



Le réseau
de transport
d'électricité

How can flexible hydrogen production contribute to the power system?

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As part of its legal duties, RTE analyzes the issues related to the development of low-carbon hydrogen produced by electrolysis

- As part of its legal responsibilities (Article L 141.8 of the Energy Code), **the role of RTE is to provide insights into the challenges associated with the medium- and long-term evolution of the energy and electricity system.**
- RTE regularly analyzes the challenges related to the development of hydrogen production via electrolysis.



Hydrogen report
jan. 2020



Energy pathways to 2050
Oct. 2021



RTE-Natran Study
Aug. 2023



Adequacy Report 2023
Sept. 2023



**2040 French Power System:
Perspectives and Analyses**

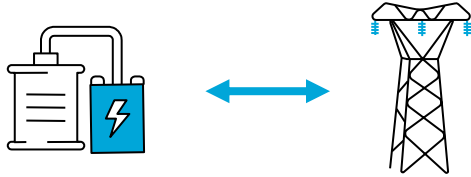


Key questions:

- What are the projected levels of hydrogen production via electrolysis in France?
- What are the electricity needs?
- What are the possible operating modes and implications for the power system?
- What are the production costs? What is the carbon content?

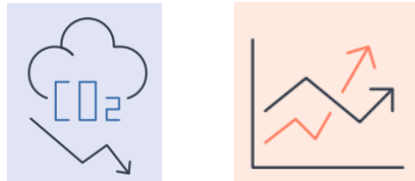


What could be the role of hydrogen in the next decades according to RTE' work ?



Today :

>> ~ 10 GW of hydrogen and derivatives projects have shown the will to connect to the power transmission network ; ~300 MW in construction



2025

Before 2040 :

>> Develop hydrogen to decarbonize current hydrogen uses and replace fossil fuels and coal in industry or freight transport

>> **Opportunities to develop power-to-X flexibility**

Today

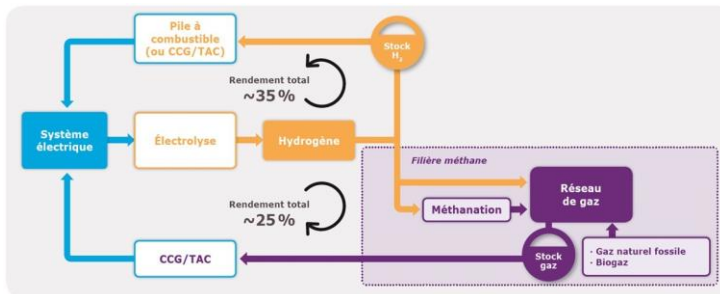
2040

After 2040 :

>> Keep decarbonizing and developing power-to-X flexibility

>> **Opportunities to develop gas-to-power to help the power system**

(depending on electricity consumption and choices about the development nuclear and renewables)

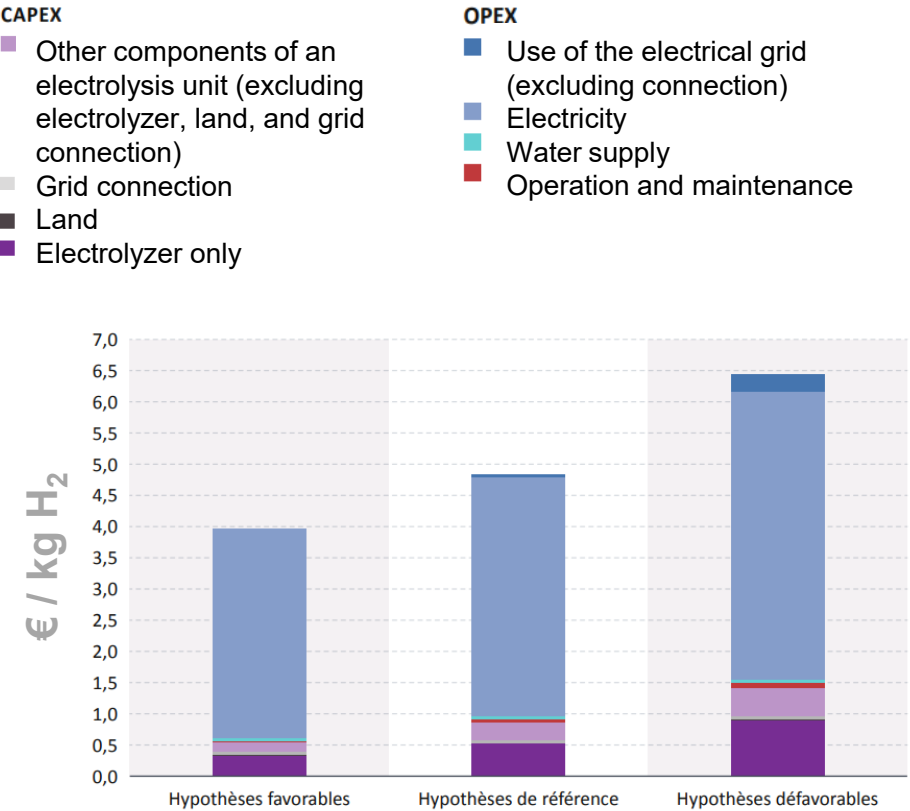




Hydrogen has a role to play in the energy transition, but its cost remains high for the moment.

An encouraging signal for 2030 : Hydrogen could cost between 4 and 7 €/kg...

...which is, so far, not reflected in the available real costs and prices.



Perspective studies

- IEA - Levelised Cost of Hydrogen Maps [2023]
- Hydrogen Council - Global hydrogen flows - update [2023]
- PWC - Green hydrogen economy [2021]
- Rocky Mountain Institute - The value of green hydrogen trade for Europe [2023]
- BNEF - 2023 Hydrogen levelized cost update [2023]

Announced real costs and prices

- European Hydrogen Bank - Résultats appel d'offres - Moyenne Europe [2024]
- European Hydrogen Bank - Résultats appel d'offres - France [2024]
- European Hydrogen Bank - Résultats appel d'offres - Allemagne [2024]
- European Hydrogen Bank - Résultats appel d'offres - Pologne [2024]
- EEX - HYDRIX Index [2024]
- Clean Hydrogen Partnership - Hydrogen cost in hydrogen valleys [2024]
- BCG - Turning the european green hydrogen dream into reality [2024]
- Total Energie - Résultat appel d'offres [2024]
- Iberdrola - Interview [2024]
- ArcelorMittal - Interview [2024]
- TNO - Evaluation of LCOH based on proposed electrolyser projects in the Netherlands [2024]

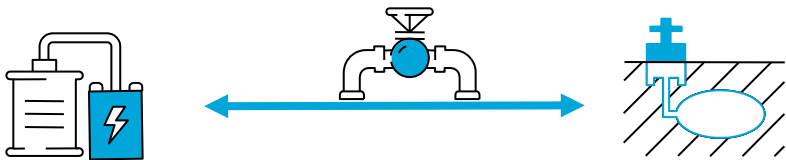


The flexibility of electrolyzers and competitiveness of imports from cheap renewables are the main levers to reduce the cost of production

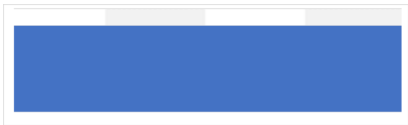
→ The effective adoption of hydrogen will partly depend on the ability to reduce its production cost :

Making hydrogen production via electrolysis more flexible benefits the power system and helps lower hydrogen production costs.

Connecting salt cavern storage to electrolyzers enables to develop an enhanced flexibility in electricity consumption.



Without flexibility



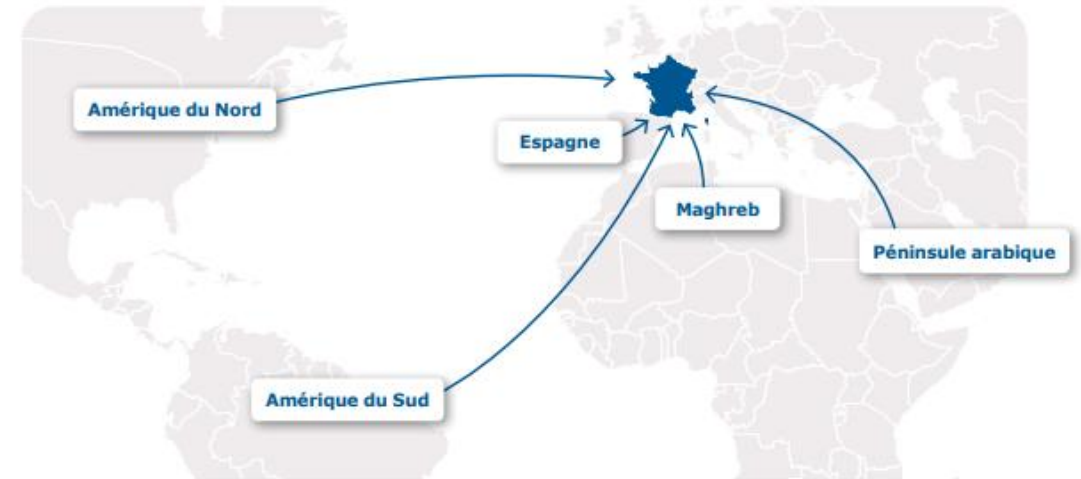
**In line with the power system
needs**



~ -1 €/kg H_2

Countries with abundant and low-cost renewable resources may be able to export hydrogen or its derivatives at highly competitive prices.

Projected commercial pathways for the import of decarbonized hydrogen by 2050 (Energy Pathways to 2050 – RTE 2021)

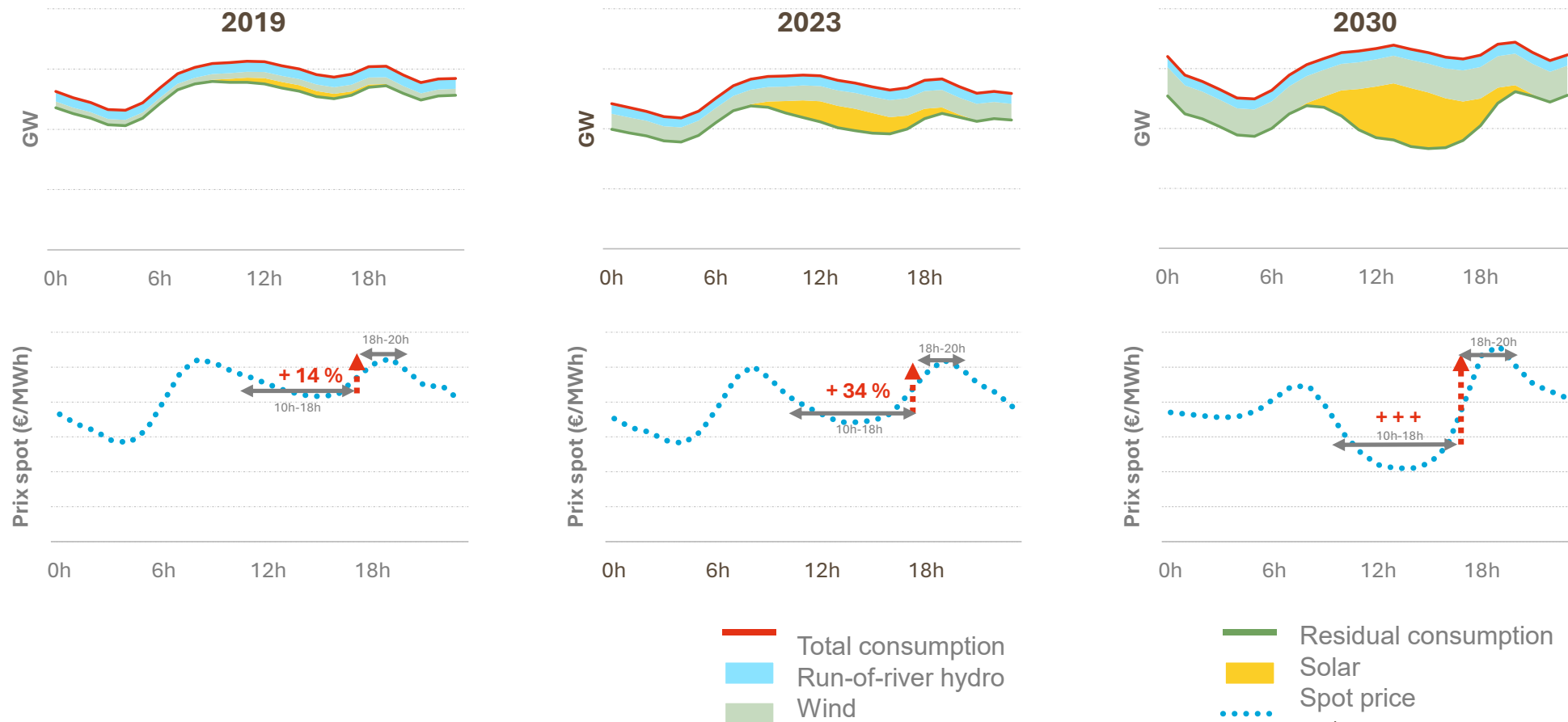


~ - 1 €/kg H_2



A simple example to understand how the power system evolves, and the associated opportunities

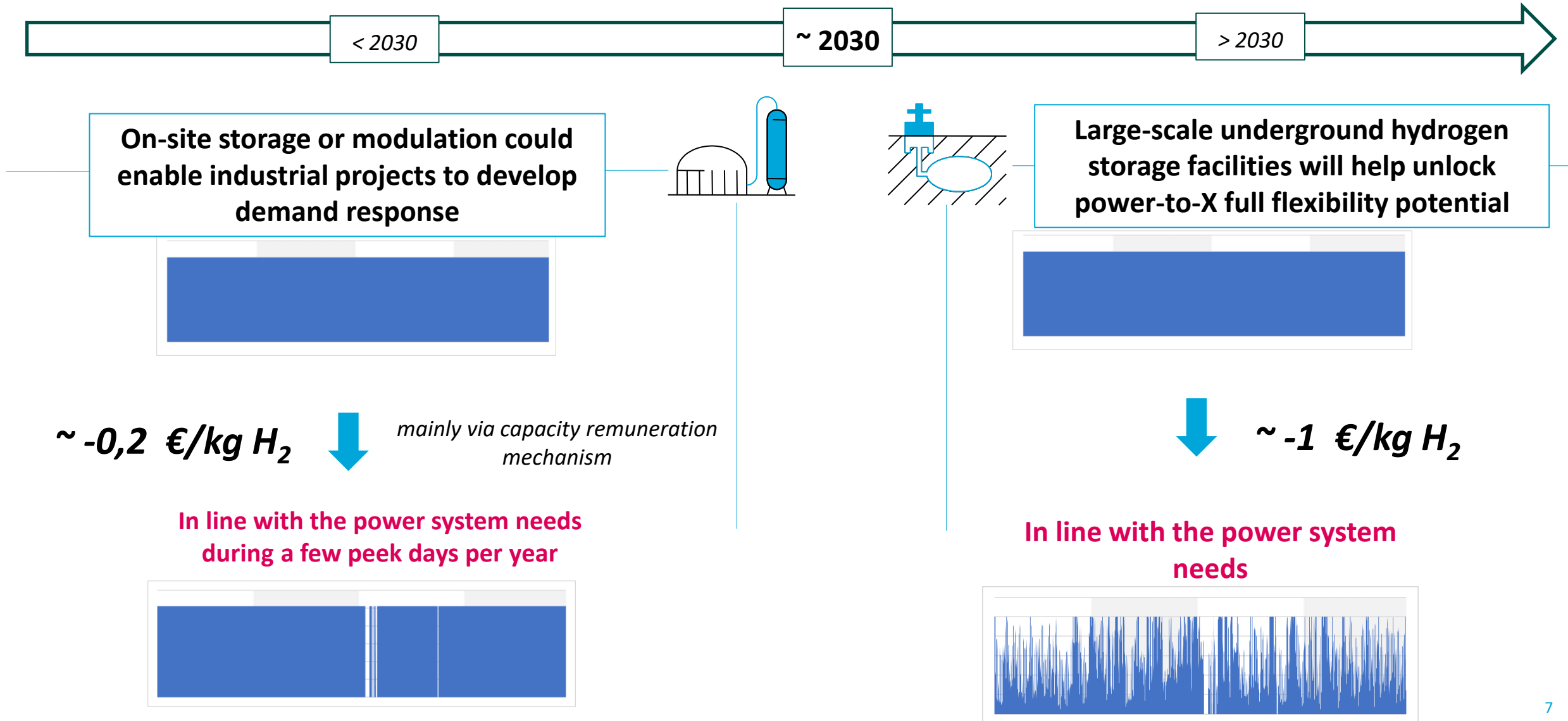
Evolution of the residual demand curve and spot electricity price profile for an average day



Wholesale electricity price dynamics enable electrolyzers to optimize power intake and hydrogen output through flexible operations. But how to ensure the hydrogen feed is uninterrupted ?



In France, salt cavern storage will not be available before at least 2030. However, demand side response could be a first step for electrolyzers to develop their flexibility





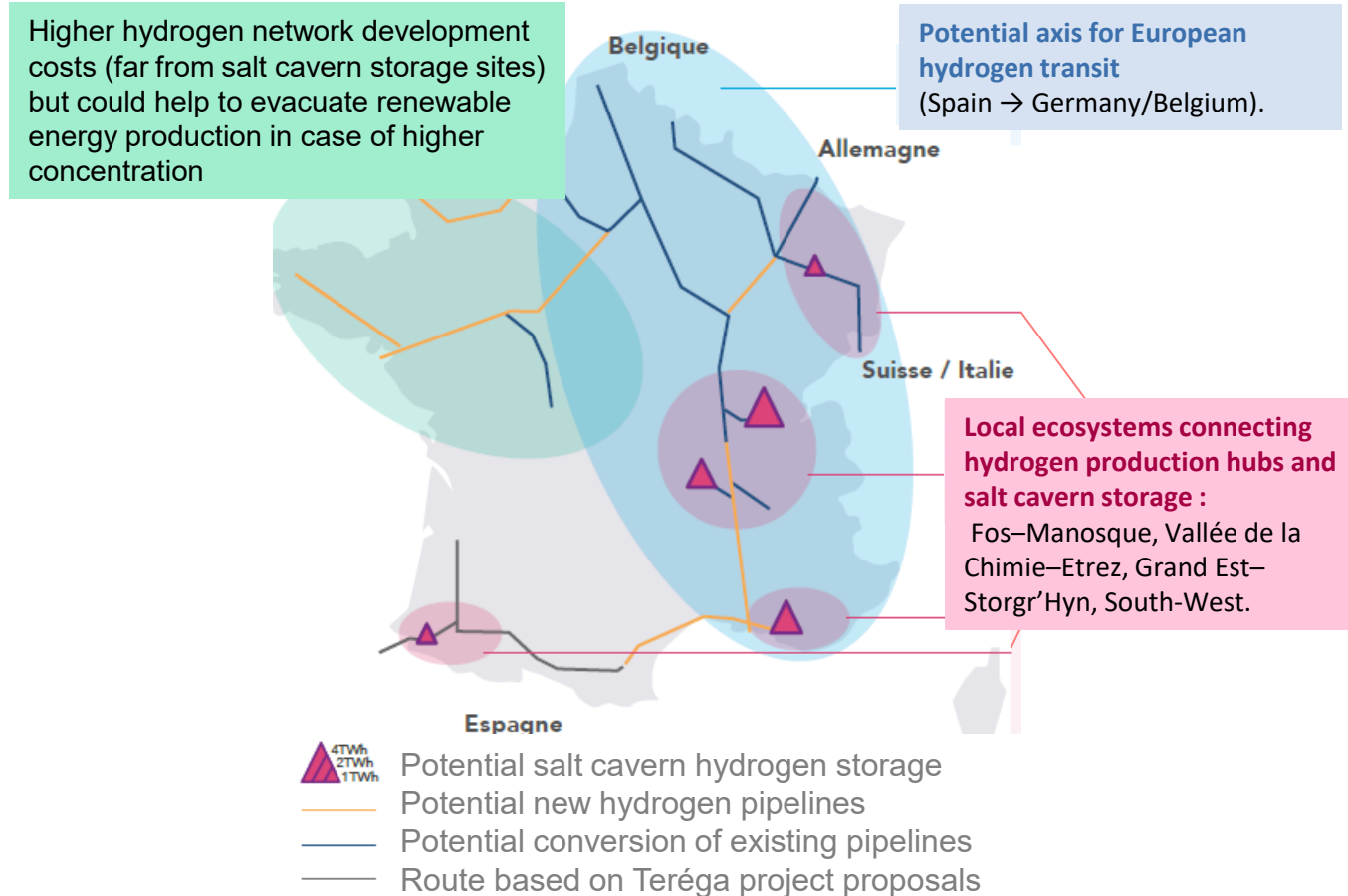
Conclusion

In the long run, underground hydrogen storage is the principal driver of the flexibility of hydrogen production

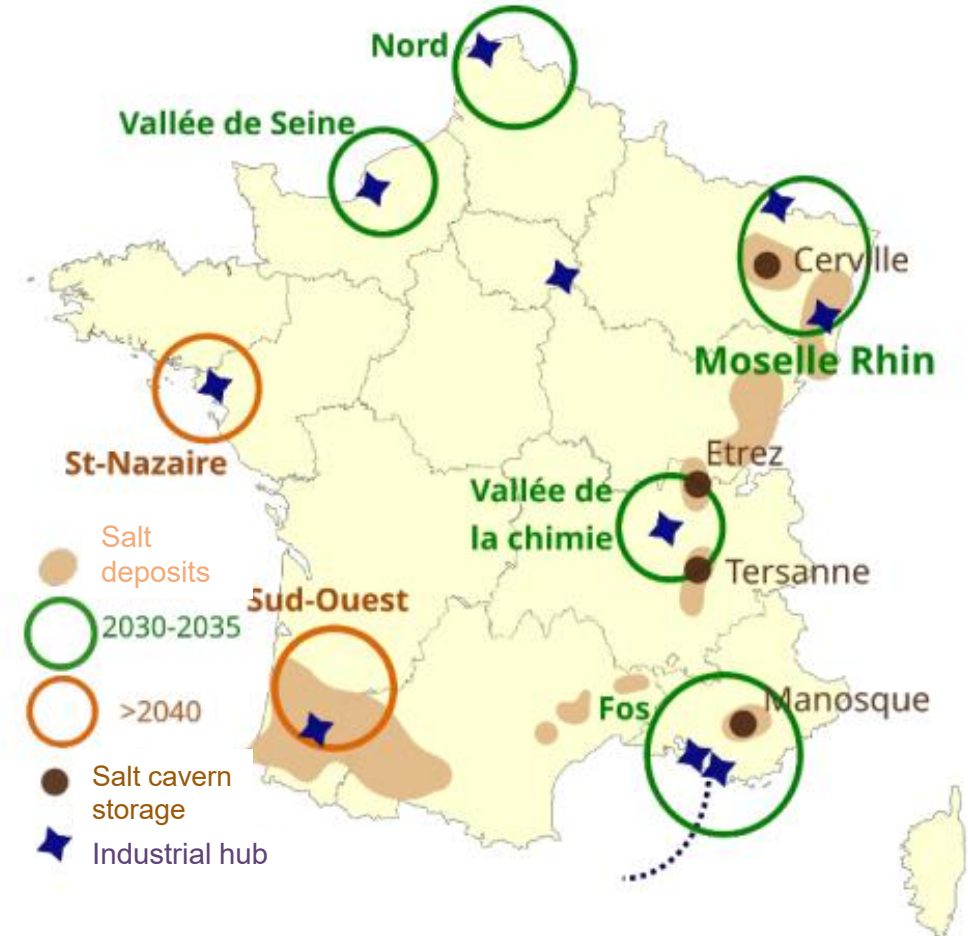
In 2050, the main value of hydrogen infrastructure in France is the connection to hydrogen storage rather than the reduction of power transmission costs



Before 2040, the priority is to develop local ecosystems to connect hydrogen hubs with underground hydrogen storage



Long-term vision of the hydrogen infrastructure from the RTE-Natran study



Roadmap for the development of hydrogen hubs in the French national hydrogen strategy



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Merci !