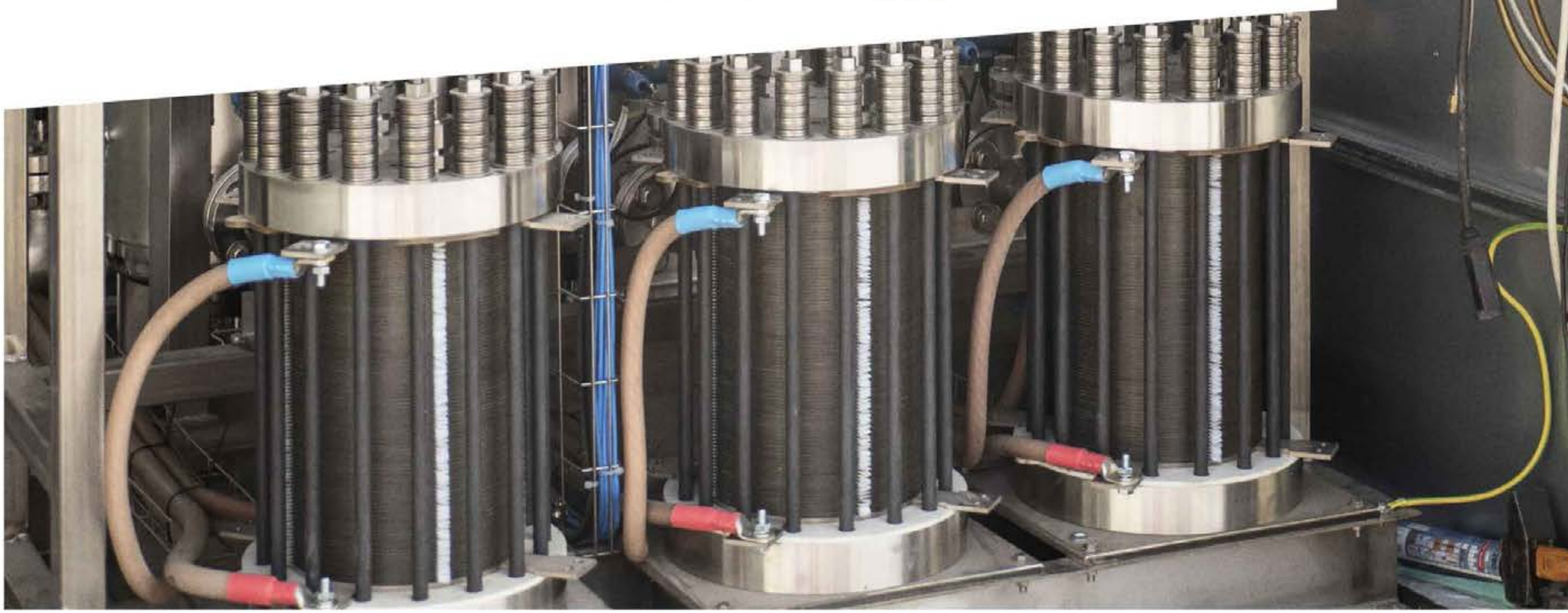
Technical and economic conditions for injecting hydrogen into natural gas networks

HIPS NET



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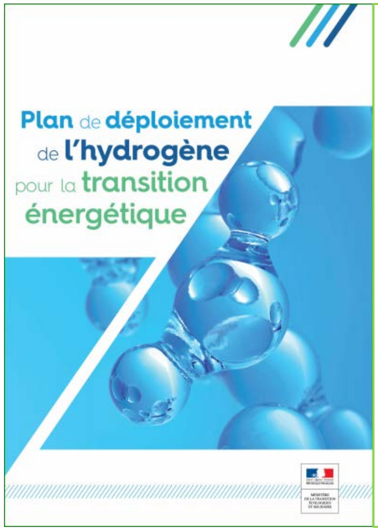
A coordinated effort by the French gas industry, led by GRTgaz, within the framework of France's Hydrogen Plan



France's Hydrogen Plan
- Measure 7

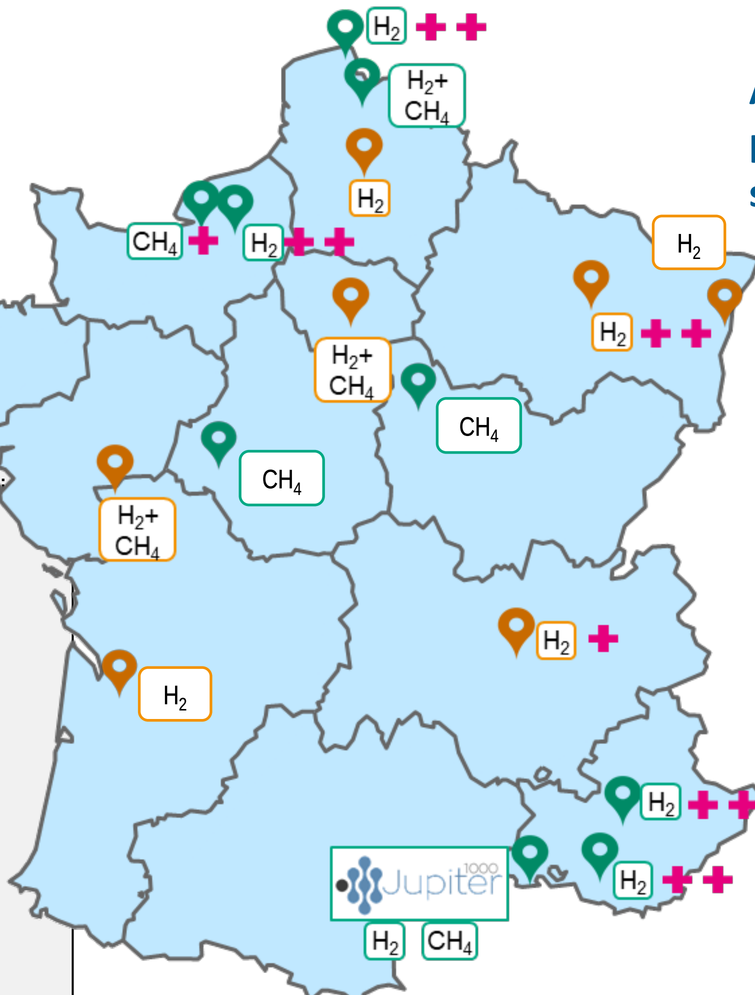
"In order to prepare for the arrival of power to gas, gas transporters and distributors will have to determine the technical and economical conditions for hydrogen injection into the grid that are: acceptable for the networks, for the installations connected to it and for end-uses (including gas mobility), in collaboration with manufacturers."

Coordinated report from the French gas operators:

- **TSOs** – GRTgaz & Teréga (representativeness: 100%)
- **DSOs** – GRDF, R-GDS, REGAS & SPEGNN association (100%)
- **SSOs** – Geométhane, Storengy, & Teréga (100%)
- **LSOs** – Elengy (75%)

Report publicly disclosed November the 15th: download link

In addition to France's Hydrogen Plan, H2 & Syngas injection already under examination by gas operators



Legend

- Study of opportunity in progress or completed
- Emerging projects, no formal requests
- H_2 — H2 injection request
- CH_4 — Synethic methane request
- H_2+ CH_4 — Blended H2 + CH4 request
- + — Injection capacity >1 kNm³/h
- ++ — Injection capacity >10 kNm³/h

Applications for the connection of projects of different nature, from synthetic gas to pure hydrogen

- **Power-to-gas** from 1 to 200 MW (total injection or surplus)
- **H_2 byproduct** (chlorine industry)
- **Pyrogasification** (biomasse, wood waste or RDF) CH_4/H_2 blend or pure H_2

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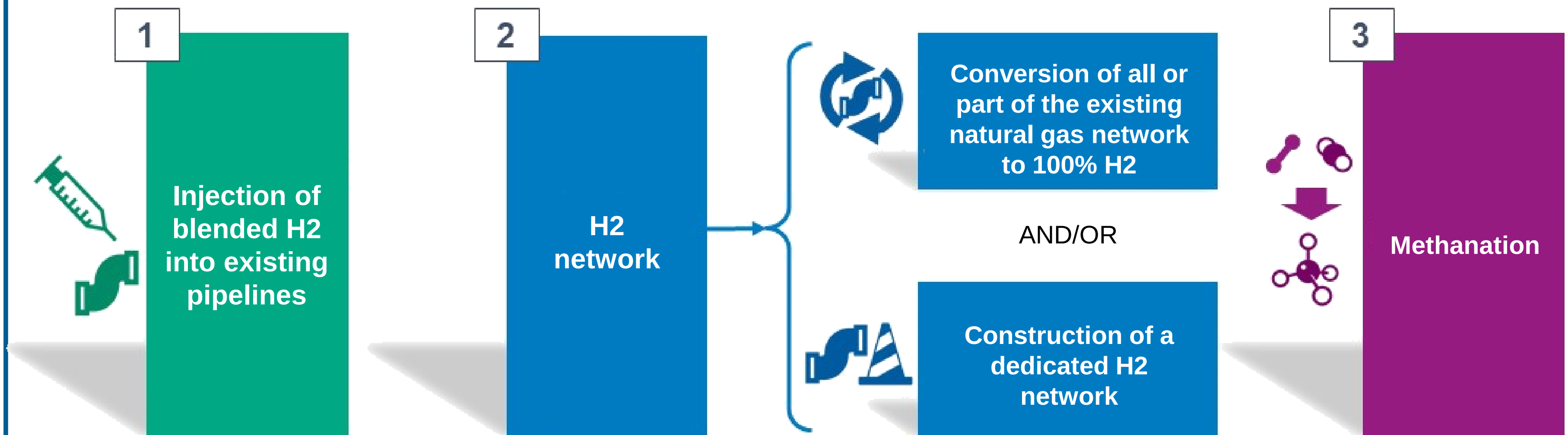
Complementary ways of integrating H_2 into the gas system



Complementary routes, consistent with a differentiated development of hydrogen in the territories, dependent in particular on:

- **Mode of production** : centralised/decentralised, base load/variable,
- **Concerned area** : characteristics of the network, gas flows
- **Temporality of projects**: gradual adaptations, « jumps » towards 100% H2 clusters

Main barriers related to blending, technical locks and solutions envisaged to remove them

TRANSPORT	STORAGE	DISTRIBUTION	END USES

STEEL PIPES: Tolerance of steel pipes at H_2 levels, depending on their grade and the pressures used (pb integrity)

Laying a coating replacement or conservation as appropriate

NETWORK EQUIPMENT: Integrity and good operation of network equipment at high H_2 rates (**Transport**: Compressors, turbines; **Storage**: Compressors, meters and desulpharisation / dehydration; **Distribution**: Regulators, Customer counters)

Retrofit or replacement of all / part of equipment according to H_2 rates

AQUIFERS: Tolerance to elevated H_2 levels

Separation of H_2/CH_4 in certain cases

END USE EQUIPMENT AND GAS SUPPLY LINE Tolerance of end-use equipment (boilers, ovens, hobs...) at high and variable H_2 levels

Separation of H_2/CH_4 for certain uses (NGV stations…)

Replacement of end use equipment with dual fuel equipment

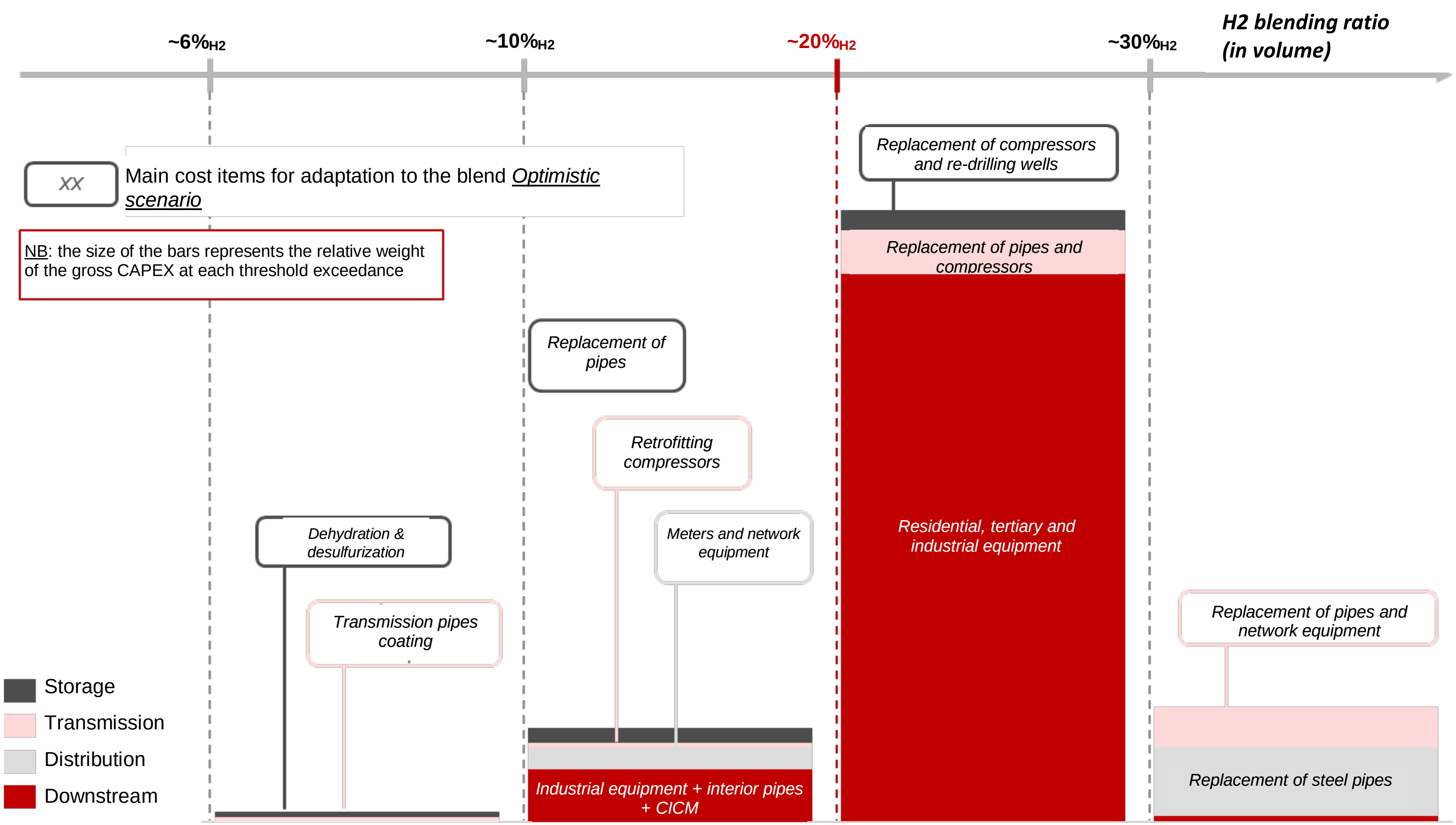
Replacement of gas suppl line and other critical parts (joints, connectors…)

Barrier

Envisaged solution

Investments : limited to adapt to 20% blending, but unreasonable beyond

Summary of adaptation costs (CAPEX) at different hydrogen levels [adaptation costs relative to the volume of equipment concerned]



Note: the operating costs of H_2/CH_4 separation upstream of NGV stations or groundwater aquifiers take effect from $1\%_{H2}$

Source: E-CUBE Strategy Consultants analysis, Gas operators WG

NB: the graphic view above is maximising as it represents the financial volumes corresponding to the cost of adapting 100% of the fleet at a given time, with no anticipation effect (gradual replacement of equipment by other compatible equipment over time)

H_2 development case studies modelized by 2050 to identify cost otpimized integration solutions

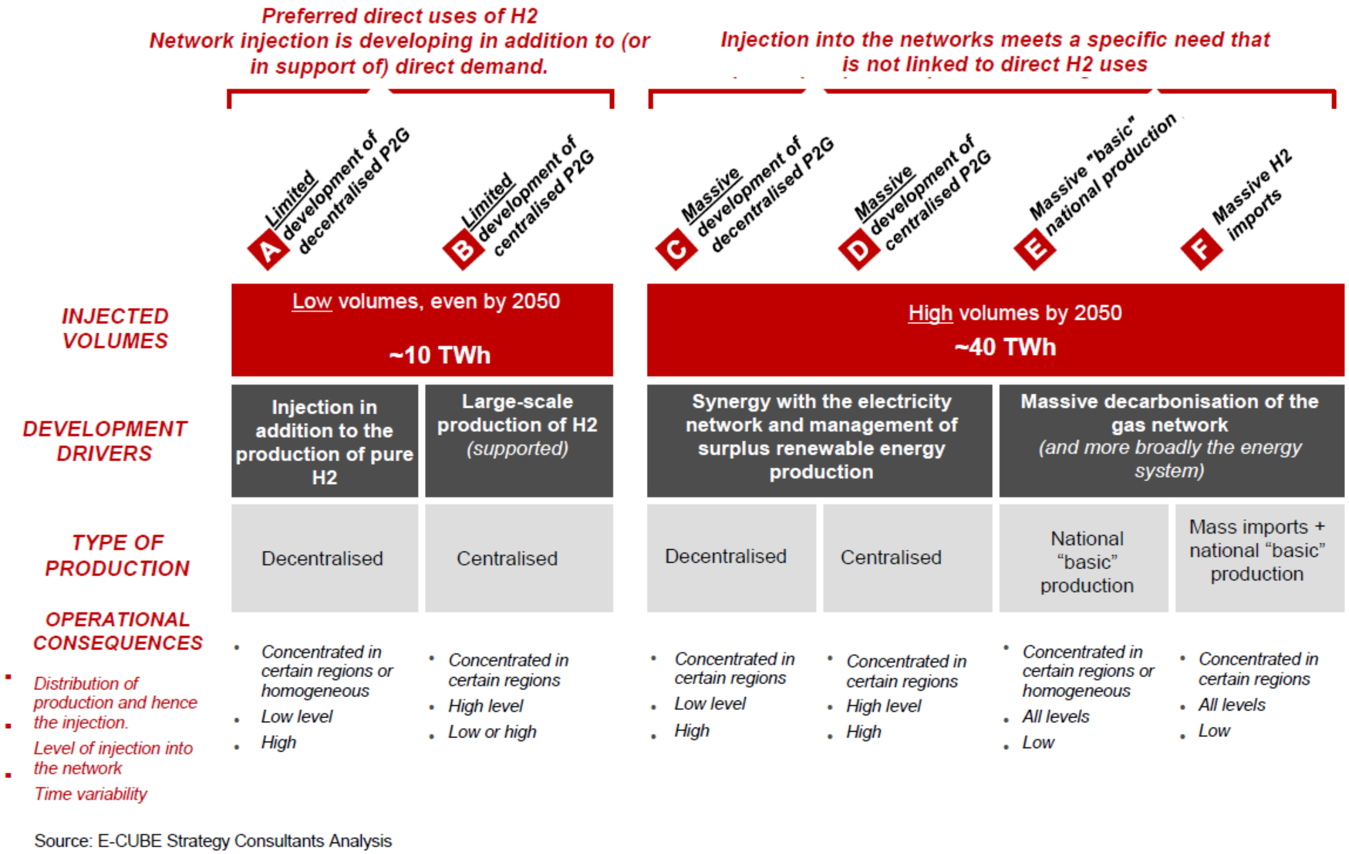
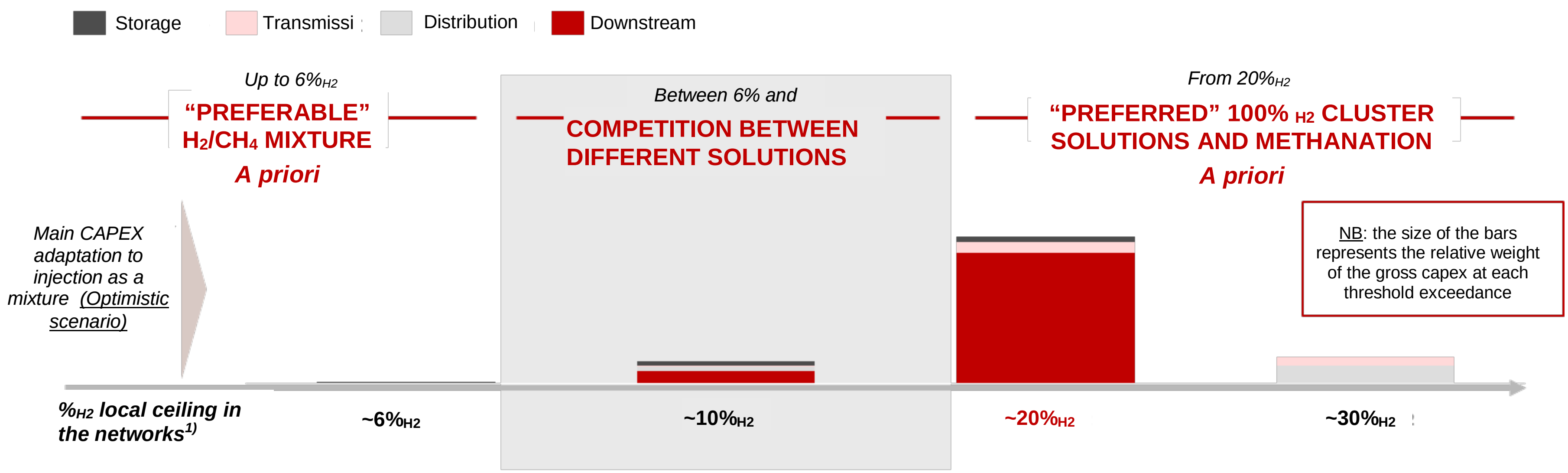


Figure 5 : Differentiated case studies used by operators for their cost modelling

Simplified model of the French gas system: 1 national transmission network, 300 regional subzones and 3,300 distribution zones

Areas of competitiveness of the different hydrogen integration solutions in gas networks

Competitive advantages of the different H_2 integration solutions in the networks according to the hydrogen level



1) H2 rate by volume

Source: E-CUBE Strategy Consultants analysis, Gas operators WG

Results of modeling: **possible to integrate hydrogen for infrastructure adaptation costs from € 1 / MWh to € 8 / MWh by 2050** depending on the scenarios studied

Conclusion on acceptable hydrogen levels in mixture

Conclusions of the work carried out by the French operators::

- **Possibility of integrating a significant volume of hydrogen into the 2050 gas mix with limited infrastructure adaptation costs.**
- Need to mobilize in a coordinated way **solutions for blending, methanation and deployment of 100% hydrogen clusters** on certain meshes by conversion of structures or creation of new networks.

In the short term, blending of 6% in terms of volumes of hydrogen is feasible in most networks, except for cases where there are sensitive structures or installations at the customer level. **Pre-identification of suitable areas** to guide projects makes it possible to integrate the first volumes of H2 with adaptation costs reduced to the strict minimum

By 2030, recommendation to set a capacity target for integrating blended hydrogen into networks: 10% and then 20% beyond, in order to anticipate equipment adaptation, particularly at end-user level.

Priority levers identified

Identify suitable areas in which the 6% blending level is applicable. When conditions are met, adapt the gas specifications to inject first 10%, then 20%.

Set a specification of 10% blended hydrogen as a sector-wide target by 2030. The aim is to mobilise equipment manufacturers and downstream users, and to manage operator investments on a case-by-case basis.

Invite operators to coordinate and share R&D efforts for all the technical injection routes. Ensure that the corresponding costs are covered in their regulated economic models under the existing processes.

Carry out an **assessment of the externalities of injecting hydrogen into the networks and of methanation**, including a life cycle analysis of these sectors.

Integrate the role of gas infrastructures in the development of hydrogen into energy mix forecasting and implement a specific work programme on the coupling of gas and electricity networks.

Define and implement a favourable framework for experimenting with the development and operation of the first 100% hydrogen clusters.

Create a framework for the development of power-to-gas in the event of market failure.

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Thank you for your attention