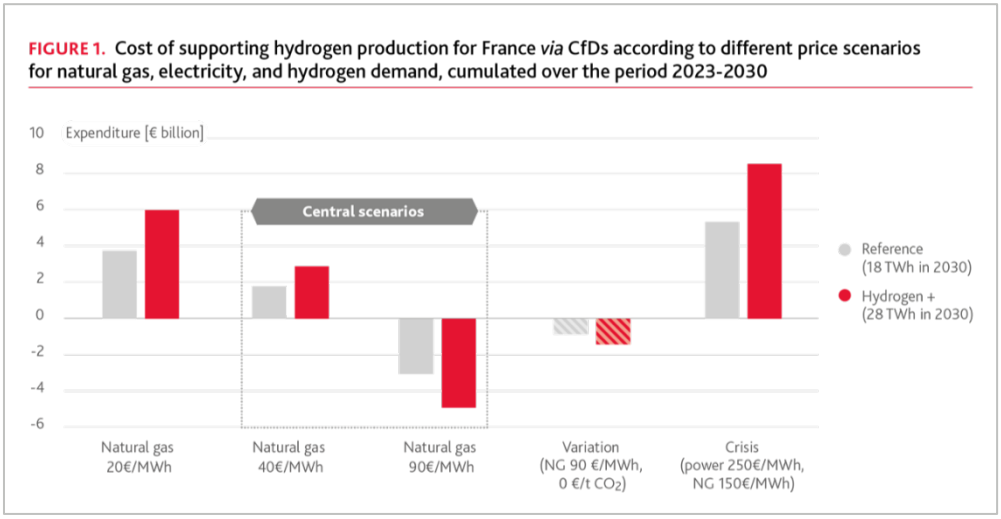
Supplementary material: methodology

Relating to the policy brief: Developing hydrogen for decarbonisation in Europe: how relevant are contracts for difference? – Ines Bouacida

Results



in € bn	**Référence (18 TWh in 2030)**	**Hydrogène + (28 TWh in 2030)**
Natural gas 20€/MWh	4	6
Natural gas 40€/MWh	2	3
Natural gas 90€/MWh	-3	-5
Variation (NG 90 €/MWh, 0 €/t CO_2)	-1	-1
Crisis (power 250€/MWh, NG 150€/MWh)	5	9

CO_2 price

	2023	**2030**
CO_2 price [€/t CO_2]	80	100

Hydrogen production in France

It is assumed that the hydrogen consumed in France is only produced in France and that no hydrogen is exported. Two trajectories – made by RTE for its long-term scenarios F*uturs énergétiques 2050* for hydrogen consumption are considered: “référence” and “hydrogène”.

Production of hydrogen from electrolysis [TWh]	**2023**	**2030**	***Source***
référence	0	17.6	(RTE, 2022)
hydrogène +	0	28.2	

Assumptions for electrolysers

		2023	2030	Source
CAPEX electrolyser	€/kW	789	265	(Bouacida & Berghmans, 2022)
OPEX	% of CAPEX/yr		3%	
Efficiency	-		70%	
Lifetime	yr		10	
Interest rate	yr^-1		10%	

Assumptions for electricity price

It is assumed that the electricity price paid by hydrogen producers reflects the total system costs. Hypotheses are from RTE's long-term scenarios (RTE, 2022). The electricity price $p_{elec,i}$ din a given year i is given from the total production of the French electricity system $P_{total,i}$ and the total annualised system cost by 2060 $C_{total,i}$.

$$p_{elec,i} = \frac{C_{total,i}}{P_{total,i}}$$

The selected production scenario is N03 because it shows the lowest values for total cost of electricity.

Considering climate and economic factors, it is likely that electrolysers are only online when low-carbon generators are online, which we assume to be 90% of the time, and which is when electricity is least expensive. Therefore, it is assumed that electrolysers only pay 80% of the total electricity cost for their electricity supply.

Assumptions for steam methane reforming

CAPEX electrolyser	€/kW_{H2}	837.2	(IEA, 2019)
OPEX	% of CAPEX/yr	4.70%	
Efficiency	%	76%	
Availability	%	95%	
Lifetime	yr	25	
Interest rate	%	5%	
Emission factor	t CO_2/t H_2	12	(Spath & Mann, 2001)

References

Bouacida, I., & Berghmans, N. (2022). Hydrogène pour la neutralité climat : conditions de déploiement en France et en Europe. *Etude IDDRI*, *2*. https://www.iddri.org/fr/publications-et-evenements/etude/hydrogene-pour-la-neutralite-climat-conditions-de-deploiement-en

IEA. (2019). *The Future of Hydrogen*. https://www.iea.org/reports/the-future-of-hydrogen

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Spath, P. L., & Mann, M. K. (2001). Life Cycle Assessment of Hydrogen Production via Natural Gas Steam Reforming. *NREL Technical Report*, *NREL/TP-570-27637*.