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Needs

Dynamic Techno - Economical Scenario Simulation Model for Sustainable Waterborne Activities and Transport

D2.2 Analysis of the potential of the maritime region

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Document information	
Short description	This deliverable assesses and describes the potential of the South-East region of Europe, and particularly Greece, in supporting the use of alternative fuels in the coastal shipping sector. Both current capacities of sustainable / renewable energy production are identified and reported vis-à-vis ongoing and planned investments, while promising opportunities not yet exploited are also highlighted
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Executive summary

Following-up the description of the Greek coastal shipping network (D2.1) and for supporting the transition towards zero-emission operations, the country's current and future potential in terms of sustainable and renewable energy production is being described herein, taking into account the fact that electrification is being acknowledged as the best fit for ferries, with ICEs powered by alternative fuels serving as the most competitive solution for ferries operating at longer-range shipping routes. Given the weather conditions prevailing in Greece (i.e. long hours of sunshine, strong winds of high speed), solar and wind energy present a highly promising potential with large capacities already being in place, and the share of those renewable energies in the current mix already having reached a good level (28,7%). There is still however large untapped potential waiting to be exploited, given that the country's investment-friendly environment is further strengthened and much needed policy instruments, such as Greece's Maritime Spatial Plan, are formally introduced unlocking and materializing investment interest. Energy infrastructure within the Greek port network is concentrated to-date on large, key ports mainly comprising of LNG bunkering facilities, with the majority of them being though at planning stage, and OPS, though fewer in number, which are close to implementation exploiting experiences from the pilot applications conducted at the port of Killini. In a nutshell, Greece is currently at a good track when it comes to RES production, with the growth pace expected to be intensified in the near future. The country's coastal shipping network offers multiple opportunities for electrification which need to be effectively exploited for transiting towards zero emission operations, coupled with the use of alternative fuels for vessels operating on longer shipping routes. Port energy infrastructure is still at its infancy and thus developments should be intensified / expedited so that supply and demand are better aligned and can grow together. The CEF programme has been very beneficial for conducting and advancing the planning and development of such infrastructure and can be further utilized in the future by other ports and for addressing other fuel types.

1. Introduction

Greece is located in the South-Eastern part of Europe, acting as a key entry point for international freight flows[1] (originating from major production areas such as the ones located in South-East Asia), thus accounting for an important blue economic center within the Mediterranean Sea. Within Europe, Greece represents a rather distinctive case when it comes to the maritime transport sector, with more than 170 inhabited islands having to be effectively served for meeting the needs of local communities (ensuring in that way social cohesion) as well as the needs of large touristic flows that the islands accommodate during the extended touristic period.

A rather complex coastal shipping network has thus been set-up consisting of both commercial lines as well as of lines that are subsidized so as to ensure that all inhabited islands are well connected to the mainland all year long. The network's density is high[2] and so is the intensity of operations, especially during the summer when both passenger and cargo traffic grows exponentially. The resulting environmental impact is profound, considering also that the average age of the corresponding fleet is quite high (i.e. 28 years[3]), with medium and small-sized shipping companies facing significant challenges in renewing[4] their existing vessels (e.g. access to financing, lack of incentives, etc.).

In light of the new environmental regulations (Figure 1) and the climate targets set in them for the medium- and long-term, the Greek Ministry of Maritime Affairs and Insular Policy (i.e. the network's planner and main policy and decision maker) is actively seeking appropriate energy transition pathways that correspond well to the network's operational conditions and fleet characteristics, thus exploit regional capacities (existing and planned) in terms of sustainable and renewable energy production as well as promising opportunities not yet exploited.

[1] Considering for example the Maritime Silk Road (MSR) of the Belt and Road Initiative (BRI)
[2] The Greek coastal shipping network is one of the most dense shipping networks in Europe
[3] https://www.newmoney.gr/roh/palmos-oikonomias/nautilia/xrtc-epitaktiki-anagki-i-ananeosi-tou-stolou-tis-aktoploïas-pinakes/
[4] New orders or retrofits

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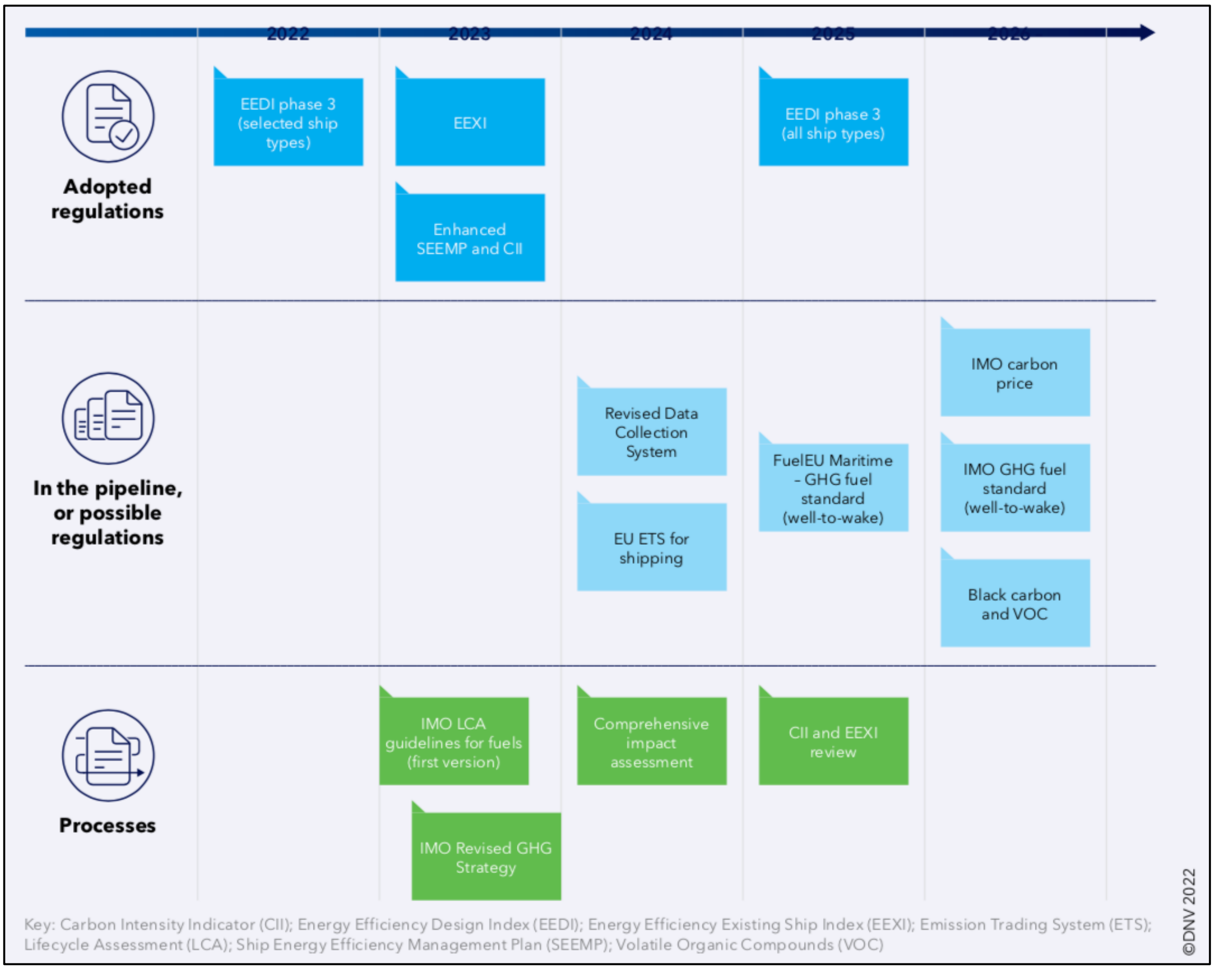

Figure 1: Timeline with key regulatory processes and decisions in the EU and the IMO (DNV, 2022[5])

With operational conditions in the Greek coastal shipping network and fleet characteristics being described in D2.1, this deliverable covers the second part of the aforementioned scope. More specifically, it has been structured as follows: taking D2.1 as the main reference point, Section 2 presents a set of clean technologies and energy carriers that can account for the highest applicability and largest potential of driving the coastal shipping fleet into achieving zero-emission operations by 2050. Of course, renewable energy should be used to this end, and thus Section 3 presents the current status and future potential of renewable energy production in Greece and the South-Eastern part of Europe. The status of the relevant energy infrastructure in Greek ports is being assessed next, in Section 4, along with estimates on the impact that will be imposed for driving this energy transition. Section 5 concludes the deliverable by effectively summarizing and showcasing the overall potential of Greece and the South-Eastern part of Europe in facilitating the energy transition of the Greek coastal shipping system.

[5] https://www.dnv.com/maritime/publications/maritime-forecast-2022/download-the-report.html (based on DNV's Alternative Fuel Insight platform)

2. Promising clean technologies and energy carriers

A range of different technologies can contribute to shipping decarbonization and the achievement of the policy targets that have been set (Figure 2).As documented in WATERBORNE Technology Platform's 'Strategic Research and Innovation Agenda for the Partnership on Zero-Emission Waterborne Transport'[6], due to the fact that coastal shipping vessels (ferries) operate between fixed points, they represent excellent candidates for becoming fully electric with completely zero emissions.

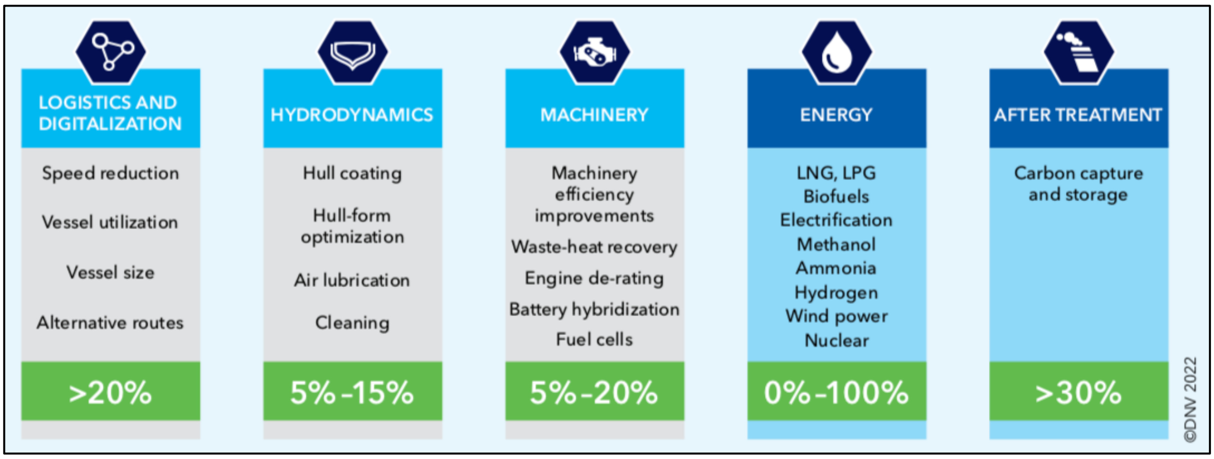

Figure 2: GHG emission reduction potential of technologies that can contribute to shipping decarbonization (DNV, 2022)

Within Europe, such vessels cover a wide range of services ranging from urban/harbour services that connect ports that are just a few nautical miles away, to larger inter island RoPax ferries providing services over routes of 50-200 nautical miles, with the longest routes extending to as much as 500 nautical miles. For both newbuilds and retrofits that operate on routes up to 200 nautical miles, the challenge will be, according to WATERBORNE TP, to opt for one of the following clean technologies: full battery electric, fuel cells and ICE powered with alternative fuels. Regional conditions as well as policy priorities will be pushing to the forefront one over the other solutions. Zero emission requirements for vessels when approaching ports and while at berth, will initially push towards hybrid solutions, with battery capacities enabling fully electric transit reducing in that way noise and emissions. For long-distance ferries, ICEs powered with alternative fuels will be the most competitive solution, supported by energy efficiency measures and exploiting smart power supply in port facilities.

As it can been seen in Figure 3 below, world fleet is still dominated by vessels running on conventional fuels, with vessels powered by alternative fuels accounting for a share of 1,2% (i.e. 1.349 vessels in total). In terms of gross tonnage, the latter hold a share of 5,5%, with LNG vessels[7] accounting for the largest majority (5,39%). Marginal is the share in gross tonnage of existing battery/hybrid vessels, although their number is quite considerable. This

[6]https://www.waterborne.eu/images/210601_SRIA_Zero_Emission_Waterborne_Transport_1.2_final_web_low.pdf

[7] Both LNG carriers and LNG-fuelled vessels

denotes, as mentioned above, that these solutions are mostly applied on smaller vessels (predominately ferries).

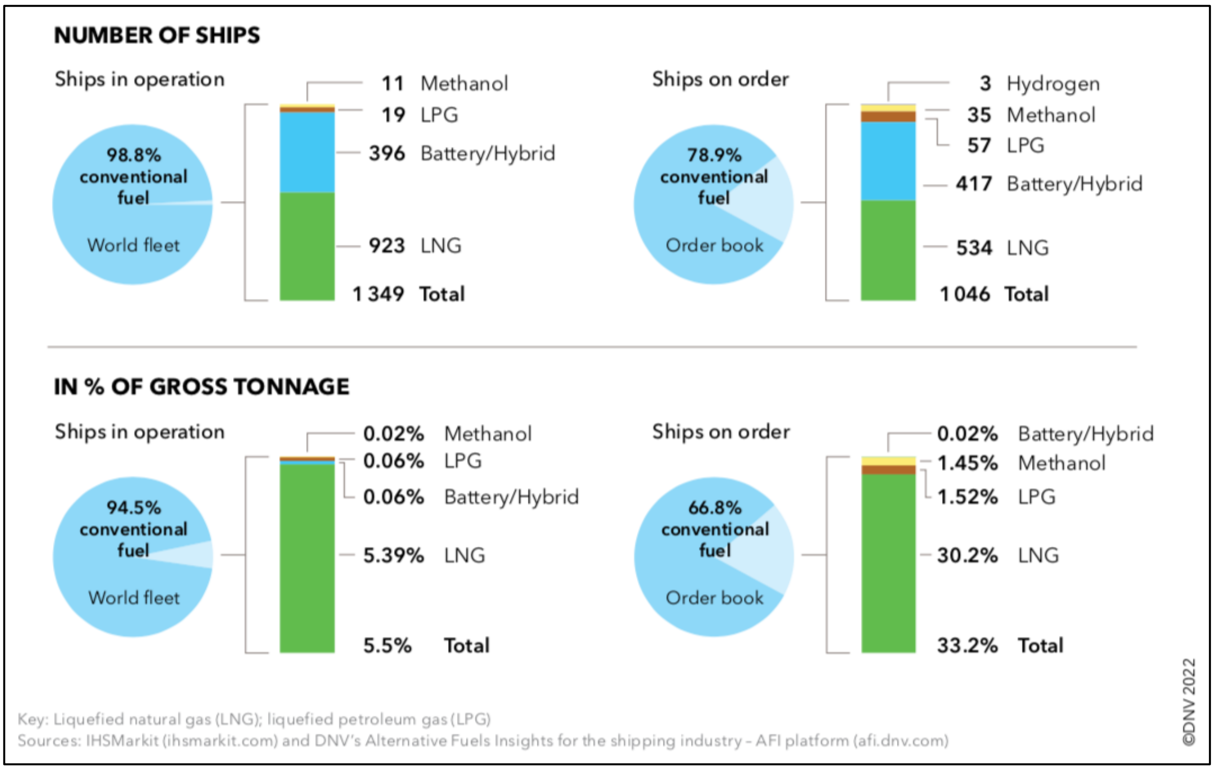

Figure 3: Alternative fuel uptake in the world fleet by number of ships and gross tonnage (DNV, 2022)

The view of the orderbook is quite encouraging with vessels powered by alternative fuels accounting for 21,1% of the number of vessels ordered (i.e. 1.046 alternatively-powered vessels are on order), and 33,2% of the current orderbook in terms of gross tonnage. LNG continues to be the most popular fuel choice, especially for car carriers and containerships, while significant uptake is also now seen for tankers and bulk carriers. In the short sea shipping sector – the first mover on LNG a few years back – there is a clear trend towards electrification, which continues to rise. However, some companies are also investigating the use of hydrogen and fuel-cell technology in effort to increase range. Methanol had previously been a sole choice of tankers, with 11 tankers in operation and 14 new ones on order. In 2022 however, uptake in the container transport industry is also documented with 21 methanol-fuelled containerships being on order. The strong interest in ammonia as fuel, reflected in existing concepts and pilot studies, is still restricted by immature converter technologies. This is expected to change though, once this kind of technology becomes commercially available (see estimated maturation timelines in Figure 4).

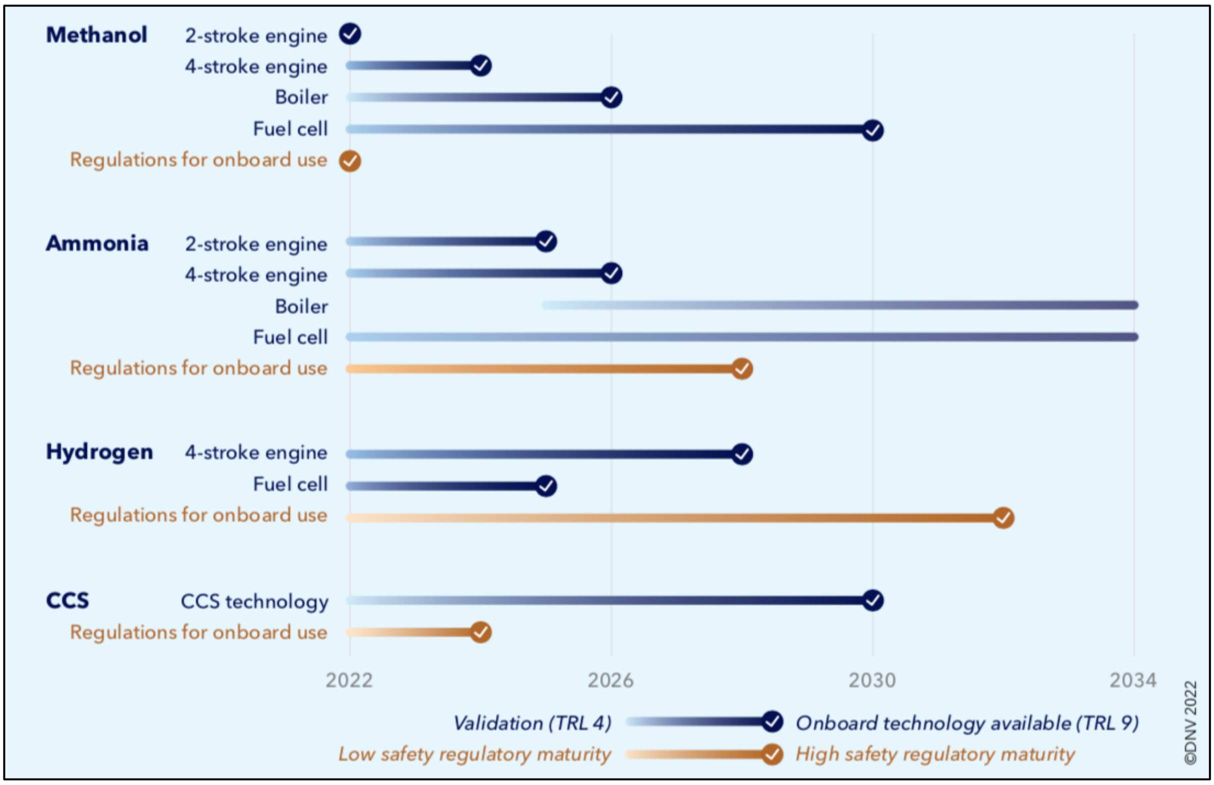

Figure 4: Estimated maturation timelines for energy converters, onboard CCS technologies, and corresponding regulations for onboard use (DNV, 2022)

3. Regional capacities of sustainable / renewable energy production: Current status and foresight

South-East Europe in general, and Greece in particular are being characterized of climate conditions that largely favour the production of renewable energy (e.g. long hours of sunshine, winds of high speed, etc.). Despite such a potential, delays in setting-up the proper policy frameworks coupled with a lack of appropriate financing mechanisms and incentives resulted in detaining relevant investments, ranking Greece only 8th in Europe in 2021, in terms of the share of wind and solar energy in total electricity generation (28,7%) (Figure 5).

According to official data published by Greece's Renewable Energy Sources Operator and Guarantees of Origin (DAPEEP), in Q3 2022, the total capacity of solar energy exceeded for the first time that of wind energy. More specifically, the latter amounted to 4.294 MW, lagging behind the total capacity of solar energy by 250 MW[8,9]. Additional capacity of 950 MW for solar energy and 910 MW for wind energy are expected to be added this year, once ongoing relevant projects are completed.

[8] PVs established on rooftops are also taken into consideration
[9] Both PVs connected to the grid and under development are

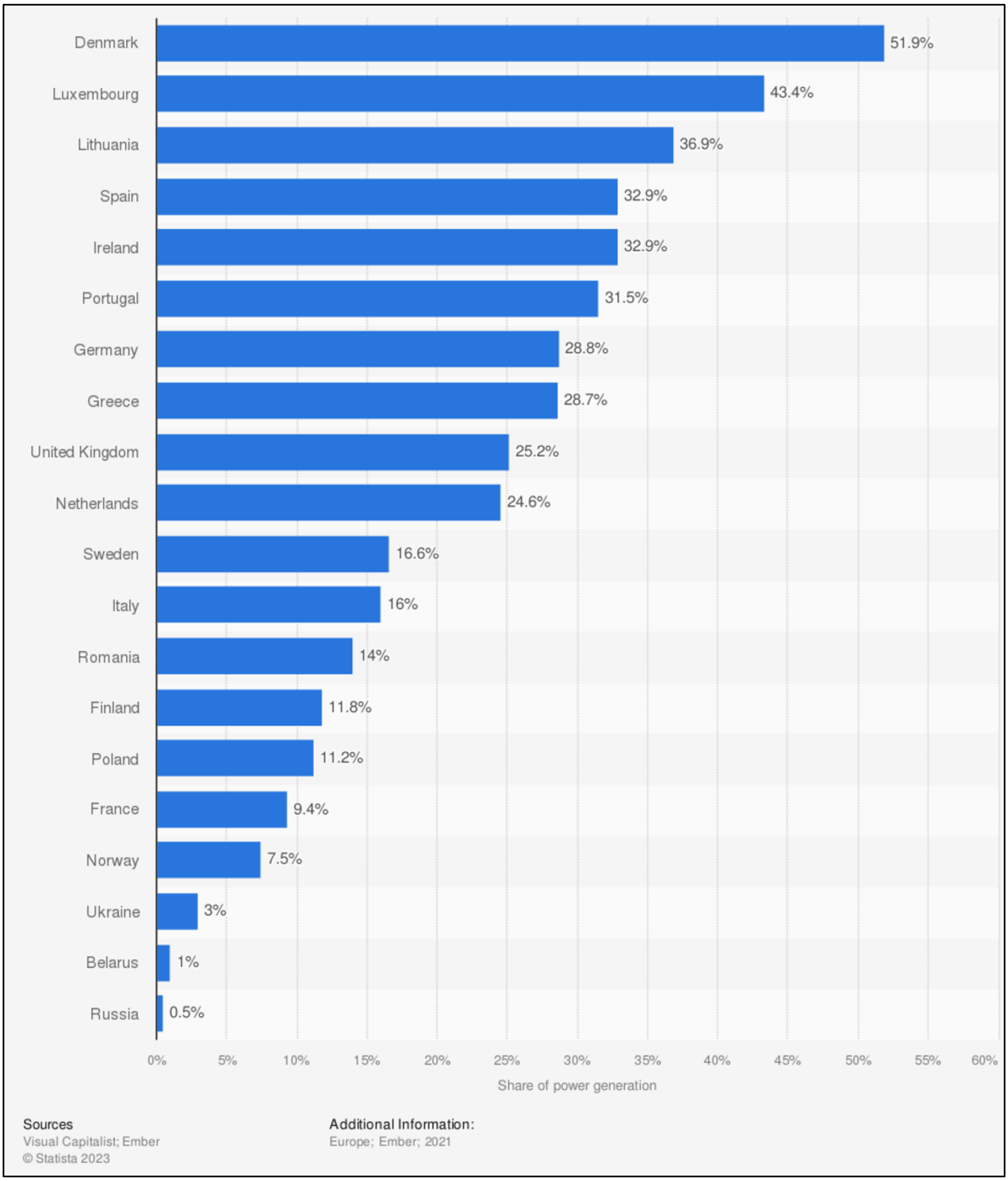

Figure 5: Share of electricity generation from wind and solar energy sources in Europe in 2021 by country (Statista and Global Data)

Within the following sections, more detailed insights are being provided for the status and outlook of all different forms of sustainable and renewable energy currently produced (or expected to be produced in the near future) within Greece. Of course, it is worth mentioning that the Russia-Ukraine war and the subsequent energy crisis had a considerable effect on this outlook.

Solar energy

As previously stated, solar energy currently holds a large share in the country's electricity production mix. There is still however significant unexploited potential, and thus large room for additional investments, considering the good weather conditions that prevail in the country throughout the whole year. Greece has also became more investment-friendly, taking into account recent regulatory reforms that have simplified relevant requirements and procedures.

According to Statista (Figure 5), solar energy production in Greece now amounts to 6,17 billion kWh which is expected to steadily increase, according to existing plans, to 6,95 billion kWh in 5 years time (+12,6%).

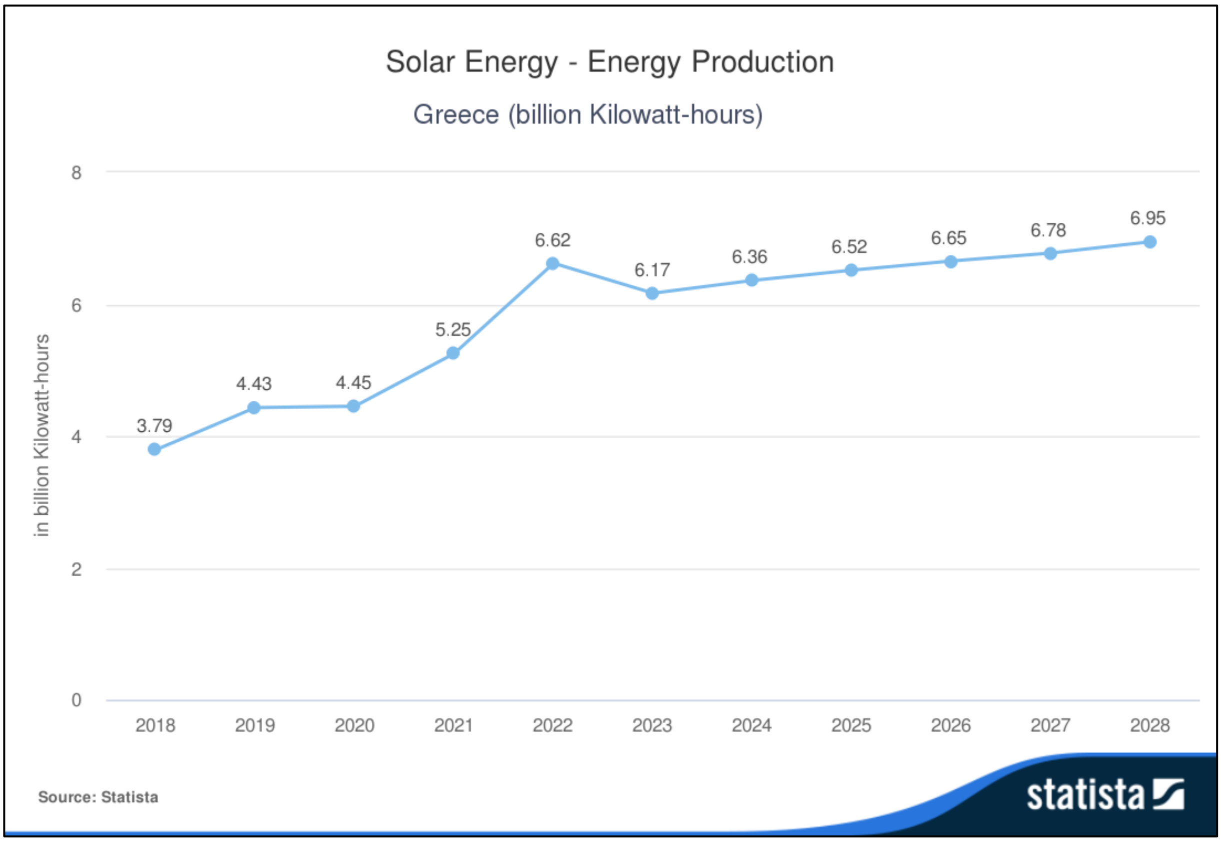

Figure 6: Current status and potential of solar energy production in Greece (Source: Statista)

More specifically, taking January 2023 as reference point, 0,48 GW are expected to be added in the existing solar capacity in the next few years, ranking Greece 7th in Europe in terms of solar capacity under construction (Figure 7).

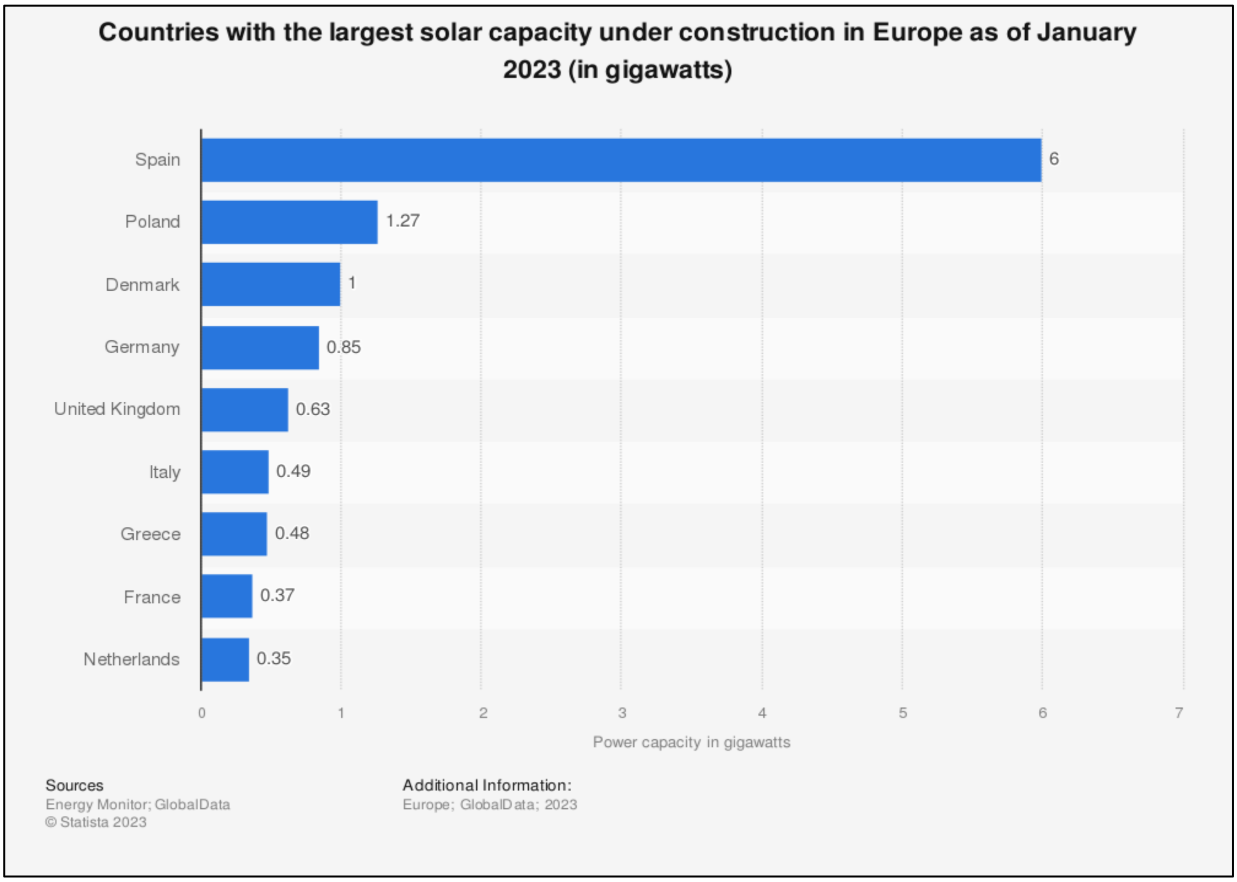

Figure 7: Solar capacity under construction in Europe as of January 2023 (Source: Statista and GlobalData)

Existing projects are scattered with different regions of the country since many of them present good productivity potential, especially the ones in the Southern part of Greece (i.e. Crete, South Aegean, Attica and Peloponnese) (Figure 8).

In addition to onshore, offshore solar parks are also under examination mostly on lakes since without a Maritime Spatial Plan still in place, investment preconditions cannot be fulfilled. Terna was one of the first companies that studied the development of such facilities in the lake 'Pournari' which is located close to the city of Arta. The study considered an area of 114,4 hectares, with the estimated annual energy production amounting to 156,2 GW with the potential to save 150.000 tonnes of CO_2. The company also plans the development of two more floating solar parks in the 'Kastraki' and 'Stratos' lakes, with the expected capacities amounting to 120 and 42 MW respectively, The overall budget of these three projects has been estimated to 170 million €[10]. Apart from Terna, the company 'PPC Renewables' has also received permits for the development of 1,9 GW solar energy capacity, of which 50 MW constitute floating projects, the first one of which will be built in the 'Polyfytos' lake on the Haliacmon river. Offshore solar parks in Greece have also caught the eye of foreign investors such as the German company SINN Power which develops floating solar power plant technologies as well as hybrid solutions utilizing wind and wave energy, with such a solution

[10] https://balkangreenenergynews.com/first-floating-pv-plant-to-be-built-in-greece-by-terna-global-market-to-reach-4-8-gw-by-2026/

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being pilot-tested in Heraklion, Crete. Other companies (e.g. BayWa r.e.) have also expressed an interest to investigate the potential of the development of relevant projects in Greece.

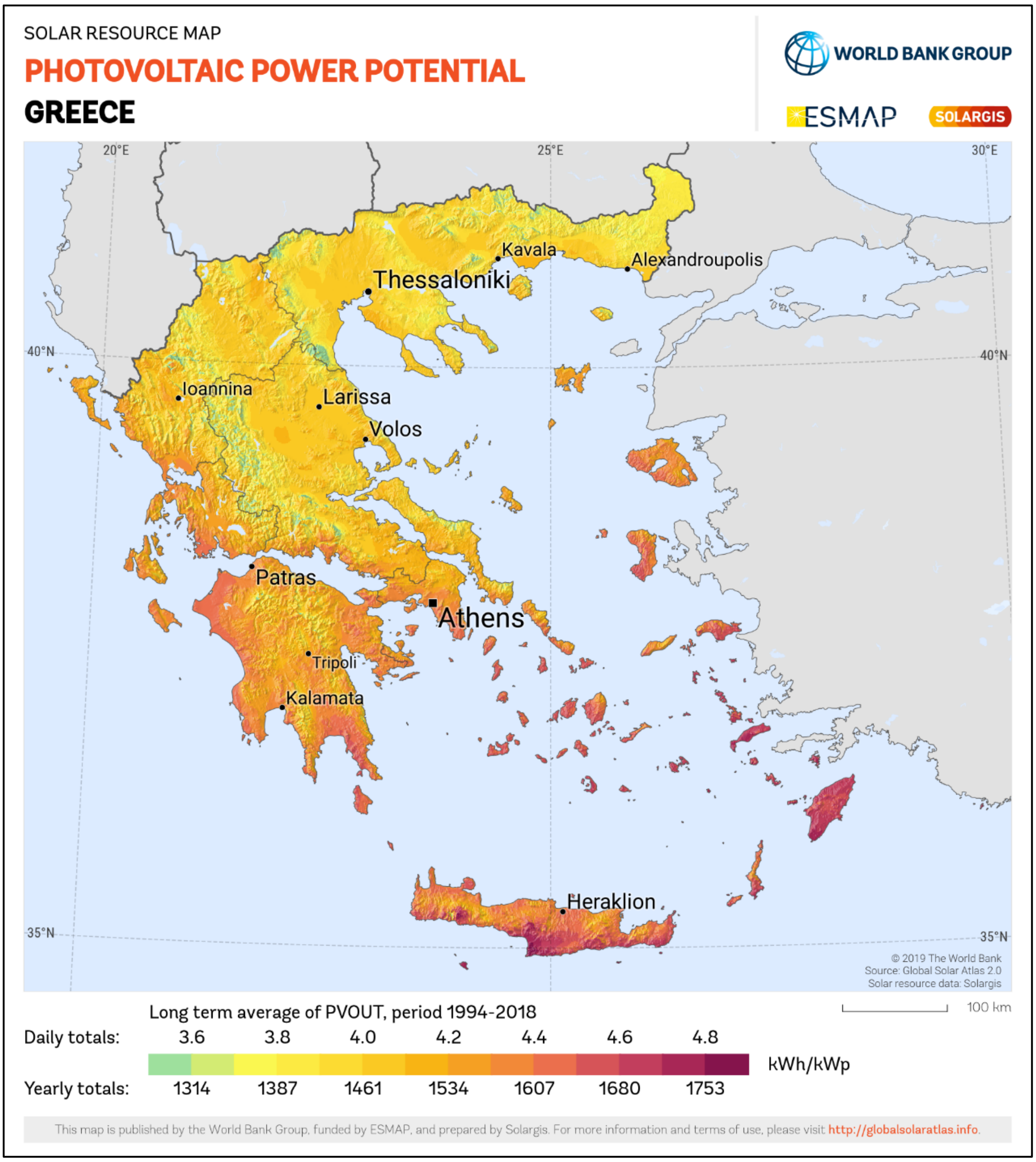

Figure 8: Photovoltaic power potential of Greece (Source: SOLARGIS)

Wind energy

As depicted in Figure 9, there is strong wind energy production in Greece. Despite accounting for a bit smaller capacity than of solar energy, productivity is larger amounting now to 10,12 billion kWh, with the same growth potential (as in solar energy) projected for the next five years (+12,5%).

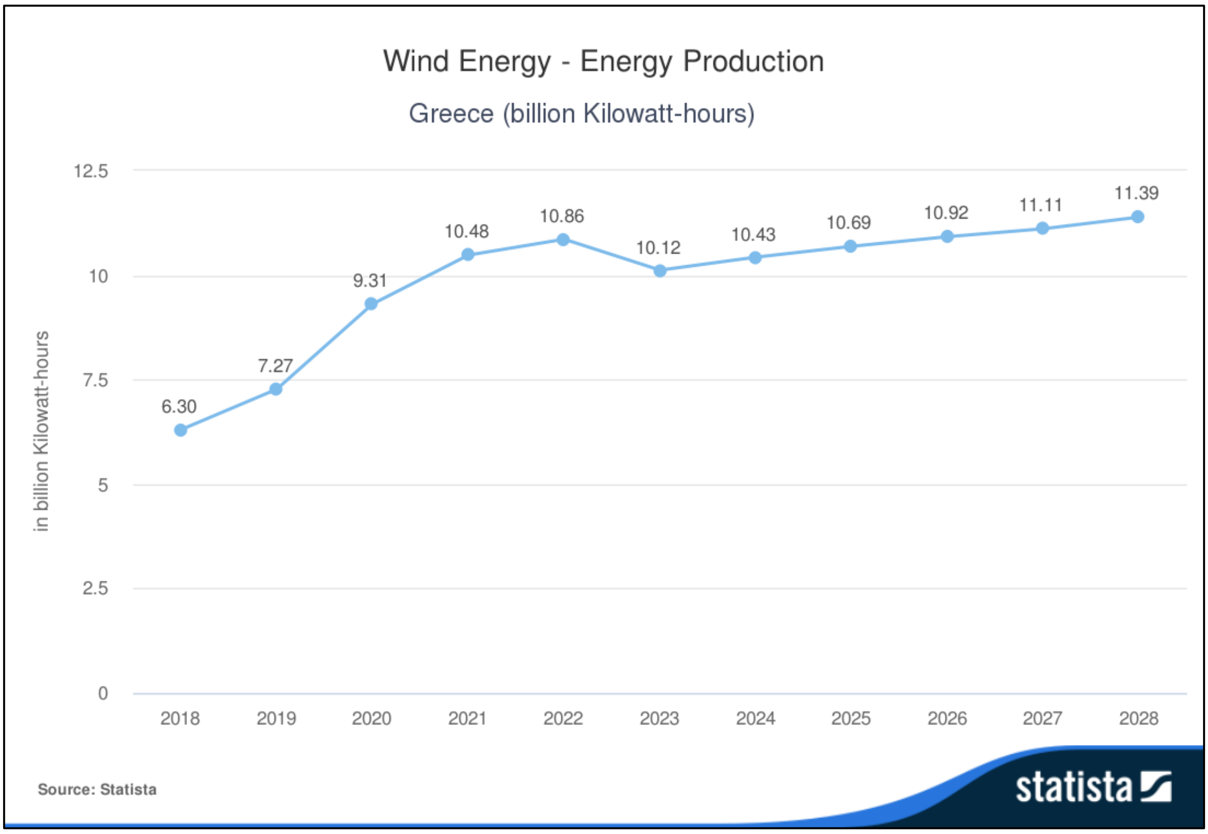

Figure 9: Current status and potential of solar energy production in Greece (Source: Statista)

According to the Hellenic Wind Energy Association (HWEA), at the end of 2022, wind farms with a combined capacity of 840 MW were under construction and are expected to be connected to the grid by Q2 2024 at the latest. Projects with planned capacity of 450 MW are also now at contracting stage. The spatial distribution of wind capacity by region of Greece is being presented in Figure 10 that follows. The largest capacities are concentrated now in Central Greece, Peloponnese and Eastern Macedonia and Thrace.

It should be highlighted that in July 2022, the Greek Parliament approved the first law that governs offshore wind energy development, a key milestone for attracting investments and initiating new projects. The current vision is to build at least 2 GW of offshore wind energy capacity[11] so as to surpass, by 2030, a total capacity of 7 GW (onshore and offshore)[12]. To this end, the Greek Ministry of Environment and Energy developed, with the support of the European Bank for Reconstruction and Development (EBRD), a 'High-level plan on the development of offshore wind power'[13].

[11] Considering the characteristics of the marine environment in Greece, mostly floating wind turbines will be installed
[12] https://windeurope.org/newsroom/news/first-greek-offshore-wind-law-seeks-2-gw-by-2030/
[13] https://www.ebrd.com/news/2022/how-greece-is-embracing-offshore-wind-energy-with-ebrd-support.html

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Figure 10: Spatial distribution of wind capacity in the Greek region (Source: Hellenic Energy Association)

Hydropower

Hydropower denotes the use of falling or fast-running water (i.e. conversion of the gravitational potential or kinetic energy of water) for producing electricity and/or (directly) powering machines. In 2021, hydropower accounted for 16% of Greece's total installed power generation capacity and 11% of the total power generation[14]. In 2023, production reached

[14] https://www.power-technology.com/data-insights/hydropower-in-greece/

4.41 billion kWh (Figure 11), and is expected to grow by 12,5% in five years time reaching pre-energy crisis productivity levels.

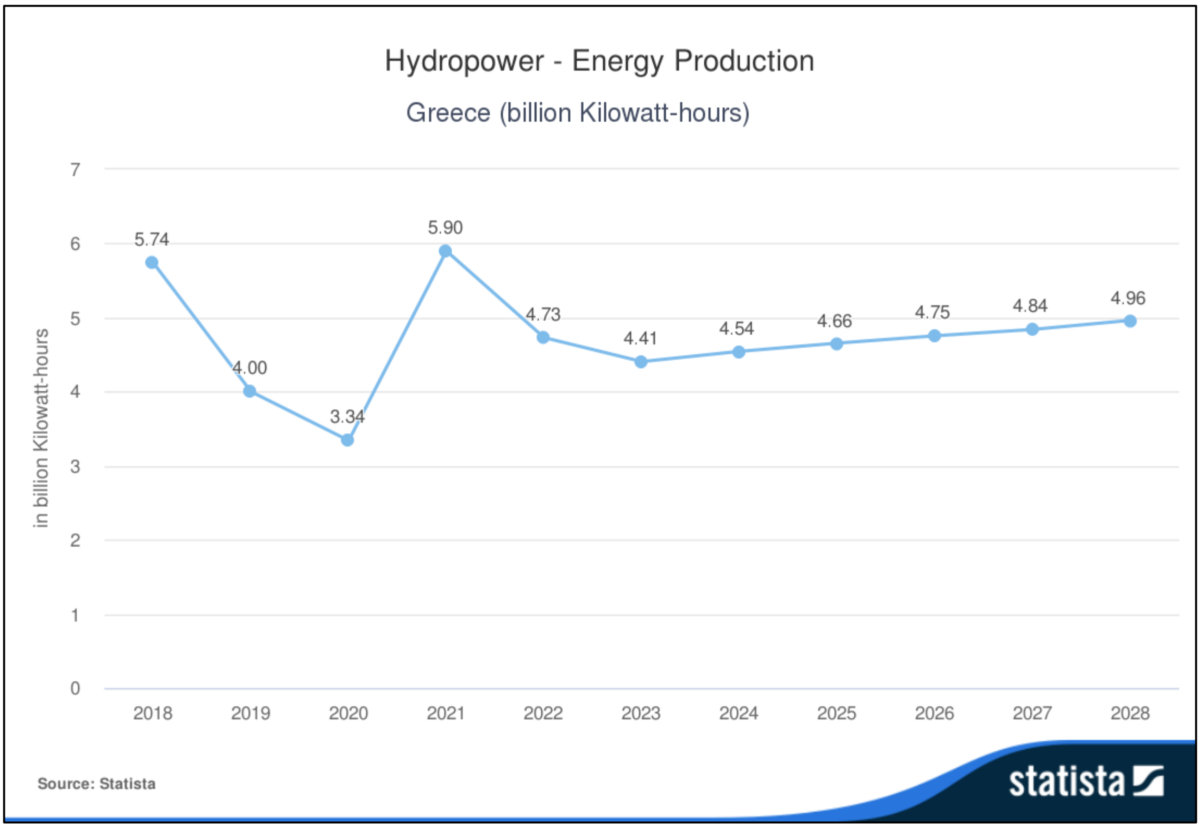

Figure 11: Current status and potential of hydropower production in Greece (Source: Statista)

The top operating hydropower plants in Greece are listed below (Table 1).

Table 1: Top operating hydropower plants in Greece

Plant name	**Region**	**Total capacity (MW)**	**Owner**	**Year online**
Kremasta	Central Greece	437,2	Public Power Corporation	1967
Thisavros	East Macedonia and Trace	384	Public Power Corporation	1997
Polyphyton	West Macedonia	375	Public Power Corporation	1974
Kastraki	Western Greece	320	Public Power Corporation	1969
Sfikia	Central Macedonia	315	Public Power Corporation	1985
Pournari I	Epirus	300	Public Power Corporation	1981

Aoos	Epirus	210	Public Power Corporation	1990
Ilarionas	Central Macedonia	155,32	Public Power Corporation	2014
Stratos I	Western Greece	150	Public Power Corporation	1989
Plastira	Thessaly	129,9	Public Power Corporation	1962

Source: GlobalData, 2023[15]

Bioenergy

Bioenergy (i.e. biomass, biogas, liquid biofuels and renewable waste) constitutes an important part of renewable energy production in the EU[16]. In Greece, bioenergy productivity lacks far behind all the aforementioned forms of sustainable / renewable energy, amounting in 2023 to 0,47 billion kWh, with projections estimating a 10,6% increase within the next five years (Figure 12).

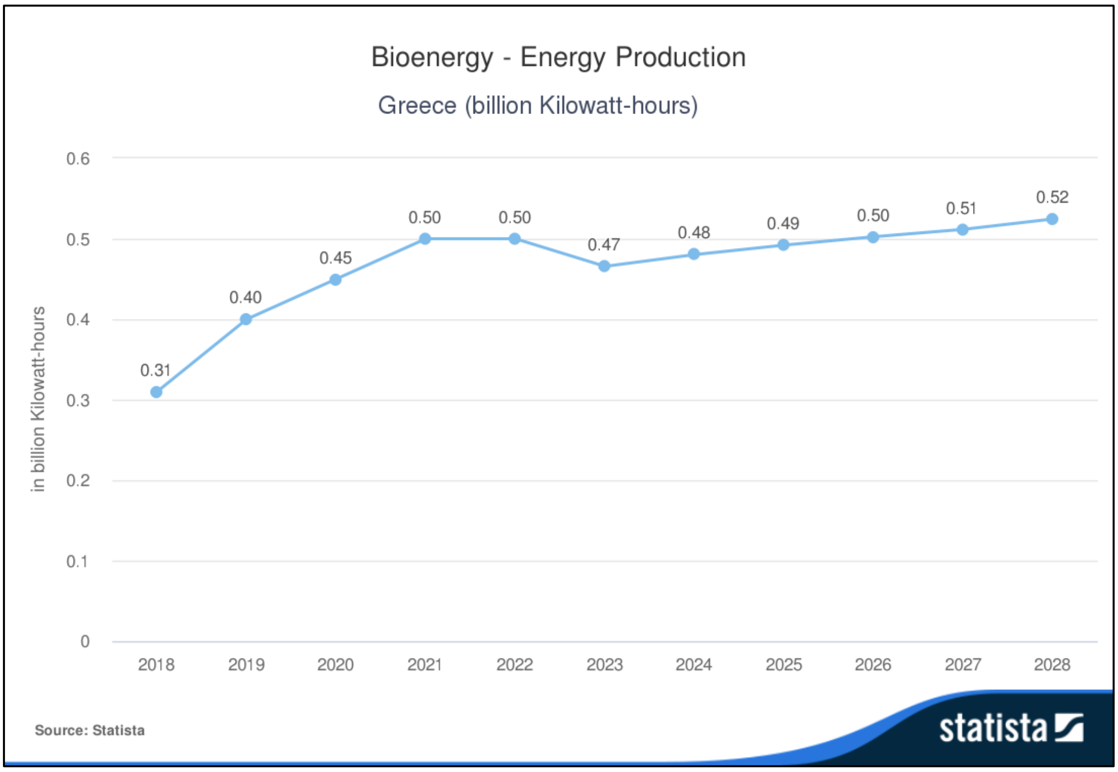

Figure 12: Current status and potential of bioenergy production in Greece (Source: Statista)

[15] https://www.power-technology.com/data-insights/hydropower-in-greece/
[16] https://www.ieabioenergy.com/wp-content/uploads/2021/11/CountryReport2021_EU28_final.pdf

New investments are currently planned. Blue Grid for example, a unit of Molgas, recently acquired a biogas plant in North Greece (i.e. in Mesti, Evros), where it plans to produce bioLNG for the heavy-duty transport sector and the maritime transport industry[17]. 'Biomesti', as the plant is called, currently produces electricity via anaerobic digestion of organic waste, mainly from cow manure and whey cheese provided by the largest cow farm in Greece (i.e. Campus of Evrofarma). Future plans for this plant include its expansion and upgrade, and ultimately the production of bioLNG.

Other forms of secondary energy: *Green Hydrogen*

Very recently, the development of a Hydrogen Innovation Hub (H2HUB) was approved, with CERTH serving as the main beneficiary[18]. 20 million € of funding are retrieved to this end, from the 'Just Development Transition 2021-2027' program, with H2HUB aiming to carry out research and development activities of H2 technologies with regard to its production, storage and utilization in Greece. As part of its research activities, H2HUB will develop a pilot unit for the production of green hydrogen and will consider appropriate applications (also in the maritime transport sector) considering for each case:

- Energy flows and energy consumption of facilities / assets
- Creation of basic pilot unit operation scenarios
- Identification of optimal pilot unit operation scenario
- Optimization of the automation of the entire installation for better energy management and for ensuring effective response to emergency security incidents
- Evaluation of the energy efficiency of electrolytes, batteries, H2 injection in a transport pipe, fuel cells of different sizes with the aim of choosing the best technology for each case

4. Energy infrastructure of Greek ports

4.1 Liquified Natural Gas (LNG)

With the shipowner community (i.e. demand side) mainly opting for LNG as an alternative fuel (Figure 3), it is only logical that ports (i.e. supply side) put LNG at the forefront of their alternative fuel infrastructure planning activities. This is also the case for Greek ports, with Law 4439/2016 incorporating into national legislation, Directive 2014/94/EU[19] of the European Parliament and of the Council which sets the rules to be followed for developing alternative fuels infrastructure. In Article 6 of this Law, it is specifically stated that "a sufficient number of public refuelling points with liquefied natural gas (LNG) should be ensured throughout the existing TEN-T central network (a) in seaports until December 31st, 2025 in order to enable the movement of inland waterway vessels (ships, boats, etc.) or maritime vessels powered by LNG; and (b) in inland ports until December 31st, 2030 in order to enable

[17] https://lngprime.com/contracts-and-tenders/greeces-blue-grid-in-bio-lng-move/84343/
[18] https://ered.gr/real-estate-news/hydrogen-innovation-hub-to-be-developed-in-ptolemaida
[19] https://www.kodiko.gr/nomothesia/document/245004/nomos-4439-2016

the circulation of inland waterway vessels (ships, boats, etc.) or marine vessels powered by LNG."

The Greek port network is still at planning stage, and this mainly applies to the country's large key ports (i.e. Piraeus, Thessaloniki, Igoumenitsa, Heraklion and Patra). Demand today remains very low, prolonging in that way the development of bunkering facilities close to the deadline that has been set by the relevant regulatory framework. This can be well understood when considering the high average age of coastal shipping vessels (i.e. 28 years which is above the European average – 21 years) with all of them still running on conventional fuels.

Table 2 below presents the alternative fuel bunkering facilities that are planned to be developed in the country's five largest ports. Planning activities are at a different stage of maturity and thus different timelines are foreseen for launching operations. DEPA (the Public Gas Corporation) will serve as the operator of all of these facilities.

Table 2: Alternative fuel infrastructure planning activities at the five largest ports in Greece

Port name	Port UN/ LOCODE	Alt. Fuel	Type of facility	Sub-type of facility	Status	Startup Year	Operator
Igoumenitsa	GRIGO	LNG	LNG Bunkering	STS	At planning stage	2025	DEPA
Heraklion	GRHER	LNG	LNG Bunkering	STS	At planning stage	2024	DEPA
Thessaloniki	GRSKG	LNG	LNG Bunkering	STS	At planning stage	2025	DEPA
Patras	GRGPA	LNG	LNG Bunkering	STS	At planning stage	2024	DEPA
Piraeus	GRPIR	LNG	LNG Bunkering	STS	Under development	2023 (Q4)	DEPA

Source: Clarksons Research

The most mature facility is the one at the port of Piraeus which will utilize the Revithoussa LNG terminal for bunkering LNG-fuelled vessels through (a) a truck loading station that will enable to provide truck-to-ship bunkering for smaller vessels, and (b) a specialized bunkering vessel that is currently under development (see its basic technical characteristics in Figure 13) which will serve the needs of larger vessels using a new small-scale jetty that will be constructed.

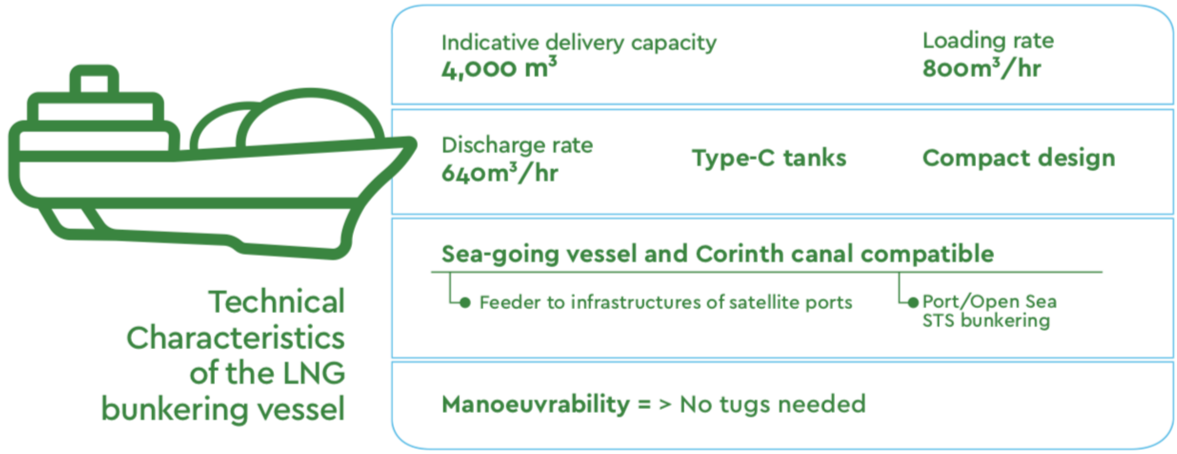

Figure 13: Basic technical characteristics of the LNG bunkering vessel to be used in the port of Piraeus (Source: DEPA, 2022[20])

The Revithoussa LNG Terminal is one of the 29 LNG terminals that are operational today in Europe and the only in Greece that receives LNG imports, temporarily stores it, regasifies it and supplies the country's National Natural Gas Transmission System. With a storage capacity of 225.000 m^3 and a regasification capacity of 1.250 m^3/h as a Sustained Maximum Send out Rate, the Terminal is a high-value energy asset for Greece, that secures energy supply, operational flexibility in the transmission system and increased capability to meet peaks in demand[21].

The new jetty to be constructed, as mentioned above, will be located at the North-East part of the Revithoussa island and will be serving bunkering vessels such as the one outlined above, as well as new ones to be built in the future for accommodating increasing demand. The smaller bunkering vessels will be serving the needs of LNG-fuelled vessels (RoPax, containerships, cruise vessels, etc.) while larger bunkering vessels will supply LNG to satellite storage and distribution stations in other ports in Greece as well as in neighbouring countries. Studies for the aforementioned activities have been performed within the framework of the POSEIDON MED II project[22], funded under the framework of the Connecting Europe Facility (CEF) programme. Besides Piraeus, within the POSEIDON MED II project, studies for the development of small-scale shore-side LNG infrastructure (with a planned capacity of approximately 3.000 m^3) were also performed in the ports of Igoumenitsa, Heraklion and Patra[23]. Other ports, such as Alexandroupoli and Volos, are just equipped with Floating Storage Regasification Units (FSRU) serving as nodes in the country's LNG transfer network.

4.2 Shore Side Electricity (SSE)

The development of SSE infrastructure – Onshore Power Supply (OPS) in Greece lags a bit behind LNG infrastructure developments, although demand may drive advancements sooner

[20] https://www.depa.gr/wp-content/uploads/2022/06/factsheet.pdf
[21] https://www.desfa.gr/en/national-natural-gas-system/lng-facility
[22] https://www.desfa.gr/en/projects/new-projects-under-constructions
[23] https://www.poseidonmedii.eu/category/THE_PROJECT/About.html

than the timeline set in relevant regulations[24] since, as mentioned before, ferries represent perfect candidates for adopting electrification.

So far, three ports in Greece have mainly worked towards implementing such infrastructure. These are the ports of Piraeus, Killini and Heraklion. The first two ports participated in the ELEMED project[25], funded by the CEF programme, within the framework of which the port of Piraeus conducted all necessary preliminary studies for the implementation of OPS, which enabled to identify prominent vessel plug-in positions. At the same time, such a facility (i.e. 500 kVA for 50/60 Hz vessels) was developed and pilot-tested at the port of Killini[26], with the RoPax vessel *Fior di Levante* (of Levante Ferries) connecting to it in December 2018, after performing all necessary arrangements / adjustments in its electric engines.

Port of Piraeus proceeded with the next round of required studies (i.e. technical, environmental, techno-economic) within the framework of the EALING project[27], also funded by the CEF programme, which will be concluding its activities at the end of the year. The final studies are currently conducted within the framework of the CIPORT – "Cold ironing in the Port of Piraeus – Taking the Final Step" project[28], funded by the CEF programme as well, which will enable the effective launch of the OPS in the port of Piraeus serving initially the cruise sector.

Financial support from the CEF programme was also exploited by the port of Heraklion for conducting, within the framework of the ELECTRIPORT project[29], all studies necessary for the implementation of an OPS, which will cover the energy needs of all different types of vessel calling at the port (i.e. technical, environmental, techno-economic, cost-benefit, socio-economic, etc.).

5. Conclusions

Greece has taken important steps towards heavily increasing the share of renewables in the current energy mix, gradually transiting away from lignite which, till now, has been one of its key energy sources. Weather conditions in Greece largely favour the production of solar and wind energy, and large-scale investments have been undertaken to this end for increasing capacity and productivity. There is still however untapped potential that can be further exploited and maximize the share of renewables, given that the country's investment-friendly environment is further strengthened and much needed policy instruments (such as the Maritime Spatial Plan) are introduced for unlocking vast amounts of renewable energy that can feed into the grid. With ferries accounting for a perfect candidate for electrification, a certain share of RES productivity will be allocated to coastal shipping especially at short routes that present lower energy requirements. For longer ones, LNG bunkering facilities currently

[24] According to the FuelEU maritime regulation all major European ports should have OPS facilities in place till 2030 since, by that year, vessels staying for more than two hours in a port would be obliged to connect to OPS
[25] https://www.lr.org/en/expertise/maritime-rules-and-safety/strategic-research/elemed/
[26] Four plug-in and one charging positions were sited at the port area
[27] https://ealingproject.eu
[28] https://www.olp.gr/en/environmental-protection/eu-projects/active/item/12847-ciport
[29] https://observatory.sustainable-greece.com/gr/practice/electriport.2280.html

under planning and development can be exploited, gradually facilitating the transition towards the use of bio-LNG.