricing trend.
2. Suppliers are leveraging high electricity prices.

PPA Pricing & the role of Greek Banks

There is no doubt that transactions involving renewable energy projects now make up a sizable share of project financings in Greece. As renewable energy projects in the country steadily move away from government subsidies toward the open market, which is volatile in terms of price, third-party funding sources, such as **banks**, would be unlikely to offer project financing without long-term security.

In the future absence of a government subsidy, a long-term PPA provides that assurance. As banks will play an integral role in the growing PPA market, it is encouraging that they are incentivising large clients to enter private PPAs by providing relatively low-interest rates, not as favourable however as for subsidised projects.

Banks consider the optimal tenor/duration for a PPA in Greece to range between 8-12 years. This provides assurance and security in terms of risk for the lender while allowing the project owner room for maneuvering if the market conditions change radically within the next decade

Greek Banks are receptive to financing projects with long-term PPAs

Acceptable tenor between 8-12 years

Offtaker bankability is the limiting factor in Greek PPAs

PPA Pricing & Risk Management

Signing a corporate PPA can help both buyers and sellers eliminate financial risks related to energy. However, PPAs are complex contracts with different parameters depending on the risk appetite of both sides. The structure and specific clauses of each contract, ultimately dictate how risk is allocated between the parties in terms of volume, project performance, balancing, credit, price fluctuations, tenure etc.

The following table provided by RE-Source, The European platform for corporate energy sourcing, summarises the different PPA risks by category.

Risks associated with corporate renewable PPAs

Risk	Summary
Development	The renewable power plant is not consented/permitted or constructed on a timely basis or at all
Performance Operational	The renewable power plant does not perform as expected (for example it fails to achieve a minimum agreed level of operational availability)
Volume	The renewable power plant does not produce the volume expected from modelling of long-term (i.e. 20-30 years) meteorological data as a result of different than expected resource levels (wind speed /solar irradiation etc.)
Shape/Profile	Even if the overall volume of output is produced as expected, the hourly production from a renewable power plant will differ from a 24-hour baseload delivery of electricity (quoted for standard products). Differences in hourly prices lead to a production value which is greater or less in aggregate than the equivalent standard baseload product
Cannibalisation	The spot price of electricity has a negative correlation with the supply of renewable electricity, and this is expected to increase as more renewable electricity penetrates the market. For example, when the wind is blowing, more electricity from wind farms enters the grid at very low marginal cost and the abundance of cheap power pushes prices down. When the wind is not blowing and the wind farms are not producing power, spot prices are likely to rise again. The same negative correlation applies to solar photovoltaics
Basis	The reference price of electricity for payments in the PPA contract can differ from electricity prices that the corporate buyer is exposed to under its local (physical) electricity supply arrangements (more rele- vant for financial PPAs or physical PPAs in markets with zonal pricing)
Balancing	The hourly deviations between scheduled production and real production due to error in weather/ elec-tricity production forecast
Credit-Settlment	The buyer may pay late or fail to make a payment at all for the electricity delivered
Credit Replacement	The buyer may default (or the subsidy may be cancelled or altered) and a replacement arrangement has to be made
Liquidity	Electricity cannot be traded quickly enough to avoid a change in price, determined by the bid-ask spread
Price	Losses can occur from adverse movements in the market price of electricity. For instance, if a corporate buyer locks in a price based on projections of future prices and the spot price falls below the agreed PPA price for long periods
Merchant Risk	The combination of revenue (or cost) risks for a seller (or buyer) arising from an unknown volume and unknown price of electricity to be produced
Tenor/Length of contract	The buyer (or seller) can be locked into costs which can be above or below market price. The risk in-creases with length of contract
Legal	Credit support, Force Majeure, Change of Control, Termination, and Conditions Precedent amongst other key clauses that need to be negotiated
Changes in law	Changes in law may affect the balance of benefit or risk between the parties, e.g. tax changes
Regulatory	Regulatory changes can affect the economics of a project. For example, retroactive changes to Feed-in Tariffs systems seen in Spain, Romania and the Czech Republic in the early 2010s.
Forse Majeure	Events can occur which are out of the control of any of the parties involved which can delay the comple-tion of a project or impact its generation e.g. flood, fire or storm damage

Source: RE-Source European platform for corporate renewable energy sourcing

PPAs Structure & Characteristics

It is extremely important for PPA off takers to recognise the development quality of the projects. The projects should abide with ESG standards, environmental best practices and local community engagement.

Types of PPA		Volume delivery obligation & delivery profile	Volume risk	Production profile risk	Merchant risk
Fixed Volume	Baseload	▪ Predefined volumes according to a predefined hourly profile. ▪ Delivery profile obligations for every hour. ▪ Pre-agreed fixed or floor price.	✓	✓	✗
	Fixed Volume for defined period	▪ Annual/quarterly/monthly pre-detined volumes. ▪ Delivery profile obligation within the predefined timeframe but no mater when. ▪ Pre-agreed fixed or floor price.	✓	✗	✗
Variable Volume	As-roduced	▪ Pre-agreed & of production at a pre-agreed fixed or floor price. ▪ No volume delivery obligation or delivery profile obligation.	✗	✗	✗
	Route-to-Market	▪ Pre-agreed % of production at market spot price ▪ No volume delivery obligation or delivery profile obligation ▪ No fixed or floor price	✗	✗	✗

Tenor 10-15 years Corporate PPAs

Willingness to participate in time-shifting risk management

Power off-takers looking for prices inclusive of aggregating and balancing costs

Contract structure assumptions influence the majority of the PPAs final price

Source: Acquila Capital

PPA Outlook: The road to 2030

There is no doubt that the PPA market in Greece will evolve rapidly in the years leading to 2030. Except for the latest regulatory developments, supply and demand forces, and the receptiveness of banks to the new route to market for renewables, market sentiment and investors' appetite also start pointing toward the direction of bilateral PPAs instead of renewable energy tenders. Investor interest in participating in tenders has declined significantly in the last cycle, while their interest in other types of support structures, such as corporate PPAs, has increased significantly.

The auction scheme is besides earmarked for a finite capacity of 3.8GW additional projects, which means that investors will need to assess different solutions for the 7.5GW of projects remaining to reach the goals of Greece's revised National Energy and Climate Plan.

Buyers' or Sellers' market?

According to Aurora Energy Research, PPA demand in 2030 is forecast to be 16% less than PPA supply.

To help large and smaller producers seamlessly participate in the PPA market, the Regulatory Authority for Energy and the Hellenic Energy Exchange started exploring options for the initiation of a centrally organised PPA platform.

Solar PPAs dropped in 2022 due to an uncertain market with major policy shifts such as high taxes and high prices resulting from upward pressure on supply chain. However, growth is expected to continue.

Wind PPA volumes on the other hand continue to decrease. It comes with a cost premium to solar and with longer development lead times Wind projects have been more exposed to supply chain and finance cost risks.

In the report produced by Afry on behalf of RAE, three different options are presented, each with different characteristics and levels of complexity suitable for the Greek market.

Renewable Energy Auctions in Greece

The Regulatory Authority for Energy in Greece (RAE) completed the first pilot competitive process in 2016. It then proceeded to the implementation of a permanent competitive processes for the period 2018-2020, during which the 2.6GW target initially set was exceeded while there was a drastic reduction of prices which benefits consumers and the national economy.

RAE has taken the necessary steps to digitize and modernize both the submission process for a production certificate and the participation to the renewable energy auctions.

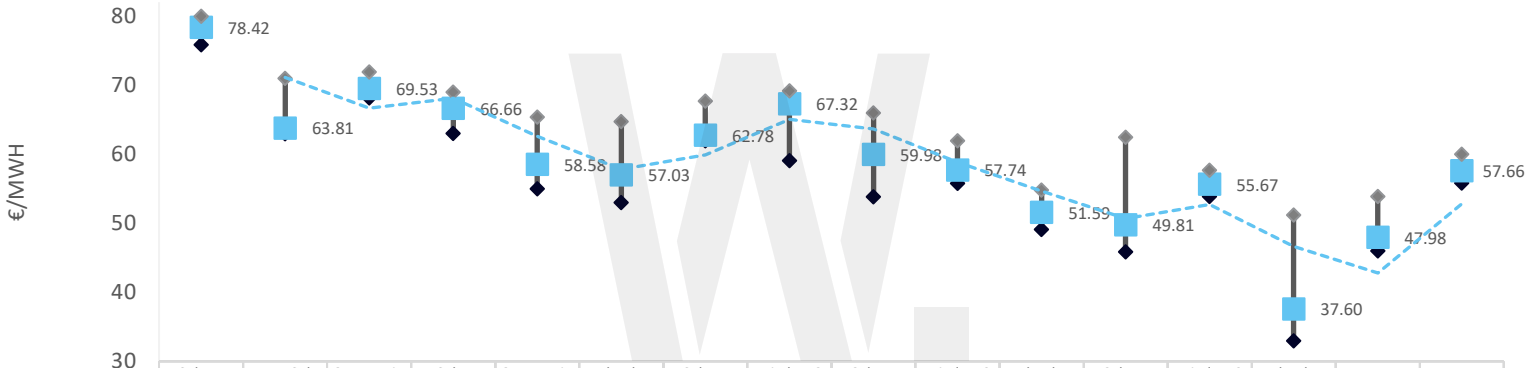
The team at Wattcrop has analyzed the results of the auctions conducted in the period 2018-2022, which are summarized on the diagram below. The price fluctuation stems from the fact that some of the auctions were technology agnostic whereas others targeted solar and wind projects separately with a cap on the total installed capacity. There is a downward trend in pricing, which intensified through 2022.

On the auction of RES in September 2022, 34 projects with a total capacity of approximately 944.5 MW participated. The total capacity awarded in the tender was 538 MW, of which 166.25 MW was awarded to wind farms and 372.16 MW to solar projects. 21 projects were selected with a total capacity of 538 MW.

After a year and a half, the renewable energy tender was particularly important since the prices at which the wind and PV projects were locked in would also affect the prices of bilateral contracts (PPAs). Indeed, the results of the tender confirmed that the prices offered were directly linked to the market prices of the PPAs.

In particular, the lowest price agreed for photovoltaic projects was around EUR 46 per MWh, while for wind projects the lowest price was EUR 55,82 per MWh. For solar, the starting price was 54 euros per MWh, while for wind 63 euros.

Weighted Average Auction Prices Jul 2018 - Sep 2022 (Including High-Low by category)



	Solar < 1MW	1MW<Solar <20MW	3MW<Wind<50PW	Solar <1MW	3MW<Wind<50MW	Technology Agnostic	Solar < 20MW	Wind < 50 MW	Solar < 20MW	Wind < 50 MW	Technology Agnostic	Solar < 20MW	Wind < 50 MW	Technology Agnostic	Solar	Wind
	Jul-18			Dec-18		Apr-19	Jul-19		Dec-19		Apr-20	Jul-20		May-21	Sep-22	
Lowest	75.87	62.97	68.18	63	55	53	61.95	59.09	53.82	55.77	49.11	45.84	53.86	32.97	46	55.82
Weighted Average	78.42	63.81	69.53	66.66	58.58	57.03	62.78	67.32	59.98	57.74	51.59	49.81	55.67	37.60	47.98	57.66
Highest	80	71	71.93	68.99	65.37	64.72	67.7	69.18	65.99	61.94	54.82	62.45	57.70	51.20	53.9	60

Lowest Weighted Average Highest 2 per. Mov. Avg. (Weighted Average)

Renewable Energy Auctions in Greece

Greece recently announced a cross-border energy auction for wind and solar power plants which will include 200 MW of projects located in Bulgaria and Italy. Members of the EEA Solar PV plants with over 1 MW capacity will be eligible for a €54/MWh tariff cap. This will include both Solar and Wind and will be facilitated by RAAEY the country's Regulatory Authority for Waste, Energy, and Water. The 200 MW tender is the country's 1st under the European Union's cross-border energy trade for countries in the European Economic Area (EEA).

The tender for state support from the Greek government is open to solar PV plants with over 1 MW capacity with a ceiling tariff of €54/MWh. Bids for wind power facilities with over 6 MW capacity are capped at €63/MWh.

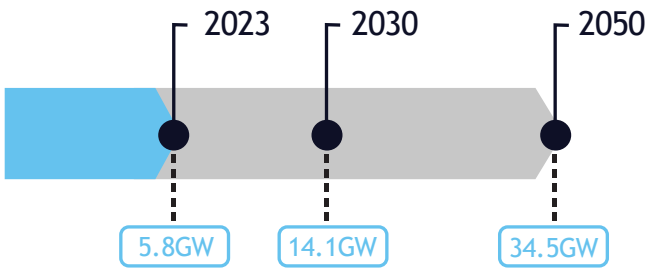
Winning projects, having secured interconnection rights, will need to sell electricity generated on the Greek day-ahead market. According to the tender announced in the Greek gazette with FEC no. 7486. At the end of June 2023, Greece's total installed solar PV capacity stood at 5.8 GW according to the country's Renewable Energy Sources Operator and Guarantees of Origin (DAPEEP). The country targets to expand its share in the national electricity mix to 14.1 GW by 2030 and to 34.5 GW by 2050.

So far in Greece, two standalone Battery Storage auction rounds have been completed in 2023/2024. Greece has awarded 411MW of capacity in the country's first energy storage auction.

The first competitive bidding process was carried out with "absolute success", under the provisions of No. 1/2023 Announcement by the Regulatory Authority for Energy (RAEYY).

The Greek energy regulator has awarded 300 MW of new battery storage capacity in the nation's second energy storage tender, split among 11 projects. A third stand-alone battery storage auction has been announced in Q3 2024, but a specified date has not been provided yet.

Total installed solar PV capacity



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The Greek Electricity Grid and International Interconnections

Key organisations in the Greek Renewable Energy Market

ADMIE (IPTO) undertakes the role of Transmission System Operator for the Hellenic Electricity Transmission System and as such performs the duties of System operation maintenance and development, to ensure the electricity supply of Greek mainland and islands, in a safe, efficient and reliable manner.

DEDDIE (HEDNO) is responsible for the development, operation and maintenance of the Hellenic Electricity Distribution Network to ensure its reliable, efficient and safe operation. DEDDIE assures transparent and impartial access for Users (Consumers, Providers) and Suppliers in order to carry out their business operations.

The Renewable Energy Sources Operator and Guarantees of Origin (DAPEEP) manages RES and High Efficiency Electricity and Heat Cogeneration (SITHYA) of the National Interconnected System, as well as the Power Supplies provided by them. DAPEEP is the auctioneer of the rights in Greece, while at the same time operates as a Cumulative Representation Body (FOSE) of RES producers.

The Regulatory Authority for Energy (RAE) is an independent regulatory authority that was introduce with Law 2773/1999 to align with EU regulations for electricity and natural gas. RAE's main responsibility is to monitor the Greek energy market and make appropriate recommendations to the Greek Government on measures for the liberalization of the electricity and natural gas markets.

EnEx Group consists of Hellenic Energy Exchange S.A. (HEnEx S.A.) and EnEx Clearing House Single Member S.A. (EnExClear). HEnEx S.A. has been designated by the Greek Regulator (Regulatory Authority for Energy-RAE) as Nominated Electricity Market Operator (NEMO) for the operation of the Day-Ahead and Intraday Electricity Markets. EnExClear, is responsible for the clearing and settlement of transactions concluded in the Day-Ahead and Intraday Markets, for the transactions \Natural Gas Trading Platform as well as the clearing and settlement of positions in the Balancing Market

Ministry of the Environment and Energy is a Greek government department responsible for the environmental and energy policy. It is tasked with environmental preservation and policymaking on the energy sector; environment; spatial planning and building control; waste management; and forestry.

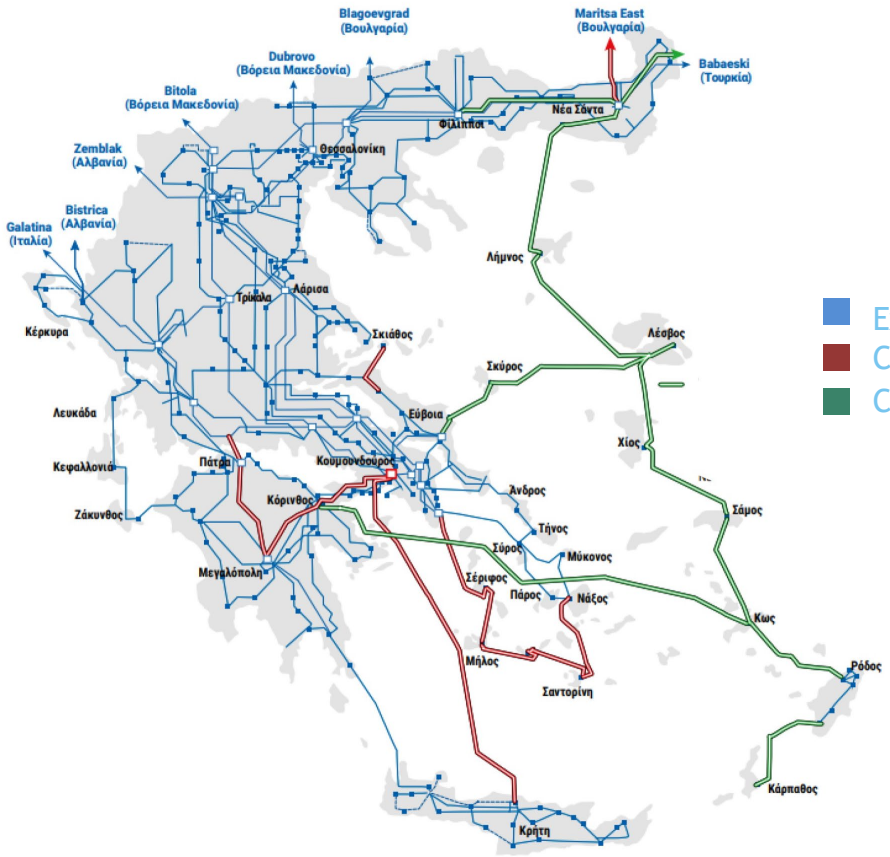
IPTO National Interconnections Plan up to 2032

As laid out in its Ten-year Network Development Plan 2023-2032, ADMIE plans to add new electrical interconnections to the existing Transmission System, with a major share of the expenditure allocated to the interconnection of the Greek islands with the mainland. This will facilitate and speed up the development of renewable energy plants, ending the islands' current fossil fuel dependence and upgrading the system substations.

The investment plan is already set in motion with Phase I set to be completed in 2025 which involves projects amounting EUR 1.6 bn. ADMIE has already managed to fully install an interconnection with Crete, currently the world's longest AC cable and the interconnection between Evia and Skiathos. The total investment amount for the Ten-Year plan is expected to approach EUR 4.0 bn.

List of National Interconnections (With expected dates of completion)

- Crete-Attica Interconnection (2025)
- Expansion of 400 kV System to the Peloponnese (2025)
- New 400kV line Filippoi - Nea Santa (2025)
- Interconnection of the Dodecanese (2030)
- Interconnection of NE Aegean (2030)



Source: ADMIE, Entso

Greece Island Interconnections

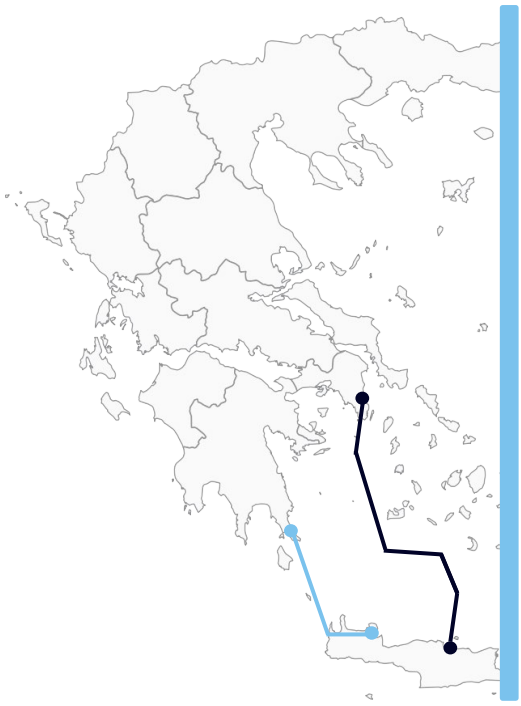
One of the main projects that the IPTO is currently undertaking is the **Crete-Peloponnese** Interconnection. The project will approximately cost EUR 350 million project which was completed in 2021, and it was co-financed by Greece and the EU. The interconnection is the first step to lifting the island's energy isolation and Crete's transition to a cleaner energy mix. This connection will cover 1/3 of the island's energy needs, replacing the production of the older local power plants. It will be followed by the large Heraklion-Attica interconnection which is under construction.

Crete-Attica Interconnection whose project name is Ariadne Interconnection has been under development since 2021 and its launch is expected in the summer of 2025. This is a very important project for the country and the investments will reach EUR 781 million. As Crete is the largest island with a population of roughly 650,000 which was up until now isolated, will be supplied its electricity from the mainland system rather than costly power plants now operating on the island. The total amount of investments for the projects will reach 1.1 billion-euro. The interconnection promises to reduce a public service compensation surcharge included in electricity bills by some 600 million euros annually, 400 million euros of which concern Crete.

As already mentioned, the undergoing plans for the Crete-Attica interconnection and the works are making a significant progress as of September 2023 as IPTO's Management has conformed (Location: Ariadni Interconnection in Damasta, Heraklion, Crete). Construction works are also progressing rapidly on the land-based section of the Crete-Attica electrical interconnection, following the successful completion of the installation of the project's submarine cables in March 2023. This will be the country's greatest electricity transmission project, which is expected to be completed at the end of 2024. Despite the technical geological difficulties, the construction works carried out at the Damasta construction site are expected to be completed by 2025. The introduction and installation of the electromechanical equipment will begin soon after.

The accompanying projects implemented on the occasion of the electrical interconnection are of the utmost importance as such as the opening of roads and the undergrounding of the Transmission Lines in Damasta which will mean the removal of the pillars that are currently located near the village.

In addition, the optical fibre cables installed by Ariadni Interconnection within the framework of the two interconnections will significantly enhance the telecommunications connectivity of Crete, creating opportunities for new international, strategic synergies.



Crete-Peloponnese Interconnection

€350 Million The cost of the project

Crete-Attica Interconnection

€781 Million The cost of the project

Cyclades Interconnection continues with the addition of the island of Naxos to the interconnected islands of the Cyclades (Syros-Paros-Mykonos-Andros-Tinos). The last phase, with a budget of EUR 389 million, will be completed during 2023-2024, with the islands of Serifos, Milos, Folegandros and Santorini

The overall project is co-financed from European and national funds. The Aegean interconnections map will be completed in 2029, with the islands of the North-east Aegean and Skyros. This project, amounting in total to EUR 885 million, includes the interconnections of Skyros, Lesvos, Limnos, Chios, and Samos with Evia in the west, Thrace in the north, and Kos in the south.

The recent agreements of Grid Telecom with a focus on Crete for the branching of 2AFRICA, the largest undersea fiber optic cable in the world as well as the Greece-Cyprus-Israel telecommunication interconnection, confirm the important role of the island in data traffic in the wider Eastern Mediterranean region and the Middle East.

IPTO also supports actively the local community through donations to hospitals, research centers, and food banks. In addition, it responds directly to the emergency needs of local residents, as it did in 2021 after the great earthquake in the area of Arkalochori, where it provided temporary homes to quake-stricken citizens.

The IPTO has committed to complete the majority of the island interconnections by 2030.

Source: ADMIE, Energypress.gr

Sustainable Greek Islands

An initiative aiming to transform small Greek islands (with a population of up to 5.000) to green and sustainable innovation hubs. The implementation of new technologies will be directed -among others- to fields such as waste management, energy generation and green transportation.

For non-interconnected islands in Greece, fossil fuel dependence involves high transportation and heating costs.

The example set by Tilos' smart, island microgrid system, based on renewable energy and batteries, could serve as model for the expansion of renewable energy and storage-based systems to other non-interconnected islands, providing a viable alternative from polluting and expensive oil-based solutions. In addition, following the initiative "30 renewable islands for 2030" further 30 islands are expected to be self -sufficient in terms of energy needs as oulined by the European Commission. Astypalaia, Lesvos, Ikaria and Kastelorizo have already started working towards this goal.

Astypalaia

Astypalaia is set to become energy sufficient, generating its power from renewable energy, coupled with storage solutions. The island is embracing EVs, replacing 1500 conventional vehicles and introducing a new electric bus network and electric vehicle sharing app for tourists.

Tilos

The first Mediterranean island to be- come entirely self-sufficient in energy featuring a clean power mini-grid which combines wind, solar and storage. The island is the first in the world to eliminate the burial of waste and has received the Zero Waste City Award.

Chalki

The first GR-eco Greek island, Chalki will benefit from the installation of solar pv, electric vehicles and charging infrastructure, among other innovations in energy and transport. This will result in a 55% electricity bill reduction for residents and 1800 tonnes of Co2 reduction annually.

40

Greek Islands

are expected to benefit from the GR-ECO islands initiative

Symi	Kasos	Nisyros	Foynoi	Irakleia	Koufonisi	Serifos
Agathonisi	Pserimos	Tilos	Thymaina	Antiparos	Folegandros	Sifnos
Megisti	Gyali	Megalonisi	Amorgos	Sxoinoysa	Thirasia	Kea
Arkioi	Leipsoi	Oinoysses	Anafi	Ios	Kythnos	Poros
Marathi	Telendos	Psara	Donoysa	Sikinos	Kimwlos	Antikythera
Gavdos	Erikousa	Othoni				

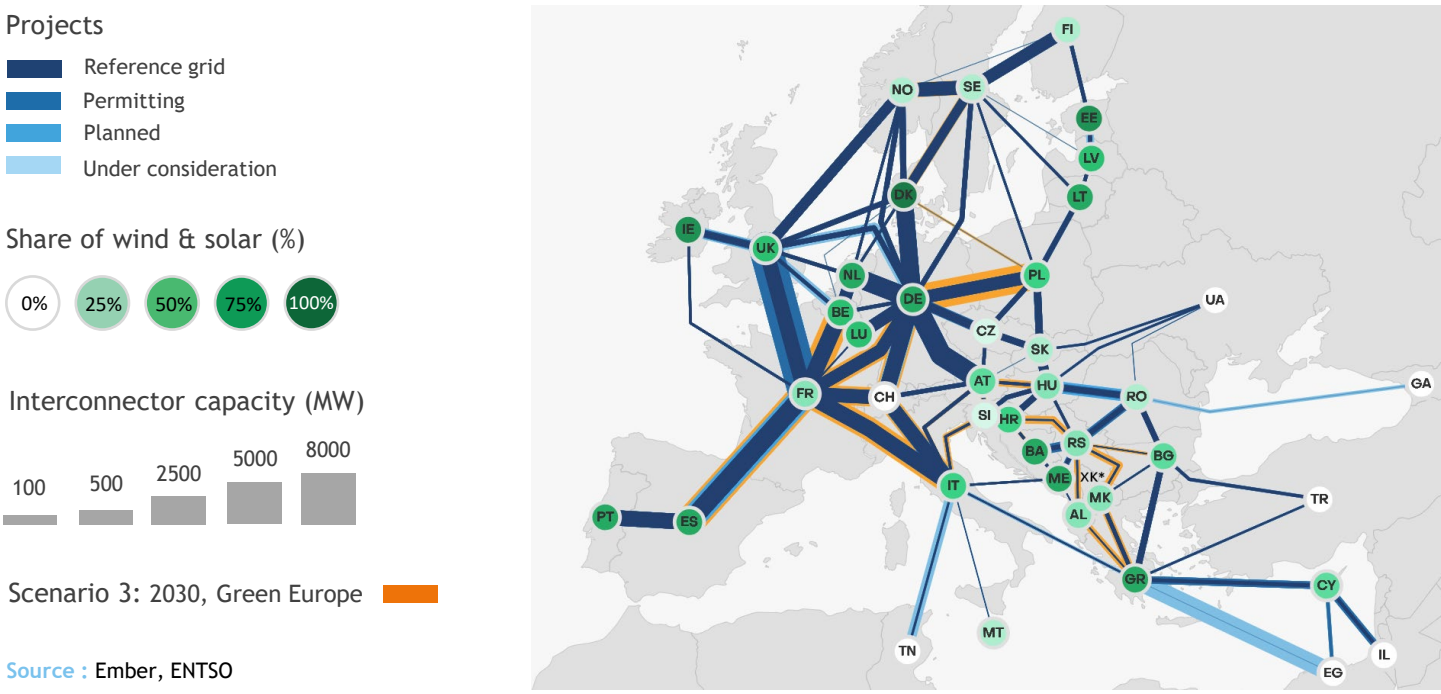
ENTSO- E's 10-year network development plan

ENTSO-E's 10-year network development plan (TYNDP) is designed to advance European electricity infrastructure. It integrates and enhances national grid plans to facilitate Europe's energy transition cost-effectively and securely through improved power links and storage. Europe aims to achieve climate neutrality by 2050 as part of the Green Deal, with a mid-term goal of reducing net greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels.

The Fit for 55 Package and REPowerEU Plan will expedite the shift to 'net zero' by increasing 2030 targets for renewable energy and energy efficiency. This involves replacing fossil fuels with renewables, electrifying more sectors, improving energy efficiency, and connecting various energy sectors. Achieving this requires cost-effective renewable energy deployment, strategic investments for market integration, competitive pricing, and reliable electricity access for all Europeans. The TYNDP is essential for coordinating this strategy across Europe's electricity system, ensuring timely implementation and secure electricity supply continent-wide.

Over the past twelve years, the European cross-border transmission grid has expanded significantly, with 12 new borders commissioning their first electric interconnection. This addition brings the total to 80 European borders interconnected either by land or sea, ensuring all borders have at least one connection. Notable new interconnections include those between Denmark and the Netherlands, the UK and Belgium, Italy and Montenegro, and Norway and Germany. Increased cross-border interconnections facilitate higher electricity exchanges.

The EU's Projects of Common Interest (PCI) program has been pivotal in these grid developments over the decade. The TYNDP also supports these advancements by providing crucial information to policymakers, regulators, TSOs, and investors, aiding in project engagement and development. The pilot TYNDP 2010 assessed investments representing over 42,000 km of lines, with nearly 11,500 km now commissioned. Some investments have been integrated into other projects, some are no longer assessed in the TYNDP, and others were cancelled.



Source : Ember, ENTSO

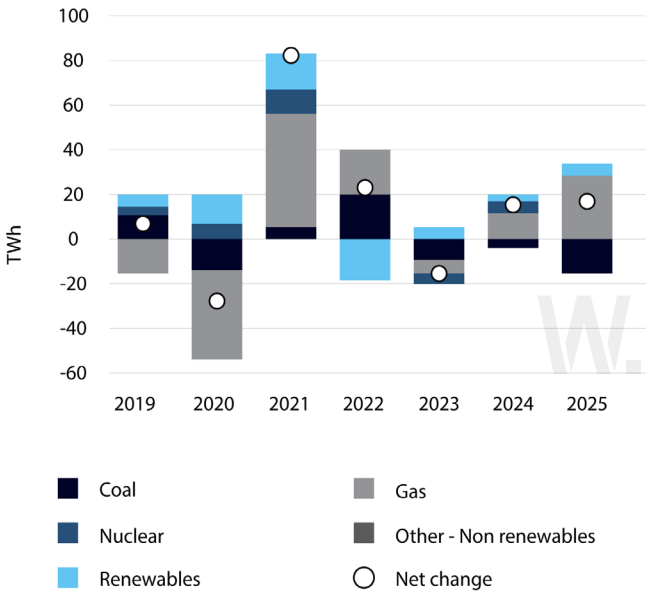
EuroAsia Interconnection

Russia's war in Ukraine in 2022 affected the growth of electricity demand in Euroasia, more specifically it has impacted Russia's domestic macroeconomic outlook, and this could have a spillover effect on other countries in the region who share close economic or political ties with Russia.

1.5% Increase in electricity Consumption year-on-year

Eurasia's electricity consumption increased by an estimated 1.5% (+24 TWh) year-on-year in 2022 – a marked slowdown compared to the record growth of 75 TWh in 2021.

Year-on-year change in electricity generation, Eurasia, 2019-2025



Source : IEA

Over 70% of incremental electricity demand was concentrated in the first half of the year. Electricity consumption growth slowed to below 1% in the second half of 2022 closely related to the decreasing economic performance and fossil-based thermal generation rose by over 3%.

The region's electricity demand growth is expected to slow to an average annual rate below 1% from 2023 to 2025. Eurasia's electricity mix will still heavily comprise of fossil-fired generation with a share of around 65% over this period.

Despite the latter, due to the commissioning of the new nuclear plants, including Belarus and Russia , will significantly reduce the CO2 emissions until renewable energy becomes a more integral part of the energy mix.

Russia is by far the largest power consumer in Eurasia, with annual consumption of over 1 000 TWh, and accounts for just over 70% of the region's electricity demand. Russia's electricity consumption grew significantly in 2021 and this was largely supported by a strong economic recovery (the country's GDP grew by 4.7%). Power generation rose by 6.3% (+69 TWh), largely supported by the country's significant thermal fleet.

In 2022, fossil-fired generation – including coal, natural gas and fuel oil-fired power plants – rose by over 3% compared to 2021 levels and accounted for over 60% of total power supply.

EuroAsia Interconnection

EuroAsia Interconnector is a 2,000-MW multi-terminal interconnection which connects the national electricity grids of Israel, Cyprus and Greece (via Crete) with Europe. EuroAsia Interconnector is the longest, at 890 km and deepest, up to 3,000 m., HVDC interconnector in the world.

Since 2011, Euroasia Interconnector Ltd. has been envisioning this iconic project aimed at ending Cyprus's electrical isolation and opening a new "electric highway" in the Eastern Mediterranean. The realization of this project will cease the energy isolation of Cyprus, ensure the security of supply for Israel, Cyprus, and Greece and create a reliable green interconnector for Europe. In addition, this will serve as a key platform to significantly reduce CO2 emissions and contribute towards the European Commission's "Green Deal" goals.

EuroAsia Interconnector is a leading European Project of Common Interest (PCI) and plans have been ongoing since its inception in 2013. It is labelled as an EU "electricity highway," interconnecting Europe with Asia. Following the approval of the CEF Grant of €658 million by the European financing mechanism "Connecting Europe Facility" and €100 million by the Recovery and Resilience Fund, EuroAsia Interconnector proceeds to the construction phase.

A strategic agreement was made between the IPTO and the EuroAsia Interconnector for the designation of IPTO as the Implementing Entity and Project Promoter of the Electrical Interconnection project between Greece, Cyprus and Israel. EuroAsia Interconnector Ltd and IPTO will work closely together to ensure that the smooth transition to the new Implementing Entity, for the Electrical Interconnection will be rapid, as required by the project implementation schedule and expected by the governments and the European Commission.

Since 2021, IPTO has been assisting the project as a technical consultant, having contributed to the design and the signing of critical contracts for its progress. Furthermore, IPTO has many years of experience and expertise in the implementation of projects of high technical complexity such as the HVDC technology Attica-Crete interconnection which is in a mature phase of construction with its completion being expected in 2024. The project has now matured as all studies have been conducted and all permits for commencing construction work have been obtained.

In addition, Euroasia Interconnector Ltd. has signed a contract with the Norwegian company Nexans for the cable segment of the interconnection and has selected the German company Siemens as the preferred contractor for the Converter Stations.

At the moment the project has reached an important milestone in its construction and its completion will mark the electrical interconnection of Cyprus, the EU's last non-interconnected member state, with the European transmission system, ensuring robust energy security for the island. Additionally, Israel will energy supply will be enhanced through the integration will enhance Israel's supply security, facilitating a quicker and of Renewable Energy Sources (RES) into its energy balance.

This is a pioneering project that will also play a strategic role in fullfing Europe's energy requirements by tapping into Israel's and Cypru's gas reserves bundled with renewable energy sources.

EuroAfrica Interconnection

The EuroAfrica Interconnector is the 2,000MW capacity electricity interconnector between Egypt, Cyprus, Greece, and Europe, labeled as an “electricity highway” connecting the national electricity grids of Egypt, Cyprus, and Greece through a 1396km subsea HVDC cable.

The EuroAfrica Interconnector comprises of a subsea DC cable and HVDC onshore converter stations at each connection point, with a total capacity of 2000MW. The project is an energy highway bridging Africa and Europe, with a total length of 1670 km. It creates a reliable alternative route for the transfer of electric energy to and from Europe.

Cyprus is an island with natural borders of just the sea and the air, the island depends exclusively on the electric power it generates from fuel imports. The 1200 MW output is not enough for the island’s needs.

Greece is a country that is geographically connected to the rest of Europe, but the country has an installed capacity of 13,000 MW which does not cover the country’s present needs and hence the country needs to import additional electricity supply which makes the end electricity more costly. Subsequently, there is an imminent need for high productivity and cheap energy.

Source : EuroAfrica Interconnector

Egypt, a major non-OPEC crude oil and natural gas producer, has a high-power system size of 38,857 MW installed generation capacity with more than 40 grid-connected plants, providing electricity access to nearly 99% of the Egyptian population. The recent discovery of record-size offshore natural gas reserves has revived confidence that Egypt will once again become a major energy hub in the output of resources and production of energy. This development also paves the way for Egypt to import and export electricity, where needed, through reliable electricity interconnections.

The Egypt-Cyprus section of the project was expected to be operational by 2023, while the Cyprus-Greece section was scheduled to enter service by 2024. The updated timeline for the implementation dates for the commencement of Stage 1 of the electricity interconnection between Egypt, Cyprus, and Greece with total transmission capacity of 1,000 MW, are:

- Cyprus - Egypt commissioning in December 2028-2029
- Cyprus - Greece (Crete) commissioning in 2028-2029

The project is estimated to cost €2.5bn ($2.70bn), the stage one development of the interconnection project will have a transmission capacity of 1GW, which will be further increased to 2GW in the next stage.

9

Greek Market Developments

Offshore wind: Key Drivers and Challenges to 2030

Main drivers of change

- The ambitious goals set by the NECP*
- The country's geography and wind potential
- The immediate necessity for new capacity due to the decommissioning of the lignite-fired power plants.
- The limitations of on-shore wind farms (availability of land, opposition by the local communities, need for grid reinforcements, environmental concerns, wayleaves and earthworks required, turbine size compared to offshore etc).

Main challenges

- **Technical Challenges** such as the steep sea-bed drop-off around mainland Greece and around most of the Greek islands.
- **Foreign affairs policy issues**, mainly due to territorial disputes in the Aegean Sea.
- **Legislative Challenges** which stem from the lack of a complete national regulatory framework, which adequately addresses spatial planning, licensing, grid interconnection and economic support issues.

The bright side

- In 2022, the Greek government introduced the regulatory framework for offshore wind development as pilot projects. This sets the foundations for the rapid development of the sector within the next decade.
- Next steps:
    - The market now anticipates the National Offshore Wind Farm Development Programme which will map out designated maritime zones for the development of offshore wind farms.
    - Determination and definition of exact terms for OWF development by 2030 (by virtue of a Presidential Decree).

Battery Storage

Battery storage was introduced in the Greek Energy Market in July 2022 and there was immediate interest from investors that had applied for Storage licenses . The current status for stand alone and collocated assets significantly overpasses the target of 1.5GW of energy storage that is in the current ESEK. The target is expected to be revised in the new ESEK in line with market expectations and requirements to enable further penetration of RES projects. The figures below represent the data up to 2023 available in RAEYY.

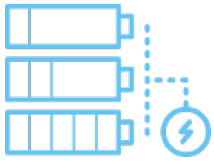
In accordance with the European Market Monitor on Energy Storage (EMMES) the forecast installed capacity for batteries is 3650MW. Based on the energy storage target for 2030 and beyond, the current projections and further penetration of RES will increase requirements for hourly, daily weekly and seasonal storage. On average 20% of electricity production for RES will require seasonal storage, 20% daily/weekly storage, and 60% hourly storage.

Source: European Association for Storage of Energy (EASE)

Batteries | Stand-Alone

6.07 GW
of pending applications

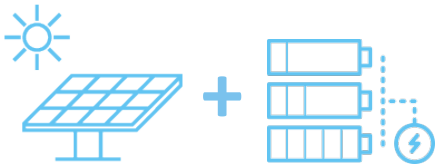
44.76 GW
storage licenses



Solar + Storage

1.76 GW
of pending applications

18.6 GW
production licenses



Wind + Storage

0.24 GW
of pending applications

2.93 GW
production licenses

Battery Storage

Battery Storage Outlook

- Based on current projections on RES installed capacity and on the fact that hourly storage will predominantly be provided by batteries, the energy storage requirement by 2030 is expected to be between 5 - 8 GW.
- The above aligns with the expectation of increasing the energy capacity in the revised NECP to 5.3 GW by 2030.
- The spatial plan which is expected to be revised will set out any restrictions on land that cannot be used for battery storage development (i.e. high productivity agricultural land) but this may clash with the areas that will require battery storage to balance the grid.

Energy Storage Auctions

- The current auction scheme aims to support 900MW of storage projects selected through two separate bidding processes. The first took place in August 2023 for 450MW stand alone BESS where 12 projects totaling 411 MW were awarded at an average annual cost of €49.748 per MW. In the second auction for the remaining 450MW took place in February 2024. However, in the latter 300MW were awarded. The 11 winning projects range in size from 8.875 MW/17.75 MWh to 49.9 MW/100 MWh.
- Another round is planned for April 2025, to allocate an additional 300 MW.
- The target date for completion of the first 900MW of stand-alone battery storage is the end of 2025 which is in line with the approved EU Recovery and Resilience Facility Greek scheme (budget of €341 million to support construction and operation of storage facilities). The scheme will offer support in the form of investment grants or annual support for the first 10 years of operation of the projects.

Residential Storage Systems

- The government aims to introduce a financial support scheme for residential PV systems coupled with storage.

5.3GW

NECP target by 2030

Energy Storage Framework

The IPTO will make the necessary changes to the Transmission System Code to enable battery storage projects to connect to the grid. This will introduce minimum technical and operational standards as well as static and dynamic curtailment limits.

The IPTO will undertake the necessary technical studies to define the aforementioned static and dynamic limits.

1st — August 2023: 12 projects totaling 411MW were awarded.

2nd — February 2024: 11 projects totaling 300MW were awarded.

3rd — April 2025: The goal is to allocate an additional 300 MW.

Source: Renewables Watch

Hydrogen

Greece could play a decisive role in the European Hydrogen Strategy

Hydrogen was spotlighted in the discussions about Europe's energy security intensified in light of the Russian invasion in Ukraine. Hydrogen is set to play a key role in the energy transition, working alongside renewable energy projects. Hydrogen will mainly replace natural gas, which is currently imported, and secondarily petroleum products in refineries, transport, and industrial sectors.

The current projections for the Greek market up to 2030 estimate a total capacity of 750MW of hydrogen projects, which translates into 3,500GWh of green hydrogen, produced through electrolysis.

To operate, this will require 3GW of renewable energy assets (80% solar and 20% wind). Members of the "National Strategy for the Promotion of Technologies - Applications of Hydrogen and Renewable Gases" Committee calculated some of the effects of the programme on an annual basis.

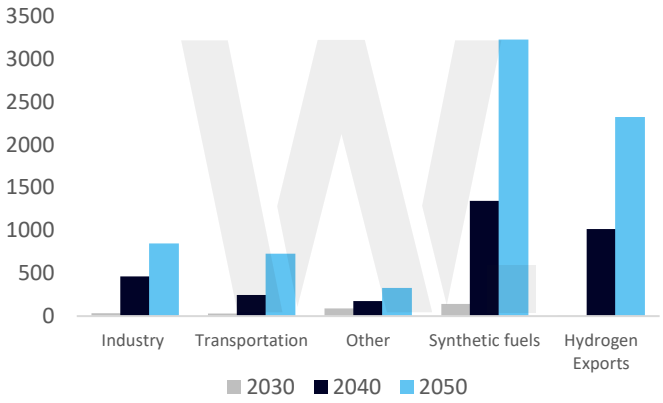
750 ktCO2

Reduction of Co2 emissions

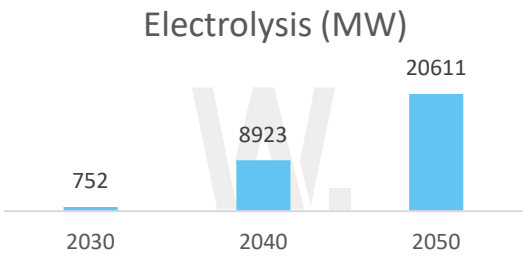
3-4 billion

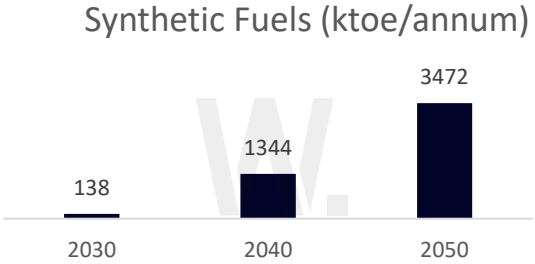
Total Investments in the hydrogen supply chain (€)

Hydrogen Uses



Domestic Production Units





90-110 million

Domestic added value (€)

3000-4000

Jobs in the hydrogen supply chain

500 ktoe

Reduction of gas and oil imports

Sources: ot.gr/tovina.gr

Hydrogen Valleys

Hydrogen valleys are integrated hydrogen ecosystems that are being developed in various European regions with the aim of both climate protection and regional economic development. They could simply be described as 'local hydrogen economies' covering a significant part of the value chain, from production, storage and transport of hydrogen to its end use in various sectors such as industry, transport and energy.

They provide an opportunity for the development and application of innovative hydrogen-related technologies, while they can complement other green energy infrastructure, gas infrastructure, electricity grids, batteries and so on.
A total of 25 hydrogen valleys are currently at various stages of implementation in Europe. Of these, two have been funded by the Clean Hydrogen Partnership. The HEAVENN hydrogen valley in the Netherlands which is the first hydrogen valley in Europe and the Green Hysland valley in Mallorca. The Partnership will fund 8 more valleys in Europe, with two of them in Greece, in **Corinth** and **Crete**.

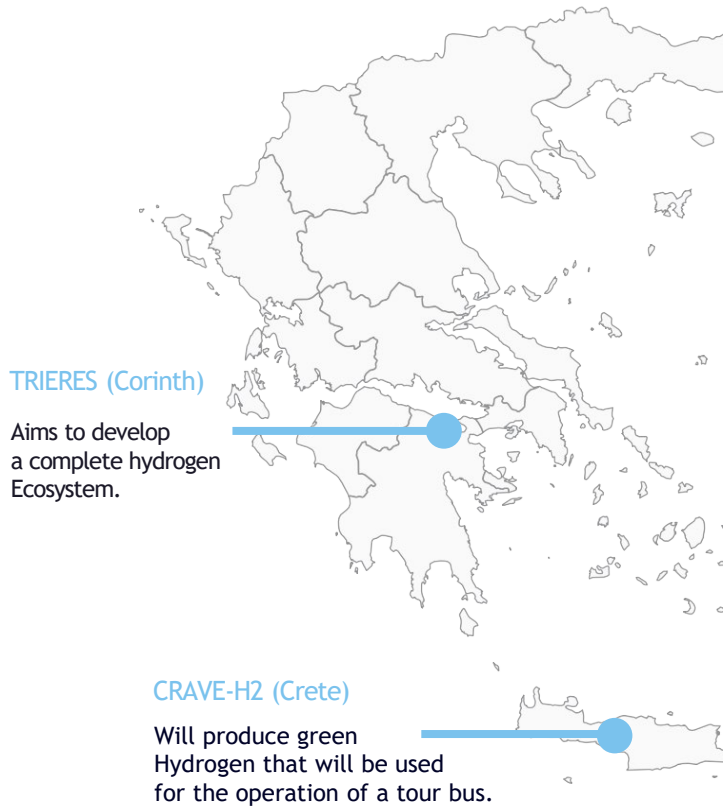
The choice of Crete for setting up one of the hydrogen valleys is due to the University of Crete having an important research group, which studies ways of storing hydrogen and uses of hydrogen in cars, the consortium was created with the code name CRAVE-H2 with the participation of the research institutions and the Region of Crete. The project envisages the creation of a photovoltaic park, the energy from which will be used to produce green hydrogen, which will be used for the operation of a tour bus for residents and visitors on the island.

In Corinth, the hydrogen consortium has the code name TRIERES and consists of 27 partners, coordinated by the Motor Oil group and operators from six different countries.

The investment will amount to €320 million and will aim to develop a complete hydrogen ecosystem focusing on the regions of the Peloponnese, Western Greece and Attica.

The center of the valley will be located at Motor Oil's Corinth Refineries and the project will have a 4-year duration. Apart from Motor Oil, the consortium partners the PPC, Fulgor, Solaris, Avin, PPA, OSI, Olympia Odos, the Peloponnese Region and the municipality of Loutraki.

Greek Hydrogen Valleys



Sources: liberal.gr

Hydrogen

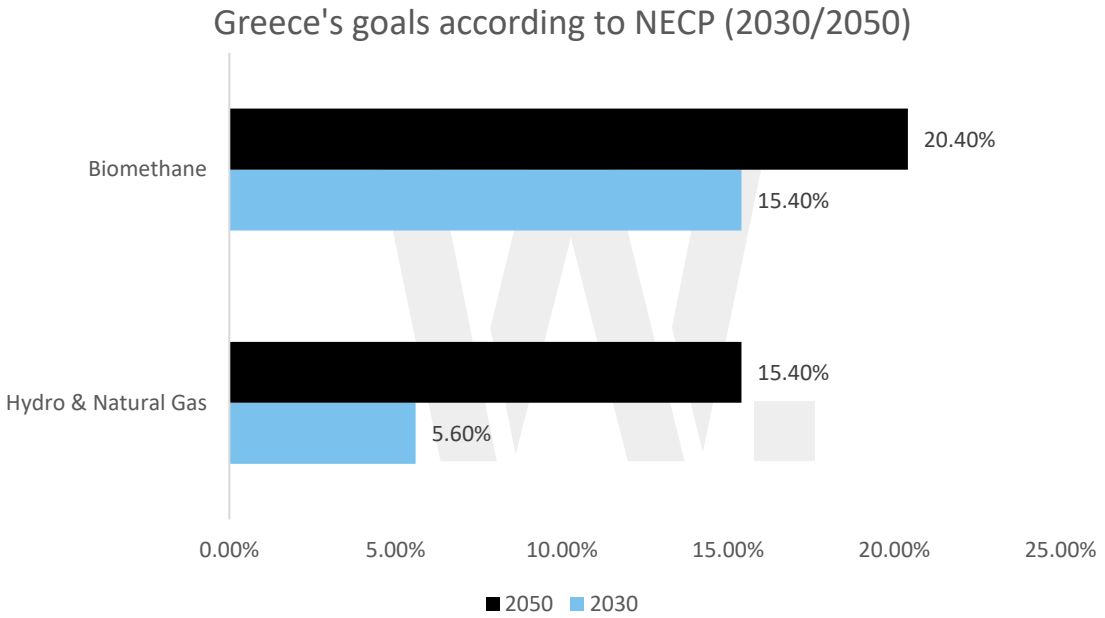
European countries, such as Germany, Spain, and Romania, have set ambitious targets for hydrogen production and infrastructure and in the UK, the government plans to allocate funds for hydrogen projects in two rounds. The EU's CBAM tool concentrates on direct emissions, and auctions across Europe aim to encourage investments in electrolyte capacity.

Greece on the other hand has set a high target of 1.2 GW electrolyser capacity by 2030, the forecast for hydrogen demand triples by 2050, with electrolysers playing a key role. The primary end use of hydrogen will be refineries the demand of such energy is predicted to shift however until 2060 to heating as well. The European electrolyser landscape sees substantial growth, with wind power as the primary energy source.

The main sectors that are interested in investing financially in hydrogen are the industrial and the mobility sectors. In addition, the introduction of Hydrogen Purchase Agreements (HPA) is expected to enhance market maturity and improve lending conditions.

Hydrogen investments vary, with four different electrolyser models: inflexible, flexible, co-located (island), and co-located (grid). Different models suit different countries based on factors such as grid mix and fees. With the further development of Hydrogen production in the coming years the the Levelised Cost of Hydrogen (LCOH) is predicted to drop by 2050, however, the transportation of hydrogen and the costs associated with this will is yet to be addressed. As hydrogen can come in different forms, different transportation methods would need to be considered based on the origin, distance and reconditioning.

Green hydrogen and renewable gasses will play a crucial part in the decarbonization of transportation and shipping. Greece has set an ambitious goal for 2030 as part of its latest National Energy and Climate Plan (NECP), while many Greek and foreign companies have expressed their interest or have already begun to invest in green hydrogen.



Hydrogen will not be used as a primarily fuel on its own but will be used together with natural gas in the Greek system totaling up to 5.6% by 2030 and to 15.4% by 2050. Biomethane is also expected to contribute with 15.4% and 20.4% respectively in order to make gas consumption cleaner.

To do this, the authorities are planning to enforce a mandatory annual minimum for gas suppliers that will gradually increase.

Source: Balkan Energy News, Energy Press

Hydrogen

According to the NECP a target of **1.7 GW** of electrolyzers installed by 2030 is set, which translates to 135,000 tons of green hydrogen production. The goal for 2050 is set to 30.6 GW of electrolyzers producing 2.3 million tons of hydrogen. The total consumption of green hydrogen in Greece is expected to reach 63.6 TWh a year by 2050, with 70% of the fuel used in transportation.

Furthermore, the Ministry of Environment and Energy and operator DESFA have expressed that the current pipeline system and compressor stations will not require much investment to make them hydrogen ready. Large international pipelines, such as Trans Adriatic Pipeline (TAP) and Interconnector Greece-Bulgaria (IGB), are already able to handle quantities of hydrogen, and new transmission and distribution projects take that into account.

According to the government, green hydrogen production will be covered by the rapid expansion of renewable energy sources in the country, which are expected to grow by 13.5 GW by 2030.

Greece, however, has expressed concerns about the EU policies regarding hydrogen installation and more specifically the green hydrogen regulation requiring RES participation in national grids to be at a level of over 90 percent.

This is related to the release of the next installment of the Recovery and Resilience Facility funds This on its own sets the target as unachievable for hydrogen levels to increase to the committed numbers by 2030 as the renewables penetration will not have reached 90 % by 2030. This might only be possible in the Nordic countries but not feasible in the rest of Europe.

Greece has committed to having prepared a regulatory framework for hydrogen by June 2024, one of the goals the country Greece has set is to secure 795 million euros in financial support for energy projects through REPowerEU.

Greece’s targets according to NECP

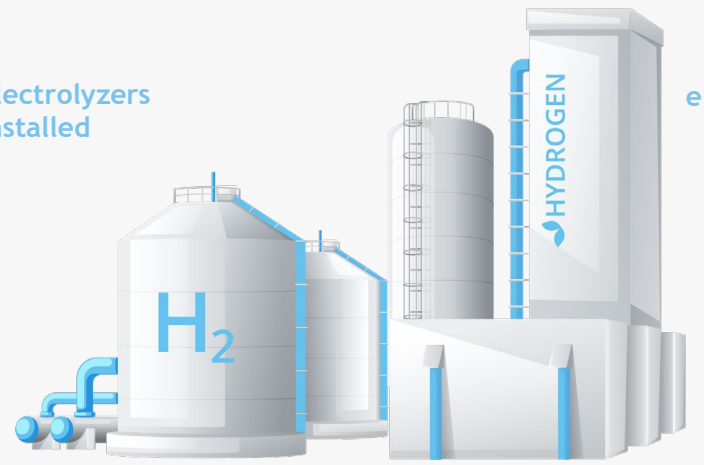
2030:

1.7GW

electrolyzers installed

135.000 tons

green hydrogen production



2050:

30.6GW

electrolyzers installed

2.3 MM tons

green hydrogen production

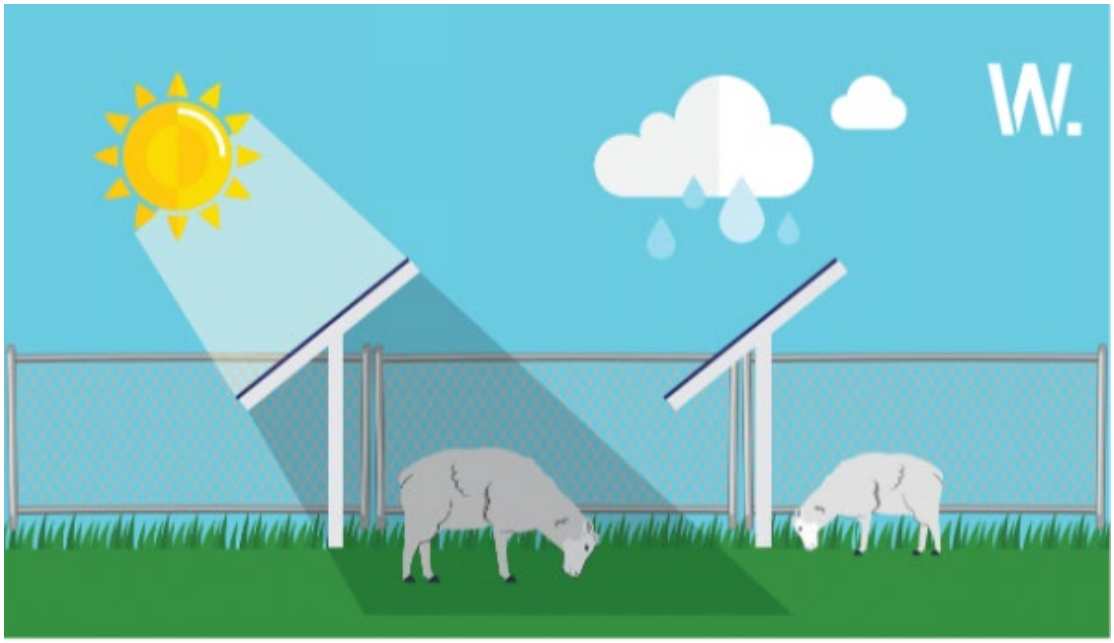
70% of green hydrogen will be used in transportation

Agri-pv

Can agriculture and solar PV work hand in hand for a more sustainable future?

The rapid deployment of renewable energy sources is a necessity not only to help tackle the effects of climate change, but also to enhance Europe's energy security. Agrivoltaics or agri-pv is an innovative solution to help with the deployment of more solar projects, without restricting the land use solely for electricity generation. Agrivoltaics combine farming and solar photovoltaic electricity production to co-exist. Agrivoltaic farming is the practice of growing crops underneath solar panels.

Even though the technology is already widely accepted in more mature markets, there is no provision in the Greek legislation for agri-PV projects yet. Given the latest developments in the market and the government's eagerness to embrace and accelerate renewable energy project development, we expect a framework for agri-PV to emerge soon.



Can crops grow better under solar panels?

Scientific studies have shown that some crops thrive when grown in this way, making use of the same parcel of land both for farming and for producing clean energy.

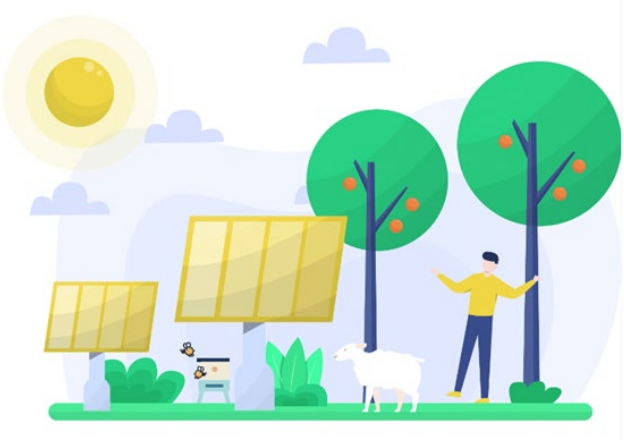
Agrivoltaic farming could be a solution to not just one but both of these problems. It uses the shaded space underneath solar panels to grow crops.

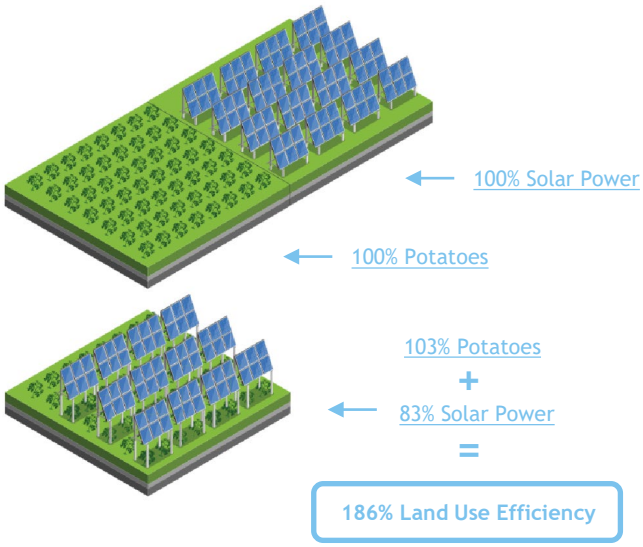
This increases land-use efficiency, as it lets solar farms and agriculture share ground, rather than making them compete against one another.

Solar panels have to sometimes be elevated or suspended to allow plants to grow beneath them. Another option is putting them on the roofs of greenhouses. This allows enough light and rainwater to reach the crops, as well as providing access for farm machinery.

Source: Weforum.org

Agri-pv





According to an EU research installing agrivoltaics on a mere 1% of EU utilized agricultural area (UAA) could help to surpass the EU's 2030 targets - 720 GW - for solar energy generation. This innovative multi land-use application shows great potential. The panels need to be installed in such a way that agricultural activities, such as growing crops, grass or fruit, remain the primary use of the land area, while also giving access for farm machinery or livestock. The panels can have a shadowing effect on the crops hence mitigating the heat stress and offering protection from severe weather. Likewise, greenhouses can be made of semi-transparent PV panels.

Agrivoltaics can help alleviate concerns about land competition between solar panels and farming activities while supporting policies related to energy transition, agriculture, the environment and biodiversity in the EU's pursuit of the European Green Deal targets for a climate-neutral Europe. This form of using solar panels could particularly thrive in countries such as Greece where the high productivity land makes up a big proportion of the available and suitable for the installation of photovoltaics. This method could potentially work in favor of the mitigation of the opposition of farmers and local communities towards the installation of photovoltaics.

Research in South Korea has been growing broccoli underneath photovoltaic panels. The panels are positioned 2-3 meters off the ground and sit at an angle of 30 degrees, providing shade and offering crops protection from the weather. It was found that the broccoli was not any lower in quality than that of broccoli grown traditionally nor there was any significant change in taste. Having said all the above, the actual configuration and day-to-day activities can be complicated as the project requires two or more parties who often have very different priorities—the farmer or land manager and the solar developer—to find a solution that works for both.

Promoting agrivoltaics is already part of the European Commission's Solar Energy Strategy, which calls on member states to encourage agrivoltaics and implement favorable policies for agrivoltaics.

Source: Joint Research Center- European Commission

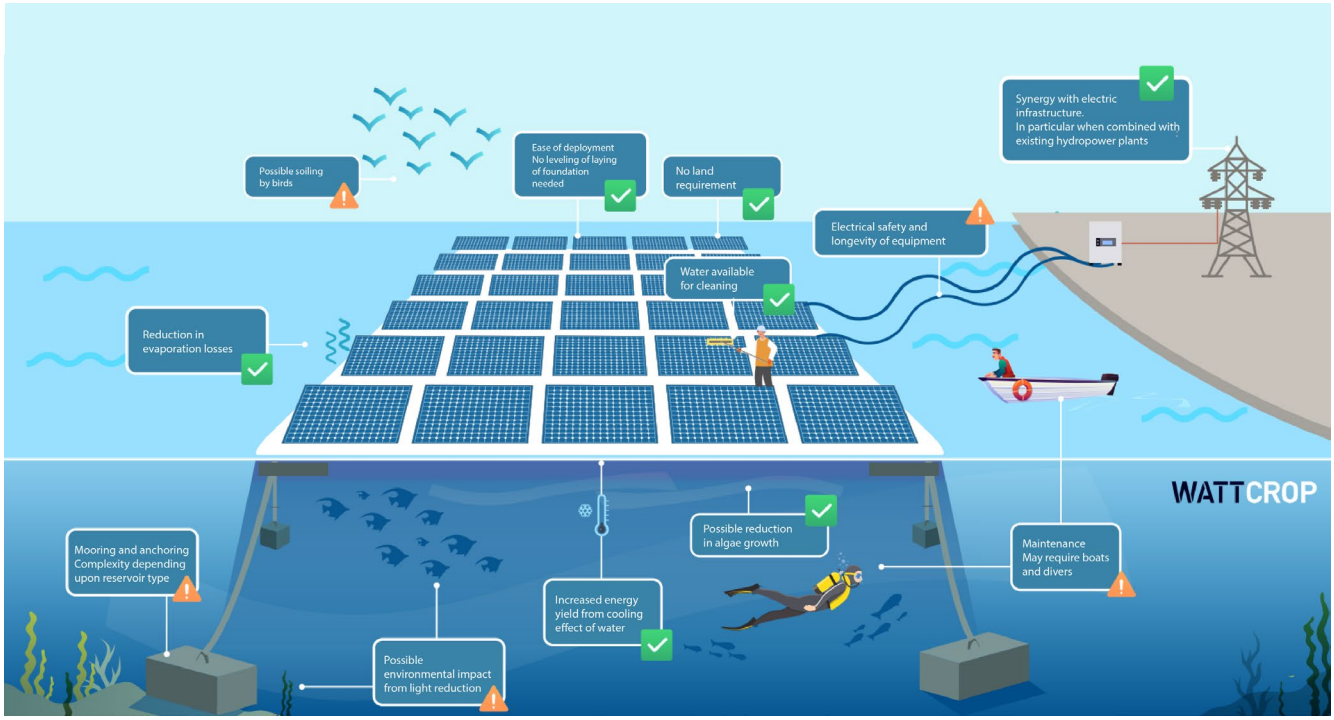
Wattcrop has produced a detailed, free to download Agri-PV guide (in Greek).
Get your copy here: https://wattcrop.com/resources/

Floating Solar

Can solar PV deployment be maximized without compromising high value agricultural land?

Floating solar installations are PV panels installed on floaters on water bodies, without the requirements for land. Floating solar has seen rapid growth since 2016 and projections for installations worldwide show total installed capacity of circa 4000MW by 2026.

This is reflective of the numerous advantages of floating solar installations both financially and environmentally.

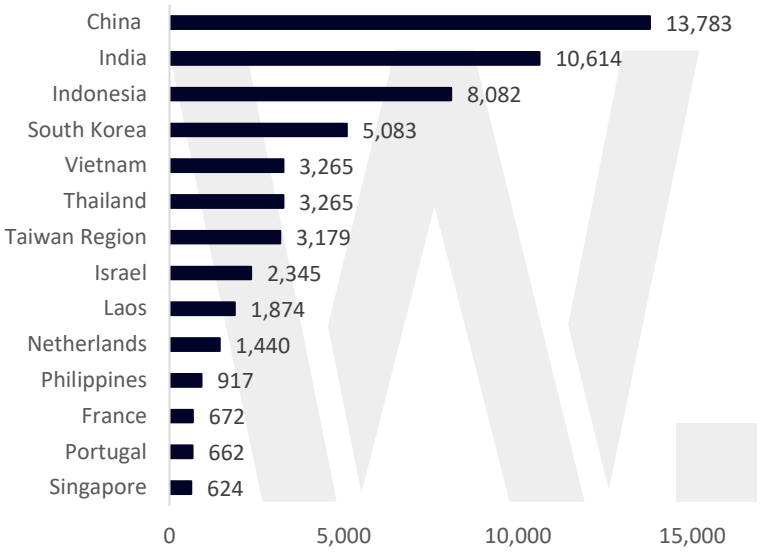


The vast amount of floating solar installations is currently in Asia with the EU and USA following. In Greece law 4951/2022 introduces the development framework for 10 pilot sea floating solar projects with installed capacity between 0.5 - 1 MW.

There is lack of legal framework for floating solar schemes in lakes and reservoirs which is a major drawback due to the complexity of developing floating solar parks in the sea.

Floating Solar PV installations worldwide in 2031

Forecast cumulative capacity of floating solar PV installations worldwide in 2031, by leading country in MW.



Source: Statista

The Greek market players, despite the luck in regulatory framework, are expressing great interest in floating solar installations and in early 2024, several applications had been submitted to RAEYY for receiving production licences both in the sea and in lakes.

Countries such as China, Indonesia and India are projected to lead the global generation of floating solar (FVP) power by 2031. The forecast shows that in China the FPV will reach an estimated capacity of 13,783 megawatts over the next 10 years.

Wattcrop has produced a detailed, free to download Floating-PV guide (in Greek).
Get your copy here: https://wattcrop.com/resources/

Air Source Heat Pumps

Air Source Heat pumps are an efficient, sustainable, and increasingly affordable heating solution that can add value to Europe's targets for a more sustainable future. Eurostat data indicates that about 50% of all energy consumed in the EU is for heating and cooling and more than 70% of that is produced by fossil fuels (predominantly natural gas). Another important remark is that 80% of residential energy is used for space and water heating.

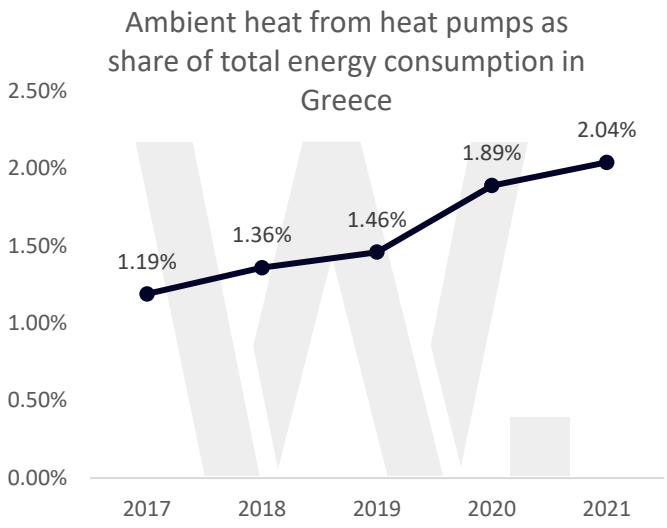
Heat pumps are a mature technology that is much more energy efficient than boilers. In buildings, heat pumps are used for heating, hot water, and cooling. Heat pumps make better use of renewable energy sources, ambient energy, and waste heat as they extract and upgrade ambient energy (heat or cold from outdoor air and surface or sewage waters) or geothermal energy (heat or cold from the ground or groundwaters) to produce heat.

A report published in 2022 by the International Energy Agency (IEA) predicts that heat pumps will lower Europe's gas demand for heating in buildings by at least 21 billion cubic meters in 2030.

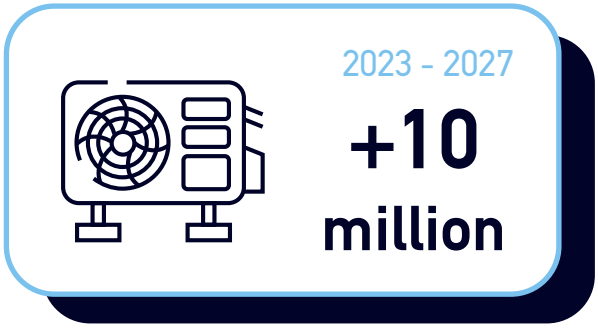
If the EU is aiming to scale up in the use of heat pumps, 750 000 more installers are needed and at least 50% of existing installers will have to be reskilled to work with heat pumps.
European Union heat pump sales went up by 35% between 2020-2021, that is to say that 2.2 million units started operation. The financing of heat pumps across the EU went from €13 billion in 2020 to €23 billion in 2023 despite a slow-down in 2023.

The largest heat pump markets in the EU are France, Italy and Germany. As of April 2023, there are an average of 3068 heat pumps per 100,000 people in Europe. In 2020, 33% of operational heat pumps were located in China, 23% were located in North America, and the EU accounted for 12%.

Heat pumps are becoming more popular mostly due to the increasing cost of energy. Policies are being introduced by that will increase the adoption of heat pumps. In the UK Energy Security Bill has provisions for grants and schemes that encourage heat pump installations and in Greece the PPC is encouraging the installation of heat pumps as well providing financial incentives with the adoption of heat pumps.



The REPowerEU Plan proposed by the European Commission to double the current deployment rate of individual heat pumps, to reach 10 million cumulative units over 2023-2027.



Source: European Commission,BloombergNEF, March 2024

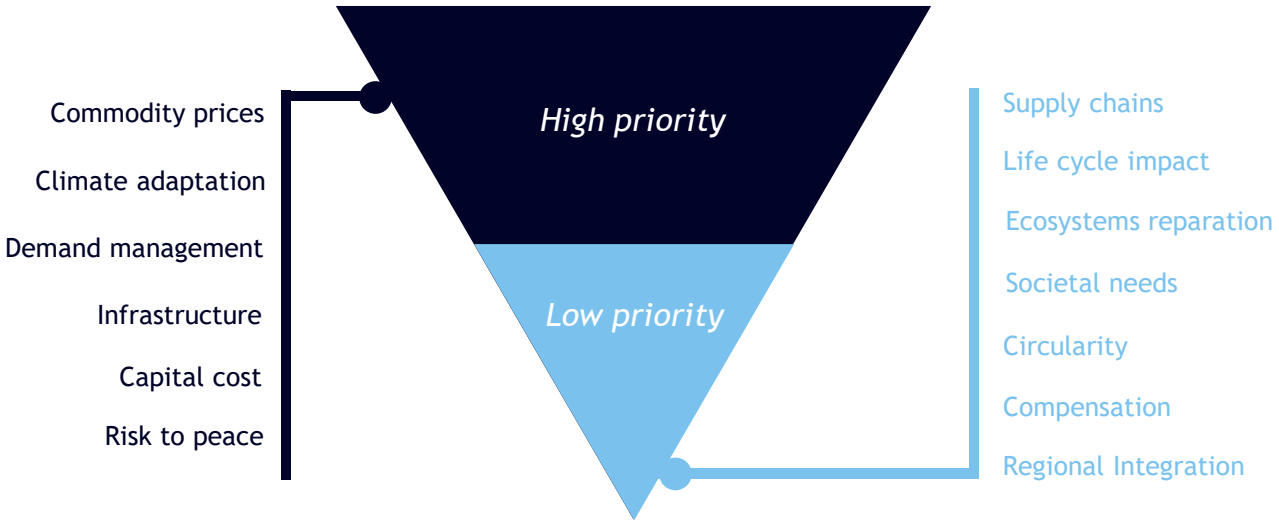
Critical uncertainties and action priorities in the EU energy market - 2024

The Issues Map produced by the World Economic Council provides a visual snapshot of the critical uncertainties and action priorities that policymakers, CEOs, and leading experts strive to address, shape, and manage energy transitions. The highest critical uncertainty for the EU region for 2024 is the risk to peace, an issue closely linked to other critical uncertainties such as supply chains and commodity prices.

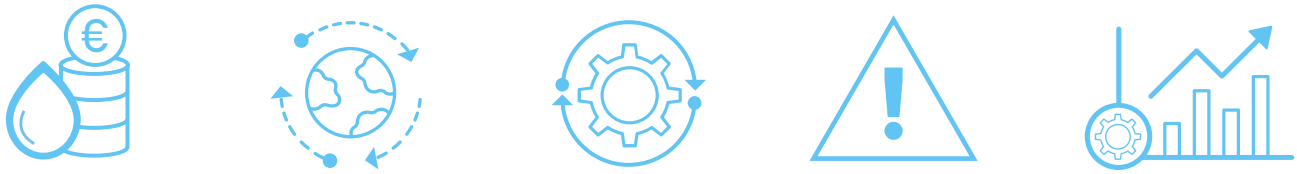
Economic growth and affordability were major uncertainties for 2022 while their impact -also high on the matrix- was visible specifically in Greek households and businesses. Renewable energies on the other hand maintain their high impact as an action priority, while uncertainty is reported as "low".

While all the aforementioned pose a concern the main thing that all leaders are focused on actioning is renewable energy which can be a vehicle for tackling all the above concerns while combating the Climate Crisis and working towards a more sustainable future.

The main concerns that World Leaders are preoccupied with are:



Critical uncertainties across Europe:



Commodity Prices | Climate Adaption | Supply Chains | Risk to Peace | Demand Management

Source: World Energy Issues Monitor, 2022, World Energy Council, Greece Member Committee, Mr. Haris Doukas

Main Project Development Risks & Uncertainties

Grid

The availability of grid capacity is one of the main limiting factors in the development of renewable energy projects in Greece. Due to the large amount of applications on the pipeline of both DEDDIE & ADMIE and the complex permitting process preceding grid applications, developers cannot make informed decisions or predict grid availability during the initial development stages of their portfolio.

Greece is fully dependent on imports for its natural gas and oil supplies. Electricity prices drastically increased in 2022 (+40% for industries and +24% for households), despite subsidy mechanisms. Per capita energy consumption is 40% below the EU average. The share of oil in total energy consumption reached 52% (2022).

One of the main challenges of the Grid in Greece is the transmission of electricity. The existing infrastructure was designed at the time to facilitate fewer power plants at a much larger scale transmission in comparison with the current state of electricity production from renewables which is dispersed, intermittent and not provide grid forming capability.

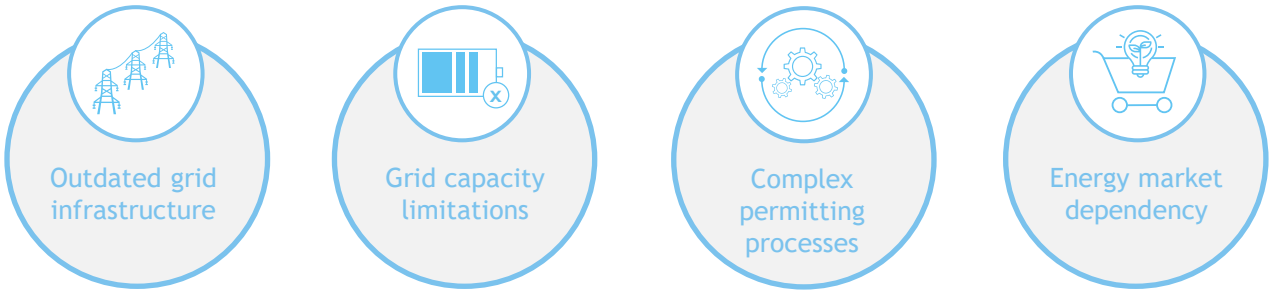
In addition, the existing grid infrastructure is mainly constructed around cities and industrial centers where energy consumption is more intensive. The renewable energy projects development requirements clash with the existing infrastructure in the sense that renewable energy projects are more often than not build at rural and remote areas due to the specific requirements concerning the terrain and environmental caveats.

Therefore, transmission lines required to connect renewable projects to load centers need to be updated, enhanced, and become more complicated than they are today for these projects to be connected to the transmission system. This process not only will require time but also significant funds and the regulatory and technical framework to bring to fruition. In addition to the above, as in countries across the globe the grid is getting significantly older which is something that has a negative impact on the process. In contrast to what many people might think, the UK has in fact the longest queue to connect to the electricity grid of any country in Europe. There are about 200 gigawatts worth of electricity projects waiting for a grid connection, according to research by Bloomberg New Energy Finance.

So far, it's been the renewable energy developers and foreign investors that are harboring the cost of this upgrade of the transmission system, despite that not much progress has been seen in the past few years.

To conclude, investment, both public and private will be require to tackle the issues concerning the Grid and achieving the country's 2030 targets (£54bn worth of investment to facilitate the connection of approximately 23 GW of offshore wind). Investors should also take into account the significant delays that their projects might face related to the obstacles outlined above.

Main risks and uncertainties:



Source:
Enerdata.net,Climateactionmarple.org.uk,
Blommberg NEF , Norton Rose Fulbright

Greece in 18th place on EY's Renewable Energy Country Attractiveness Index

The Renewable Energy Country Attractiveness Index (RECAI) ranks the world's top 40 markets on the attractiveness of their renewable energy investment and deployment opportunities.

Greece is showing good progress toward 2030 and 2050 targets. It has recently surpassed 11GW of installed renewables capacity, with 1.7GW of green hydrogen electrolyzers in planning.

The government continues to implement policy measures to support the growth of renewable energy.

The new solar-plus-storage scheme will aid residential and agricultural consumers to claim subsidies to cover up to 65% of the installation cost of rooftop panels and batteries.

Additionally, policy has also been introduced for old operating wind turbines to be moved to isolated islands, to boost renewables production at remote areas as well as extending the useful life of the turbines.

November 2023

Rank	Previous Rank	Movement Previous Index	Country Region	RECAI score
17	20	^	Sweden	61.4
18	16	v	Greece	61.1
19	18	v	Brazil	60.8

Technology-specific scores						
On-shore wind	Off-shore wind	Solar PV	Solar SCP	Bio-mass	Geo-thermal	Hydro
49.0	42.6	42.6	16.3	44.3	18.8	36.6
49.0	30.9	47.9	36.0	43.6	25.5	39.0
50.0	31.9	52.5	24.8	49.4	12.9	45.0

November 2022

Rank	Previous Rank	Movement Previous Index	Country Region	RECAI score
15	16	^	Canada	62.0
16	21	^	Greece	61.5
17	14	v	Chile	61.4

Technology-specific scores						
On-shore wind	Off-shore wind	Solar PV	Solar SCP	Bio-mass	Geo-thermal	Hydro
54.9	35.6	46.2	19.0	33.3	23.0	45.8
51.2	30.9	48.2	35.4	44.2	25.1	41.3
51.5	20.6	48.1	54.7	41.9	45.8	44.9

Source: EY
https://assets.ey.com/content/dam/ey-sites/ey-com/en_gl/topics/power-and-utilities/ey-recai-61-report.pdf
https://assets.ey.com/content/dam/ey-sites/ey-com/en_gl/topics/power-and-utilities/ey-recai-62-v9-final.pdf

Main Project Development Risks & Uncertainties

Environment

The environmental authorities play a key role in the licencing process of renewable energy projects in Greece. There are several restrictions concerning the high productivity land - something that could be soon resolved with agrivoltaics projects - Natura protected areas and areas of significant environmental importance due to important species that inhabit those areas.

Therefore, finding suitable land that meets the technical as well as the environmental criteria can be challenging, and investors should not proceed further with their projects if environmental authority licensing has not been obtained.

Archaeological Remains

The discovery of archaeological remains is one of the key uncertainties when it comes to renewable energy project development in Greece. Even though during the pre-development process the archaeological authority digs sample trenches on the plots, archaeological remains can be still discovered during construction.

From Neolithic to Classical Greece and later the Byzantine Empire, there is an array of archaeological finds throughout Greece. Additionally, certain restrictions prohibit renewable energy project development close to archaeological sites, due to visual impact.

Other Risks & Limiting Factors

- Land Productivity
- Natura 2000 areas
- Bird migration corridors
- Crowed market
- High fragmented land
- Local community resistance to renewable energy projects
- High volatility of equipment costs

Source:
Enerdata.net,Climateactionmarple.org.uk,
Blommberg NEF , Norton Rose Fulbright

CO2 Emissions Greece

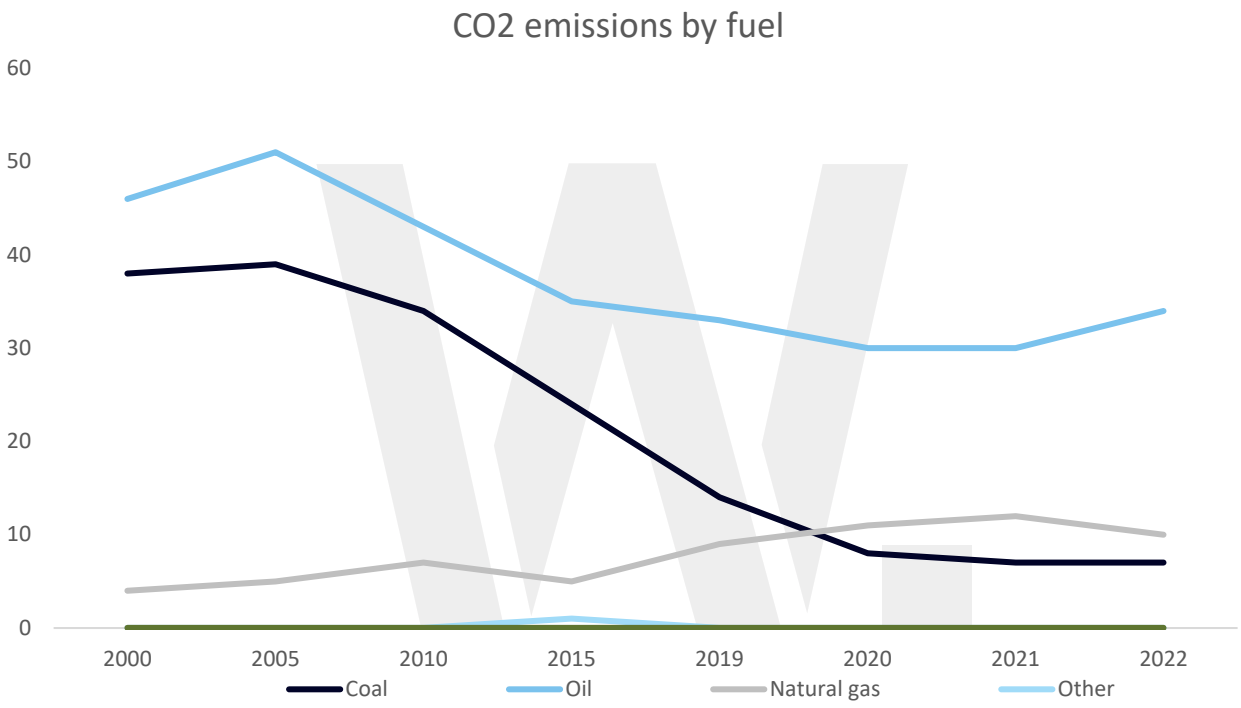
By fuel

Having recorded net emissions of 86 MtCO2e in 2019, Greece's emissions make up 2.4 % of the EU total and have decreased by 36 % from 2005 to 2019. This is above the EU-wide emissions reduction of 19 % in the same period.

In 2019, Greece was the seventh most carbon-intensive economy in the Union, above the EU average by 203 gCO2e per euro. With a 42 % share of the total, energy industries accounted for the largest share of Greece's GHG emissions in 2005. Emissions from energy industries fell by almost 45 % in the 2005-2019 period, reducing their share of total emissions by close to 14 %.

As depicted in the chart below, the CO2 emissions deriving from coal energy production have decreased dramatically since 2010.

One of the reason attributing to this reduction is the installation and development of natural gas in the market as well as the penetration of renewables that have played a part in the phasing out of coal. CO2 emissions produced by oil products have a declining trend with the exception of 2022 where there was a slight increase.



Source: Europarl

CO2 Emissions Greece

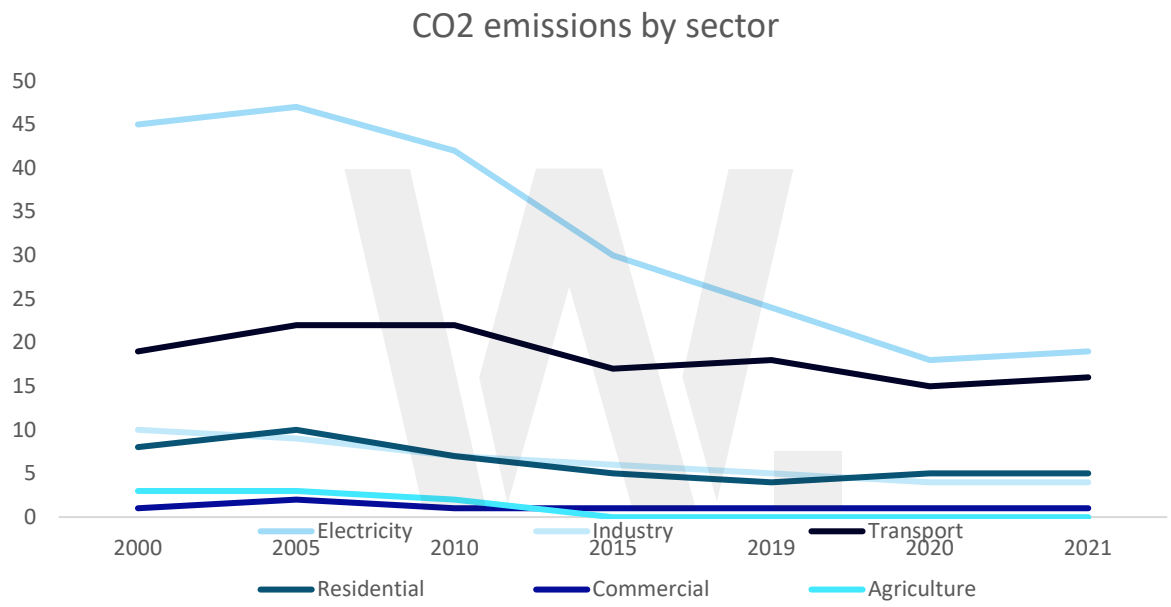
By sector

The CO2 emissions released by each sector depends on the structure of the economy and the energy system. Power plants generate emissions by burning fuels to generate electricity and heat. In transport, the vast majority of emissions in most countries come from cars, which despite the rapid growth of EVs are still overwhelmingly reliant on oil-based fuels.

Fossil fuel heating is the predominant source of residential emissions in most countries. In industry, emissions come primarily from burning fossil fuels to produce heat for industrial processes such as making paper or steel

Total GHG emissions in Greece are expected to decrease to 60.6 MtCO2e in 2030. This decrease is being driven mostly by the power sector through the reduction in diesel-fired plants and the phasing-out of lignite plants as a power source, in combination with an expected increased use of renewable energy sources.

So far, the biggest emissions reduction has been evident in the manufacturing industries and construction sector, which reduced its share of total emissions from 2005 until 2019 from 7.4 % to 5.3 %. This translates into a 54% reduction in emissions since 2005.



*Note that CO2 emissions generated directly by certain processes, like cement making, are not included here, and can be substantial.

The sectors with the lowest emissions reductions between 2005 and 2019 were agriculture and transport (13 % and 21 % respectively). Emissions linked to waste management increased by 0.4 %.

As can be seen in the graph below, electricity generation had the sharpest decrease of sectors, mainly due to the penetration of renewable energy into the electricity mix as mentioned earlier, which has been used as a substitute for coal and lignite fired plants.

Source: Europarl

10

EVs

Passenger Vehicles & Electromobility Outlook

1st oldest fleet in Europe

with an average age of 17 years, when the EU average is 12 years.

Low penetration of EVs & Hybrids

The share of battery electric vehicles & plug-in hybrid vehicles falls very low, at 2.7% and 5.2% of total new vehicle registrations in 2022. However, the number is increasing steadily with 392 vehicles registered in 2023.

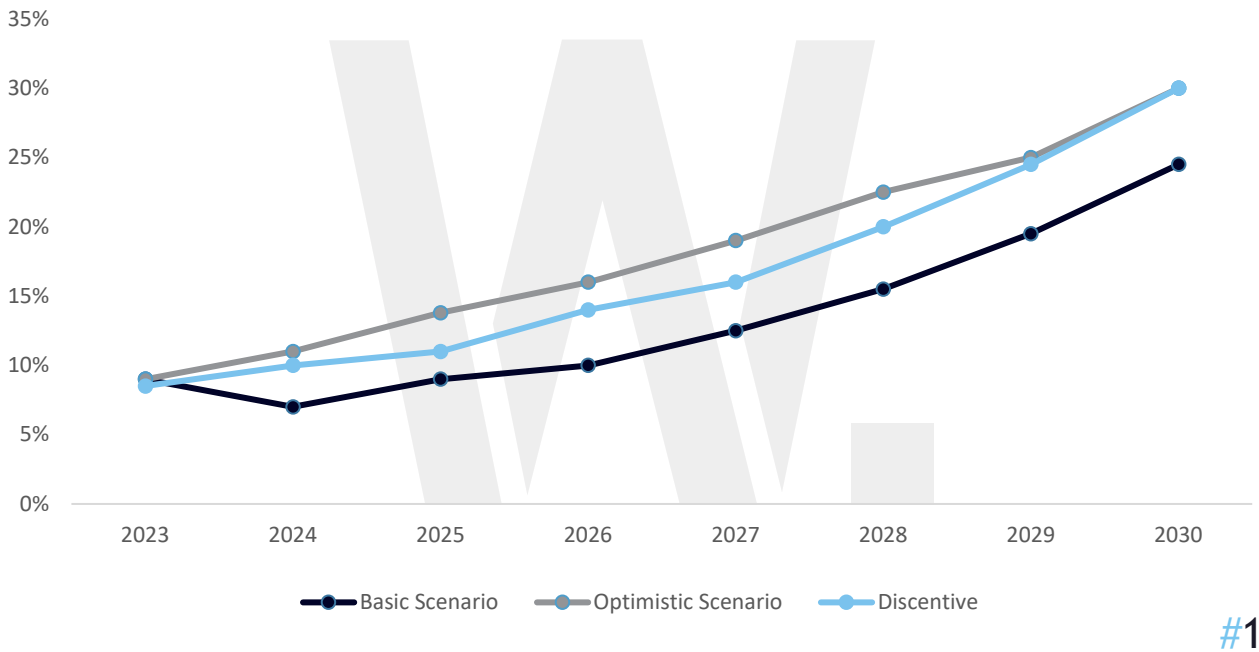
EVs to represent 30%

Of new vehicle registrations by 2030 according to the National energy and climate plan.

EVs Incentives

- ✓ % subsidy for purchase
- ✓ Tax benefits at purchase & during use
- ✓ Free parking and exemption from restricted areas.

National EV Market share projection

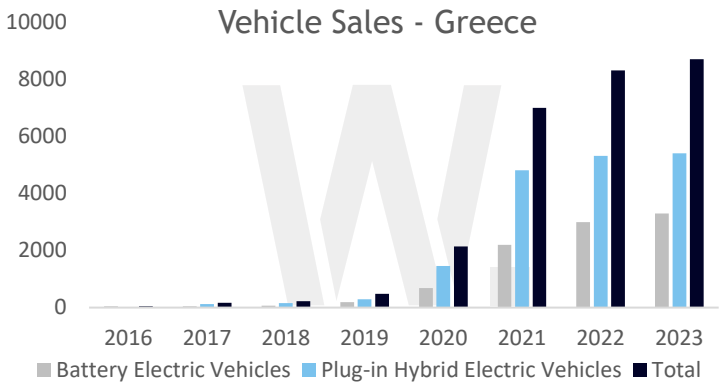


In 2023 the European Automobile Manufacturers Association (ACEA) reported that car sales in the European Union increased by almost 14% in that year, reaching over 10.5 million new registrations. This was the highest number of new car registrations in Europe since before the pandemic. In 2023, battery-electric (BEV) models became the third most popular type of car for buyers, overtaking diesel cars for the first time.

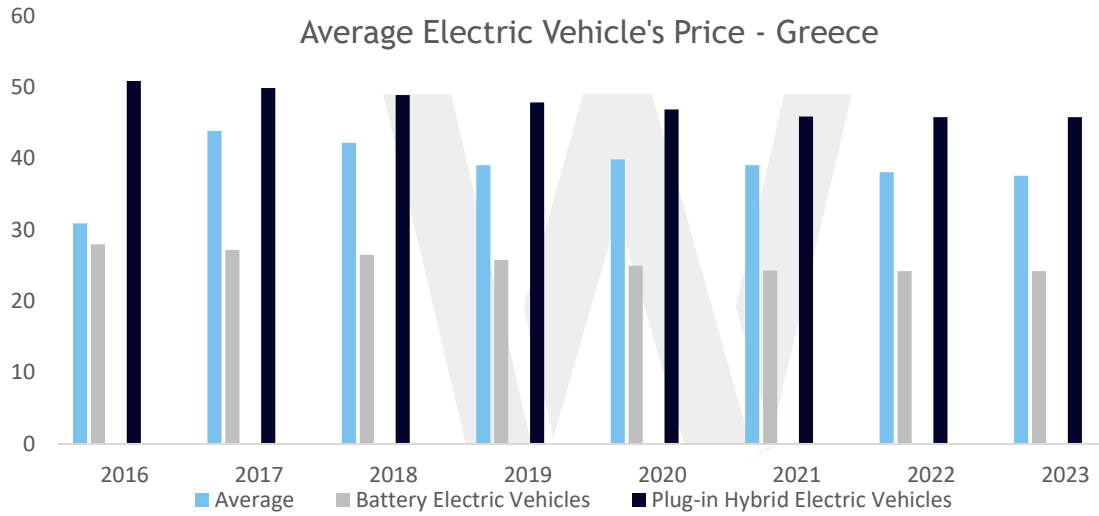
BEV sales increased by 37%, constituting 14.6% of the market compared to 12.1% in 2022 with over 1.5 million units sold. By 2025, BEV sales are expected to surpass those of ICE vehicles in Europe. At the same time, Plug-in Hybrid Electric Vehicles (PHEVs) had a 7.7% market share (down from 9.4% in 2022). The stock of BEVs reached a total of 4.7 million units and PHEVs at 3.4 million units. Despite the positive increases, December 2023 market a record low number of sales of EVs, particularly in Germany which is Europe's largest car market. This can be mainly attributed to the seizure of the subsidies in Germany while the market was working towards rebalancing itself.

More specifically now in Greece, by 2024, the Electric Vehicles market is anticipated to see robust growth, with projected revenue reaching EUR 335.50 million. With an expected annual growth rate of 10.69% from 2024 to 2028, the market volume is forecasted to soar to EUR 503.72 million by 2028. This growth trajectory is indicative of the increasing adoption of electric vehicles in Greece, driven by factors such as environmental concerns, government incentives, and advancements in EV technology. By 2028, unit sales are projected to reach 15,440 vehicles, reflecting a significant shift towards sustainable transportation solutions in the Greek automotive sector.

In 2024, the Electric Vehicles market in Greece is poised for growth, yet faces challenges compared to global leaders like China. The volume weighted average price of electric vehicles in Greece is projected to be EUR 37.1k, indicating a market that is still evolving. However, Greece's revenue in this sector pales in comparison to China, which is expected to generate a staggering EUR 296,304.74 million in the same year.

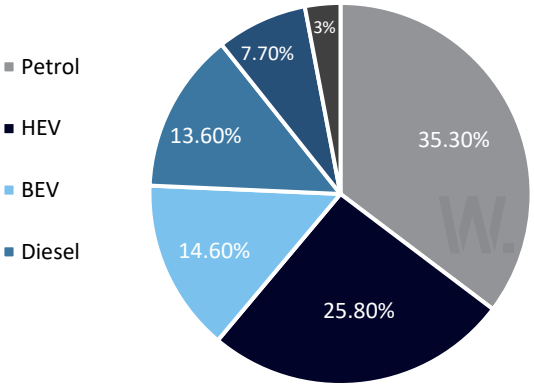


This vast discrepancy underscores Greece's struggle to fully embrace electric vehicles, primarily due to constraints such as limited charging infrastructure and high purchase costs. Despite the global trend towards electric mobility, Greece remains behind the curve, requiring concerted efforts to overcome these barriers and accelerate the adoption of sustainable transportation solutions.



Car Sales in the European Union in 2023

European Union Car Sales 2023



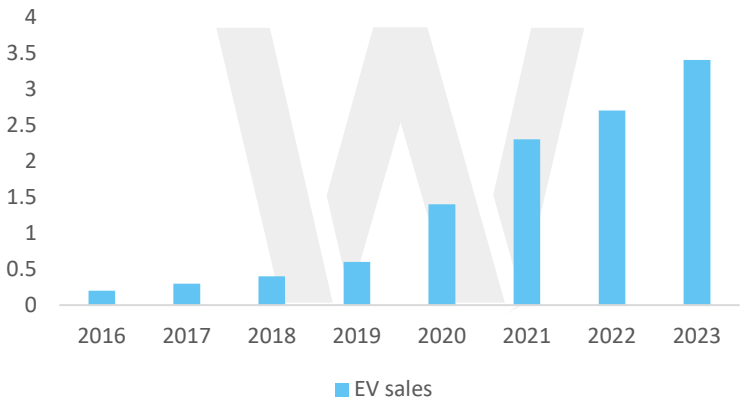
Passenger cars are responsible for about 12 percent of total EU carbon dioxide emissions. In February, the European Parliament voted to approve a new law banning the sale of petrol and diesel cars from **2035**.

The adjacent graph shows vehicle sales by fuel in the EU in 2023.

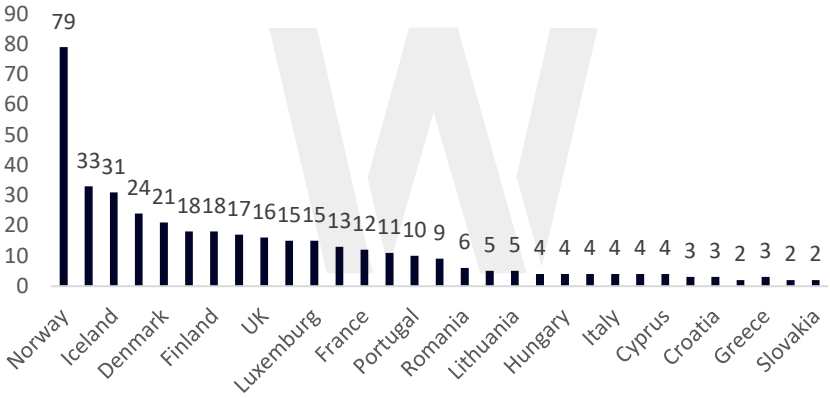
Electric car sales saw another record year despite supply chain disruptions, macroeconomic and geopolitical uncertainty, and high commodity and energy prices.

Europe remained the world's second-largest market for electric cars after China in 2022, accounting for 25% of all electric car sales and 30% of the global stock.

EV Sales in Europe

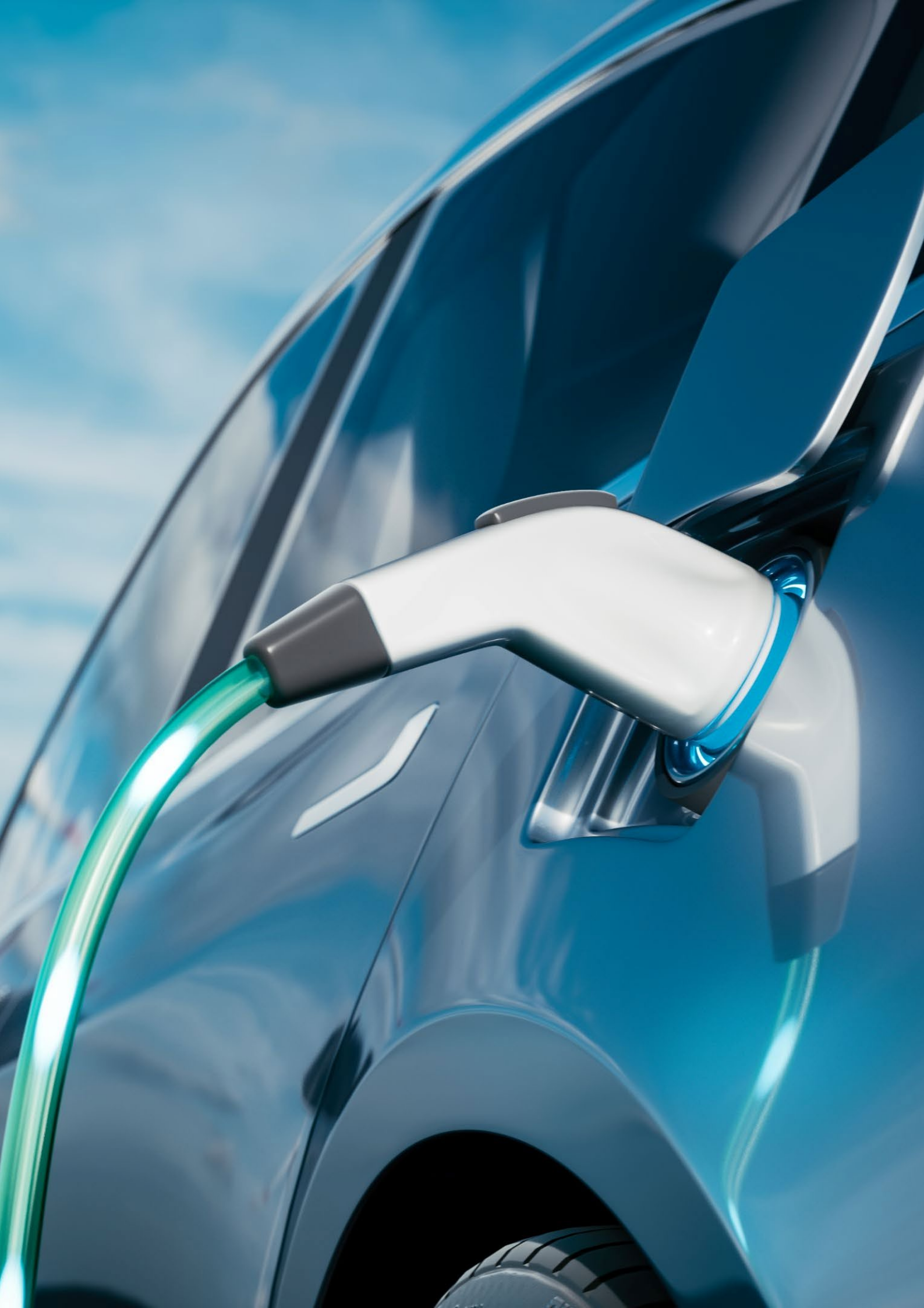


Battery-only electric passenger cars among newly registered passenger cars in 2022%



The transition towards fully electric vehicles has showcased remarkable disparities across European countries in 2022.

Spearheading this shift are Scandinavian nations, particularly Norway, where an overwhelming 79 percent of newly registered cars are fully electric.



11

Legislation

Key takeaways from the recent grid priority framework

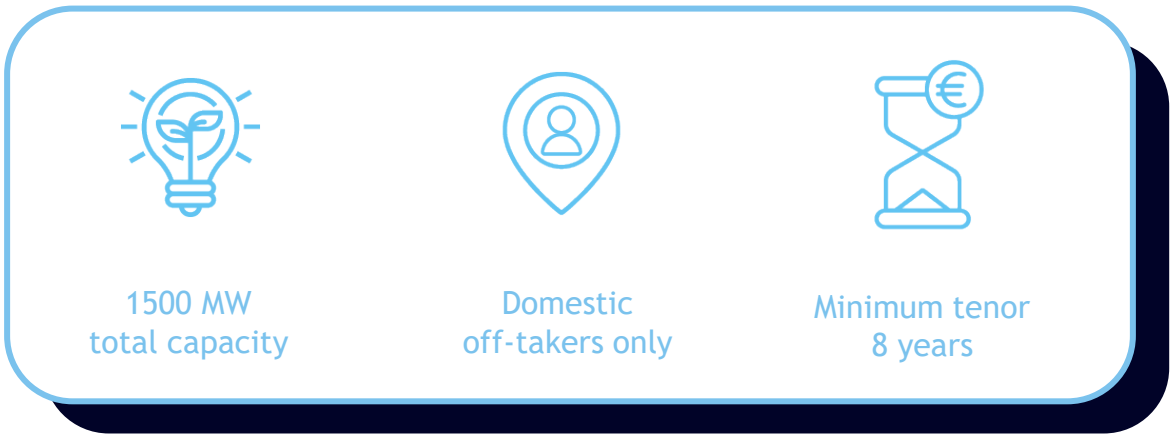
Although the Ministerial Decree that surfaced in August 2022 does not provide the much-anticipated framework for PPAs in Greece but rather lays out the criteria for grid connection priority, it presents useful indications of how the market will evolve:

- The framework covers up to 1500MW of projects with draft PPAs until October 2022. It is uncertain whether this is the first in a series of incentives for PPA-backed projects or if the total capacity of 1.5GW will be covered by the deadline. It definitely sets the stage for utility-scale projects, either wind or solar, to negotiate and close bilateral supply contracts with major industrial consumers, helping the market mature rapidly. This in turn will create a snowball effect, generating more interest from developers and industry alike.

- Eligible PPAs only involve large domestic and commercial consumers, leaving households and foreign potential offtakers out of the picture – for the time being. The rationale behind this is that consumption from industrial consumers is significant and fluctuations in fixed costs, such as electricity, devastating for their budget.

At the same time, PPA negotiations with large companies can be more straightforward than structuring a product for households or navigating cross-border energy interconnections and trade rules. Nevertheless, there are cases of corporate PPAs with foreign entities, such as the collaboration between CERO Generation and AXPO, as well as products for households, like Heron ENA, a small-scale long-term PPA for residential customers.

- The minimum duration of eligible PPAs is set to 8 years, which is on the shorter side, but still renders a project bankable. This is in line with the trend observed in Europe, where in 2021 the length of publicly disclosed PPA deals was on average just over 11 years. Just 3 years earlier, in 2018 the average tenor was 14 years, dropping from 16.5 years in 2016, according to ICIS, the Independent Commodity Intelligence Services. Finally, the average tenure of PPAs reported in 2022 was 10 years.



Renewable energy laws introduced that change the legal landscape

Law 4951/2022 (OJ 129/A/04.07.2022) "Simplification of RES licensing process"

The RES licensing process is simplified with the introduction of Law 4951/2022. The specific law also covers the licensing process for electrical energy storage systems; introduces a framework for the development of pilot marine floating solar projects; and specific amendments for energy and environmental protection. The purpose of this law is to modernize the licensing framework for Renewable Energy Sources, as well as introduce the digitalization of more parts of the process.

The main changes to the licensing process include:

- Reducing the average licensing period for new Renewable Energy Projects from give years to 14 months.
- Digitalization and simplification of the licensing process
- Determines the regulatory framework for storage licensing

Ministerial decree 84014/7123 (OJ 433/B /12.08.2022) on Grid priorities

This law introduces a framework which sets out specific categories of RES, CHP and storage projects that are set to be prioritised to receive Grid Offers. Determination of the priority framework for the granting of final Connection Offers for RES and CHP plants and storage plants by the Grid Operators including areas designated as saturated networks, notwithstanding any other general or specific provision, under Article 89 of Law No. 4951/2022.

Key points:

- A categorization is created for the granting of final offers for connection to the grid, based on priorities, to RES projects to be implemented.
- Separation into priority groups and subgroups, based on criteria including the distance of large projects from the country's borders, their inclusion in the strategic investments, their location in the deforested areas, and their combination with energy storage.

Law 4964 (Government Gazette A 150/30.7.2022

Provisions for simplifying environmental licensing, establishing a framework for developing Offshore Wind Farms, addressing the energy crisis, environmental protection, and other provisions.

Key points:

- Establishing the framework for the development of Offshore Wind Farms
- Simplification of the environmental permitting and control process
- Regulation of forest maps and permitted uses in forests/forest areas.

Government Gazette 275/B – 20.01.2023

Amendment of the decision of the Ministry of Environment and Natural Resources 84014/ 7123/12.08.2022. This amendment introduces changes in the total capacity of groups or subgroups in each category as per the Ministerial Decree 84014/7123, see above.

Source: Ministry of Energy - YPEN

Further Simplification of RES licensing

Ministerial Decree DAPEEK/53607/1559/2023 (Government Gazette 3328/B/19-5-2023

Electricity injection restrictions and Renewable Energy Sources (RES) and High-Efficiency Combined Heat and Power (CHP) plants and electricity storage plants by Article 10 of Law No. 4951/2022 (A' 245).

Law 5095/2024 (Government Gazette A 40- 15.03.2024)

The Greek government once again changes the priority categorisation on Grid Offer receival for RES projects. After the issuance of grid offers to projects with geographical or "strategic importance" criteria, the government defines new criteria for the RES projects that have a PPA draft.
In particular, priority is granted with a complete PPA and not a draft such as before, and three categories are formed:

- PPA with an electricity supplier which guarantees that the electricity will be sold to farmers.
- PPA with electricity supplier which guarantees that the electricity will be sold to industrial consumers
- PPA directly with the industrial consumer

Joint Ministerial Decree 55948/1087 /2023 (Government Gazette 3416)

This Ministerial Decree sets out the framework for Storage Auctions in Greece for the first time. In this Decree the terms for the first three auctions were announced regarding the capacity, maximum tariffs and technical specifications etc.

Source: Energypress

Offshore Wind – legal framework

Introduction of law **4964/2022** sets the legal framework for offshore wind projects

The introduction of the specific law aims to kick-start the development of offshore wind projects, which will contribute towards the reduction energy dependency, decarbonization and dependency on fossil fuel. The aspiration is to construct 2 GW of offshore wind projects by 2030.

The key items introduced are:

- A national plan will be established imminently which will set out the areas of organized development of off-shore wind projects. The national plan will also set the conditions for development of off-shore wind projects.
- Specific exploration licenses will be issued to complete surveys, measurements and preliminary design in the areas of organized development.
- Following the exploration licensing process, a competitive tendering process will determine who will be licensed to develop and operate off-shore projects in the specific development areas.
- The competitive tendering process main criteria will be lowest offer in Euro per MWh.
- Further areas of organized development for off-shore wind will be introduced, following the issue of exploration licenses for the previously determined areas.

Source: Energypress

Sources

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