Towards a UNECE comprehensive classification for hydrogen

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Enabling a Hydrogen Ecosystem

31st Session of UNECE Committee on Sustainable Energy, September 22nd 2022

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Increasing and diversifying H2 demand

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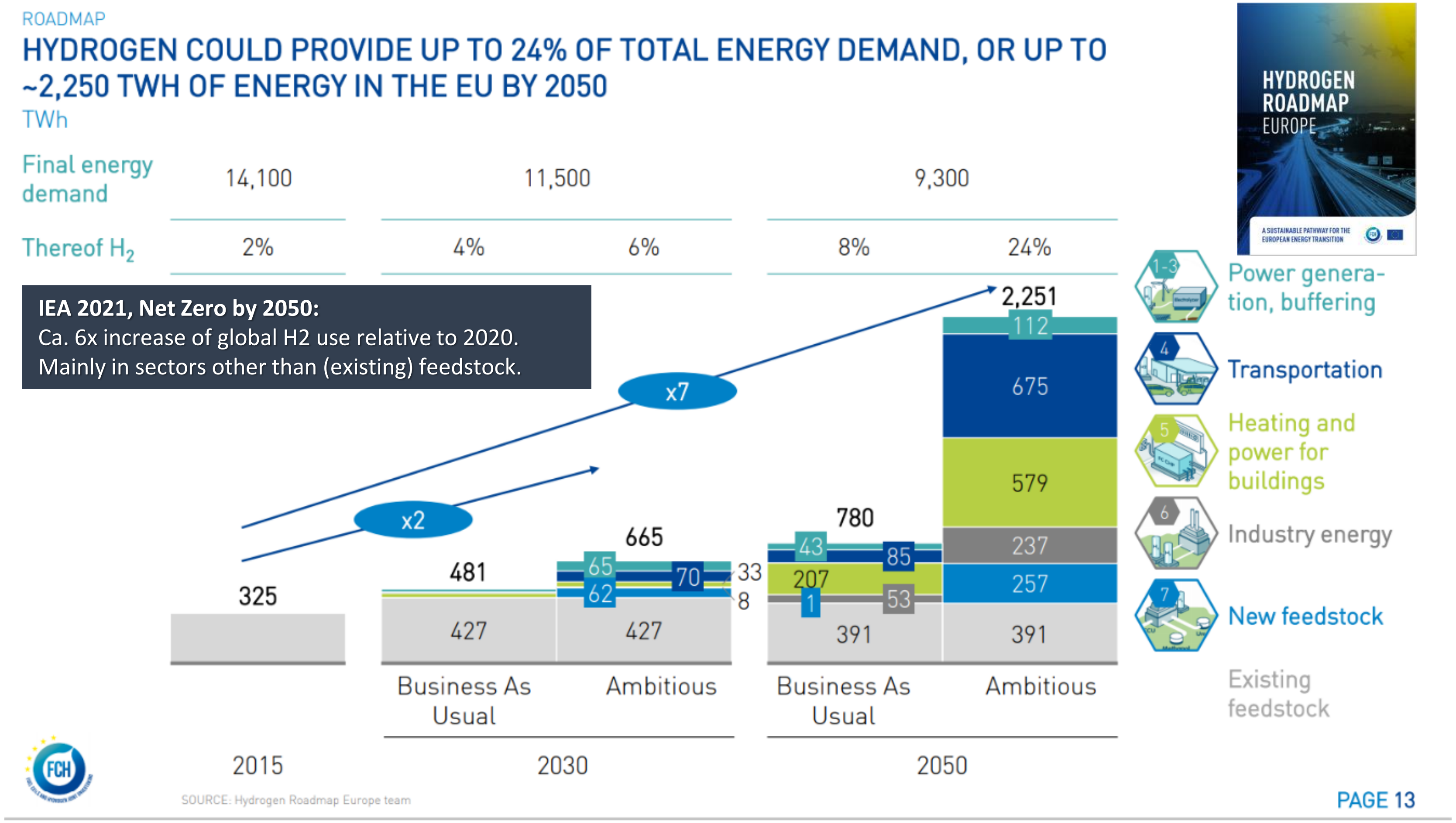


fch-ju-2019: https://www.fch.europa.eu/sites/default/files/Hydrogen%20Roadmap%20Europe_Report.pdf

"The quicker we switch to renewables and hydrogen, combined with more energy efficiency, the quicker we will be truly independent and master our energy system"

EU Commission President Ursula von der Leyen, 2022

- Grey -> low carbon & renewable H2
- Sector and system integration/transformation
- Feedstock -> transport, green industry, transport, flexibility, energy security, heating, etc.

Hydrogen Projects and Programmes

Stage 3 of the Dutch hydrogen network (completed in 2030) Source: Gasunie.nl

The implementation of hydrogen depends on the development of projects across the entire value chain.

- Production
- Import/Trade
- Distribution, Transport
- Storage
- Applications

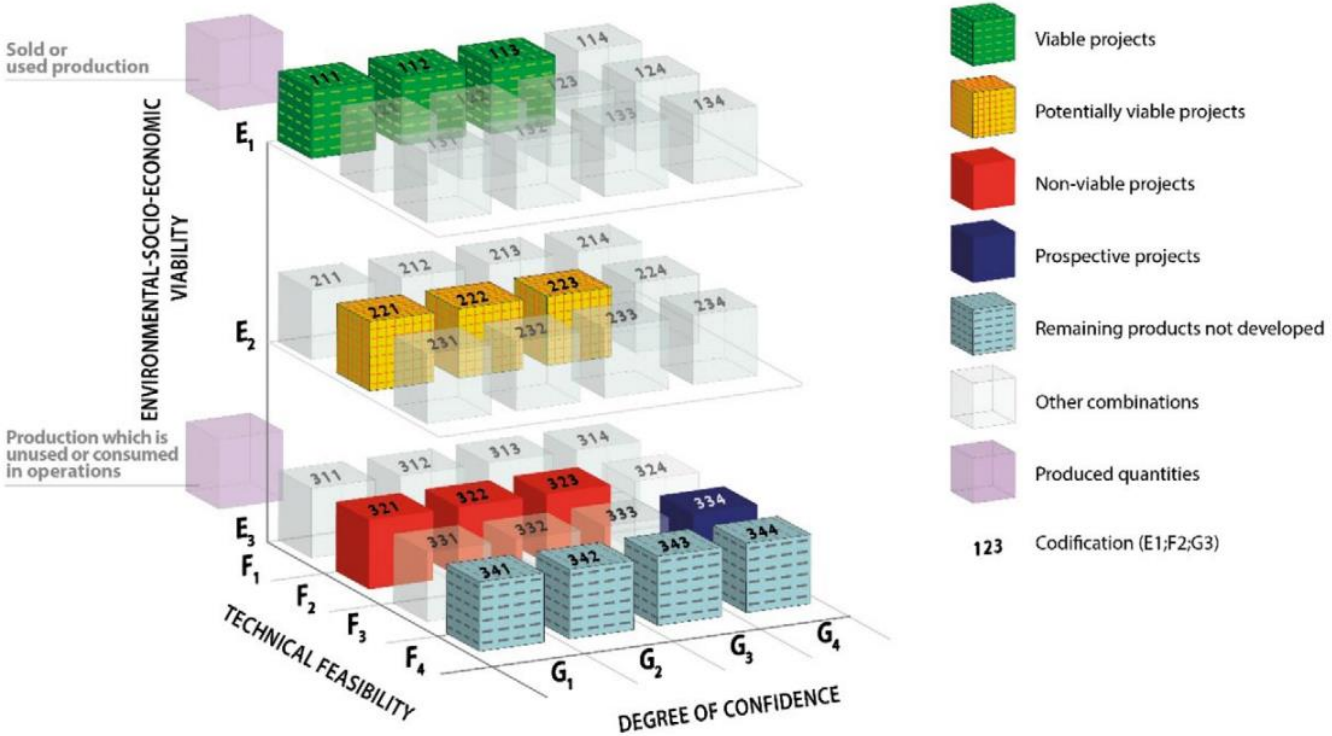
Strong interdependency of H2 projects
Connecting Sectors & Industry Clusters
Re-use of existing infrastructure
Carbon footprint of value chain
Life cycle evaluation
Origin of Hydrogen
Cost reduction/market/economy of scale

Reporting of Hydrogen Projects

Conclusion of 30th Session of Committee on Sustainable Energy: It is necessary to agree on

- a comprehensive and science-based terminology and classification of different types of hydrogen that would provide a clear taxonomy
- foster collaboration and investment flows
- support better understanding of the origin of hydrogen to accelerate its sustainable deployment

UNFC and UNRMS are equipped for a consistent and transparent reporting of Hydrogen Projects and support states to enable a sustainable hydrogen ecosystem



Hydrogen Colours do not capture Carbon Footprint of H2 Value Chain and Life Cycle

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Hydrogen is the most abundant element of the universe (97% atom percentage, 75% weight percentage), yet it's sustainable production is challenging.

Colors	Black Hydrogen	Grey Hydrogen	Blue Hydrogen	Turquoise Hydrogen	Yellow Hydrogen	Pink Hydrogen	Green Hydrogen
Process	Gasification	SMR	SMR or gasification with carbon capture (85-95%)	Pyrolisis	Sulfur–iodine cycle	Electrolysis	Electrolysis
Source	Coal	Methane	Methane or coal	Methane	Nuclear power	Nuclear power	Renewable Energy

Current colour schemes for Hydrogen (grey, blue, green, pink, yellow, etc.) refer to **different production methods**.
Little information is included on

- associated carbon emissions of full value chain (Production → Transport → Storage → Use)
- Technical feasibility
- Economic, environmental, societal and governmental consequences

Hydrogen Supply, Transport, Storage and Demand

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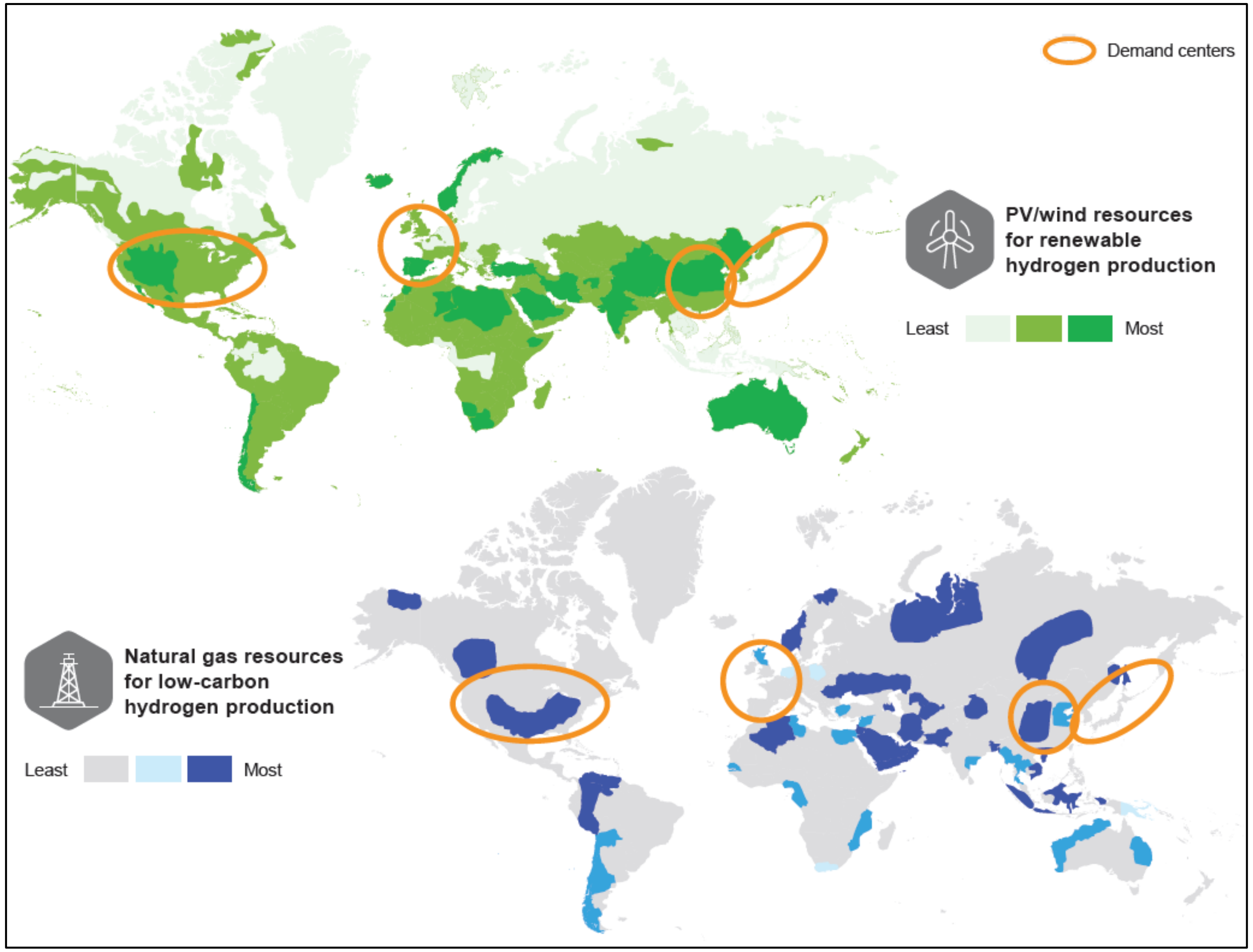

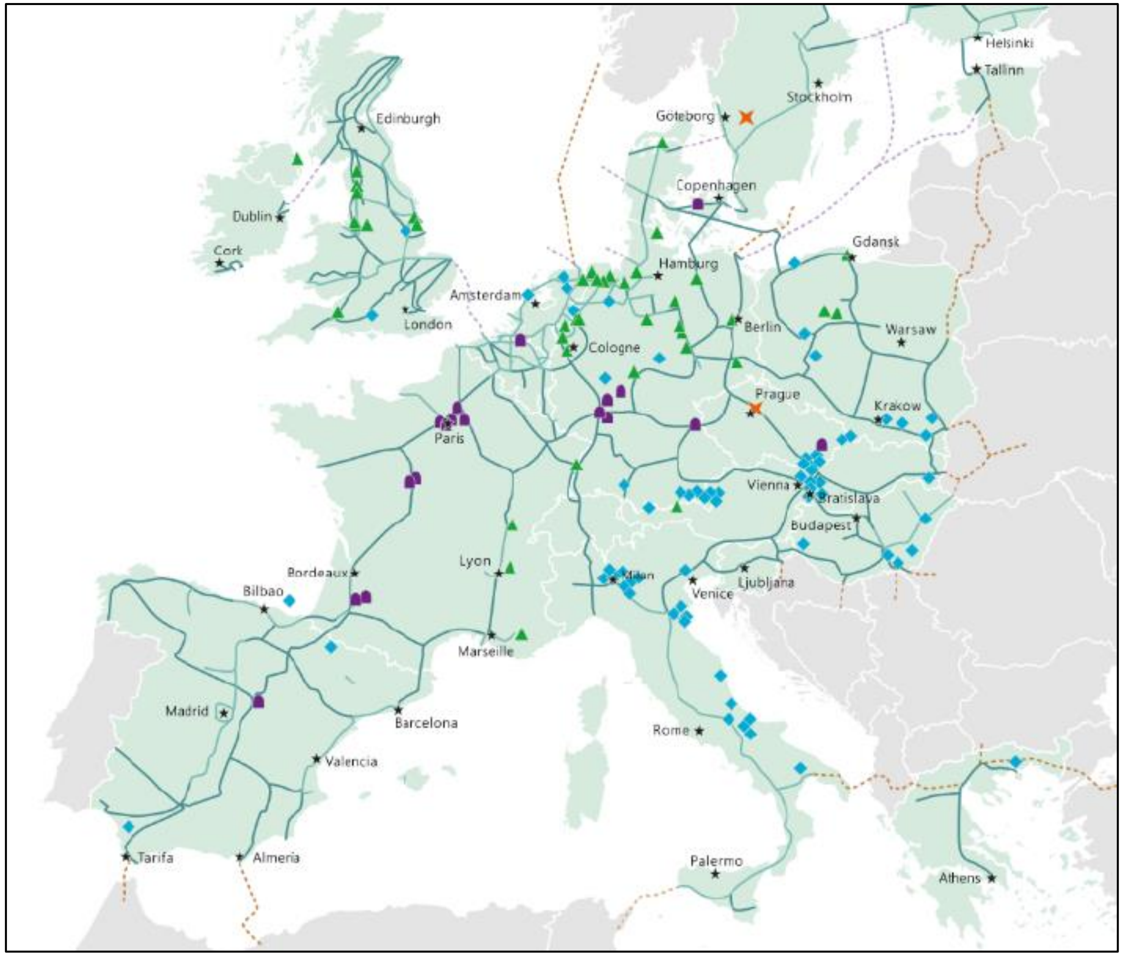

Source: Hydrogen Council: Hydrogen insights 2021

https://hydrogencouncil.com/en/hydrogen-insights-2021/

Guidehouse for GIE, 2021: Picturing the value of underground gas storage to the European hydrogen system

Hydrogen Geological Storage and Injection

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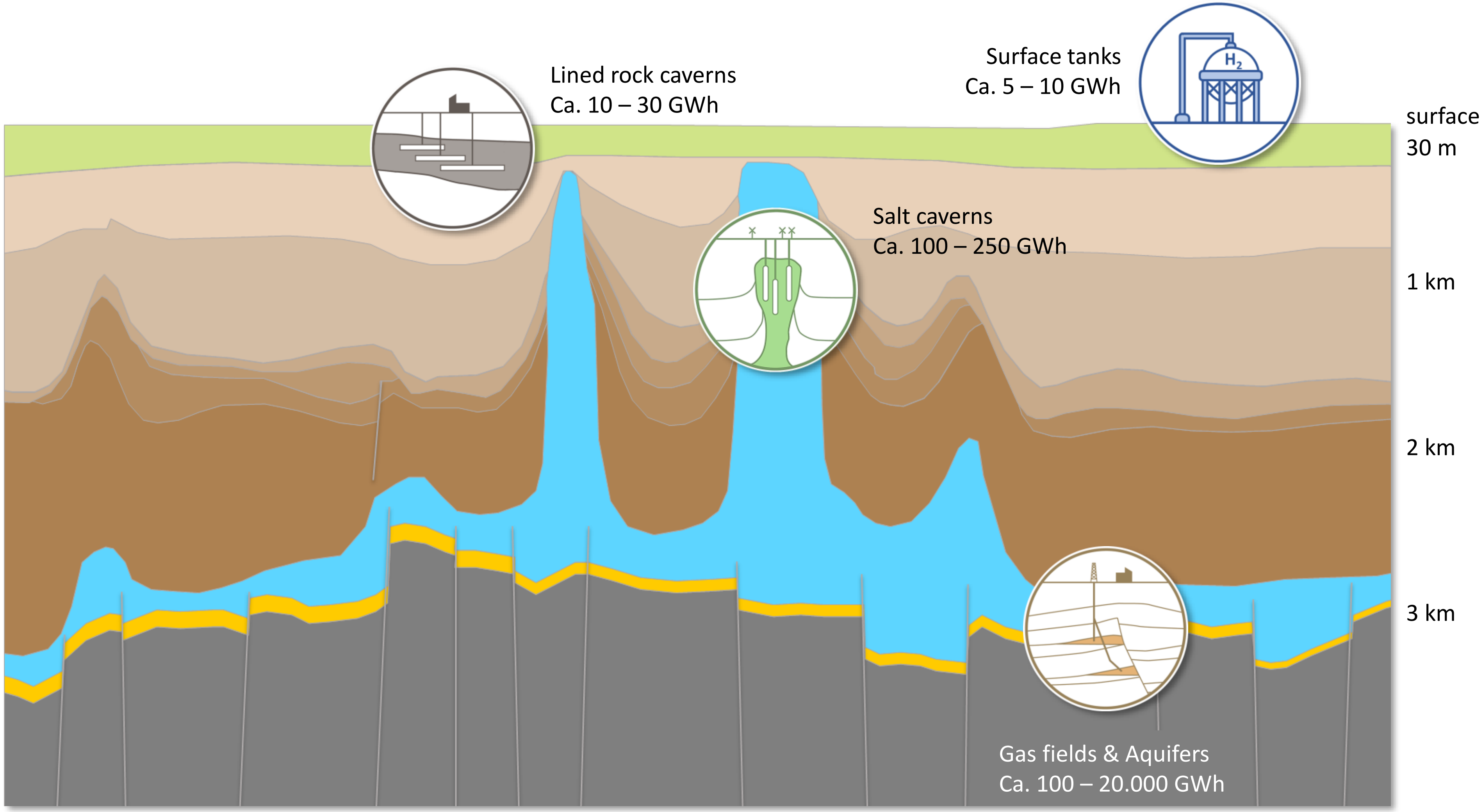

Source: Hydrogen TCP

A comprehensive life cycle evaluation is key

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Technical Life Cycle	Feasibility & Screening	FEED & Construction	Operations & Optimization	Closure & Decom-missioning
Economy, Value, Market	End-use criteria: Pure or Blended?	Flexibility demand (cyclicity, volume, rates)	Societal needs (strategic, security)	Costs & Revenues
Environment & Safety	(Bio)chemical reaction products	Flammability, HSE & Risk management	Green House Gas effects	Sensoring & Monitoring
Organization, Legislation	Planning & System integration	Regulatory framework (life cycle)	Standards, Norms, Procedures	Training & Experience
Society, Policy, Employment	Public awareness &, Participation	Education & Information	International	Decision support

Source: Hydrogen TCP

Hydrogen relation to other UNFC Applications

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UNFC focused on elementary form of production projects >> does not capture project links and carbon emissions and feasibility of entire H2 value chain

UNFC Applications (primary resources)

- Minerals (coal → Gray)
- Petroleum (gas → Gray; + ccs → Low Carbon)
- Nuclear (→ Low Carbon)
- Bioenergy (→ Low Carbon)
- Geothermal
- Hydropower
- Solar
- Wind
- Anthropogenic
- Groundwater

(Geothermal, Hydropower, Solar, Wind → Renewable)

- Injection projects (underground)

Hydrogen as secondary product generated from primary resources

- Gray
- Low Carbon (blue, pink)
- Renewable (green)

CO2 (Low Carbon → Injection projects)

Hydrogen as primary resource (prospect)

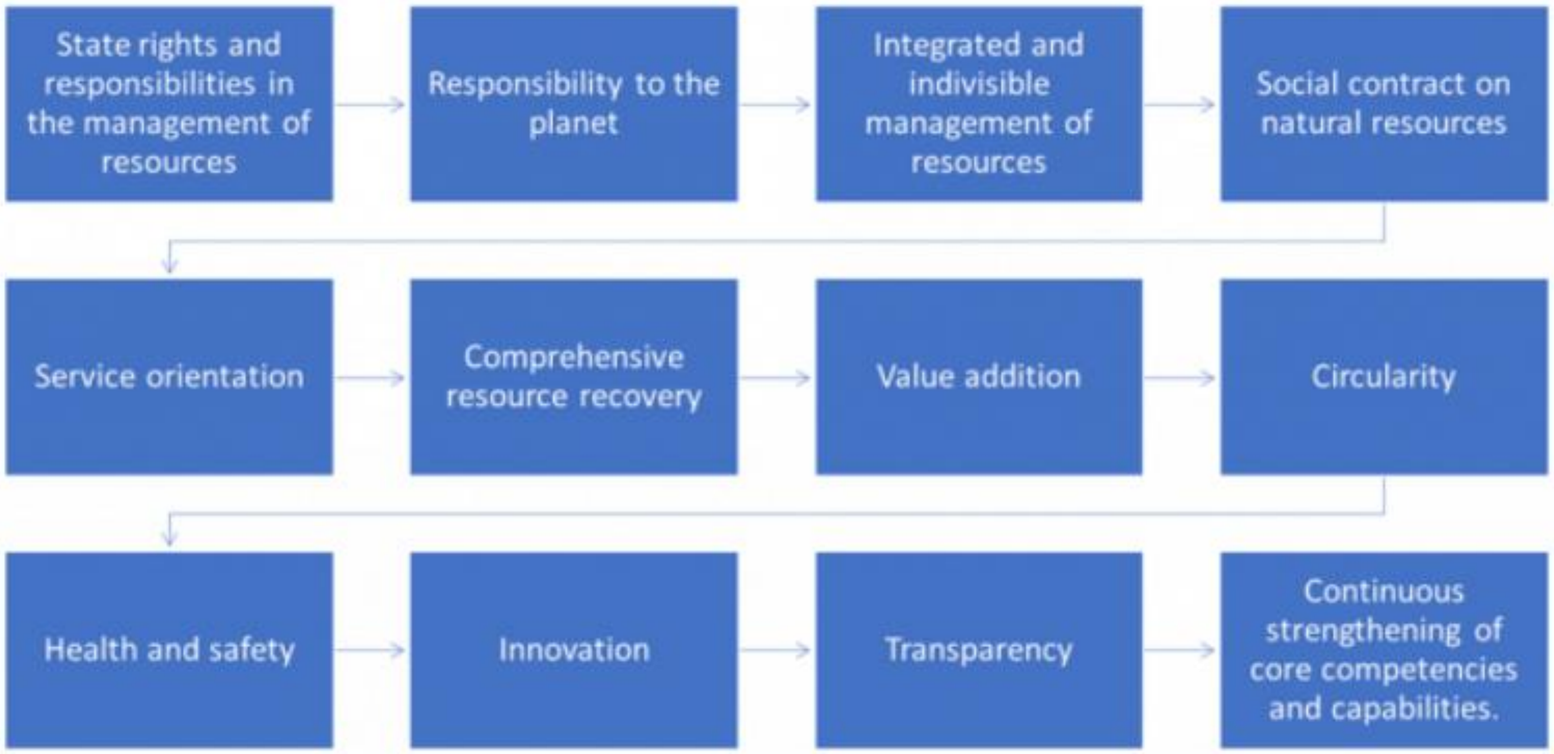
- Natural Hydrogen (gold)

Hydrogen transport, storage and use

- Gas (pressurized)
- Blended (nat. gas)
- Ammonia
- Liquid H2
- Liquid Organic H2 Carrier (LOHC)

(Gas (pressurized), Blended (nat. gas) → Injection projects)

UNRMS Principles provide a framework for H2 Project Life Cycle evaluation



UNRMS Fundamental Principles

Recommendations:

- Extend the United Nations Framework Classification for Resources (UNFC) to all hydrogen projects and production technologies
- Establish a task force/working group that would prepare the Specifications for the application of UNFC to Hydrogen
- Develop a pilot hydrogen production project applying United Nations Resources Management System (UNRMS) principles
- Establish a Guarantee of Origin for Hydrogen (GOH)

Thank you!

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