



Federal Ministry  
for Economic Affairs  
and Climate Action



MITTELSTAND  
**GLOBAL**  
ENERGY SOLUTIONS  
MADE IN GERMANY

# Requirements for establishing a value chain for green hydrogen on an industrial scale

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May 9, 2023, Helsinki



Facilitator



## Industry association of the German hydrogen economy

DWV is committed to developing the green hydrogen economy. Our companies and citizens should receive an integrated, sustainable, climate-neutral, ecological, economical, socially acceptable and secure energy system

Initiation of  
measures to  
introduce the  
hydrogen economy

Moderator between  
politics, economy,  
associations, science  
and the public

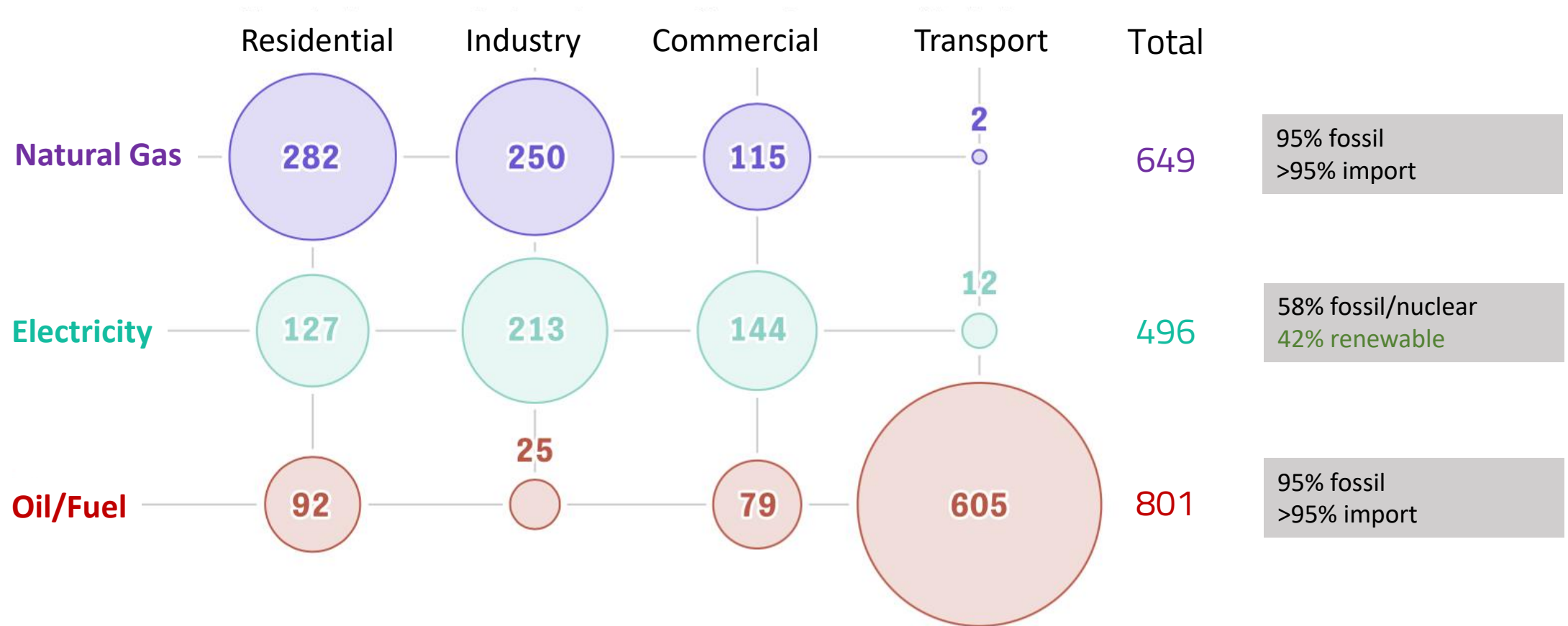
Development of  
concrete, regulatory  
proposals

# DWV-German Hydrogen and Fuel Cell Association





# German Energy Demand (TWh, 2021)



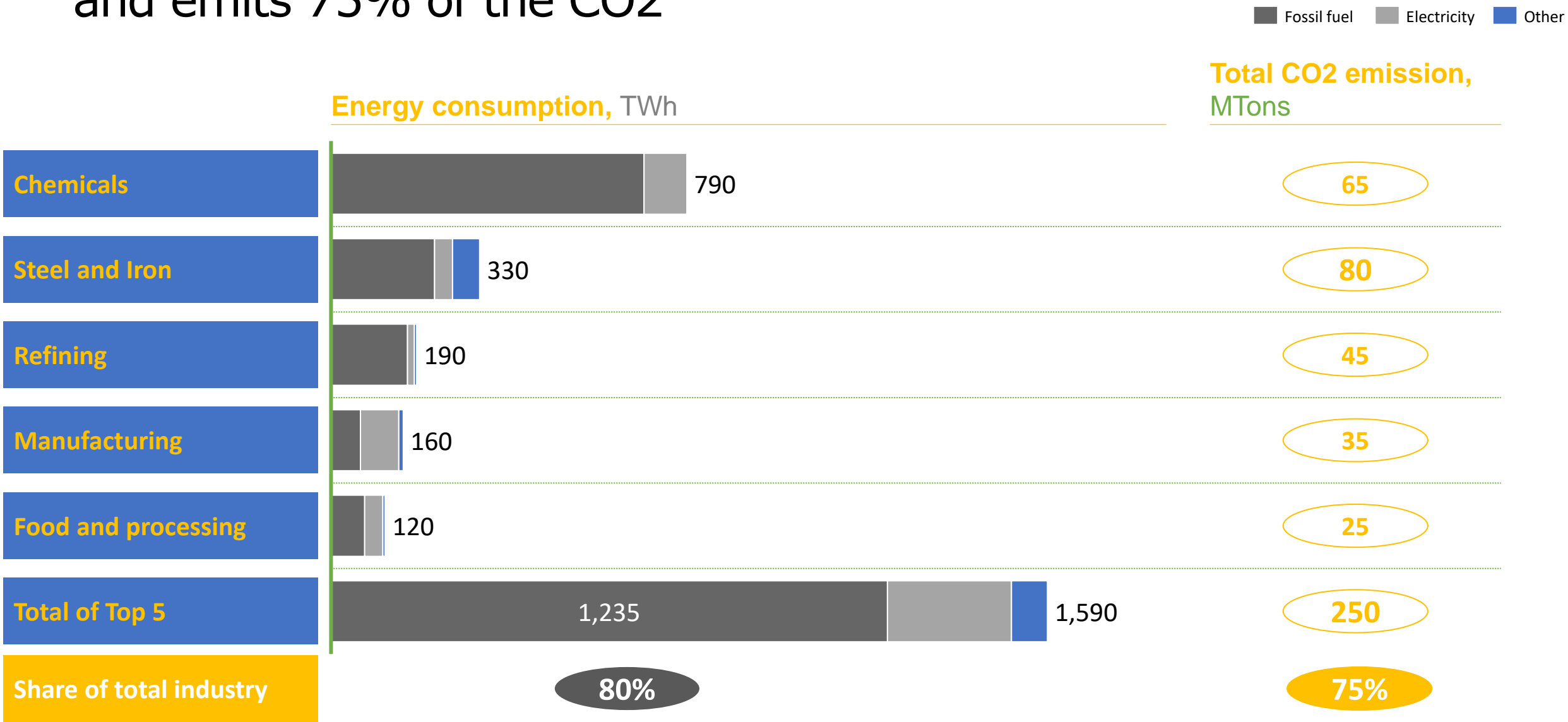
Source: AG Energiebilanzen e.V. / Zeit

# Industrial decarbonization





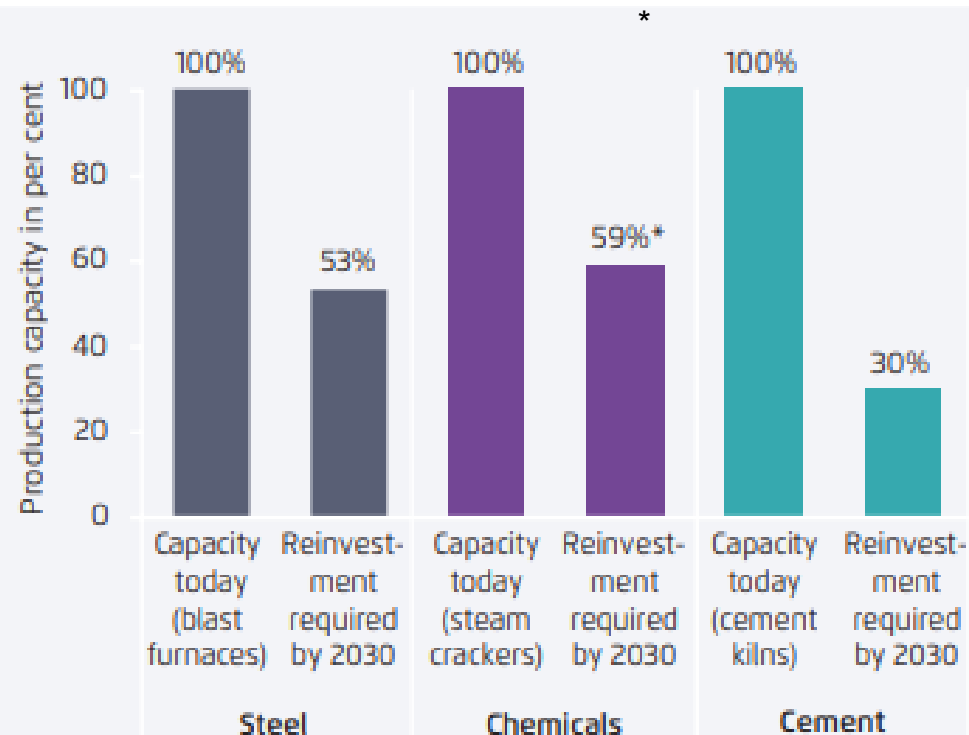
# Top 5 industries consume 80% of the fossil fuel (1,235 TWh) and emits 75% of the CO2



SOURCE: Voorstel voor hoofdlijnen voor het Klimaatakkoord/McKinsey

# Industrial investment needs - Push for decarbonisation efforts across German industries needed

REINVESTMENT REQUIREMENT OF PRIMARY PRODUCTION CAPACITIES IN GERMANY BY 2030



- Chemical and Steel Industry and Steel with high investment needs short- to mid-term.
- Investment cycles for furnaces 30-40 years – new assets will reach far into a potentially carbon-neutral future. Likely to trigger a strong push for high sustainability requirements
- Investment cycles for chemical assets approx. 15 years – less danger of "stranded assets" due to increasing sustainability requirements

\* Agora Energiewende, Climate Neutral Industry,



# Renewable Hydrogen as carbon free energy/feedstock



**DWV**  
Deutscher Wasserstoff- und  
Brennstoffzellen-Verband



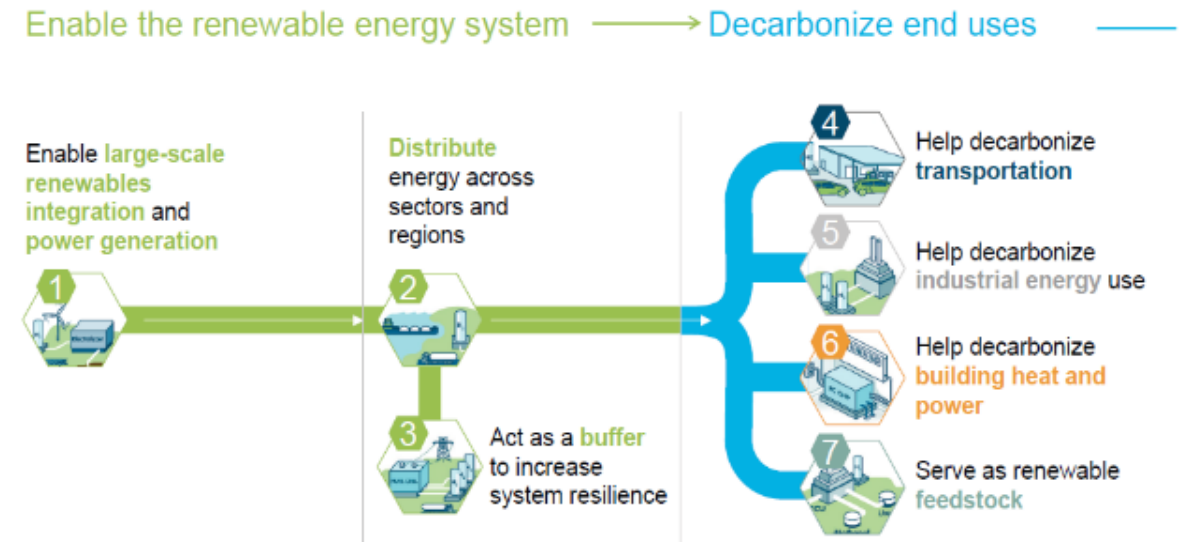
Source: agro&chemistry





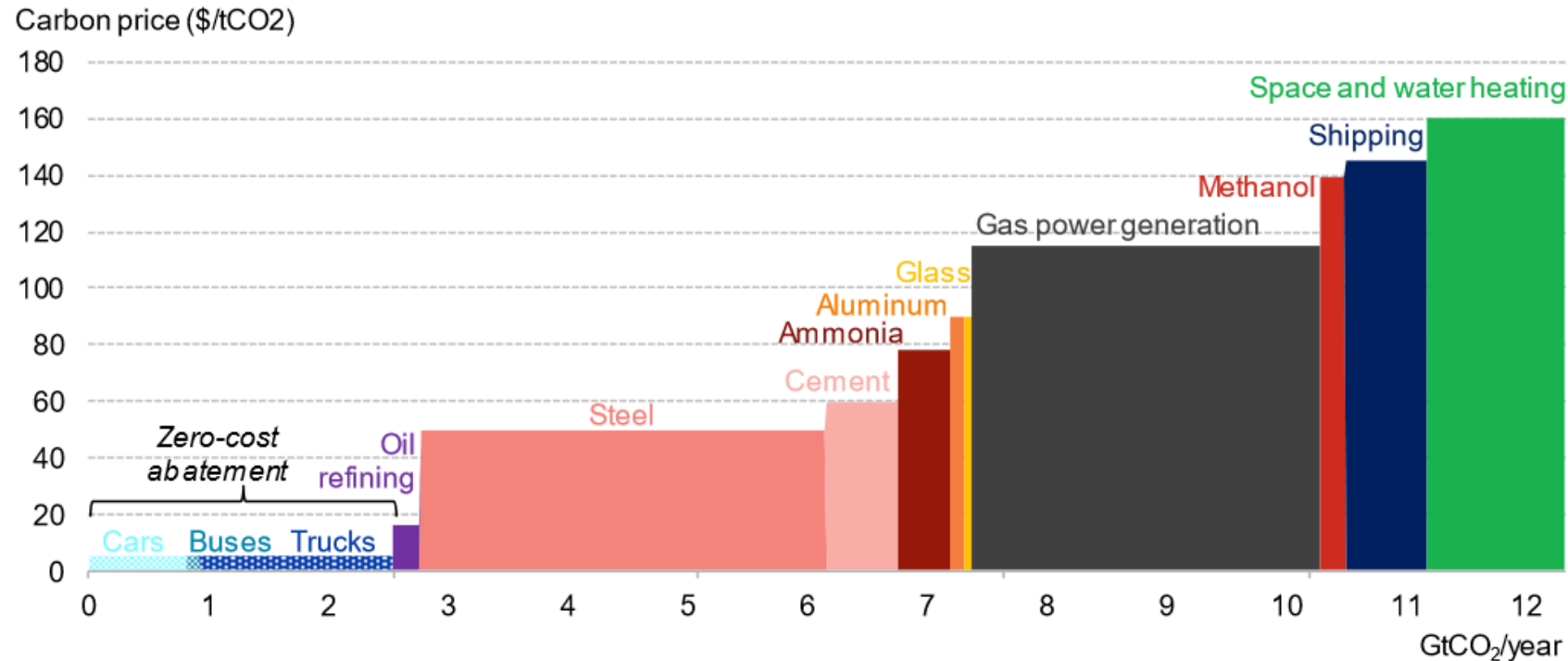
# Why is sector integration with renewable hydrogen important?

- Enable decarbonization in hard to abate sectors like industry, transport, (heat)
- Independency from fossil resources
- Increase volatile renewable production implies grid congestion and increasing demands for flexibility -> hydrogen production with electrolysis
- Green hydrogen production offers additional value stream for green electricity



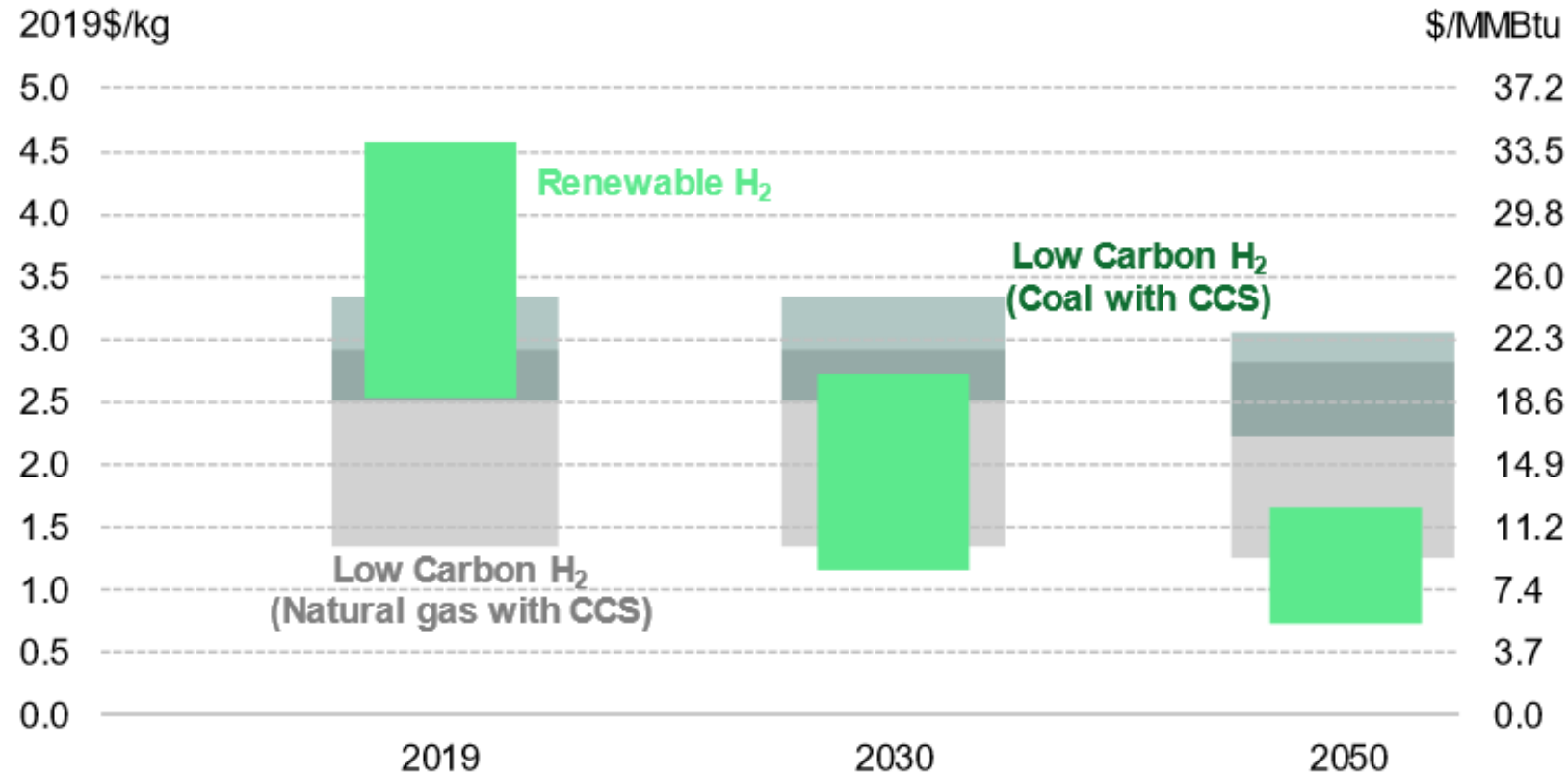
Source : Hydrogen Europe

# Marginal abatement cost curve from using \$1/kg hydrogen for emission reductions, by sector in 2050



Source: BloombergNEF. Note: sectoral emissions based on 2018 figures, abatement costs for renewable hydrogen delivered at \$1/kg to large users, \$4/kg to road vehicles. Aluminum emissions for alumina production and aluminum recycling only. Cement emissions for process heat only. Refinery emissions from hydrogen production only. Road transport and heating demand emissions are for the segment that is unlikely to be met by electrification only, assumed to be 50% of space and water heating, 25% of light-duty vehicles, 50% of medium-duty trucks, 30% of buses and 75% of heavy-duty trucks.

# Forecast global range of levelized cost of hydrogen production from large projects (BloombergNEF)



Note: Figures before the war in Ukraine

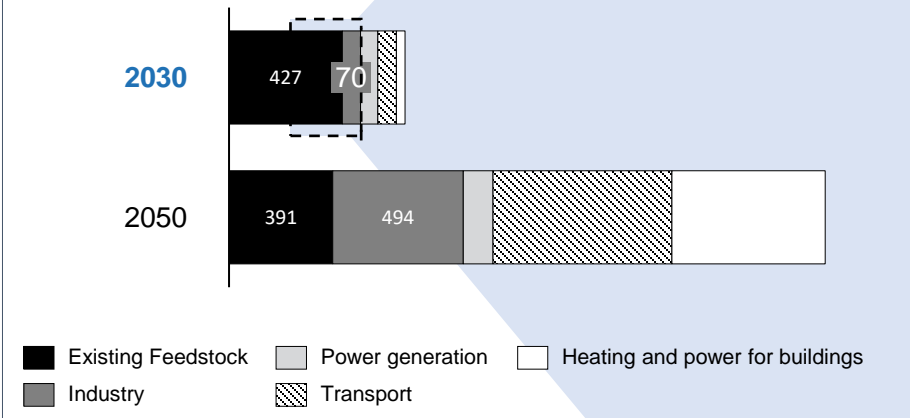
Source: BloombergNEF. Note renewable hydrogen costs based on large projects with optimistic projections for capex. Natural gas prices range from \$1.1-10.3/MMBtu, coal from \$30-116/t.



# Where will the main demand for decarbonized hydrogen emerge and where will it come from

## European H<sub>2</sub> demand 2030 & 2050 in a 2°C climate scenario (TWh)

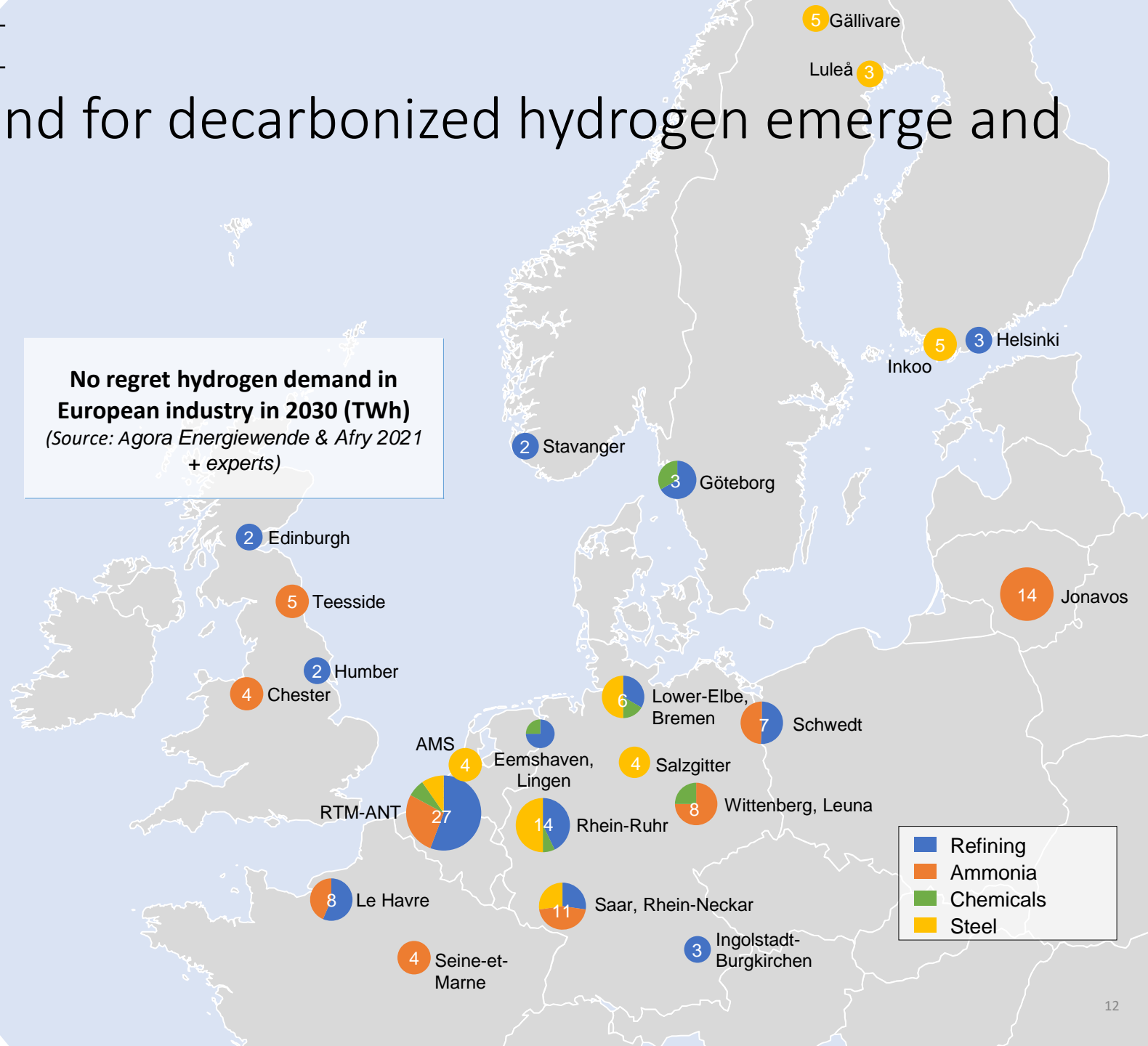
(Source: Fuel Cells and Hydrogen 2 Joint Undertaking)



Sources: Graph: Hydrogen Roadmap Europe: A sustainable pathway for the European Energy Transition. Image: Agora Energiewende / Afry: No-regret hydrogen: Charting early steps for H<sub>2</sub> infrastructure in Europe, experts

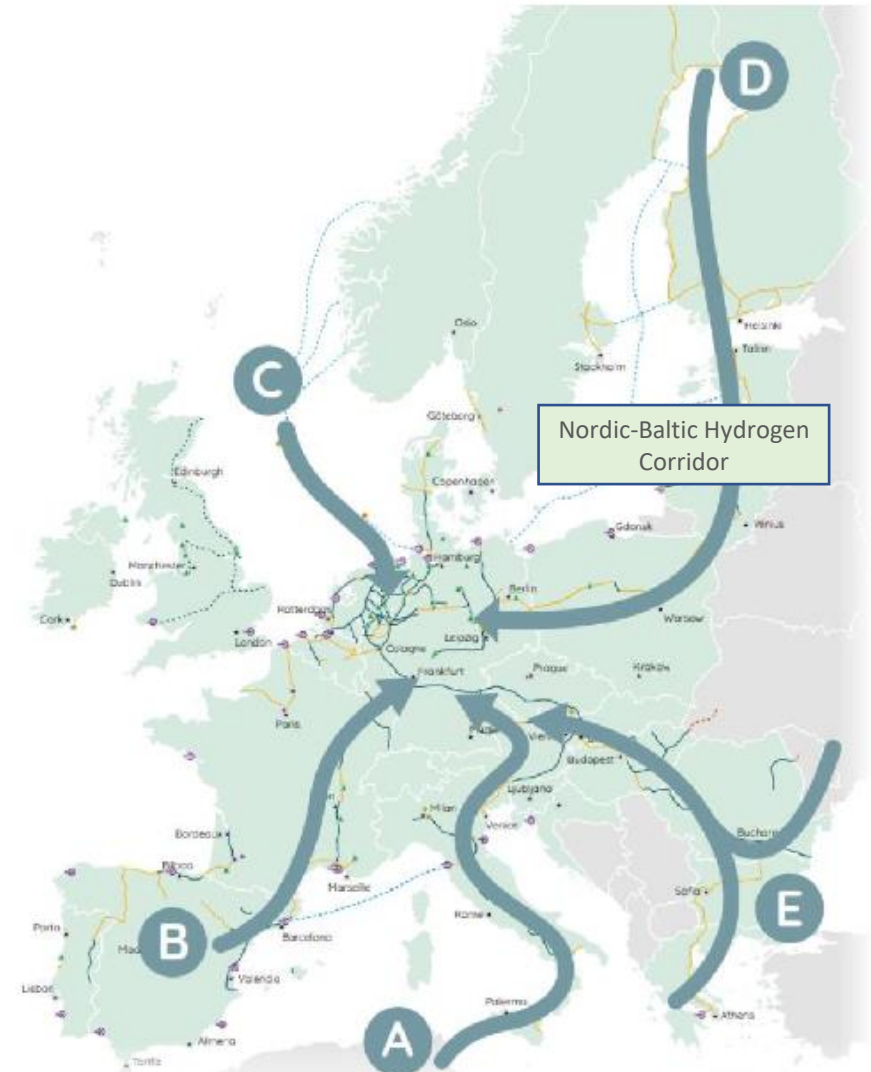
## No regret hydrogen demand in European industry in 2030 (TWh)

(Source: Agora Energiewende & Afry 2021 + experts)



# Import of Green Hydrogen by Pipeline

- Huge existing natural gas pipeline grid (transmission & distribution) and storage system
- Moderate cost for conversion to Hydrogen in existing pipelines
- New pipelines need to be built
- Transport capacity 5-10 times more than transmission power line



Quelle: European Hydrogen Backbone

# Import of Green Hydrogen Derivates with Vessels

- Applicable for liquid hydrogen derivates
  - Ammonia
  - Methanol
  - Sustainable Aviation Fuels
- Option for long distance transportation and liquid fuels
- Existing and established infrastructure (ports, vessels)





# Promising Applications for clean hydrogen

## TRANSPORTATION



Green hydrogen as fuel for

- ✓ **Heavy duty trucks**
- ✓ **Fuel cell busses**
- ✓ **Fuel cell trains**
- ✓ **FCEV Passenger vehicles**

## REFINERIES



- ✓ **Substitution of biofuel additives (e.g. RME) in conventional fuel production by green hydrogen (REDII)**
- ✓ **Synthetic fuels (e.g. SAF)**

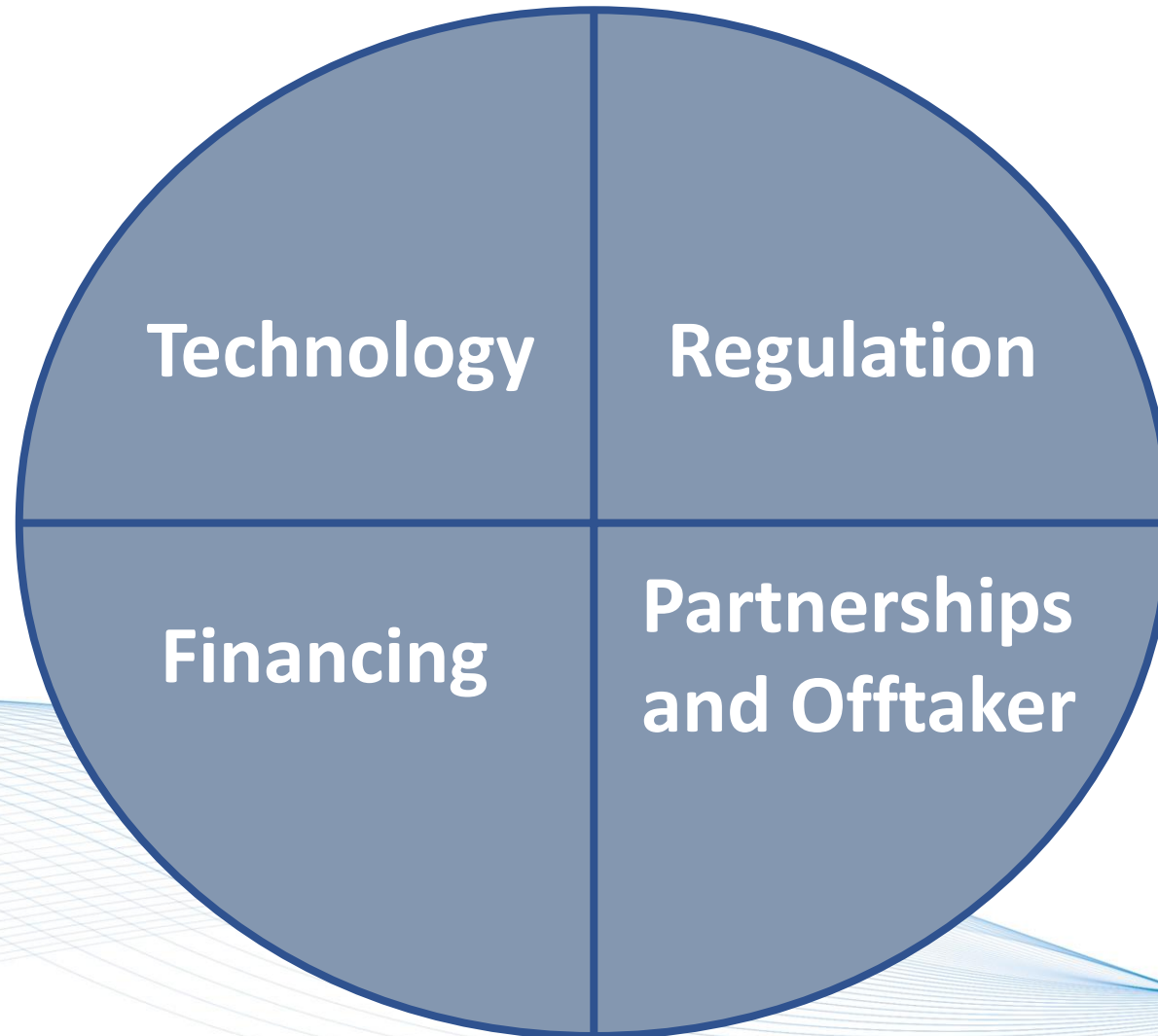
## INDUSTRIES



Substitution of industrial process gases by green hydrogen

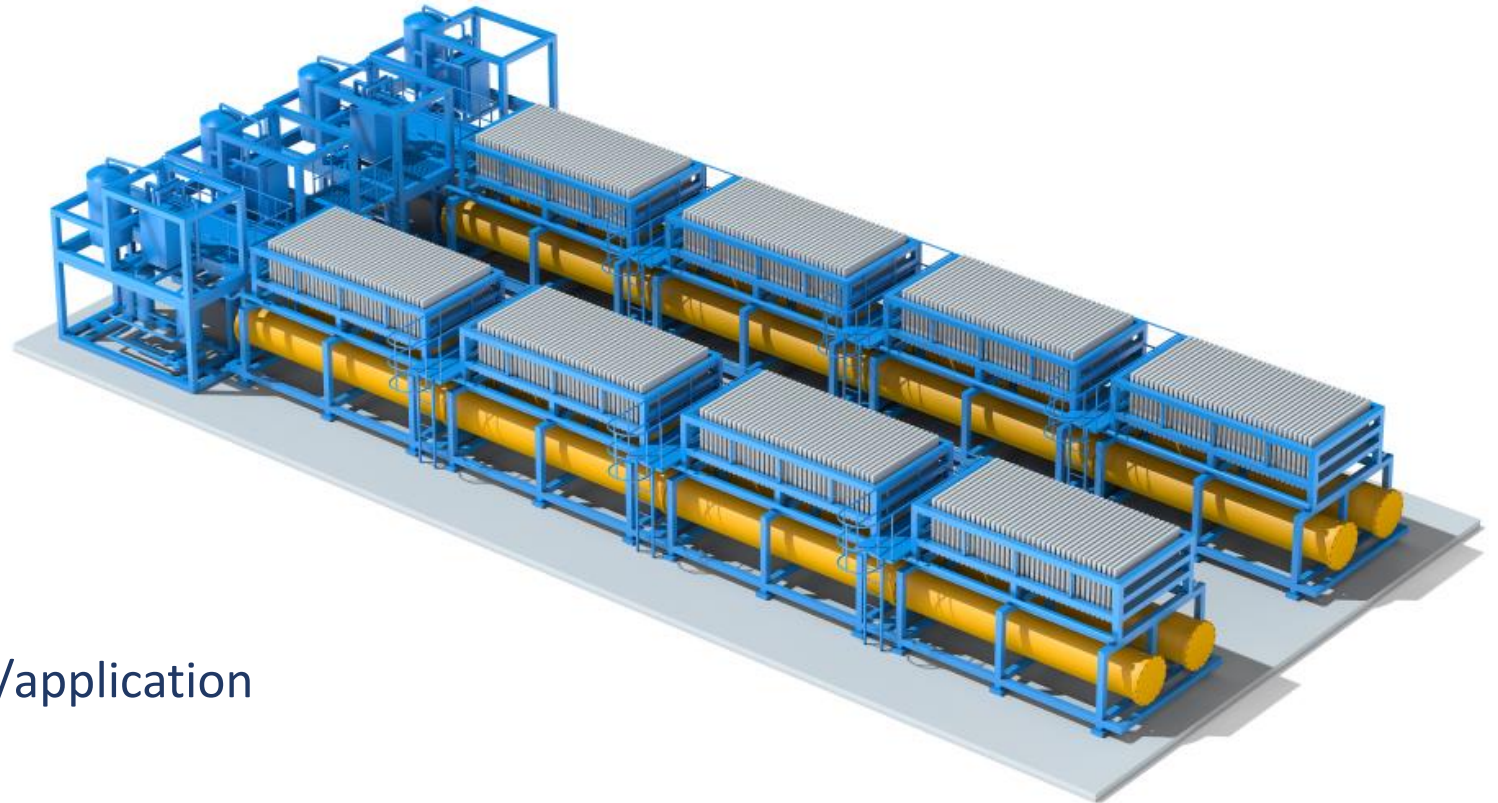
- ✓ **Steel production**
- ✓ **Ammonia production**
- ✓ **Green Methanol**

# Requirements for a successful market introduction



## Electrolyzer – key technology

- Efficient
- Low Capex and Opex
- Ramp-up of production capacity



Source: ThyssenKrupp

Various technologies in distribution/application



# Key German technology suppliers

(examples, no complete list)

## Electrolyser

## production capacity

Siemens

3 GW in 2025

Nucera (thyssenkrupp)

2 GW for NEOM

H-Tec Systems (MAN)

5 GW in 2025

Sunfire

0.5 GW in 2024

.....



Source: Sunfire

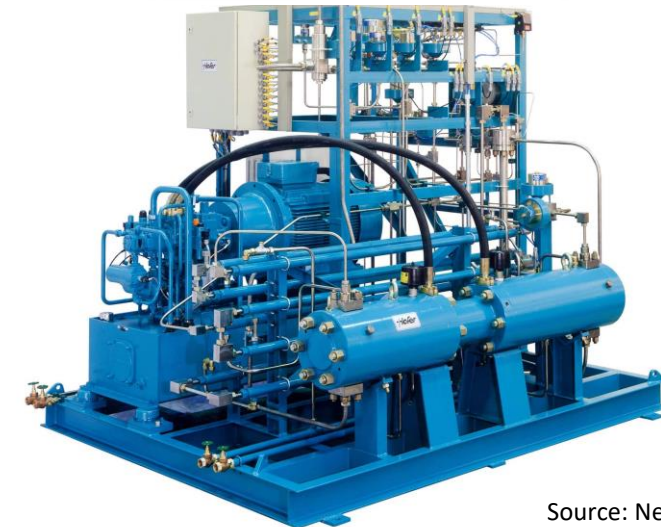
## Compressors (large scale)

Linde

Neuman & Esser

Mehrer

.....



Source: Neuman & Esser

# Regulation

Investment friendly regulation is key

- EU: RED 2 and Delegated Act / RED 3
- National regulation, eg BImSchG (Germany)
- Permit procedures
- .....





# Financing

## Large scale projects need a sound business case

Funding is necessary for the market ramp-up:

- should be limited for a dedicated period
- should cover opex and capex

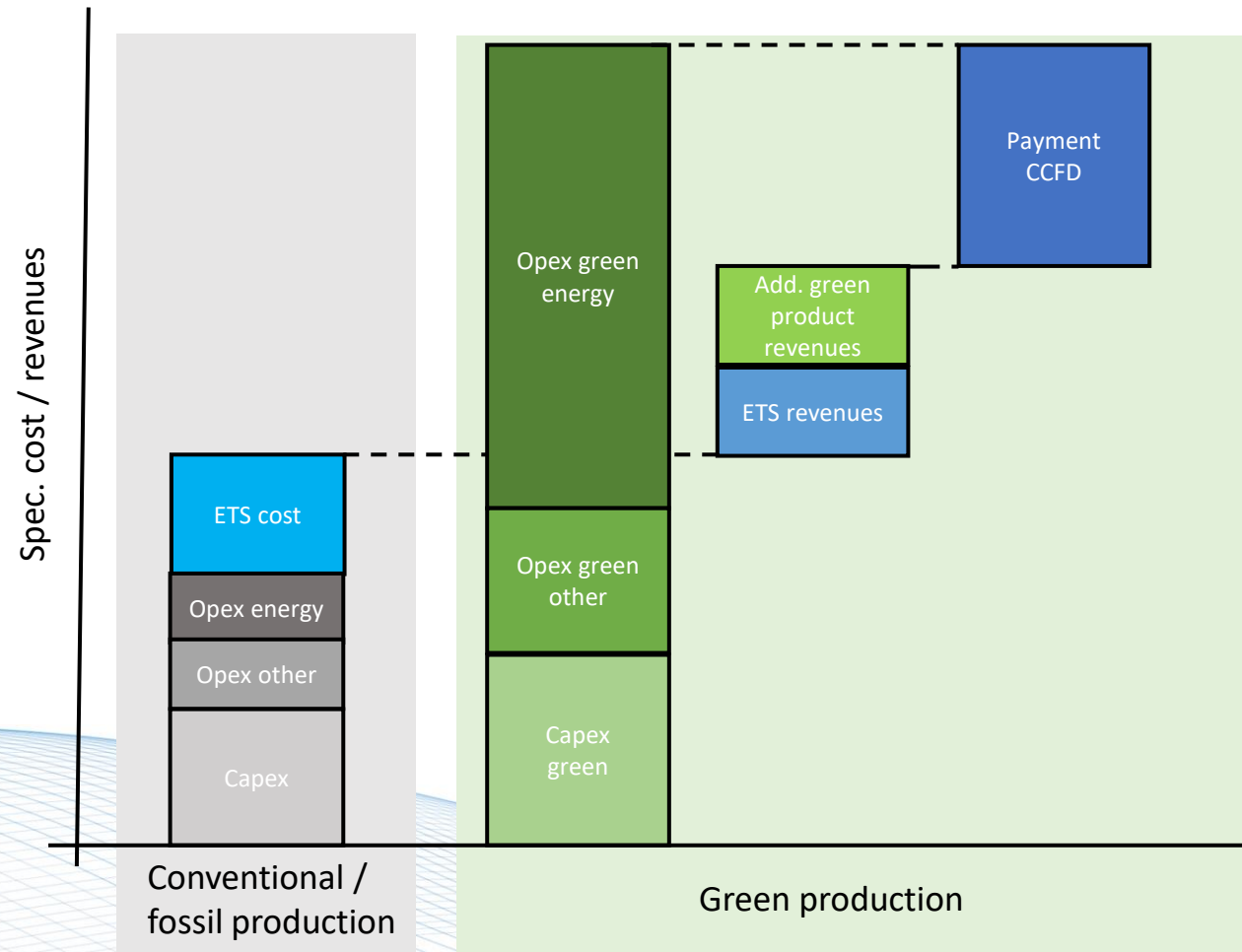
## Funding instruments

- On European and national level
- Examples: IPCEI, CCFD, Innovation Fund, tax credits, H2Global, H2 Bank





# CCFD-Carbon Contracts for Difference



- CCFD covers the cost delta between conventional production (grey) and green production (green)
- the CCFD payment is calculated based on the cost difference between grey and green production minus revenues from green production (ETS and potential additional revenues for green labelled products)



## Shaping the global energy transition.

H2Global | Idee, Instrument und Intention  
March 2023

- ▶ **EUR 900m subsidies program of the German federal government (Federal Ministry of Economic Affairs and Climate Action)**
- ▶ **Goal: Establishing infrastructure for long-term procurement of green H2 derivatives outside of Europe**
  - ▷ Production
  - ▷ Transport
  - ▷ Storage
- ▶ **Green H2 derivatives: No CO2 emissions in the production process**





# H2Global Mechanism

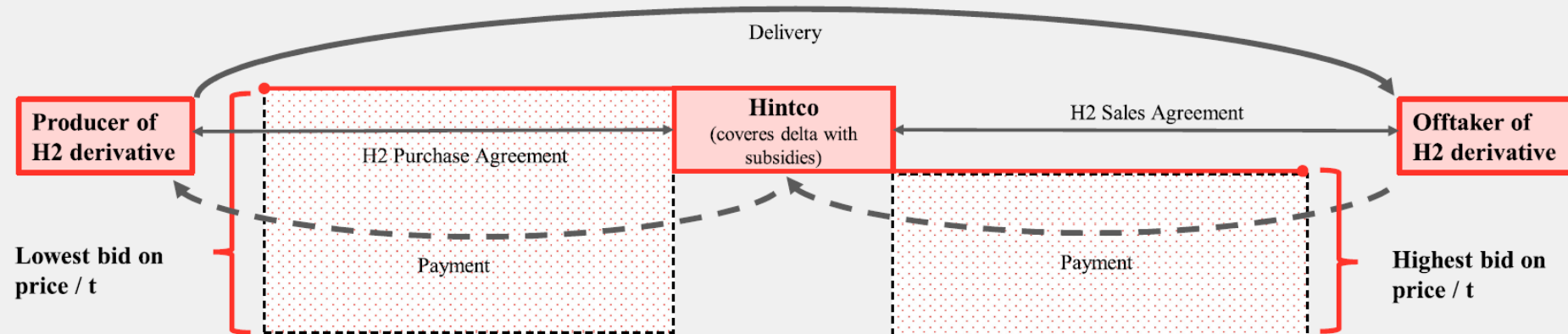
Mechanism: Long-term buy-side / short-term sell-side

▶ **Buy-side:**

- ▶ Hintco receives funding
- ▶ Tenders long-term (10yrs) procurement contracts for H2 derivatives ammonia, methanol and SAF to bidder with lowest price per ton and highest delivery volume

▶ **Sell-side:**

- ▶ Hintco tenders short-term sale contracts for H2 derivatives ammonia, methanol and SAF to bidder with highest price per ton
- ▶ Subject of H2Global subsidies: Delta between purchase price and sales price



Source: Chatham House

# H2 Bank

On March 16 the Commission outlined the European Hydrogen Bank

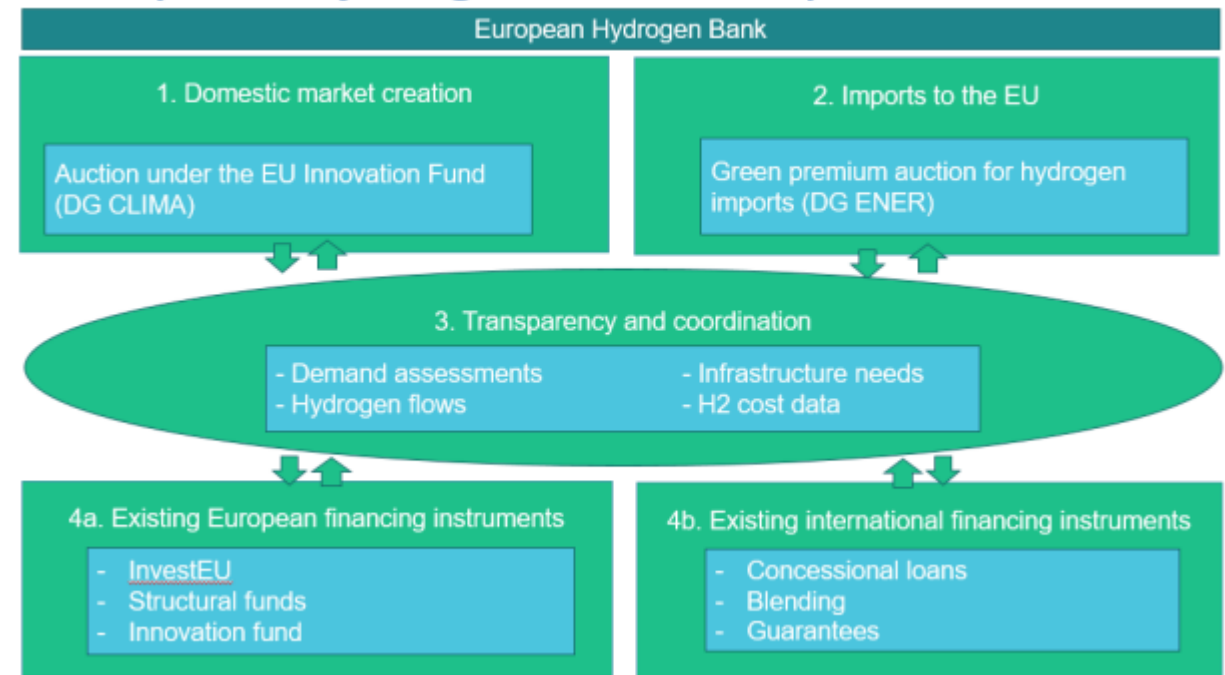
The H2 Bank will comprise four pillars:

1. Domestic production
2. International Production
3. Transparency and coordination
4. Coordination of existing financing instruments

Operational by end of 2023

Financial requirements: the total investment needs to produce, transport and consume 10 million tonnes of renewable hydrogen in the EU are expected to be in the range of EUR 335-471 billion, with EUR 200- 300 billion needed for additional renewable electricity production

## European Hydrogen Bank: Proposed activities



Source: EC

# Domestic Production

## Key objectives:

- Connecting EU domestic renewable hydrogen supply and demand.
- Bridging and reducing the cost gap in the EU between renewable and fossil hydrogen as effectively as possible.
- Allowing for price discovery and market formation in the EU
- De-risking European hydrogen projects, bringing capital costs down and leveraging private capital
- Ensuring a fast roll out and simple implementation, thereby significantly reducing administrative burden and costs thanks to short, lean and transparent procedures.

## Supply side auctions

Production and consumption in the EU/EEA

Type of support scheme will be simple fixed premium (4 EUR/kg produced)

No prioritization on end-use mentioned

Cumulation with other funding instruments not possible

Main prequalification criteria: production of renewable hydrogen according to the Delegated Acts

Budget from EU Innovation Fund (need to be increased), initial budget for the first tender: 800m€

Timeline: Terms & Conditions on eligibility, auction clearing and payments summer 2023, first tender in autumn 2023



# Partnerships and Offtaker

Partnerships are essential in the ramp-up phase

- Risk mitigation
- Financing
- Offtaker with willingness to pay
- Long term agreements





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# Thank you for your attention!

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