Report 2022

Greece

Wind turbine in Attiki, Greece. *Photo: G. Sotiriadis, HWEA photo contest 2023, Courtesy of Hellenic Wind Energy Association HWEA.*

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By the end of 2022, Greece's total installed wind power capacity reached 4,681 MW [4], a 5.2% increase since the end of 2021.

Although the installed capacity in 2022 was below the 10-year average of 292 MW, 68 new wind turbines with an average nameplate capacity of 2.67 MW made up the 230 MW of new capacity installed in Greece. Aside from natural gas, wind energy remains the largest domestic energy source for the Greek electricity system, providing 20% of total demand. In addition to a 12.6% share from PV, as well as small shares from biomass and small hydro, the RES share in the Greek electricity mix exceeds 35.5%. This ranks Greece at number seven in global RES penetration of electricity demand. Furthermore, the annual electricity consumption in 2022 declined from that of 2021 by an estimated 4%.

Table 1. Key National Statistics 2022: Greece

Total (net) installed wind power capacity	4.6GW
Total offshore capacity	0 GW
New wind power capacity installed	0.230 GW
Decommissioned capacity (in 2022)	GW
Total electrical energy output from wind	10.7 TWh
Wind-generated electricity as percent of national electricity demand	20.2%
Average national capacity factor	26.8%
Target (2030 National Plan for Energy and Climate)	7.0 GW
National wind energy R&D budget	N/A

Highlight(s)

- Legislative framework for offshore wind development approved.
- Wind energy continues as a major domestic energy source, reaching a record 20% share of electricity demand.

Market Development

Targets and Policy

The national target for renewable energy for 2030, as set in the National Plan for the Energy and the Climate [1], projects a 66% RES share in electricity production by 2030. To reach this target in time, an estimated total wind capacity of 7,000 MW is needed. Such a target requires an annual installation rate between 250-300 MW per year, which is comparable to the average rate of new installations achieved in the last three years. Strong political ambition to accelerate the transition to a 100% carbon-free electricity system has been expressed by EU countries. However, this has yet to be depicted into concrete new targets.

After several years of debating and delays, the Greek Parliament ratified a legislative framework for licensing offshore wind farms in July 2022. A mixed system allows centralised planning and identification of greater areas for offshore wind development by the state, while the final selection of wind farm sites and licensing is to be accomplished by the developers. An auction system is also anticipated for offshore wind farms. Due to the geography of the Greek seas, offshore wind development is expected to consist mostly of floating wind turbines. To assist in its development, the Greek state has set a provisional target of 2 GW in offshore wind farms to be operational by 2030. The target is a considerable increase from the current estimation from the NPEC falling between 200-300 MW. The first batch of 600 MW pilot projects, accounting for up to 250 W each, in preselected areas, is planned to start earlier under a feed-in tariff scheme. Further elaboration of the targets and the roadmap for offshore wind development is expected to be incorporated in the upcoming revision of NPEC.

An auction system for guaranteed feed-in prices for wind farms and PV systems has been in effect in Greece since 2018. The auction system applies to wind farms with installed capacity greater than 3 MW competing for eligibility in a "Contract for Difference" payment scheme. In 2022, one auction round was held for PV (>1 MW), wind (3 MW – 50 MW), and 1,000 MW of combined capacity. A minimum technology quota of 30% per technology was applied to encourage a balanced energy mix. A total capacity of 538 MW was awarded, of which 382 MW were awarded to PV projects and 166 MW to wind farms. The mean price of €48/MWh ($51.8/MWh) offered by PV projects increased by 20% compared to 2021, while the mean price of €57.7/MWh ($62.4/MWh) offered by wind farms was 1% higher than in 2021. Since the beginning of the auction system in 2018, a total of 1,585 MW of new wind farms and 1,680 MW of PV systems have been awarded. The auction system will continue until 2024 without specific guidance for a successor plan.

Progress and Operational Details

Greece's total installed wind power capacity at the end of 2022 reached 4,681 MW [4]. The 230 MW of newly installed capacity constituted a 5.2% increase compared to the end of 2021. However, this level of deployment fell below the 10-year year average of 292 MW.

During the year, wind and other non-dispatchable RES penetration to the electricity system performed well. The maximum 1-hour average wind energy penetration on the main electricity grid was 83.4%. Total non-dispatchable RES penetration was higher than 50% for 1.601 hours in 2022, almost doubling the 2021 figure of 851 hours. Notably, the total RES production exceeded the total demand for 31 hours for the first time, making Greece a net exporter of RES electricity.

The total value of the new wind capacity set in operation in 2022 in Greece is estimated to be 230 million EUR (249 million USD). By the end of 2022, an additional 840 MW of new wind energy plants were under construction, most of which are expected to be operational within the next 18 months [4].

Matters Affecting Growth and Work to Remove Barriers

Licensing: A major review of the current Greek licensing framework has been in progress in the last few years. The goal is to reduce the typical time needed to complete the wind farm licensing procedure from the current 8 to 10 years to as close to the EU target of two years as possible. The first part of the legislation review was completed in 2021. The main documents, Laws 4,951 and 4,964, regarding the second part of the revision were published in July 2022 and include the framework for offshore wind development. Some secondary documents and decisions are still pending. The effects of the licensing revision are anticipated in the coming years.

Grid restrictions: Significant grid reinforcing activities are either in progress or planned for the near future. These projects aim to connect the mainland with all major islands of the Greek archipelago, which currently operate in isolation via diesel-powered grids. The first line connecting Crete (400 MVA) has been fully operational since 2021, while a second line of 1,000 MW is under construction and expected to be operational by 2024. In addition to the significant decrease in the cost of electricity, the second connection has the benefit of increasing security and improving the quality of electricity provided to the island. Furthermore, it will allow 2,000 MW of additional RES capacity to be added to the system. Targeted grid-strengthening projects are also in progress on the mainland of Greece.

Public opposition: As the revised licensing framework is still to have an effect on the planning and development of wind farms, interaction between the local public, developers, and licensing authorities remains limited.

RD&D Activities

In Greece, R&D activities in wind energy are funded mainly through EU and national programs. A significant funding tool for applied research in Greece is the Program for Research, Technological Development and Innovation, "EREVNO", which is co-funded by the Greek state and the European Regional Development Fund. The total budget of the entity for the period 2016-2023 is 510 million EUR (551 million USD). A non-exhaustive review of R&D proposals, oriented mainly in wind energy that was active in 2022, is given in the following:

- AIOLIKOS: Development of an innovative scanning Lidar system for wind energy applications.
- PARALOS²: Redesign and operational evaluation of a 50 kW wind turbine suitable for near-shore applications.
- Specialised technologies for the accurate estimation and mitigation of electromagnetic waves scattered from wind turbines.
- AIOLOS: Development of multifunctional fibre-reinforced nanocomposites for wind turbine structures.

The total budget of the projects listed above is 3.8 million EUR (4.1 million USD).

The next major national funding round for applied research projects is expected to be launched in 2023. The total national funding for all research areas between 2023 and 2030 is estimated at 300 million EUR (324 million USD).

Test Facilities and Demonstration Projects

- **GREEN ISLAND – Agios Efstratios:** The project concerns the conversion of a small, isolated island grid into a RES-powered system. Primary power sources on the island will be a 900 kW wind turbine and a 227 kWp PV array. A 2.7 MWh Li-Ion battery bank is also expected to be used for short-term energy storage, while thermal storage for district heating will provide load balancing to limit power shredding and medium-term storage. Diesel generators, currently covering the total electricity demand on the island will be limited to backup operation only. The target value for mean annual RES penetration is 85%, making the project a small-scale test benchmark for future electricity networks where RES will be the major contributor. Construction started in 2022 and is in full progress. The plant is expected to be fully operational by Q1 2024. The total budget is 8.5 million EUR (9.2 million USD), co-funded by

the Greek state and the European Regional Development Fund [3].

Impact of Wind Energy

Wind energy produced 10,700 GWh of electricity in 2021, accounting for 20% of the annual electricity demand in Greece while offsetting the equivalent of 648,000 tons of CO2 emissions. This volume of reduced CO2 emissions is equivalent to taking 3.8 million cars off the road, which accounts for 74% of private cars currently circulating in Greece.

The electric energy produced by wind in Greece enabled a 34% reduction in natural gas import compared to the import that would have been necessary in the absence of wind farms [4]. In addition, similarly to all RES, wind energy is to a great extent immune to the volatility of fossil fuel prices as it feeds electrical power to the grid at stable prices, significantly reducing the effect of the energy crisis. During the peak period of the crisis, spanning July 2021 to January 2023, electricity generated from the wind in Greece allowed consumers to save 4.2 billion EUR (4.5 billion USD) either directly by avoiding natural gas imports or indirectly by keeping market prices low [4].

On the local level, 3% of electricity sales from all wind farms return to the local communities as extra funding to the local administration bodies and as direct subsidies to consumers' electricity bills in the communities hosting the farms. For 2020, a total of 23.5 million EUR (25.4 million USD) was distributed to local communities through this mechanism. In the employment field, wind energy is estimated to support the equivalent of 6,300 full-time jobs.

Next Term

As wind energy takes a position as the major pillar for a zero-emission, resilient and independent energy system in Greece, the following challenges are outlined by members of the wind industry in Greece.

- Implementation of the revised licensing framework to enable faster deployment.
- Offshore wind development.
- Local supply chain strengthening and improvement.
- End-of-life issues.

References

[1] Ministry of Environment and Energy, Greece. (n.d.). National Energy Strategy for Greece. http://www.opengov.gr/minenv/?p=10155

[2] WindEurope. (n.d.). Wind Energy Statistics. https://windeurope.org/about-wind/statistics/

[3] Aistratis. (n.d.). Aistratis Renewable Energy Projects. http://aistratis.agenso.gr/

[4] Hellenic Wind Energy Association (ELETAEN). (n.d.) http://eletaen.gr/