Work in progress

Bridging the gap:

Comparing infrastructure deployment in long-term Energy System Models (ESMs) to real-world trends

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Our apologies — the slides with initial results shown during the conference cannot be shared as a PDF at this time, as the information is still a work in progress and pending publication.

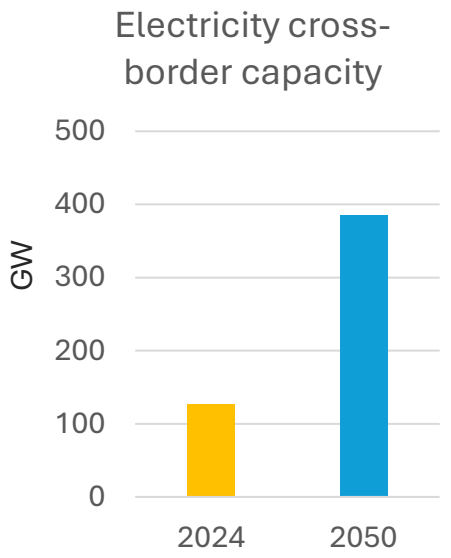
For any questions, please don't hesitate to contact us.

Context

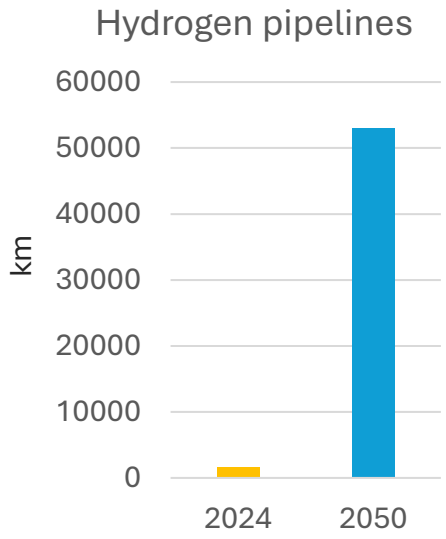
A low-emission energy system requires large-scale deployment of new infrastructure

Defined in this project as ‘the physical systems that transport and store energy from production to end use’. This includes grids, pipelines, terminals, storage facilities, and conversion infrastructure.

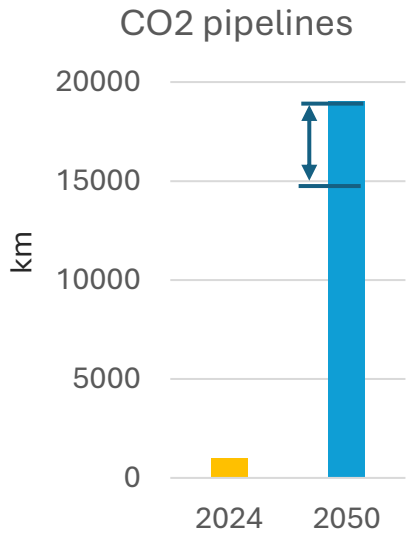
Examples of projected infrastructure needs for a low-emission energy system in Europe



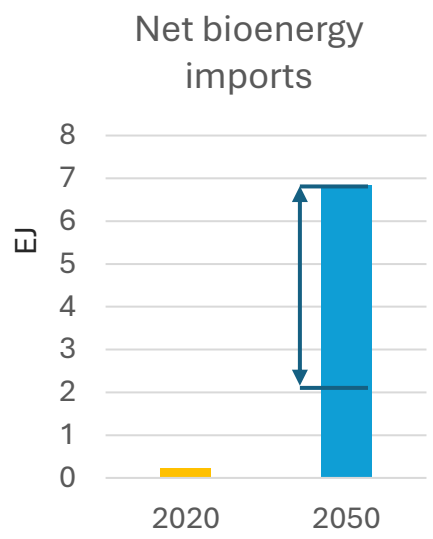
ENTSO-E (2025). System needs study



European Hydrogen Backbone (2025)



Tumara et al., (2024)



Mandley et al., (2020)

Context

Infrastructure deployment is a major bottleneck

The challenges that we encounter strongly influence the possible pathways to a low-emission energy future.


NEWS

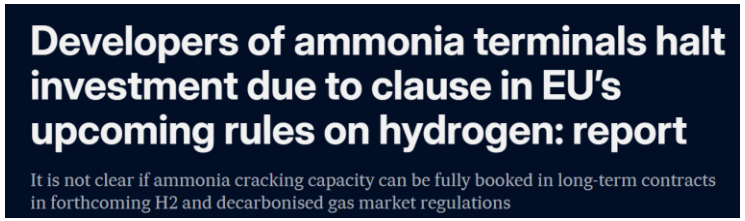
Grid delays stalling Colombia renewables expansion

Bnamericas

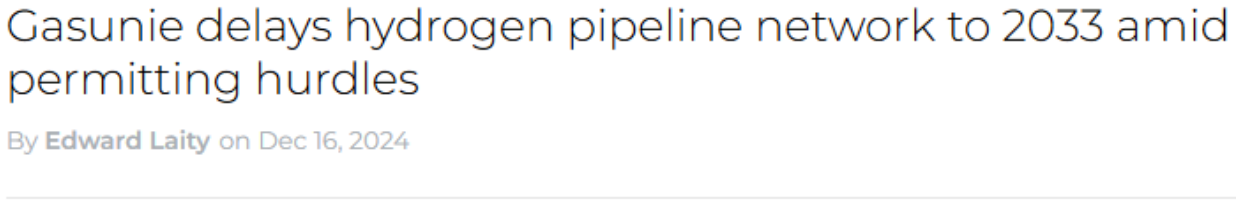
Published: Friday, May 23, 2025


Carbon capture projects facing delays around the world: Rystad CEO

Nearly half of all announced CCS projects are encountering hurdles, Jarand Rystad says


Developers of ammonia terminals halt investment due to clause in EU's upcoming rules on hydrogen: report

It is not clear if ammonia cracking capacity can be fully booked in long-term contracts in forthcoming H2 and decarbonised gas market regulations


Gasunie delays hydrogen pipeline network to 2033 amid permitting hurdles

By **Edward Laity** on Dec 16, 2024

Context

ESMs often overlook infrastructure deployment challenges

Raising doubts about the feasibility of modelled generation portfolios and transition pathways, while providing limited insight into which supply mixes might actually work.

Main research question:

In what ways is infrastructure deployment represented in long-term Energy System Models (ESMs), and to what extent are the identified transition pathways feasible considering empirical deployment data?

Approach: Empirically grounding analytics (EGA)

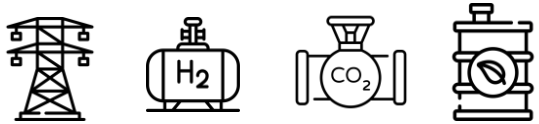
Comparing model outcomes with real-world data and observed system constraints

Step 1:

Analyze the **representation** of **infrastructure** in influential long-term **ESMs**

Elements:
- Stock
- Expansion mechanism
- Yearly growth constraints
- Lead time constraints
- Siting constraints

Scope:



Step 2:

Compare model **outcomes** with empirical deployment records and **real-world constraints**

Empirical data:
- Historic growth rates
- Current project pipelines
- Average project lead times

Step 3:

Suggestions for modelling **more feasible** infrastructure **deployment scenarios**

Thank you

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