THE ROLE OF PROJECTS OF COMMON INTEREST IN REACHING EUROPEAN ENERGY POLICY TARGETS
— working title —

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Tags: resilience, infrastructure, energy system modelling, energy policy

43rd International Energy Workshop — relevant conference topics:
(1) Reaching net-zero emissions and climate neutrality • (2) Role of renewable energy in the energy transition • (3) Role of hydrogen, ammonia, e-fuels and e-methane in the energy transition • (4) Managing power system transitions — integration of variable renewable energy and power-to-X • (5) Sectoral pathways for the energy transition — transport, industry, and buildings • (6) Energy transition infrastructure — assessment of infrastructure to enable the energy transition, including electrical transmission, storage, EV charging, and hydrogen distribution, CCS and CDR • (12) Climate resilience of energy systems • (13) Utilisation of scenarios by governments

Summary

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Introduction and motivation

In the research project RESILIENT[1], our team develops the first truly multi-vector energy infrastructure planning tool that can handle uncertain environments. We build upon the open-source, widely-used, multi-vector energy planning tool PyPSA-Eur [2], and improve its ability to optimise energy infrastructure in a resilient way.

Methodology

We use the open-source, sector-coupled energy system model PyPSA-Eur [2] to optimise investment into generation, storage, and transmission infrastructure (including electricity, natural gas, hydrogen, CO_2, and Power-to-X conversion) as well as operation/dispatch. The model is spatially and temporally highly resolved and covers the entire European continent, including stocks of existing power plants, renewable potentials, and availability time series. It covers today's high-voltage transmission grid (AC 220 kV to 750 kV and DC 150 kV upwards) [3].

By accessing the REST API of the PCI-PMI Transparency Platform [1] and associated public project sheets provided by the European Commission, we implement the PCI-PMI projects into the PyPSA-Eur model to assess their impact in the power, heat, transport, industry, feedstock, and agriculture sector.

[1]https://resilient-project.github.io/

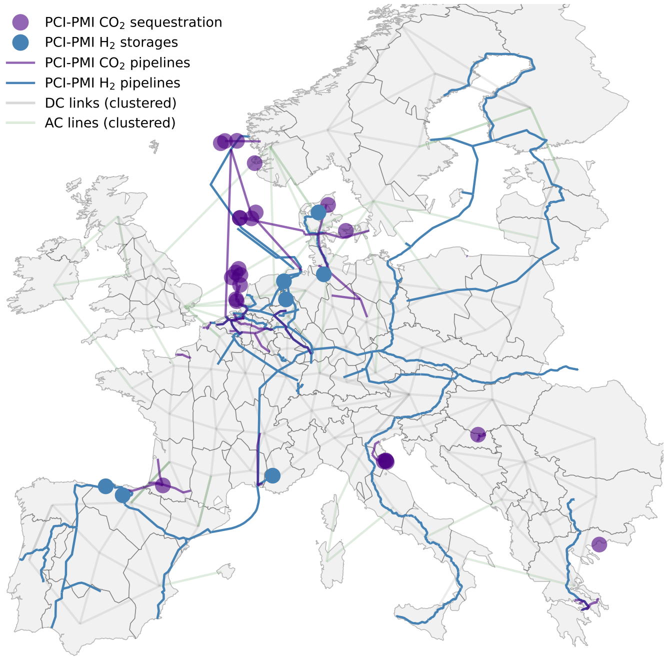


Figure 1: PCI-PMI projects implemented in the PyPSA-Eur model. Own illustration based on data from the European Commission [1].

Results (preliminary)

First results for the modelling year 2030 show that reaching the EU's 2030 H_2 production and CO_2 sequestration targets translates into around 20 bn. € p.a. in total system costs for all included sectors, with or without PCI-PMI infrastructure projects (see Figure 2).

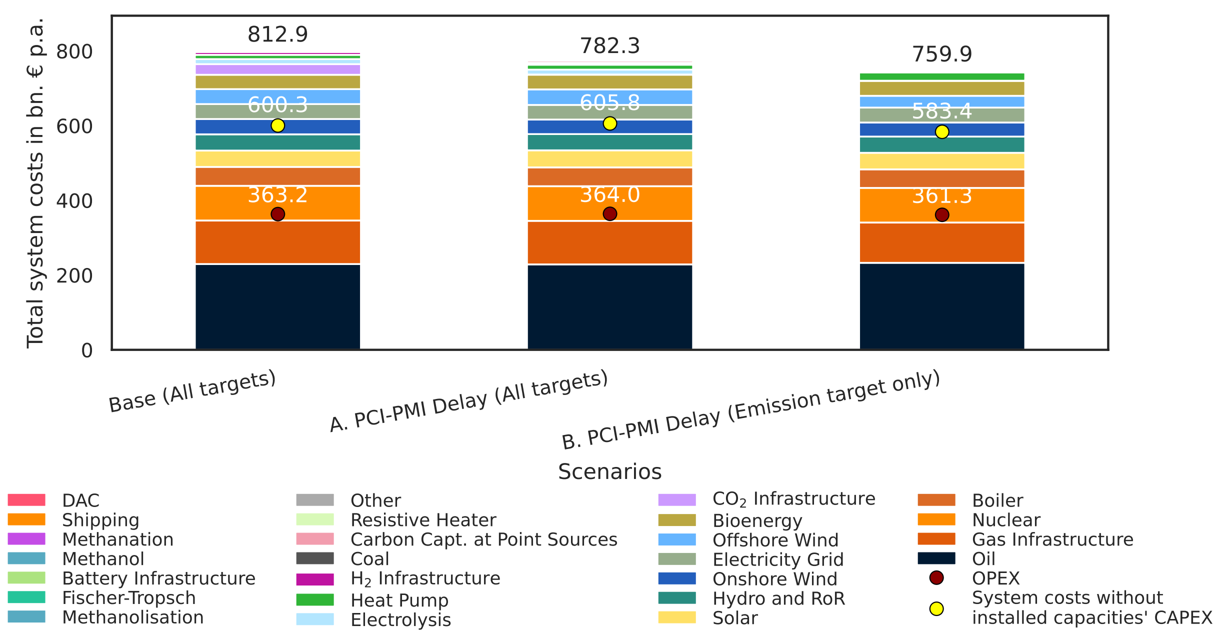
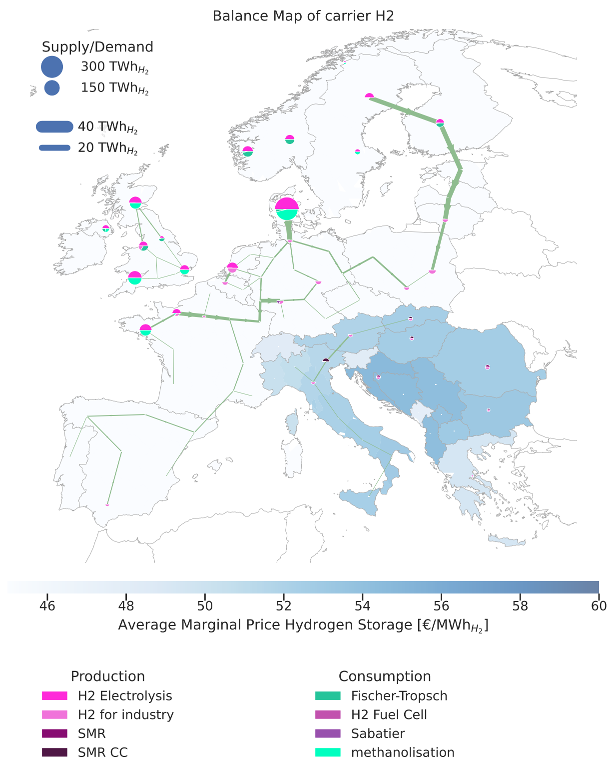


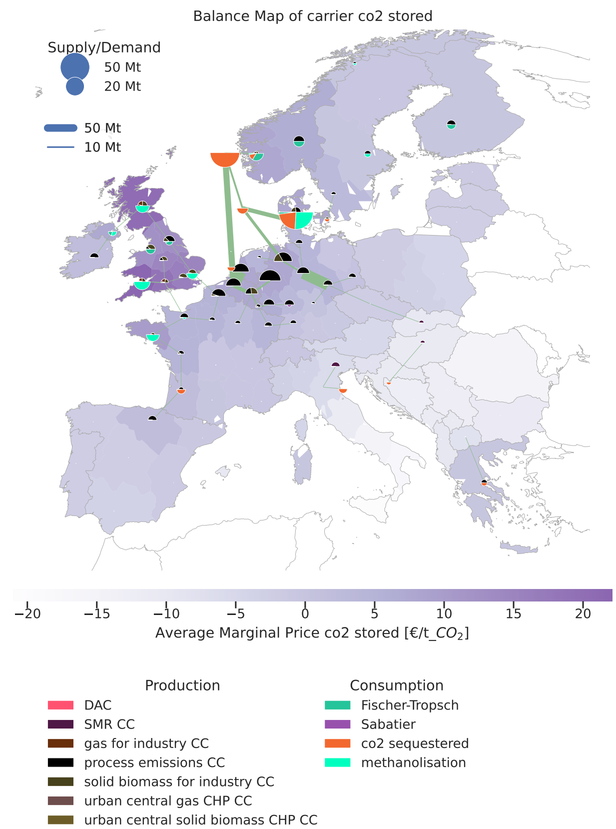
Figure 2: Results — Total system costs by technology and infrastructure. Own illustration.

By omitting an H_2 target, almost no electrolysers are installed. Around 8 Mt are still produced to cover industrial H_2 and methanol (primarily shipping) demand. However, this demand is met by decentral steam methane reforming instead of electrolysers. Setting an H_2 target may however be essential to kick-start the H_2 economy. H_2 is then primarily produced through electrolysis and used as a precursor for methanolisation to meet industrial and shipping demand.

Without specifying a CO_2 sequestration target, the system still captures and sequesters around 21 Mt of CO_2 p.a. primarily from process emissions in the industry sector.



(a) H_2 regional balances and flows.



(b) CO_2 regional balances and flows.

Figure 3: Results — Regional distribution of H_2 and CO_2 production, utilisation, storage, and transport. Own illustration.

Conclusion (preliminary)

We conclude that while all three EU policy targets for 2030 can be achieved without PCI-PMI infrastructure, they bring additional benefits: i) H_2 pipelines projects help distribute more affordable green H_2 from northern and south-western Europe to high-demand regions in central Europe; ii) CO_2 transport and storage projects help decarbonising the industry by connecting major industrial sites and their process emissions to offshore sequestration sites in the North Sea (Denmark, Norway, and the Netherlands).

Research outlook — Next steps include the implementation of remaining PCI-PMI projects, such as hybrid offshore interconnectors (energy islands), electricity storages, and CO_2 shipping routes. To evaluate the long-term value of PCI-PMI projects in a sector-coupled European energy system, we will model pathway dependencies towards 2050. We will also assess the sensitivity of the infrastructure to technology-specific build-out rates.

References

[1] European Commission. PCI-PMI transparency platform. Projects of Common Interest & Projects of Mutual Intereset - Interactive map. https://ec.europa.eu/energy/infrastructure/transparency_platform/map-viewer, 2024.

[2] Jonas Hörsch, Fabian Hofmann, David Schlachtberger, and Tom Brown. PyPSA-Eur: An open optimisation model of the European transmission system. *Energy Strategy Reviews*, 22:207–215, November 2018. ISSN 2211-467X. doi: 10.1016/j.esr.2018.08.012.

[3] Bobby Xiong, Davide Fioriti, Fabian Neumann, Iegor Riepin, and Tom Brown. Modelling the High-Voltage Grid Using Open Data for Europe and Beyond. *Preprint*, August 2024. doi: 10.48550/arXiv.2408.17178.