Infrastructure for a decarbonized gas system, which choices?

Group South East Europe (Italy, Greece, Cyprus, Malta, Slovenia, Croatia, Bulgaria)

Members

Jitraporn INCHUNJIW (jitraporn.i@egat.co.th), Manuel MANUZZI (manuel.manuzzi@rews.org.mt), Lucia MONTAGANO (Lucia.Montagano@edison.it), Nicolas TERRACOL (n.terracol@taggmbh.at)

Section 1: Description of the South East European region

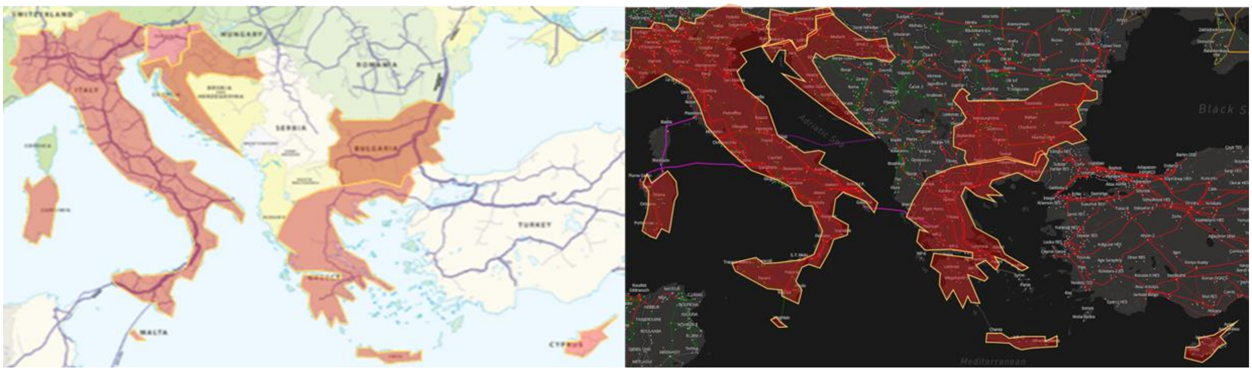

Figure 1: the South East region – gas and electricity infrastructure overview (Source www.entsog.eu & www.entsoe.eu)

1.1 A vast and scattered area at the border of the EU…

Composed by 7 countries[1], the South-East region constitutes at the same time the periphery of the European Union and a major interface with several key countries for the supply of natural gas.

Except for Italy, this region suffers from a relatively limited infrastructure energy network, which can be explained by the great number of small islands (718 for Croatia and over 6 000 for Greece!) or specific geographic position (Slovenia is surrounded by mountains) as well as a few highly populated islands of medium to large size (Sardinia, Cyprus, Crete, Malta), on which imported oil-based centralized installations are vital for the energy supply.

But this region also benefits from its strategic location, with several major import routes (North Africa, Turkey and Azerbaijan, Middle-East, Russia via the Black Sea).

1.2 Still very dependent from fossil energy but with a good dynamic towards decarbonization

With approximately 18% of its energy supply coming from renewable and bioenergy in 2018[2], the South-East region remains slightly above the EU28 (15%) with little evolution over the past years.

[1] Italy, Malta, Greece, Slovenia, Croatia, Bulgaria and Cyprus

[2] The Total energy supply represents the quantity of energy necessary to satisfy inland consumption (also referred as Inland Fuel Deliveries). https://ec.europa.eu/energy/data-analysis/energy-statistical-pocketbook_en

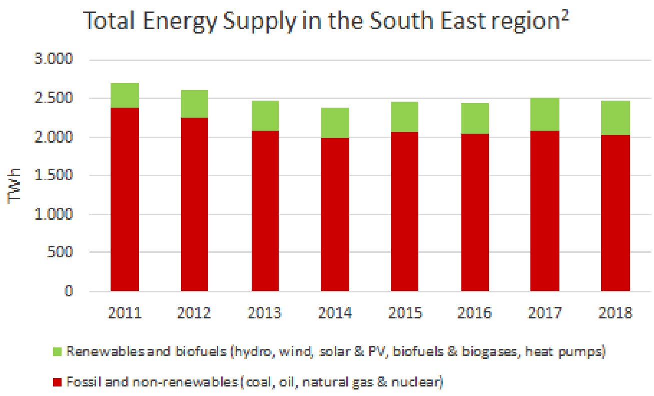

Figure 2: Total Energy Supply in the European South East region

However, the high dependence to fossil fuels and the absence of existing infrastructures can create a very favorable situation for the introduction of alternative supply solutions. Coupled with its strategic position at the cross-roads of international supply, the countries of this region constitute great candidates for decarbonization.

Focus: the Vassilikos Port LNG Terminal in Cyprus

Scheduled for commissioning in 2021-2022[3], the terminal will reduce the dependence on imported oil and petroleum products, hence contributing to significantly reducing the carbon emissions. Carbon emissions for production of electricity from natural gas are reduced by around 33% in comparison with heavy oil.

Focus: Malta, the greener island

With only 7% of the total energy supply coming from renewables in 2018, Malta ranked 27th on the EU28 countries, explained by the high dependence on fossil fuels and obstacles to renewable plants, in particular on/offshore wind energy due to land scarcity and the willingness to preserve the rural aspect of the country and safeguard its tourism attractivity.

However, Malta is making good progress towards decarbonization, having increased more than 6 times its PV installed capacity between 2013 and 2019[4]. This objective has been archived making profits of its high solar irradiance potential and by a favorable supporting FiT program, that led PV domestic rooftop installations to represent more than 50% of the total capacity installed.

After having commissioned one LNG terminal at Delimara in 2017, Malta is now working on the connection to the European Gas Network, via an interconnector with Italy. In 2020, the project has been reassessed to enable the transportation of green gases including 100% hydrogen and bio-methane[5], showing the resolution of the country to go green.

From a regulatory perspective, Malta has made of its remote island position a strength: a coherent framework has been developed at the island scale, creating favorable conditions for improvement.

[3] S&P Global Platts (2020), Cyprus enters LNG era with FSRU groundbreaking at Vassilikos
[4] REWS Annual Market Monitoring Report 2020
[5] ACER, PCI Monitoring Report 2020

Section 2: Applicability of the European strategies

2.1 EU Strategies on Energy System Integration and Hydrogen

In July 2020, the EU Commission launched a Strategy for the *Energy System Integration*[6] whose main objectives are:

- A more 'circular' energy system, with energy efficiency at its core;
- A greater direct electrification of end-use sectors;
- The promotion of clean fuels for those sectors where electrification is difficult.

Taking for granted that electricity (produced by renewable) is the preferred energy carrier wherever feasible, the main strategic question related to the full decarbonization of the energy system is about which energy vector to choose for those sectors where electrification would bring higher costs. A study published by EU in April 2020[7] took into consideration 3 different options (fully electrification, biomethane and hydrogen) to decarbonize the European energy system by 2050. The main finding can be summarized by the fact that hydrogen is foreseen to be the more economical energy carrier to archive a complete decarbonization, as shown by the following figure.

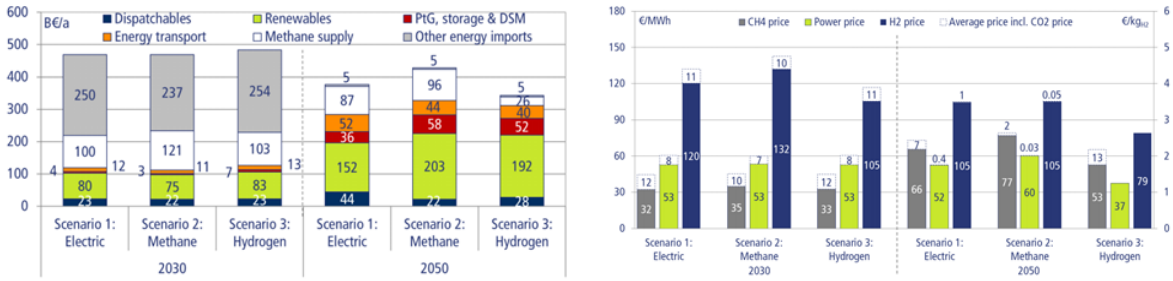

Figure 3: Estimated annual Energy System and Energy Carriers costs[8]

It is not by chance that the EU published its Strategy on Hydrogen contextually with the one of Energy System Integration, implying that this is a preferred direction. The use of hydrogen as an energy carrier, however, presents technological challenges that still need to be addressed. For this reason, the Commission foresees three main phases for the development of this energy carrier by 2050:

- From 2020 to 2024: the installation of at least 6 GW of renewable hydrogen electrolysers and the production of up to one million tons of renewable hydrogen;
- From 2025 to 2030: hydrogen needs to become an intrinsic part of the EU integrated energy system, with at least 40 GW of renewable hydrogen electrolysers and the production of up to ten million tons of renewable hydrogen;
- From 2030 to 2050: renewable hydrogen technologies should reach maturity and be deployed at large scale across all hard-to-decarbonize sectors.

2.2 SWOT analysis on hydrogen infrastructure development in South-East Europe

The analysis of EU strategies towards a climate-neutral economy by 2050 shows a preference for the development of hydrogen for those sectors not easy to decarbonize. In this section, we propose a SWOT analysis on the development of an Hydrogen infrastructure in South-East Europe.

2.2.1 Strengths

[6] European Commission (2020), An EU Strategy for Energy System Integration.

[7] European Commission (2020), Impact of the use of the biomethane and hydrogen potential on trans-European infrastructure.

[8] European Commission (2020), Impact of the use of the biomethane and hydrogen potential on trans-European infrastructure, pages 47 and 53.

1) South-East region is the part of Europe with the highest level of solar radiation over the year (together with the Iberian Peninsula). The further development of PV capacity in this region will lead to an excess of electricity production during peak hours. This fact will help the development of Power-to-Gas technology, namely the production of hydrogen by electrolysers. This path is remarked by the EU strategy on hydrogen, where is stated that “the priority for the EU is to develop renewable hydrogen, produced using mainly wind and solar energy”[9].

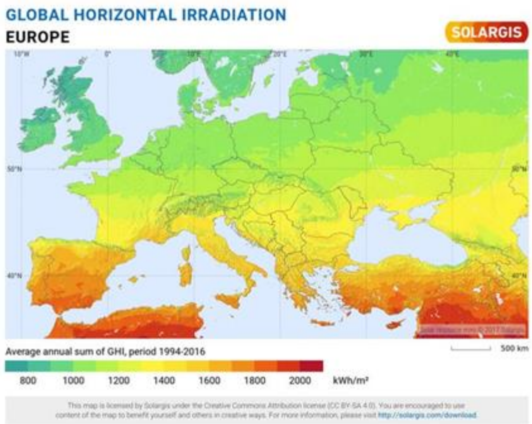

Figure 4: Solar irradiation in Europe (Source https://solargis.com/maps-and-gis-data/download/europe)

2) No relevant production of natural gas is present in this European region, which means less lobbying against the use of hydrogen as an energy vector is expected.

2.2.2 Weaknesses

1) The Hydrogen strategy foresees that “elements of the existing pan-European gas infrastructure could be repurposed to provide the necessary infrastructure for large-scale cross-border transport of hydrogen. Repurposing may provide an opportunity for a cost-effective energy transition in combination with (relatively limited) newly built hydrogen dedicated infrastructure”[10]. It must be highlighted that in this region only Italy has a developed and meshed natural gas network grid that could be repurposed for the transportation of hydrogen. It is estimated than the refurbishment of natural gas pipelines is more than three times cheaper than the construction of new infrastructure[11].

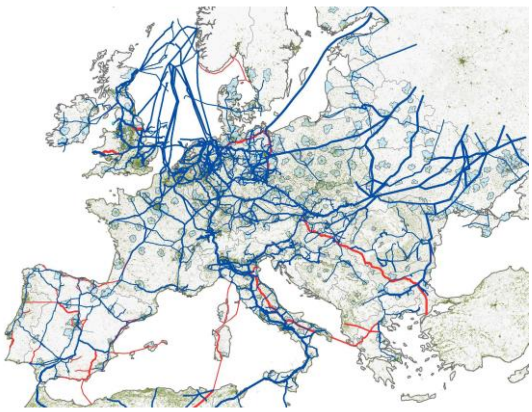

Figure 5: The European natural gas network. The existing network is shown in blue; planned pipelines in red. (Source: ETH Zurich https://ethz.ch/en/news-and-events/eth-news/news/2014/03/erdgas-krisen-verhindern.html)

[9] European Commission (2020), Hydrogen Strategy, page 5.
[10] European Commission (2020), Hydrogen Strategy, page 15.
[11] European Commission (2020), Study on Hydrogen generation in Europe, pages 15-16.

2) In the National Energy and Climate plans[12] of the countries of this region no clear indications regarding development of hydrogen infrastructure are made. Only Bulgaria indicates a pilot project for a hydrogen plant with total installed capacity of 20 MW will be developed by 2030[13].
3) In this region there are many islands and this leads to higher cost of transportation.
4) This region has not much potential for the development of wind farms, except for Greece.

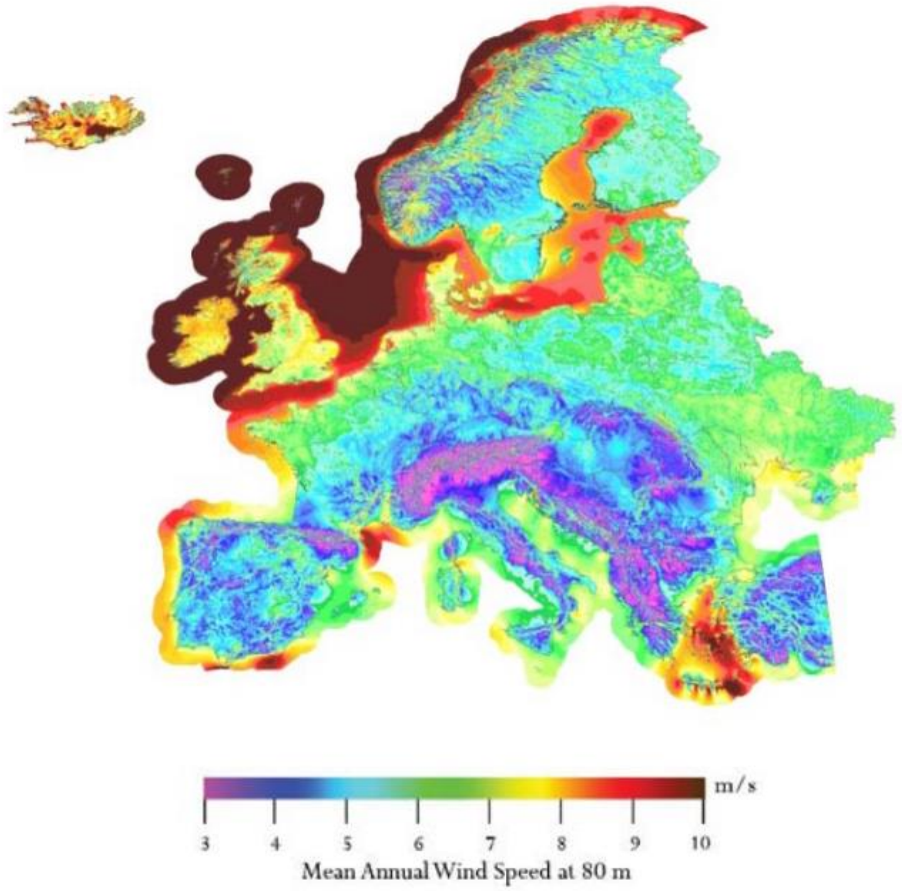

Figure 6: Mean Annual Wind Speed in Europe (Source https://aws-dewi.ul.com/assets/2017/08/High-Resolution-Wind-Resource-Maps-and-Data-Methods-and-Validation.pdf)

5) The Hydrogen Strategy affirms that "hydrogen can also provide cyclical or seasonal storage, e.g. in salt caverns, to produce electricity to cover peak demand, secure hydrogen supply, and allow electrolysers to operate flexibly"[14]. This region has not much potential for the development of storage in salt caverns, except for the Greek area[15].

2.2.3 Opportunities:

1) The fact that this region overlooks Mediterranean Sea allows them to import (become transit countries towards the rest of Europe for) the renewable Hydrogen produced in the North Africa region[16]. A part converting the existing pipelines between Tunisia - Libya and Italy,

[12] https://ec.europa.eu/energy/topics/energy-strategy/national-energy-climate-plans_en
[13] Integrated Energy and Climate Plan of the Republic of Bulgaria 2021–2030, page 163.
[14] European Commission (2020), Hydrogen Strategy, page 14.
[15] D. Gulcin Caglayan, N. Weber, H. Heinrichs, J. Linßen, M. Robinius, P. A. Kukla and D. Stolten, Technical Potential of Salt Caverns for Hydrogen Storage in Europe, International Journal of Hydrogen Energy, vol 45, iss 11, 28, pages 6793-6805.
[16] A.J.M. van Wijk - F. Wouters (2019), Hydrogen. The Bridge between Africa and Europe.
S. Bhagwat, M. Olczak (2020), Green Hydrogen: Bridging the energy transition in Africa and Europe, EUI.

another pipeline landing in Greece would allow the transport of renewable hydrogen produced in the Egyptian area.

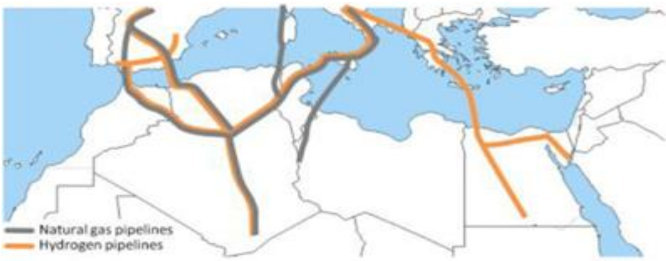

Figure 7: Proposed Gas Pipelines between Africa and Europe (Source A.J.M. van Wijk - F. Wouters (2019), Hydrogen. The Bridge between Africa and Europe*)*

2) It is possible to take advantage of the presence of islands (among which 2 Member States, Malta and Cyprus) to develop local pilot projects of decarbonization by the use of hydrogen. Possible funds may be obtained through the EU Clean Energy for EU Islands program.

2.2.4 Threats

1) The low economic and financial performances of countries in this area can hinder investments (except for Malta and Cyprus, which have had the highest GDP growth in EU zone in the last years).

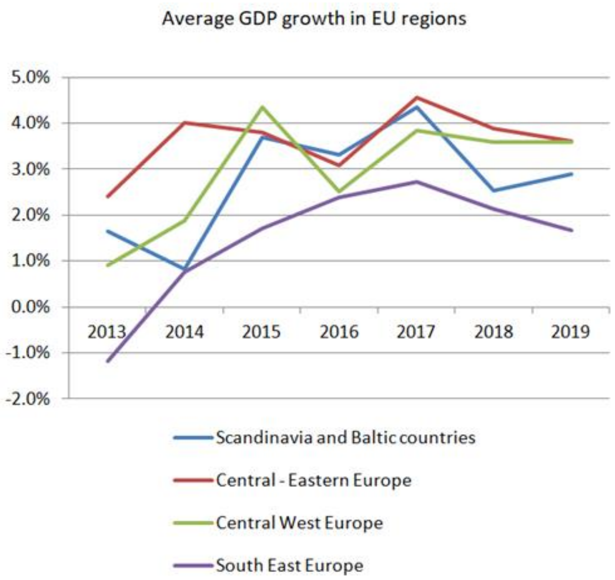

Figure 8: Average GDP growth in EU regions (Elaboration from EU Autumn forecast data*).*

2) Geographical heterogeneity of the region, that hinders the possibility of developing common infrastructures among the whole region. Projects with maximum 3-4 countries involved are foreseen.

Section 3: Recommendations for a decarbonized gas system

In order to take into account the particular situations of the countries of this area, the recommendations for the decarbonization of the gas systems are done at country level.

Country	Infrastructure situation (Strenghs-Wicknesses-Opportunities-Threats)	Recommended decarbonization pathway of the gas system
Italy	S: Mature gas and electricity network, diversified supply, well organized gas value chain. W: Not specific targets related to hydrogen deployment set in the NECP. O: Strategic country for the Mediterranean region and possibility become a hydrogen hub between Northern Africa and Central Europe. T: Land availability for additional renewable capacity and approval procedure, higher costs could arise when repurposing the well-established natural gas value chain.	**Increase the share of green energy and upgrade the existing infrastructure. Set targets to the development of the hydrogen economy and plans for the realization of the hydrogen backbone.**
Malta	S: Possibility to further increase the PV installations. Its small and centralized energy network is easy to be decarbonised if compared to other European Countries. A pipeline suitable for hydrogen transportation already present in the National Energy and Climate Plan. W: Remote location on island, absence of natural gas network. O: High economic growth and fast administrative system in place, closeness to Northern Africa, central position in the Meditarranean strategic for Hydrogen bunkering. T: Absence of liberalised energy markets, high dependence on energy imports.	**Support the development of local PV electricity generation and using the surplus to produce hydrogen that can be used for gas-to-power (seasonal storage), bunkering or clean local transport.**
Bulgaria	S: Geographic position interesting for transit from the Middle East region toward Europe. Target of 20 MW of hydrogen production by 2030 is set in the NECP. W: Exclusive supply from Russia and downstream market concentration. O: IGB interconnection should start operation in 2021, and TAP pipeline will be the second source of gas. T: Low political interest to directly move to decarbonised energy vectors.	**Prompt development of the Hydrogen objectives proposed in the NECP. Convince decision makers to align on decarbonization shifting to hydrogen without developing a natural gas infrastructure before.**
Cyprus	S: Location at cross-roads of Eastern Mediterranean, North Africa and Europe Europe, small and adaptable free-market economy with a positive long-term outlook (strong economic performances and GDP growth). W: Remote location (island), absence of gas network. O: Develop local pilot projects of decarbonization for H_2, highest potential for solar power of any EU country. T: High dependency on fossil fuel for energy (reliant on heavy fuel oil and diesel imports for its electricity and spends over 8% of its GDP to cover the cost).	**Support the development of local PV electricity generation and connect the power grid of Cyprus with Greece and Israel via undersea cable. Promote the role of the country as a hydrogen hub between Northern Africa, Middle East and Europe.**
Slovenia	S: Good energy connectivity with Austria and Italy. W: The significant amount of nuclear energy (Krško plant) hinders renewable competitiveness, solar and wind potential is relatively low. O: Possibility to further developing hydroelectric generation. T: Tiny market energy, with little dynamic.	**Increase integration with Italy and Austria to benefit from synergies at regional level and its role as transit country.**
Croatia	S: Regional gas network developed in eastern region. W: Limited connectivity with main gas import routes, great number of small islands. O: Potential for PV and hydroelectric development. T: Small energy market, with little dynamic.	**Develop local "green" islands with predominant position of electricity (solar) and possibly H_2 terminals. In eastern part of the country, promote the development of hydroelectricity generation (possible feeder for electrolysis) and the conversion of existing regional gas grid to maximize synergies.**
Greece	S: Planned the increase of renewable capacity (solar and wind) and gas supply diversification (due to new FSRU and TAP both planned for 2021). W: Low flexibility due to the lack of storage infrastructure. O: The geographical position is ideal for planning hydrogen interconnection to the Middle East and Northern Africa. The presence of salt caverns candidates Greece to become the hydrogen seasonal storage hub of the region. T: The local energy market is not liquid and the economic performances are low.	**Developing PV and wind can boost the local market for hydrogen.Greece should aim to become a regional hydrogen hub due to its position (European gate for Egypt-Middle East region) and the possibility of developing seasonal hydrogen storage.**