



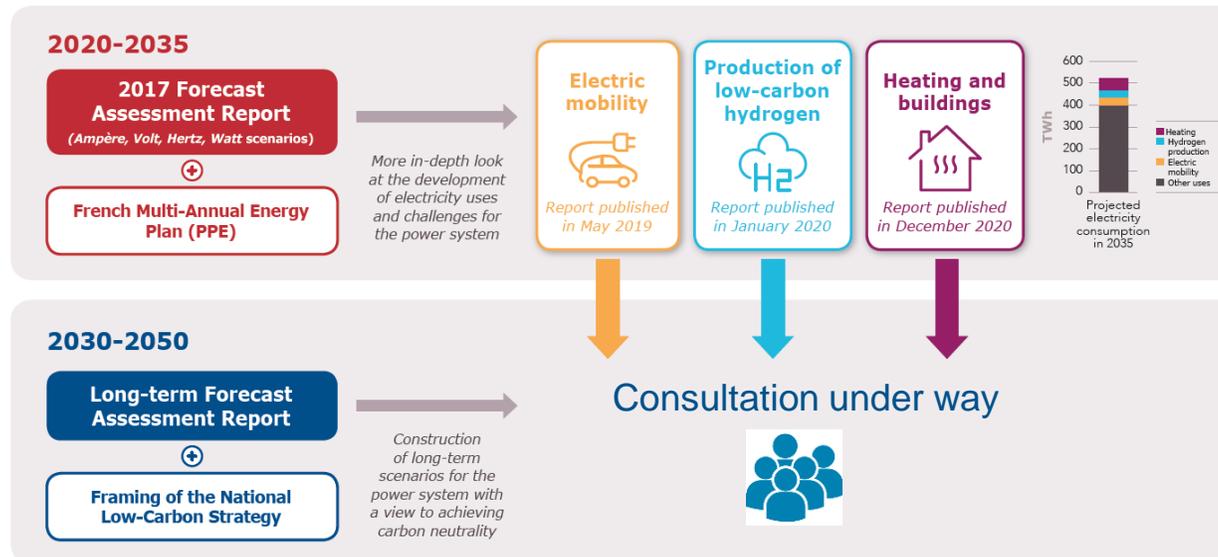
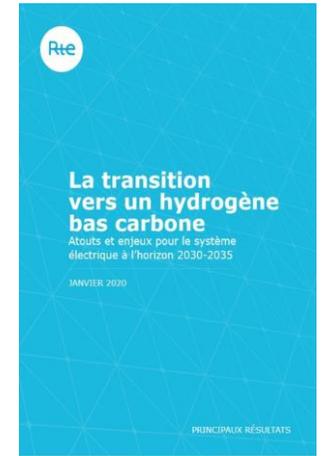
Hydrogen and power system

OFATE/DFBEW conference
18th March 2021

Power-to-H2 perspectives in France by 2035

In January 2020, RTE published a report on the development of low-carbon hydrogen and the opportunities and challenges for the power system by 2030-2035

- 1 As part of the work programme on **new uses of electricity**:
 - electric mobility
 - hydrogen production by electrolysis
 - heating in the building sector (in collaboration with ADEME)
- 2 As part of the **national hydrogen plan** published by the government in June 2018, by responding to the energy minister's request regarding the services that electrolysers can provide to the power system. Framework consistent with the **France Hydrogen** strategy published in September 2020.
- 3 Finally, it contributes to the work and consultation of the **long-term scenarios 2050**.



RTE report in French available here:
<https://assets.rte-france.com/prod/public/2020-07/rapport%20hydrogene.pdf>

English version here:
https://assets.rte-france.com/prod/public/2021-03/Hydrogen%20report_0.pdf

Two distinct reasons to develop hydrogen are often confused

Scenarios proposed in the report

Possible needs specific to each scenario, analyzed later

1

Decarbonising gas uses (hydrogen, methane...) or mobility



To help meet French and international decarbonisation targets

➔ **Opportunities in 2020-2035**

Power-to-X



2

Contributing to the balance of the power system by generating or even storing electricity



Generation from non carbonated fuels and flexibility of loads

➔ **Possibly of interest as a long-term solution**

X-to-Power & flexible load

2035

- No absolute need for seasonal storage in France
- A clear interest in decarbonizing the hydrogen used in industry, replacing natural gas steam reforming.
- Potentially use of hydrogen fuel for heavy mobility

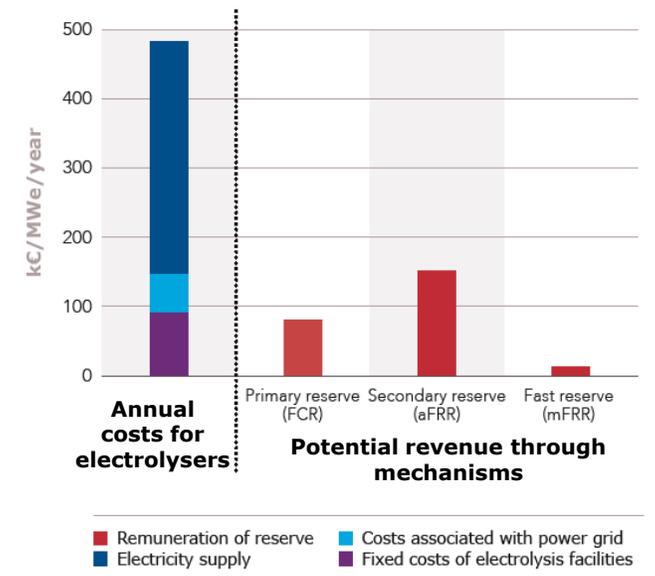
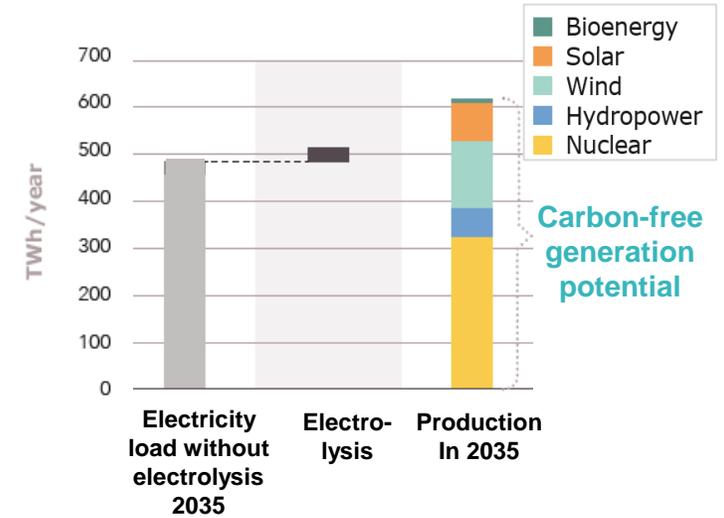
Rte The power system planned under the French Multi-Annual Energy Plan can accommodate the development of electrolysis

• In energy :

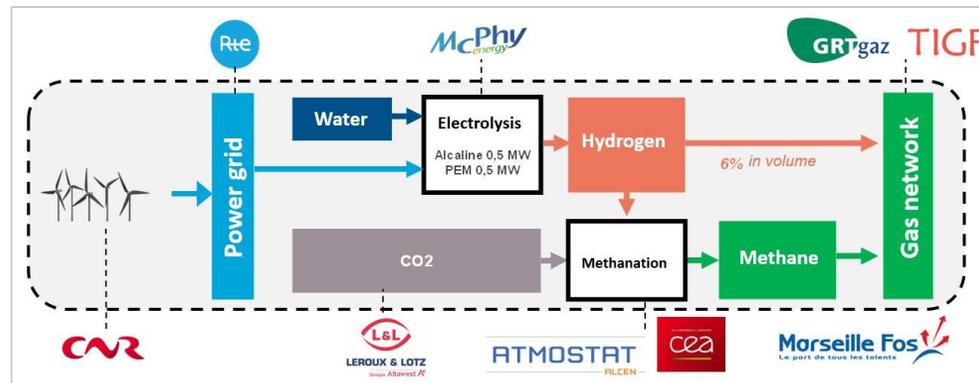
- The French Multi-Annual Energy Plan puts the **carbon-free electricity** generation potential at **615 TWh** by **2035**. This appears to be more than sufficient to cover the development of electrolysis envisaged by public authorities (**30 TWh_e**).

• In power :

- Electrolysers are **flexible** by nature and can be turned off during peak periods.
- Electrolysers also “technically capable” of **providing flexibility services** to the power system for supply-demand balance and for grid operation, but the associated **value remains of secondary importance** in the medium-term hydrogen economy.



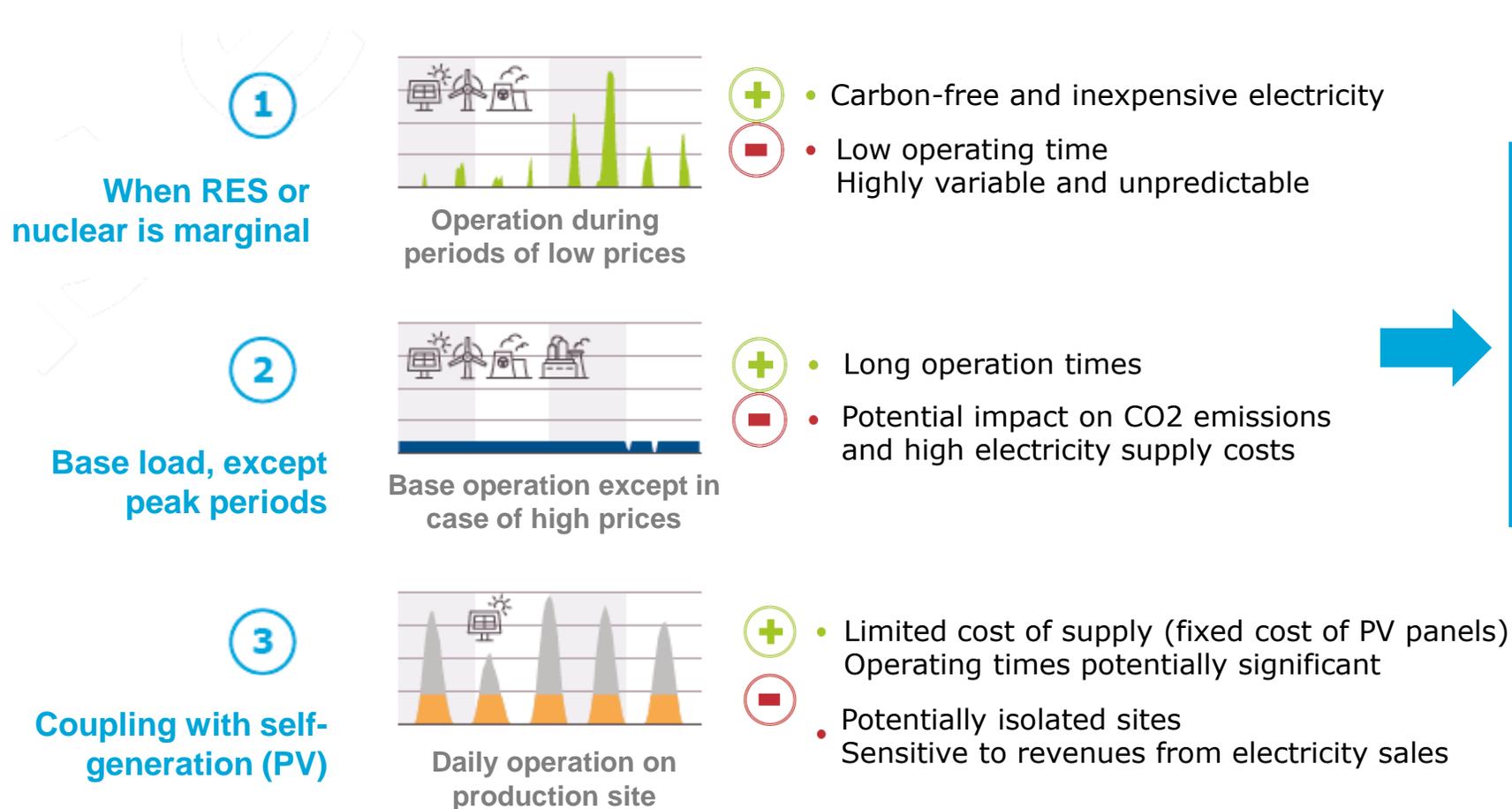
Jupiter¹⁰⁰⁰
 Demonstrator project
 Test technical operation
 of electrolysers under real conditions





Impacts on power system strongly dependent on the preferred electrolysis operating modes

The study explores 3 distinct operators' business models :



Different electrolysis capacities, needs for storage, load factor, CO₂ impacts, ...



Replacing fossil hydrogen by electrolysis leads to a reduction in CO₂ emissions ...

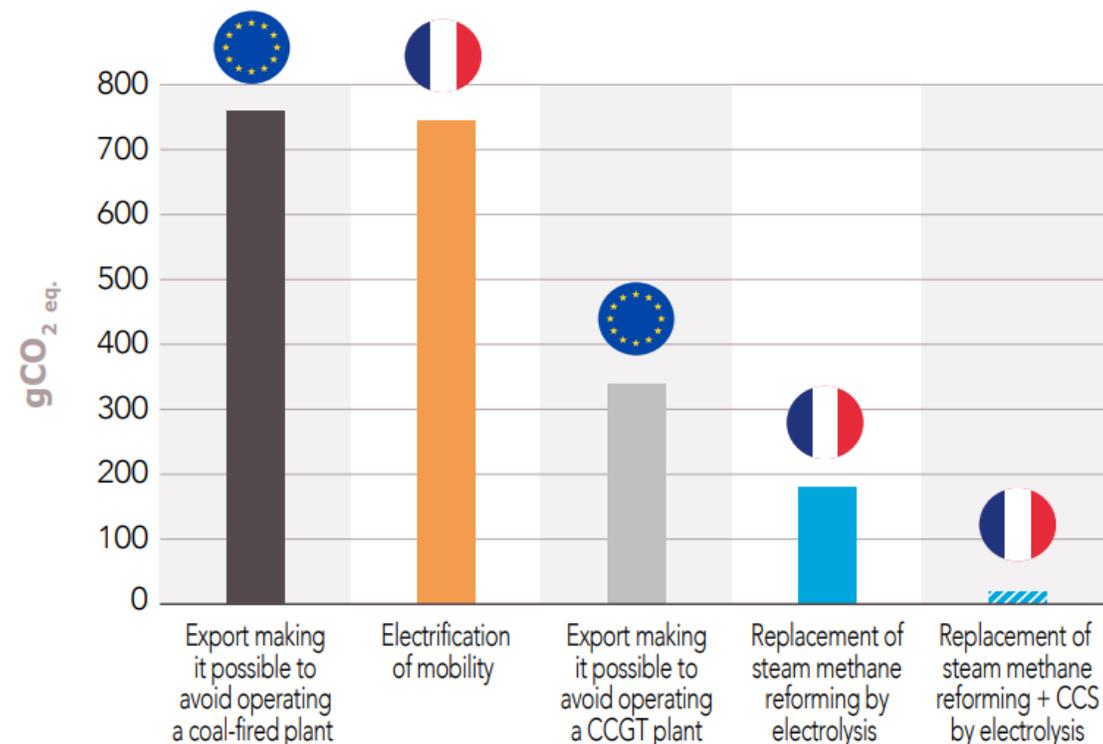
- ... in France, in all scenarios

- Electricity generation in France is to a large extent **already carbon-free**.
- Significant reductions in CO₂ emissions in France, **5 to 6 MtCO₂/year**, comes essentially from the substitution of steam reforming with of carbon-free electricity.

- ... in Europe, if the power mix is adapted with more carbon-free generation

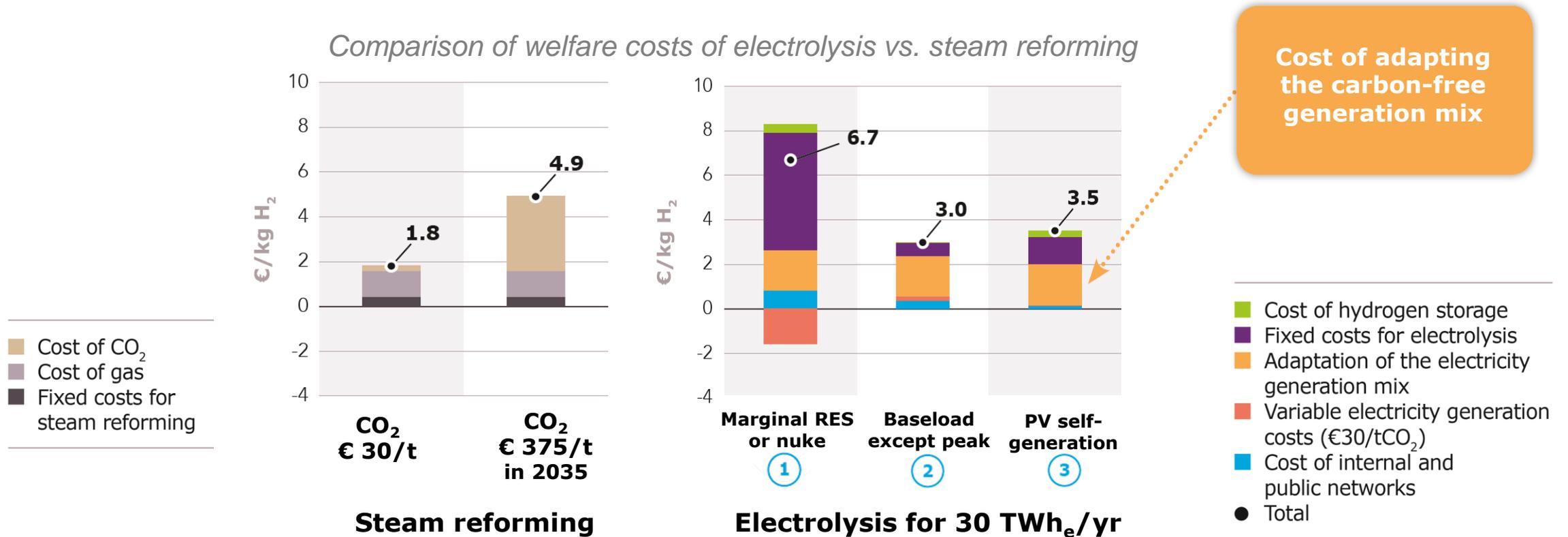
- All other things being equal, **exporting carbon-free electricity** appears to be a **more efficient way to reduce European emissions** than replacing steam reforming with electrolysis of water.
- But if the carbon-free power mix is **developed**, the carbon balance is positive at European scale.

Emissions avoided by producing 1 kWh of carbon-free electricity in France depending on whether it is used in France or Europe



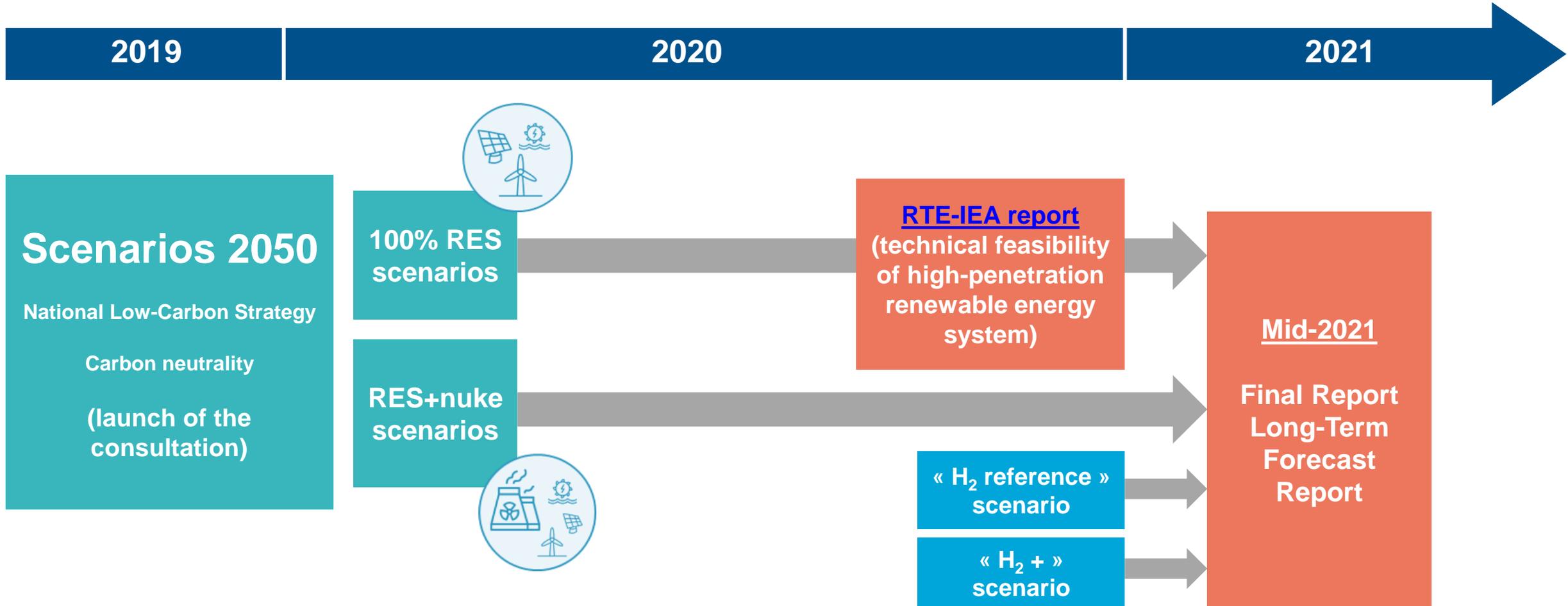
The cost of transitioning to electrolysis is high but justified by the reduction in CO₂ emissions

- The cost of hydrogen produced by electrolysis (€ 3 /kg to € 6,7 /kg depending on the mode) appears to **be higher by 2035** than hydrogen produced by steam reforming ...
- ... except if CO₂ is based on the **shadow price of carbon** (€ 375 /t in 2035 in France)





Further work and publication on the 2050 horizon



Thank you for your attention !

