Investor

FACTSHEET

ENERGY

in Greece

اتاق مشترک بازرگانی ایران و یونان

Iran-Greece Chamber of Commerce

Introduction - State of play

Greece, as the rest of the EU, has set important goals concerning energy use and production and is shifting its focus towards alternative/renewable energy sources. Simultaneously, the country is facing challenges stemming from the war in Ukraine, including shortages of fuels and an increasing pressure of energy independence, an issue of national strategic importance. Greece is aiming to reduce fossil fuel consumption and has set targets regarding its environmental impact. A new climate law has set the goal of **reducing by 55% greenhouse gases** compared to 1990 and to have a **carbon neutral economy by 2050 (Climate law 4936/2022)**[1].

This goal was also confirmed by the 2023 NECP announcement. The energy sector corresponds to about 5% of Greece's GDP. [2] However, energy has a profound impact on all sectors of the entire economy. The Public Power Corporation, the largest energy company in Greece, alone, had a revenue of 11.2 bn€. The subsequent three largest power companies in Greece (ELPEDISON, Heron, NRG) had a total of 3.3 bn€ in revenues[3].

[1]http://www.opengov.gr/minenv/wp-content/uploads/downloads/2021/11/%CE%A3%CF%87%CE%AD%CE%B4%CE%B9%CE%BF-%CE%9D%CF%8C%CE%BC%CE%BF%CF%85.pdf

[2]https://www.iene.eu/greek-energy-directory-2021-p6403.html
[3]https://www.dnb.com/business-directory/company-information.electric_power_generation_transmission_and_distribution.gr.html

Current state of energy sector

Currently there are numerous projects planned or underway aiming at reducing fossil fuels in the Greek energy sector. Solar and wind energy can be found in abundance in Greece, due to its climate. However, other forms of energy sources are also explored and facilities to use them are developing. It is estimated that between 2021 and 2030 prospective investments deriving from Greece's energy and climate plan would be more than double compared to the previous NECP estimates (i.e., previous NECP announced investments of 44 bn€).[4] A significant part of the investments concern the energy, industry, and other sectors. In addition, major household expenditures related with purchasing of more efficient household equipment and electric vehicles are to be expected by 2030, actions included and partially funded by the RRF.

Table 1: Total electricity capacity of Greece in 2021 and evolution over the last 7 years[5]

Electricity Source	Capacity in Mega Watts						
	2015	2016	2017	2018	2019	2020	2021
Hydro and marine	3,392	3,392	3,392	3,409	3,412	3,417	3,421
Solar	2,604	2,604	2,605	2,651	2,834	3,287	4,277
Wind	2,091	2,370	2,624	2,877	3,589	4,119	4,649
Total renewable	8.09	8.37	8.62	8.94	9.84	10.82	12,347
Combustible fuels	10,294	10,231	10,233	10,075	10,075	9,403	7,801
Total	18,381	18,597	18,855	19,013	19,910	20,227	20,148

[5]https://ec.europa.eu/eurostat/databrowser/view/NRG_INF_EPC__custom_6213893/default/table?lang=en

There is a growing capacity in RES in Greece (Table 1) leading to displacement of fossil-based power generation sources (i.e. lignite power plants). The latter includes the retirement of all lignite plants by 2030. Regarding the islands in Greece, the GR-eco islands initiative looks into establishing hybrid power stations in non-interconnected islands and emissions reduction through electrification of demand sectors and energy efficiency. Although in the right path, Greece's energy sector can be improved further through investment as the market still has a lot of potential to exploit. This is also evident from the reduction in fossil fuel usage in electricity production (from 66.5% in 2015 to 27.9% in 2021) and the increase in Renewables and biofuels (from 31.7% in 2015 to 70.9% in 2021).[6]

According to Eurostat, Greece's consumption of renewable energy as a percentage of total energy consumption, is approximately 0.5% below the European average (around 22%), and significantly less than the frontrunners in Scandinavia.[8] Regarding electricity generation, Table 2 shows the increase of renewable energy generation per capita.

Table 2: Evolution of per capita electricity generation kWh[7]

Electricity Source	Capacity in Mega Watts					
	2015	2016	2017	2018	2019	2020
Renewable	1,400	1,400	1,200	1,600	1,600	1,800
Total	4,900	5,050	5,150	5,000	4,200	4,200

[4]https://www.greeceinvestorguide.com/sectors/energy/

[6]Source: EUROSTAT –energy primary production

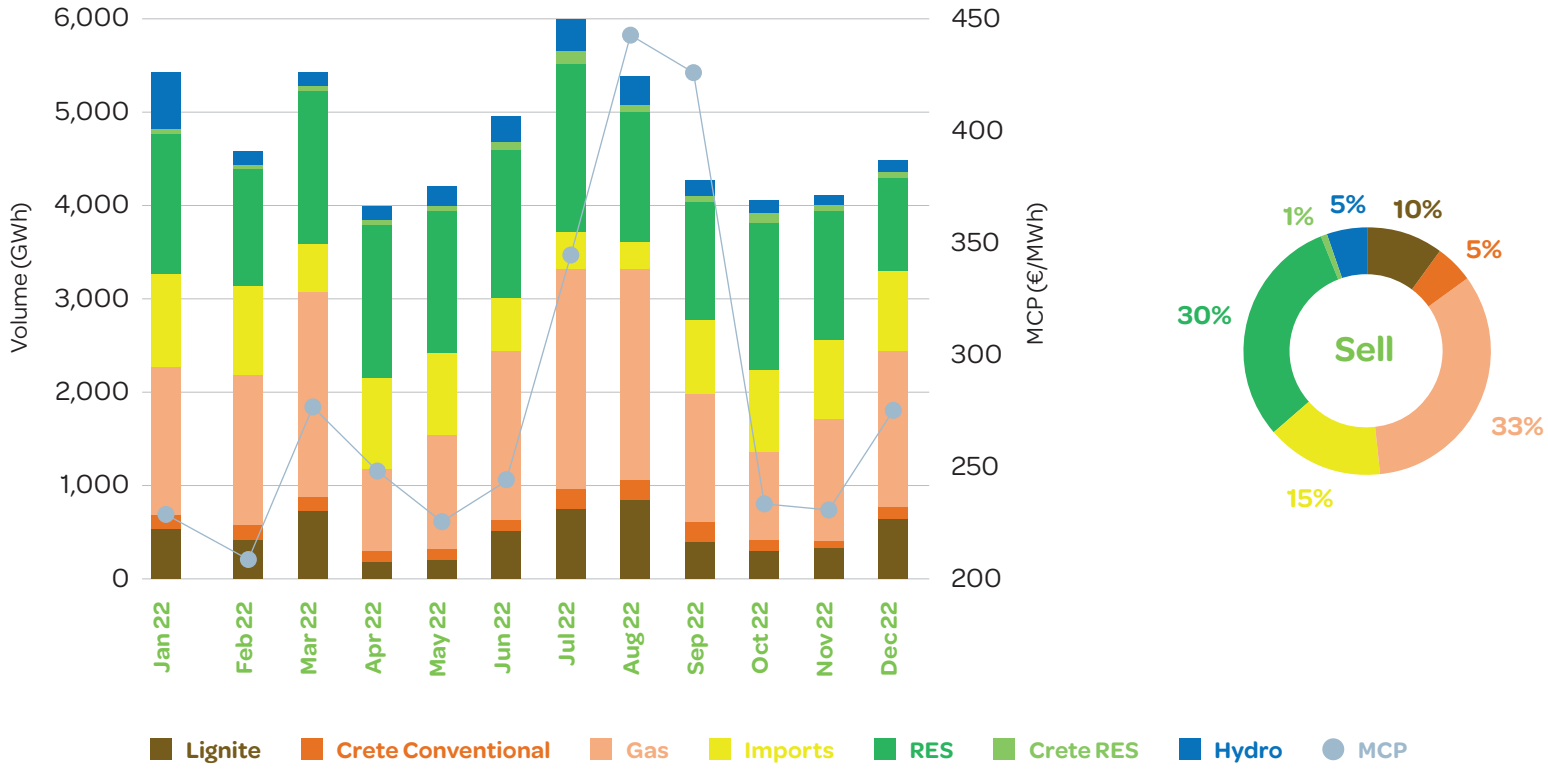
[7]https://www.irena.org/IRENADocuments/Statistical_Profiles/Europe/Greece_Europe_RE_SP.pdf

[7]https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Renewable_energy_statistics

Current state of energy sector

In 2022, RES generation made up ~30% of the total energy mix, compared to ~28% in 2021. Figure 1 displays the volumes of the 2022 monthly mix by source of energy.[9]

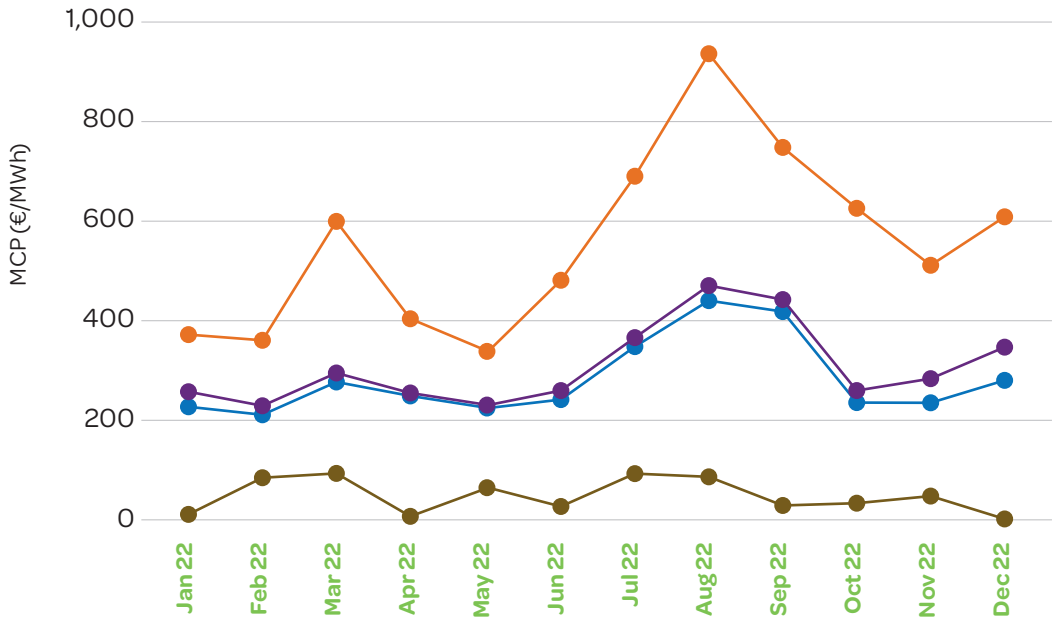
Figure 1: Greece monthly energy mix distribution



[9] https://www.enexgroup.gr/el/c/document_library/get_file?uuid=63f699f5-429d-17e3-4a6a-0c6c76878372&groupId=20126

Average electricity prices increased 140% in 2022 over 2021 as shown in Figure 2, which already had risen by 158% in 2021 compared to 2020. This trend is not particular to Greece, as all EU countries faced the same challenge of rising energy prices. In 2023 electricity prices eased down, with the average cost as of May 2023 being 60% that of the average of January 2023, and 58% compared to the average of May 2022[10].

Figure 2: Average electricity prices



Change '22 / '21	
304.3	+130.16%
936.33	+72.60%
279.90	+140.38%
-0.01	0,00%

Minimum
Average
Maximum
Peakload

[10]https://www.enexgroup.gr/el/c/document_library/get_file?uuid=63f699f5-429d-17e3-4a6a-0c6c76878372&groupId=20126#page=7&zoom=100,73,500

Current state of energy sector

The reduction in electricity prices is driven by the reduction in natural gas prices, as the natural gas power stations are the ones largely determining the electricity prices. The following indicates a steady short-term reduction in the TTF gas prices, compared to the spikes observed back in 2022.

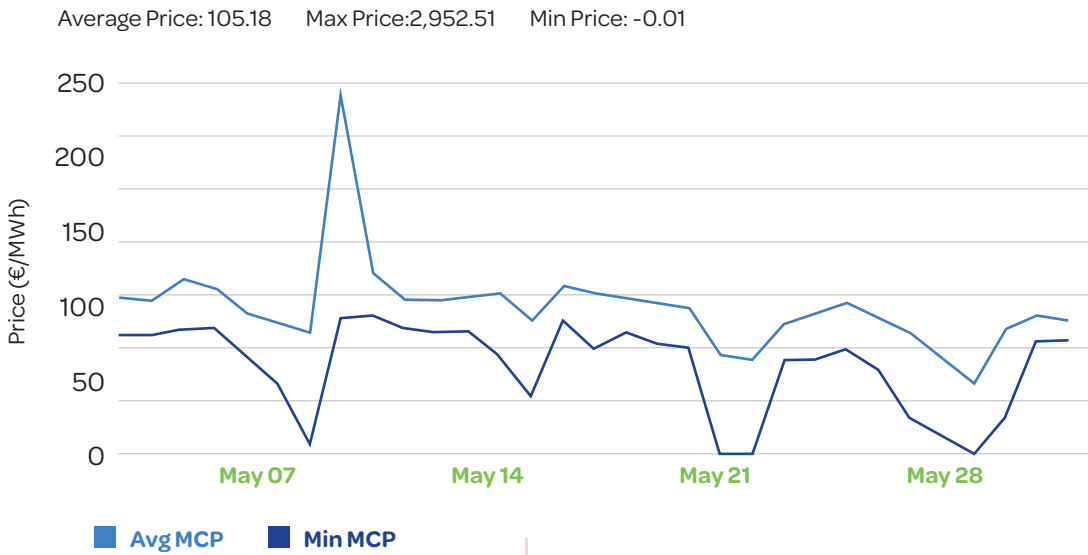
Interestingly, as seen in figure 3, during the month of May 2023 there were multiple instances where prices reached 0 due to excess RES production. For example, based on hourly values[11], prices for the 28th of May dropped to 0 for the hours of 9am until 4pm. This indicates the volatility of the daily electricity prices, which will be a common feature of the electricity market in the coming future.

Greece has set a goal of withdrawing most lignite plants (over 80%) by 2023 and all of them by 2030, making room for new energy sources. However, given the recent energy crisis, it is uncertain how the short-term developments will be and how the political discussions will evolve. Carbon capture, utilization, and storage (CCUS) potential is also being explored as potential emission reduction option for power generation and heavy industries. In this regard, Greece also has available natural storage capacity in the Prinos basin.

[11]https://www.enexgroup.gr/el/web/guest/markets-publications-el-intraday-market?p_p_id=com_liferay_asset_publisher_web_portlet_AssetPublisherPortlet_INSTANCE_6eBaUXF5VIb7&p_p_lifecycle=0&p_p_state=normal&p_p_mode=view&_com_liferay_asset_publisher_web_portlet_AssetPublisherPortlet_INSTANCE_6eBaUXF5VIb7_delta=7&p_r_p_resetCur=false&_com_liferay_asset_publisher_web_portlet_AssetPublisherPortlet_INSTANCE_6eBaUXF5VIb7_cur=2

Figure 3: Dutch TTF Natural Gas Futures

Figure 4: Average and minimum electricity prices



Investment opportunities in the Greek Energy Sector

Energy Trends

The Greek energy sector is quickly transforming towards sustainability. This has been confirmed by the recent climate law and the updated national energy and climate plan. At the same time, there are considerations to increase the resilience of the energy sector against geopolitical threats (dependance on Russian natural gas). These conditions highlight the need for the Greek energy sector maximize the utilization of its national resources. In particular, the key trends are summarized in the following pillars:

RES Development:

The need for development and use of renewable energy sources around the world and in the EU has been growing rapidly recently. For the case of Greece, offshore wind is a technology which has not developed so far but has significant potential.

Offshore wind farms are progressively being supported through the 4964/2022 law which has called for 2GW of offshore wind capacity by 2030, likely by floating platforms. Currently, Greece's capacity of approx. 4.9GW of wind energy is all found onshore. According to the plans for offshore wind projects auction-based measures will take place in 2025 or 2026. The 2023 NECP has further pushed the goal to 2.7 GW of offshore wind power by 2030.Other sources of RES such as from waves is being explored (e.g. for specific islands such as Halki[12]).

[12] https://www.offshore-energy.biz/eco-wave-power-unveils-plans-for-wave-energy-project-in-greece/

[13] https://www.irena.org/IRENADocuments/Statistical_Profiles/Europe/Greece_Europe_RE_SP.pdf

Table 3a: Distribution of PV and Wind energy capacity [13]

Annual Generation per unit of installed PV capacity (kWh/kW/yr)	Percentage of Land Area	
	Greece	World
<1200	15	25
1200-1400	70	13
1400-1600	15	20
1600-1800	0	20
1800-1900	0	15
1900-2000	0	5
>2000	0	2

Table 3b: Distribution of Wind energy capacity [13]

Wind Power density at 100m height (W/m2)	Percentage of Land Area	
	Greece	World
<260	30	62
260-420	22	23
420-560	18	8
560-670	18	2
670-820	9	2
820-1060	0	1
>1060	3	2

Table 3a & 3b illustrate (with measurements considered valid in 2022) the potential annual generation of power in Greece from solar and wind energy for parts of Greece and compares these values to the rest of the world (for example, about 70% of Greece's land area, if used for solar power generation, would produce 1200-1400 kWh/kWp/yr or about 15% utilization rate). It is deduced that investing in wind or solar power in Greece is a safe investment choice, which can consistently yield profits and a more effective utilization of assets.

In particular, the updated Greek NECP envisages an additional installation of around 7.1 GW of onshore wind capacity by 2030.

RES Development:

A general issue of RE electricity generation is intermittence. In this direction, energy storage can solve this issue. The recovery and resilience plan has allocated approximately 500mil € for the creation of energy storage systems, and the Regulatory Authority for Energy has passed a (4951/2022) law in 2022, aiming for a 3.5GW of energy storage[14].

Energy storage technologies include the following:

- Batteries are expected to play an important role along with RES expansion. Batteries allow storing excess RE electricity at times of low demand and, injecting it back to the system, at times of peak demand. More than 3GW of batteries are expected to be installed by 2030 in Greece[15], with the goal being at 5.6 GW of battery capacity by 2030, according to the updated NECP.
- Hydroelectric energy storage is another possible storage solution. In 2022, Greece was operating two such storage systems, and had issued licenses for 14 more[16]. The NECP capacity goal for 2030 is 2.5 GW.
- Alternative fuels: Electricity produced through RES can be used to power an electrolysis procedure which can produce "green" hydrogen which is seen as a feedstock for zero-emission synthetic liquid fuels for sectors of the demand. The NECP states a goal of 200 thousand tons of production for both green hydrogen and synthetic fuels by 2030 as the first part of a growing operation. A large facility of hydrogen production through electrolysis and fuel cell systems in Western Macedonia will be funded through the "Important Projects of Common European Interest" (IPCEI).

Energy efficiency supports emission reduction and aims at minimizing consumption, a need also induced by the recent energy crisis. The Greek energy transition plan foresees renovations of more than 100,000, in this regard, leading also to jobs creation.[17]

To achieve the **energy efficiency targets**, multiple approaches have been implemented:

- **New buildings are required to adhere to energy ratings standards**, with a large part concerning insulation aiming to minimize heating and cooling energy needs. New buildings that achieve particularly good energy ratings are awarded greater building coefficients (5%-10%), providing incentives particularly attractive to larger projects[18].
- **Large-scale renovation projects of public buildings to improve their energy rating**, within the scope of total building renovation. The NECP estimates average annual renovation spending for buildings between 2021 and 2025 at a height of 642mil€, and projects over 900mil€ between 2026 and 2030, per annum.

[14]https://iea.blob.core.windows.net/assets/5dc74a29-c4cb-4cde-97e0-9e218c58c6fd/Greece2023.pdf

[15]https://ypen.gov.gr/synantisi-tou-ypourgou-perivallontos-kai-energeias-kosta-skreka-me-meli-tou-amerikanikou-kogkresou-kai-ton-presvi-ton-ipa-stin-ellada/

[16]https://iea.blob.core.windows.net/assets/5dc74a29-c4cb-4cde-97e0-9e218c58c6fd/Greece2023.pdf

[17]https://ec.europa.eu/info/business-economy-euro/recovery-coronavirus/recovery-and-resilience-facility/greeces-recovery

[18]http://www.opengov.gr/minenv/?p=10818-and-resilience-plan_en

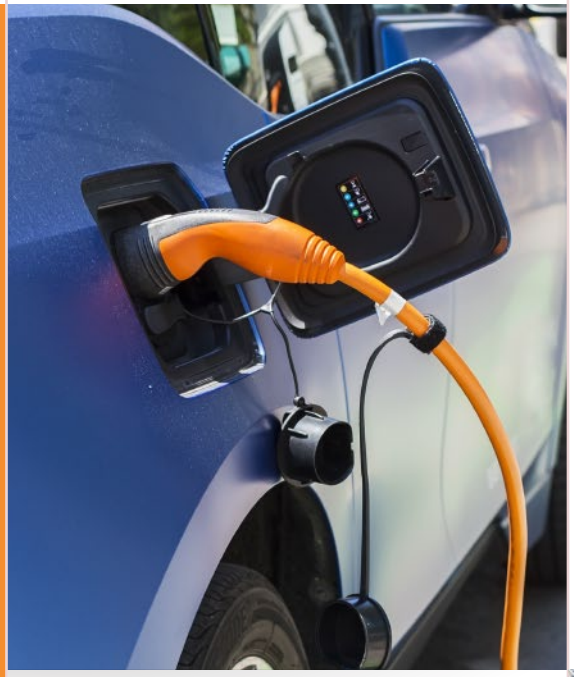
Energy infrastructures

The Independent Power Transmission Operator (IPTO) is planning new interconnections and network upgrades to enable and facilitate increased renewables use and increased reliability. Infrastructure also includes setting up a network of electric vehicle charging points. There is a growing interest in this area due to the expected uptake of electromobility. The trend is showing a strong increase in the number of charging points, which is expected to continue all the way until 2025 and beyond. EU regulation on Alternative Fuel Infrastructure presupposes that at least one electric vehicle charging station should exist every 60km in main EU roads[19].

[19]https://www.haee.gr/FileServer?file=d9018443-6ca1-44d0-a229-1cca0fa2052d

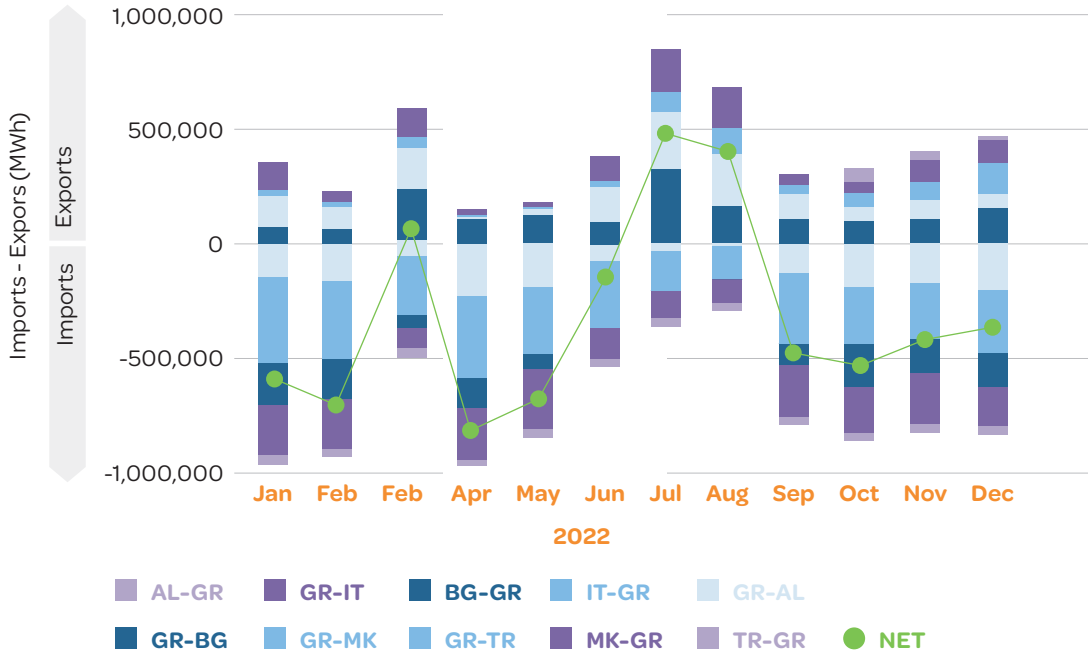
Table 4: AC & DC charging points per year

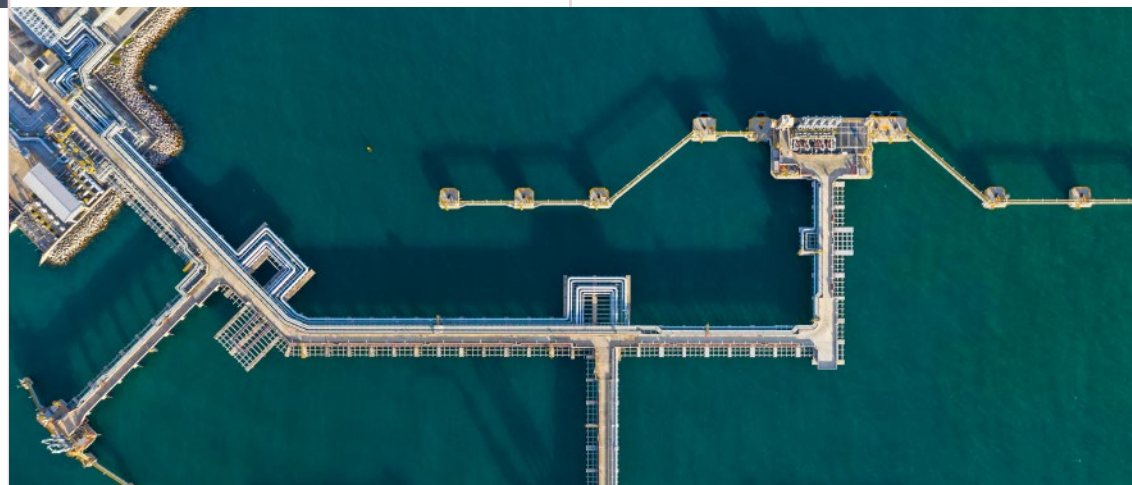
	2020	2021	2022
AC charging points	292	607	1908
DC charging points	6	22	160



In addition, upgrading and development of cross-border electricity grid interconnections (Maritsa East, Euro-Asia InterConnector) will make exports easier and increase the market size. A graph with the analytical balance of trade of the Greek energy sector is shown next.

Figure 5: Balance of trade - Greek energy sector





Greek unique benefits-key considerations

- Greece's **geographical location** provides it with a beneficial starting point in playing a role in the energy sector as it connects the Western world with the Eastern world while agreements like the one between Greece, Cyprus and Israel enhance this advantage.
- Moreover, because of **Greece's climate** (more than 250 days of sunlight and very high wind energy potential) there is a lot of renewable energy unexploited. This has also been shown with data from IRENA (Table 3a & 3b)
- Additionally, over the past years, the **Ministry of Environment and Energy** and the **Ministry of Development and Investments** have **welcomed** and very much helped in the progression of major energy projects on RES, natural gas pipelines and liquified natural gas terminals, while the energy investment regulatory framework incentivizes spending on the sector. This is amplified with the recent energy crisis and the need to develop import routes for LNG. There are already FSRU projects that are under consideration such as a new gas terminal in Corinth[20] and the FSRU in Thessaloniki[21].
- The state currently foresees subsidies to consumers (e.g., renovations for energy efficiency, replacement of old electrical equipment, EV purchasing) to support spending and the purchasing of less polluting and energy consuming devices through the RRF, among others.
- The Greek islands have sufficient natural resources to enable their energy transition. Particularly smaller or less populated islands, which have historically been troubled with issues due to poor grid connectivity, are positioned to uniquely benefit from hybrid power stations. Further, the GR-eco Islands[22] initiative connects the energy transition of islands within a general scope for resilience and sustainability of the local economies.

[20]https://www.reuters.com/business/energy/greece-approves-construction-fsru-off-athens-2023-01-27/

[21]https://www.elpedison.gr/en/news-room/press-releases-announcements/read-news/?nid=136

[22]https://clean-energy-islands.ec.europa.eu/news/gr-eco-islands-turning-greek-islands-models-green-sustainable-development