Hydrogen as an opportunity for a new energy dialogue among the Mediterranean shores

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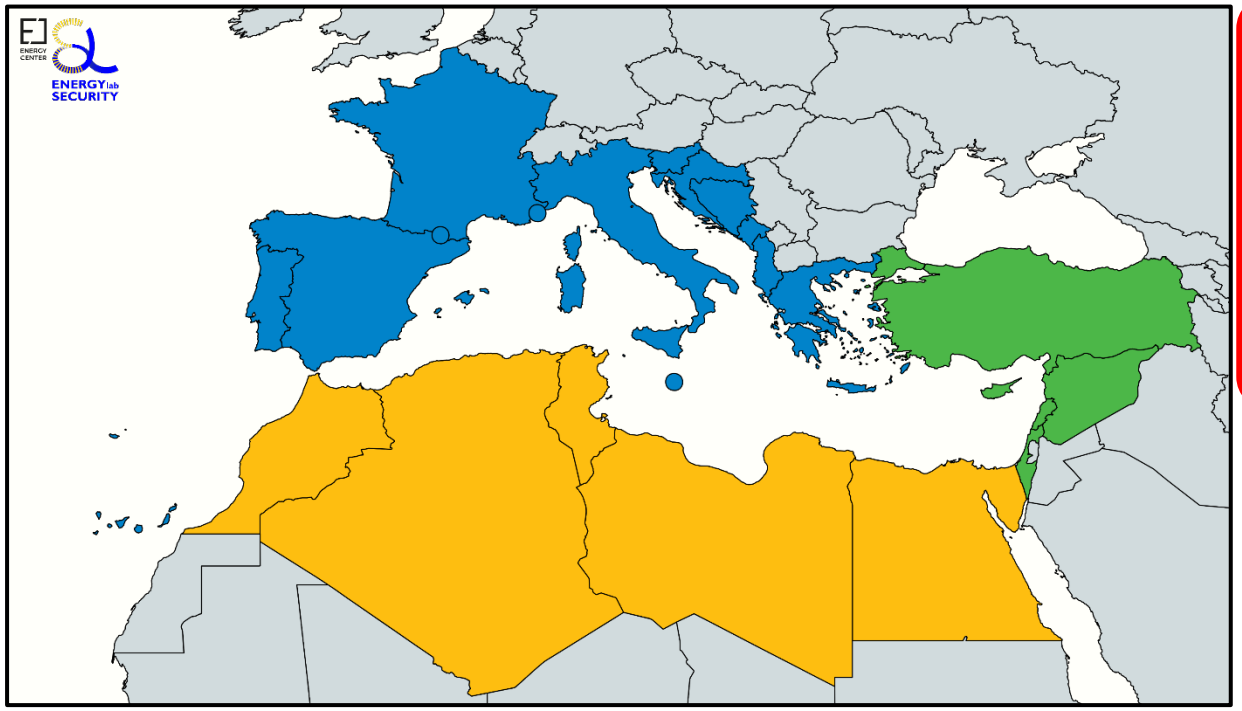
OUTLINE

- The current socio-economic and energy situation of the Mediterranean countries
- The «black» energy dialogue
- Three main triangles for implementing the energy transition in the Mediterranean
- The «energy underground»: different pathways for decarbonising the Mediterranean energy system
- The regulatory framework for supporting hydrogen penetration
- The «predisposition» to green hydrogen
- Technologies for hydrogen production and critical raw materials
- The cooperative approach as a key for a harmonic development of the Mediterranean
- Conclusions

SOCIO-ECONOMIC AND ENERGY SITUATION IN THE MEDITERRANEAN



Northern Shore Southern Shore Eastern Shore

N: 40.8%	S: 36.2%	E: 23.0%	Population: 512 M pers.
			EU 209 NA 185 ME 118
N: 75.5%	S: 7.4%	E: 17.1%	GDP: 9,646 billion $
			EU 7,285 NA 715 ME 1646
34,856	3,865	13,949	GDP p.c. ($/pers)
67.6	26.7	41.6	WGI Index
N: 51.4%	S.: 24.3%	E: 24.3%	CO_2 emissions: 2,021.4 Mt
			EU 1,038.6 NA 491.6 ME 491.2
5.0	2.7	4.2	CO_2 p.c. (tCO_2/pers)
52.3	58.7	64.6	Carbon Int. of supply (t/TJ)
0.32	0.66	0.58	Carbon Int. of GDP (kg/$)
N: 60.1%	S.: 20.9%	E: 19.0%	TPES: 41,364 PJ
			EU 24860 NA 8645 ME 7859
118.9	46.7	66.6	TPES p.c. (GJ/pers)
5.7	11.4	9.3	Energy Intensity (MJ/$)
N: 68.7%		E: 17.0%	RES Capacity: 268.5 GW
RES in the EU TFC by 2030: 30%		Electricity from RES by 2030: 17÷52%	EU 184.1 NA 9.3 ME 45.5

- The 3 shores have different socio-economic conditions, with a significant gap between the Northern shore (high economic development and welfare) and the Eastern and Southern ones.

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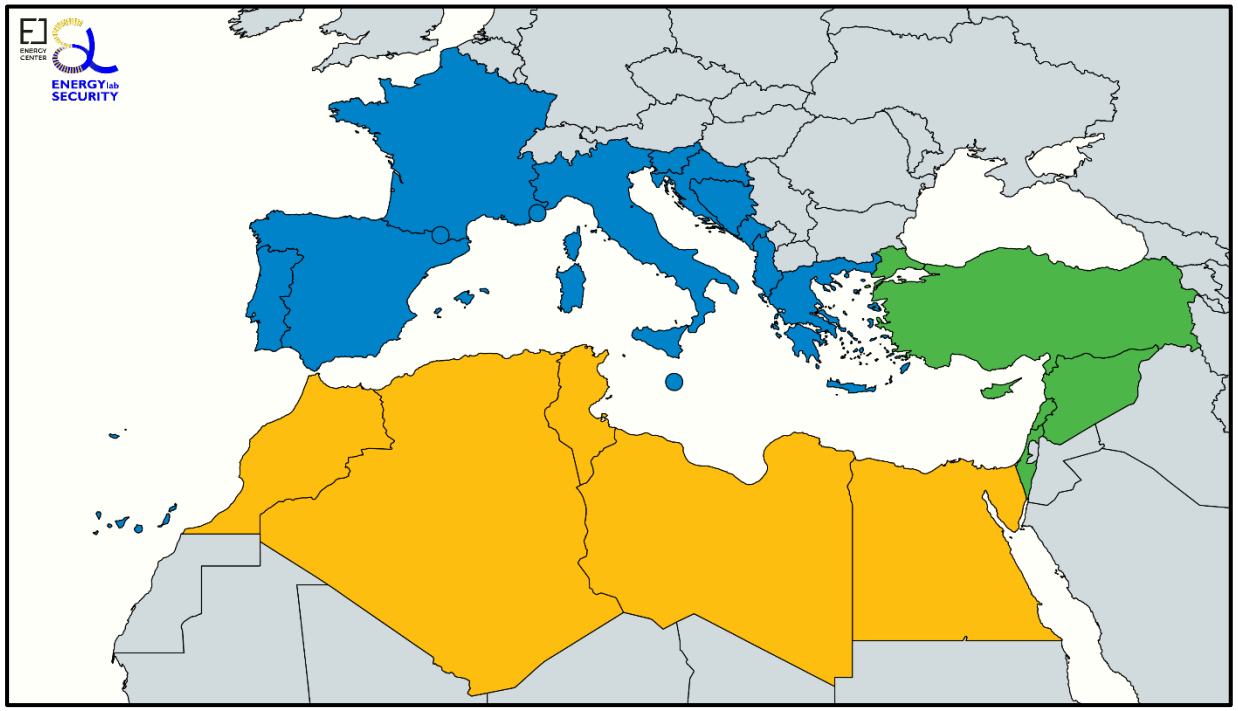

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- The **different development** is reflected in **higher** per capita energy **consumption** in the Northern area, but also in a **lower energy intensity** (→ higher efficiency and better use of energy).

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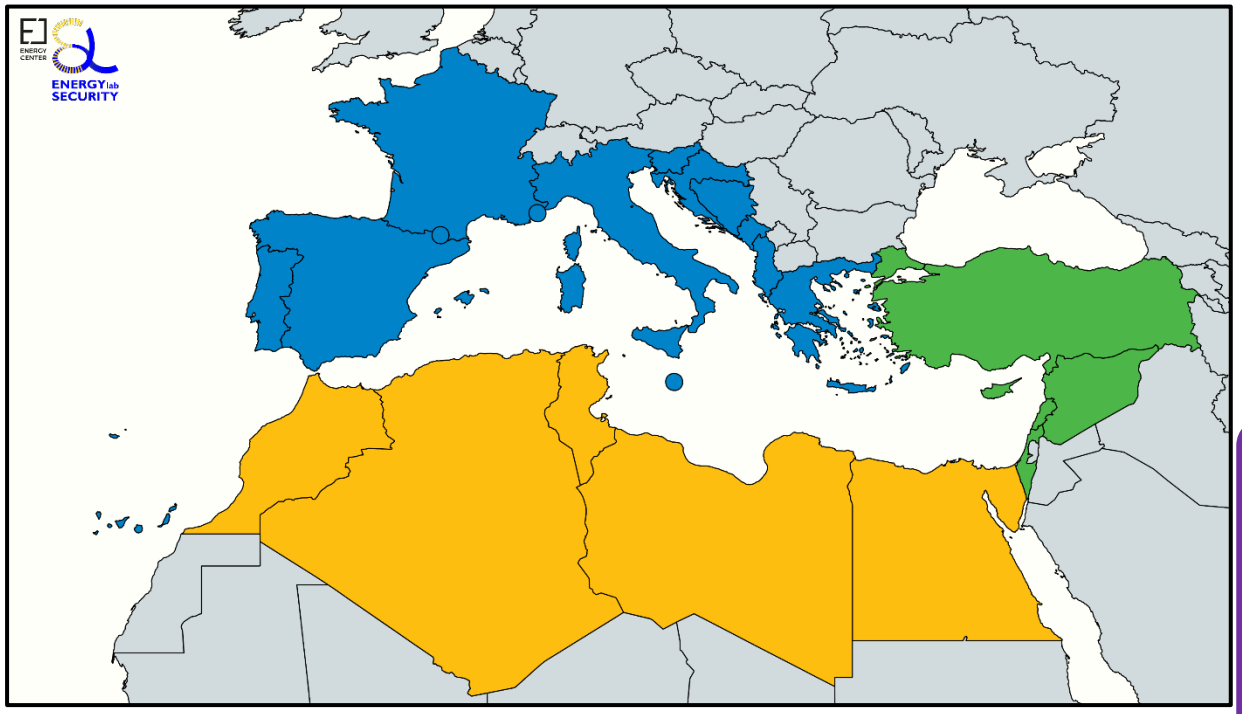

Northern Shore Southern Shore Eastern Shore

- Despite a lower renewable potential, the **Northern** shore already carried out **sustainability** strategies and promoted the installation of **renewables capacity** for electricity generation.

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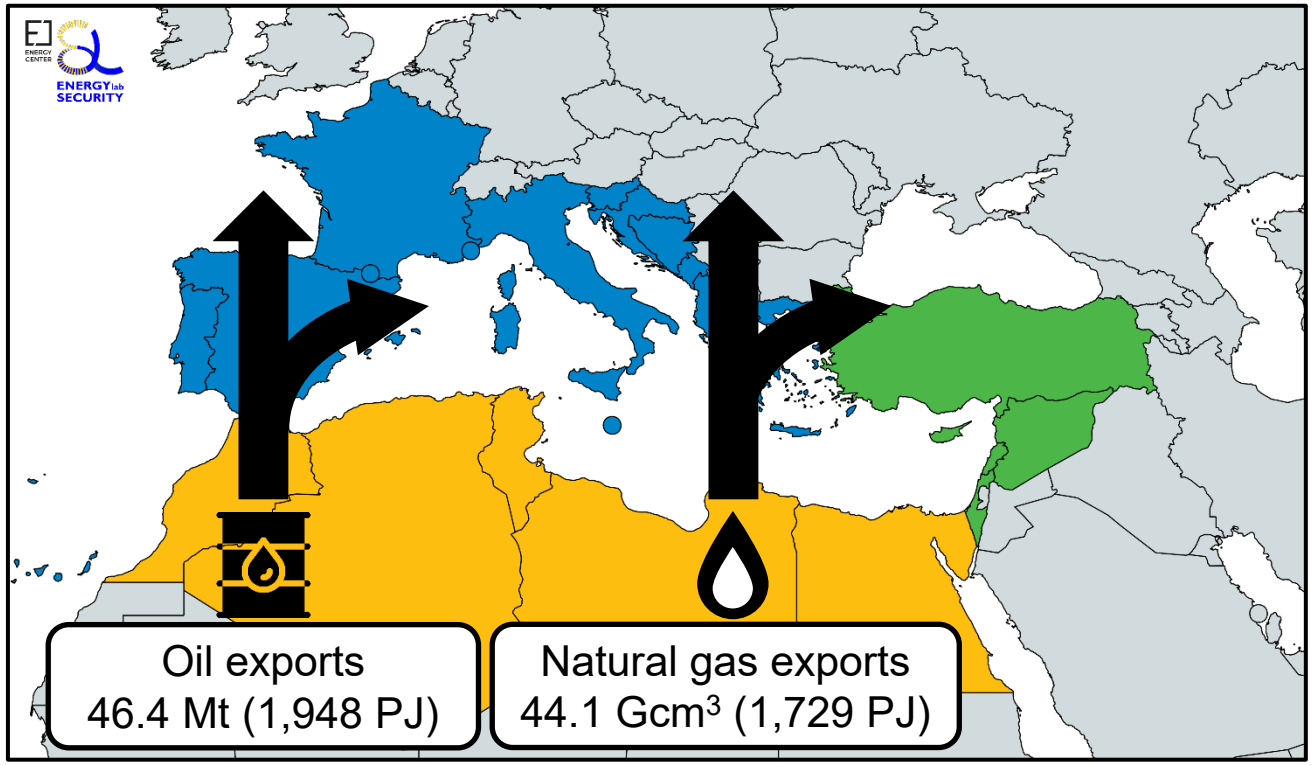
THE "BLACK" ENERGY DIALOGUE



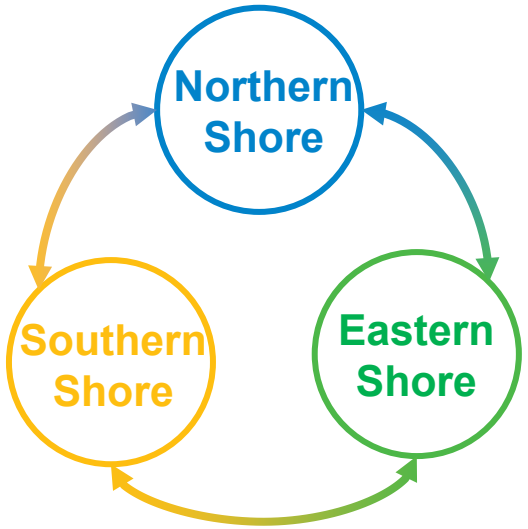
Northern Shore Southern Shore Eastern Shore

Economic Value of Export (2019)			
Country	**Commodity**	**Value (G€)**	**Economic share on export (%)**
Algeria	Crude oil	13.9	41.7
	Refined Petroleum Products	6.3	18.9
	Natural Gas	10.9	32.7
Libya	Crude oil	22.5	85.7
	Refined Petroleum Products	0.9	3.3
	Natural Gas	1.3	5.0
Egypt	Crude oil	4.2	11.5
	Refined Petroleum Products	3.3	9.1
	Natural Gas	1.8	4.9

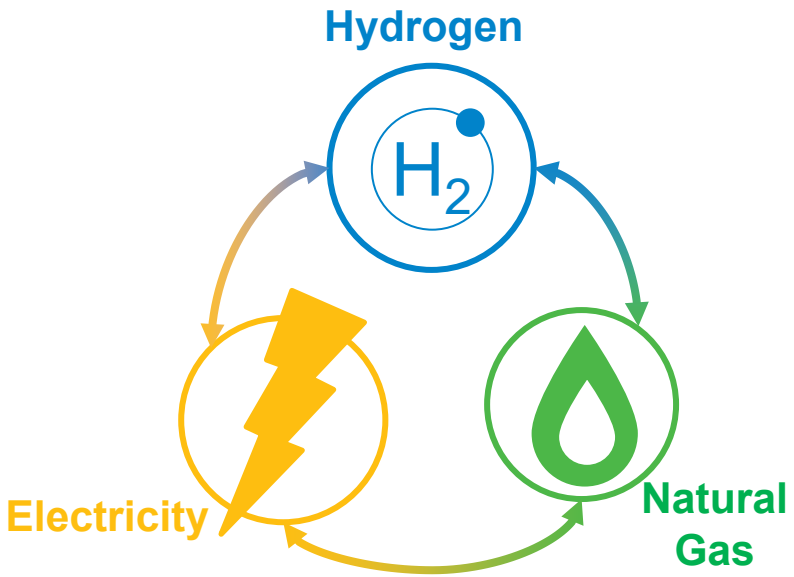
- The current **energy dialogue** among the 3 shores is based on oil and natural gas.
- **Oil from Southern** shore is **12.3%** of the total import of Northern and Eastern.
- Natural **gas from Southern** shore is **19.6%** of the total import of Northern and Eastern.
- **Algeria** and **Libya** are classified as "**rentier states**".

THE TRIPLET OF TRIANGLES

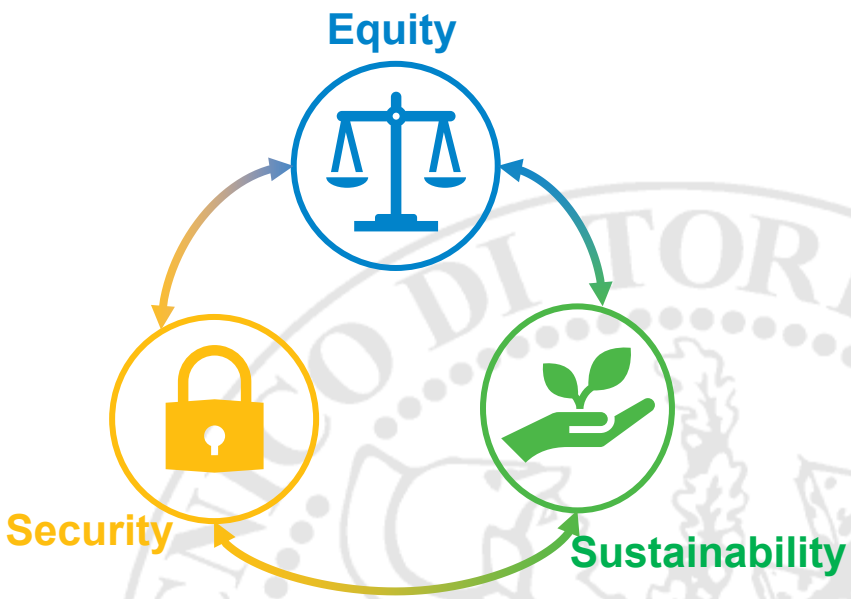
- The need for the **decarbonisation** of the energy system, and the consequent reduction of CO_2 and pollutant emissions implies an energy transition towards renewables and, therefore, a radical **change** of the current **energy dialogue** in the Mediterranean region.
- This **transition**, however, **cannot be conflicting with** the **social** and **economic development** of the region.
- For this reason, it cannot disregard the **interaction** among a **triplet** of **triangles**: a **geographical** triangle, a triangle of energy **attributes**, and a **commodity** triangle.



The Geographical Triangle

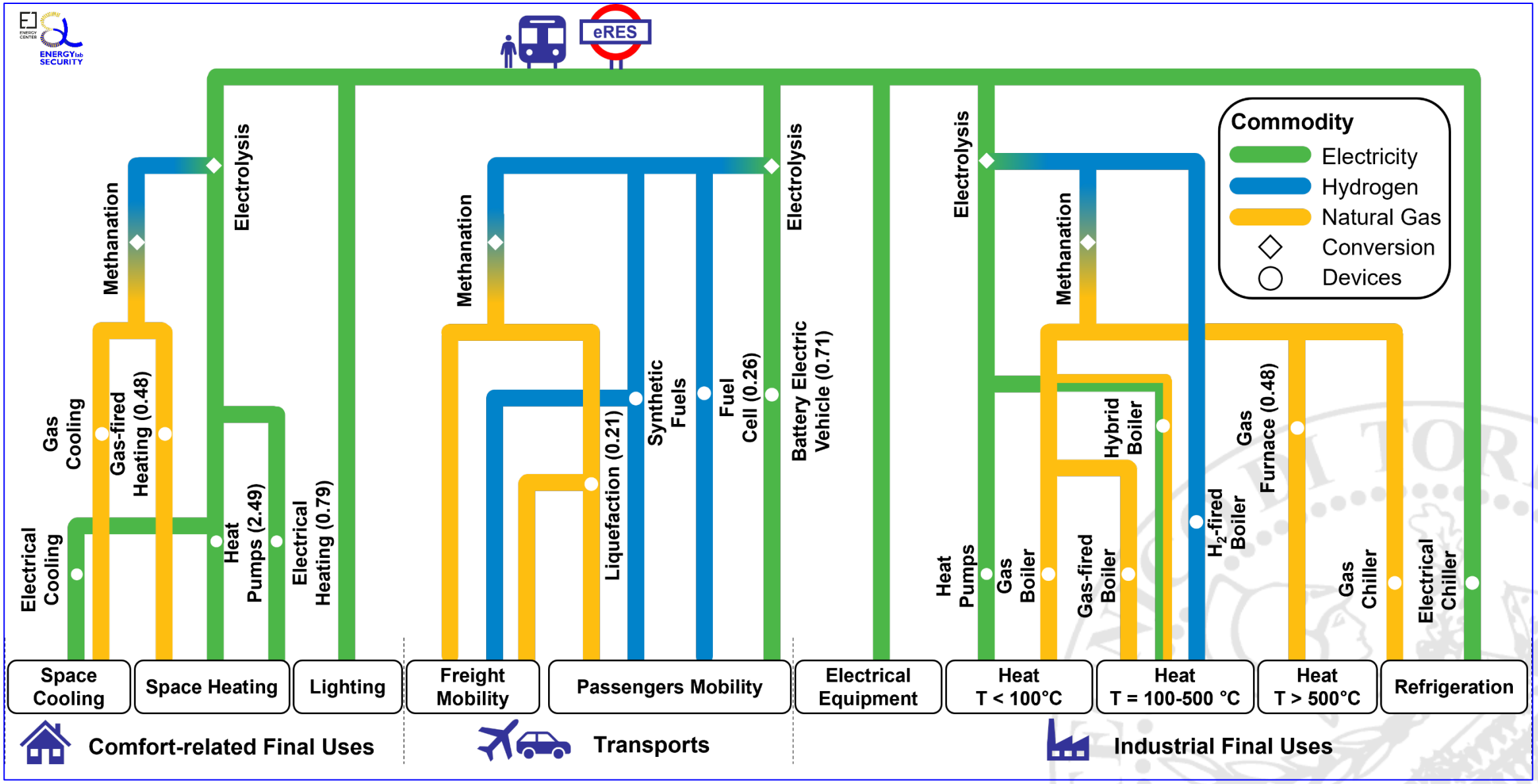


The Commodity Triangle



The Energy trilemma from the World Energy Council

THE "ENERGY UNDERGROUND"



THE REGULATORY FRAMEWORK

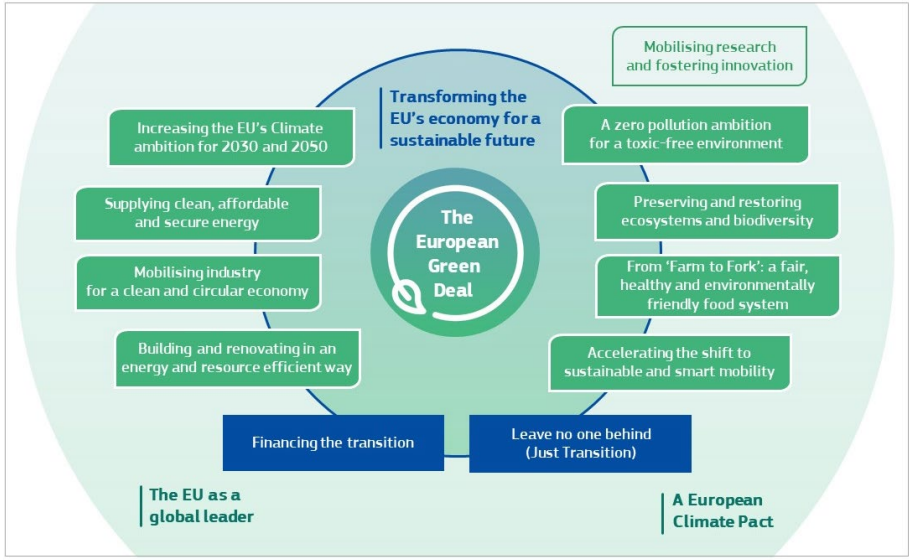
- The penetration of hydrogen and its role in the energy transition will be influenced by the presence of an ad hoc **policy** and a **regulatory framework** able to support them.
- **European** countries have already made a **step forward** in this direction:
  - Hydrogen is already included in the **Green Deal** strategy.
  - This strategy has been translated into specific targets on renewable energy, energy efficiency, and GHG emissions through the "**Fit for 55**" package in 2021.
  - Moreover, in 2020, the European Commission published the European **Hydrogen Strategy** and the **Energy System Integration strategy** (including hydrogen among its pillars).
- On the opposite, **Middle East** and **North African** regions sometimes still **lack organic strategies** on hydrogen penetration, **even if some countries** (Jordan, Qatar, Saudi Arabia, and Tunisia) have **identified hydrogen** as a commodity that can **help** in **achieving** their **sustainability** targets.


EUROPEAN COMMISSION

Brussels, 8.7.2020
COM(2020) 301 final

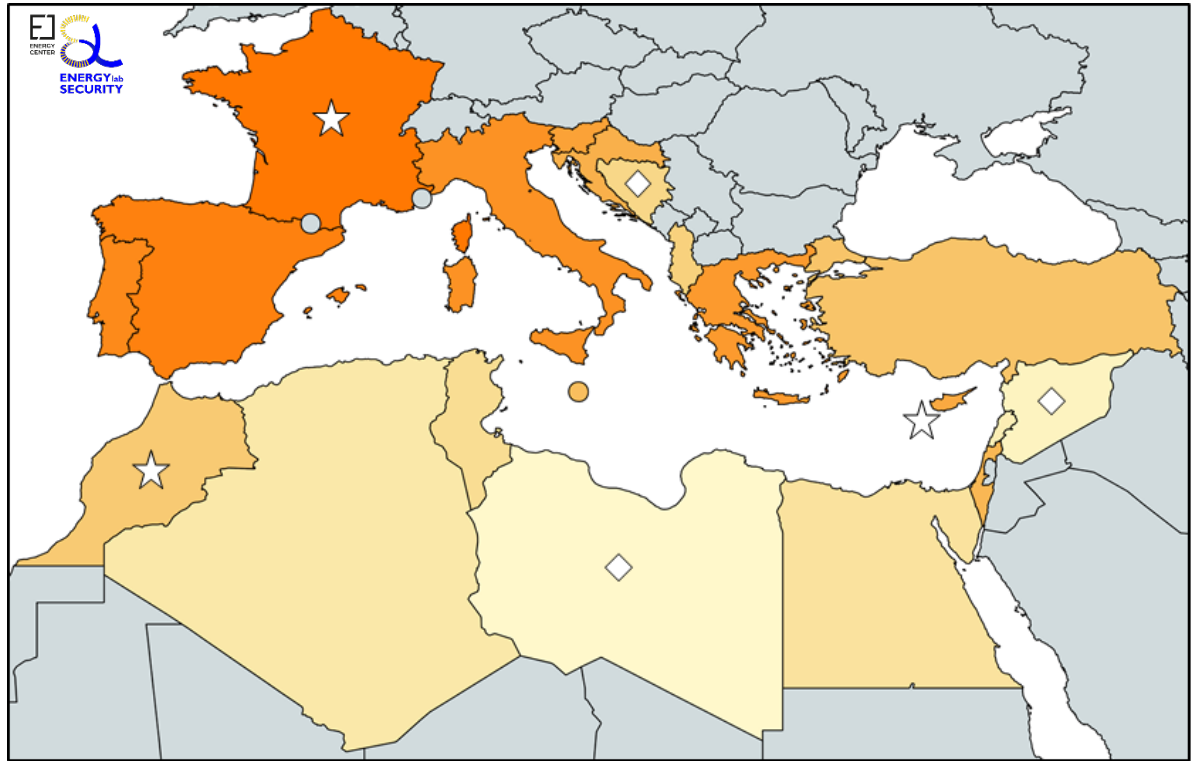
COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

A hydrogen strategy for a climate-neutral Europe



THE PREDISPOSITION TO GREEN HYDROGEN

- Ad hoc **supporting policies** influence the **penetration** of **hydrogen**. However, the implementation of hydrogen strategies **requires** a **predisposition** of the different countries in encouraging the green hydrogen adoption.
- A Multi-Criteria Decision Analysis (**MCDA**) has been performed, taking into account the **different dimensions** involved (**society**, **economy**, **geopolitics**, **environment**, **technology**). It shows that **Northern countries** are **more predisposed** to green hydrogen than Eastern and Southern ones.



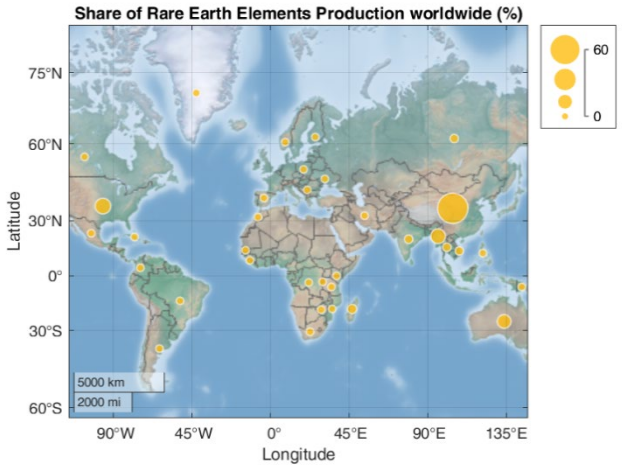
- The **best** performances are those of **France** and **Spain**, while **Libya** and **Syria** seem to be the **least** predisposed.
- On the Eastern shore, **Cyprus** and **Israel** show a **strong potential.**
- In **North Africa**, **Morocco** is the best performer, followed by **Tunisia**, even if both still have to solve geopolitical and social weaknesses to better exploit their renewable attractiveness.

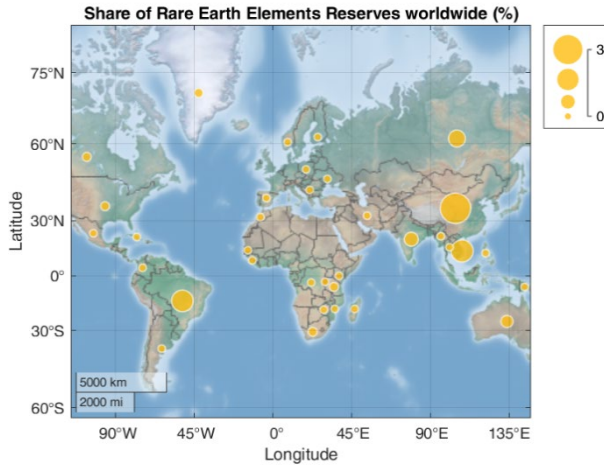
CRITICAL RAW MATERIALS IN HYDROGEN PRODUCTION

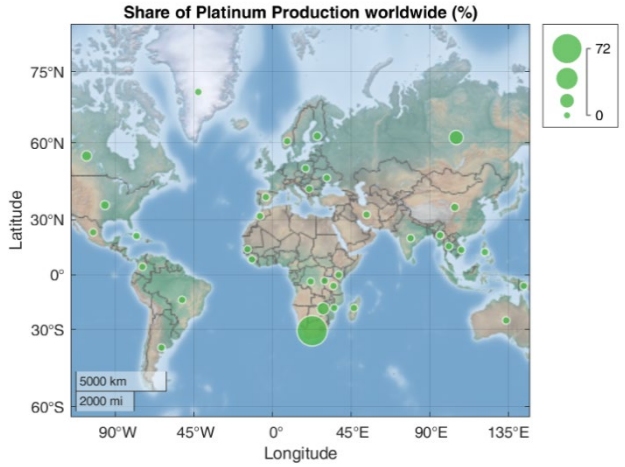
- The European Hydrogen Strategy plans to install at least 6 GW of **electrolysers** within 2024 and **40 GW** in 2030. The installations will involve:
  - **Alkaline** electrolysers (76%)
  - Proton Exchange Membrane (**PEM**) electrolysers (21%)
  - Solid Oxide Electrolysers (**SOE**) (3%)
- These technologies widely use **critical raw materials** (CRMs). Particularly:
  - the PEM technology deploys Platinum Group Materials (PGMs) and Titanium
  - the SOE technology makes an intensive use of Rare Earth Elements (REEs)
  - Alkaline electrolysers show a relative absence of critical materials, although in some cases they are doped or coated with noble metal-based electrocatalysts to improve the performances
- However, **research** efforts have been carried out to **reduce** or **substitute noble metals**, exploited as electrocatalysts in **PEM** technology. Noble-free catalysts, such as Mn-based oxides, are considered as possible actual electrocatalysts replacement in order to reduce as low as possible the deployment of critical materials in PEM.

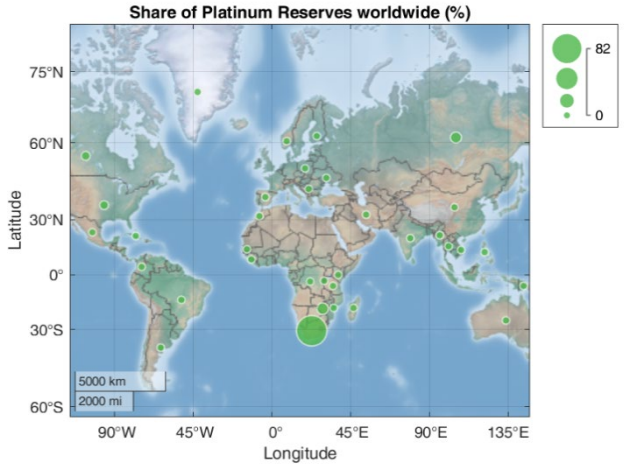
CRITICAL RAW MATERIALS IN HYDROGEN PRODUCTION

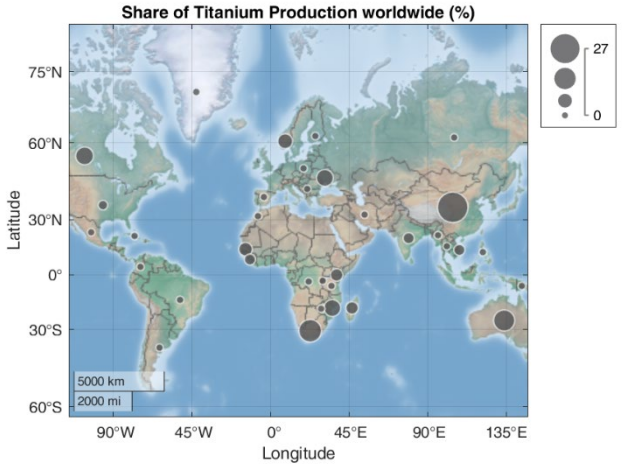
- The Platinum Group Materials (**PGMs**) are mainly located in **South Africa**, while Rare Earth Elements (**REEs**) are predominantly available in **China**. **Strontium** instead can be found mainly in **Spain**.

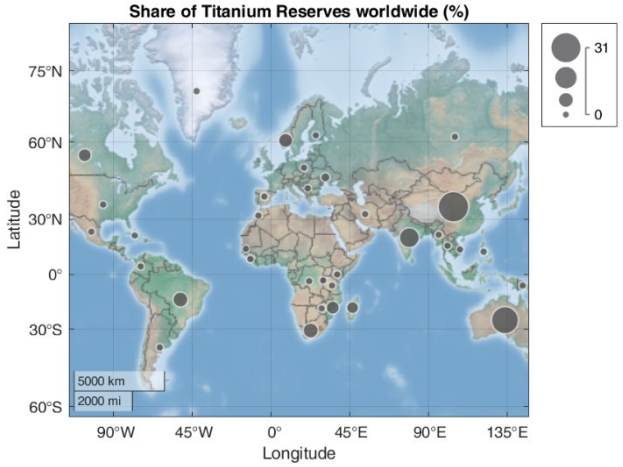


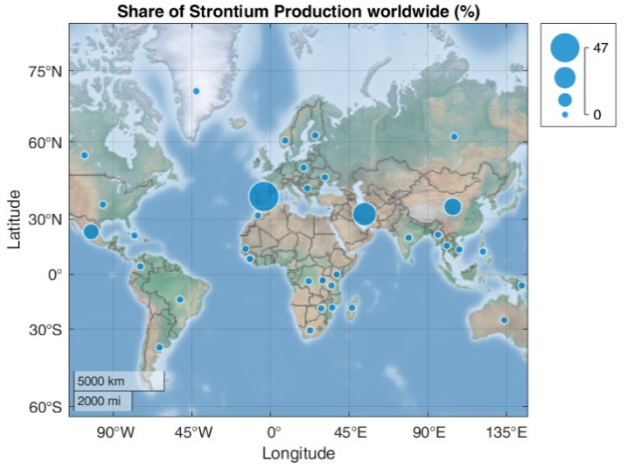


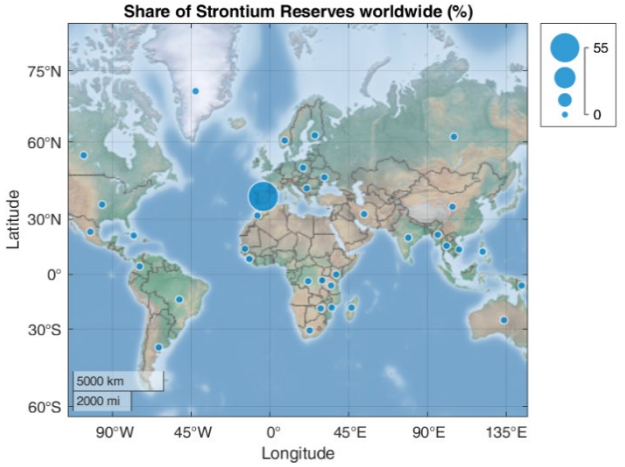






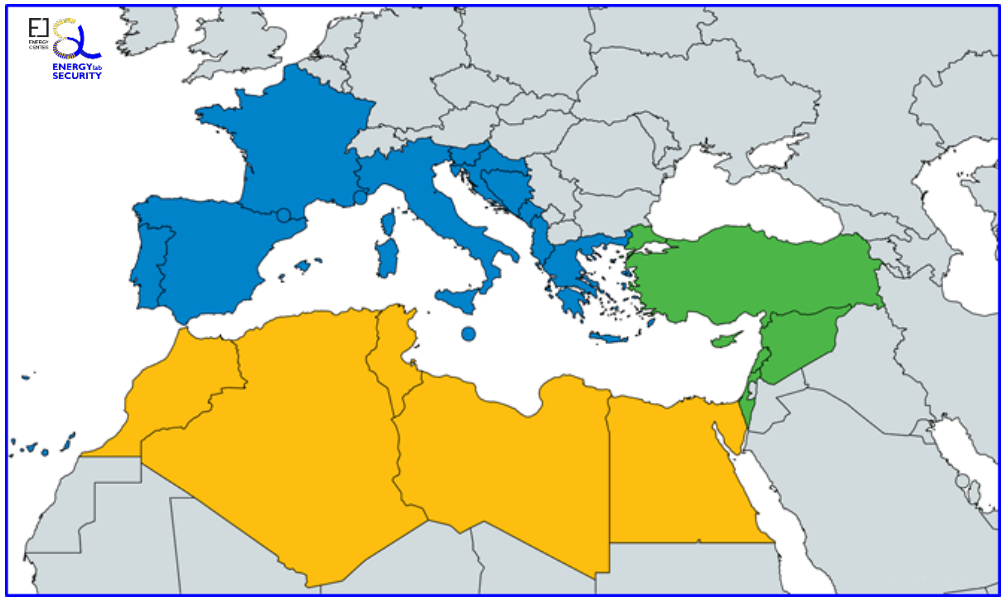


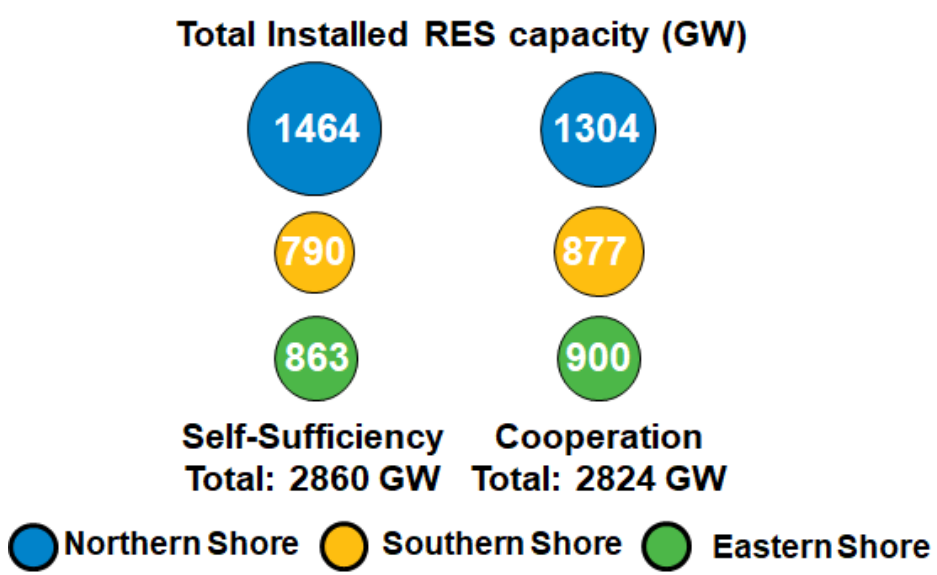




COOPERATION VS. SELF-SUFFICIENCY: A SCENARIO ANALYSIS

- A **scenario analysis** up to **2040**, with different hypotheses on **hydrogen penetration** and fulfilment of its demand, has been performed, evaluating the **RES** plants **capacity** to be installed for matching the **electrical** and **hydrogen demand** of the 3 shores.
- If a **high hydrogen penetration** (**25%** of the final energy uses of the 3 shores) is foreseen, a **cooperative approach** allows for satisfying the same hydrogen demand with an installed capacity **36 GW lower than** the one requested by a **self-sufficiency** approach, thanks to a **better exploitation** of the available **resources** of the whole region.
- The **reduction** in the installed capacity is particularly **relevant** in the **Northern** shore, with a positive sustainability effect, considering the relative scarcity of available land for the installation of RES power plants.





CONCLUSIONS

- The **interplay** among the **3** energy **commodities** that are expected to be crucial in implementing the energy transition (**electricity**, **hydrogen** and **gas**) will probably play a **key role** in the evolution of the Mediterranean energy mix.
- In particular, **hydrogen** can **not only** enhance **decarbonisation** of the Mediterranean region, **but** its value chain can be a **significant business perspective** for the whole area, thanks to the high exploitable RES potential, with positive economic impacts.
- The adoption of a **cooperative approach** in supporting hydrogen penetration can **enhance** the **social** and **economic development** of the **Eastern** and **Southern** countries, by creating a **new industrial chain** related to hydrogen supply and **new job positions**, leading to an **improvement** of the **living conditions** of citizens and possibly a **stabilization** of the area → more **harmonic development** of the entire region.
- A **new energy dialogue** built on **renewables**, with **electricity** and **hydrogen** as key commodities, can be therefore implements, substituting the “black” current on based on fossil fuels.
- This could at least partially **counteract** the negative **economic effects** related to the transition from fossils to RES, particularly in **countries** whose economy presently strongly **relies on oil** and **gas** industry (like Algeria and Libya).
- The role of **Critical Raw Materials** in hydrogen technologies, however, **require careful analyses** on the possible critical **geopolitical dependencies** that can arise.

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