Artelys | OPTIMIZATION SOLUTIONS

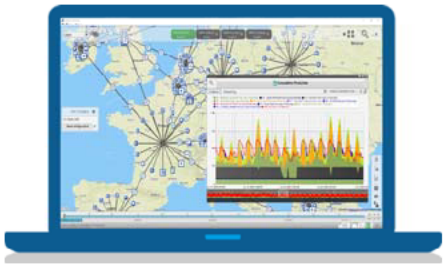
The future of hydrogen

Roundtable discussion

Artelys Belgium

Virtual meeting, 26 May 2020

Artelys - Short presentation and references



Artelys

Artelys is an **independent** consulting and software edition company specialised in decision support, modelling and energy systems optimisation.

Key references on the topic of hydrogen include:

- DG ENER – Development of a multi-energy modelling tool (METIS) and provision of 20+ studies, including on gas-electricity-heat interactions, development of 2050 energy scenarios, etc.
- DG ENER – Contribution of energy storage to the electricity security of supply in Europe, at the 2030 and 2050 horizons
- ENTSOG & ENTSO-E – Analysis of the impacts of interlinkages between electricity and gas systems on infrastructure project assessment
- ECF – A Perspective on Infrastructure and Energy Security In the Transition (recently updated)
- Project promoters – Cost-benefit analysis of investment projects, e.g. in electrolysers

The future role of hydrogen

Where do we see hydrogen playing a role?

Decarbonising the European economy will require using decarbonised gases, at least in sectors that cannot be electrified in a direct way. In the studies we have recently carried out, we find that hydrogen has a role to play in many sectors of the economy.

- In the **industry**, in particular for processes requiring high/very high grade heat (e.g. iron, steel, cement, etc.)
- For the provision of **heat**, in particular via hydrogen boilers as back-up of electric heat pumps that can help reduce the costs of electricity generation / network expansion.
- In **transport**, in particular after transformation in e-fuels (applications in e.g. heavy transport, long haul, maritime/aviation)

In a 2050 decarbonised energy system, electrolysers are likely to become the primary source of hydrogen. This interlinkage between the electricity and gas systems enables additional roles for hydrogen:

- Provision of **flexibility**: electrolysers could decrease operations during high residual load episodes, increase operations during periods of high RES output. Electrolysers can provide flexibility on various timescales (e.g. act as ”virtual” batteries, or via a power-to-gas-to-power loop for the provision of seasonal flexibility, etc.)

A holistic approach is required

Implications for system planning

Selecting a consistent set of projects (network infrastructure, RES, etc.) will be key to ensure we exploit synergies and avoid inefficiencies, such as:

Country A Electricity → H2	*simultaneously to*	Country B Gas → Electricity

Assessing the implications of the use of hydrogen on the infrastructure needs requires additional scenario-building efforts that should consider various options for the relevant end-uses:

Industrial/mobility end-uses – Electrolysis could be close to industrial clusters. The need for large-scale cross-border infrastructure would be limited in such a case.

Heating end-uses – If hydrogen is used to supply back-up of electric heat-pumps, one should study the economic implications for gas distribution networks (depending on the frequency of use of the back-up).

Flexibility end-uses – If electrolysers are used to provide flexibility to the power sector, it is likely that electrolysers will tend to develop in all countries, enabling to avoid investments in other flexibility solutions.

Implications for system planning and TEN-E

Step 1 - Scenario building

- ✓ The hydrogen infrastructure should be explicitly represented in the scenarios, as well as blending.
- ✓ Scenarios with various options for the provision of hydrogen should be explored (e.g. role of hydrogen imports, RES dedicated to electrolysers or connected to the electricity network, centralised *vs* decentralised approach, etc.)

Step 2 - Project assessment

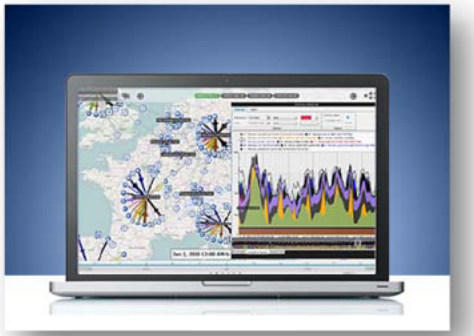
- ✓ The use of an interlinked model to perform the assessment is key if we are to explore ambitious P2X scenarios.
- ✓ A specific cost-benefit methodology may be required for hydrogen infrastructure (the drivers for investments in hydrogen infrastructure are different from the ones for conventional gas, other indicators might be required)

Step 3 – Selection of PCIs

- ✓ The selection of PCIs should consider all time horizons (incl. 2050 to ensure they are future-proof), and recognise the interactions between energy vectors/sectors (rather than independently selecting gas and electricity projects)

Thank you for your attention!

We would be pleased to share the results of upcoming studies with DG ENER, and potential insights that could be useful for the revision of the TEN-E regulation.



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