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"New challenges for the European energy security.

The new energy routes from South to North"

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**"Νέες προκλήσεις για την ευρωπαϊκή ενεργειακή
ασφάλεια. Οι νέες ενεργειακές οδεύσεις από τον Νότο
στον Βορρά"**

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Κόρινθος, Νοέμβριος 2023

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The author is the only responsible for the opinions that are expressed and the supervisor, the examiners, the department and the University of Peloponnese do not adopt the opinions expressed neither are they responsible for any mistakes or omissions".

Georgios Sakoufakis

DEDICATION

I dedicate my dissertation work to my mother.

Αφιερώνω την παρούσα εργασία στη μητέρα μου.

ACKNOWLEDGEMENTS

"I would like to thank Dr. Marika Karagianni for her constant support and advice throughout the writing of my dissertation.

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"...Τουλάχιστον στην θάλασσά μας πλέουμε
νερά της Κύπρου, της Συρίας, και της Αιγύπτου,
αγαπημένα των πατρίδων μας νερά...."

Κωνσταντίνος Π. Καβάφης, Επάνοδος από την Ελλάδα

ABSTRACT

This paper refers to the new EU energy planning that is being pursued with the aim of energy transition towards climate neutrality, decoupling from Russian energy and achieving energy security.

It focuses mainly on the new South-North energy routes that are being shaped to achieve these objectives, focusing on South-Eastern Europe and the Eastern Mediterranean.

The chapters describe the institutional framework and the new policies and instruments that the EU has put in place for this purpose. The pipelines that transport gas from South to North and contribute to the decoupling from Russian gas are examined, and the LNG infrastructure system in the Mediterranean is presented.

It also describes the interconnections and power cables that will carry electricity from the Mediterranean south to central Europe, and the emerging infrastructure landscape for the production and transport of hydrogen, which is seen as the key fuel of the future for industry and transport in the EU.

The conclusions underline the importance of the new planning and the future critical role of the regions of South-Eastern Europe, Eastern Mediterranean and North Africa for Europe's energy sufficiency and security.

ΠΕΡΙΛΗΨΗ

Η παρούσα εργασία αναφέρεται στο νέο ενεργειακό σχεδιασμό της ΕΕ που ακολουθείται με στόχο την ενεργειακή μετάβαση προς την κλιματική ουδετερότητα, την απεξάρτηση από τη ρωσική ενέργεια και την επίτευξη ενεργειακής ασφάλειας.

Εστιάζει κυρίως στις νέες ενεργειακές οδούς με κατεύθυνση από Νότο προς Βορρά που διαμορφώνονται για την επίτευξη των στόχων αυτών, με ιδιαίτερη έμφαση στη ΝΑ Ευρώπη και Ανατολική Μεσόγειο.

Στα επιμέρους κεφάλαια περιγράφεται το θεσμικό πλαίσιο και οι νέες πολιτικές και τα μέσα που η ΕΕ έχει θεσπίσει για το σκοπό αυτό. Εξετάζονται οι αγωγοί που διακινούν φυσικό αέριο από Νότο προς Βορρά και συντελούν στην απεξάρτηση από το ρωσικό φυσικό αέριο, ενώ παρουσιάζεται το σύστημα υποδομών υδροποιημένου φυσικού αερίου στη Μεσόγειο.

Επίσης, περιγράφονται οι διασυνδέσεις και τα ηλεκτρικά καλώδια που θα μεταφέρουν ηλεκτρικό ρεύμα από τον μεσογειακό νότο προς την κεντρική Ευρώπη, καθώς και το υπό διαμόρφωση τοπικό υποδομών παραγωγής και μεταφοράς υδρογόνου, το οποίο θεωρείται ως το βασικό καύσιμο του μέλλοντος για τη βιομηχανία και τις μεταφορές στην ΕΕ.

Στα συμπεράσματα τονίζεται η σημασία του νέου σχεδιασμού και ο μελλοντικός κρίσιμος ρόλος των περιοχών της ΝΑ Ευρώπης, της Ανατολικής Μεσογείου και της Βορείου Αφρικής για την ενεργειακή επάρκεια και ασφάλεια της Ευρώπης.

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FOREWORD

Post-war Europe has been energy-dependent on the major energy-producing states of its immediate and wider neighborhood. Its main suppliers were for decades, oil-producing states of the Middle East and Russia.

The "Old Continent", poor in energy resources, relied on imports of low-priced oil and natural gas necessary for the development of its industry and for covering heating and other needs of its population. Since the 1990s, the import of energy products and mainly natural gas from Russia has become increasingly essential for the European economy.

Russia provided cheap and abundant natural gas to Europe and gradually became Europe's main supplier. Initially, a mutually beneficial relationship was formed as Europe managed, due to cheap energy, to maintain the competitiveness of its industry, with Germany being the main beneficiary. On the other hand, Russia based its economy on the exports of energy products, with Europe as its main customer. (Turksen, 2018, p.76)

This energy relationship with Russia continued despite the gradually stronger criticism of Europe's monopoly dependence: over the years an increasingly complex supply network was formed with a series of pipelines that transported natural gas to Europe. In other words, the supply of Europe was formed from East to West and then in a direction from North to South.

The deterioration of Russia-West relations due to political developments and especially since 2014 with the Russian annexation of Crimea, led to the re-estimation of this relation and gradual planning of de-dependence from Russian energy. At the same time, the increasingly obvious impact of climate change has led to the planning of weaning off hydrocarbons and the development of renewable energy sources, which cover an increasing percentage of the energy mix of the EU member states. The EU's basic policy was formulated with the "Green Deal Europe" with the goal of "zero CO2 emissions in 2050".

However, the key milestone in the reorientation of Europe's energy map and the radical reshaping of energy policy was the war in Ukraine that started on 24.2.2022.

This shift is founded with the important Repower EU project, which radically transforms energy policy, aiming to achieve a new orientation, new interconnections between member states, self-sufficiency and sustainability of energy supply.

In recent years, Greece has emphasized the enrichment of its energy mix, the achievement of a large penetration of RES in the energy mix, as well as its inclusion in the natural gas pipeline networks and the electricity networks. The rapid transformation of the energy landscape in Europe gives our country a new, weighty role in it: Greece is thus becoming an energy hub both in the East Mediterranean as well as in the North- South axis. In the near future, natural gas pipeline interconnections, electricity cables and future hydrogen pipeline interconnections coupled with investments in RES are of essence in this respect.

This paper examines the transformation of the energy landscape in Europe especially after the war in Ukraine, the new policies being formed, the new routes, the competitions, the dynamic entry of new energy producing countries and the role of our country in the "brave new world" of the European Continent.

CHAPTER 1. MAIN EUROPEAN POLICIES FOR ENERGY INDEPENDENCE AND TRANSITIONS

The redesign of the European Union's energy landscape and the search for new sources of energy, as well as new routes and connections, is based on its new policies, the main ones being the following:

1.1 "The European Green Deal"

The European Parliament in November of 2019 declared climate emergency and called on the European Commission to adopt policies and secure resources to limit climate warming to under 1.5°C. This action was followed by a set of proposals as a plan to respond to the ongoing climate crisis: The "European Green Deal", a roadmap for Europe becoming a climate-neutral continent by 2050. It includes coordination of the policies on climate and energy using a package of financial and fiscal measures to achieve a reduction in net greenhouse gas emissions of at least 55% by 2030, compared to 1990 levels. Through the "Green Deal", the EU moves closer to its climate neutrality by 2050 and confirms its commitment to be a leader in the global fight for tackling climate change. This policy is in accordance with the "17 Sustainable Development Goals of the Agenda 2030" of the UN, providing a roadmap for actions that will reduce emissions and build climate resilience and more specifically, with Goal 7 "To ensure access to affordable, reliable, sustainable and modern energy for all". (Tanil, 2023, p.38)

The new legislation, under the name "Fit for 55" in 2021, includes 13 interlinked revised laws and six proposed climate and energy laws. The European Parliament adopted the "EU Climate Law" on 24 June 2021, which makes the above-mentioned targets legally binding.

The estimated results will be reduced emissions, the protection of water and soil, reduced energy bills, energy-sufficient buildings, better public transport and more charging stations for e-cars, less waste, healthier food and better health, creation of new jobs in renewable energy.

The key elements of the program are as follows:

Renewable Energy, Energy Efficiency, the review of the EU Emissions Trading Scheme, the review of the "Market Stability Reserve", a carbon leakage instrument imposing a carbon price on imported products from carbon-intensive industries, the implementation of a "Social Climate Fund", the "EU Circular Economy Action Plan", a sustainable food system, and the conservation of biodiversity Environmental Regulation, and the Green Finance. Environmental regulation, green finance:

For the financing of “the Green Deal”, the Commission presented the "Sustainable Europe Investment Plan", in 2020, (at least €1 trillion worth of public and private investment over the next decade). (https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en)

1.2 REPowerEU

As a reaction to the Russian war on Ukraine, and to the turbulence and disruptions in the global energy supply chain and in particular the supply of fossil fuels to European countries, the European Union, announced the REPowerEU program in May 2022. The program signifies the decision of the EU to wean itself off Russian energy. Perhaps the key parameter of the REPowerEU plan is to accelerate the path towards the transition to a greener economy and create an accumulation of investments in renewable energy. (Tanil, 2023, p.135)

The REPowerEU is aiming at making EU energy independent and self-sufficient through diversification of energy sources, production of renewable energy, and energy saving. Through this program EU "protect its citizens and businesses from potential energy shortages, supports Ukraine by depleting Russia from income, and accelerates the transition to clean energy".

The main actions of the program are the diversification of the energy supplies, the finding of affordable energy supplies, the energy saving and the investments in renewable energy sources. ("https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/repowereu-affordable-secure-and-sustainable-energy-europe_en")

Diversification of the energy supplies is being achieved by agreements with other countries than Russia for natural gas supplies (e.g. Azerbaijan), common purchases of Liquefied Natural Gas (LNG), strategic partnerships with third countries for supply of renewable hydrogen (e.g. with Namibia, Egypt and Kazakhstan), and agreements with Egypt and Israel for the export of natural gas to Europe. It is indicative that in August 2021 Russian natural gas accounted for 41% of EU imports while in September 2022, it represented only 8% of all natural gas imports. A main instrument of the “REPowerEU Plan” is the **“EU Energy Purchase Platform”** renamed as *“AggregateEU Mechanism”*, is the in dealing with the issue of *“diversification of gas supplies”*.

Securing affordable energy supplies. The Commission launched the EU Energy Platform in April 2022 aiming at coordinating EU policies of securing energy imports in the global market. Its objectives are the aggregation and joint purchasing of gas, the most efficient use of existing infrastructure and the international outreach. The target set for the fullness of natural gas storage facilities was set at 90% of capacity by November 1. The effectiveness of the action is already evident as for 2023 the EU already reached the 90% target in mid-August.

Saving energy. As a first step, Member States have agreed to the Commission's proposals for a voluntary reduction in gas use during the winter of 2022-2023. There is also a gas price intervention mechanism, namely a price cap for gas transactions to be applied in cases where prices reach excessive levels. (valid until February 2024). ("https://ec.europa.eu/commission/presscorner/detail/en/ip_22_7065").

Investing in renewables. The REPowerEU plan promotes the transition to green energy and investments in all renewable energy sources with the aim of maximizing their participation in the energy mix.

The EU's binding target for 2030 is for its renewable energy capacity to reach 42.5% of the energy mix and with an optimistic estimate to reach 45%. Achieving this target would be equivalent to roughly doubling the current share of renewables (41 GW new solar energy capacity, 16 GW wind capacity). The plan requires many reforms a huge amount of investment and in the energy market, approximately €300 billion namely €72 billion in grants and €225 billion in loans. The basic steps are national

REPowerEU plans, investments in energy infrastructure and interconnections and emphasis in hydrogen production. ("https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/repower-eu-affordable-secure-and-sustainable-energy-europe_en")

1.3 “Projects Of Common Interest” And “Projects Of Mutual Interest” /PCIS - PMIs

Another key program concerning Europe's energy planning is the "**Projects of Common Interest (PCIs)**", which finance key energy infrastructure and interconnection projects which link, homogenise and integrate the European energy systems, namely the Trans-European Energy Networks. They contribute to the achievement of the EU's energy and climate objectives, as well as to the EU's energy security, they provide funding and mainly concern renewable energy and decarbonisation projects in line with the Paris Agreement. They also include and finance projects connecting two or more European countries with some neighboring countries. ("https://energy.ec.europa.eu/topics/infrastructure/projects-common-interest_en")

The main regulation governing their operation is Regulation (EU) 869/2022, which revised Regulation (EU) 347/2013 and sets out guidelines for the establishment, development and operation of trans-European energy networks. These networks run through all the Member States of the European Union and connect the EU with one or more third countries and concern electricity, natural gas, oil and carbon dioxide. **With the Regulation (EU) 869/2022, the term Projects of Mutual Interest is introduced, which refers to "infrastructure projects linking the Union's networks with third-country networks that are mutually beneficial and necessary for the energy transition and the achievement of the climate targets".** ("<https://eur-lex.europa.eu/eli/reg/2022/869/oj>").

According to article 3 paragraph 4 of the regulation, every two years the European Commission publishes a list of the projects included in the EU PCIs. So far 5 PCI lists have been drawn up and the 6th list is expected to be published before the end of the year.

In order to be eligible, a project must enhance competition in the energy market of the European Union, and contribute substantially to the strengthening of Europe's energy security mainly through the increase of suppliers and, by extension, the diversification of energy sources. It should also contribute to the EU's energy and climate objectives by integrating renewable energy sources. During the application, selection and approval process, an important criterion is whether the project fits into the corridors that serve Europe's energy interconnection, as defined by the **Trans-European Energy Networks policy**. The body responsible for assessing each project proposal for inclusion in the PCI list is the "Agency for the Cooperation of Energy Regulators (ACER)" which assesses the compliance of electricity and gas projects with the PCI criteria. (<https://www.rae.gr/en/natural-gas/infrastructure/pci/>).

Our country has managed to integrate into PCIs lists, a series of projects which strengthen its role as an energy producer, transit hub and supplier of the European energy market.

The fifth list of "Projects Of Common Interest" of November 2021 includes the following projects of Greek interest (The numbers correspond to the numbering of the PCI list):

3. "Priority Corridor North-South Electricity Interconnections in Central Eastern and South Europe" ("NSI East Electricity")

3.10 "Cluster Israel – Cyprus – Greece" (currently known as "EUROASIA Interconnector"), including the following PCIs: 3.10.1 Interconnection between Hadera (IL) and Kofinou (CY), 3.10.2 Interconnection between Kofinou (CY) and Korakia, Crete (EL)

3.24 "Hydro-pumped electricity storage in Amfilochia" (EL)

6. "Priority Corridor North-South Gas Interconnections in Central Eastern and South Eastern Europe" ("NSI East Gas")

6.8 "Cluster of infrastructure development and enhancement enabling the Balkan Gas Hub", including the following PCI: 6.8.1 Interconnection Greece – Bulgaria [currently known as "IGB"] between Komotini (EL) and Stara Zagora (BG) and

compressor station at Kipi (EL), 6.20 Cluster increase storage capacity in South-Eastern Europe, including one or more of the following PCI: 6.20.3 South Kavala UGS facility and metering and regulating station (EL)

7. “Priority Corridor Southern Gas Corridor” (“SGC”)

7.3.1 “Pipeline from the East Mediterranean gas reserves to Greece mainland via Cyprus and Crete” (currently known as “EastMed Pipeline”), with metering and regulating station at Megalopoli and dependent on it the following PCI: 7.3.3 Offshore gas pipeline connecting Greece and Italy (currently known as “Poseidon Pipeline”) (["https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32022R0564"](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32022R0564))

Regarding the 6th list of PCIs - PMIs we mention the following:

At the meeting of 26.10.2023 the High Level Decision-Making Body for the next, 6th, List of Projects of Common Interest and Projects of Mutual Interest PCI/PMI, approved the Draft List proposed by the European Commission.

Regarding projects of Greek interest, the following projects are included in the list:

- PCI projects

- a. Electrical Interconnection of Greece - Cyprus - Israel EuroAsia Interconnector (IPTO/ADMIE)
- b. Pumped storage hydropower plant Amfilochia (Terna Energy)
- c. Ptolemaida Battery Energy Storage System (EUNICE ENERGY GROUP)
- d. Greece-Bulgaria Hydrogen Interconnection (DESFA)
- e. Prinos carbon storage reservoir offshore Kavala. (ENERGEAN PLC)
- f. East Med natural gas pipeline (IGI POSEIDON) – by way of exception under Article 24 of the Regulation 869/2022

- PMI projects

- a. Electrical Interconnection of Greece - Egypt GREGY Interconnector (ELIKA Mediterranean Interconnector)

This list will then be formally approved by the College of Commissioners and subsequently adopted as a draft Executive Decision of the European Commission. Commission, by the European Commission. Parliament and the Council, within two months of the adoption of the list (in both cases the adoption concerns the whole list and is not a matter of substance but of proportionality and subsidiarity). Then, it will be attached as an Annex (ANNEX) to Regulation 869/2022 on Trans-European Networks. The whole process is expected to be completed with the publication in the EU Official Journal, around the end of January - early February 2024. ("<https://balkangreenenergynews.com/eu-adds-greece-egypt-power-interconnection-project-to-pci-pmi-list-proposal/>")

1.4 "Trans-European Networks for Energy"/ Priority corridors

A new EU policy focusing on the interconnection of EU countries' energy infrastructures is the Trans-European Energy Networks (TEN-E). Within this policy, eleven main pillars and three priority thematic areas have been defined.

The eleven priority corridors cover the sectors of electricity, offshore grid and hydrocarbon infrastructure in different regions of the EU with the aim of strengthening cross-border interconnections and will contribute to the integration of renewable energy production. They are divided into electricity corridors, Offshore grid corridors and Hydrogen and electrolyzers corridors. The following corridors are of interest to our country:

“North-south electricity interconnections in central eastern and south eastern Europe” (NSI East Electricity): North-South and East-West interconnections to complete the EU internal market and integrate renewable energy sources.

“South and East offshore grids” (SE offshore): Development of offshore electricity networks, integrated offshore electricity and, related interconnections in the Mediterranean Sea, Black Sea and neighboring waters.

“Hydrogen interconnections in Central Eastern and South Eastern Europe” (HI East): Hydrogen infrastructure and natural gas infrastructure compatibility, for a future hydrogen traffic. Interconnection of the countries of the Central and South Eastern Europe and creation of a hydrogen transport network throughout the Union. It includes Bulgaria, Czech Republic, Germany, Austria, Poland, Hungary, Slovakia, Croatia, Slovenia, Romania, Italy, Greece and Cyprus. (["https://energy.ec.europa.eu/topics/infrastructure/trans-european-networks-energy_en"](https://energy.ec.europa.eu/topics/infrastructure/trans-european-networks-energy_en))

The European energy policies mentioned above and accelerated by the war of Russia against Ukraine, resulted in the re-engineering of energy routes or the acceleration of the creation of pipelines and networks that will ensure the diversification of supply, the non-dependence of the EU on one energy provider or monopolistic situations and the supply of green energy. The area of SE Europe and the SE Mediterranean are becoming more and more important for the supply and routes of all forms of energy. Current and planned natural gas, electricity and hydrogen routes originating or passing through these regions and ending up in EU supply are examined below.

CHAPTER 2. NATURAL GAS PIPELINES FROM SOUTH TO NORTH

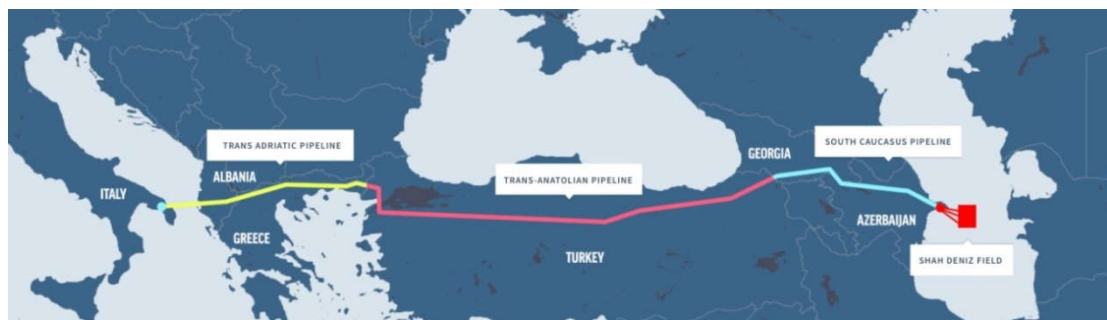
Map 2.1 Natural Gas Pipelines in SE Mediterranean



Source: IENE

2.1 Southern Gas Corridor – SGC

- Map 2.2 "Southern Gas Corridor - SGC"



Source: <https://www.sgc.az/en>

The “Southern Gas Corridor”, which carry from the beginning of 2021 natural gas from the Shah Deniz 2 field in Azerbaijan and, via Georgia, Turkey, Greece, Albania, ends up in South Italy and, from there, in other European markets. SGC was founded on 31 March 2014 by the State of Azerbaijan (51%) and the State Oil Company of Azerbaijan - SOCAR (49%). ("<https://www.sgc.az/en>")

The “Southern Natural Gas Corridor” consists of the following four projects: i) Shah Deniz gas field, ii) “South Caucasus Pipeline – SCP” and its extension, iii) “Trans-Anatolian Natural Gas Pipeline –TANAP” and iv) “Trans Adriatic Pipeline - TAP”. Upon completion of the expansion (SD2 project), it will be able to provide additional 16 bcm of natural gas production capacity to the 11 bcma of production capacity already in place. The total length of the pipelines is over 3,200 kilometers. The project aims to diversify Europe's supply sources and increase the available quantities of natural gas from the Caspian Sea and, consequently, achieve its ambitious energy and climate goals. (Stergiou, Karagianni, 2019 and Karagianni 2022).

2.2 Trans-Adriatic Pipeline of Natural Gas – TAP

Map 2.3 "Trans-Adriatic Pipeline (TAP)"



Source: "<https://www.tap-ag.com/about-tap/the-big-picture>"

The “Trans-Adriatic Pipeline (TAP)” is a major natural gas pipeline project that is part of the “Southern Gas Corridor”. TAP runs across Greece and Albania before reaching its endpoint in southern Italy, traveling a distance of approximately 878 kilometers. has the capacity to transport around 10 billion cubic meters (bcm) of natural gas annually. Through Italy, the natural gas supplied by TAP is channeled to other European markets. Together, “TANAP”, “South Caucasus Pipeline (SCP)” and TAP pipelines create a direct route for natural gas from the Caspian region to European consumers. It plays a vital role in bringing Caspian gas to European markets and contributes to the broader goal of reducing Europe's reliance on gas

imports from Russia. For Greece, the transfer of natural gas from the Caspian to Europe via TAP, is considered a factor of strategic significance for energy security in the region, as it feeds the developing markets of SE Europe with two-way flow vertical interconnectors. (www.tap-ag.com).

Greece supports the integration and complementarity of the energy infrastructures in SE Europe. In this context, the various systems of natural gas pipelines and LNG stations can work complementary to each other for the supply of south-eastern and central Europe and the energy autonomy of the region.

The following projects are essential for the operation of the TAP, as well as for the under creation "Vertical corridor". (see below).

2.3 Natural Gas Interconnector of Greece – Bulgaria (IGB)

The IGB was launched in 2022 and connects the natural gas systems of Greece and Bulgaria (Komotini - Stara Zagora). It has a total length of approximately 182 km, of which 31 km within Greek territory and the possibility of reverse flow, while it is a key project for the utilisation of the "Vertical Natural Gas Corridor" (Greece, Bulgaria, Romania, Hungary, Ukraine and Moldova). Its importance is pivotal for the independence from Russian energy resources, while it works in competition with Turkstream 2, as it is expected to supply Serbia, through the under construction Interconnector pipeline Bulgaria - Serbia (IBS, capacity 1.8 bcm/a) whose completion is estimated in October 2023. ("<https://www.icgb.eu/about/igb-project/>").

2.4 Natural Gas Interconnector Greece - North Macedonia

It will connect the natural gas systems of Greece (Nea Mesimvria) Thessaloniki with North Macedonia (N/Egotian) and will contribute to the weaning off of Russian natural gas, providing access to North Macedonia to sources such as the Caspian natural gas through the TAP pipeline. Its completion expected in 2025. On 4.7.2023, it was announced that DESFA (National Natural Gas System Operator) took over the management of the project for the section of the Greece-North Macedonia pipeline that will run through the neighboring country by winning the relevant tender announced by the state-owned company of North Macedonia "Nomagas". This practically means that DESFA will supervise the construction of the entire

infrastructure as it is responsible for the development of its domestic leg. On 30.8.2023 DESFA proceeded to announce the Greek section of the project, with an estimated value of 32.53m Euros. The construction will last 18 months and work is expected to start in early 2024.

2.5 Ionic Adriatic Pipeline -IAP

Map 2.4 Ionic Adriatic Pipeline -IAP



Source: "<https://socar.az/en/page/southern-gas-corridor>"

The IAP project aims to connect the transmission system of natural gas of Croatia through Montenegro and the Republic of Albania with the TAP (Trans Adriatic Pipeline) natural gas transmission system. The total length of the natural gas pipeline is 511 km (from Split to Fieri), and its total capacity is 5 bcm/a. With the IAP, a new energy corridor will be created for the Western Balkans region, which in essence will be the fourth leg of the “Southern Natural Gas Corridor (SGC)”, with the aim of creating a new natural gas supply route to Central and Eastern Europe from the Caspian region. It is currently in the Feasibility Study phase, and is scheduled to be operational in 2025/2026. In August 2016, an MoU on cooperation and implementation of the IAP was signed in Dubrovnik between Albania, Croatia, Montenegro and Bosnia and Herzegovina. It should be highlighted that this pipeline project is still in the negotiation phase, as there is no FID (Final Investment Decision)

issued nor additional gas contracts have been signed with the respective Western Balkan countries. ("<https://projects.3seas.eu/projects/iap-ionic-adriatic-pipeline>")

2.6 Vertical Gas Corridor

Map 2.5 Vertical Gas Corridor Countries



Source: <https://www.desfa.gr>

On December 1, 2022, a "Memorandum of Understanding (MoU) for the implementation of the Vertical Corridor" was signed in Athens within the framework of the 22nd World LNG Forum, from the companies DESFA (Greece), Bulgartransgaz (Bulgaria), Transgaz (Romania), FGSZ (Hungary), ICGB (joint venture IGB management company) and Gastrade (Private company, Greece), confirming their commitment for the transmission of natural gas in the transit countries and in the EU market from Greece through Bulgaria, to Romania and Hungary and vice versa by building the necessary infrastructure (new pipelines, interconnections or strengthening of existing networks). National gas operators and companies also agreed to explore, where appropriate and relevant, all possibilities for cooperation and guidance from the European Commission.

The basis for the above agreement on the Vertical Corridor is based on the earlier Memorandum of Understanding/Joint Declaration signed by the Energy Ministers of

Greece, Bulgaria, Romania and Hungary for the development of the "Vertical Gas Corridor" at the CESEC meeting held in Budapest on 8 September 2016.

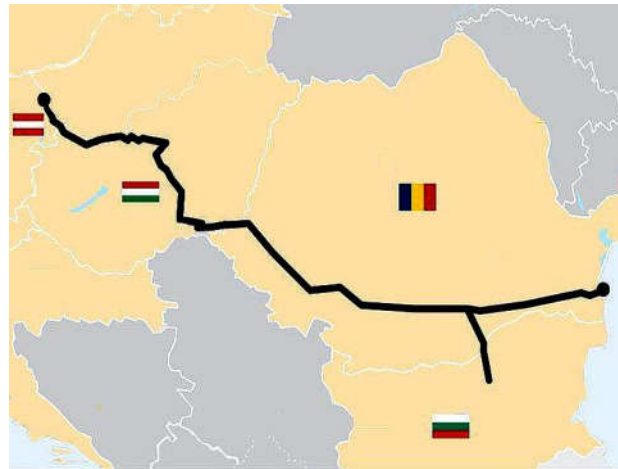
On 10/9/2023 a working meeting for the Vertical Natural Gas Corridor took place in Thessaloniki, organized by DESFA with the participation of the companies that manage the natural gas and LNG transmission systems in Greece, Bulgaria, Romania, Hungary and Slovakia and EUSTREAM as an observer.

During the meeting, participants recognized the importance of implementing targeted projects and strengthening the interconnection between the systems of the countries in question, allowing two-way gas flows from the South to the North and vice versa, and further ensuring energy security and diversification of Europe's sources of supply. The representatives of the companies presented their planned investments in the systems they manage, aiming to increase the natural gas transport capacity of the Vertical Corridor. At the same time, they presented the results of the non-binding market tests they have carried out, as well as the initial estimates for the future capacity demand at the interconnection points of their systems. These are essential steps in the process of increasing the transmission capacity of the national systems of the participating countries, in accordance with what is foreseen by the EU regulations.

The full activation of the "Vertical Corridor" will significantly upgrade the role of the countries participating in it, for the security of supply of the EU energy market, allowing access to diversified sources of supply through European natural gas and LNG transmission systems. According to its planning, the Vertical Corridor will be able to supply Moldova and Ukraine through existing or future connections. Furthermore, LNG terminals and FSRUs will become integral parts of the Vertical Corridor as, for instance, the Alexandroupolis FSRU will supply gas the whole system of interconnectors in South Eastern and Central Europe in the future. The planned infrastructures are designed so that in the future it is possible to trade for renewable gases and hydrogen (Hydrogen Ready). ("<https://www.desfa.gr/en/press-center/press-releases/memorandum-of-understanding-between-gas-systems-operators-from-bulgaria-greece-romania-and-hungary-for-the-development-of-the-vertical-corridor>").

2.7 The BRUA gas corridor

Map 2.6 The BRUA gas corridor



Source: www.romaniajournal.ro/

The BRUA gas corridor, (Bulgaria-Romania-Hungary-Austria), is a natural gas infrastructure project designed to enhance energy security, diversify gas supply sources, and improve gas transmission capabilities in Southeastern and Central Europe. The project primarily involves the construction of gas pipelines and associated infrastructure to connect the gas networks of several European countries with bidirectional gas transmission. It will link the gas transmission systems of Bulgaria, Romania, Hungary, and Austria, allowing for more efficient gas flows and enhancing market access. Its aim is to enable the transfer of natural gas from various sources, such as the Caspian region and the Black Sea, to Central Europe. The BRUA Corridor is considered a key element in facilitating the transportation of natural gas from the "Southern Natural Gas Corridor", which includes pipelines such as the "Trans-Adriatic Pipeline (TAP)". Diversification enhances energy security and reduces critical dependence on a single natural gas supplier, such as Russia. The BRUA project is being implemented in 3 phases, with each phase focusing on specific pipeline segments and connections. (<https://www.hydrocarbons-technology.com/projects/transgaz-brua-gas-interconnection-project/>)

2.8 Eastern Mediterranean pipeline (EastMed)

Map 2.7 EastMed pipeline



<https://twitter.com/EEmerison14/status/1514312406394097685/photo/1>

The “Eastern Mediterranean pipeline (EastMed)” project concerns the proposal for the construction of a natural gas pipeline that starts from the deposits of Cyprus and Israel in the Eastern Mediterranean, and, with subsea and land sections, channels the natural gas through Crete and mainland Greece to Italy and the European markets.

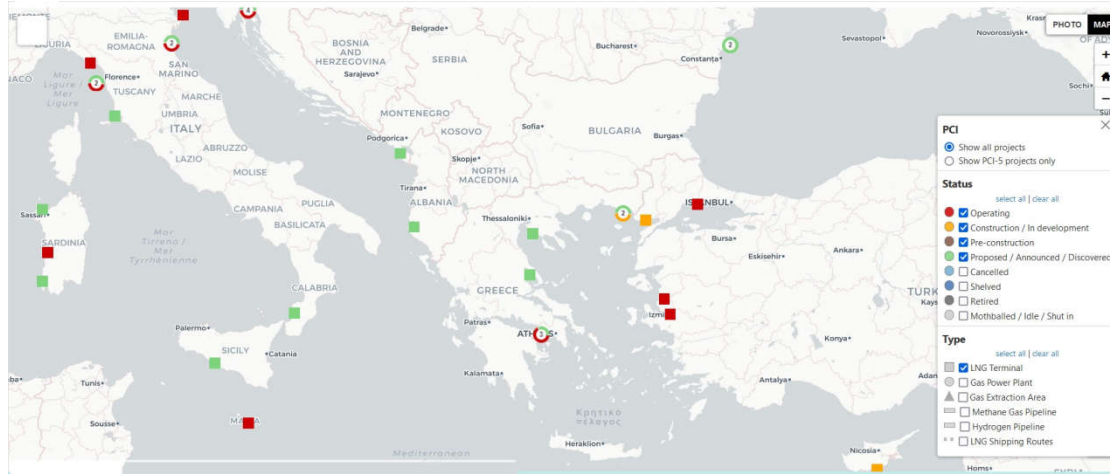
The project consists of an approximately 1,900 km long pipeline with offshore and onshore sections, which will transport Eastern Mediterranean resources directly through Cyprus and Crete and mainland Greece and then, through an interconnection with the offshore Poseidon pipeline, to Italy and European markets. The plan for the creation of this pipeline has the same objectives as all gas interconnection and transmission projects, namely the diversification of Europe's natural gas supply sources, increasing energy security and reducing dependence on natural gas imports from Russia. It will also contribute to European security of gas supply and end the isolation of Cyprus and Crete from European gas markets. There will also be the possibility of a reverse flow between Cyprus and the EU gas network via Greece. The main source of gas for the EastMed pipeline is the large Leviathan gas field, located in Israel's exclusive economic zone in the Mediterranean. The pipeline can also be connected to potential gas sources around Cyprus.

The EastMed project is recognised by the Greek Parliament as a project of national importance and public interest. The project managed to be included in the 5th list of "projects of common interest (PCI)", initially for the section connecting Greece and Italy, namely the Poseidon interconnector.

Nevertheless, the EastMed pipeline faces technical, geopolitical, and economic challenges, including the depth of the pipeline's route, high costs, competing energy interests, and the potential environmental impact. These challenges have led to debates and uncertainties about the project's feasibility. In general, the project, although important politically, is not considered economically viable. The uncertainty for its implementation is also based on the fact that Israel has not made a final decision on the route of its exports to Europe, on the setbacks of the Italian side and, most importantly, on the fact that the US does not support the project. However, it continues to concern the countries involved, Greece, Cyprus and Israel, while recent developments in the Middle East may give impetus to the project due to its geopolitical importance. ("<https://depa-int.gr/en/interconnector-pipeline-eastmed/>")

CHAPTER 3. LIQUEFIED NATURAL GAS TERMINALS

Map 3.1 LNG Infrastructure in East Mediterranean



Source: "<https://globalenergymonitor.org/projects/europe-gas-tracker/tracker-map/>"

The dilemmas posed by the need to wean Europe off Russian energy were mainly addressed by leveraging LNG / LNG facilities as both governments and the EU turned to offshore suppliers.

The price difference between LNG and pipeline gas, as well as the fact that LNG supplies are tied to long-term contracts, has meant that regasification capacity in Europe has been under-utilised. (Mete, 2020, p. 61). This situation changed dramatically after the Russian invasion of Ukraine and LNG became Europe's main gas supply. The infrastructures of LNG terminals were fully exploited and at a frenetic pace most countries moved towards the solution of the floating storage and regasification units/ FSRUs.

Contracts with countries such as the USA, Norway, Qatar, Egypt and Israel as well as with African countries multiplied reaching 100 within a year. Other countries with available gas export facilities, are Nigeria, Cameroon, Angola, Equatorial Guinea or the DRC Great potential producers are Senegal and Mauritania Tanzania, South Africa and Mozambique. (Kardaś, 2023, p. 2)

These infrastructures offer flexibility, easier supply from multiple suppliers, avoidance of dependencies such as pipelines, as well as serving landlocked countries.

The EU's strategy is to contribute to the best possible interconnectivity of its member states and its neighbors through the creation of interconnection pipelines between its member states. Some LNG regasification units have been included in the "projects of common interest" under the "Trans-European Energy Infrastructure Guidelines Regulation".

A particularly important role for the region of SE Europe was played by the Revythoussa project which covered to a very large extent the needs of our country as well as of Bulgaria. In fact, through the interconnections of the grids through IG, Greece contributed to the lifting of the energy isolation of Moldova. The port of Krk in Croatia acquired similar importance and of course the LNG terminals of Italy, France, Spain and Portugal, and Malta. It is noted here that Cyprus has under construction an LNG terminal in Vassiliko. ("https://energy.ec.europa.eu/topics/energy-security/diversification-gas-supply-sources-and-routes_en").

3.1 Cooperation between EU, Egypt and Israel

On 15 June 2022, the EU, Egypt, and Israel signed a memorandum of understanding on cooperation related to trade, transport, and export of natural gas to the European Union by exploiting Egypt's natural gas infrastructure. The Memorandum aims to develop energy ties with Israel, which will become an important partner and supplier of natural gas to Europe, contributing to Europe's decoupling from Russian gas.

The Israeli gas will be transported by pipeline to the LNG terminal of Idku in Egypt and will then be transported by tankers to European LNG terminals. The agreement is indicative of deepening cooperation between Israel and Egypt in the energy sector. The agreement also envisages that Europe will take an active role in the field of exploration and exploitation of the untapped gas reserves belonging to the two countries by encouraging European companies to participate in exploration tenders in Israel and Egypt.

The agreement which was signed during a visit to Cairo by European Commission President Ursula von der Leyen recognises that "natural gas will have a central role in the EU's energy market until 2030". The year 2030 is the time limit after which the

use of natural gas in the EU will be continuously reduced in implementation of the European policy for climate neutrality until 2050. In this perspective, the Memorandum of Understanding will have an initial effect for a period of three years while it will be automatically renewed for another two consecutive three-year periods. ("https://energy.ec.europa.eu/publications/eu-egypt-israel-memorandum-understanding_en")

The main provisions of the Memorandum are the assistance for the development of the oil and gas sector, continued support for the necessary reforms in the electricity sector and support for Egypt's goal of becoming an energy hub in the Mediterranean.

Egypt is also in talks with Israel to boost Israeli natural gas flows. Much of this Israeli gas is re-exported as LNG from the ports of Damietta and Idku. These two infrastructures will be the main points of the future exports of Israel's natural gas, when these reserves become fully exploitable. For this reason, Egypt also creates more pipelines with Israel in order to cover its potential future needs. In May 2023, Israel's cabinet approved the expansion of natural gas infrastructure, a plan that includes a pipeline between Asalim and Nitsana that will increase exports to Egypt, as well as a new pipeline from Ramat Hovav and Nitsana. The project is being developed by Israel's Israel Natural Gas Lines with the support of the country's Ministry of Energy. The new pipeline will have a length of 65 km and a capacity of 6 bcm annually to Egypt. (<https://energypress.gr/news/prasino-fos-apo-israil-gia-neo-agogo-fysikoy-aerioy-pros-tin-aigypto>)

3.2 Greek Infrastructure for LNG

Greece, both due to the recent developments in the energy and geopolitical sector, as well as due to the expansion and upgrading of its infrastructure and the interconnectivity with neighboring countries, has the potential to develop into an important energy hub. The main infrastructures that strengthen this role are the following:

Revythoussa LNG Station: In 2000, the LNG terminal on the island of Revythoussa began operating as one of the then 20 existing LNG terminals in the EU and the only one in SE Europe. It played a key role during the Ukrainian crisis, especially in the

supply of fuel in Bulgaria, which was the first to "cut off" the supply of Russian natural gas.

Alexandroupolis Floating Storage and Gasification Unit (FSRU): The project concerns an offshore Floating Station for the Temporary Storage and Gasification of Liquefied Natural Gas (LNG) with a connection pipeline to the National Natural Gas System and promotion through the IGB pipeline to Romania and SE Europe. The floating unit is expected to arrive by the end of the year with the prospect of starting operations in January '24.

2nd Thrace FSRU:The creation of a second FSRU in Alexandroupoliis planned with a perspective of completion by 2025. The project will further strengthen energy security and diversification of sources and routes aiming mainly of supplying Ukraine.

Floating unit FSRU DIORYGA Gas: The floating unit is being implemented by DIORYGA Gas, a subsidiary of Motor Oil S.A., in the bay of Ag. Theodoroi in Corinth. It is included in DESFA's 10-year development plan (2021-2030) and will be connected to the "National Natural Gas System (NSGS)" via an onshore pipeline (to be built with hydrogen blending technology).

Floating unit FSRU Thessaloniki: The unit in question is being implemented by ELPEDISON in Thermaikos Gulf, off Thessaloniki and is expected to be operational within 2025.

Floating unit FSRU ARGO:The unit in question was designed by the Mediterranean Gas company to operate in Volos. On 10.2.2022 it received a license from the Energy Regulatory Authority.

3.3 East Mediterranean Gas Forum (EMGF)

It is also worth mentioning the of the International Organization "East Mediterranean Gas Forum (EMGF)" established on the initiative of Egypt. The EMGF, informally established in 2019, is considered an official Organization since March 1, 2021. The Organization is based in Cairo with Egypt, Greece, Cyprus, Israel, Italy, Jordan and Palestine as founding full members. France has applied to join the forum, and as of

9/3/2021 is the 8th member of the EMGF, while the EU, the World Bank and the USA have Observer status. (<https://emgf.org/>)

The Organization's mission is to develop the supply chain of natural gas in the Eastern Mediterranean region, strengthen the energy security of the involved countries and the wider area, contribute to the global energy transition policy, and cooperate with the private sector in attracting investment.

Its main purpose is to act as “a bridge that will bring together gas producers, consumers and transit countries, with the ultimate goal of developing a sustainable regional gas market in the Eastern Mediterranean for the benefit of the peoples of the region”. The EMGF aspires to serve in the future as a forum for all states in the region and will support the efforts of participating states, both as producers and consumers, to make the best use of the region's gas reserves and infrastructure.

Greece ratified the Statute of the EMGF with Law 4769/2021 (Government Gazette A14 – 29.01.2021) and strongly supports the strengthening of cooperation between all the countries of the Eastern Mediterranean region, as it seeks to create closer ties that will allow the countries to utilize the large energy potential of the region. (["https://ypen.gov.gr/forum-fysikou-aeriou-tis-anatolikis-mesogeiou-east-mediterranean-gas-forum-emgf/"](https://ypen.gov.gr/forum-fysikou-aeriou-tis-anatolikis-mesogeiou-east-mediterranean-gas-forum-emgf/))

CHAPTER 4. ELECTRICAL NETWORKS INTERCONNECTIONS

Another important dimension of energy security, promoted by the EU, is the interconnection of electrical networks and mainly the creation of infrastructures that will transport electricity produced from renewable sources to the countries of Southern Europe and neighboring countries in the direction of Central Europe.

The EU's electricity interconnection policy with third countries in the Southern Neighbourhood is not sufficiently advanced and, despite the favorable geography of the Mediterranean, only two electricity interconnections exist: a) The networks connecting Turkey, Bulgaria and Greece (1.9 GW) and b) the submarine cable connecting Morocco to Spain (1.4 GW). (Καραγιάννη, 2022)

In light of the ongoing war in Ukraine, a consensus has been reached among EU Member State governments on the need to develop of domestic renewable energy and interconnectivity potential in order to achieve energy security. (Dekanozishvili, 2023, p. 226).

The favorable conditions for the production of "green" energy in SE Europe, North Africa and the countries of the Caucasus, combined with the energy transition and the goal of "making Europe the first climate-neutral continent around 2050", have contributed to the creation of transmission cables energy from South to North as well as interconnection of national networks. Isolated electricity systems in the European Union such as islands can benefit from the interconnectivity of electricity grids by gaining balance and avoiding repetitive fluctuations. (Althaus, 2023, p.2)

It is worth noting that in **2022 Greece ranked 7th in the world in the utilization of RES** in its energy mix and is well on track to meet the national target of 80% electricity from RES by 2027. With 20.7% of electricity coming from wind energy and 12.6% from photovoltaics, the total contribution of RES to the energy mix in Greece amounted to 33.3%. ("<https://www.ot.gr/2023/04/12/green/energeia-i-ellada-ek-ton-igetidon-sti-dieisdysi-ton-ape-sto-energeiako-meigma/>")

Other electrical connections between Greece and Neighbouring Countries: The Greek system is connected to Albania, Bulgaria, North Macedonia, Turkey and via a submarine cable to Italy.

New connections are the new N. Santa - Maritsa (Bulgaria) line, which is a PCI project, completed in July 2023 and the under development 400kv ultra-high voltage Greece-Albania electrical interconnection, while the upgrade of the Greece-North Macedonia Line has been agreed .

<https://energyexpress.eu/ipto-seeks-green-aegean-grid-link-entry-into-entso-e-plan/>).

Some of the main projects are as follows:

4.1 The Greece Egypt - GREGY Interconnector Project

Map 4.1 GREGY Interconnector



Source: www.africanews.com

In October 2021, Greece and Egypt signed a "Memorandum of Understanding" on the connection of electricity grids between the two countries, the so called GREGY Project Interconnector. The electricity Interconnection, that will flow both ways, will be implemented by the use of Renewable Energy Sources by 2026 (**solar and wind energy**). This project will bring 3 GW from green energy (photovoltaic and wind parks) to Greece: 1 GW will be used by Greek industries, 1 GW will be exported

(mainly to Bulgaria and Italy) and 1 GW will be transformed to green hydrogen not only for our domestic use, but also for exports. The project has the support of the Greek, Egyptian, Bulgarian and USA Governments and the cables will be passing through the already set maritime zones between Greece and Egypt. GREGY is a flagship project for South East Europe and fully supports the EU's plan for the creation of green energy corridors between North and South, connecting the power systems of Europe and North Africa.

The project has recently been included as a "Project of Mutual Interest/PMI" (July 2023) of the European Commission and is awaiting approval from the European Parliament. It is noted that the Ministry of Finance of Bulgaria sent a Letter of support to the EU for inclusion in the Projects of Common/Mutual Interest (PCI/PMI) as it is expected to contribute to the increase of the cross-border transmission capacity of the electric green energy network on the Greece-Bulgaria border. The budget of the project reaches 3,5 billion euro and its length is approximately 950 km.

GREGY reduces Europe's dependence on fossil fuels and, most importantly Europe's dependence on Russian gas as it can replace 4.5 bcm of Russian natural gas per year.

GREGY project will be a pioneering project in the new energy map of Europe. It will serve energy security, grid interconnectivity, and the transition to green energy as defined in the SDGs of the Agenda 2030.

A Memorandum of Understanding has been signed in Abu Dhabi, in June 2023, between the Emirati energy operator Masdar (Abu Dhabi Future Energy Company) and the Egyptian Infinity for "the evaluation of the possibility of joint development of renewable energy projects in Egypt, which will supply green energy to the electrical interconnection "GREGY". (<https://elicagroup.gr/en/gregy/>).

4.2 EuroAsia Interconnector

Map 4.2 EuroAsia Interconnector



Source: "<https://euroasia-interconnector.com/at-glance/the-big-picture/>"

In October 2022, the works on the electricity Interconnection between Greece, Cyprus, and Israel, the so called **EuroAsia Interconnector**, were inaugurated with the presence of the EU Commissioner for Energy, Mrs Simson. This interconnection is of strategic importance because the electrical flow coming from Israel and Cyprus will reach the European markets via Greece and will lift the isolation of Cyprus and connect Israel with the European Systems.

The EuroAsia Interconnector is of critical importance, since through Greece, the energy flow will reach the European Electricity market and not only the “isolation” of Cyprus will be lifted but also Israel will be connected with the European electricity market. The “Greece-Cyprus part” of the Interconnector recently renewed its status as a PCI/PMI EU Project. It has recently renewed its position in the EU's 6th “List of Projects of Common Interest (PCI)/Projects of Mutual Interest (PMI)”. In addition recently ADMIE (Independent Electricity Transmission Operator) was declared as a 25% participant - with the possibility of expansion to 33 % - and an Israeli fund announced its participation with 33% in the share capital and in the Board of Directors of the Private Implementation Agency of the project, while the Cypriot Government is considering the possible participation of the State in the share capital. The Implementing Agency and Project Promoter of the Electricity Interconnection Project between Greece, Cyprus and Israel is the Greek Independent Power

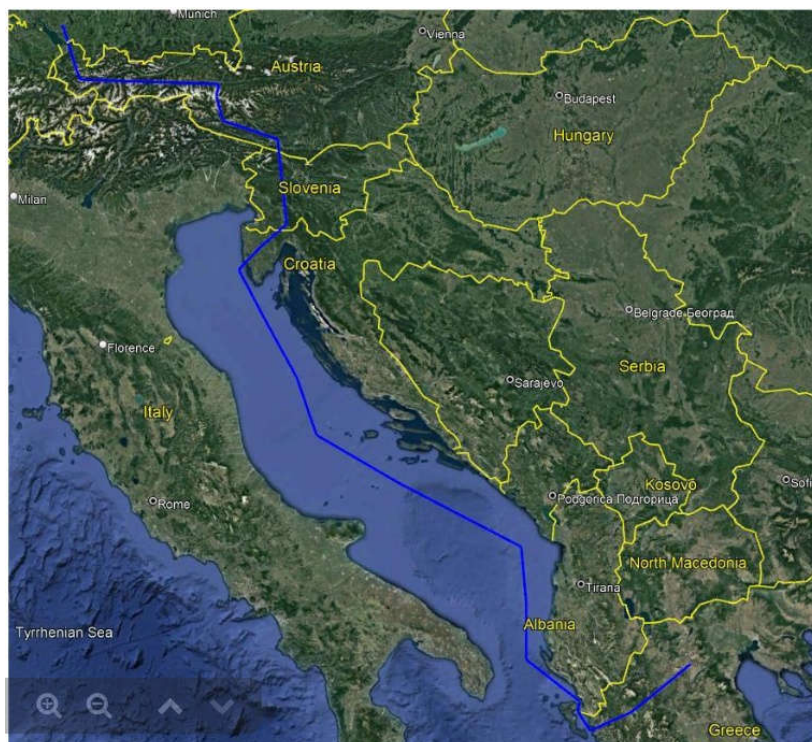
Transmission Operator S.A. - IPTO. (<https://energynews.gr/news/o-admie-neos-foreas-ylopoiisis-tis-ilektrikis-diasyndesis-elladas-kyproy-israil>).

In January 2022, the European Commission decided to finance the Greece-Cyprus section with 657 million Euros, while Israel has requested support in order to finance the Israel-Cyprus section as well. The project enjoys American support.

The project will end the energy isolation of Cyprus and Israel.

4.3 Electrical interconnection of Greece-Austria-South Germany - Green Aegean Interconnector

Map 4.3 Green Aegean Interconnector



Source: <https://www.docdroid.net/oa4CUjR/greenaegeaninterconnector-2-pdf>

Greece is promoting electrical interconnection with Austria and Southern Germany, in the context of the transition to green energy. It will transport green energy that will be produced in Greece, but it will probably channel amounts of green energy that will reach our country through the GREGY Interconnector.

The project is also combined with Greece's strategy for active participation in the implementation of energy corridors for the transfer to Europe of "green" energy from the wider Eastern Mediterranean region, a strategy that is consistent with the EU's goal of finding alternative energy suppliers.

The electrical interconnection according to the existing design will have an initial capacity of 3 gigawatts with the prospect of increasing it to 6 to 9 gigawatts at a later stage. The aim is to transfer "green" energy from the sun-rich south to the European north, with a new line approximately 1300 km long for which two alternative routes

are being considered: through the Balkans (Greece - North Macedonia - Serbia - Croatia - Slovenia - Austria - Germany) or with a submarine connection (Greece - Adriatic - Slovenia - Austria - Germany).

The National Electric Network Operator of Greece - IPTO is preparing the studies for the maturation of the project in order to be included in the ten-year plan of the "European Network of Transmission System Operators for Electricity (ENTSO-e)" and in the list of projects of common interest. The equity participation of other System Operators in the business scheme is not excluded.

The Green Aegean Interconnector project enhances the country's export potential and the use of renewable energy sources, as the energy produced that cannot be absorbed by the Greek system (e.g. during periods of intense sunshine and strong winds) will be available for export instead of being put out of the market and rejected, as is sometimes the case, for reasons of system stability.

The project is seen as vital for transferring, in central Europe, great quantities of green energy that are expected to enter Greece in the near future from the Middle East and Asia through projects such as GREGY Interconnector and the Saudi Greek Interconnection.. (<https://energypress.gr/news/i-diasyndesi-green-aegean-interconnector-kai-o-kathetos-diadromos-anabathmizoyn-rolo-tis>, <https://energypress.eu/ipto-seeks-green-aegean-grid-link-entry-into-entso-e-plan/>).

4.4 Saudi Greek Interconnection

In July 2022, a "Memorandum of Understanding" was signed in the field of Energy between Greece and Saudi Arabia. Part of this is the construction of an electrical interconnection and the realization of exports of renewable electricity from Saudi Arabia to Greece and the EU.

In the context of the aforementioned Memorandum, an agreement was signed on 27.9.2023 to set up a Special Purpose Company (SPV) between the Electricity Transmission System Operators (TSOs) of Greece (IPTO) and National Grid S.A. with the purpose of preparing a feasibility study of electrical interconnection. The team will undertake the preparation of the commercial viability studies of the interconnection. A key parameter of the viability study is the route that the new

interconnection will follow, the mapping of which will also be the subject of the special purpose company. As Saudi Arabia aims to become a green electricity exporter in the future, it is looking forward to working with Greece to get its electricity exports to Europe. (Karagianni, 2023).

The two Sides underline the strategic importance of energy for the deepening of bilateral cooperation and the promotion of regional stability, in the context of the wider rearrangements created by the new intended economic and commercial corridor India-Central East-Europe (IMEC). The issues of Hydrogen, RES, and Electrical Infrastructure were defined as priority areas of Greek-Saudi cooperation.

The route that will be followed by the Greece-S.Arabia interconnection depends on the geopolitical parameters: the route could be S. Arabia - Jordan - Israel - Greece, or alternatively, S. Arabia - Egypt - Greece.

(<https://balkangreenenergynews.com/greece-saudi-arabia-launch-power-interconnection-joint-venture/>).

4.5 Energy corridor ELMED between Italy and Tunisia

Map 4.4 Electricity corridor ELMED between Italy and Tunisia



Source: <https://carthagemagazine.com/tunisia-italy-interconnection/>

The European Commission in December 2022 approved a project to build a new undersea power line that will transport clean energy from Tunisia to Italy. The new cable will supply Europe with electricity generated from clean energy, mainly solar, with a capacity of 600 MW. It is considered a decisive step towards strengthening Europe's energy security and reinforces the importance of North Africa as a key supplier as well as the importance of energy routes from South to North. The submarine power line will be built by Terna Spa and STEG Tunisie and will run from the Cape Bon peninsula in Tunisia to the Partanna power station in the Trapani province of Sicily. "ELMED", has been included in the list of "Projects of Common Interest (PCI)" and will be worth EUR 850 million, of which EUR 307 million will be co-financed by the Commission through the "Connecting Europe Facility (CEF)", the EU fund dedicated to the development of projects to upgrade the EU's energy infrastructure. This was the first time that CEF funds have been used for transcontinental infrastructure, which actively connects an EU country with a non-EU country. (<https://www.arabnews.com/node/2213606/world>).

4.6 Export of "green" energy to Europe from Azerbaijan

On 17.12.2022, a Strategic Partnership Agreement was signed in Bucharest between the Governments of Azerbaijan, Georgia, Romania and Hungary in the field of development and transmission of green energy, in the presence of the President of the European Commission Ms. Ursula von der Leyen. The agreement provides the financial and technical framework for the implementation of the undersea cable project for the transfer of energy from renewable sources from Azerbaijan to Romania, through Georgia and the Black Sea. Subsequently, it is planned to transfer this energy to Hungary and the rest of Europe, through the European energy transmission system. The project is part of the EU-Azerbaijan agreements in the field of energy, while it is also a flagship project for Georgia, as part of the EU Global Gateway Strategy.

This project when implemented will be the largest undersea electric cable in the world (with a total length of approximately 1,200 km and a capacity of 1 GW) allowing the export of "green" energy to Europe supporting the EU's efforts to diversify its energy supply. The project is estimated to be implemented within 3-4 years. It is understood that the European Commission intends to finance the project with 2.3 billion euros. (<https://eurasianet.org/azerbaijan-positioning-itself-as-green-energy-exporter>).

4.7 Gas – Fired Power Plant in Alexandroupolis

It should be mentioned that on January 14th 2023 the start of the construction of a new Gas – Fired Power Plant in Alexandroupolis was inaugurated, an investment of high importance for Greece, which is expected to ensure energy security in our country, as well as to cover the needs of our partners in neighboring countries. With this project, Greece becomes an energy hub for electricity and natural gas networks and upgrades its role in energy diplomacy, aspiring to be a potential “key” export player in the broader region of SE Europe, where a potential cooperation of mutual interest may be opened. The project is expected to be completed at the end of 2025. ("<https://www.power-technology.com/projects/alexandroupolis-combined-cycle-power-plant-greece/>").

CHAPTER 5. HYDROGEN STRATEGY AND INFRASTRUCTURE

Hydrogen is one of the key technologies that will enable the global energy transition and sustainability. It should be noted that depending on how it is produced, hydrogen is classified as blue (from natural gas), pink (from nuclear power) and green (from renewable energy sources).

According to many estimates, green hydrogen will play a crucial role in the future European economy. One of the main advantages of hydrogen is the fact that it can be stored and transported using existing gas infrastructure. (Wijk, Wouters 2021, p. 91)

The EU is promoting projects on the future use of green hydrogen. Greece has the potential to emerge as an important European hydrogen market, both as a supplier and as a transit country for green hydrogen. The EU's hydrogen strategy is a comprehensive framework for decoupling from imported fossil fuels and is based on the production and import of hydrogen produced from renewable energy sources. The European Commission, under the REPowerEU project, envisages the production of 10 million tons of 'green' hydrogen and 10 million tons of imported hydrogen by 2030 to replace the use of natural gas, coal and oil in the industrial and transport sectors. Renewable hydrogen can be produced through electrolysis using renewable electricity to split water into hydrogen and oxygen.

The “EU Hydrogen Strategy” (COM/2020/301) was adopted in 2020 and proposed policy action points in 5 areas: supporting investment; supporting production and demand; building a hydrogen market and infrastructure; research and cooperation; and international cooperation. ("https://energy.ec.europa.eu/topics/energy-systems-integration/hydrogen_en#related-links")

Two key instruments for promoting hydrogen policy are the **European Hydrogen Bank**, which promotes investment in the sector and provides insurance cover, and the **Hydrogen Energy Network**, which brings together representatives of the relevant EU energy ministries to coordinate public policies on the use of hydrogen as an energy source and to help national energy authorities exploit the opportunities offered by hydrogen.

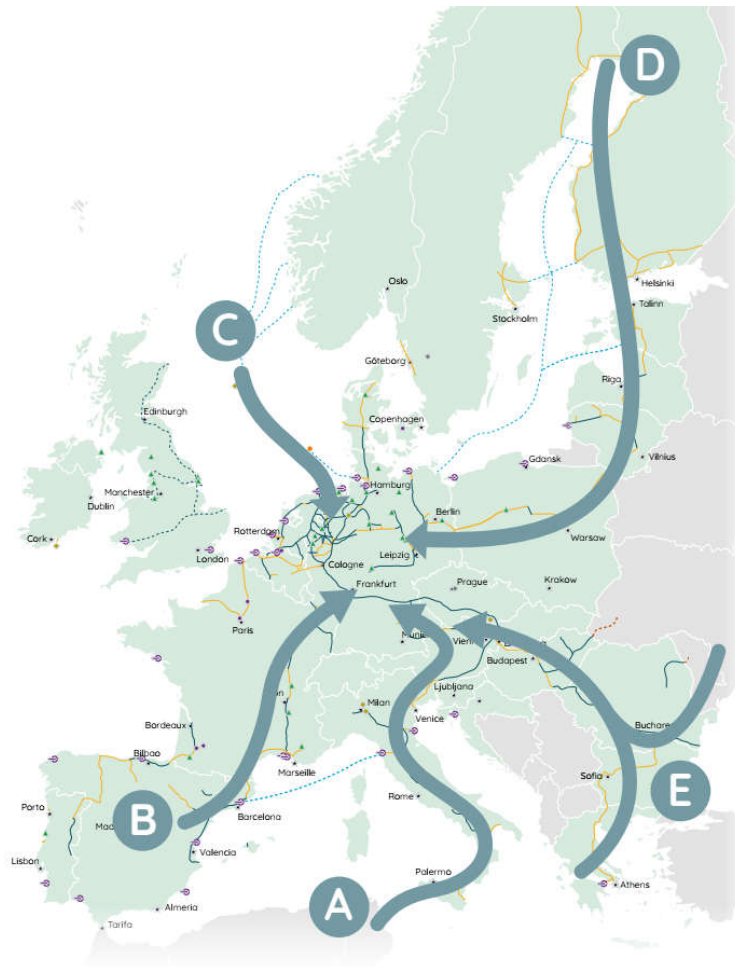
At the same time, the EU is promoting initiatives to fund research and innovation in the hydrogen sector, such as the “**Clean Hydrogen Partnership**”, a joint public-private partnership and the “**European Clean Hydrogen Alliance**”, which launched in parallel with the "EU Hydrogen 2020 strategy" involving industry, national and local authorities, civil society and other stakeholders aiming to develop hydrogen technologies by 2030.

As far as the institutional framework is concerned, in the text of the "Fit-for-55 package" environmental strategy, Europe lays the foundations for the creation of the necessary infrastructure for the use of hydrogen. A series of 41 hydrogen investment projects are included in the "Important Projects of Common European Interest (IPCEIs)" "IPCEI Hy2Tech" list, followed by the later "IPCEI Hy2Use", which refers to infrastructure. (<https://ipcei-hydrogen.eu/>)

In 2023, the “European Hydrogen Bank” was established (COM/2023/156), a financial - credit instrument that will create an initial market for renewable hydrogen sources, offering new development opportunities and jobs. ("https://energy.ec.europa.eu/topics/energy-systems-integration/hydrogen_en#related-links").

5.1 "The European Hydrogen Backbone (EHB)" initiative.

Map 5.1 The five hydrogen supply corridors in the EU/EHB initiative



Source: "<https://ehb.eu/files/downloads/EHB-Supply-corridors-presentation-ExecSum.pdf>"

The "European Hydrogen Backbone (EHB) initiative" consists of a group of thirty-three energy infrastructure operators. It aims to accelerate Europe's decarbonization process by building the hydrogen infrastructure – through the use of existing "hydrogen ready: gas pipelines or the construction of new hydrogen pipelines – and the pan-European market for renewable energy and low-carbon hydrogen, as well as creating cross-border cooperation between European countries and their neighbors.

The European Hydrogen Backbone consists of five main hydrogen supply corridors starting from regional points in the EU and neighbouring countries, which transport hydrogen to central Europe and key industrial production areas.

In order to meet the 2030 hydrogen demand targets set by the RePowerEU plan, five key high-capacity pipeline corridors are designed, which can provide access to abundant and low-cost hydrogen supply by 2030. The European Hydrogen Backbone at its 2040 deployment will be 53,000 km long and require an estimated total investment of €80-143 billion Euros. The infrastructure it will use will be 60% existing gas pipelines that are hydrogen ready or require modifications and 40% new hydrogen pipelines.

The corridors will initially connect production to demand within EU countries, linking regions at an early stage and then expanding to connect Europe with neighbouring regions with export and import potential.

This declared policy and the rapid development of pipelines and other infrastructure is expected to provide an incentive for market players to develop supply and demand more rapidly.

The five hydrogen supply corridors are:

- Corridor A: "North Africa and Southern Europe"
- Corridor B: "South West Europe & North Africa"
- Corridor C: "North Sea"
- Corridor D: "Nordic and Baltic regions"
- Corridor E: "Eastern and South-Eastern Europe"

These five corridors serve both domestic and importing supply markets, and are being developed following the RePowerEU project which establishes three corridors. The three corridors of the RePowerEU plan correspond to the corridors of the European Hydrogen Backbone as follows: corridor through the Mediterranean (corridors A and B), through the North Sea, (Corridor C, D) and via Ukraine (Corridor E).

The three corridors running from South to North are as follows:

Corridor A: North Africa and Southern Europe

"Corridor A" is a 3,300 km long hydrogen pipeline project connecting North Africa, Italy, Austria and Germany. It aims to supply low-cost renewable hydrogen produced in the South to countries and industrial plants in Central Europe. It will use 70% existing but suitably upgraded infrastructure, with new pipeline sections where needed. Corridor A will play a vital role in facilitating the transport of both imported and produced hydrogen in Italy, as it is estimated that it could provide more than 40% of the REPowerEU import target. (<https://www.south2corridor.net/>)

According to some experts, in the near future, North Africa has all the potential to be Europe's main supplier of green hydrogen. Most North African countries have huge potential in terms of available land and resources for green hydrogen production from solar and wind energy. Exporting hydrogen from North Africa will be beneficial for both North Africa and Europe, contributing to energy security and economic growth respectively. (El-Katiri February 2023, p. 3)

Corridor B, Southwest Europe & North Africa

"Corridor B" will transport green hydrogen from the Iberian Peninsula and North Africa to Germany. It is planned to be linked to underground hydrogen storage facilities to be built in France to provide a stable supply of hydrogen. Corridor B will serve the needs of Portugal, Spain, France and Germany and will contribute to reducing carbon dioxide emissions from industrial production in these countries by replacing the use of fossil fuels.

In January 2023, construction of a hydrogen pipeline to transport green natural gas from the Iberian Peninsula to the rest of Europe was confirmed and should be operational by 2030.

The project, called H2Med, will connect Portugal and Spain (main producing countries) with France and Germany (consuming countries) and will account for around 10% of the European Union's hydrogen demand by 2030. The undersea pipeline (under the Mediterranean Sea) will transport green hydrogen produced from water through electrolysis using renewable energy sources. It is estimated that H2Med will be able to supply 2 million metric tons of hydrogen per year. ("<https://www.dw.com/en/germany-to-join-mediterranean-hydrogen-pipeline-project/a-64483071>").

Corridor E of Eastern and Southeastern Europe

"Corridor E" will have two sections: a) from SE. Europe, i.e. from Greece, Bulgaria, Romania which have high supply potential due to favourable conditions for solar and wind energy production and b) from Ukraine taking advantage of huge availability of land and abundance of natural high-capacity underground storage. Corridor E will supply hydrogen to recipients in Central Europe and in particular Germany.

5.2 Greece's national Hydrogen Strategy

Greece, due to its abundant RES resources and its hydrogen ready pipeline infrastructure, has the potential to emerge as a major component of the European Hydrogen market, both as a supplier and as a transit country for green hydrogen. Greece's national Hydrogen Strategy sets specific goals in that direction and, between those goals, the issue of interconnectivity is of major significance. The Greek Government, in the context of the new "National Energy and Climate Plan" for the next 10 years, has set an ambitious goal of replacing the traditional energy sources with Green Hydrogen until 2030.

The Ministry of Environment and Energy in the context of the revision of the "National Energy and Climate Plan" presented in January 2023 a new plan which is currently under approval. One of the objectives is to create a green hydrogen economy: It is envisaged Hydrogen use in transport (heavy vehicles, shipping, Transport, transport, transport, aviation), industry, and under certain conditions in power generation. Our country, capable of being both producer and distributor of green hydrogen, aspires to constitute a critical energy Hub for the broader region, as well as the E.U.(IENE, 2023, p. 47).

In this context, it is worth mentioning the ongoing project for the Interconnection of Greece's and Bulgaria's Hydrogen Networks to be planned by Bulgartransgaz EAD and DESFA S.A. The project has a completion horizon of 2029 and a budget of 1 billion euro. It is worth mentioning that this joint hydrogen project, promoted by the two national gas TSO's, is eligible for the under finalization 6th PCI list. The Greece-Bulgaria Clean Hydrogen Pipeline will be the first part of the future European Hydrogen Backbone and in particular the Southeastern Hydrogen Transport Corridor.

The Greek section, which will be 540 km long, will transport green hydrogen mainly from the southern part of Greece to the interconnection point of the National Gas System with Bulgaria. It will also supply hydrogen to the industrial areas of Athens, Corinth and Thessaloniki as well as to North Macedonia.

In general, it will exploit Greece's strategic position and potential for low-cost green hydrogen production for export to Central Europe, where high demand is expected.

(<https://www.naftemporiki.gr/business/1485150/thetiki-axiologisi-gia-ton-agogo-metaforas-prasinoy-ydrogonoy-elladas-voylgarias/>).

CHAPTER 6. CONCLUSIONS

Based on the EU's current energy policy, its legislation, the redesign of energy supply and production, the increasingly important position of energy routes (natural gas, electricity and hydrogen) from South to North becomes clear. The main conclusions we can draw from this new energy reality could be summarized as follows:

The transition to clean and renewable forms of energy is a definitive choice for the EU. Its role as a pioneer in dealing with climate change, the goals for and the achievement of climate neutrality and decarbonization make irreversible its departure from the old policies of seeking energy supply with the lowest cost as the main criterion.

The need to achieve energy security, avoiding dependencies on countries like Russia, which especially after the war in Ukraine (Feb. 2022) became an unfriendly country, makes the need to diversify its suppliers imperative.

The definitive interruption of energy relations with Russia, with no visible restoration in the immediate future, increases the importance of the development of energy networks in a South-North direction. The classification of natural gas as a transition fuel, which is Russia's main exported form of energy, also contributes to this assessment.

The countries of the Mediterranean South of the EU, the countries of the Western Balkans and the countries of the SE Mediterranean and North Africa have a particularly large energy potential both in natural gas reserves and, mainly, in Renewable Energy Sources. The utilization of these, the creation of infrastructure and transmission networks from the South to Central Europe has become a priority, as it ensures access to sufficient and clean energy but, above all, diversification of sources and avoidance of dependencies.

The completion of the interconnections of the natural gas pipelines - that become hydrogen ready - and the electricity networks of the EU countries is moving at a satisfactory pace and adds to the energy security of the EU, as well as, of the neighboring accession countries. The new policy also ensures energy security in energy-disadvantaged regions such as the island regions of the Union.

North Africa and gradually the entire African Continent is becoming more and more important for the energy supply of the EU. There are, to be exploited, large quantities of African natural gas that may reach Europe in the form of LNG. But, most importantly, the countries of North Africa have a huge untapped energy potential from renewable sources, i.e. solar and wind energy. Proximity, the relative ease of establishing interconnection networks and, potentially, the relatively cheaper cost of production, make it a fairly attractive source of energy and justify greater investment in this area.

The utilization of the significant energy potential of the countries of North Africa, but also of Africa in general, is of enormous importance for the development of these countries. With the EU's increasing investment in energy, infrastructure and production and subsequently its purchase, the economies of these countries are strengthened. This results in the reduction of the unemployment and the improvement of the living conditions of the inhabitants and consequently less pressure on Europe from migration flows.

Nevertheless, it is worth noting that the volatile geopolitical developments in the Eastern Mediterranean area, with a particular emphasis on the Israeli- Arab conflict, add a factor of uncertainty and constant review of interconnection plans as well as energy routes.

In the medium and long term, this new energy policy will also have beneficial effects on the lives of European citizens and consumers with cheaper energy prices and less financial burden on households. At the same time, renewable energy and the consequent cleaner environment improve the quality of life. Furthermore, areas of energy production from polluting sources such as coal are being upgraded. The ensuing cooperation in the utilization of all potentially green energy forms contributes to the development of research and innovation and has wider positive effects on the European economy.

Correspondingly, the new energy networks will also help the development of the Accession countries such as the Western Balkans, but also Ukraine and Moldova. The energy corridors cross them and make them transit centers or end up in them and strengthen their energy position and their economies.

The clean, abundant and cheaper energy supplied by the EU through the energy corridors will have positive consequences for its production, especially industry, and will contribute to improving the competitiveness of European products. In the period after the start of the war in Ukraine, the EU became one of the most expensive energy markets due to the sudden interruption of its supply from the Russian market, the search for new suppliers and global competition in access to energy sources.

As natural gas is already considered a transition fuel, great emphasis is placed on the development of hydrogen as a key future energy source. The EU aims to become one of the leading regions in the development and use of green hydrogen in the medium term. In this process, the European countries of the South as well as the neighboring ones have all the preconditions to become the main producers of green hydrogen produced from their abundant sources of renewable energy.

The EU needs to develop a more proactive energy cooperation with the Middle East and North Africa, which serves both its urgent need for energy security and its climate objectives. The Gulf States also represent a prime area for potential cooperation, given their large green energy production programmes, their abundant resources and their importance in combating climate change.

In addition, the new energy reorientation of the EU presents a great opportunity for our country. Through this, Greece can become an energy hub for the transport of both natural gas and electricity produced from RES. This would be possible by developing pipelines and interconnection cables that start from the Eastern Mediterranean, cross and supply the neighboring countries and end up in Central and Western Europe. But above all, it is a unique opportunity for Greece to utilize its own potential, either by exploiting its untapped natural gas reserves or as a producer and supplier of green electricity to the European market. Finally, it is a particularly crucial opportunity for our country to become a producer of green hydrogen as it has all the necessary conditions. The inclusion of our country in the new European energy networks and corridors is of decisive importance for upgrading its role in this sector as well as for the future strengthening of its economy. The current planning is sufficient but a persistent and sustained effort is required for its implementation, approval and inclusion in its entirety in the European energy planning.

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