Hydrogen as the solution to many problems – but how and when?

Symposium on EUROPEAN GRID SERVICE MARKETS

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Uniper at a glance

Our operations

Power Generation
Commodity Trading
Energy Storage
Energy Sales
Energy Services

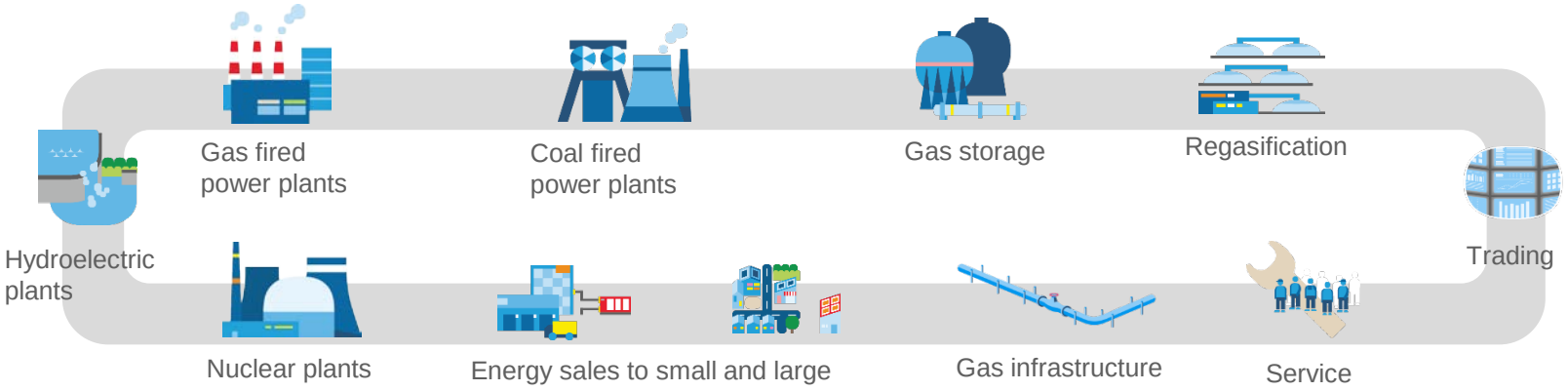
We operate in 40+ countries around the world

€1.7bn
EBITDA in 2017

100 years
Experience

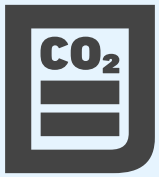
~36 GW
Generation capacity

Main activities



Drivers for Climate Neutral Hydrogen Market

Climate protection



Avoiding CO_2 emissions in the sectors mobility, heat & industry

Limits for local emissions

Urban areas are lowering limits for NOx, fine dust and noise

Diversification of energy dependency

Countries decide strategically to diversify the import portfolio

Perspective for gas infrastructure

A fuel switch to green gases gives a perspective for existing infrastructure

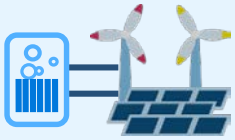
Intermittent & growing generation

Decongest power grids, peak shaving, grid services, RE integration

Industrial growth in tech. applications

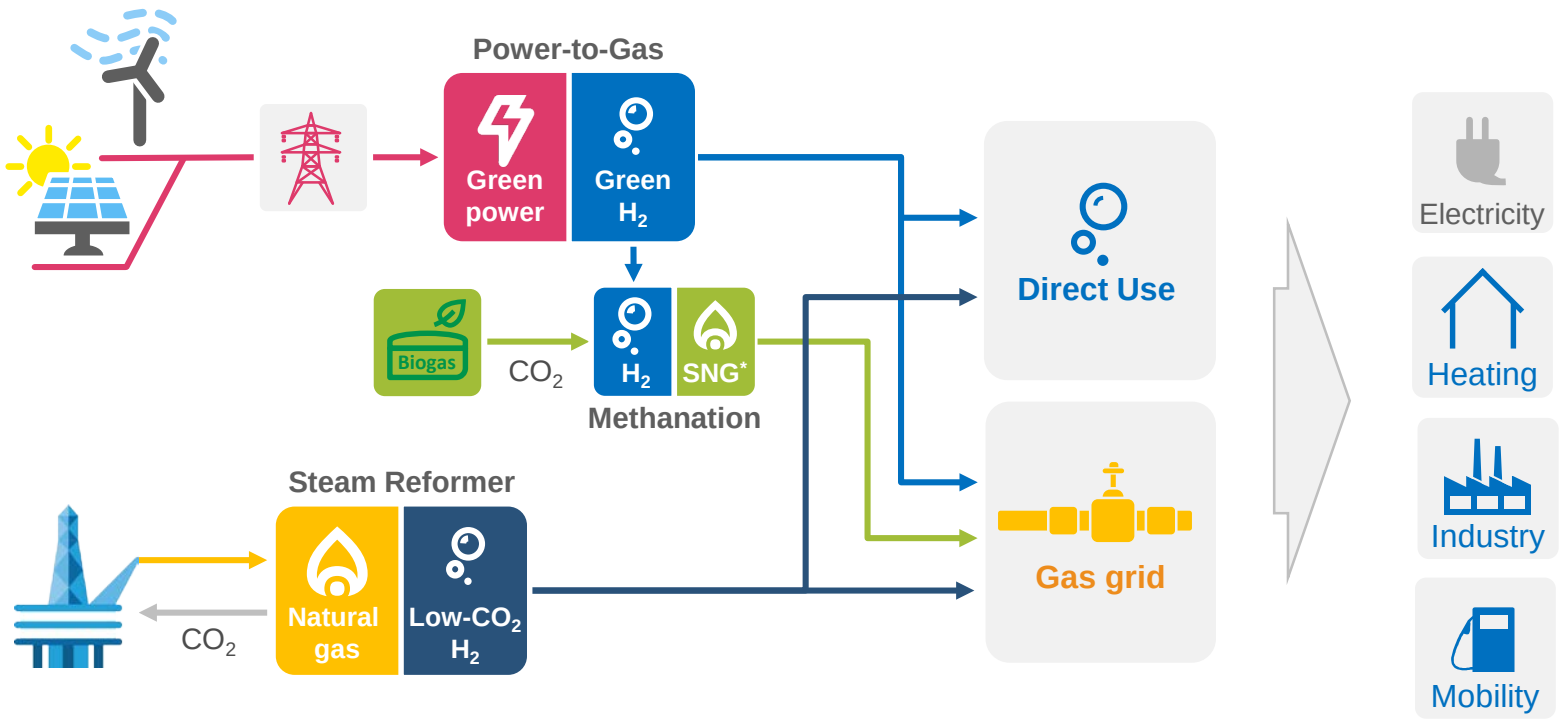
E.g. fuel cell cars and decentral stationary FC are a growth story in Japan.

Technology development



Cost for renewable energy and electrolysis will continue to decline

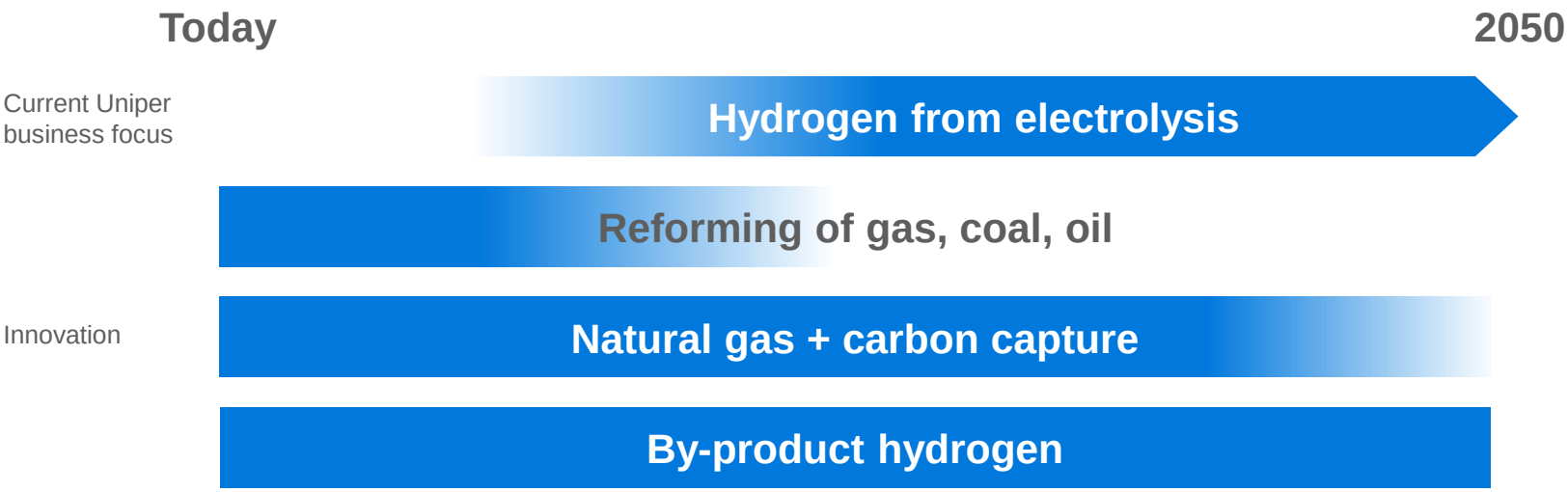
Pathways



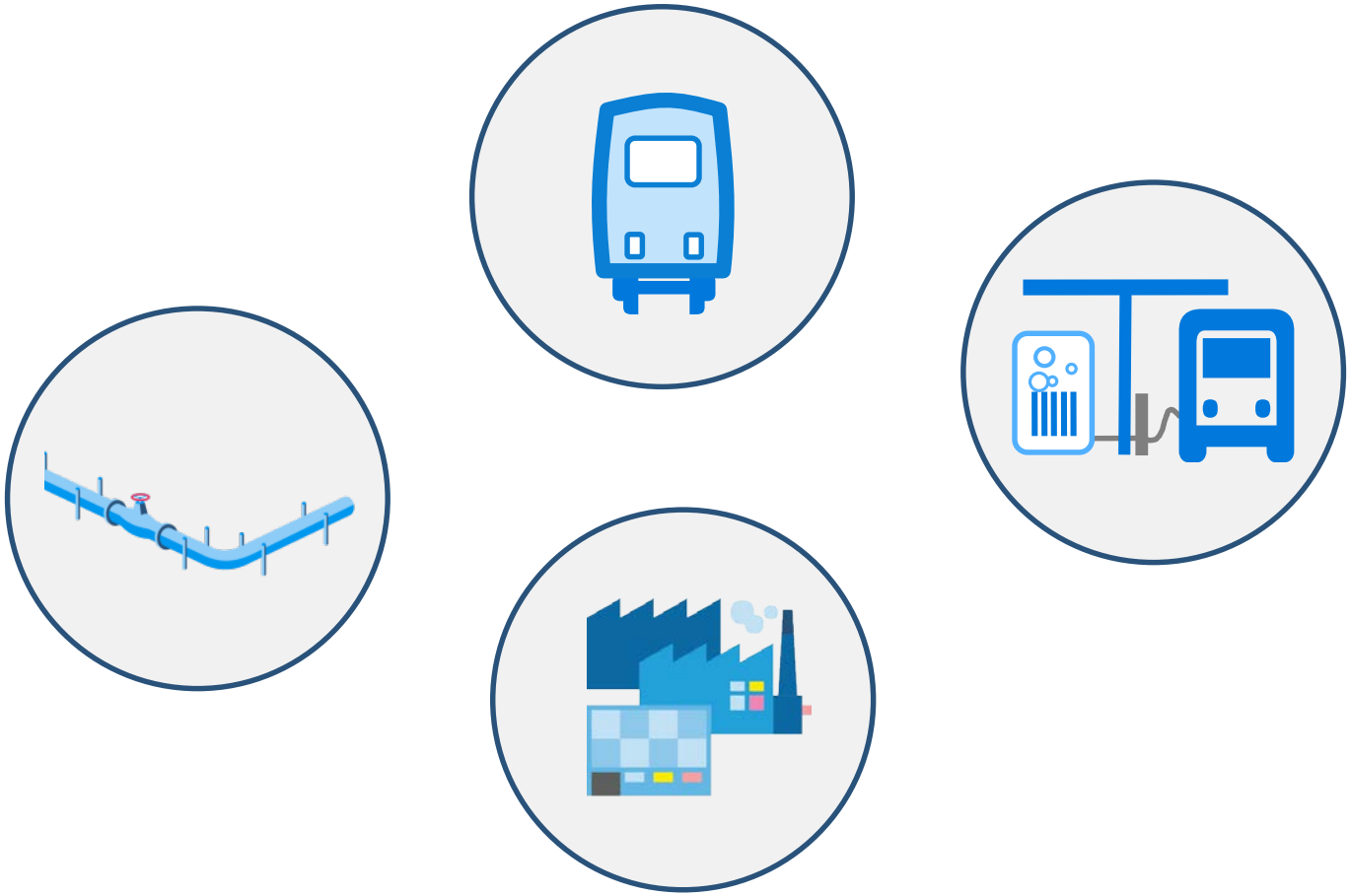
Most important drivers are climate protection, diversification of energy portfolios and lowering emissions locally

* SNG = Synthetic Natural Gas

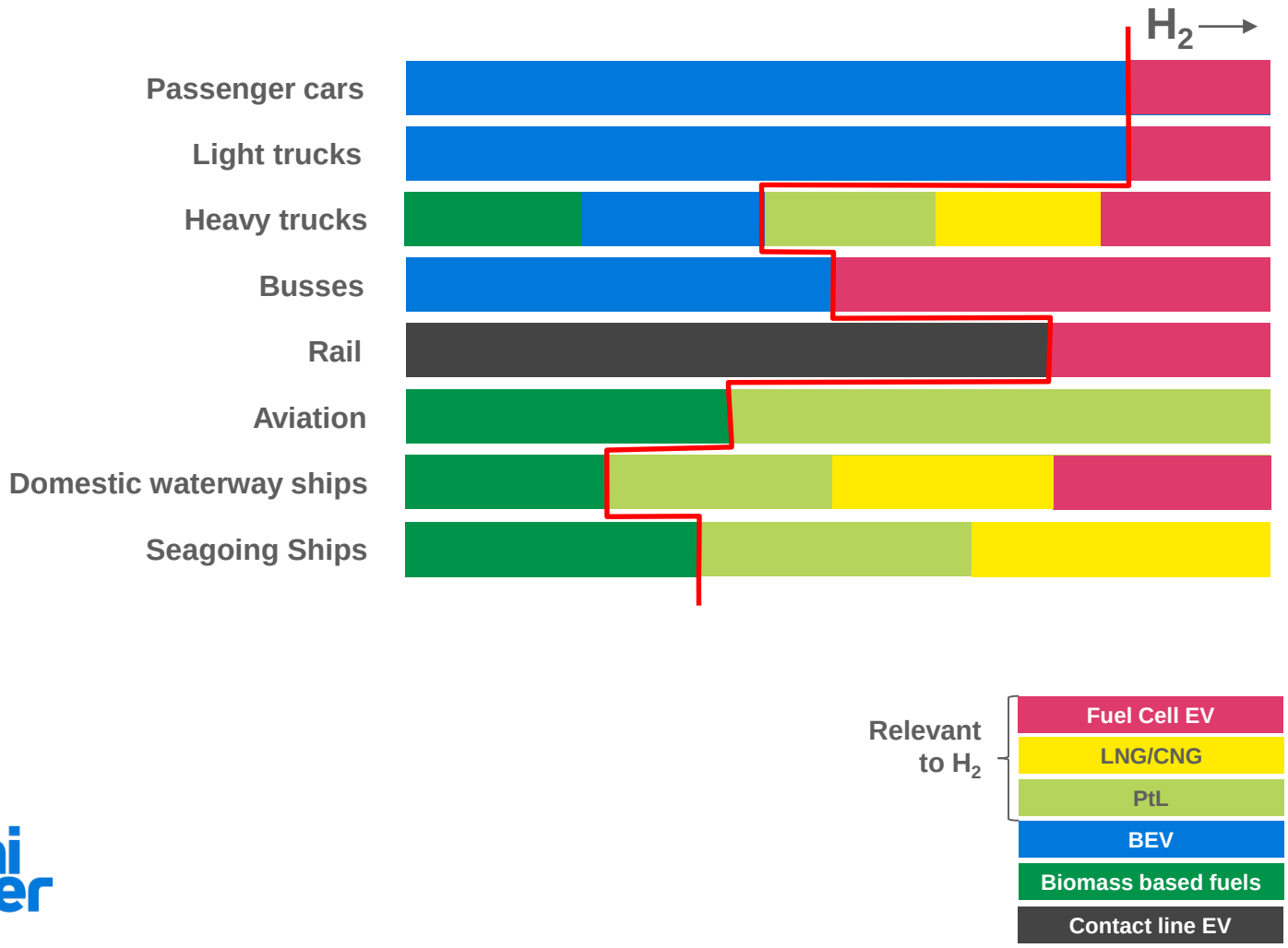
Technology: Electrolysis is a preferred sustainable solution



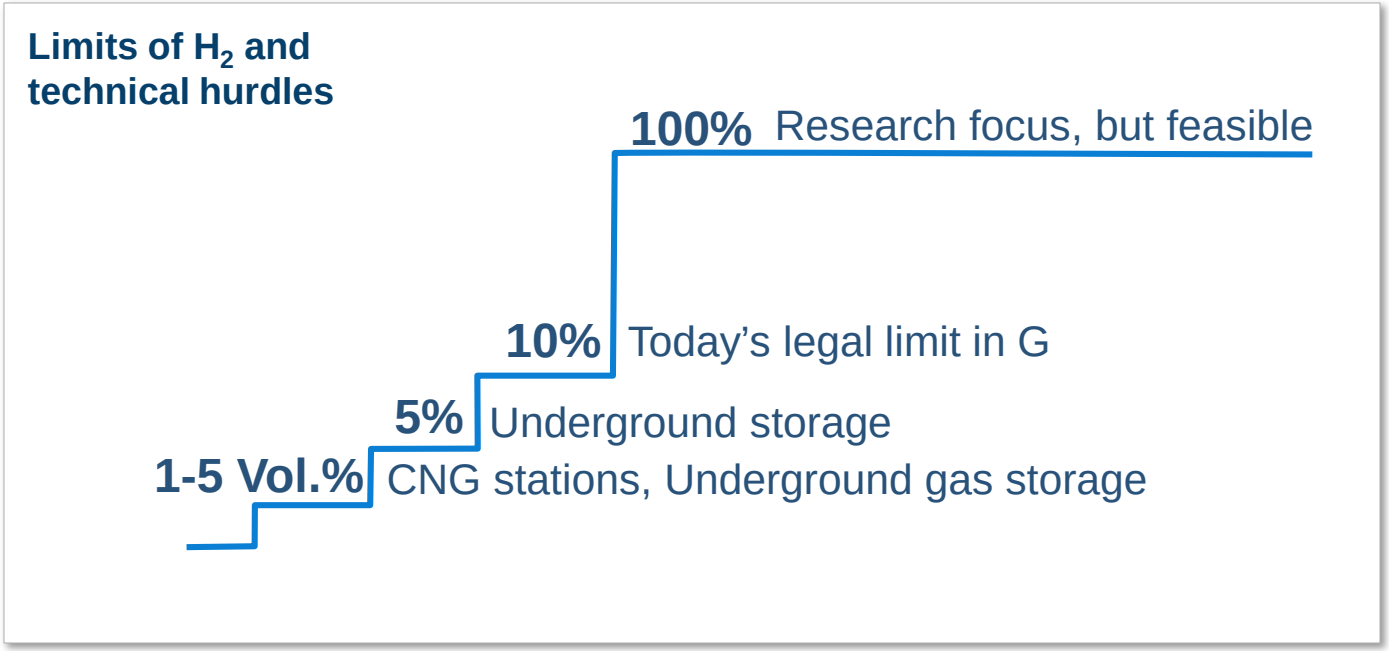
Emerging Use Cases



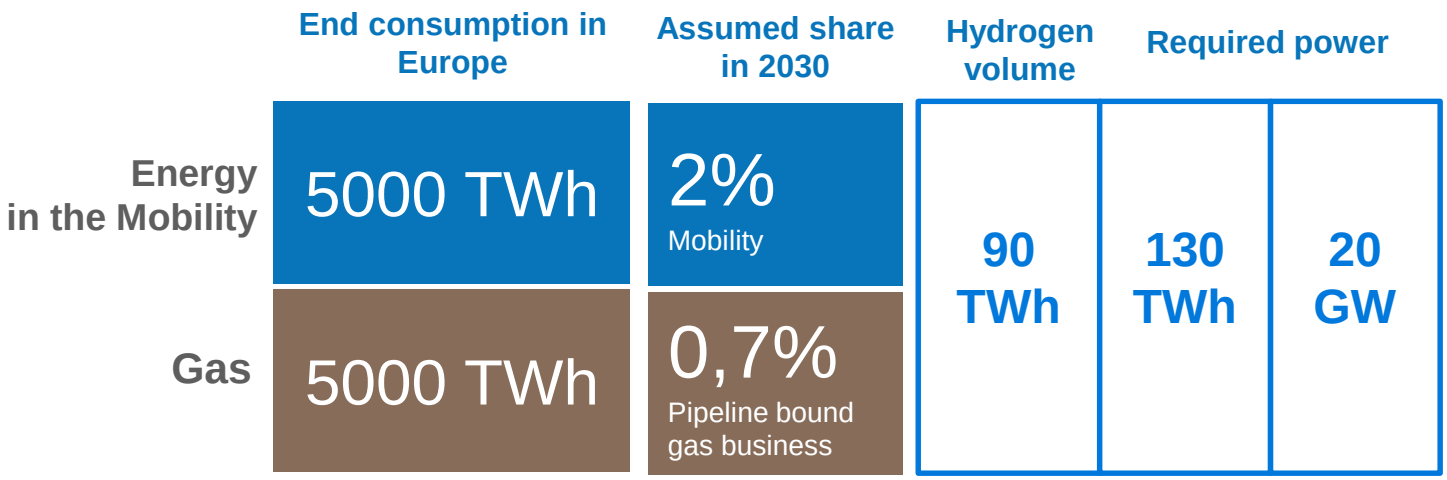
Hydrogen in the Mobility: Indicative, Conservative Assumption for Hydrogen Markets



Hydrogen in the Natural Gas System



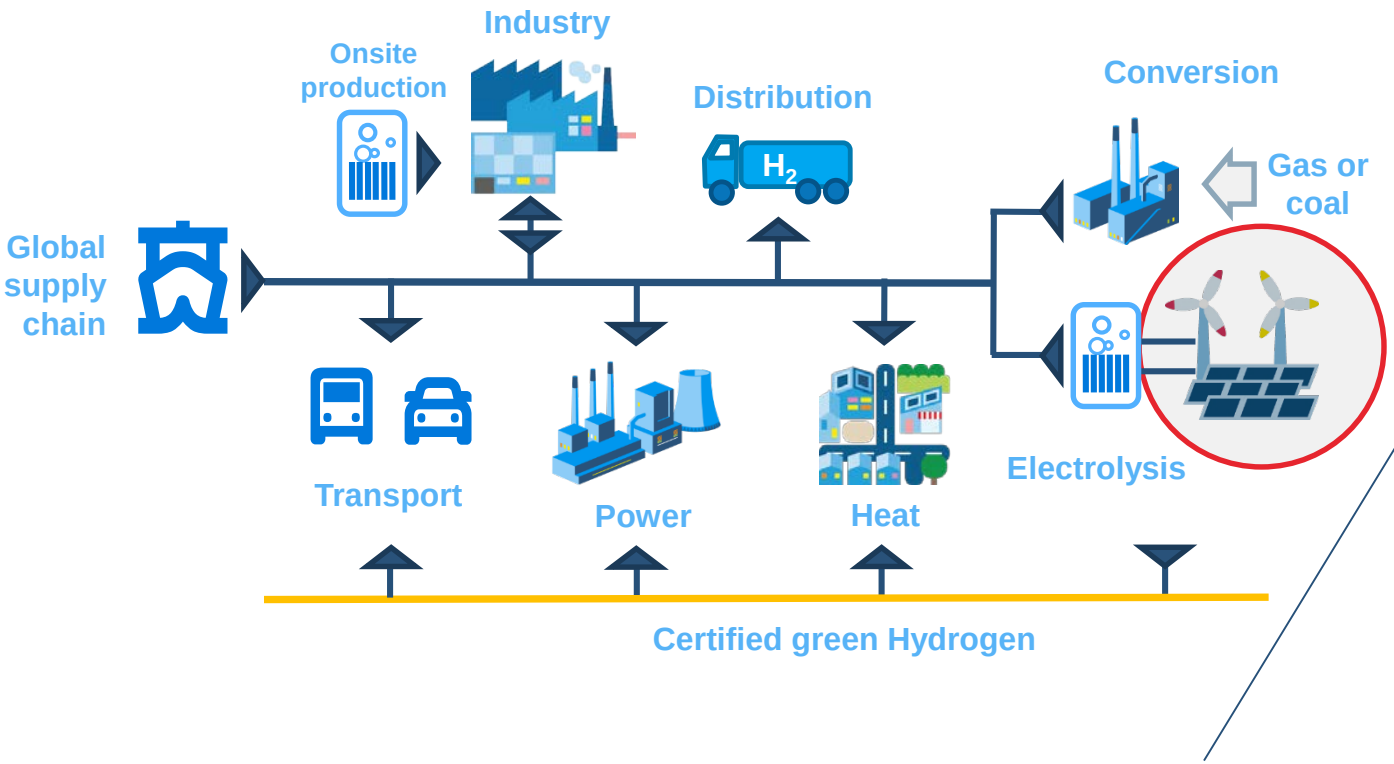
Market Size in a Hypothetic Scenario



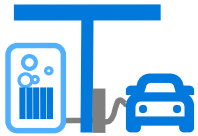
Further Assumptions:
2% volumetric content of hydrogen in the gas grid

Total market size	Share	Use case efficiency factor	H_2 Share (TWh)	Eff. Eletrolysis	Power (TWh)	op. Hours	Power (GW)
5000	2%	0,55	55	70%	78,6	6000	13,1
5000	0,7%	1	35	70%	50,0	6000	8,3
			90		129		21

Market Vision

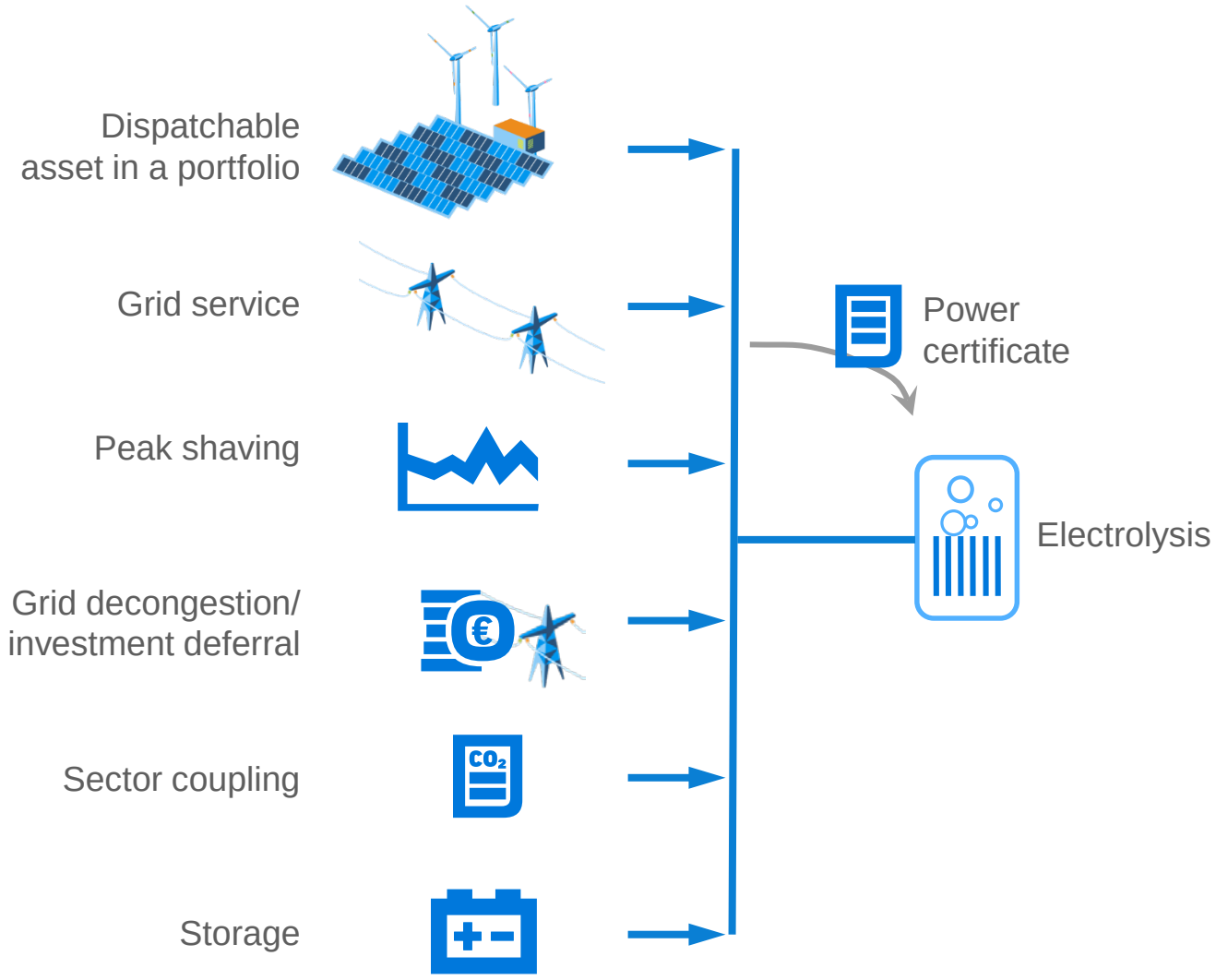


Decentral solutions for FC mobility



The hydrogen market will comprise different sources of hydrogen and grow to a pipeline based network.

Value Generation at the Power Side



Roadmap

Today

- Regulation is the main hurdle for green hydrogen from power.
- Grey hydrogen and by-product hydrogen will compete with green H_2.
- Internationally, niche applications for green hydrogen emerge and early adopters step in.
- Market players develop required capabilities

in 1 to 5 years

- Power market regulation quota or environmental targets provide commercial scalable business cases for green/sustainable hydrogen.
- Costs of technology/applications decrease

Future

- Hydrogen economy is a key pillar for climate and environmental protection
- Market exceeds domestic resources and H_2 is traded internationally

Summary

- Green hydrogen is key for a sustainable energy system
- To achieve long-term targets action is required today
- Regulation needs to set incentives in the sectors mobility, heating, power and industry: create level playing field with other fuels, lower fees and taxes on power
- Alignment of different stakeholders is required: government, utilities, grid operators, manufacturers, industry, ….
- Grids can benefit from flexibility of the electrolysis assets. Perceiving electrolysis just as a consumer would be misleading.