ENERGY: A FOUNDATION FOR PROSPERITY AND STABILITY

Energy plays a crucial role in economic development and stability. The establishment of the European Coal & Steel Community in 1951 and Euratom in 1957 reflected the recognition of energy's importance in shaping Europe's future. European Union (EU) energy policy decisions are driven by a combination of technical, economic, environmental, political, legal and societal factors.

Currently, fossil fuels supply approximately 80% of the world's primary energy, a figure that has remained stable over the past 30 years[1]. Given the finite nature of these resources and the impact of fossil fuels on the global environment, transitioning to alternative solutions is an important consideration, particularly for the EU, which imports around 80% of its gas and over 90% of its oil[2]. Following the Paris Agreement (2015), the EU is committed to decarbonisation and is leading the path in this respect. From 1990 to 2022 the EU-27 reduced greenhouse gas (GHG) emissions[3] [4] by 33%. Over the same period, its share of global emissions dropped from 16% to 7%, due to the implementation of EU energy policies, industrial carbon leakage[5], and development of other nations. Meanwhile, global emissions increased by 65% between 1990 and 2022 [6].

The partial decarbonisation of the electricity sector contributed to this significant GHG emission reduction in the EU, notably through wind, solar and nuclear technologies, with fossil fuel backup systems to address the variability of the renewable components.

To continue reducing its emissions and reach net zero by 2050, the EU plans to increase its share of Variable Renewable Energy Sources (VRES), requiring, according to the most recent estimate by the European Commission, of the order of €10 trillion of investment by 2040[7]. While VRES technologies contribute to decarbonisation, increasing their share of the electric energy market poses significant challenges. Ensuring a continuous, affordable, and reliable energy supply requires the following points to be addressed:

i. Electrical grid stability and the ability to meet thermal energy demands remain key considerations for long-term energy planning.

Until efficient, scalable, and affordable energy storage systems become available, the widespread deployment of VRES will necessitate maintaining a balanced grid through dispatchable sources. These sources must be capable of meeting the entire power demand, primarily in the form of gas fired power plants due to their flexibility. These back-up solutions unavoidably emit GHGs. High penetration of VRES could therefore be hindered both by system cost[8] and decarbonisation targets.

ii. Carbon Capture and Storage [9] (CCS) technology makes energy production less efficient (typically 20% for a gas-fired power plant), more expensive and hinders EU competitiveness. Initially seen as a "bridge" towards a carbon-free economy, after more than 15 years of research and development a lack of progress makes it an unsuitable technology for its planned goal [10].

iii. Combining the hydrogen overall production efficiency (about 28% for the P2G2P process – power to gas to power) with, for example, wind capacity factor (24%) reveals [11] the massive scale and cost challenges in integrating H_2 in VRES energy systems, calling into question the viability of largescale deployment of H_2 for electricity production.

iv. Critical raw materials and, to a lesser extent, rare earths presently required for the energy transition and clean industrial development are becoming essential elements in our current energy strategy.

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The Draghi report [12] has recently highlighted the negative economic and industrial impacts of the current energy transition policies, including considerations related to increase of energy costs, technological innovation, and supply chain dependencies.

Effective energy policies must indeed balance three key factors, namely (a) security and reliability of energy supply, (b) low energy cost for households and industry, (c) minimal impact of energy systems on both local and global ecosystems.

Given the decarbonisation level that the EU has already reached, and points (i)-(iv) above, we recommend shifting priorities to enhance security of supply, affordability and sustainability of the energy system, considering the following points:

1. *Diversification of Energy Strategies*. The 1955 Messina Declaration [13] emphasized the importance of reliable and affordable energy. Under Article 194(2) of the Lisbon Treaty, Member States retain the ability to determine their own energy mix. Leveraging a diverse set of energy sources can help enhance security of supply, manage costs, and optimise national resources. Ensuring energy availability remains a key factor in achieving long-term sustainable development[14].

2. *Advancement of Nuclear Energy*. The Euratom Treaty [15] highlights the role of nuclear energy in supporting energy security. Extending the operational life of existing nuclear reactors and investing in advanced technologies, including Gen III+, Gen IV, and small modular reactors (SMRs), is presently contributing or will contribute to a stable and sovereign energy mix. R&D of breeder reactors and nuclear fuel recycling may allow to enhance longer-term energy independence while addressing resource constraints[16]. Development of nuclear fusion is another important component of a long-term strategy for energy independence.

3. *Support for Energy Research*. As electrification accelerates across the energy sector, the design and security of the electricity system become increasingly critical. R&D of energy storage, smart grids, and energy efficiency technologies are key for long-term competitiveness. Investment in a broad range of energy solutions can foster technological leadership and contribute to the global energy transition. By developing scalable and cost-effective energy solutions, along with recycling and sustainable policies, the EU can support sustainable development while strengthening its economic resilience.

4. *Thermal Energy Considerations*. Many sectors depend on reliable heat supply, which is currently provided mostly by natural gas. While ongoing research into advanced nuclear reactors and renewable heating solutions could provide future heat alternatives, natural gas remains an important transitional fuel. As a predominantly imported commodity, its use should be minimized, especially through energy efficiency measures. Additionally, the chemical industry depends on natural gas as a feedstock, further underscoring the importance of a secure and sustainable supply.

5. *Public Awareness and Education*. Providing fact-based information on energy topics can help improve public understanding and facilitate informed decision-making. Educational programs focused on energy systems, technological advancements, sustainable development and economic considerations can contribute to a well-informed society capable of engaging in constructive discussions on energy policy.

By considering a balanced approach that integrates diverse energy solutions, technological advancements, and economic sustainability, the EU can develop an energy strategy that supports long-term prosperity while affirming its commitment to environmental responsibility.

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