

Fossil gas electricity exports: the cost to the Greek electricity market and the climate

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Text

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Summary

Electricity exports clearly have a positive effect on the country's electricity trade balance; however, when they rely on the combustion of additional quantities of fossil gas, they also increase domestic wholesale market (Day Ahead Market, DAM) prices. Given the strong correlation between DAM and retail prices, this additional export-oriented gas production ultimately imposes a financial burden on Greece's end consumers.

This analysis is based on a trained machine-learning model designed to quantitatively assess the impact of additional gas production intended for export on both Greece's wholesale electricity market and the corresponding sector's emissions. Given that the country became a net exporter in 2024, the model was used to examine two counterfactual scenarios over the period from January 2024 to July 2026 (31 months). In **Scenario 1**, fossil gas-fired production was assumed to be limited to meeting only domestic demand and downward reserve requirements, resulting in reduced exports. In **Scenario 2**, exports were maintained at actual levels, while export-oriented gas-fired output was substituted with additional RES production.

The main findings are summarized as follows:

- The average share of gas in the domestic electricity production mix during Greece's net-export hours reached **35.8%**. Therefore, gas-fired production could have been **reduced by 6.56 TWh, or 11.4%**, had fossil gas use been limited to meeting only domestic needs (Scenario 1).
- The carbon footprint reduction under this counterfactual scenario is estimated at **2.6 million tons of CO₂**.
- According to the results of Scenario 1, the additional use of gas for electricity exports increased the DAM price by an average of **€6.23/MWh**, resulting in a burden of **€914.4 million** on the Greek wholesale market. This amount exceeded the cumulative benefit from the positive trade balance, which, for the period through June 2026 (latest available complete data from the Hellenic Statistical Authority), totaled **€821.2 million**.
- According to the results of Scenario 2, if, over the same period, exports had been met by an equivalent amount of RES production instead of gas-fired output, the DAM price would have decreased further, with the average reduction reaching **€7.24/MWh**. The Greek wholesale market would therefore have benefited by **€1.065 billion**, while the trade balance would have also accumulated benefits of **€605.4 million** (through June 2026).

These findings lead to a key policy conclusion: ***continuously expanding the capacity of export-oriented gas plants***, framed as a means of strengthening Greece's role as a regional energy security pillar in Southeastern Europe, ***is economically and environmentally unsustainable***. By contrast, ***further development of RES and storage infrastructure can maintain a strongly positive trade balance*** and, most importantly, **reduce the DAM price** for the benefit of the national economy, Greek consumers, as well as consumers in neighboring countries.

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Introduction

According to the National Energy and Climate Plan (NECP), Greece was expected to become a net exporter of electricity within the five-year period 2031-2035, namely, after 2030¹. However, the country became a net exporter in 2024. This development was not isolated or transitory; on the contrary, it intensified rapidly, as net exports increased tenfold between 2024 and 2025. Moreover, over the first half of 2026 alone, they exceeded by 74% the total net exports of the whole of 2025, according to the Independent Power Transmission Operator's (IPTO) data.

The pace and magnitude of this shift have placed the issue at the center of intense public debate, with competing interpretations of its underlying drivers and implications. The prevailing narrative attributes the increase in electricity exports primarily to the expansion of low-cost, clean Renewable Energy Sources (RES), and presents this development as an achievement of national energy policy with positive implications for the economy. From this perspective, Greece's position as a net electricity exporter is interpreted as an indication of increased competitiveness, based on the assumption that domestic electricity prices are lower than those in neighboring markets, thereby contributing to a positive electricity trade balance^{2,3}.

An important counter-perspective has emerged, challenging this interpretation along three main dimensions:

First, the country's "terms of trade" -defined as the ratio of the average export price to the average import price multiplied by 100- remain below 100 in most months. This finding suggests that Greece is not fully capitalizing on the low cost of its own RES; instead, limited storage infrastructure constrains domestic absorption and increases the need to export surplus electricity⁴.

Secondly, the claim that exports of low-cost renewable electricity to Bulgaria are detrimental to Greece has been widely endorsed, on the grounds that this energy is stored in the neighboring country's battery systems and subsequently re-imported at significantly higher prices during evening hours^{5,6}. Nonetheless, an analysis of data obtained from the European Network of Transmission System Operators for Electricity (ENTSO-E) refutes this

¹ National Energy and Climate Plan (NECP), January 2025, Table 31, p. 476. <https://bit.ly/4bNVr6M>

² Insider 26.5.2026. "Tsafos: The results of the transformation in electricity for investments, exports, RES" <https://bit.ly/4gb4tvV>

³ G. Fintikakis, energypress. 14.8.2026 "Historic record today in electricity exports from Greece - How production from RES and fossil gas plants supplies Romania, Hungary, Austria and Croatia" <https://bit.ly/4x6gABS>

⁴ P. Kapros, energypress. 2.6.2026. "Should we be proud that the electricity trade balance (in money) became positive in 2025 and 2026?" <https://bit.ly/4xDRs5d>

⁵ C. Mamoulakis, SYRIZA MP, 2.6.2026. "We sell free electricity and buy it back up to 2,000% more expensive! (video)" <https://bit.ly/4x1OEPs>

⁶ To Pontiki, 27.5.2026. "Bulgaria earns millions from Greek RES: it purchases electricity at almost zero cost at midday and resells it at night at a 2,000% mark-up" <https://bit.ly/4fVpkV8>

claim, indicating that Greece was, on average, a net exporter to Bulgaria at all hours of the day during the first half of 2026⁷.

The third line of criticism links the increase in exports to higher prices in Greece's wholesale market, attributing this effect to the increased reliance on fossil gas-fueled plants to meet neighboring countries' demand^{8,9}. This dimension has indeed been acknowledged by T. Skylakakis, former Minister for Environment and Energy, who described exports as a potential "boomerang" for exporting countries¹⁰.

Nevertheless, to date, the upward pressure on the Greek wholesale market (Day Ahead Market or DAM) associated with the additional use of fossil gas for electricity exports has not been quantified. Consequently, it is impossible to determine whether exports, as a whole, ultimately benefit or harm Greek consumers and the national economy.

This analysis addresses this key question through a four-stage **methodological approach**. First, data obtained from the Hellenic Statistical Authority (ELSTAT) on the monthly electricity trade balance -the value of electricity exports minus the value of imports- are presented for the period from January 2024, when Greece first became a net electricity exporter, through June 2026 (latest available data). Next, data from the Hellenic Energy Exchange (HEnEx) are used to estimate the contribution of different electricity production sources during Greece's net export hours.

In order to quantify the potential economic effect of additional fossil gas use associated with exports, four machine-learning models are initially trained using 18,960 hourly DAM price values (HEnEx) for the period January 2024-February 2026, together with 14 additional independent variables, including fossil gas production and net electricity exports. Model performance is then evaluated against 3,671 hourly observations covering the test period (March 2026-July 2026), and the most robust out-of-sample estimator is selected. Two counterfactual scenarios are subsequently developed. Under Scenario 1, fossil gas-fired electricity production is restricted to meeting domestic demand and downward reserve requirements, driving a proportional decline in exports. Scenario 2 preserves net exports at baseline levels, while substituting gas-fired output with additional RES production. The above-mentioned selected model is then employed to simulate the Greek DAM price under both scenarios for the full period under consideration (January 2024-July 2026).

Finally, the simulated results under both scenarios are compared against the baseline, which reflects actual data, so as to quantify the relative impact of using either additional fossil gas or RES production to fulfill electricity export demand. These findings, in turn, identify the conditions under which electricity exports may generate a net economic benefit or impose a net economic cost on the Greek economy.

⁷ N. Mantzaris, energypress 30.6.2026. "What is happening with electricity exports to Bulgaria?". <https://bit.ly/4wvJ7zi>

⁸ The Green Tank, 10.9.2024. "How much gas capacity does Greece need?" <https://thegreentank.gr/en/2024/09/10/thermal-capacity-report/>

⁹ A. Kontoleon, Kathimerini, 31.1.2025. "Exports have increased the price of electricity" <https://bit.ly/4qlAsOQ>

¹⁰ C. Liaggou, Kathimerini, 31.1.2025 "Exports have increased the price of electricity" <https://bit.ly/4wsLNOj>

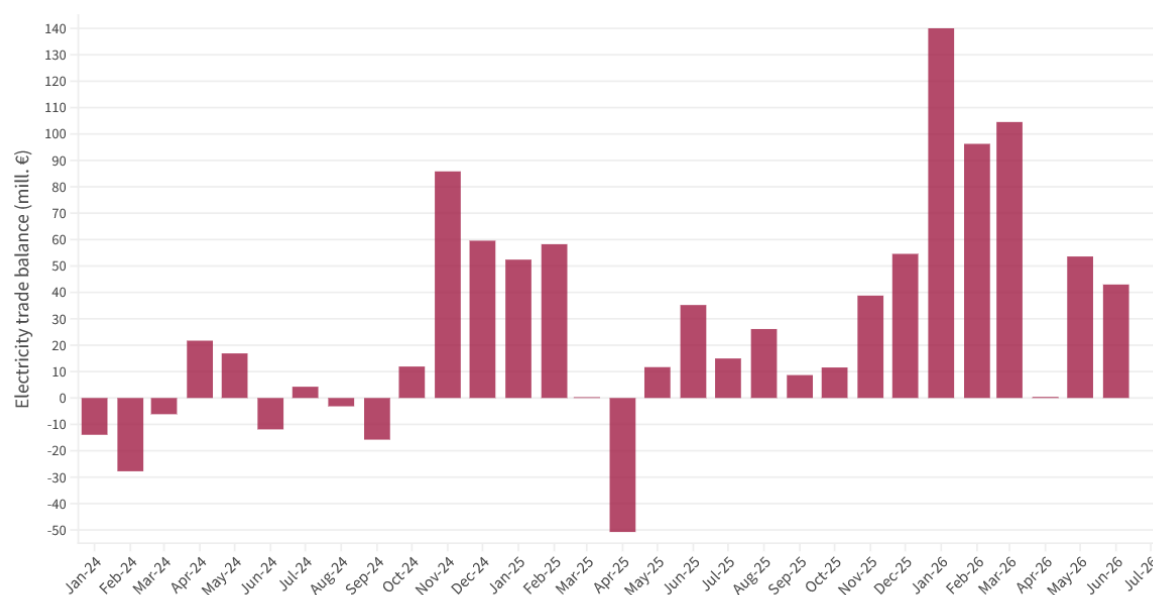
The electricity trade balance

The surge in net electricity exports from 2024 onward resulted in Greece's electricity trade balance shifting from a persistent deficit in previous years to a positive value. Over the 2.5-year period through June 2026, the cumulative electricity trade balance reached **+€821.2 million** (Table 1), representing significant revenues for electricity producers.

Table 1. Net exports and electricity trade balance

Year	Net exports (GWh)	Trade balance (€ million)
2024	307.3	121.5
2025	3,010.3	261.8
2026 (1st semester)	5,243.6	437.8
Total	8,564.2	821.2

In particular, according to the latest available ELSTAT data, the value of electricity exports from Greece to neighboring countries exceeded the value of imports in 23 of the 30 months between January 2024 and June 2026 (**Figure 1**). The highest positive monthly values were recorded during the first quarter of 2026, when the cumulative trade balance exceeded €340 million, followed by November 2024 (€85.8 million). Between November 2024 and June 2026, Greece recorded only one month of net electricity imports; April 2025 saw the electricity trade balance hit the examined period's low (-€50.8 million), largely due to the temporary interruption of the Greece-Italy electricity interconnection¹¹.



Sources: ELSTAT, own calculations

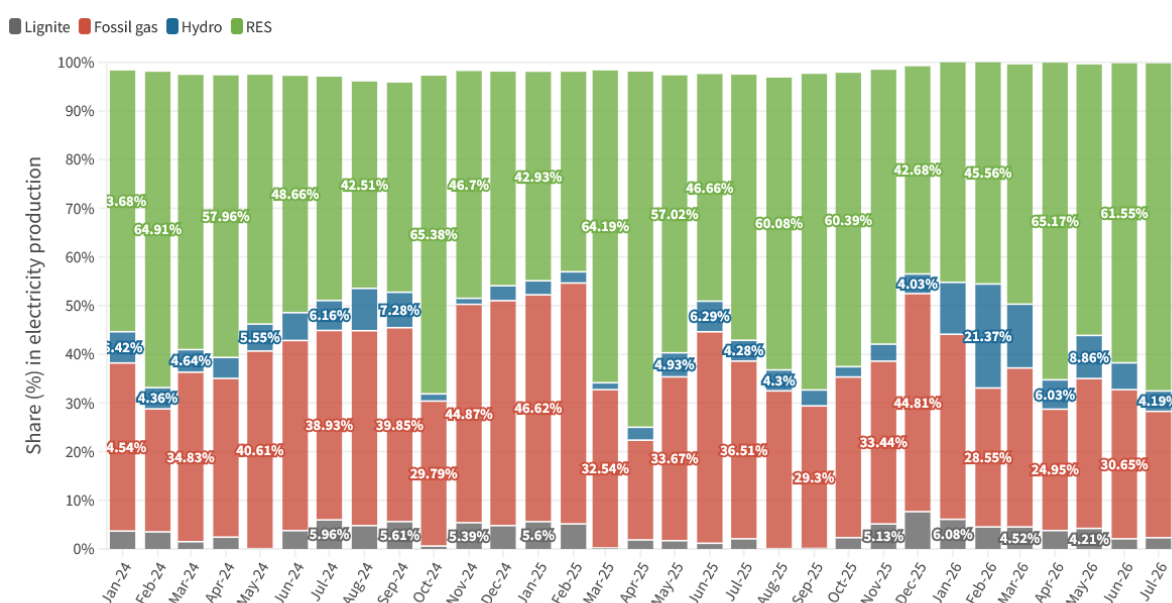
Figure 1: Net value of electricity trade (exports minus imports) over the period January 2024 - June 2026.

¹¹ Worldenergynews 28.3.2025. "The interconnection between Greece and Italy is out of service due to a technical failure, with restoration expected in Mid-April" <https://bit.ly/4gvZ8k5>

The electricity mix of exports

Despite the improvement in Greece's electricity trade balance from 2024 onwards, net electricity exports have both positive and negative effects on the country's economy. The exported electricity is produced within Greece, thereby affecting the domestic wholesale electricity market (DAM); consequently, increased fossil gas-fired production, intended to meet neighboring countries' demand, places upward pressure on the country's DAM prices. Given the strong correlation between wholesale and retail electricity prices in Greece¹², the additional costs resulting from higher DAM prices ultimately burden end-consumers.

Greece is widely regarded as “an exporter of renewable electricity”; however, HEnEx data for the period under review indicate that fossil gas production accounted for a significant share of the electricity mix during Greece's net export hours (**Figure 2**). Specifically, *the monthly average share of fossil gas*, weighted against exported electricity, ranged from 20.5% in April 2025 to 49.5% in February 2025, *with an average share of 35.8%* over the period January 2024–July 2026. These data indicate that Greece's exported electricity is produced by both RES and fossil gas, with large hydro and lignite accounting for much smaller shares of the mix.



Sources: HENEX, own calculations

Figure 2: Average monthly electricity production mix, contributing to wholesale market price formation, during Greece's net export hours over the period January 2024–July 2026.

These findings raise a central quantitative question: *had fossil gas production been lower, to what extent would Greece's wholesale (and, in turn, retail) electricity prices be driven downward?*

¹² The Green Tank, 21.5.2026. “Trends in Greece's retail electricity market” <https://thegreentank.gr/en/2026/05/21/retail-prices-report-en/>

Machine Learning Models for DAM Price Estimation

The first step in the quantitative analysis was to develop a model capable of estimating DAM prices conditional on a defined set of independent variables. To this end, 14 independent variables were selected, as presented in **Table 2**, together with their respective data sources. It was assumed that the variables affecting DAM price formation include the following: the electricity production fuels and sources contributing to the mix during all hours, namely lignite, oil (in Crete), fossil gas, large hydro, RES (including in Crete), and battery storage; net electricity exports; domestic electricity demand; and residual load, which quantifies the share of total demand -including the interconnections balance- that remains to be met by conventional production plants after deduction of clean energy output. In addition, the hour of the day, the day of the week, and the month of the year were also incorporated as variables, in order to account for temporal effects in DAM price formation. All data regarding the above variables were sourced from the HEnEx. Finally, as the cost of fossil gas-fired production is primarily driven by fuel supply costs, as well as by the cost of emissions allowances under the EU Emissions Trading System (EU ETS), the model also incorporated fossil gas prices obtained from the Netherlands' virtual gas trading hub (Title Transfer Facility, TTF)¹³ and CO₂ emissions allowance prices (front December futures). The latter particularly affect the bids submitted to the DAM prices by lignite plants, given their significantly higher carbon intensity.

Table 2. Independent variables included in the DAM price estimation model

Variable	Unit	Source
Production from lignite-fired plants	MW	HEnEx
Production from oil-fired plants in Crete	MW	HEnEx
Production from fossil gas-fired plants	MW	HEnEx
Production from large hydroelectric power plants	MW	HEnEx
Production from RES including RES in Crete	MW	HEnEx
Injection from batteries (after 1/4/2026)	MW	HEnEx
Net exports (exports - imports)	MW	HEnEx
Domestic Demand	MW	HEnEx
Residual load (Total demand - RES)	MW	HEnEx
Time of day	0-23	HEnEx
Day of the week	1-7	HEnEx
Month of the year	1-12	HEnEx
TTF ¹³	€/MWh	ICE ¹⁴
Emission allowance prices (front December futures)	€/tn	ICE ¹⁴

¹³ The daily gas supply price was calculated as the average of the daily TTF price for the following month (Month-Ahead) and the TTF price recorded 30 days earlier. This methodology combines the current signal from the futures market with a TTF price subject to a 30-day lag, thereby smoothing short-term price fluctuations.

¹⁴ <https://www.ice.com>

Model comparison

Four different ensemble decision-tree algorithms used in electricity market simulations, namely, XGBoost¹⁵, LightGBM,¹⁶ CatBoost¹⁷, and Extra Trees¹⁸, were systematically tested to train the model employed in the scenario analysis, using actual hourly DAM data and the 14 independent variables for the period January 2024-February 2026. Their performance was subsequently evaluated against the actual values for the test period March-July 2026. An impressive surge in electricity exports, combined with a substantial increase in RES and large hydro production, first observed in January and February 2026, guided our decision to include these two months in the training period.

Of the 4 algorithms, XGBoost demonstrated the highest accuracy on the training data (best in-sample fit) with a high coefficient of determination ($R^2 \approx 0.97$). Nonetheless, the Extra Trees algorithm was selected for the simulation of the scenarios, as it performed best during the test period ($R^2 \approx 0.81$) albeit showing a lower fit to the training data ($R^2 \approx 0.89$). This decision was based on the fact that the scenario analysis is not a simple evaluation on the baseline training data; it is rather a form of extrapolation beyond the known sample. Each modification to the variables (such as fossil gas, net exports, or RES) across the two counterfactual scenarios creates new, distinct combinations of input values that the model would not have encountered during training, even when each individual variable remains within its historically observed range. Consequently, model selection in this analysis was based on out-of-sample performance rather than accuracy on the training dataset.

After testing across alternative test periods, Extra Trees consistently performed better ($R^2 \approx 0.81$) than the other three algorithms ($R^2 \approx 0.70$ - 0.76) (**Figure 3**). This robust performance is attributed to the algorithm's built-in randomness, namely the random selection of both variables and split points in each tree, which reduces the risk of overfitting to the specific characteristics of the historical sample. Model selection therefore prioritized the reliability of the counterfactual estimates over the higher -but less transferable under new conditions- accuracy demonstrated by the other algorithms on the baseline dataset.

Despite the profound volatility observed in the Greek electricity market in 2026, including surges in exports, RES and large hydro production, fossil gas supply costs, and the number of hours with negative prices, the Extra Trees model approximated the actual DAM remarkably well. Specifically, on an average hourly price basis, it achieved highly reliable forecasts, capturing both the duration and height of the peak evening demand surges, as well as the midday price “valley” driven by high photovoltaic production. The observed deviations concern an underestimation of both the morning peak magnitude and the duration

¹⁵ Yılan, Y., & Beykent, A. (2026). “Day-Ahead Electricity Price Forecasting Using the XGBoost Algorithm: An Application to the Turkish Electricity Market”. *Computers, Materials & Continua*, 86(1), 1-16. <https://bit.ly/46bNuoz>

¹⁶ Michalakopoulos V. et al. (2026). “Less Is More: Data-Driven Day-Ahead Electricity Price Forecasting with Short Training Windows” (2026). *Energies*, 19(2), 376. <https://bit.ly/45Gu6zR>

¹⁷ Zhang, F., Fleyeh, H., & Bales, C. (2022), “A hybrid model based on bidirectional long short-term memory neural network and Catboost for short-term electricity spot price forecasting”. *Journal of the Operational Research Society*, 73(2), 301-325. <https://bit.ly/4wG7SJu>

¹⁸ McGlynn, D., Coleman, S., Kerr, D., & McHugh, C. (2018). “Day-Ahead Price Forecasting in Great Britain's BETTA Electricity Market”. Paper presented at the 2018 IEEE Symposium Series on Computational Intelligence (SSCI), Bengaluru, India. <https://bit.ly/4qqLSAy>

of the mid-day valley, with the model predicting a shorter period of depressed prices and, consequently, overestimating the actual DAM during the remaining hours of high solar availability.

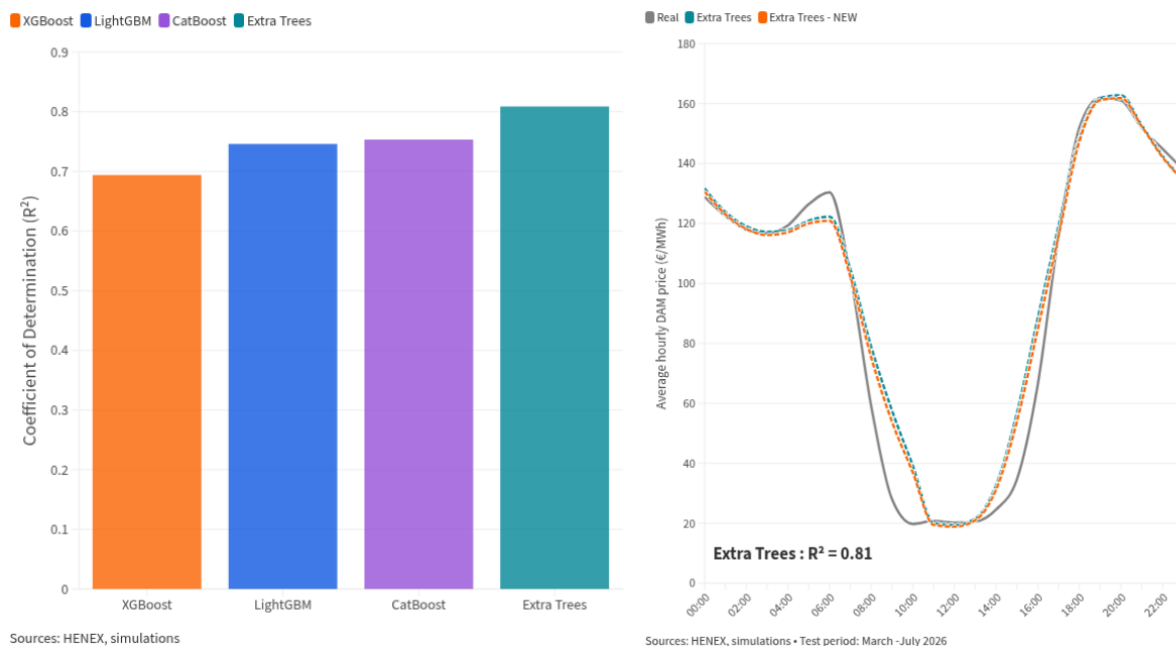


Figure 3: Left: Comparison of the coefficient of determination (R^2) of the 4 machine-learning algorithms for the test period (March - July 2026). Right: Comparison of the Extra Trees model forecasts with the actual average hourly DAM price over the same period.

Alternative scenarios

Scenario 1: Reduced gas-fired electricity production

Following the training of the model, which reproduced DAM prices with satisfactory accuracy, two counterfactual scenarios were formulated to assess the economic impact of the additional use of fossil gas for electricity exports. The first alternative scenario entailed lower fossil gas-fired electricity production.

In order to quantify the hourly gas-fired electricity production that could have been avoided during the period under consideration (January 2024-July 2026), this scenario was constructed to simultaneously satisfy the following three key constraints:

1. The potentially avoidable gas-fired electricity production may not exceed actual electricity exports from fossil gas plants during net export hours.
2. Sufficient fossil gas production capacity must remain available to ensure the required downward reserve in the system, allowing gas-fired units to reduce their output if necessary.
3. The remaining gas-fired electricity production must be sufficient to meet domestic demand.

To satisfy the first constraint, electricity exports were multiplied by the share of fossil gas in electricity production (see **Figure 2**), for each net export hour during the period under consideration. This provided an estimate of the maximum amount of gas-fired electricity production that could have theoretically been avoided.

To satisfy the second constraint, the actual values for the three categories of downward reserve (FCR, aFRR, and mFRR) provided by fossil gas plants were initially obtained from the IPTO's daily Integrated Scheduling Process records (ISP2 and ISP3). The total downward reserve requirement for each hour of the day was calculated as the sum of these requirements across the three subcategories.

To simultaneously satisfy the first two constraints, the reduced gas production during net export hours was determined as the maximum between the energy quantity remaining after subtracting the exported portion produced from gas and the quantity corresponding to the required downward reserve at the same hour.

The third constraint (meeting domestic electricity demand) is satisfied by construction, as net exports decrease by an amount exactly equal to the reduction in fossil gas-fired electricity production.

Based on the above data and assumptions, the potentially avoidable gas-fired electricity production during January 2024-July 2026 was estimated at **6.56 TWh (Table 3)**, corresponding to **11.4%** of total electricity production from fossil gas plants clearing Greece's wholesale electricity market during the same period. Furthermore, the evolution of the share of exports in total gas-fired electricity production reflects producers' increasing shift toward cross-border markets. This share increased from 9.0% in 2024 to 10.1% in 2025, and nearly doubled over the first seven months of 2026 (18.4%).

Table 3. Exports from fossil gas-fired plants

Year	Electricity exports from gas plants (GWh)	Export share (%) of total gas-fired production	CO ₂ emissions (million tons)
2024	1,979.6	9.05%	0.79
2025	2,408.7	10.07%	0.96
2026 (7 months)	2,167.9	18.35%	0.87
Total	6,556.2	11.38%	2.62

It is worth noting that this additional fossil gas-fired electricity production, exclusively intended for export, had a significant climate impact, resulting in an estimated **additional 2.6 million tons of CO₂ emissions**¹⁹.

The ever-rising share of gas-fired electricity production directed toward exports is associated with the rapid development of RES. In recent years, RES have covered an increasingly large share of domestic electricity demand, reducing the need for gas-fired production. In the first half of 2026, RES met 56.4% of domestic electricity demand,

¹⁹ Assuming an average carbon intensity of 0.4 tons of CO₂/MWh for Greek gas-fired plants.

exceeding the corresponding share during the same period of 2025 (46.0%) by 10 percentage points²⁰. Moreover, the number of hours during which production from clean energy sources exceeds domestic electricity demand is rapidly increasing. According to a recent analysis based on ENTSO-E data, during the first half of 2026, electricity production from RES and large hydropower plants exceeded domestic demand for 435 hours or 10% of the six-month period in question²¹. **Consequently, fossil gas-fired electricity producers are increasingly shifting toward exports, capitalizing on lower domestic DAM prices (compared to neighboring countries), which are driven by the accelerated expansion of low-cost RES.**

At the monthly level (**Figure 4**), estimated electricity exports from gas plants (defined as the difference between actual and counterfactual gas-fired electricity production) ranged from 28 GWh in April 2025 to 565.4 GWh in January 2026, with an average monthly value of 211.5 GWh. The gap between the actual and counterfactual scenarios exhibits a seasonal pattern, widening during the winter months. Thus, during the four-month winter period November 2024-February 2025, cumulative exports from gas plants were estimated at 1.39 TWh, while, over the respective 2025-2026 period, they increased by 15% to 1.60 TWh.

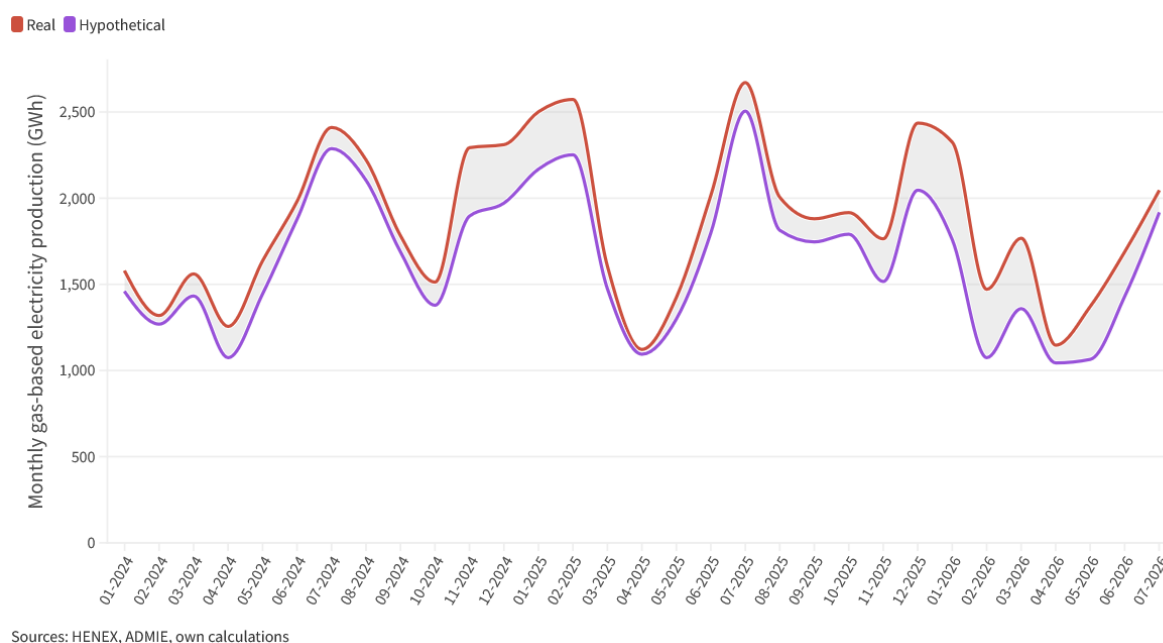


Figure 4: Electricity production from fossil gas plants setting the daily DAM price (red, solid line) and estimated minimum possible gas-fired electricity production (purple, dotted line) during net export hours over the period January 2024-July 2026. The shaded area represents the estimated electricity exports from gas-fired plants.

The reduction in gas-fired electricity production in the counterfactual scenario resulted in a corresponding decrease in electricity exports. However, Greece's net exporter status was maintained throughout the entire period under consideration; the balance of interconnections shifted from +7.9 TWh in the baseline scenario to +1.33 TWh in the counterfactual scenario, with this 6.56 TWh reduction exactly matching the decrease in gas-fired electricity production.

²⁰ The Green Tank, July 2026. Trends in Electricity Production - June 2026. <https://thegreentank.gr/en/2026/08/03/admie-june26-en/>

²¹ The Green Tank, 16.7.2026. LinkedIn post on the evolution of the number of hours during which clean energy production exceeds domestic demand. <https://bit.ly/4gr5voK>

Scenario 1 simulation results

The Extra Trees algorithm was employed to simulate the Greek DAM under counterfactual Scenario 1. This model was trained on actual hourly data (January 2024-February 2026) and achieved the highest performance during the test period (March-July 2026) among the four algorithms examined, yielding an R^2 score of 0.81. During the simulation process, hourly values were modified for only three of the model's 14 independent variables. First, actual gas-fired electricity production data (red, solid line in Figure 4) were replaced with the corresponding values from the counterfactual scenario (purple, dotted line). Second, net exports were reduced by the difference between actual and counterfactual gas-fired electricity production (shaded area in Figure 4). Third, residual load was adjusted accordingly, as total electricity demand was assumed to decrease by the same amount as the reduction in net exports.

Using these modified input data, the Extra Trees model estimated the counterfactual DAM price corresponding to reduced gas-fired electricity production for each hour of the period under review. The results presented in **Table 4** indicate that, over the entire period, the decrease in fossil gas-fired electricity production resulted in an average DAM price reduction of €6.2/MWh, which is equivalent to 6.2% of the average actual DAM price (€100.6/MWh) over the 31-month period. This effect was more pronounced during the first seven months of 2026. Thus, in the absence of additional gas-fired electricity production dispatched for export, the average DAM price over this 7-month period (€94.9/MWh) could have settled at €87.6/MWh.

Table 4. Differences Between Actual and Counterfactual (Scenario 1) DAM prices

Year	Difference between actual and counterfactual DAM (€/MWh)	Actual DAM (€/MWh)	% of Actual DAM
2024	6.27	100.88	6.22%
2025	5.54	103.60	5.35%
2026 (7 months)	7.32	94.92	7.72%
Average	6.23	100.59	6.23%

The higher actual DAM price -as compared to counterfactual Scenario 1- applies to the entire domestic electricity demand, which remains unchanged and is fully met in both scenarios (baseline/factual and counterfactual Scenario 1). Therefore, multiplying the difference between the actual and counterfactual DAM prices by domestic electricity demand provides an estimate of the financial burden borne by consumers in Greece as a result of the additional use of fossil gas for electricity exports. This figure further yields two distinct interpretations. First, *it measures consumer net benefit had gas-fired production been capped at domestic demand levels rather than allocated to exports*. Second, it reflects the aggregate revenues captured by all electricity producers from domestic consumers, due to the expansion of export-oriented gas-fired production.

The results (**Figure 5**) indicate that, *over the entire 31-month period, Greek consumers incurred a cumulative financial burden estimated at €914.4 million. This amount also represents the corresponding potential savings under the counterfactual scenario*

where fossil gas use is limited to meeting domestic electricity needs. Moreover, over the January 2024–June 2026 period, the estimated consumer burden (€889.4 million) exceeded these 30 months' cumulative electricity trade balance (€821.2 million).

At the monthly level, the largest estimated financial burdens associated with additional gas-fired electricity production (and therefore the largest potential economic benefits from its counterfactual reduction) were recorded in November 2024 (€75.3 million), January 2026 (€67.0 million), and February 2025 (€58.2 million). These months combined relatively high domestic electricity demand with increased electricity exports and large shares of fossil gas in the domestic electricity mix.

Scenario 1: Less Gas

■ Benefit for Greek consumers ■ Electricity trade balance



Sources: HENEX, ELSTAT, own calculations, simulations

Figure 5: Scenario 1 results: estimated monthly financial benefit for domestic consumers resulting from the avoidance of additional gas-fired electricity production for exports (green bars) and the corresponding monthly electricity trade balance (red bars).

As expected, the reduction in electricity exports under counterfactual Scenario 1 negatively affects the electricity trade balance. The respective monthly figures under Scenario 1 were estimated by taking into account both the reduction in exports and the lower DAM prices under the counterfactual scenario, while assuming that the value of electricity imports remained unchanged (**Figure 5**). Cumulatively over the period January 2024–June 2026, the electricity trade balance under counterfactual Scenario 1 was estimated at **-€118.1 million**, considerably lower than the baseline scenario's positive trade balance of **+€821.2 million** that significantly benefited Greek electricity producers (see **Figure 1**).

Scenario 2: Reduced gas production - increased RES production

Scenario 1 simulations indicated that reducing gas-fired electricity production would yield significant benefits for domestic consumers, albeit at the cost of producer revenues due to lower electricity exports. Thus, a critical question arises: **under what conditions could both Greek consumers and electricity producers simultaneously benefit?**

To examine this question, a second counterfactual scenario was constructed, applying the same reduction in gas-fired electricity production as in Scenario 1. However, in contrast to Scenario 1, this decrease does not result in lower electricity exports. Rather, exports are held constant at baseline (actual) levels, and the deficit in gas-fired output is substituted by increased RES production.

Scenario 2 simulation results

Based on the above assumptions, the Extra Trees algorithm was used to simulate counterfactual Scenario 2; hourly values were modified for only three of the model's 14 independent variables. First, the actual gas-fired electricity production data (red, solid line in **Figure 4**) were replaced by the corresponding counterfactual scenario values (purple, dotted line in **Figure 4**). Second, RES production data were adjusted upward by the difference between actual and counterfactual (reduced) gas-fired electricity production, as represented by the shaded area in **Figure 4**. In contrast to Scenario 1, net exports remained unchanged and equal to their baseline values. Therefore, over the entire period under consideration, the additional RES production assumed under Scenario 2 amounts to 6.56 TWh, of which *a substantial share could have been captured had Greece deployed sufficient electricity storage infrastructure to absorb excess RES output. Specifically, over the reviewed period, unutilized surplus RES production reached 4.5 TWh.* Finally, as in Scenario 1, the residual load was reduced by the additional amount of electricity supplied by RES.

Using these modified input data, the Extra Trees model estimated the counterfactual DAM price corresponding to Scenario 2 for each hour of the period under consideration. The results (**Table 5**) indicated that replacing gas-fired electricity production for exports with an equivalent amount of additional RES output results in a 16.2% greater reduction in the DAM price compared with that achieved by gas reduction alone under Scenario 1 (**Table 4**). Under counterfactual Scenario 2, the DAM price was estimated to be, on average, **€7.24/MWh** (or 7.2%) lower than the actual average DAM price over the 31-month period. Specifically, during the first seven months of 2026, the estimated reduction (9.6%) approximated 10% of the actual average DAM price; thus, had electricity exports been supplied by RES rather than gas-fired production, the average DAM price during that particular period would have settled at €85.8/MWh instead of €94.9/MWh.

Table 5. Differences Between Actual and Counterfactual (Scenario 2) DAM prices

Year	Difference between actual and counterfactual DAM (€/MWh)	Actual DAM (€/MWh)	% of Actual DAM
2024	6.90	100.88	6.84%
2025	6.47	103.60	6.25%
2026 (7 months)	9.15	94.92	9.64%
Average	7.24	100.59	7.20%

The economic benefit for Greece's consumers resulting from RES replacing gas production dispatched for exports was calculated by multiplying the difference between the actual and counterfactual DAM prices by domestic electricity demand for all net-export hours. The

electricity trade balance under Scenario 2 was calculated, assuming that both electricity imports and exports remain unchanged from the baseline scenario; thus, the DAM price used to value exports under the counterfactual scenario constitutes the only variable affecting this simulation.

As illustrated by the simulation results in **Figure 6**, *substituting fossil gas with increased RES production to actual electricity exports (baseline levels) would have yielded an estimated financial benefit of €1.065 billion for domestic consumers over the entire 31-month period (January 2024-July 2026). At the same time, the electricity trade balance would have maintained a robust surplus, accumulating €605.4 million (through June 2026).*

Scenario 2: Less Gas - More RES

■ Benefit for Greek consumers ■ Electricity trade balance



Sources: HENEX, ELSTAT, own calculations, simulations

Figure 6: Scenario 2 results: estimated monthly financial benefit for Greek consumers resulting from the substitution of export-oriented fossil gas production with equivalent RES output (green bars), and the corresponding monthly electricity trade balance (red bars).

Relative to the baseline scenario (actual data), exporting the same volumes under Scenario 2 yields lower benefits for electricity producers, with revenues falling by €215.7 million due to substantially lower DAM prices. Nonetheless, this downward pressure on the latter generates significantly larger savings for Greece's electricity consumers. Therefore, overall, the implementation of this scenario would significantly reduce electricity costs for domestic consumers, while strengthening the competitiveness of the national economy.

Conclusions

Greece's transition to a net electricity exporter in 2024 -significantly ahead of NECP projections- may initially appear to be an unequivocally positive development, given a cumulative electricity trade surplus of €821.2 million between January 2024 and June 2026. However, this analysis reveals that this figure fails to capture both the economic cost borne by domestic consumers and the environmental impact of electricity exports. Consequently, a positive trade balance should not serve as the primary metric for evaluating national energy policy success, even when it reflects lower domestic electricity prices relative to neighboring markets.

The financial cost incurred by Greek consumers

The additional financial burden associated with electricity exports stems from the significant contribution of gas-fired production to exported volumes; over the 31-month period under review, 6.56 TWh of gas-fired electricity were exported, accounting for 11.4% of total gas-fired electricity production. Although this electricity was delivered to neighboring countries, the production plants cleared and set prices in Greece's DAM, thus inflating the electricity costs borne by domestic consumers. Using a machine learning model (Extra Trees) trained on actual DAM data across 14 independent variables, this additional financial burden on Greek consumers was estimated at €914.4 million over the full period (€889.4 million up to June 2026).

The climate dimension

Beyond financial considerations, export-oriented gas-fired production accounted for an estimated 2.6 million tons of additional CO₂ emissions, thereby undermining the decarbonization progress achieved through the expanding share of RES in the electricity mix.

Electricity exports are not problematic; their source is

The financial burden on consumers is not inherent to electricity exports as a whole; rather, it is solely associated with the share produced by fossil gas plants, which exerts upward pressure on the DAM price, inflating the cost of meeting domestic electricity demand. This distinction is demonstrated by simulations under a counterfactual scenario (Scenario 2), in which export-oriented fossil gas production was replaced with equivalent RES output, thereby maintaining total exported volumes unchanged. Under this scenario, the model estimated a substantial reduction in the DAM price, yielding €1.065 billion in savings for Greek consumers. Concurrently, the electricity trade balance remained strongly positive, accumulating €605.4 million to the benefit of producers. Therefore, when driven by RES production, electricity exports strengthen the national economy, simultaneously delivering benefits to both consumers and producers.

Key Conclusion

These findings yield a key policy conclusion: continuously expanding export-oriented gas-fired capacity -framed as a means of anchoring Greece as a regional energy security pillar in Southeastern Europe- is unsustainable from both economic and environmental standpoints.

Furthermore, this strategy exposes Greece to external conditions beyond its direct control. Accelerated penetration of low-cost RES in neighboring electricity markets could drive down wholesale prices in those regions and, consequently, diminish demand for electricity imports from Greece. Moreover, international fossil gas supply prices remain highly sensitive to geopolitical tensions, recently exceeding €70/MWh; this volatility introduces a significant layer of economic uncertainty. Finally, continued reliance on gas-fired production risks triggering domestic policy interventions that would impose additional financial burdens on consumers. For instance, providing financial support to gas-fired plants through capacity remuneration mechanisms would constitute a secondary, indirect subsidy for gas-fired electricity production, ultimately borne by end-users.

National energy policy should not be assessed through relative price comparisons with neighboring markets, such as Bulgaria; rather, its true benchmark of success is whether electricity prices are minimized for domestic consumers themselves. As long as Greece continues to export substantial amounts of electricity produced from fossil gas, this objective will remain unattainable.

Energy policy priorities should therefore shift from expanding gas-fired capacity -particularly in the absence of older plant retirements- toward accelerating energy storage infrastructure alongside deeper RES penetration. This dual strategy would enable Greece to sustain a positive electricity trade balance while driving down wholesale prices, thereby lowering energy costs for domestic consumers, enhancing Greece's competitiveness, and securing national climate targets.

Methodology as a policy tool

The methodology developed in this study -combining machine learning to quantify the impact of electricity production sources and market variables on wholesale prices with scenario-based simulations- provides a robust tool for energy policymaking. This framework enables a more comprehensive assessment of the benefits and detriments resulting from electricity exports, extending beyond conventional trade balance metrics. Most importantly, it advances a broader conceptualization of benefits derived from exports, incorporating trade outcomes alongside associated domestic consumer costs and environmental impacts (greenhouse gas emissions).

