

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

— working title —

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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

On the pathway to a climate-neutral by 2050, the European Union (EU) has set ambitious targets for 2030, three of the most prominent including 55 % greenhouse gas emission reduction [2], 10 Mt p.a. green H₂ production [3], and 50 Mt p.a. CO₂ sequestration [7].

To support reaching these targets, the EU has identified a list of Projects of Common Interest (PCI) which are key cross-border infrastructure projects that link the energy systems of EU countries, ranging from storages, over transmission lines to pipelines and carbon sinks [4]. Projects of Mutual Interest (PMI) further include cooperations with countries outside the EU, such as the United Kingdom. In order for projects to be eligible for PCI-PMI status, their potential benefits need to outweigh their costs [4]. Given the political and lighthouse character, these projects are highly likely to be implemented. However, any large infrastructure project, including PCI-PMI projects, are commonly facing delays due to permitting, financing, procurement bottlenecks, etc. [1].

From the ambitious policy targets and the nature of PCI-PMI projects, we derive the following key research questions:

1. At what cost do we stick to reaching the EU policy targets?
2. How does a delay of PCI-PMI projects affect the system, its costs, and the ability to reach the EU policy targets?
3. What is the impact of missing the EU 2030 policy targets for CO₂ sequestration and H₂ production?

Methodology

We use the open-source, sector-coupled energy system model PyPSA-Eur [6] to optimise investment into generation, storage, and transmission infrastructure (including electricity, natural gas, hydrogen, CO₂, 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) [8].

Feature implementation By accessing the REST API of the PCI-PMI Transparency Platform [5] 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. Our implementation can adapt to the needs and configuration of the model, including selected technologies, geographical and temporal resolution, as well as the level of sector-coupling. An overview of the implemented PCI-PMI projects is shown in Figure 1.

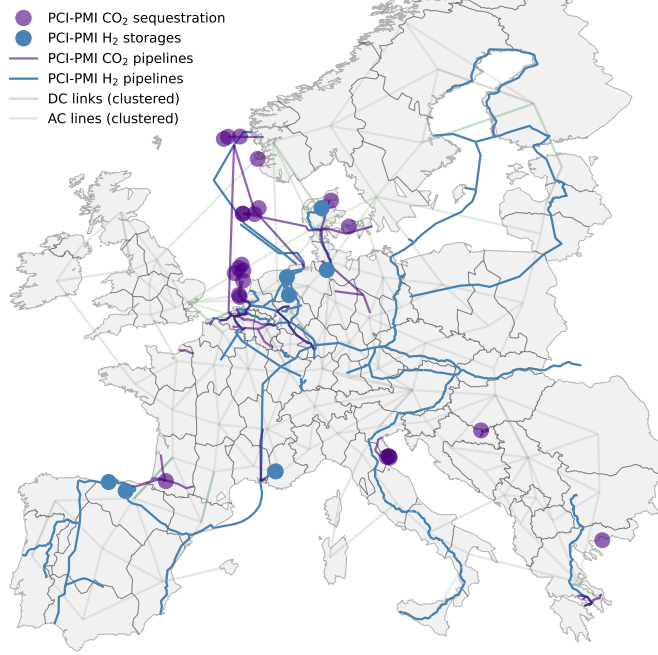


Figure 1: PCI-PMI projects implemented in the PyPSA-Eur model. Own illustration based on data from the European Commission [5].

Scenario setup As of the date of submission, we model three key scenarios for the target year 2030 which will set the base year for pathways towards 2050: a ‘Base’ scenario in which all all projects are commissioned on time and policy targets are achieved and two PCI-PMI delay scenarios ‘A’ and ‘B’. Table 1 gives an overview of the scenarios’ key assumptions.

Table 1: Scenarios setup. Own illustration.

Assumption \ Scenario	Base	A. All targets	B. Emission target only
PCI-PMI projects	on time	delayed	delayed
CO ₂ emission target	−55 %/2 Gt p.a.	−55 %/2 Gt p.a.	−55 %/2 Gt p.a.
CO ₂ sequestration target	50 Mt p.a.	50 Mt p.a.	—
H ₂ target	10 Mt p.a.	10 Mt p.a.	—
CO ₂ sequestration sites	PCI-PMI	endogeneous	endogeneous
CO ₂ pipelines	PCI-PMI + endogen. expansion	—	—
H ₂ storage	PCI-PMI	endogeneous	endogeneous
H ₂ pipelines	PCI-PMI + endogen. expansion	—	—
AC and DC transmission	PCI-PMI	—	—

Solving We solve all scenarios by minimising total system costs, resolving 34 countries to 90 buses at 3-hourly temporal resolution.

Results (preliminary)

First results for the modelling year 2030 show that reaching the EU's 2030 H₂ production and CO₂ 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).

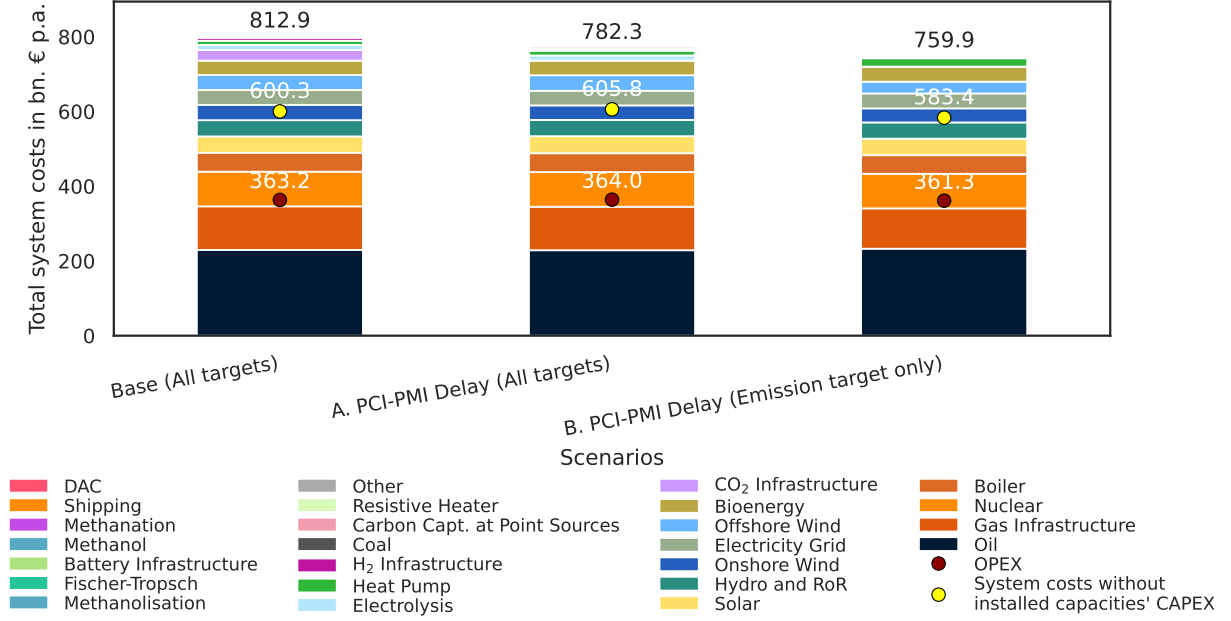


Figure 2: Results — Total system costs by technology and infrastructure. Own illustration.

By omitting an H₂ target, almost no electrolyzers are installed. Around 8Mt are still produced to cover industrial H₂ and methanol (primarily shipping) demand. However, this demand is met by decentral steam methane reforming instead of electrolyzers. Setting an H₂ target may however be essential to kick-start the H₂ economy. H₂ is then primarily produced through electrolysis and used as a precursor for methanolisation to meet industrial and shipping demand.

Without specifying a CO₂ sequestration target, the system still captures and sequesters around 21 Mt of CO₂ p.a. primarily from process emissions in the industry sector.

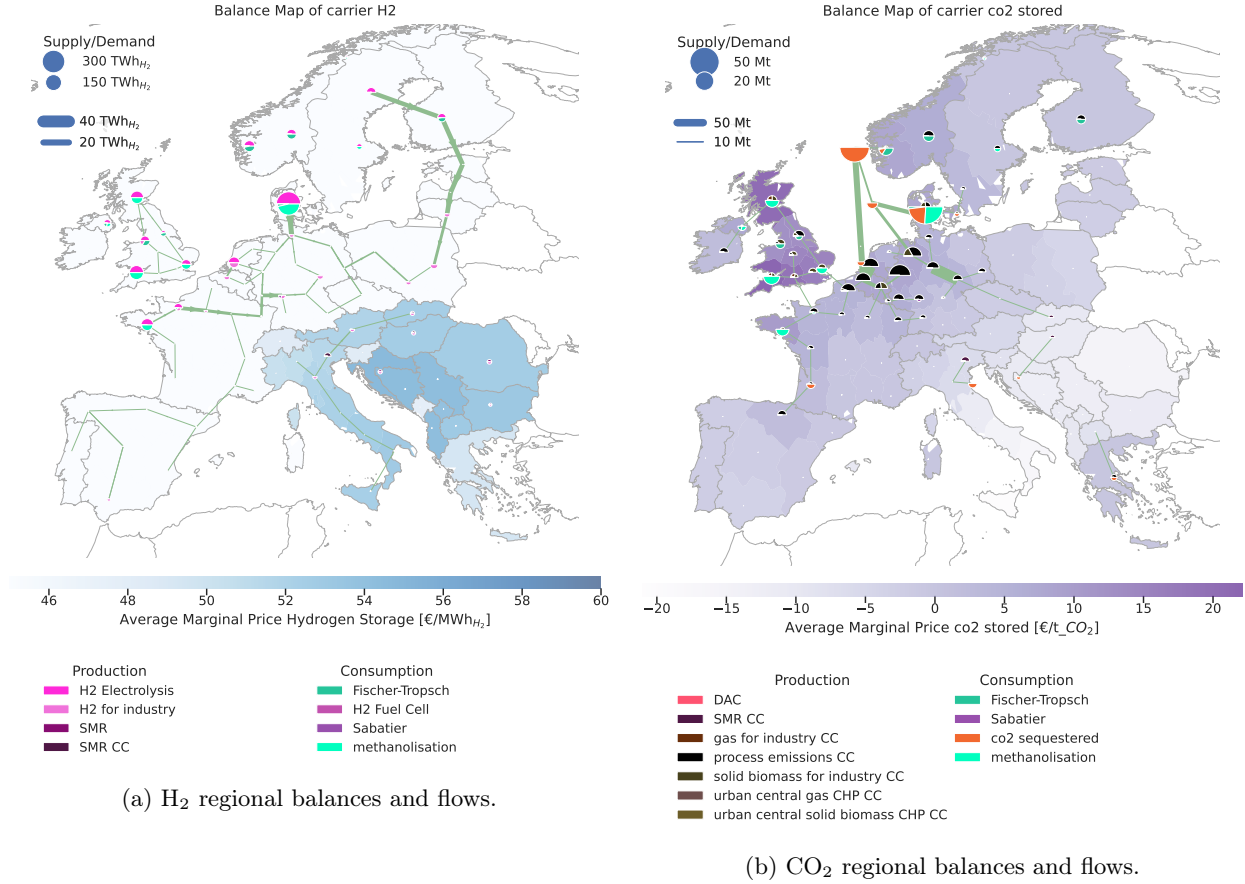


Figure 3: Results — Regional distribution of H₂ and CO₂ production, utilisation, storage, and transport. Own illustration.

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) H₂ pipelines projects help distribute more affordable green H₂ from northern and south-western Europe to high-demand regions in central Europe; ii) CO₂ 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 CO₂ 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.

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