

Cleaning Up Industry – The Role of Green Hydrogen

Klaus SEHLING

Philip SCHWILLINSKY



Status Quo – Commitment & Announced Investments in Green Hydrogen Projects

1 NORTH AMERICA

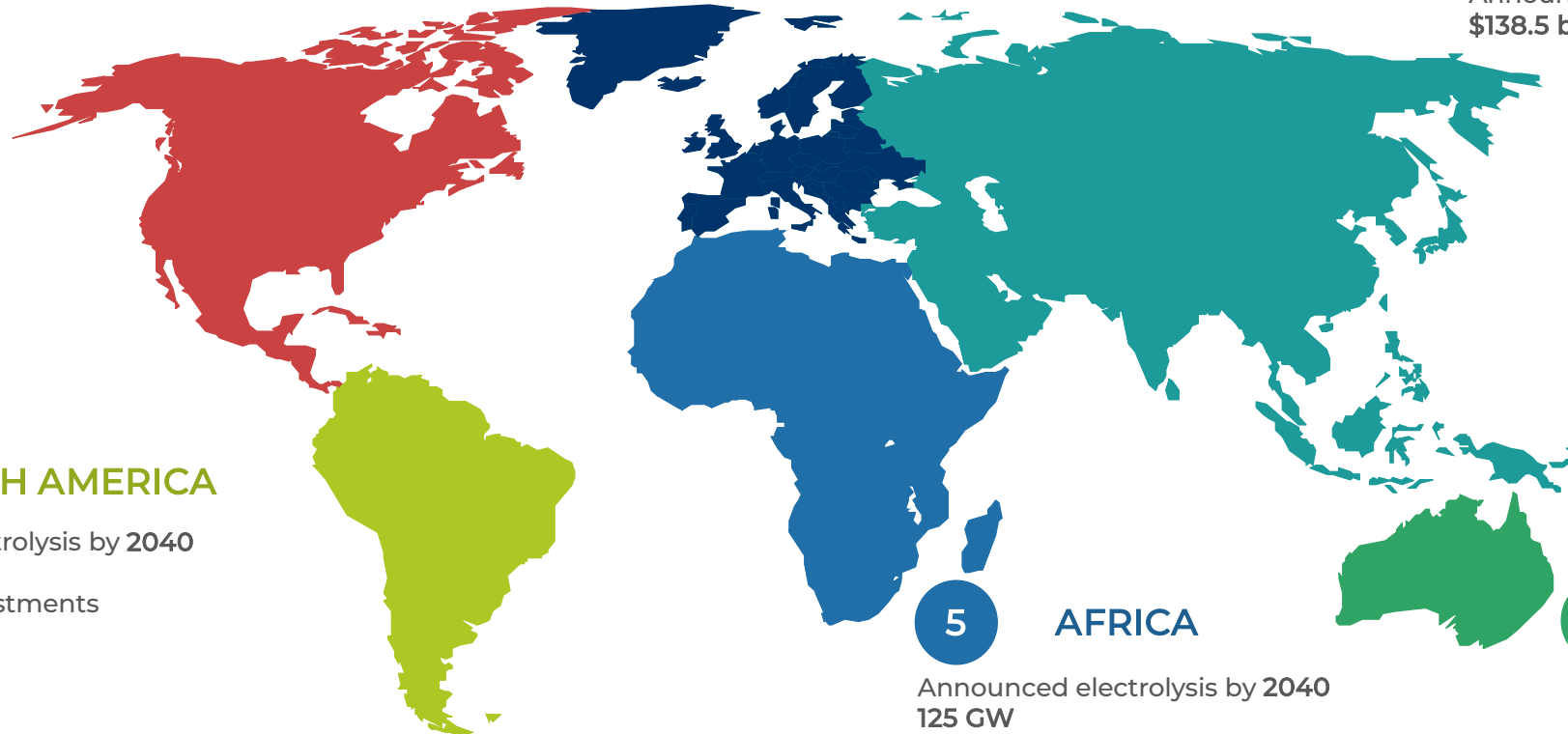
Announced electrolysis by 2040
67 GW
Announced investments
\$66.9 billion

2 EUROPA

Announced electrolysis by 2040
151 GW
Announced investments
\$178 billion

3 MIDDLE EAST & ASIA

Announced electrolysis by 2040
158 GW
Announced investments
\$138.5 billion



6 SOUTH AMERICA

Announced electrolysis by 2040
85 GW
Announced investments
\$69 billion

5 AFRICA

Announced electrolysis by 2040
125 GW
Investments announced
\$81 billion

4 AUSTRALIA

Announced electrolysis by 2040
113 GW
Announced investments
\$117 billion



Source: Rystad Energy – only green hydrogen projects

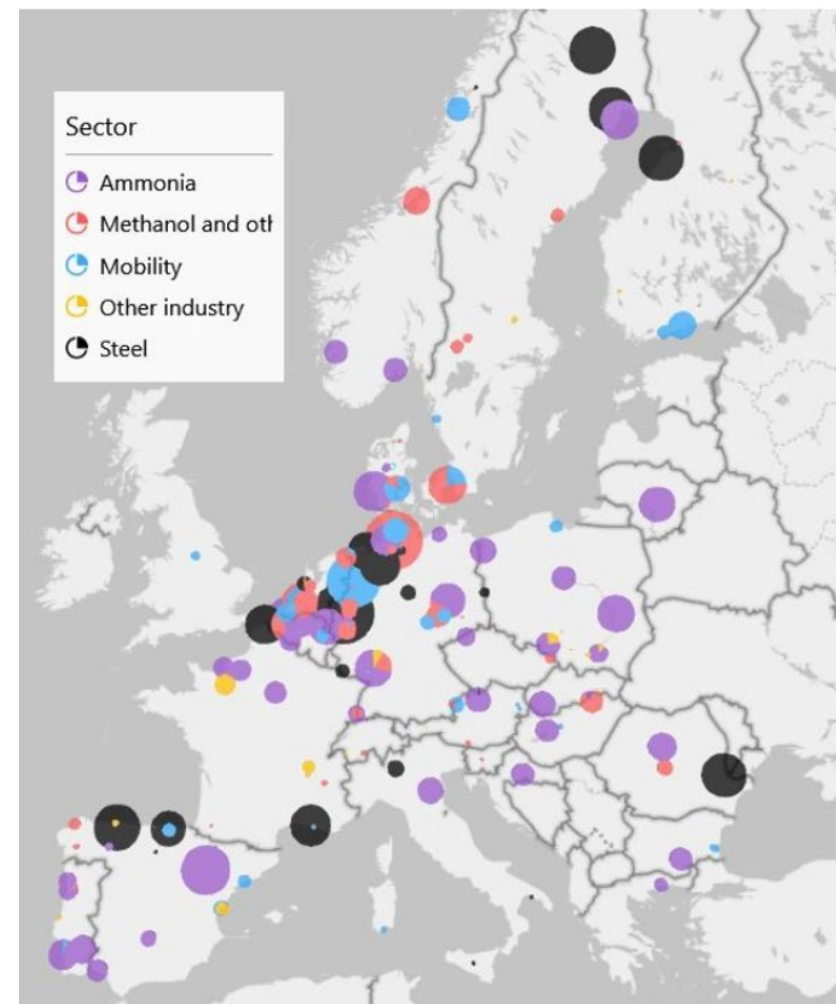
Green H₂ Demand Hubs of Industry in Europe by Sector Fostered by REDIII

Green H₂ demand in transport expected from **0.5. to 3 Mt** (depending on adoption of advanced biofuels)

Green H₂ Demand in industry stimulated by the **REDIII targets** (42% by 2030) can be estimated at **1.5 Mtpa - 2 Mtpa**

Ammonia is one of the **most affected sectors**, followed by **Methanol and other chemicals**

Steel sector as **large demand source**, but not covered by REDIII obligations



Graph: Demand Hubs for Green Hydrogen in Europe, Source: Hydrogen Eurooe

Climate Policy on European and National Level as a Key Driver for a H₂ Economy

EUROPEAN UNION

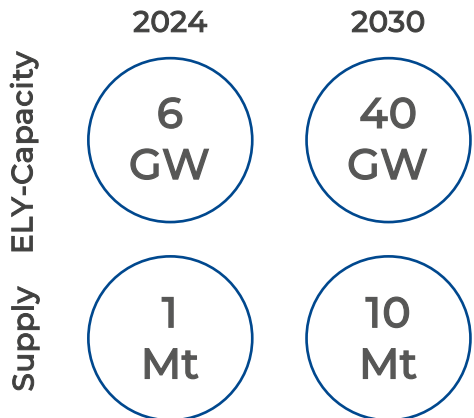


European H₂ Strategy (06/2020)

Phase I (2020-2024): ELY close to refineries, chemicals, steel, gas stations. Decarbonization of existing H₂ applications + implementation of new applications

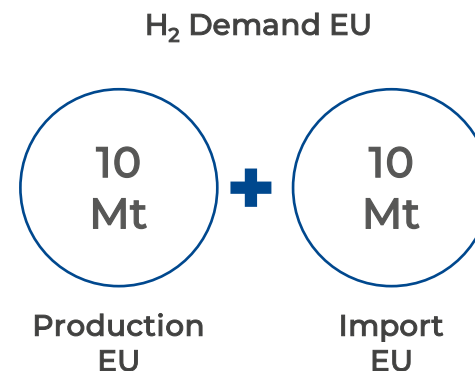
Phase II (2025-2030) – Additional applications

Phase III (2031-2050): ¼ of electricity production for ELY, market maturity of H₂ technologies in all sectors



REpowerEU (05/2022)

Goal
Achieve a 42% share of green hydrogen in industrial end-use by 2030 (RED III)



AUSTRIA



AT H₂ Strategy

ELY-Capacity 2030



- **Infrastructure** development
- Creation of support framework for production
- **Substitution** of fossil fuels with climate-neutral H₂ (energy-intensive industry)
- Establishment of international partnerships for climate-neutral hydrogen

GERMANY



GER H₂ Strategy

ELY-Capacity 2030



- Increase domestic ELY capacity to 10GW by 2030 (previously 5GW, 2020)
- Total H₂ demand by 2030 95 to 130 TWh (2.4 to 3.3 Mt)
- **Covering 50-70% of demand through imports**
- **1,800 km hydrogen start-up network by 2027/28 (IPCEI subsidies). Expansion by 2032**

SPAIN



ESP H₂ Strategy*

ELY-Capacity 2030**

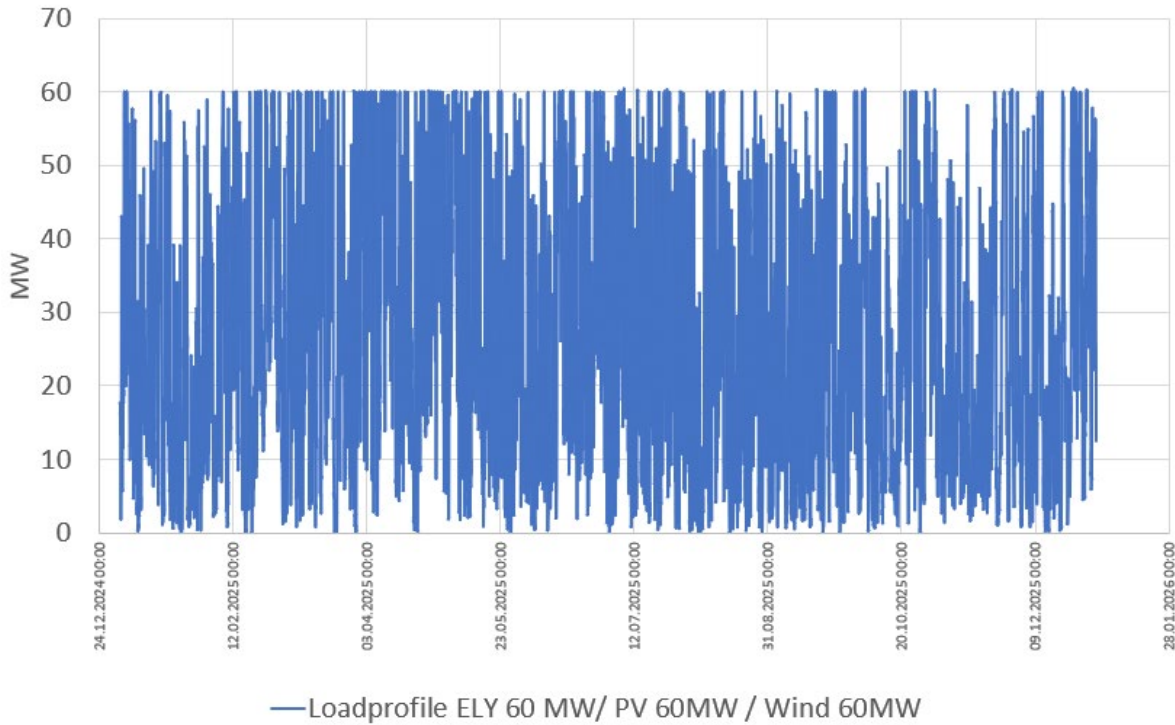


- Climate neutrality by 2050
- **25% renewable H₂ in industry**
- Reduction of GHG emissions by 4,6 Mt CO₂-equivalent (2020-2030)
- 150 H₂ filling stations, 200 fuel cell buses and 7,500 fuel cell vehicles

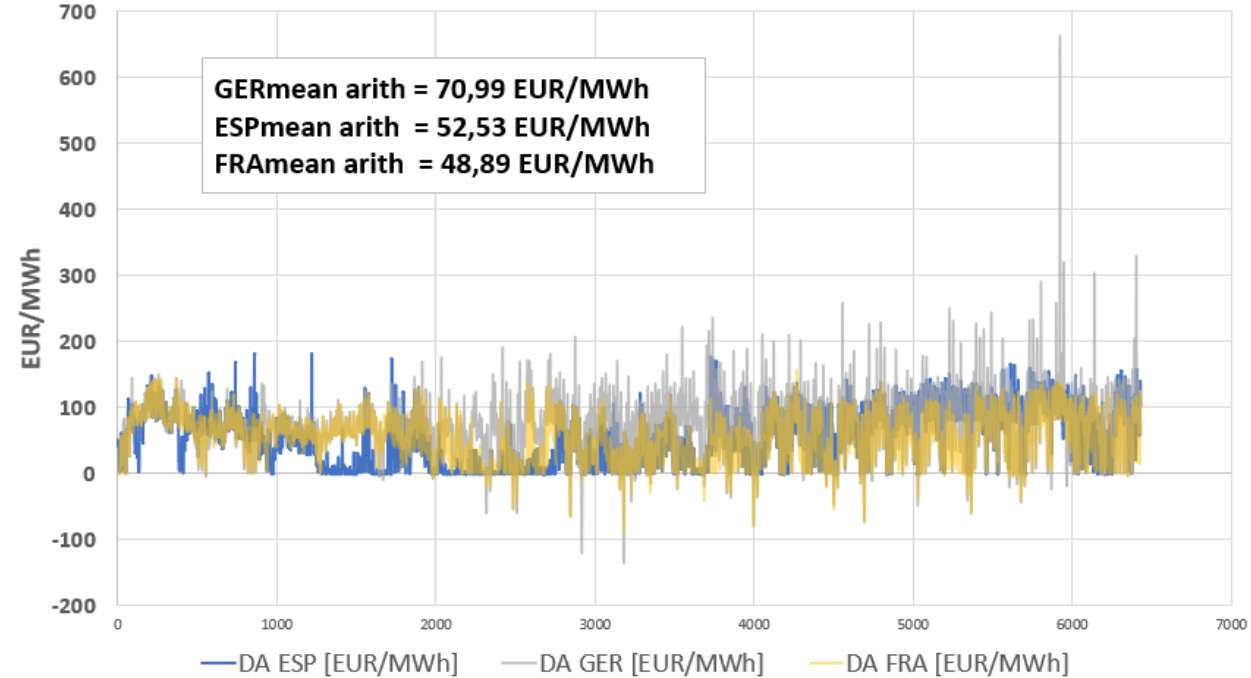
→ Regulation, especially national implementation of policy goals as the most critical lever for H₂ demand

Technical Operational Constraints & Competitive Advantages of Several Bidding Zones

Electrolyzer 60 MWel PPA Sourcing PV, Wind only

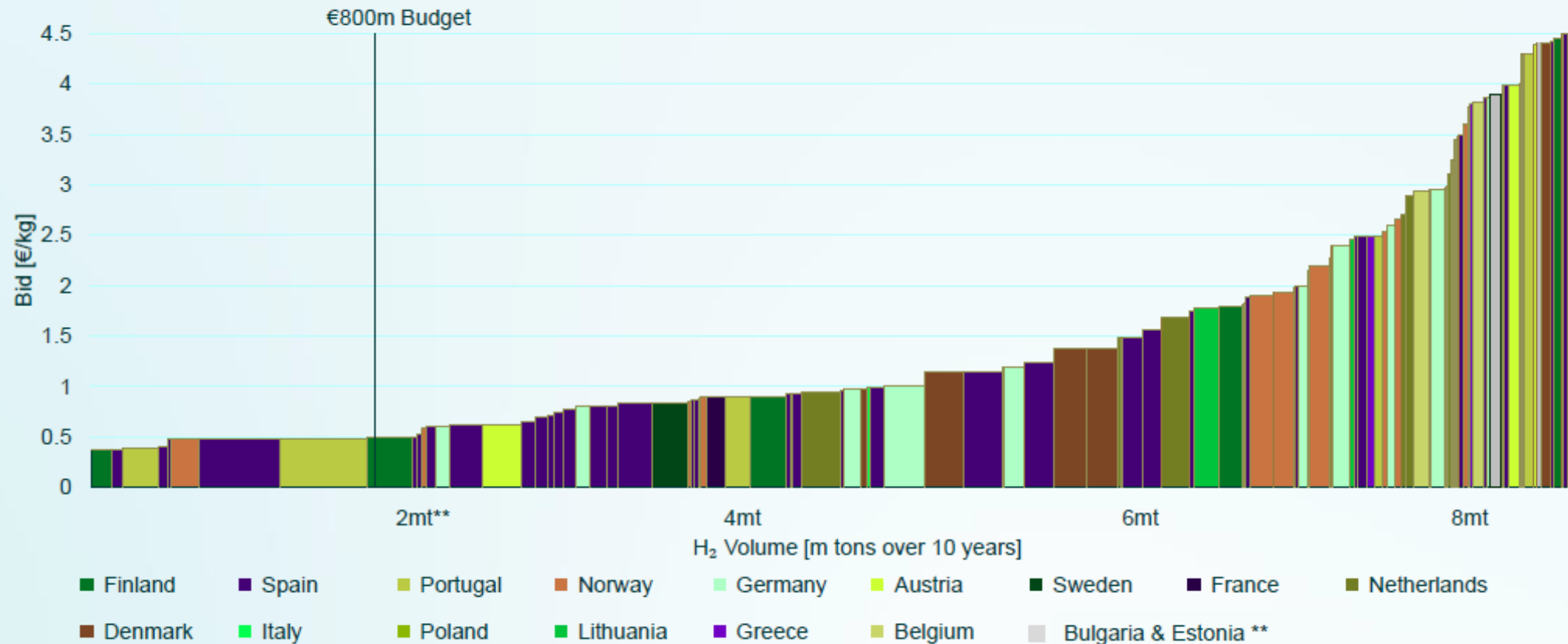


Time series, spot power hourly [EUR/MWh] ESP - FRA - GER
01.2024 - 09.2024



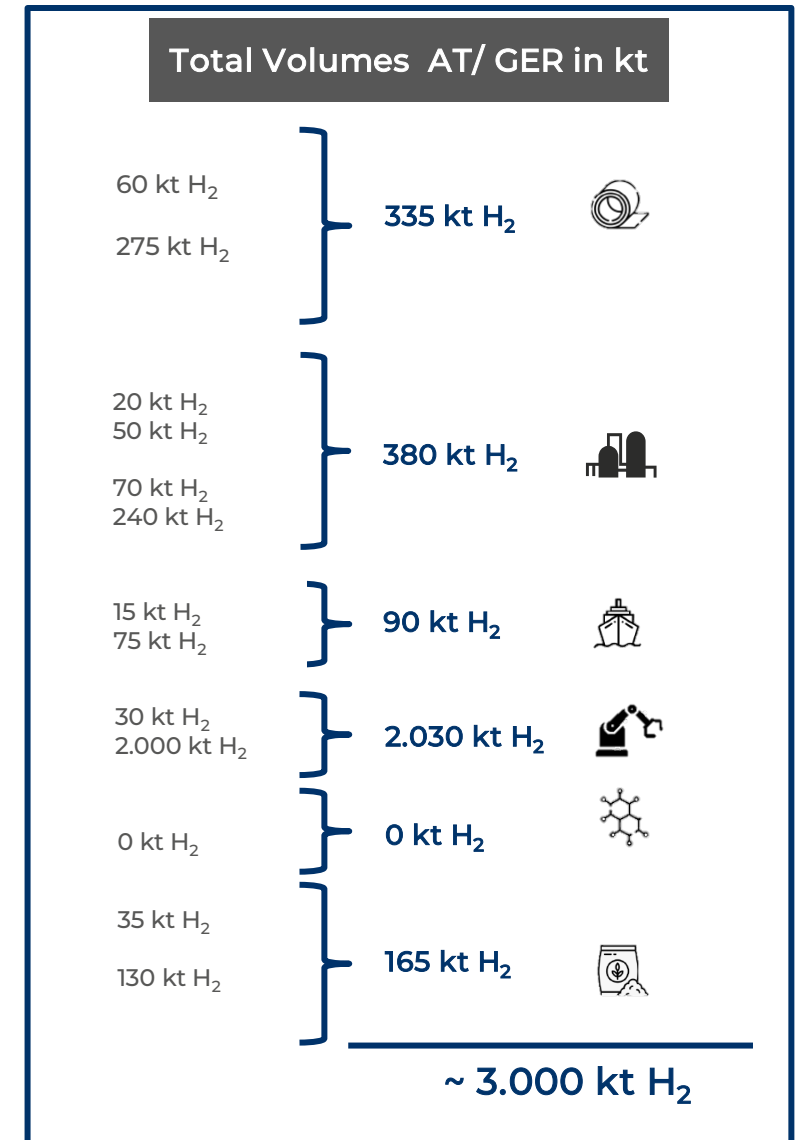
The Innovation Fund Pilot Auction Results Give Interesting Insights Regarding the H₂ Production Cost

Budget 15x oversubscribed. Bids are well distributed in size and price, resulting in a continuous bid curve



AT-DE // Refineries and Heavy-Duty Transport are Demand Driver

	Green H ₂ -based product	End-use sector	Total	W2P
STEEL	Steel via DRI	Automotive, buildings,...	60 kt H ₂ 275 kt H ₂	2 – 5 EUR/kg
2030 REFINERY	Green gasoline, SAF, green propylene, ...via hydrocracking and hydrofining	Transport (fuel for airlines, maritime, road transport, ...), Base chemicals	PtL 20 kt H ₂ SAF 50 kt H ₂ PtL 70 kt H ₂ SAF 240 kt H ₂	> 7 EUR/kg
2030 HEAVY DUTY TRANSPORT	Pure H ₂ as feedstock for heavy duty transport	e.g. transportation companies	15 kt H ₂ 75 kt H ₂	> 7 EUR/kg
ENERGY-INTENSIVE IND.	Substitution in thermal processes	e.g. Bricks/Ceramics, Cement, Paper, etc.	30 kt H ₂ 2.000 kt H ₂	> 7 EUR/kg
HVC	Poly-Propylene, Olefines, ...	Automotive, packaging, ...	No significant demand until 2040 detected	< 5 EUR/kg
FERTILIZER	Green fertilizer	Agriculture	35 kt H ₂ 130 kt H ₂	< 5 EUR/kg



VERBUND Activities in Hydrogen Projects

On site/ Near site/ Import

- Feedstock for industry and mobility
- Energy carrier for electricity system – energy storage
- Global commodity – securing long term demand in Europe

in operation
 in design phase

H₂Future on site
 Steel industry
 6MW

Underground sun storage
 Seasonal Storage
 2MW

H₂ Mellach near site
 Commercial filling
 6-60 MW

H₂ on site
 Mobility
 5MW

Green Ammonia Linz
 Chemical industry 60MW

Burgenland near site
 Industry in Eastern Austria
 60-300 MW

H₂Mobility on site
 Mobility
 6-10MW

H₂ Import corridors
 diversified Import-portfolio, ~ 2GW (2030)

1 South
 2 North
 3 East
 4 West

Way Forward – Major Next Steps to Enable a Green Hydrogen Commodity Economy

Midstream Infrastructure
(TAG & WAG)



DSOs



Other Decarbonization
Paths



Certification



Accelerating National
Implementation



Extension of
Delegated Act



Commercial Business Development // VERBUND Green Hydrogen

Klaus SEHLING

klaus.sehling@verbund.com

+43 664 88248957



Philip SCHWILLINSKY

philip.schwillinsky@verbund.com

+43 664 8287136