At the dawn of a new era

A roadmap for an ambitious hydrogen strategy

France Hydrogène

Engagée pour la transition écologique

INTERNATIONAL CONFERENCE ON MOBILITY CHALLENGES

9. December 2021

Philippe BOUCLY, President

French Hydrogen Strategy (8. September 2020)

- **Priority 1 : To Decarbonize industry**

Objective : to scale up a competitive French electrolysis industry

- **Priority 2 : To Develop hydrogen for professional mobility**

➢ Vans, Buses, Trucks, Railways, Ships, Airplanes –

- **Priority 3 : To Develop R&D&I**

➢ Implementation of a Priority Research Programme for hydrogen applications and a programme to increase competences and training

✓ In total : **7,2 + 1,9 billion €** up to 2030 (**3,4** during 2020-2023 period)
6500 MW of electrolysers – **680 000** tons of Hydrogen

✓ Objective : to create between **50 000** and **150 000** jobs

✓ Cooperation with European partners (**IPCEI**)

Support of the French Government

- Through “Calls for projects” (managed by ADEME)
  - Technological bricks : **350** Million euros
  - Territorial ecosystems (mixing industry and mobility) : **275** Million euros

- and also through an IPCEI (Important Project of Common European Interest) within the European framework (**1,5 +1,7** billion euros)

- A support mechanism in order to fill the gap between the costs of low carbon/renewable hydrogen and grey hydrogen
- and also a specific mechanism for refineries (TIRUERT)

The use of hydrogen will be mainly concentrated within large industrial clusters for industry and mobility (*for instance : big cities, harbours, airports*)

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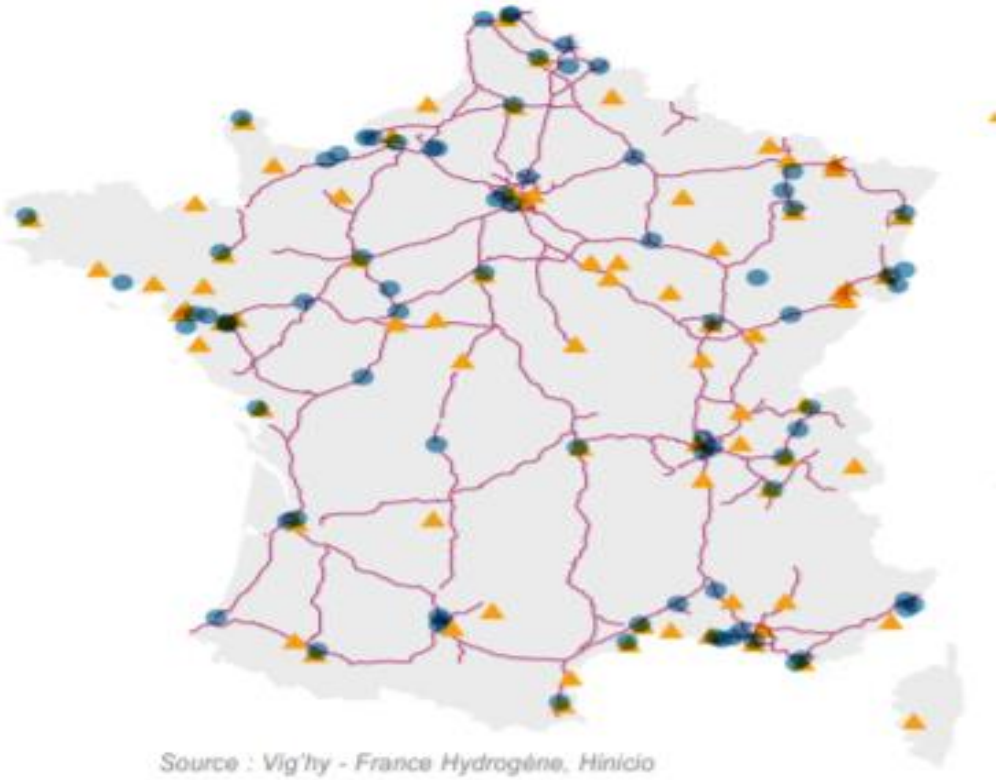
Cartographie des projets H_2 et des sites majeurs de consommation 2030

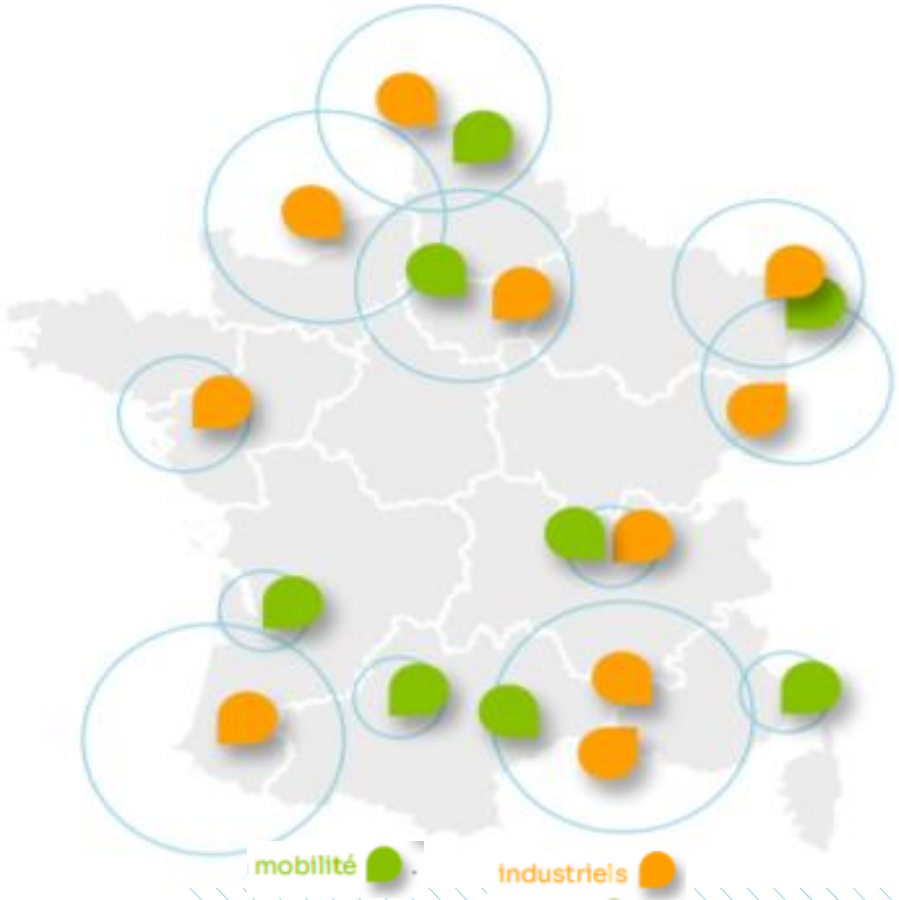


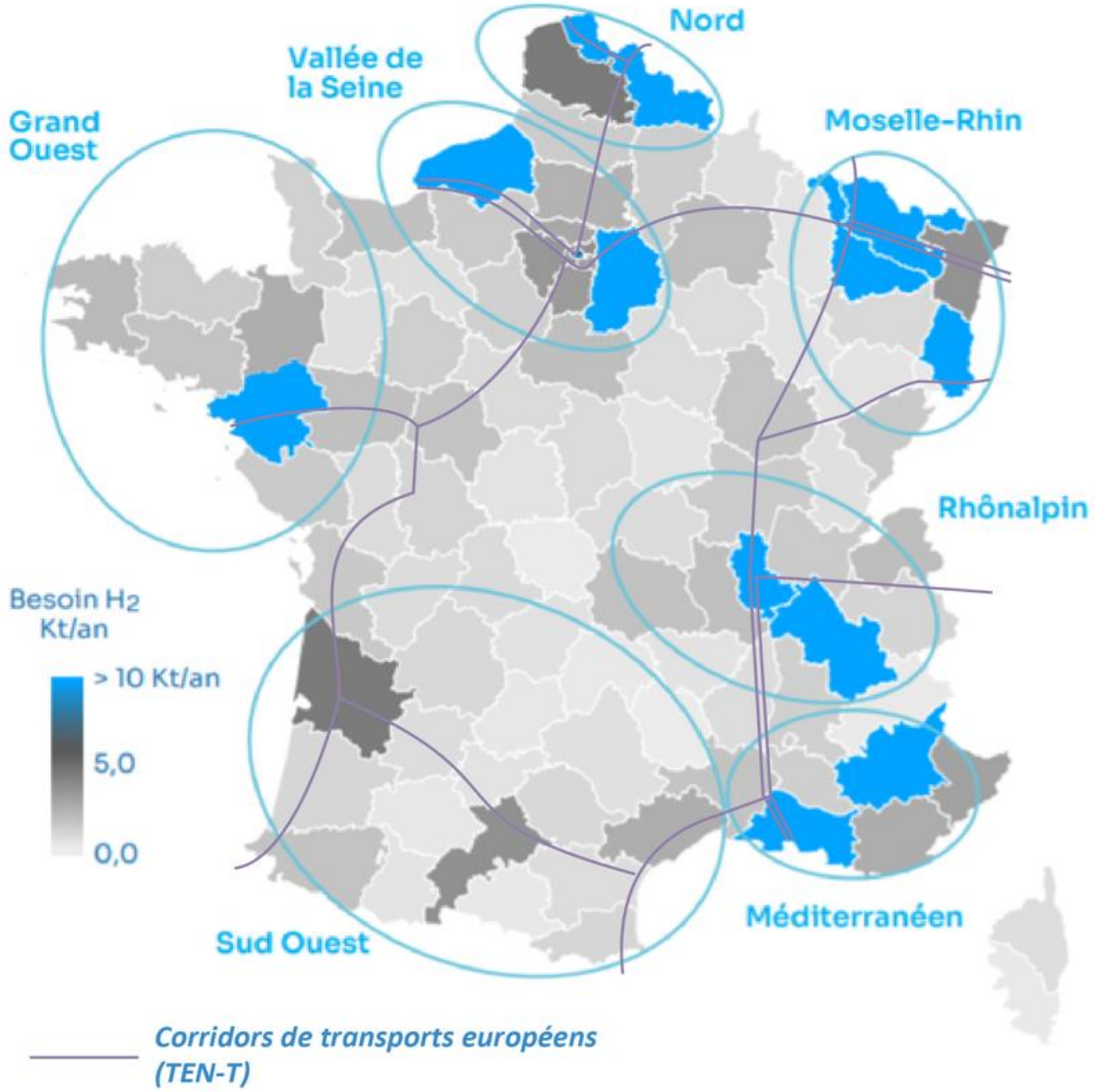
Source : Vig'hy - France Hydrogène, Hinicio

▲ Projets H_2 recensés en cours de montage

● Sites de consommation majeurs d'ici 2030

Principaux pôles de consommation 2030





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Deployment by 2030 : Consumption is concentrated within 7 bassins

- **680 to 1090 kt** of hydrogen
- **6.5 to 10 GW** of electrolysis power
- **37 to 60 TWh** of low carbon or renewable electricity
- **1000 à 1700 H2 refuelling stations**, mainly public

Bus deployment by end November 2021

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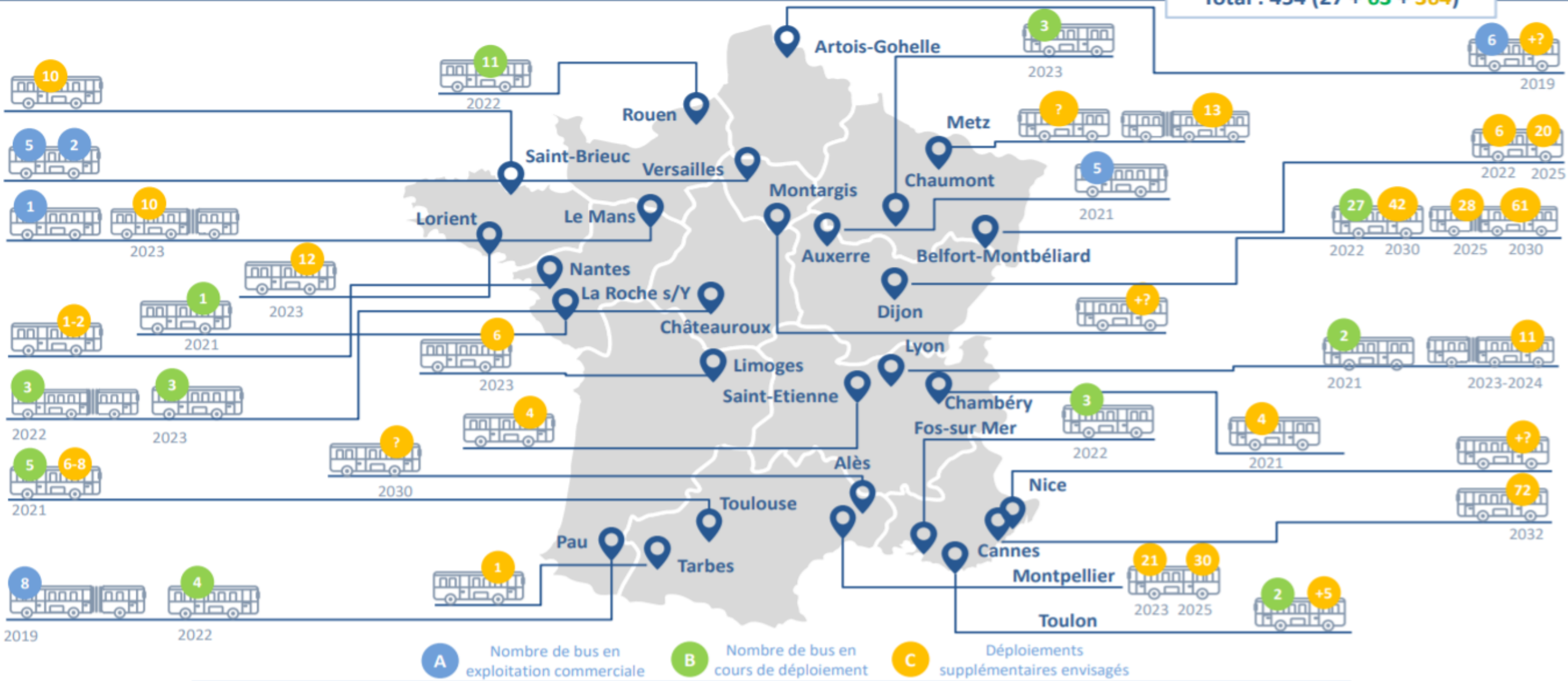
Total : 454 (27 + 63 + 364)



Deployment of garbage trucks by end November 2021

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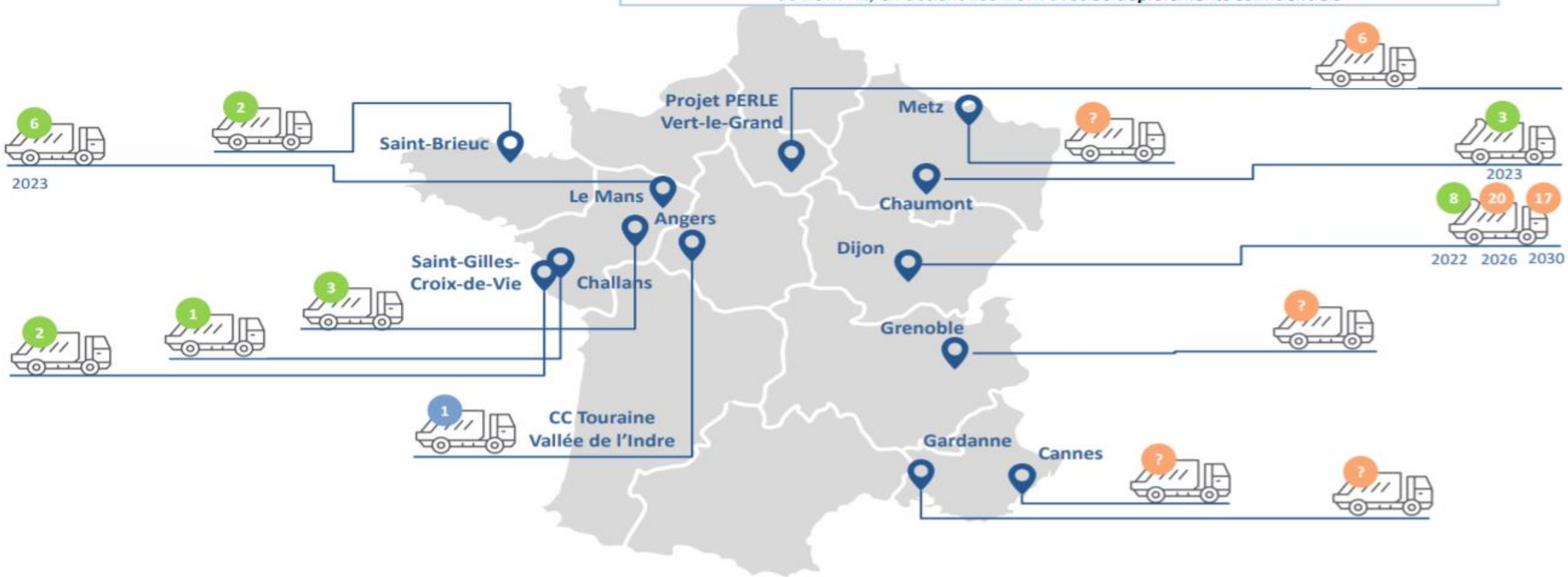
Total : 105 = 1 + 25 + 43 + 36

En incluant à ce total les projets à ce jour confidentiels et les projets ayant des intentions de déploiement de BOM H2, on obtient **105 BOM avec 36 déploiements confidentiels**



A — Nombre de BOM en exploitation commerciale

X — Nombre de BOM qui seront déployées avant 2023

Y — Nombre de BOM qui seront déployées après 2023

Occitanie Region : H2 Corridor project

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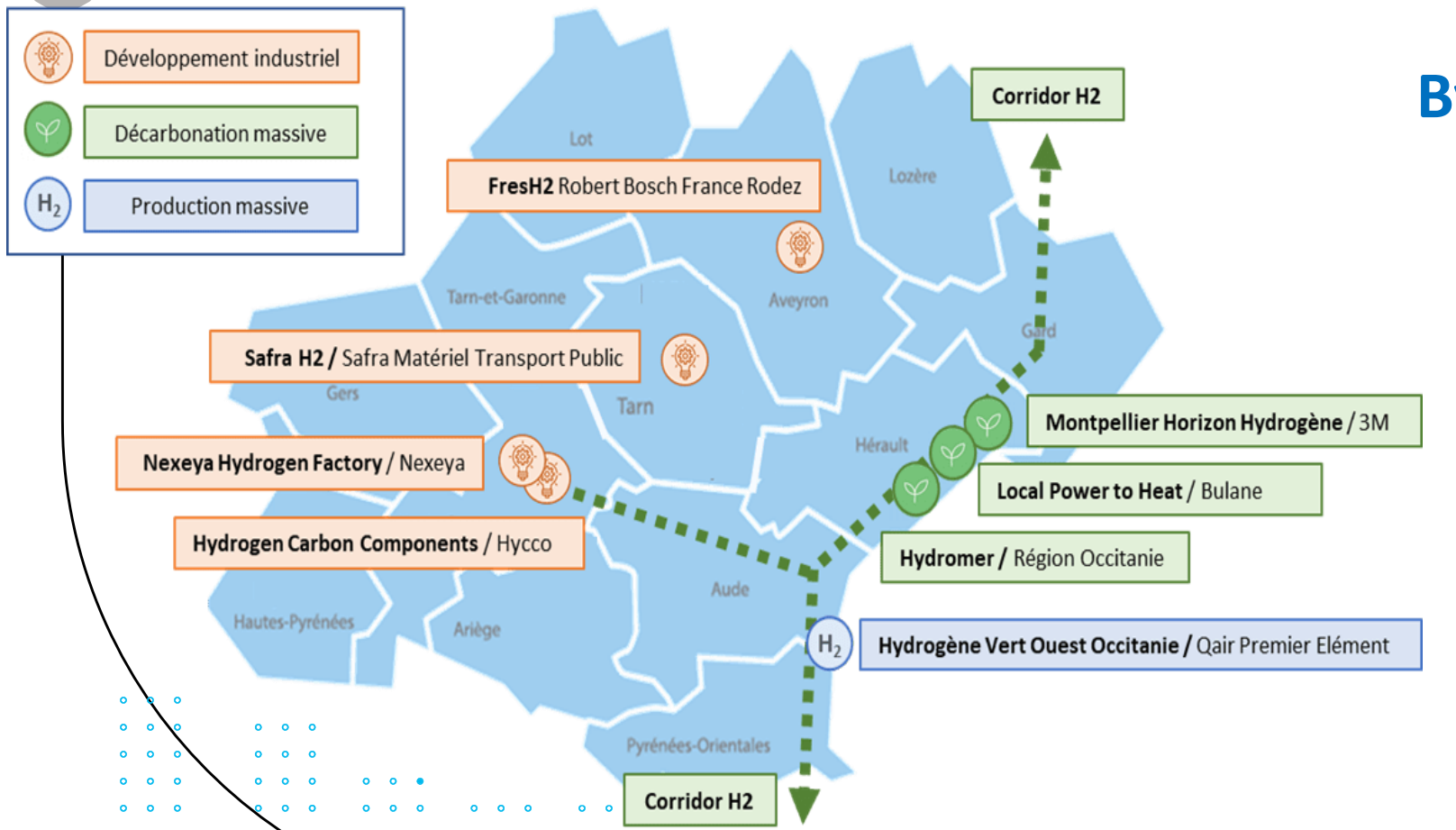

By end 2023 :

- **2** production units of renewable H2
- **8** HRS
- **40** H2 trucks
- **40** refrigerated trailers
- **15** H2 retrofited coaches

Other initiatives : EAS-HyMob in Normandie and ZEV in AuRA

Hydrogen production cost as a function of the load factor

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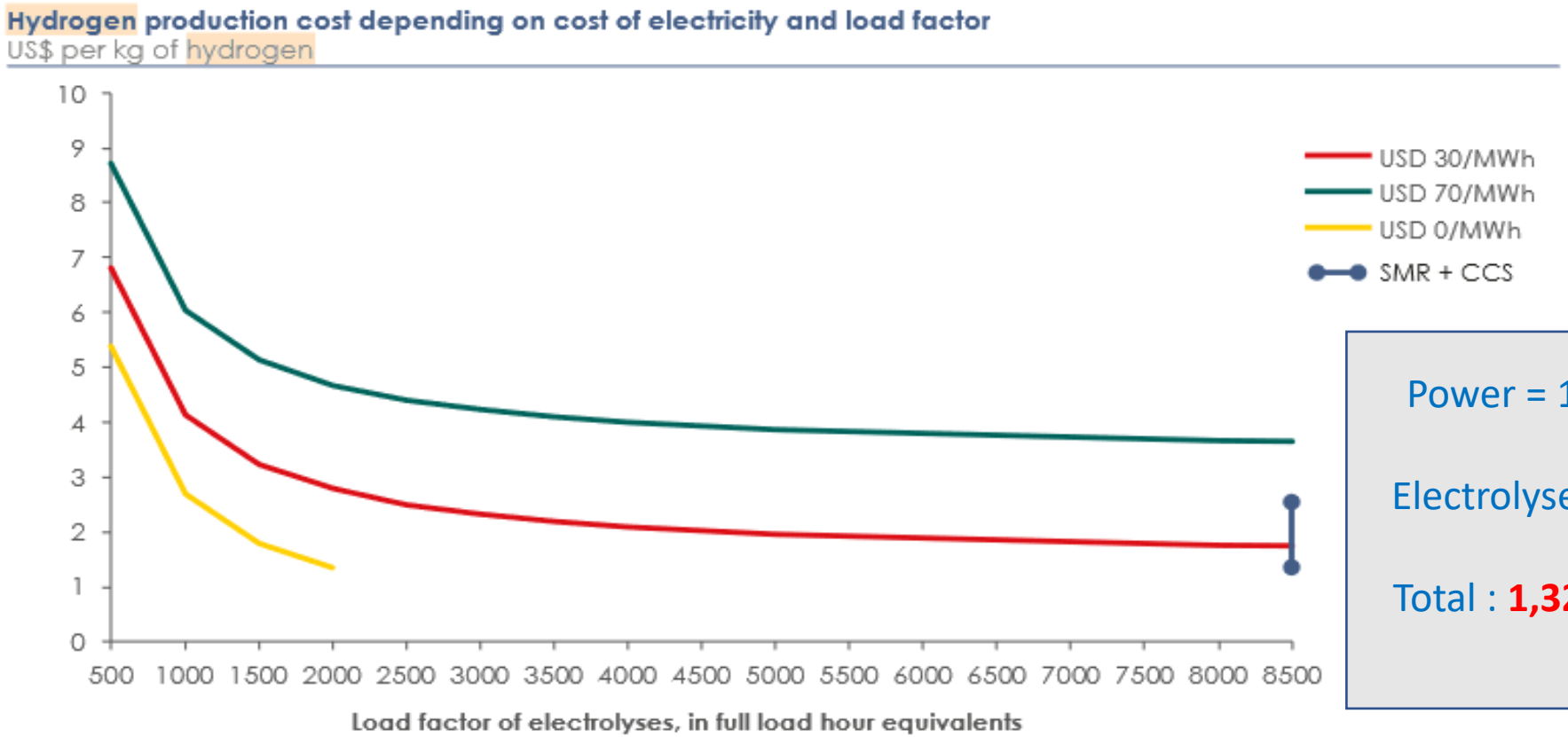
Electrolyser cost : 1000 €/kW – 2 000 hours – Discount Rate : 5% - 20 years – Opex=2% → **2,75** €/kg
55 kWh →1kg H2 Electricity cost : 50 €/MWh → **2,75** €/kg →**TOTAL COST**= **5,5 €/kg**



Assumptions: electrolyzers CAPEX US$450/kW, WACC 7%, 30 years lifetime, 70% efficiency
Source: Adapted from Philibert, C. (2017), REFI, Insight Papers, IEA, Paris, *Producing hydrogen from renewable energy*

Power = 10 €/MWh → **0,55**

Electrolyser : 350 €/kW (2500 hours)
→ **0,77**
Total : **1,32 €/kg** (at electrolyser)

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Challenges for the French Hydrogen Sector

- To **reduce costs : scaling up**
- To promote **technological neutrality**
- To contribute to **reindustrialisation** :

SCALING UP

Objective : To reduce costs

- To contribute to the blooming of large-scale territorial ecosystems
- To develop industrial offer : electolysers, fuel cells, vehicles,..
- To develop transport and distribution (HRS) infrastructures
- To develop usages within downstream sectors (mobility, industry, energy).

…….in a nutshell , to build a new market !

Toward a European market for hydrogen

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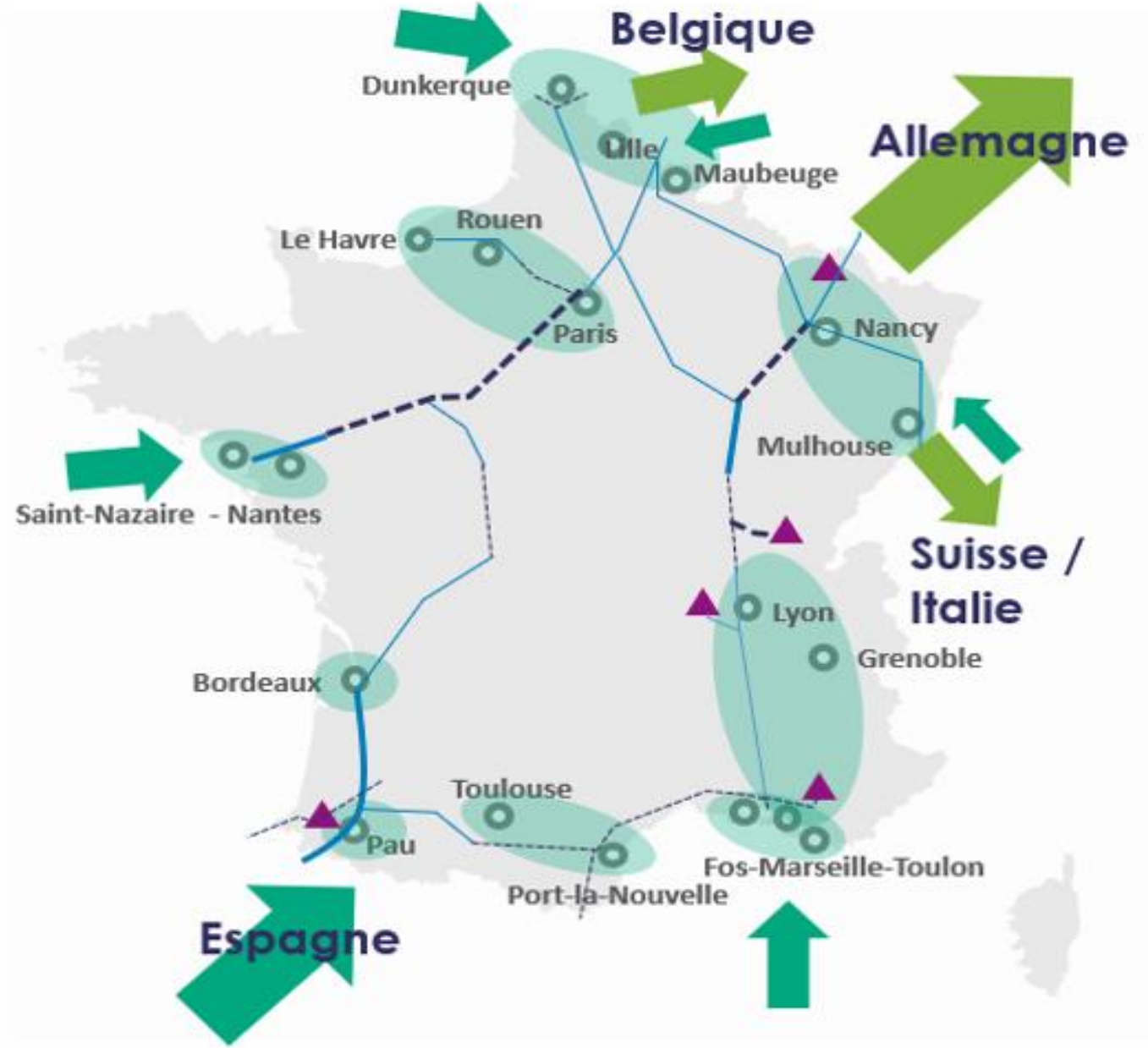

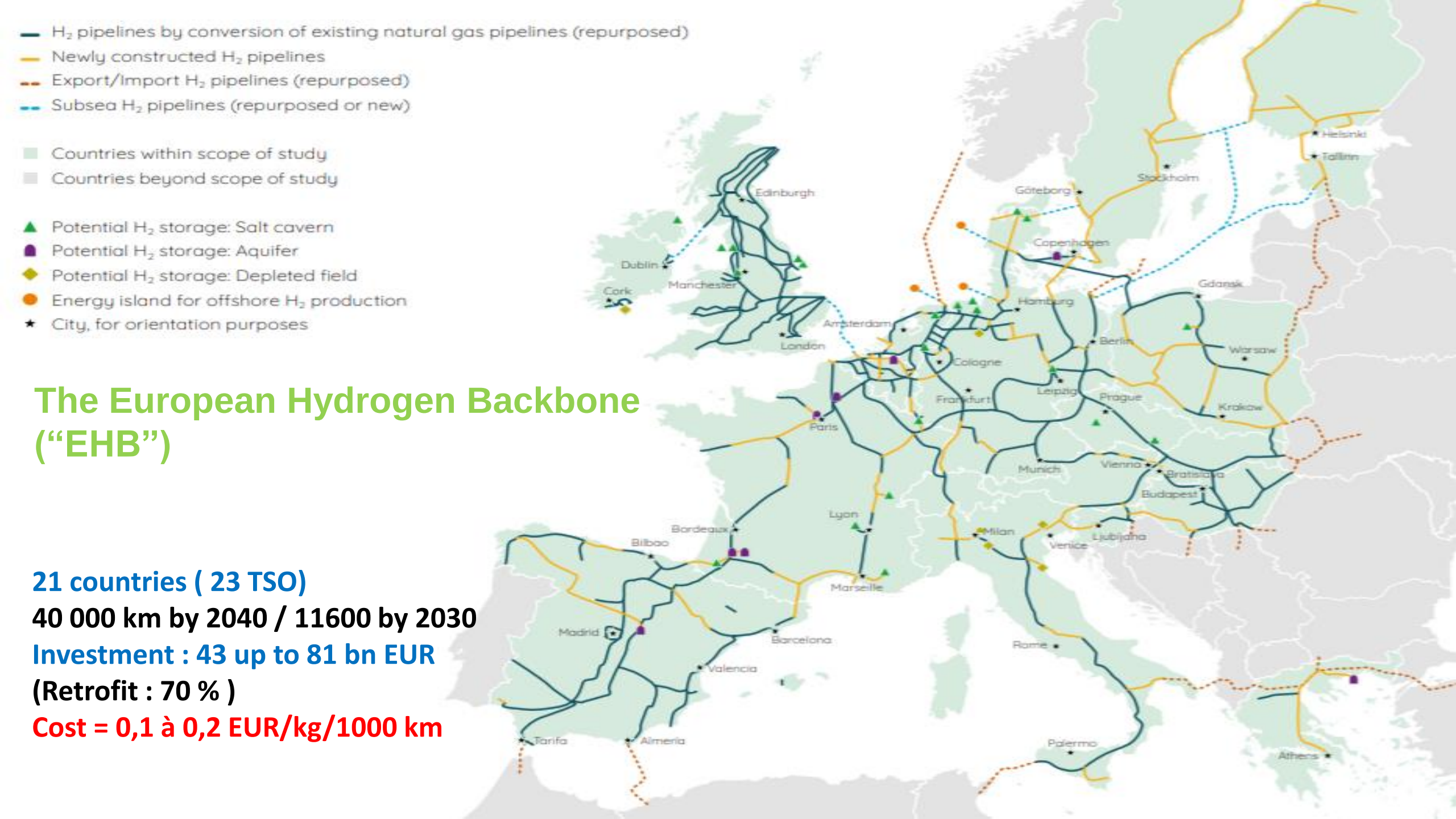

The European Hydrogen Backbone ("EHB")

21 countries (23 TSO)

40 000 km by 2040 / 11600 by 2030

Investment : 43 up to 81 bn EUR

(Retrofit : 70 %)

Cost = 0,1 à 0,2 EUR/kg/1000 km

To Promote technological neutrality

- **Not only renewable electricity ! GreenTaxonomy**
- **To consider also other means to produce renewable or low carbon hydrogen : NOT ONLY electrolysis !**
  - Steam Methan Reforming of natural gas (SMR) with Capture and Sequestration/Utilisation of CO2 (CCUS)
  - Pyrogasification / Thermolysis of biomass (Haffner process)
  - Methan Pyrolysis (Plasma torch, microwave)
  - Native hydrogen
- **Balance between Supply and Usages of renewable hydrogen by 2050**
- **(Sofar development of renewable is NOT sufficient)**

sovereignty

To contribute to **re-industrialisation**

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- To maximise the local content while reinforcing all the components of the value chain.
  (Public procurement is key)

- To develop competences and training

It is about TECHNOLOGICAL SOVEREIGNTY

As a CONCLUSION

- **Without Hydrogen, we will NOT succeed**
- **Versatile energy carrier : holistic/systemic approach is needed**
- **Massifiing/ Pooling usages in order to reduce costs : to build territorial ecosystem, to scale up, import of H2 ?**
- **To maintain R&D efforts and foster innovation**
- **Europe benefit from strong and valuable assets : it is also about an industrial challenge**
  Maximising the local content & renforcing the whole value chain.
- **Regulation AND public financial support (Carbon tax)**

Thank you
for your attention !

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