Heat-to-Fuel project · Interface workshop on e-fuels · 8 March 2021

E-fuels prospects – Where are we (heading to)?

Keynote

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LBST · Ludwig-Bölkow-Systemtechnik GmbH · Munich · Germany

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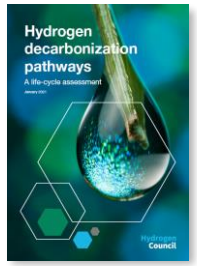
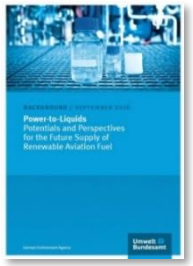
Profile

- Independent expert for sustainable energy and mobility for over 30 years
- Bridging technology, markets, and policy
- Renewable energies, fuels, infrastructure
- Technology-based strategy consulting, System and technology studies, Sustainability assessment
- Global and long term perspective
- Rigorous system approach – thinking outside the box
- Serving international clients in industry, finance, politics, NGOs





References

- Hydrogen Council – *H_2 Decarbonization Pathways*
- World Energy Council (Germany) – *International Hydrogen Strategies*
- CertifHy – *European H_2 guarantees of origin system*
- Numerous PtX studies for industry, politics, and associations

2020 has seen PtX announcements totalling gigawatts

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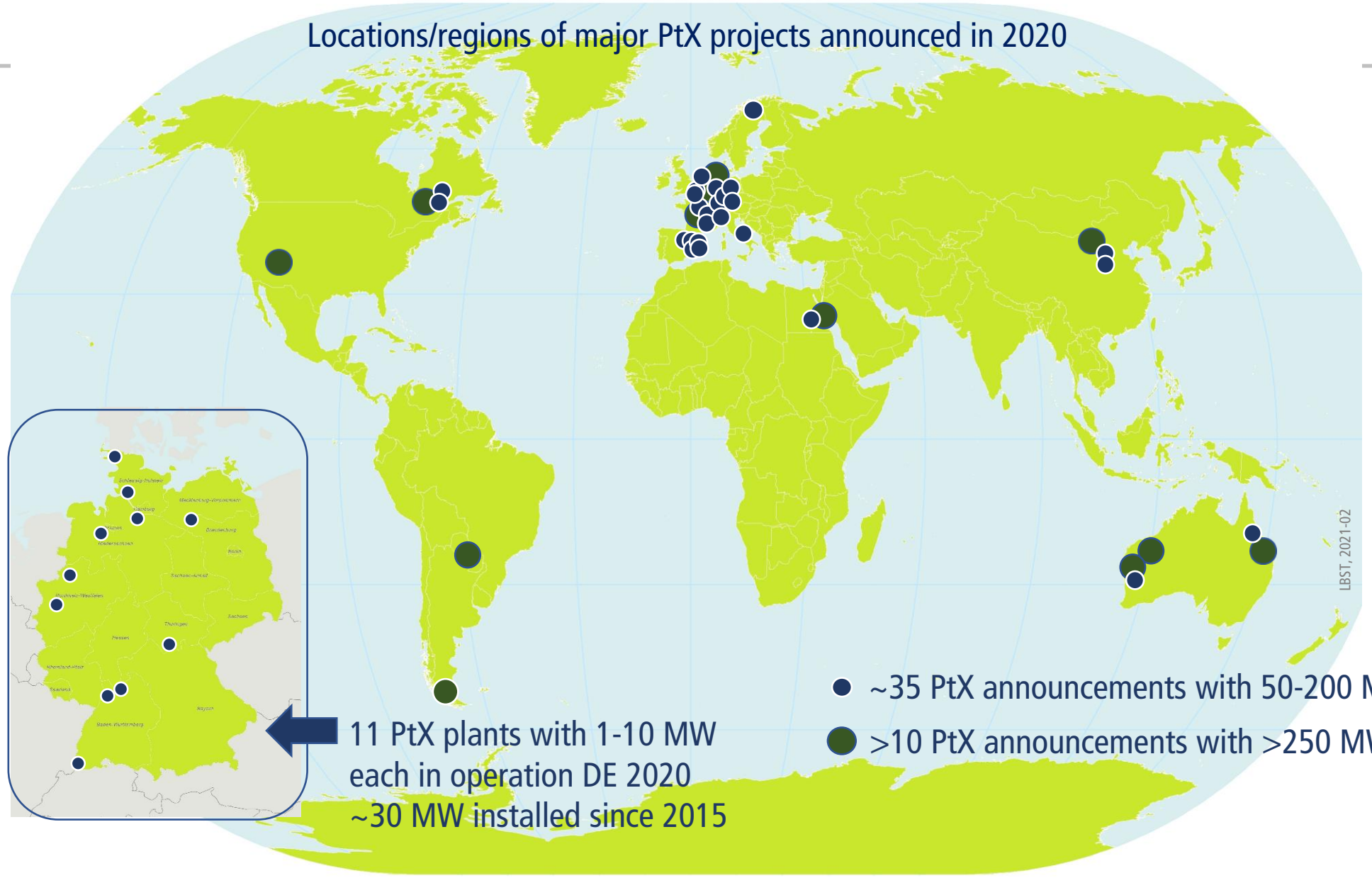

Power-to-gas (PtH_2, $PtCH_4$) in Germany – Taking-off in 2019 and further accelerating since

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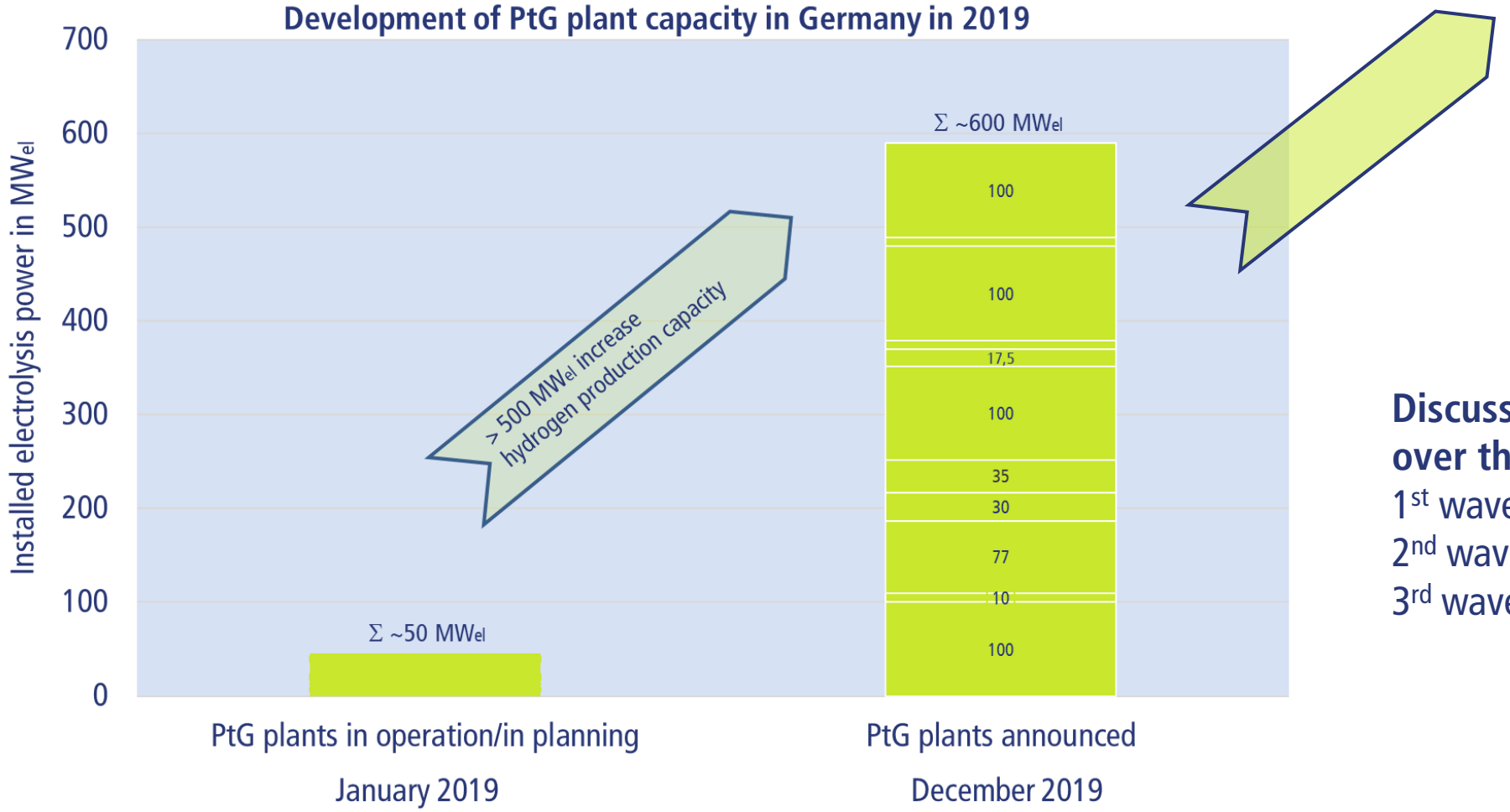

>1000 MW announced?

Discussions have broadened up over the past ten years:

1st wave – Power-to-methane

2nd wave – Power-to-hydrogen

3rd wave – Power-to-X (incl. liquids)

~~Three~~ Four drivers for PtX development

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1. Climate change policies start shaping the economy
2. Renewable power has become a low-cost option in many parts of the world
3. Opportunities from technology innovation, industry transformation and sector integration
4. COVID 19 green recovery funds NEW!

⇒ The next years will be decisive for mainstreaming PtX through regulatory frameworks

56 countries analysed 2020: Hydrogen activities are well spread around the globe. Major interest in Europe, Asia & Pacific, and the Americas

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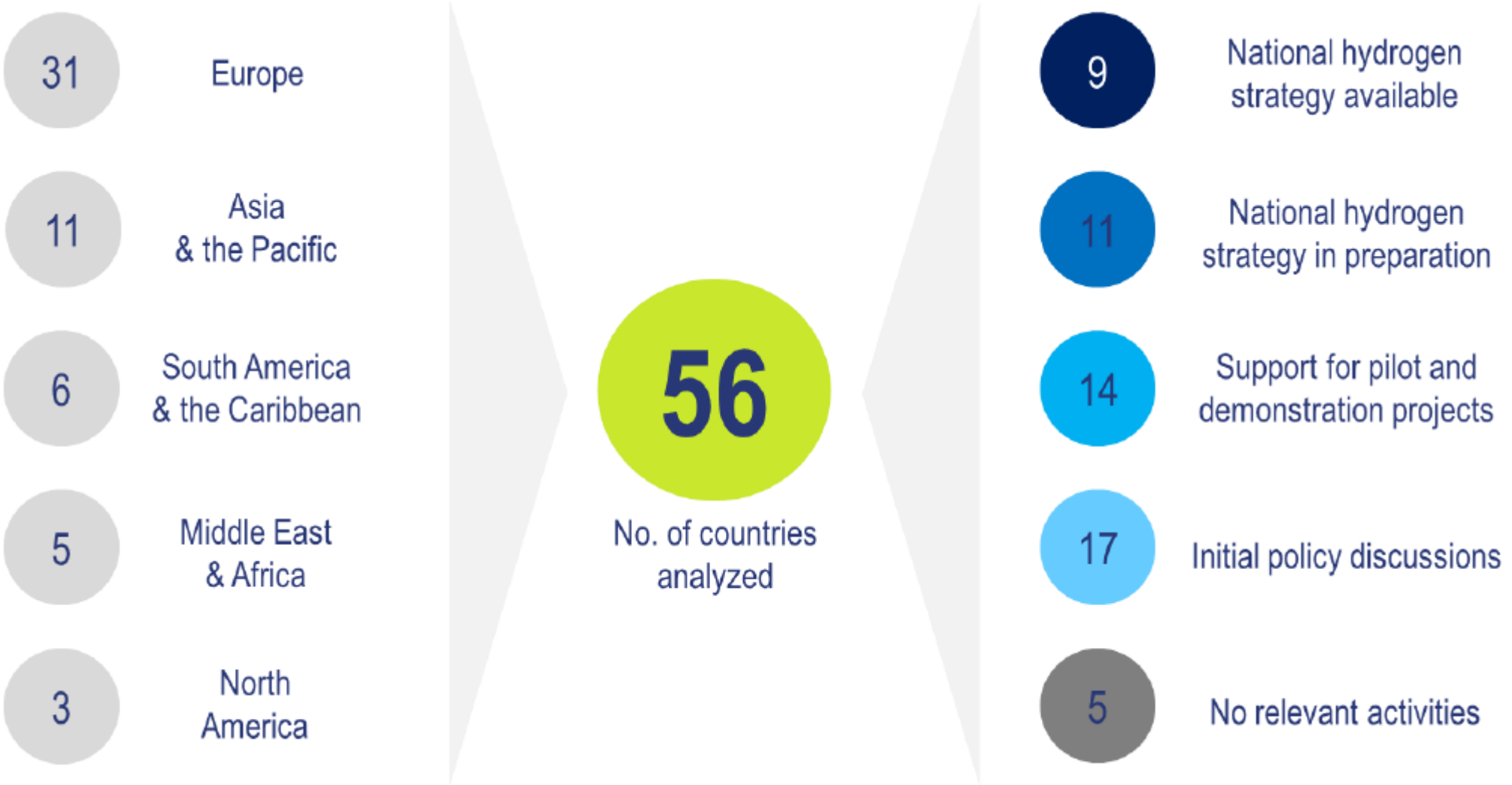
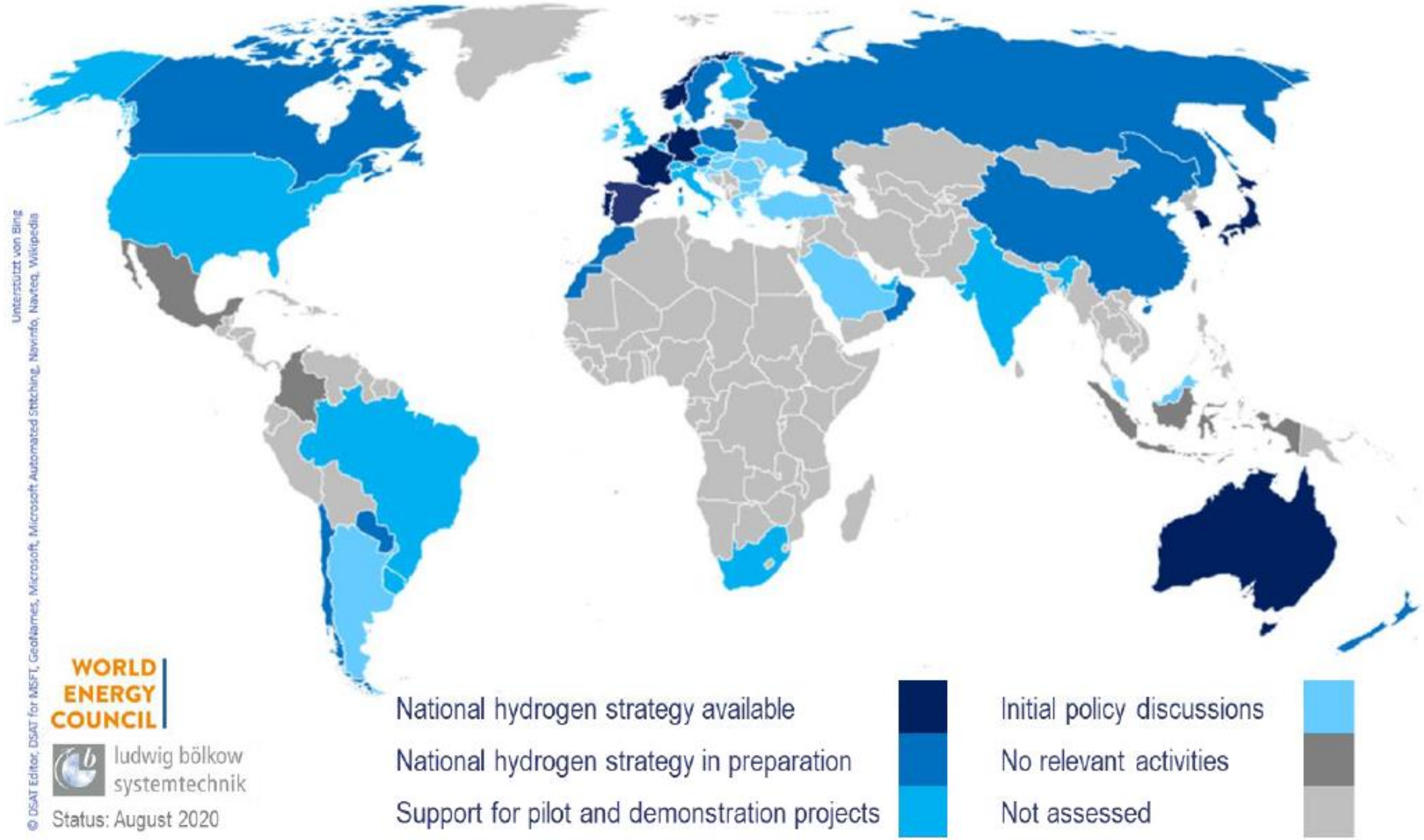


August 2020, World Energy Council, LBST

Reference: International Hydrogen Strategies; LBST expertise for the World Energy Council (WEC) Germany, September 2020

International status of hydrogen activities of national governments

- Just three strategies until early 2019 (JP, FR, KR)
- Most strategies since late 2019 (AU, NL, NO, DE, EU, ES)



Reference: International Hydrogen Strategies; LBST expertise for the World Energy Council (WEC) Germany, September 2020

Many national H_2 strategies are motived by emissions reduction, innovation and business opportunities, and renewables integration

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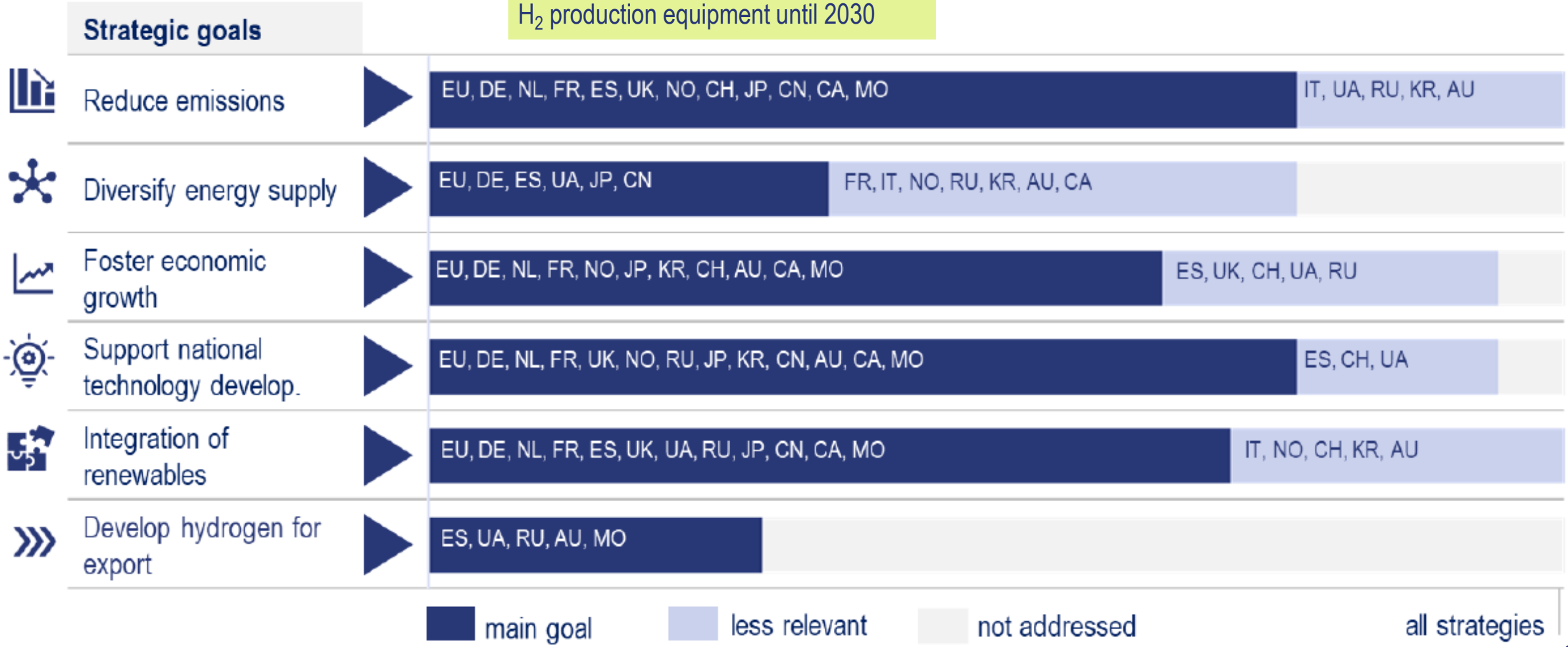
EU cumulative market >40 G€ for green H_2 production equipment until 2030



Reference: International Hydrogen Strategies; LBST expertise for the World Energy Council (WEC) Germany, September 2020

Expected annual hydrogen consumption (TWh_{H2} per year)

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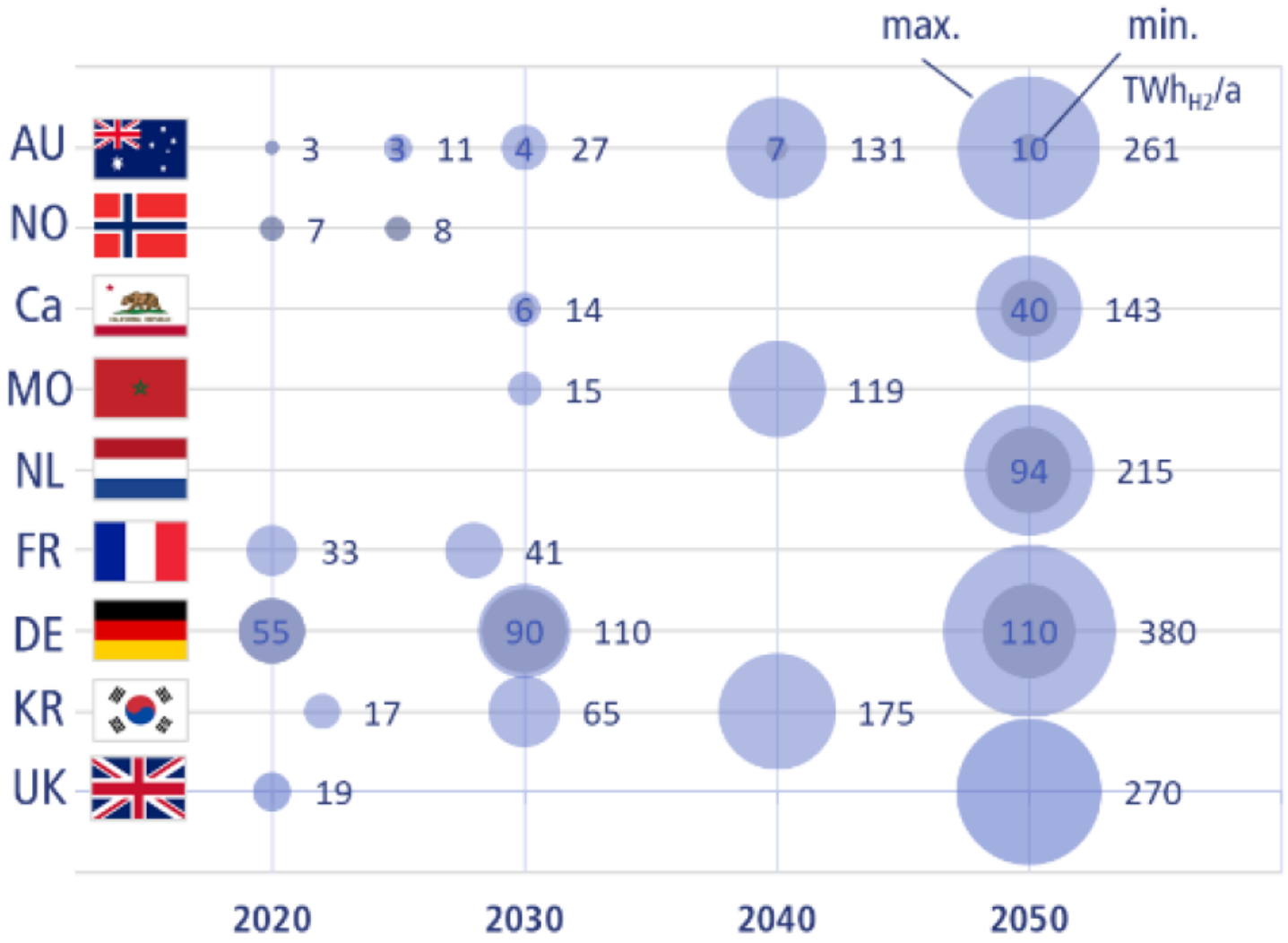
- Scaling demand expectations for 2050 indicates a global H_2 potential of up to **9000 TWh***
- Initial applications focus on the **transport & industry** sectors
- Countries with high energy demand opt for H_2 **imports** (e.g. KR, JP)



* Subject to a range of sensitive assumptions; for comparison: the Hydrogen Council's "Scaling Up" report (2017) indicates 21,800 TWh H_2 demand in 2050

Reference: International Hydrogen Strategies; LBST expertise for the World Energy Council (WEC) Germany, September 2020

Where does the hydrogen come from?

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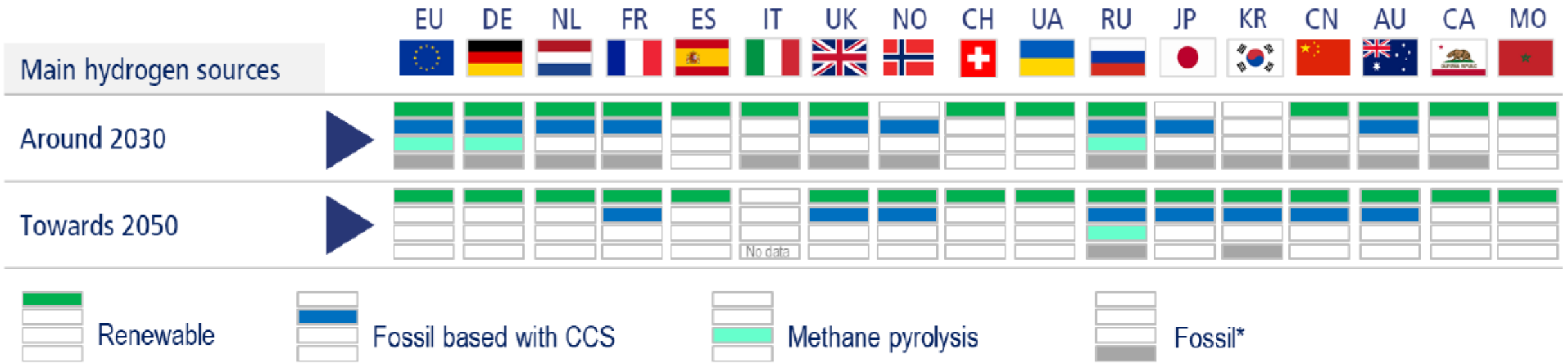
- Almost all countries take renewable energy sources into account already in the short term
- About half of the countries consider fossil with CCS as an option
- A few countries consider methane pyrolysis, mostly for bridging
- The majority of countries considers renewable sources as the main or even only option in the long term



Reference: International Hydrogen Strategies; LBST expertise for the World Energy Council (WEC) Germany, September 2020

Technical renewable electricity generation potentials EU

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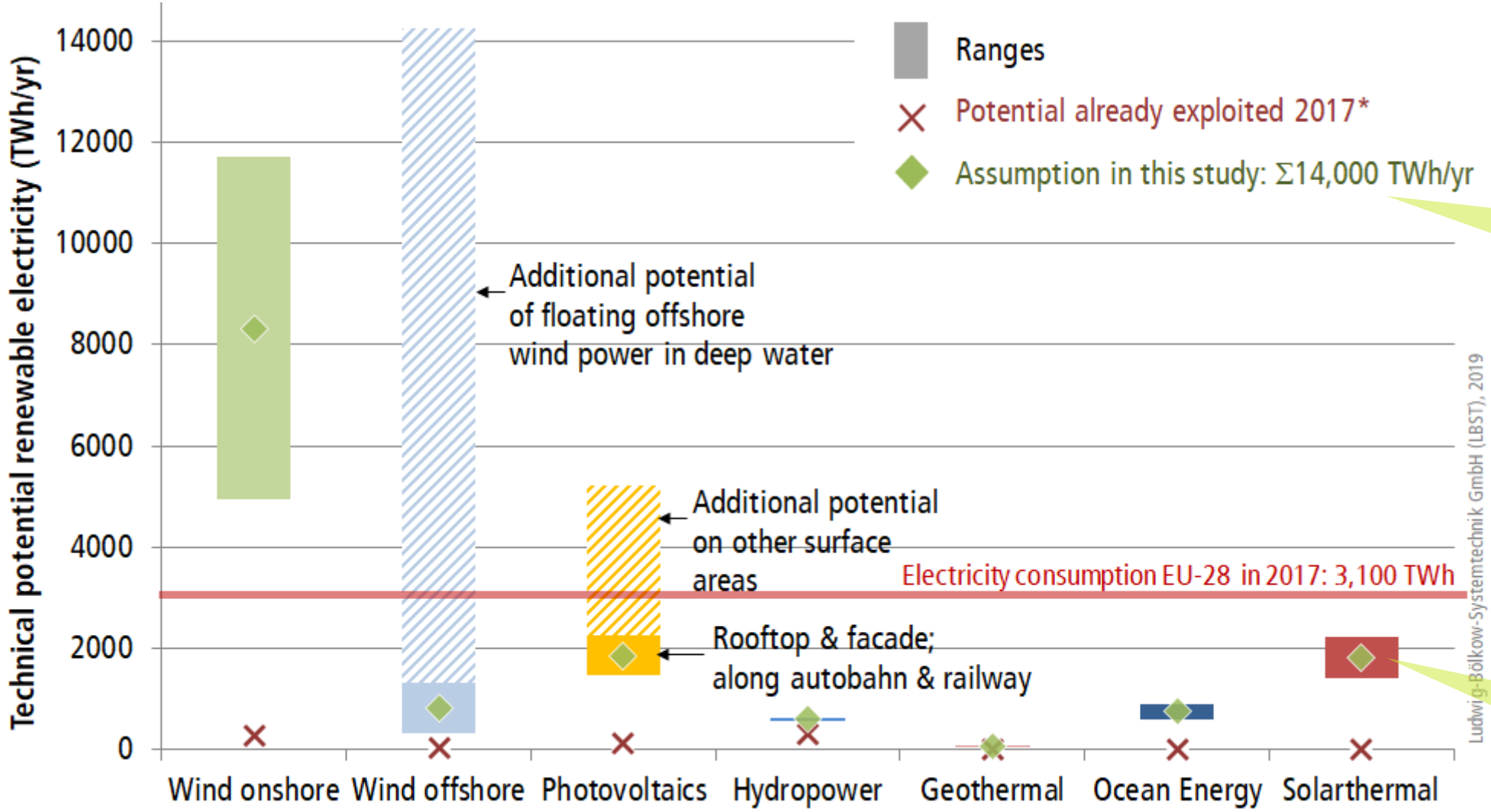

>4 times today's EU-28 electricity demand

SOT potentials could also be realised using PV

LBST.de

8 March 2021

Reference: Trinomics/LBST/E3M, Impact of the use of the biomethane and hydrogen potential on trans-European infrastructure, November 2019

Conclusions

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- **Wind and solar** are about to become the pillars of global primary electricity supply
- **Power-to-H_2 and derivatives** are considered key enablers for renewable power integration and sector transformation to achieve a carbon-neutral world
- Some **questions** are timely to debate:
  - What support instruments are suited to bridge the economic gap and drive industrialisation?
  - Which sustainability requirements and certification are needed to safeguard multiple benefits?
  - What is the right level of domestic production versus energy imports?

* Extending the economic lifetime of fossil-based value chains that would otherwise be decommissioned

Thank you!

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Reference

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Hydrogen Council with analytical support from LBST and McKinsey
Hydrogen decarbonization pathways
January 2021

Reports

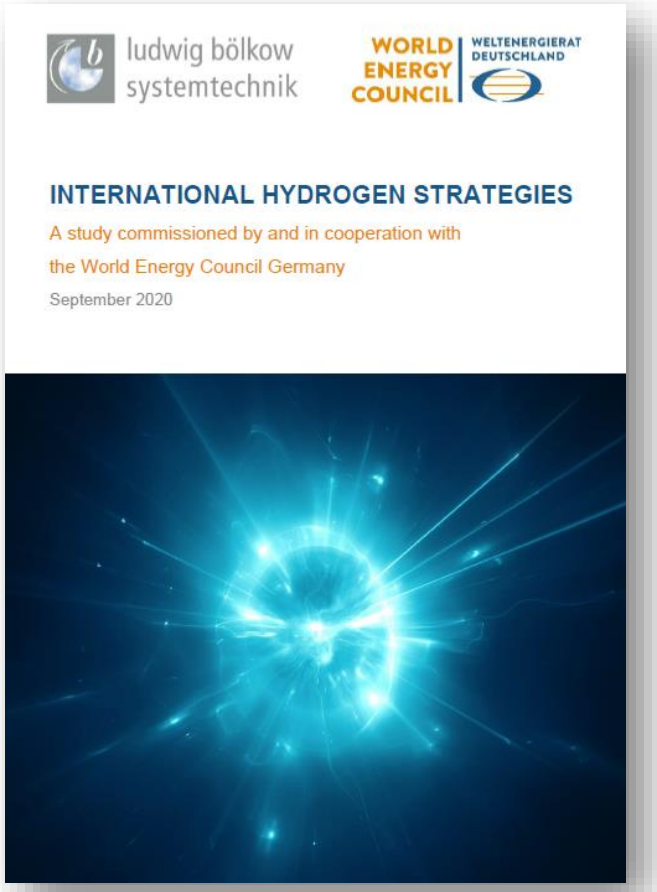
- Executive summary
- LCA part
- Scenario part

Download

https://hydrogencouncil.com/en/hydrogen-decarbonization-pathways/

Reference

World Energy Council (WEC) Germany
Ludwig-Bölkow-Systemtechnik GmbH (LBST)
INTERNATIONAL HYDROGEN STRATEGIES
September 2020



Report

https://www.weltenergierat.de/wp-content/uploads/2020/10/WEC_H2_Strategies_finalreport.pdf

Executive summary

https://www.weltenergierat.de/wp-content/uploads/2020/10/WEC_H2_Strategies_Executive-Summary_final.pdf

Reference

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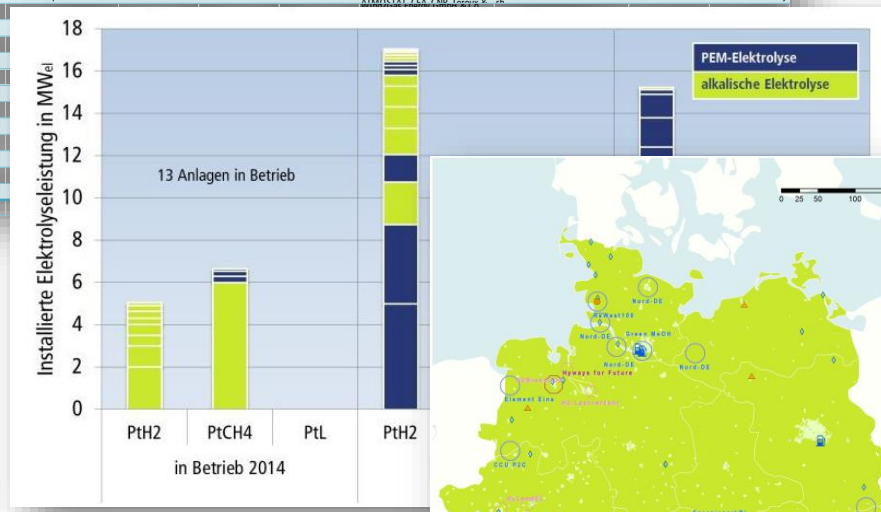
PtX database

LBST information tool

10 years of collected experience

LBST_PtX_ ID	project name	continent	country	status	project start date	start of H2-production (planned)	end date operation or end funding	involved companys	(project) website	type of electrolysis	electrolyser manufacturer
9	H2 Herten - 2	EU	DE	in operation	Apr-18	Apr-18	Dec-18	Asahi Kasei	http://wasserstoffstadt-herten.de/	AEL	Asahi Kasei
51	MefCO2	EU	DE	in operation	Dec-14	Jan-19	Jun-19	the MefCO2 consortium consists	http://www.mefco2.eu	PEM	Hydrogenics
67	Jupiter 1000	EU	FR	in operation	Jul-14	Jun-19	Dec-19	GRTgaz (coordinator),	https://www.jupiter1000.eu/engli	AEL + PEM	McPhy
85	Wind2Gas / NEW 4.0	EU	DE								
88	Hypos LocalHY	EU	DE								
97	Store&Go-Falkenhagen	EU	DE								
97	Store&Go-Puglia	EU	IT								
103	REFHYNE	EU	DE								
104	HyBalance	EU	DK								
105	HyDeploy	EU	UK								
112	Windgas Haurup (NEW 4.0)	EU	DE								
117	DOMQURCHOTE: Demonstration	EU	BE								
157	HYBRIT (Hydrogen	EU	SE								
165	Haeolus	EU	NO								
170	ALIGN-CCUS WP 4	EU	DE								

Database



Statistical evaluations

Map visualisations