INSTITUTE OF ENERGY FOR SOUTH-EAST EUROPE

1ST GREEK-TURKISH ENERGY FORUM

Thursday, April 25, 2024 | Istanbul

Background Paper

Greece and Türkiye in the New Energy Era

Institute of Energy for South East Europe (IENE)
3, Alexandrou Soutsou, 106 71 Athens, Greece
tel: 0030 210 36 28 457, 3640 278 fax: 0030 210 3646 144
website: www.iene.eu, e-mail: admin@iene.gr

Greece and Türkiye in the New Energy Era

BACKGROUND PAPER

APRIL 23, 2024

Prepared by IENE's Research Team

Institute of Energy for South East Europe (IENE)

3, Alexandrou Soutsou, 106 71 Athens, Greece

tel: 0030 210 36 28 457, 3640 278 fax: 0030 210 3646 144

website: www.iene.eu, e-mail: admin@iene.gr

Contents

Introduction

Before analyzing the energy relations between Greece and Türkiye, it is crucial to make an important distinction. On the one hand, Türkiye's size and energy sector are significant in comparison with those of other countries in the SE European region, including Greece, and therefore if seen together with the East and West Balkan region, they tend to distort the overall picture, as analysed in IENE's flagship "SEE Energy Outlook 2021/2022" study **(1)**. On the other hand, Greece's size and energy sector is smaller than those of Türkiye, but both countries play and will continue to play an important role in regional energy issues and developments.

It should be mentioned that Greece and Türkiye have been working on joint energy projects since the start of this century. Today Greece and Türkiye are partners in a number of key energy areas, including electricity, gas, renewables, energy transmission and energy trading. Over the last two decades, Greece and Türkiye have established major electricity and gas interconnections across the Greek-Turkish border in Evros, Thrace, and have developed active cross border transmission and trading in electricity and gas. At the same time, the two energy exchanges, EXIST in Istanbul and HENEX in Greece, have developed close business ties and are pursuing areas of common interest.

This Background Paper has been prepared in order to focus on the latest energy developments in Greece and Türkiye and also highlight the various areas in the energy sector where cooperation between the two countries already exist. Furthermore, this paper explores energy issues of common interest which present potential for closer cooperation between Greece and Türkiye.

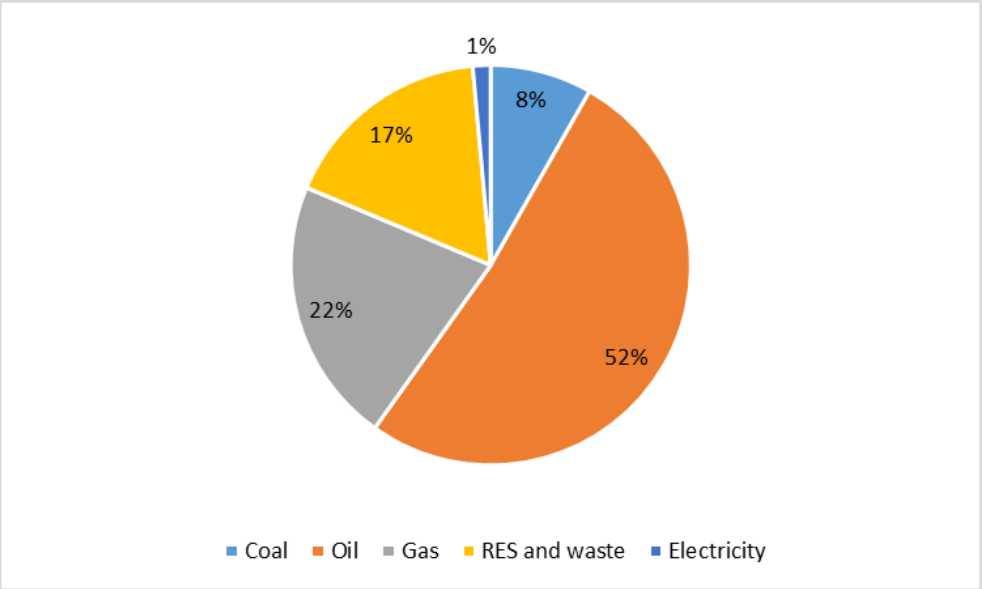
1. Energy Mix

Greece is reliant on imported fossil fuels to cover most of its energy demand. Historically, a notable share of electricity demand was covered by lignite-fired power plants located next to lignite mines in the north of Greece. However, domestic lignite production has steadily declined as Greece phases out lignite-fired generation. Over the last decade, domestic energy production from RES grew, mainly because of increasing electricity generation from wind and solar PV.

Greece produces only a marginal amount of oil but has expressed interest in increasing domestic oil and gas production. In 2022, oil covered the largest share (52%) of the total energy supply, followed by natural gas (22%) and RES and waste (17%), while the contribution of coal is steadily decreasing, reaching 8%, as shown in Figure 1.

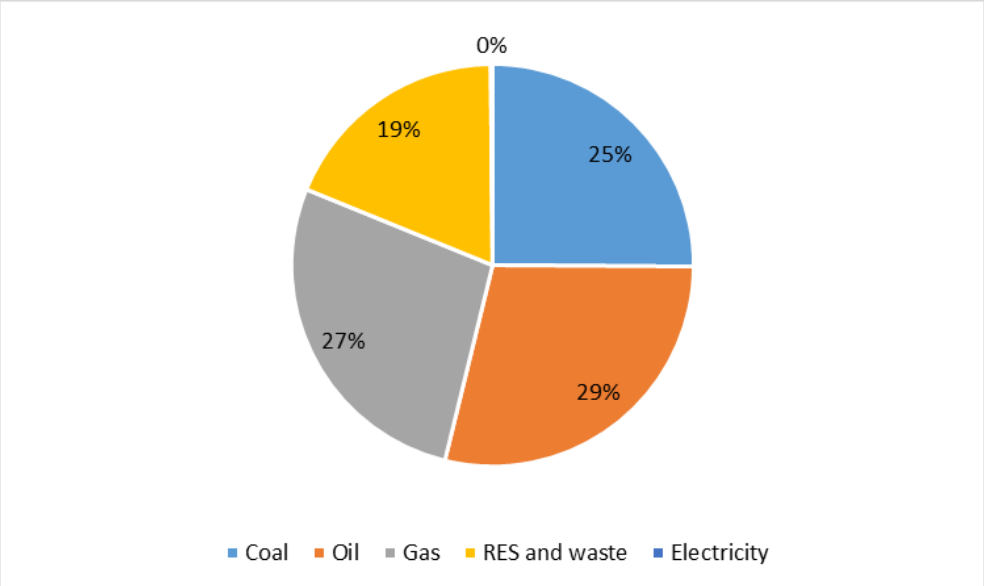
Similarly, Türkiye's energy system is characterised by a large share of fossil fuels, which accounted for 81% of the total energy supply in 2022 (see Figure 2). The remaining (19%) is from various RES and waste, most of which consist of geothermal and hydro used in power generation. While nearly all of the oil and gas consumed is imported, around half of the coal and all types of RES are produced domestically.

Figure 1: Total Energy Supply in Greece, 2022



Source: IEA

Figure 2: Total Energy Supply in Türkiye, 2022



Source: IEA

2. Electricity Infrastructure and Trade

Greece's electricity infrastructure consists of large thermal plants (natural gas and lignite) and renewable generation (large-scale hydro, wind and solar PV, and small-scale distributed generation, mainly solar PV), cross-border interconnections to Albania, Bulgaria, Italy, North Macedonia and the Republic of Türkiye, a transmission and distribution network that serves the mainland and interconnected islands, and numerous isolated distribution networks on non-interconnected islands.

In 2022, Greece was interconnected with Albania, Bulgaria, North Macedonia and Türkiye via five 400 kV alternating current (AC) lines (one line to each country), with Albania via one 150 kV AC line, and with Italy via one direct current (DC) undersea cable, as shown in Table 1. More specifically, a major electricity interconnection (400 kV) is in place since 2010 linking Nea Santa to Babaeski with daily electricity exchanges between the two countries. **(2)**

A second power line connecting the electricity grids of Greece and Türkiye is scheduled for completion by 2029, according to a MoU signed in December 2023 in Athens by Greece's Independent Power Transmission Operator (IPTO or ADMIE) and its Turkish equivalent, TEIAS. The new line will run from Nea Santa, in northern Greece, to the town of Babaeski, in European Türkiye, and aims to increase the two-way electricity flow by a capacity of 600 MW. A current line on roughly the same route connects the two countries' grids, via a 400 kV line. The new power line will run for 130 kilometers, of which 70 will be in Greece. The second Greece-Türkiye high-voltage power connection, along with a 400 kV line connecting Türkiye with Transmission Bulgaria, has been submitted as part of the East Balkan Corridor within the European Network of System Operators' (ENTSO-E) 10-year network development plan, which affirmed the need for an increase in transport capacity. **(3)**

Map 1: Major Existing and Planned Electricity Infrastructure in Greece, 2022

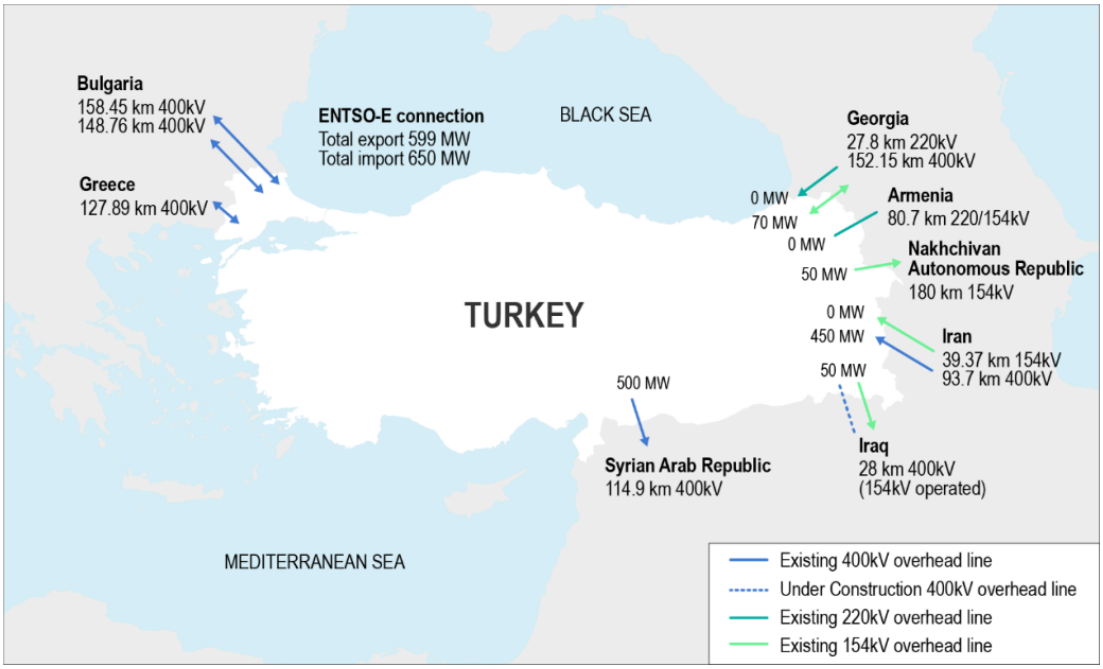
Source: IEA

Table 1: Greece's 2022 Interconnection Capacity and Growth Through 2025

Cross-border interconnection capacity (MW)	2022		2025	
	Export	Import	Export	Import
Albania	250	250	400	400
Bulgaria	400	600	1 400	1 700
Israel	0	0	1 000	1 000
Italy	500	500	500	500
North Macedonia	1 100	850	1 100	850
Türkiye	218	166	660	580
TOTAL	**2 468**	**2 366**	**5 060**	**5 030**

Source: IEA

Map 2: Cross-border Interconnection Capacity in Türkiye, 2021



Source: IEA

Electricity mix

From 2016 to 2022, Greece's installed generation capacity increased from 16.2 GW to 20.4 GW, excluding capacity on non-interconnected islands (Table 2). Most of this growth came from increased capacity of solar PV (+2.5 GW), wind (+2.2 GW) and a new natural gas combined-cycle gas turbine (CCGT) in Megalopolis (+0.81 GW), as well as smaller additions for hydro, biogas and co-generation. Lignite-fired capacity dropped by 1.6 GW with the closure of several older units.

Table 2: Installed Capacity in Greece, 2016-2022 and Estimated Capacity, 2025-2030

Installed capacity (GW)	2016	2017	2018	2019	2020	2021	2022	2025	2030
Natural gas	4.4	4.4	4.9	4.9	5.2	5.2	5.2	6.9	6.9
Lignite	3.9	3.9	3.9	3.9	3.9	2.8	2.3	0.7	0
Wind	2.1	2.3	2.6	3.3	3.8	4.3	4.3	5.2	7
Solar PV*	2.44	2.45	2.49	2.64	3.08	4.0	4.9	5.3	7.7
Large hydro	3	3	3.2	3.2	3.2	3.2	3.2	3.8	3.9
Small hydro	0.22	0.23	0.24	0.24	0.25	0.25	0.26	0.26	0.26
Biogas and biomass	0.06	0.06	0.08	0.09	0.1	0.11	0.1	0.1	0.3
Co-generation	0.1	0.1	0.1	0.11	0.11	0.24	0.12	0.12	0.12
Total	**16.2**	**16.5**	**17.4**	**18.3**	**19.6**	**20.1**	**20.4**	**21.7**	**26.2**

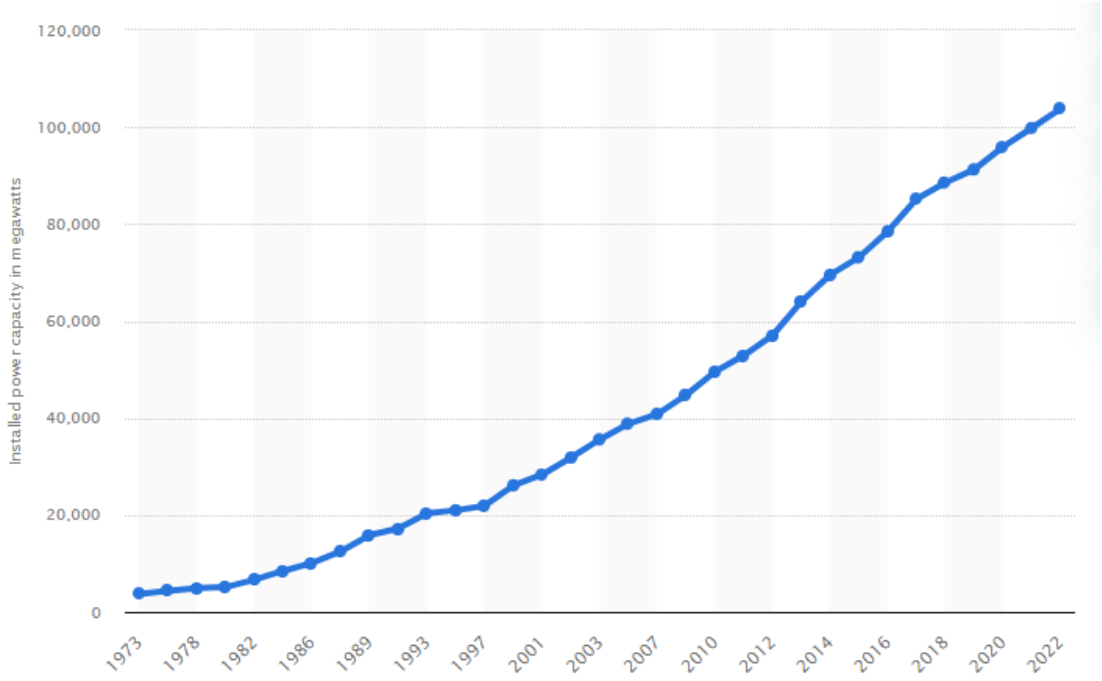
* Including small-scale solar PV in the distribution grid.

Source: IEA

The government estimates that installed generation capacity will increase to 26 GW by 2030, mainly because of increasing renewables capacity, primarily solar PV (+2.8 GW), wind (+2.7 GW) and large hydro (+0.7 GW), along with an expected increase of natural gas (+1.7 GW) and smaller additions for biogas, geothermal and solar thermal. As of July 2021, around 4.3 GW of new renewable projects had binding terms for a grid connection, mainly wind (2.4 GW) and solar PV (1.8 GW). The NECP set a target for 19 GW of renewable capacity (excluding large hydro) by 2030 versus around 9.6 GW in 2022.

Türkiye, with a 2023 electricity generation capacity of approximately 105 GW, is Europe's sixth-largest electricity market and the 14th largest in the world. Approximately 56% of Türkiye's electricity generation capacity consist of RES, including hydro, wind, solar, geothermal, and biomass power plants, making Türkiye the fifth-largest generator of renewable energy in Europe and the 11th largest in the world. Türkiye currently has approximately 31.6 GW of hydro, 25.75 GW of natural gas, 21.3 GW of coal, 11.45 GW of wind, 9.93 GW of solar, 1.7 GW of geothermal, and approximately 2 GW of biomass power plant installed capacity. **(4)**

Figure 3: Total Installed Power Capacity in Türkiye, 1973-2022



Source: IRENA

3. Gas Infrastructure and Trade

Greece has no gas production and covers all gas demand through imports. As shown in Figure 4, Türkiye is one of the countries from which Greece imports natural gas. Currently, Greece's National Natural Gas Transmission System (NNGTS) has four entry points supporting gas trade. The largest is the Revithoussa LNG terminal, which was upgraded in 2018 and again in 2022 to increase import capacity to around 7 bcm. The Kipi cross-border pipeline interconnection supports imports from Türkiye. The Sidirokastro cross-border pipeline interconnection supports bidirectional flows between Greece and Bulgaria. The Nea Mesimvria entry point started operation in 2020 and connects the NNGTS to the TAP near Thessaloniki. In 2022, the Sidirokastro, Nea Mesimvria and Kipi entry points had a combined import capacity of around 5.4 bcm due to congestion issues on the northern part of the NNGTS. The TSO is planning to add two new compressor stations to remove these restrictions, which could increase total import capacity to 13.5 bcm.

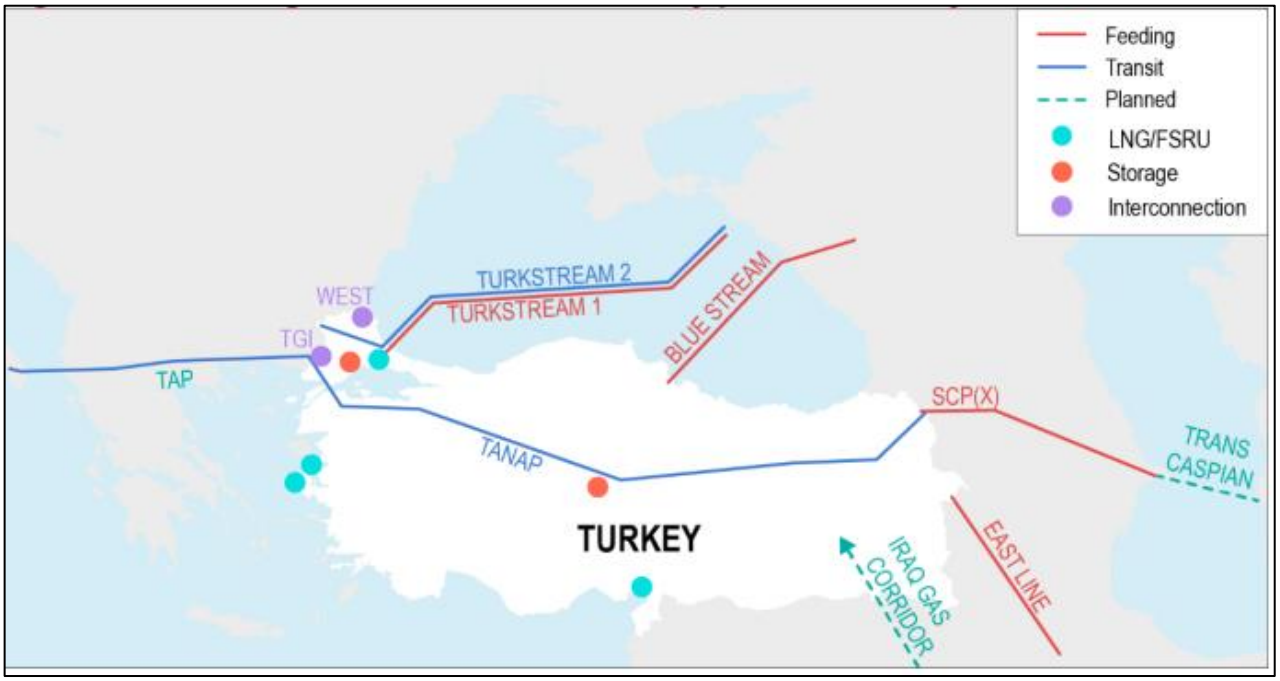
It is important to mention that Greece and Türkiye have developed a 280 km gas Interconnector pipeline, which links Komotini in Greece to Karacebey in Türkiye, which came on stream in 2007 and through which Greece's Public Gas Company (DEPA) imports some 0.75 bcm of gas annually from Botas.

Map 3: Natural Gas Infrastructure in Greece, 2023

Source: IEA

Türkiye's only pipeline export capacity to Greece is through its national gas transmission system from Karacabey (Türkiye) to Komotini (Greece). In addition, there is TANAP export capacity to Greece and TurkStream 2 export capacity to Bulgaria, but these export points are not part of the national gas transmission system of Türkiye and therefore are not regulated by the Energy Market Regulatory Authority. The export capacity of the Kipi interconnection point at the border with Greece has doubled from its original capacity, increasing the maximum capacity to 4.6 mcm/day (1.7 bcm/year), creating capacity that exceeds Botas' current exports to Greece. Initial volumes of Trans Adriatic Pipeline gas were tested at this exit point in November 2019. **(5)**

Map 4: Natural Gas Import-Export Routes in Türkiye, 2021

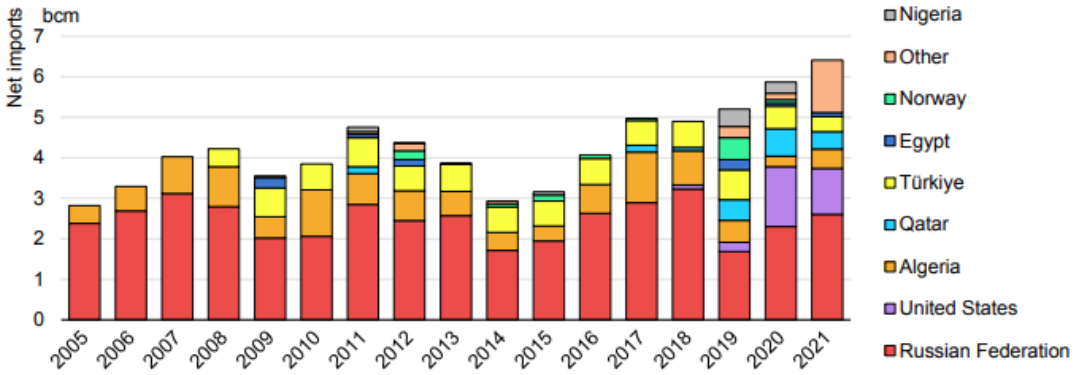


Source: IEA

Map 5: Natural Gas Infrastructure in Türkiye, 2021

Source: IEA

Figure 4: Greece's Natural Gas Net Trade by Country, 2005-2021



Source: IEA

4. Oil Trade

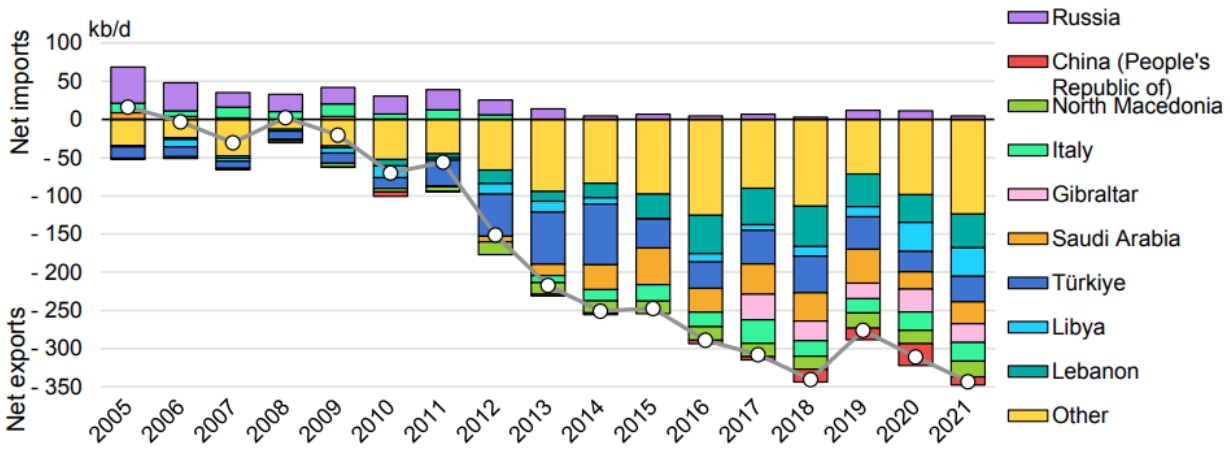
Greece has a stable oil product trade with Türkiye, among other countries (see Figure 5). From 2011 to 2021, Greece's net oil product exports through its 4 oil refineries increased from 56 kb/d to 343 kb/d (+513%). Greece has little net imports from Russia (4.5 kb/d in 2021), but these ended in February 2023, when the EU ban on imports of Russian oil products enters into force.

Map 6: Oil Infrastructure in Greece, 2023

Source: IEA

Greece has four oil refineries, with a total distillation capacity of 669.6 kb/d in 2020. Helleniq Energy owns three refineries (Aspropyrgos, Elefsina and Thessaloniki) with a combined capacity of 424.6 kb/d. Motor Oil owns the largest refinery (Korinthos), with a capacity of 245 kb/d. In 2021, the four refineries produced 634 kb/d of oil products.

Figure 5: Greece's Oil Products Net Exports by Country, 2005-2021



Source: IEA

Türkiye has five operational refineries that cover close to 80% of total oil product demand in the country. Türkiye Petrol Rafinerileri A.Ş (Tüpraş) is the country's largest industrial company and is also active in the oil sector. Tüpraş operates four out of five Turkish refineries with combined processing capacity of 646 kb/d. Currently, there are five refineries operating in Türkiye with a total crude distillation capacity of 860 kb/d.

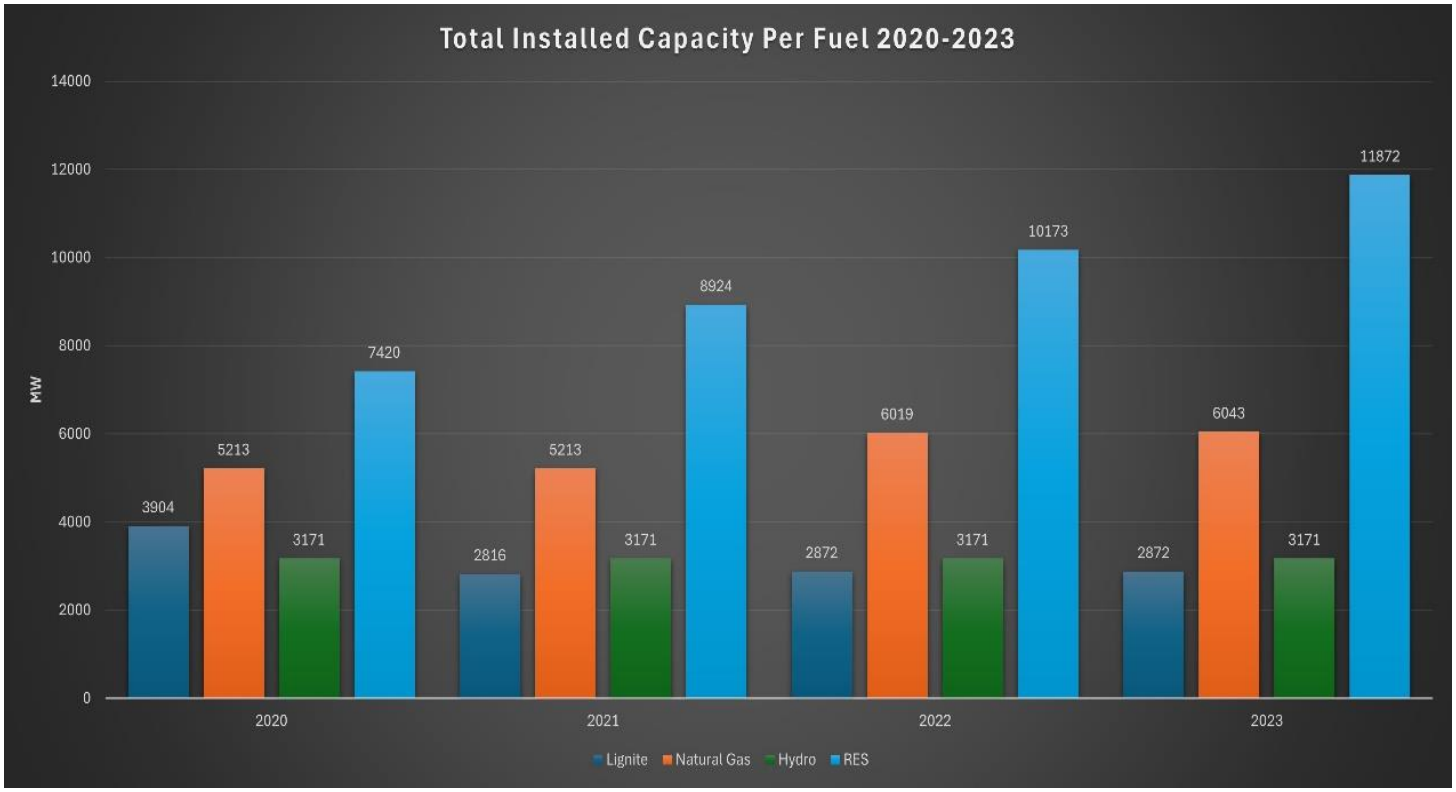
Map 7: Oil Infrastructure in Türkiye, 2021

Source: IEA

5. Renewables' Growth

In Greece, RES have experienced a significant growth over the last few years, from 7.4 MW in 2020 to 11.9 GW in 2023 (see Figure 6). Greek RES capacity in 2022 reached 10.17 GW, an increase of 12.94% in respect to 2021. For the first time it exceeded the 10 GW.

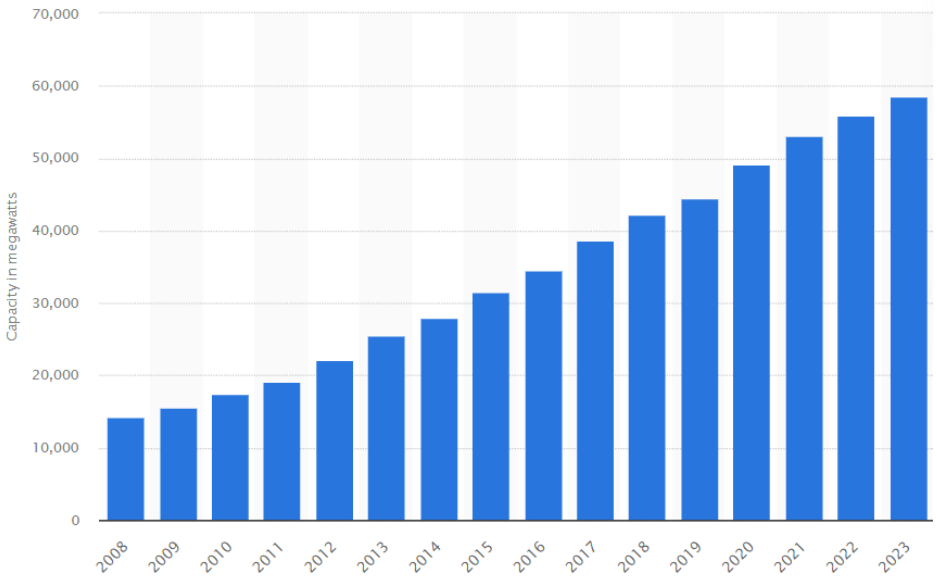
Figure 6: Total Installed Capacity per Fuel in Greece, 2020-2023



Source: IEA

Türkiye increased its renewable electricity capacity by 2,845 MW last year. Out of 59.2 GW in total, just under 32 GW was hydropower, compared to 11.8 GW from wind and 11.3 GW in photovoltaics, the Ministry of Energy and Natural Resources said. Geothermal power plants accounted for almost 1.7 GW and the bioenergy segment was 2.5 GW. **(6)**

Figure 7: Installed RES Capacity in Türkiye, 2008-2023



Source: IEA

6. Energy Exchanges

Greece has successfully completed a number of reforms in the wholesale electricity market over the last years (i.e. electricity market design, unbundling of electricity and gas TSOs). Greece has also started to successfully implement its Recovery and Resilience Plan with significant reforms and investment in the electricity market.

In 2022 and 2023, several reforms were completed, like demand side response participation in the market and simplification of renewables permitting. More reforms and investments are needed for Greece to achieve its ambitious plans regarding the green transition while addressing the significant geopolitical challenges and increased energy prices. Ensuring security of supply while increasing competition in the markets and ensuring affordable prices for vulnerable consumers in the short, mid and long term are essential.

Greece plans to complete the wholesale electricity market design reforms. The day-ahead market is the main market segment with sufficient liquidity because of the mandatory participation of electricity producers (apart from renewables). Reforms are still pending in the intraday and balancing segments. In the short term, reforms in the intraday market are a high priority to further enhance competition through the integration of renewables and demand side response (including via aggregators) and the full participation of electricity traders.

Greece was integrated into the Pan-European intraday coupling (XBID) in November 2022, allowing closer to real-time participation of all players. Along with coupling within EU borders, Greece is making efforts to increase coupling through intraday auctions outside the European Union (Albania, North Macedonia and Türkiye). This will allow allocating the remaining day-ahead cross-zonal capacity to the market participants, who are expected to manage their market positions more efficiently closer to real-time delivery.

To support better integration with the European common wholesale electricity market and ensure more competitive and efficient wholesale electricity trading, Greece is implementing structural changes to its wholesale electricity market. A day-ahead mandatory pool system, in operation since 2005, was replaced in 2020 with three wholesale spot markets (day-ahead, intraday and balancing) and a derivatives market. The day-ahead, intraday and derivatives markets are operated by Hellenic Energy Exchange (HEnEX), while transaction clearing is performed by the Athens Exchange Clearing House (ATHEXClear) for the derivatives market and the Hellenic Energy Exchange Clearing House (EnExClear) for the spot markets. The balancing market is operated by the TSO.

Similarly, Energy Exchange Istanbul (EXIST) or Enerji Piyasaları İşletme A.Ş. (EPİAŞ) by its Turkish name is an energy exchange company that was established on March 18, 2015. EXIST, legally incorporated under the Turkish Electricity Market Law and enforced by the Energy Markets Operation License granted by the Energy Markets Regulatory Authority (EMRA) of Türkiye. EXIST is responsible for managing and operating energy markets, including power, gas and environmental commodities. EXIST ensures transparent, reliable and trustworthy market conditions as well as equal access for all market participants by providing a counterparty guarantee of the transactions. As an energy exchange EXIST, provides market environments where Exchange members send their orders to buy or sell energy in determined delivery platforms. Its task is to carry out matching all buy or sell orders in transparent manner, according to the regulatory manner and to establish a reference price.

EXIST operates Day-Ahead and Intraday Spot Power Market, Spot Natural Gas Market, Power Futures Market, Natural Gas Futures Market and Renewable Energy Guarantees of Origin System & Organized YEK-G Market. EXIST also performs financial transactions such as settlement, collateral and invoicing in these markets, settlement activities regarding the Balancing Power Market (BPM) and Ancillary Services Market, imbalance settlement activities in natural gas market, the operation of the Renewable Energy Resources Support Mechanism and carries out eligible costumer transactions. Besides all these EXIST develops all of the markets and services software in-house.

Discussion

Due to their geographic location, both Türkiye and Greece have great strategic importance to both energy suppliers and large energy consumers. Greece, being part of the EU, presents some tactical advantages from an energy security viewpoint, especially concerning energy transmission for European countries. Türkiye is a special country, which has proximity to 75% to all proven oil and gas reserves of the world; therefore, it is difficult to avoid Türkiye when considering energy transmission infrastructure in the region. In existing and proposed projects, both Türkiye and Greece are playing key role as primary and secondary energy hubs respectively. Thus, it is important for both countries to maintain and improve political and economic relations.

With major energy challenges lying ahead for this part of SE Europe, especially with regard to energy security and decarbonization, as Greece and Türkiye are committed to lower Green House Gas Emissions, a lot remains still to be done with both countries benefiting by forging

even closer relationships in the energy sector. With strong electricity and gas interconnections, electricity and gas trading and closer cooperation between the two energy exchanges is taking precedence.

In addition, a number of Greek companies have invested in Türkiye' dynamic renewables sector and vice versa. As both countries are pursuing policies, which favour greater penetration of RES into the electricity grid, cooperation in this field but also in energy efficiency could be mutually beneficial.

At first glance Greece and Türkiye may appear antagonistic in terms of energy infrastructure and market development. However, there exist certain areas of mutual interest where both countries can benefit from closer cooperation. One can think of certain niche areas where the two countries could develop collaborative projects. Such niche spots include cyber security for electricity and gas transmission, electricity and gas trading through the existing platforms of EPIAs and ENEX and joint the development of some mega RES projects.

Overall, there appear to be good prospects and opportunities for further cooperation between Greece and Türkiye in the broad energy sector. In this Background Paper we only touched upon the surface of the energy landscape and a lot more work needs to be done towards this promising direction.

References

1. IENE (2022), "SE Europe Energy Outlook 2021/2022", https://www.iene.eu/en/congress/47/iene-study-see-energy-outlook-2021-2022
2. IEA (2023), "Greece 2023 Energy Policy Review", https://iea.blob.core.windows.net/assets/5dc74a29-c4cb-4cde-97e0-9e218c58c6fd/Greece2023.pdf
3. OT (2023), "Second Grid-Connecting Greece-Turkey Power Line Eyed for 2029", https://www.ot.gr/2023/12/09/english-edition/second-grid-connecting-greece-turkey-power-line-eyed-for-2029/
4. International Trade Administration (2024), "Electric Power – Renewables, Smart Grid, Energy Storage, Civil Nuclear", https://www.trade.gov/country-commercial-guides/turkey-electric-power-renewables-smart-grid-energy-storage-civil-nuclear
5. IEA (2021), "Turkey 2021 Energy Policy Review", https://iea.blob.core.windows.net/assets/cc499a7b-b72a-466c-88de-d792a9daff44/Turkey_2021_Energy_Policy_Review.pdf
6. Todorović, I. (2024), "Renewables had 99.5% share in new capacity in 2023 in Turkey", https://balkangreenenergynews.com/renewables-had-99-5-share-in-new-capacity-in-2023-in-turkey/