

1-2. Creating Demand in the Industry Sector

APERC Clean Hydrogen Workshop
associated with the EGNRET 60 meeting
23 April 2024 – Kaohsiung, Chinese Taipei

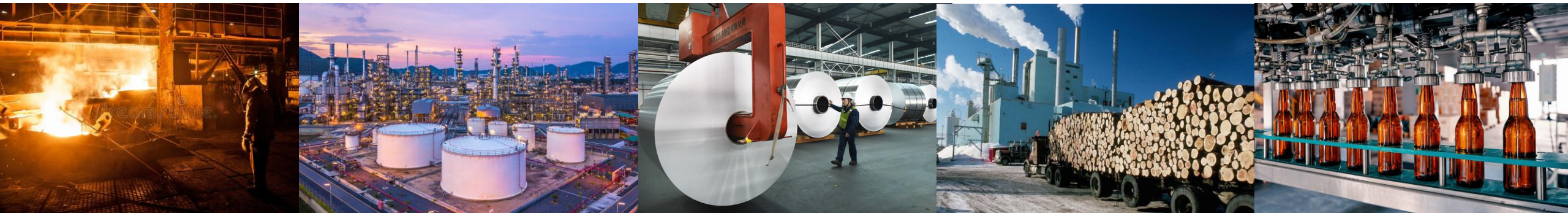
Mathew Horne, Senior Researcher, APERC



Outline

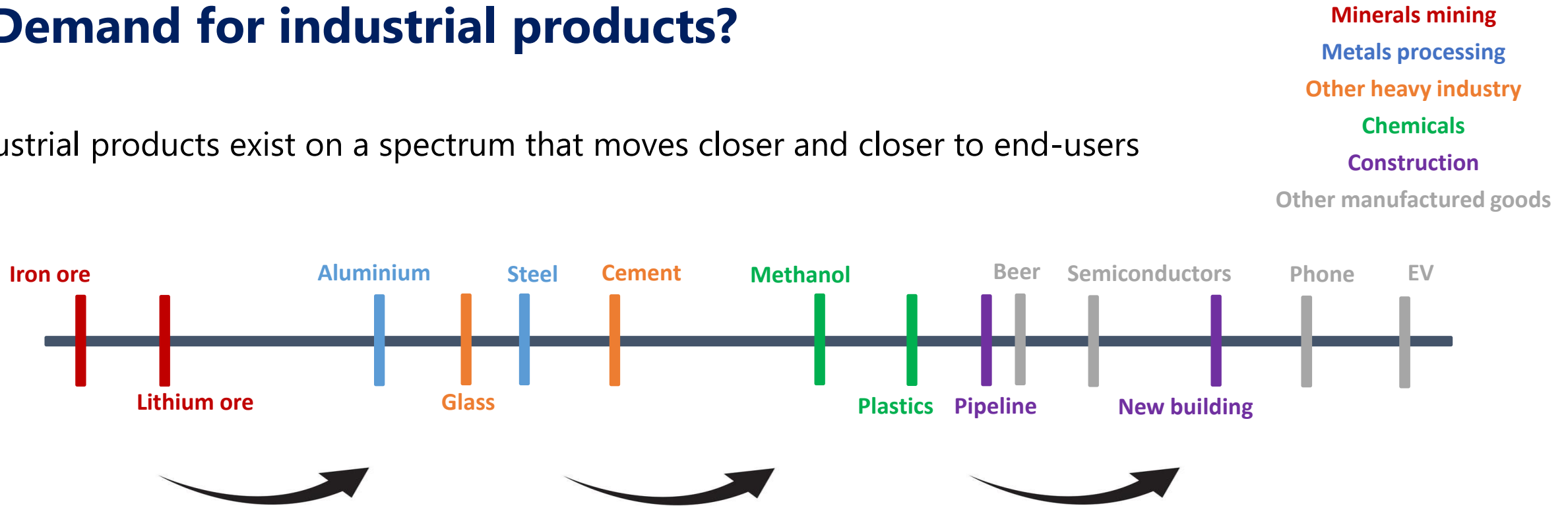
- The industry sector
- Hydrogen is already used by industry
- What is really meant when talking about creating demand?
- Limiting factors
 - Cost
 - Technology readiness
- The steel sector
- Other potential new demand uses for hydrogen
- Conclusions

The industry sector



Demand for industrial products?

Industrial products exist on a spectrum that moves closer and closer to end-users



Intermediate manufacturers and end-users drive demand

→ Sometimes, innovation by producers/manufacturers creates demand for an entirely new product

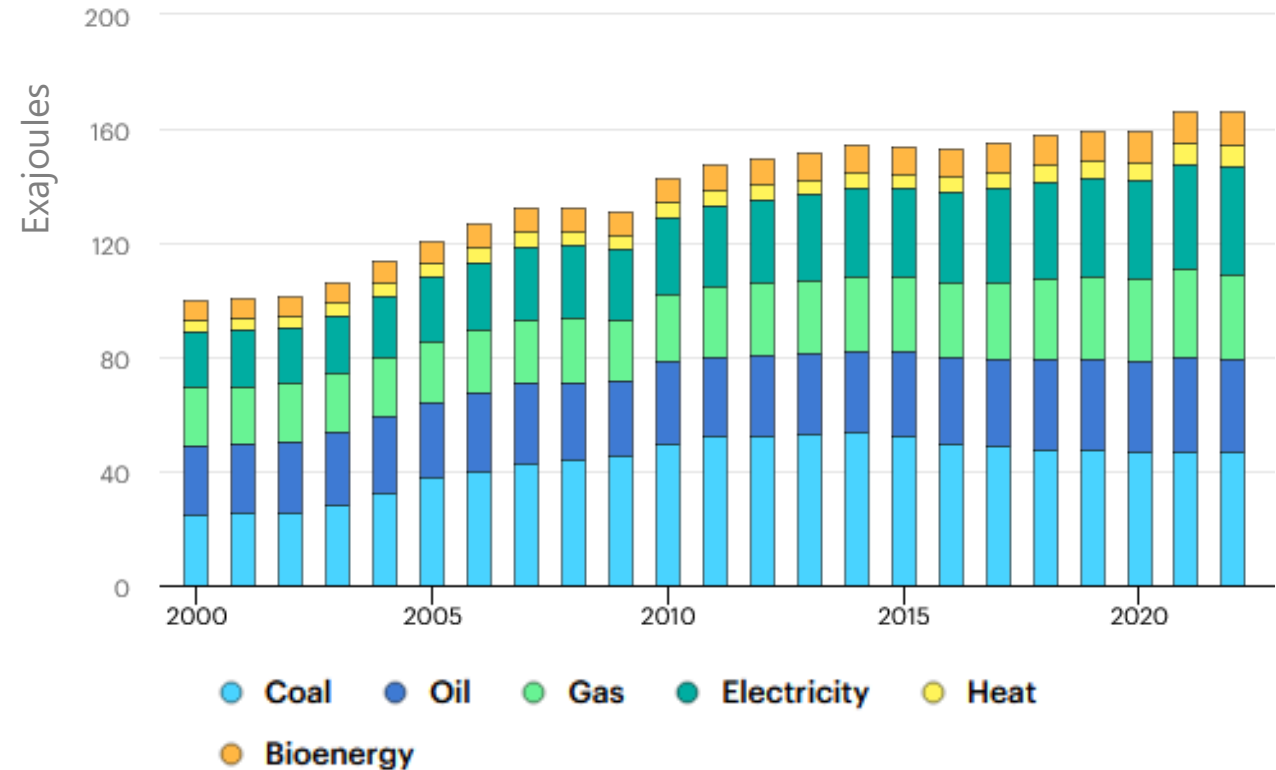
The relationship between industrial production and energy use

Most industrial energy requirements are for process heat

- Low: washing, rinsing, food prep
- Medium: drying, evaporating, distillation
- High: steam reforming, cracking
- Very-high: ceramic and metallurgical processes

→ The higher the heat requirement, the greater the reliance on combustion of fossil fuels

Global industrial energy consumption by fuel



IEA. Licence: CC BY 4.0

So where does hydrogen fit in this discussion?

Hydrogen is already important for industry

- Refining petroleum
- Treating metals
- Producing fertilizer
- Processing foods

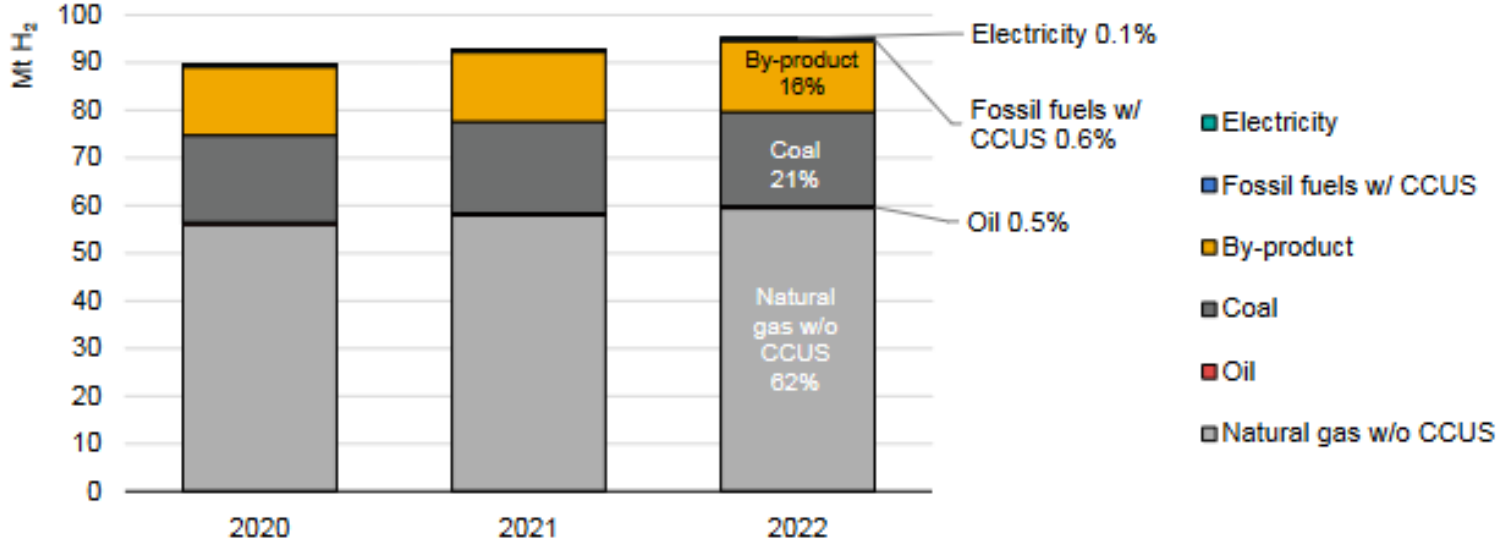
Global consumption 2022

95 million tonnes

(But this use is not as an energy source)

Current supply is overwhelmingly from fossil fuels

Hydrogen cost:
Input fuel cost +
processing



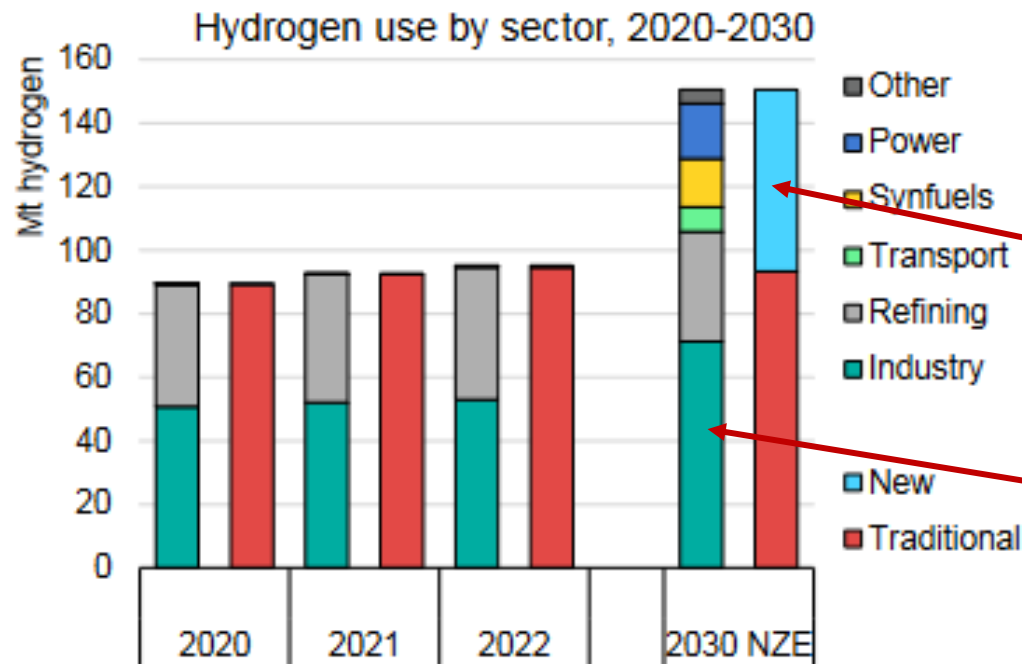
Note: CCUS= carbon capture, utilisation and storage.



Given that significant industrial demand for hydrogen already exists

→ What is really meant when discussion turns to **hydrogen for industry** is:

Low emissions hydrogen used as a replacement for fossil fuel energy supply



From the IEA that is the intersection of:

New uses

and

Industry

Hydrogen is not currently used by industry as an energy source

This is not surprising from a cost perspective

→ In the absence of a price on carbon, hydrogen will always be more expensive than **natural gas** and the **coal** from which it is currently derived

→ Hydrogen will almost always remain more expensive than fossil fuels

→ **Blue hydrogen is still derived from fossil fuel inputs**

→ **Green hydrogen could theoretically become cheaper than fossil fuels if the clean electricity used for generation becomes very cheap**

Unlikely
anytime
soon



\$1/kg hydrogen

roughly equivalent to

\$8/MMBtu of natural gas

Optimistic cost targets (\$1/kg) for **low emissions hydrogen supply** are still higher than current **natural gas prices** in many regions

Hydrogen that costs \$1/kg and comparison with natural gas

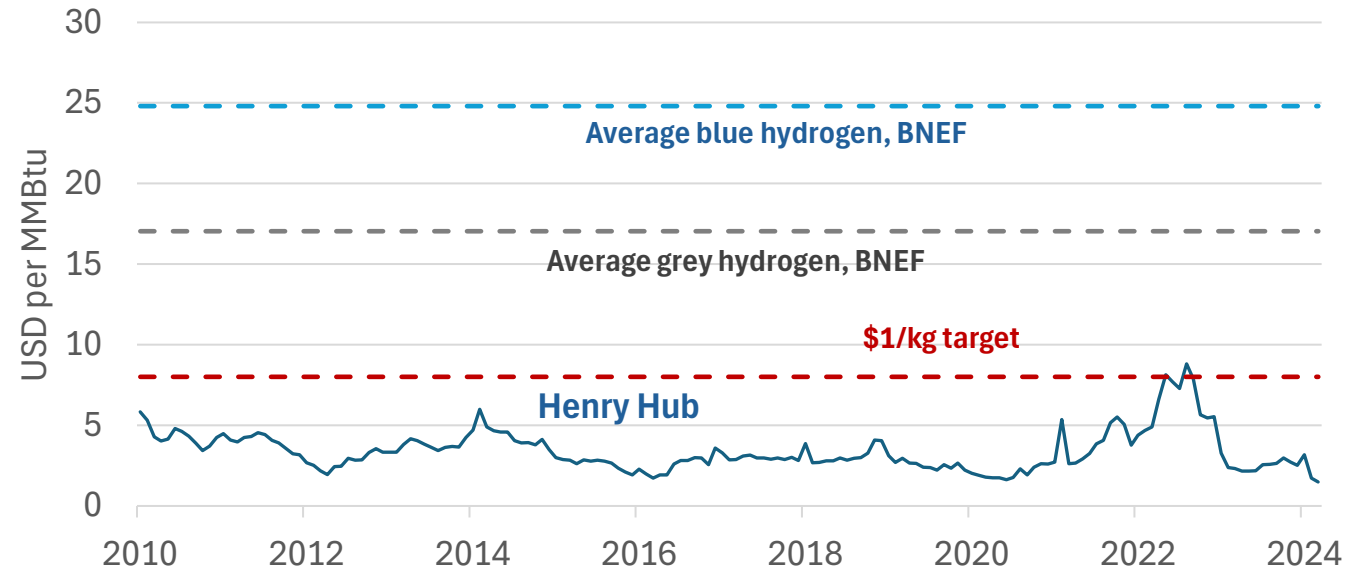
IEA

Hydrogen can get down to \$1/kg by 2050, assuming renewable electricity supply can get down to \$10 to \$20/MWh

Hydrogen may become more competitive in regions of the world with higher gas prices.

→ It's currently difficult to justify as an energy source

Henry hub gas price compared to cost of hydrogen



Color	Definition	Average production cost in 2023
Gray	Produced from natural gas without abatement	\$2.13 per kilogram
Blue	Produced from natural gas with carbon capture	3.10
Green	Produced from water electrolysis using renewable electricity	6.40

Source: BloombergNEF

BloombergNEF

The hydrogen cost challenge

Multiple APEC economies are intervening in hydrogen markets (subsidies, tax credits, etc.)

A reduced cost for hydrogen enables producers to supply hydrogen at a more competitive price to potential consumers

→ The populace wears the cost through a higher tax burden and/or greater debt levels with the world benefiting from lower emissions

USA → The Inflation Reduction Act (2022)

Carbon Intensity (kg CO ₂ e per kg H ₂)	Max Hydrogen Production Tax Credit (\$/kg H ₂)
4-2.5	\$0.60
2.5-1.5	\$0.75
1.5-0.45	\$1.00
<0.45	\$3.00

Japan → GX (Green Transformation)

New legislation provides subsidies to suppliers of hydrogen and ammonia that is less than

3.4 kg of CO₂e per kg H₂

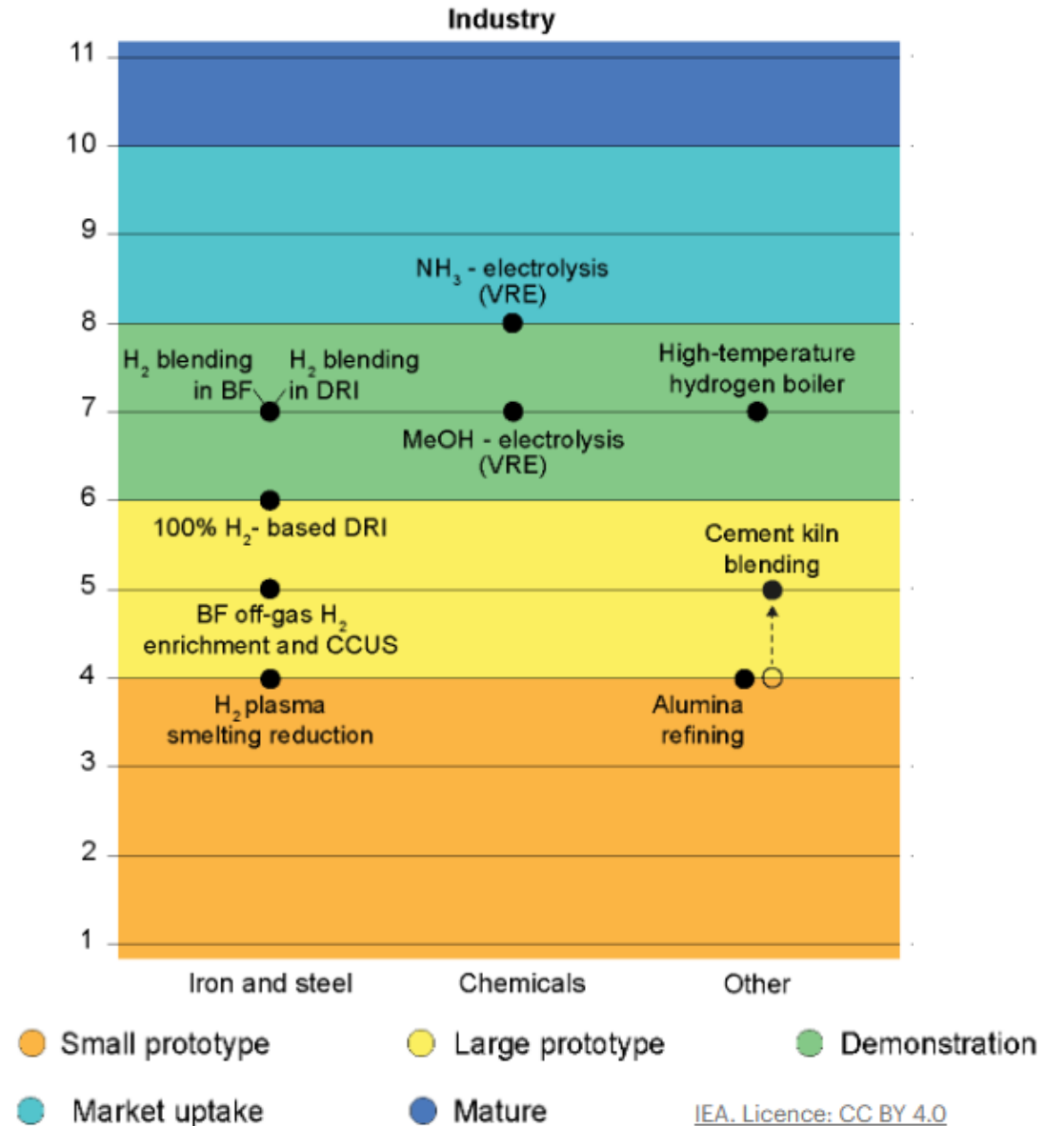
3 trillion yen over 15 years

Solve cost challenges and hydrogen will be used to decarbonise

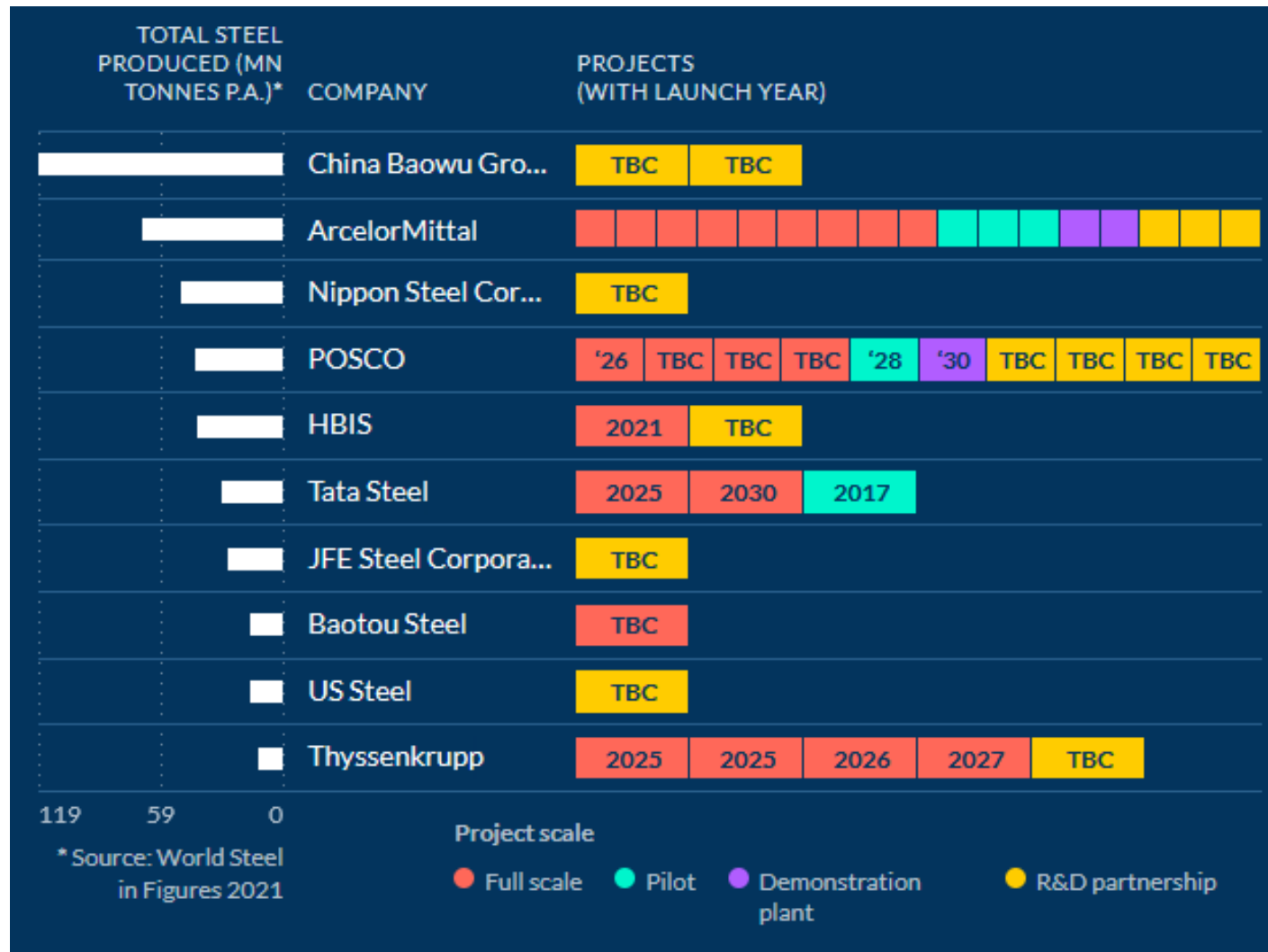
But the speed at which hydrogen can be deployed remains a challenge

→ For low process heat, **electrification** is often more viable in terms of decarbonisation

→ For high process heat needs, technologies for replacing fossil fuels with hydrogen are mostly not yet at a commercial and scalable stage



Low emissions hydrogen used in the steel sector



Cost of hydrogen is still a significant challenge

- But anticipation of a market for green steel has spurred a flurry of investment
- Government involvement is often crucial for these projects to offset some of the project risk
- Some of these projects rely on grey hydrogen in development
- It is crucial that low carbon hydrogen supply is secured eventually

Chicken or the egg?

Where should efforts be concentrated to deliver the most impact?

- A large portion of the current **95 million tonnes** of global hydrogen consumption is associated with the industry sector
- **Supply challenge:** Incentivising low emissions supply to meet a larger portion of this demand will contribute to decarbonisation objectives

The demand already exists

Other prospects for increasing hydrogen demand

Current industrial heat processes that use natural gas



20% blend rates or lower

Hydrogen can typically be blended with limited need for upgrades

Hydrogen's role in an energy transition for industry

Preliminary modelling for the 9th Outlook

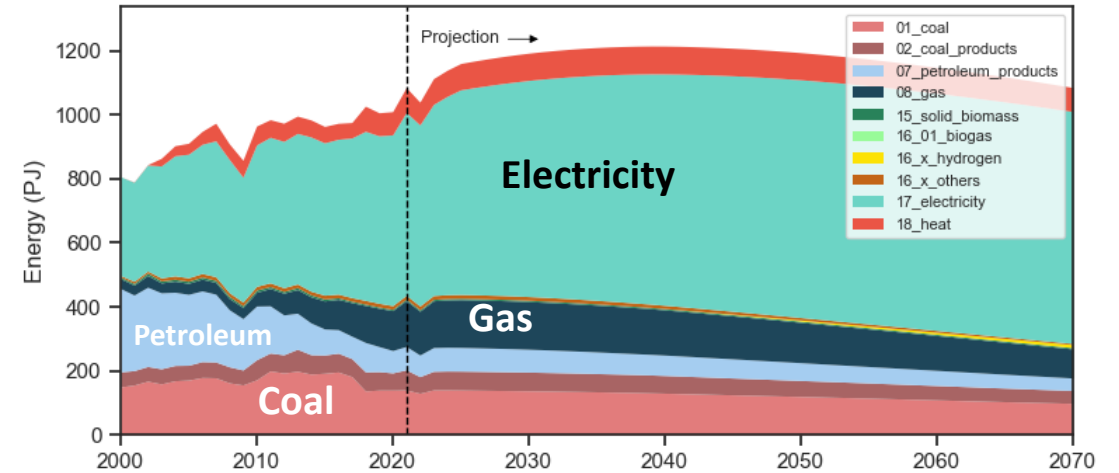
→ Incorporating some of its most likely applications

- Steel production
- Co-firing with natural gas
- Feedstock for methanol and ammonia

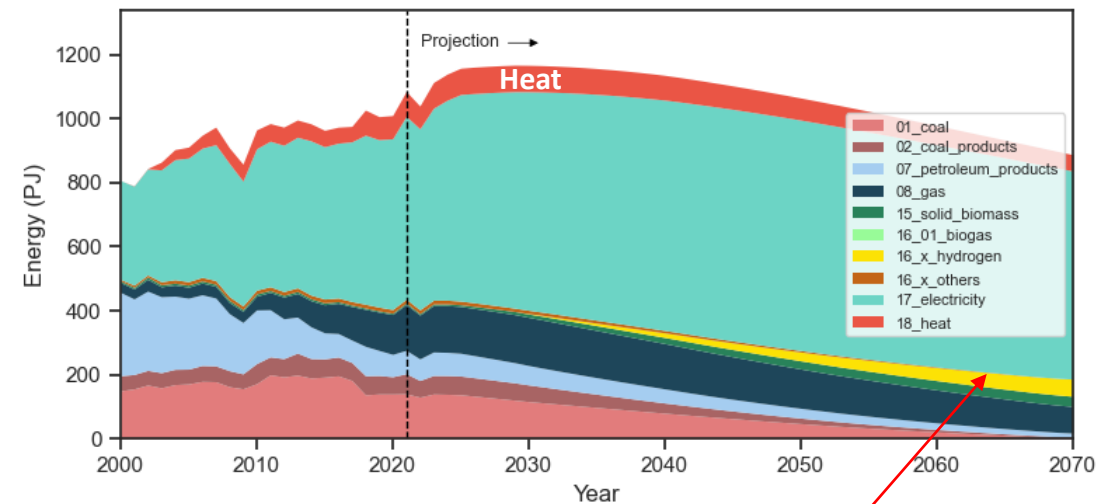


Leads to a contribution in concert with a portfolio of other approaches including electrification, material efficiency, energy efficiency, and CCS

Chinese Taipei industry energy consumption, REF



Chinese Taipei industry energy consumption, TGT



Hydrogen

Conclusions

- Significant demand for hydrogen already exists
- 99%+ of this hydrogen demand is met by high emissions hydrogen production
- Currently, using lower emissions sources of hydrogen is not only more expensive
- But low emissions sources of hydrogen are not yet available at scale
- Chicken or the egg: If low emissions hydrogen becomes more available at scale, it will remain more expensive than grey hydrogen without
 - Policy intervention
 - Green hydrogen becoming very cheap (possible eventually but unlikely for many years)
- Solve the cost challenge and consumers will happily switch to low emissions hydrogen
- New applications using hydrogen for energy can also readily make use of low emissions hydrogen
 - Can assist decarbonising high heat applications within heavy industry

Thank you.

<https://aperc.or.jp>

[**mathew.horne@aperc.or.jp**](mailto:mathew.horne@aperc.or.jp)

