GIE Position Paper on the GIE Study by FfE, Consentec and Congas

"Unlocking Energy System Efficiency:
The Strategic Role of Hydrogen Infrastructure in Sector Coupling"

Takeaway messages

- Sector-coupling where electricity and molecules are closely interlinked pillars of the future energy system should be put at the centre of energy infrastructure developments.
- TYNDP scenarios should continue to be developed by ENTSOG, ENTSO-E and ENNOH, on an equal footing under oversight from ACER, with a strengthened role for Storage System Operators (SSOs).
- The revised TEN-E Regulation should empower the European Commission to develop de-risking measures including sufficient guarantees to incentivise investment in cross-border hydrogen networks and storages.
- Accelerate permit-granting procedures and recognise all hydrogen infrastructure projects, including hydrogen storages, as being of overriding public interest.
- Ensure electricity and hydrogen infrastructure offshore are planned on equal footing through coordinated ENTSO-E and ENNOH efforts.

1. Why is sector coupling fundamental for the EU energy system?

The necessity of resilient, well-connected and fit-for-purpose energy infrastructure across Europe has never been greater than it is right now.

Europe is currently in the midst of a transition that will fundamentally reshape the European energy system. The European Climate Law stipulates that the EU shall achieve net-zero emissions by 2050. Already in 2030, emissions should be reduced by 55% of their 1990 levels. To achieve this, the EU needs to reduce its use of fossil fuels and greatly increase the use of renewable energy. At the same time, there is a growing recognition that future energy policy should also focus on ensuring security of supply and energy affordability alongside emissions avoidance. Increasingly, stakeholders are asking the question of how these various goals can be united.

Secure and affordable energy supply forms the bedrock of European competitiveness in a globalised economy. A resilient energy system is also a diversified energy system. Recent geopolitical developments have shown the danger of overreliance on a small number of energy suppliers and the need for the EU to better prepare for potential future system shocks. In the context of EU targets for decarbonisation, energy affordability and resilience, it is absolutely vital that the EU utilise every possible option to realise the Energy Transition in the most efficient and cost-effective manner. Hydrogen, when efficiently coupled with electricity and other energy carriers, will play a key role in achieving these multiple goals.

Hydrogen can be used as a key enabler for an energy system based on renewables. The European electricity transmission grid faces widespread reinforcement needs with grid congestion issues already extreme and becoming systemic well before 2050. The strategic usage of electrolysers combined with hydrogen infrastructure construction can absorb renewables peaks and mitigate spatial stress patterns. Hydrogen-ready power plants will be key for the energy system to provide sufficient flexibility and enhance system resilience, while meeting balancing needs. Hydrogen can also provide a lifeline for energy intensive industries for which electrification would not be economically viable. Supported by hydrogen pipeline and large-volume (underground) storage infrastructure allowing access to the most economical production locations, both in the EU and beyond, hydrogen and other energy molecules can enable European industry to decarbonise in an affordable manner, securing European jobs and avoiding carbon leakage.

When used together with other energy carriers as part of an integrated multi-carrier energy system, hydrogen can supply crucial energy security for European customers. The mix of both domestic-EU hydrogen production as well as imports provides diversity and resilience.

The underlying requirement for this energy system is the coherent and coordinated planning and development of European energy infrastructure connecting the efficient production and consumption of electricity, hydrogen and other energy carriers. The challenge of developing infrastructure fit for the challenges of the twenty-first century will not be small. This study aims to demonstrate the role of hydrogen in maximising the benefits of sector-coupling for the operation of the future integrated EU energy system.

2. Coordinated approach to EU infrastructure planning

Coordinated infrastructure planning and scenario development between transmission system operators and storage system operators from electricity, hydrogen and natural gas is fundamentally necessary to ensure that a secure EU energy system is developed efficiently and economically. ENTSOG, ENNOH and ENTSO-E have decades of modelling expertise, command the system-level data needed for cross-vector planning, and operate transparent processes under ACER's oversight.

Considering the results of the study, certain recommendations could be made to improve current infrastructure planning and scenario development. Firstly, the electricity system should be planned considering the operational characteristics of other energy vectors, in particular the hydrogen system. As outlined in the study, hydrogen infrastructure is essential to ensuring the efficient use of electricity by providing much-needed flexibility across the EU energy system. A reliance on "electricity-system-only" flexibility options, such as battery storage, will cause an inefficient, overdesigned and unstable electricity system. The study results demonstrate that in the long run the cost-optimal build-up of the hydrogen system reduces the need for such electric flexibility options by around 30% compared to the current national trends scenarios. Only when combined with hydrogen infrastructure, can electricity production and renewables penetration be ensured in a cost-optimal manner. Secondly, the role of molecules storage facilities to provide stability and resilience for the EU energy system cannot be overlooked. Therefore, storage system operators should also be more directly included in EU infrastructure planning and scenario development. Augmenting the current infrastructure planning framework in this way will allow greater synergies between energy carriers and infrastructure operators and more efficient infrastructure development processes.

Key Policy Recommendations

- TYNDP scenarios should continue to be developed by ENTSOG, ENTSO-E and ENNOH, on an equal footing under oversight from ACER.

- The role of the SSOs in future TYNDP processes should be strengthened. At present, SSO involvement in the process is limited to consultation and participation in the TYNDP Stakeholder Reference Group. This ignores the crucial importance of molecules storage facilities for the efficient functioning of the EU energy system.
- The TYNDP scenario cycle should remain every two years. The EC proposal to extend the scenario cycle to “at least every four years” for electricity, hydrogen and gas is too long and misaligned with other key infrastructure development processes (e.g. national development plans definition; PCI/PMI selections). Especially for hydrogen, which is still in its emerging status, very dynamic developments are expected, which cannot be reflected by a 4-years cycle.

3. An EU-wide de-risking mechanism to ensure that investments in hydrogen infrastructure can be carried out in a timely manner to support EU industry and achieve EU climate targets

The development of EU-wide hydrogen infrastructure, including both cross-border transport corridors and large-scale and flexible storage options, is a crucial factor in the creation of a cost-effective EU energy system. As shown in our study, hydrogen infrastructure are expected to only account for less than 1% of total energy system cost with benefits far surpassing the initial investment needs. It is imperative that the EU now focus on the timely realisation of this infrastructure.

Multiple projects are already under way to ensure the timely development of the relevant hydrogen infrastructure with several projects expected to enter operation already by 2030. However, the hydrogen market remains immature when compared to other major energy carriers such as electricity and gas. As such, the development of hydrogen infrastructure projects is hampered by risks that need to be overcome (the so-called “chicken-or-the-egg dilemma”). To overcome these investment risks, several member states are implementing regulatory models designed to de-risk the investments in their domestic hydrogen infrastructure on a national level. These models include intertemporal cost-allocation mechanisms backed by a state guarantee, state subsidies, long-term capacity bookings and combinations thereof.

An EU-wide solution will also be necessary in order to realise the development of sufficient cross-border hydrogen infrastructure. This should take the form of de-risking measures that can be applicable across multiple member states together with a sufficient EU guarantee to incentivise such anticipatory investments. While the current discussion on de-risking focuses on the hydrogen transport corridors, comparable mechanisms will also be required to enable the development of complementary hydrogen storage facilities. As clearly depicted in the study, the development of hydrogen storage is a time-critical element due to ever-increasing congestion and flexibility issues in the electricity system.

It should be noted that, unfortunately, the EU Clean Energy Investment Strategy does not address these topics sufficiently. Instead, the strategy largely focuses on measures supporting electricity grid investments (e.g. considering liquidity issues faced by electricity TSOs) and does not address the risks and the initial revenue gap issues associated with anticipatory investments (such as those into hydrogen infrastructure). Therefore, it is imperative that the European Commission now also consider hydrogen-specific measures to ensure their timely and efficient development.

Key Policy Recommendations:

- The revised TEN-E Regulation should empower the EC to develop de-risking measures (e.g. the Inter-temporal cost-allocation mechanism) including sufficient guarantees to incentivise investment in cross-border hydrogen networks. These measures should be available to all hydrogen import corridors.
- Similar measures should also be developed to de-risk investments in hydrogen storage infrastructure.

4. Streamline permitting and administrative procedures

A considerable hurdle facing the repurposing or construction of hydrogen infrastructure are delays caused by extensive planning and permitting procedures. Cross-border permitting procedures must be aligned and accelerated including binding deadlines. As part of the EU Grids Package, permit-granting procedures are being revised in three EU directives. The proposals made in the Grids Package, including procedures that lead to tacit approval without timely response by the regulator are a promising step in the right direction. Measures have been proposed that will accelerate such procedures by recognising renewables production facilities and electricity infrastructure as projects of overriding public interest. Due to its key role in providing renewable and low-carbon energy for industrial users and its flexibility towards the electricity system, it is essential that these measures also be extended to renewable and low-carbon gases, in particular hydrogen infrastructure. Aligning permit-granting procedures across energy carriers will support co-ordinated planning and facilitate efficient infrastructure development.

Key Policy Recommendations:

- Amend the proposed directive to accelerate permit-granting procedures (2025/0400 (COD)) and to also recognise hydrogen infrastructure projects (including hydrogen storages) as being of overriding public interest.
- Build upon the proposals made by the Grids Package to further streamline cross-border permitting procedures.

5. Integrated approach to offshore development plans in which electricity and hydrogen networks cooperate to ensure efficient network planning

Offshore energy production will become an even more important source of electricity supply than it already is today. By 2050, almost 24% of Europe's installed renewable capacities will be offshore wind. Offshore hydrogen networks present an excellent opportunity to maximise the potential of offshore renewable energy generation. Already today a range of large-scale electrolyser projects are being developed in the North Sea, Baltic Sea, Atlantic Ocean and Mediterranean Sea. Hydrogen and integrated infrastructure provide system efficiency, affordability and sustainability.

The current regulatory framework does not adequately address offshore hydrogen infrastructure development and reduces it to a cursory high-level overview as part of the electricity network development plan conducted by ENTSO-E. This position is now outdated. A clear regulatory basis for the combined development of offshore electricity and hydrogen networks is of fundamental importance to ensure system efficiency and maximise renewables penetration. However, this basis remains lacking from the proposed revision within the EU Grids

Package. The joint development of offshore network planning by ENTSO-E and ENNOH would ensure the efficient development of energy infrastructure.

Key Policy Recommendations

- Ensure electricity and hydrogen are planned on equal footing through coordinated ENTSO-E and ENNOH efforts (with ENNOH in charge for the hydrogen part), requiring TEN-E Regulation amendments.
- Include offshore hydrogen in regional sea-basin coordination among Member States.
- Promote smart combinations of electricity and hydrogen infrastructure to reduce project costs and line congestion (bypass congestion through pipelines and storages).

6. Integration of Hydrogen in the Security of Supply Legislation

The current geopolitical environment has underlined the peril of over-reliance on a limited number of energy supply sources. In order to increase the resilience of the EU energy system, a diversification of energy carriers and supply sources – including both production inside the EU and imports from other regions – is necessary. As outlined by the study, hydrogen will play a key role in ensuring security of supply for the EU energy system. The ability to produce hydrogen both inside and outside the EU will enable liquid markets and make these less susceptible to shocks.

Natural gas and, in the future e hydrogen and other low-carbon/decarbonised molecules, also provide highly scalable flexibility options for the electricity system. The growing deployment of renewable, volatile electricity increases the need for clean, dispatchable baseload solutions which can guarantee clean energy generation during cold and cloudy winter days (*Dunkelflaute*). Molecules – natural gas today and hydrogen and biomethane in the future – are essential to secure constant energy flows to European citizens and households. In particular when combined with hydrogen storage, the size and scale of molecule-based flexibility would greatly reduce stress on the power grid and have a stabilising effect on EU electricity prices. The study results show that storage is of particular importance in the early phases of the EU-wide system development when congestion in the power grid caused by renewables is most acute and hydrogen infrastructure is still being developed.

The upcoming revision of the EU energy security of supply will adapt to new challenges and developments in the energy system. One element is the need for stronger interaction between the electricity, gas and hydrogen sectors against the background of the European climate agenda, which also has a Security of Supply dimension, besides the decarbonisation focus. The revised energy security framework needs to take these system needs into account.

Key Policy Recommendations

- Better integrate hydrogen into security of supply legislation, taking into account its potential for EU-production and EU-based storage.
- Ensure a holistic approach to resilience and security of supply by better considering how multiple energy carriers interact.
- Hydrogen infrastructure together with electrolysers and hydrogen-ready power plants must be explicitly recognized as system-relevant infrastructure for security of supply in the future electricity sector.

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