Green H2: a potential export commodity in a new global marketplace

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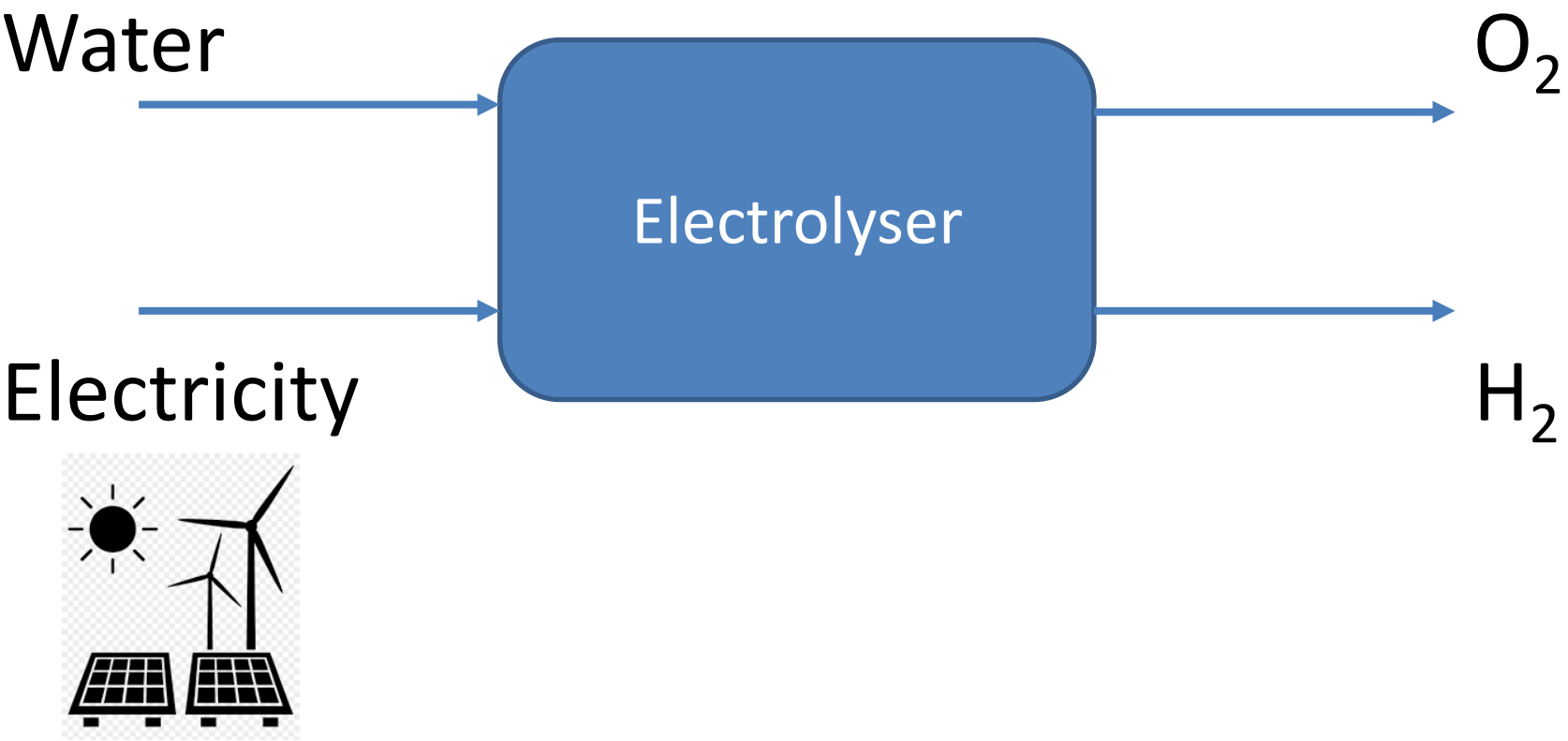
Climate problem and opportunity

- Mitigation efforts in certain sectors such as industry, transport, buildings, and power generation are only able to limit emissions up to a point
- Hydrogen offers further decarbonisation, particularly in traditionally difficult applications (e.g. aviation, shipping)
- Energy security
- Currently a lot of focus on developing the sustainable hydrogen economy globally
- South Africa has key resources to leverage in developing green hydrogen
- Green hydrogen presents an opportunity to create a new and sustainable industry with export potential

Electrolysis process

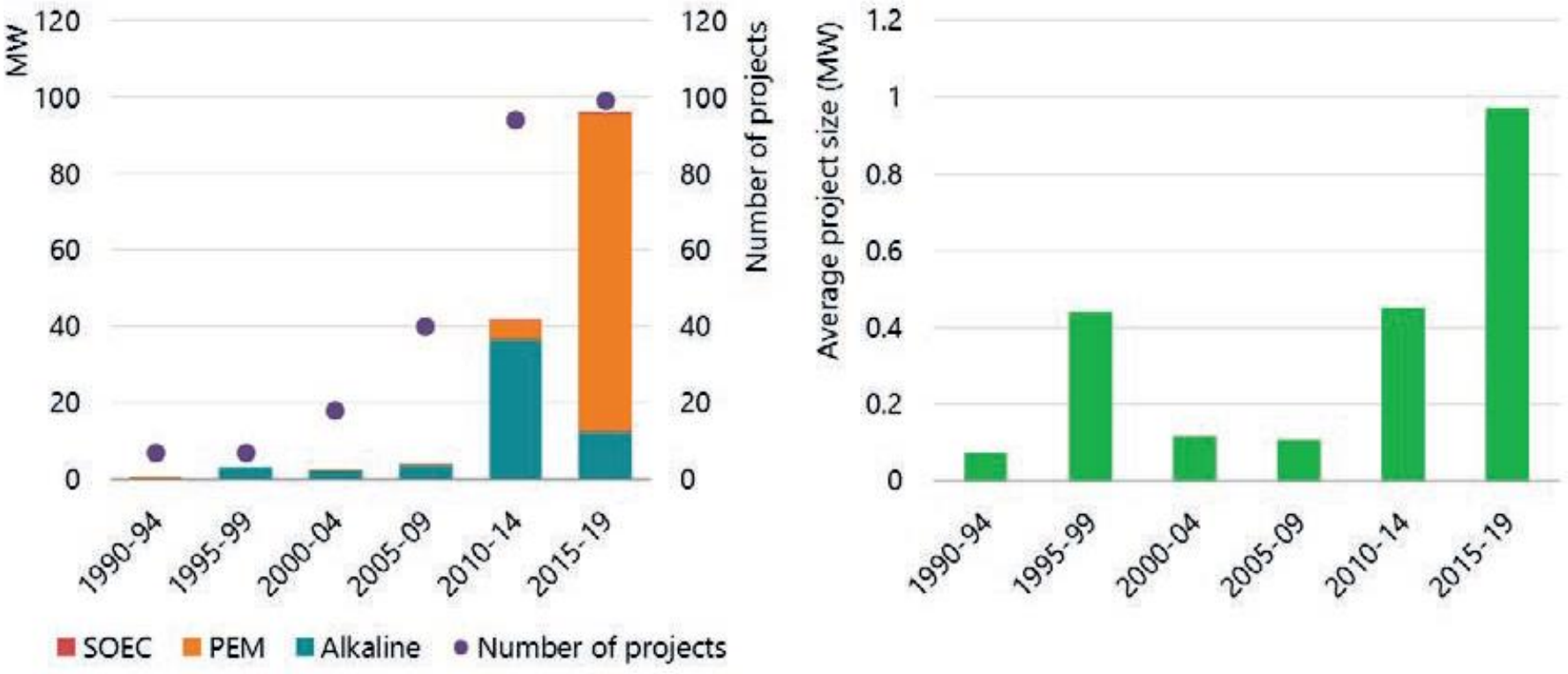


Electrolyser technologies

Electrolysis Technology	Alkaline Electrolysis		Proton Exchange Membrane (PEM)		Solid Oxide Electrolysis Cell (SOEC)	
Time frame	Current	Long term	Current	Long term	Current	Long term
Lifetime (operating hours)	60 000 – 90 000	100 000 – 150 000	30 000 – 90 000	100 000 – 150 000	10 000 – 30 000	75 000 – 100 000
Operating Temperature (^{0}C)	60 - 80	Not available	50 - 80	Not available	650 - 1000	Not available
Electrical efficiency (%, LHV)	63 – 70	70 - 80	56 – 60	67 - 74	74 – 81	77 - 90
Plant footprint (m2/kWe)	0.095	Not available	0.048	Not available	Not available	
CAPEX (USD/kWe)	500 – 1400	200 – 700	1 100 – 1 800	200 – 900	2 800 – 5 600	500 – 1 000

Green hydrogen – global penetration

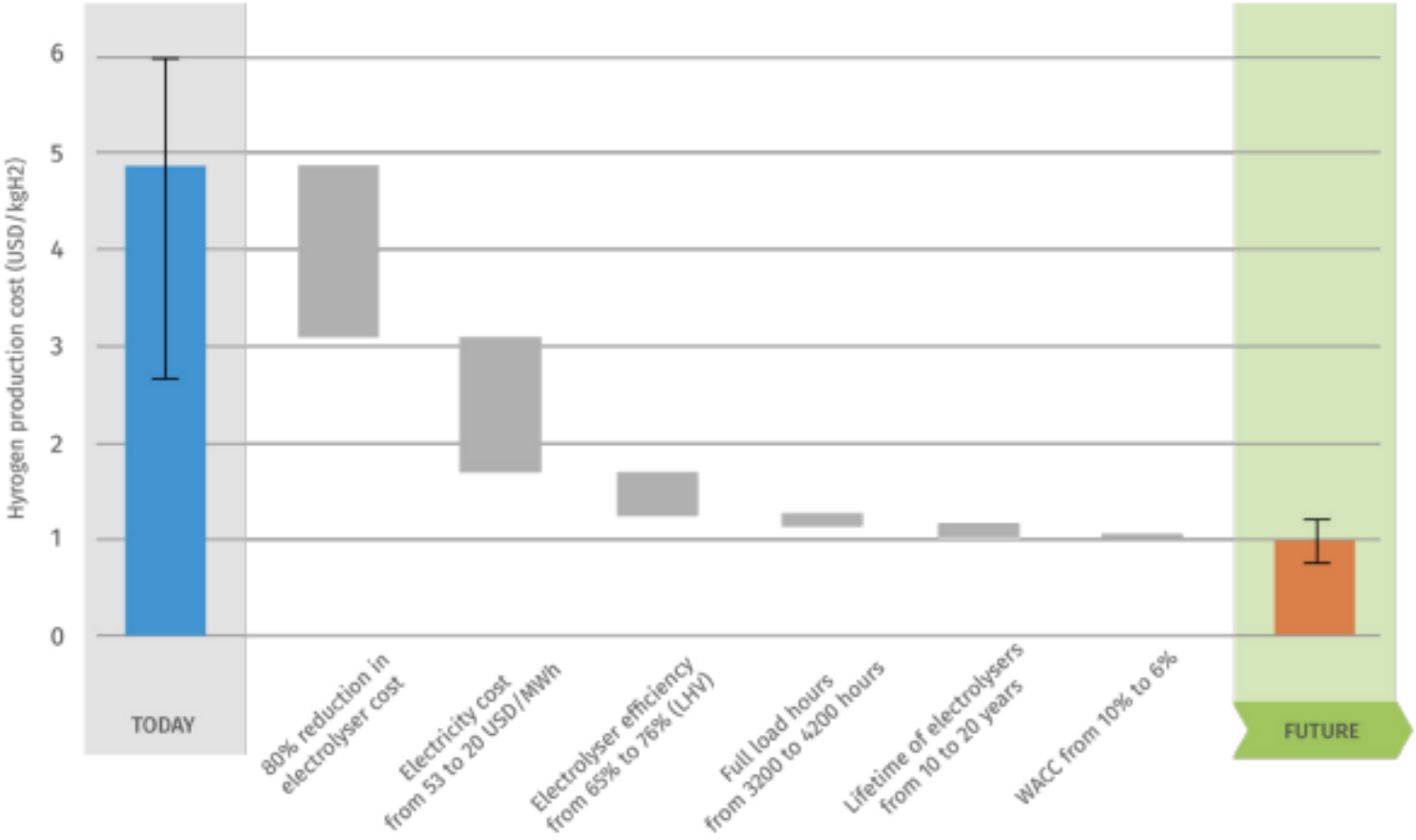
Figure 1. Electrolyser installation by technology and electrolyser size



Source: IEA, 2019

Cost drivers

Figure 2. GH2 Cost drivers



Source: IRENA, 2020

SA hydrogen supply

- Main players in the marketplace
  - Sasol
  - Afrox/Linde
  - Air Liquide

- All commercial production is currently based on SMR of natural gas/coal

- Natural gas principally sourced from Mozambique, coal is domestic

SA Capabilities

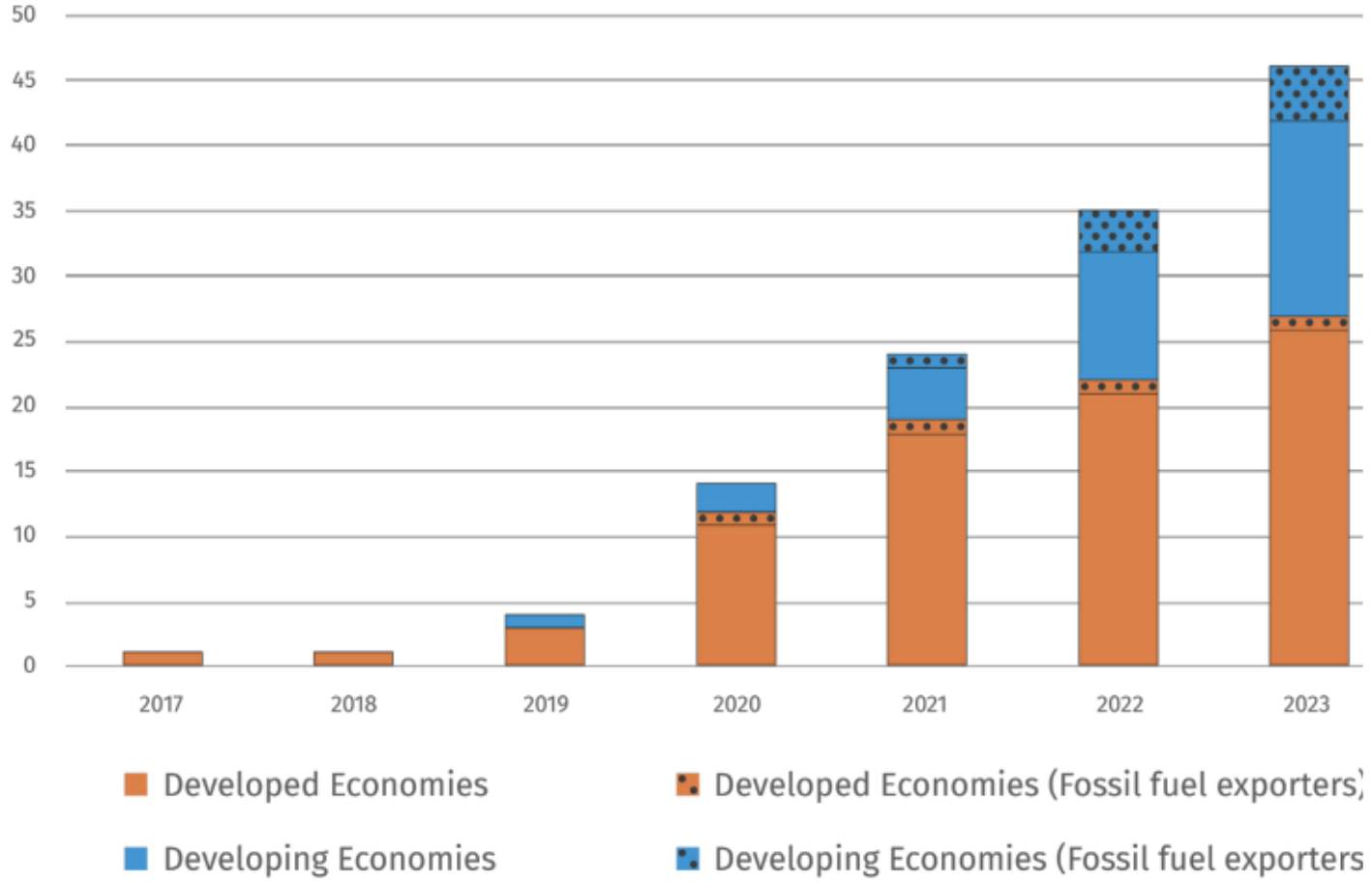
- Good renewables conditions for solar and wind
  - Combined solar and wind power provide a hydrogen production capacity factor of almost 100% during daylight hours
  - In the evening wind generation can be harnessed to produce hydrogen at a capacity factor of about 30%, which exceeds the international norm of approximately 22%
- First mover advantage in Fischer-Tropsch
  - Large scale commercial FT reactor deployment
  - Skills in FT process
- Access to Pt resources which are vital in PEM systems

Demand outlook

- By mid-2019, a combined total of 50 targets, mandates and policy incentives were in place globally in support of the hydrogen economy.
- Among the Group of Twenty (G20) and the European Union, 11 have such policies in place and 9 have national roadmaps for hydrogen energy.
- Countries have incorporated a range of policy tools to drive the hydrogen economy and they include funding mechanisms, targets for hydrogen applications, subsidy mechanisms, investment funds, and tax credit schemes.
- Countries are beginning to place themselves in global hydrogen value chains and signal to the global market their intentions related to the import, production, or export of hydrogen.

Demand outlook

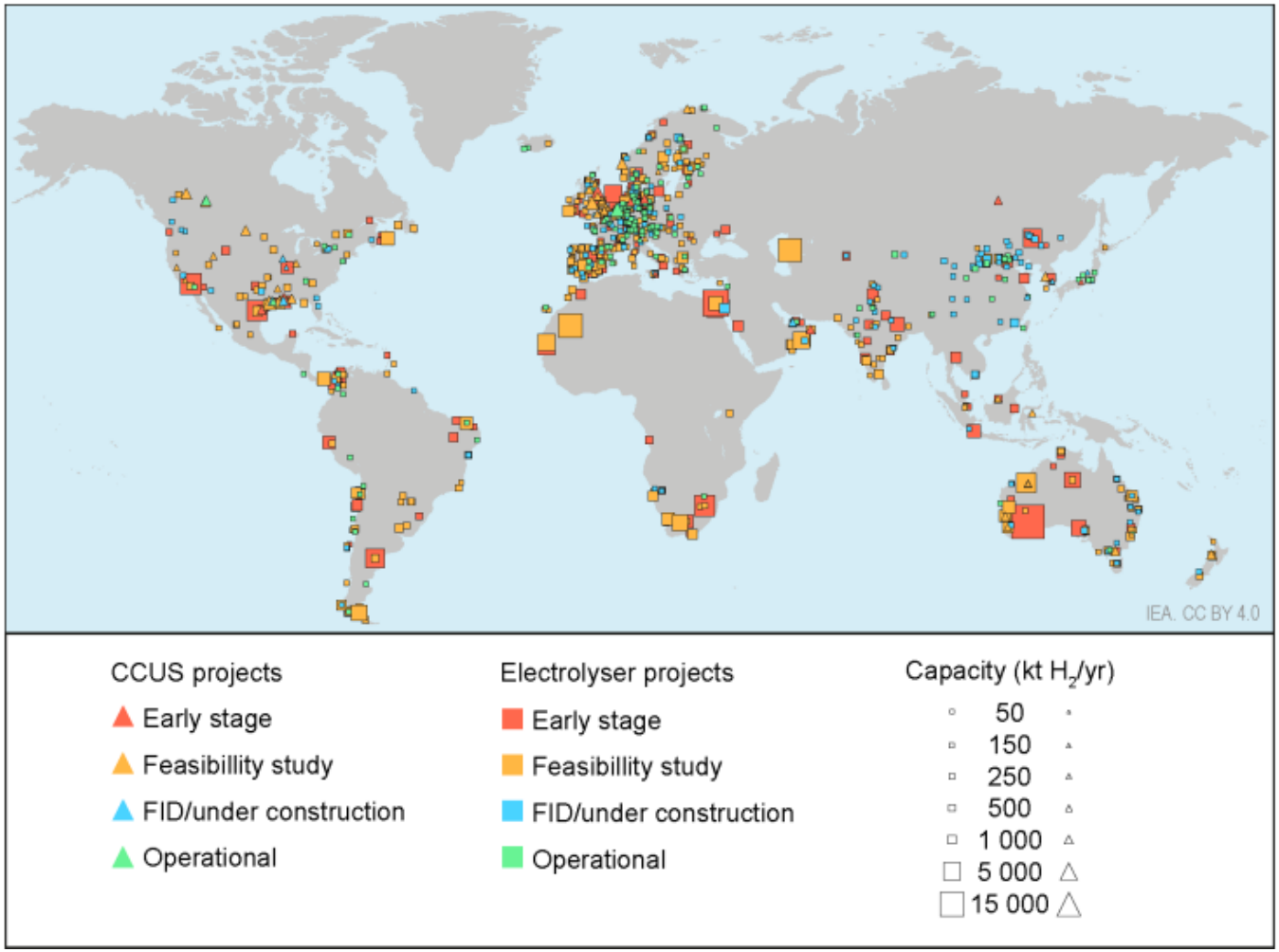
Figure 3. Number of countries with National Green Hydrogen Strategies



Source: IRENA, 2024

Policy direction

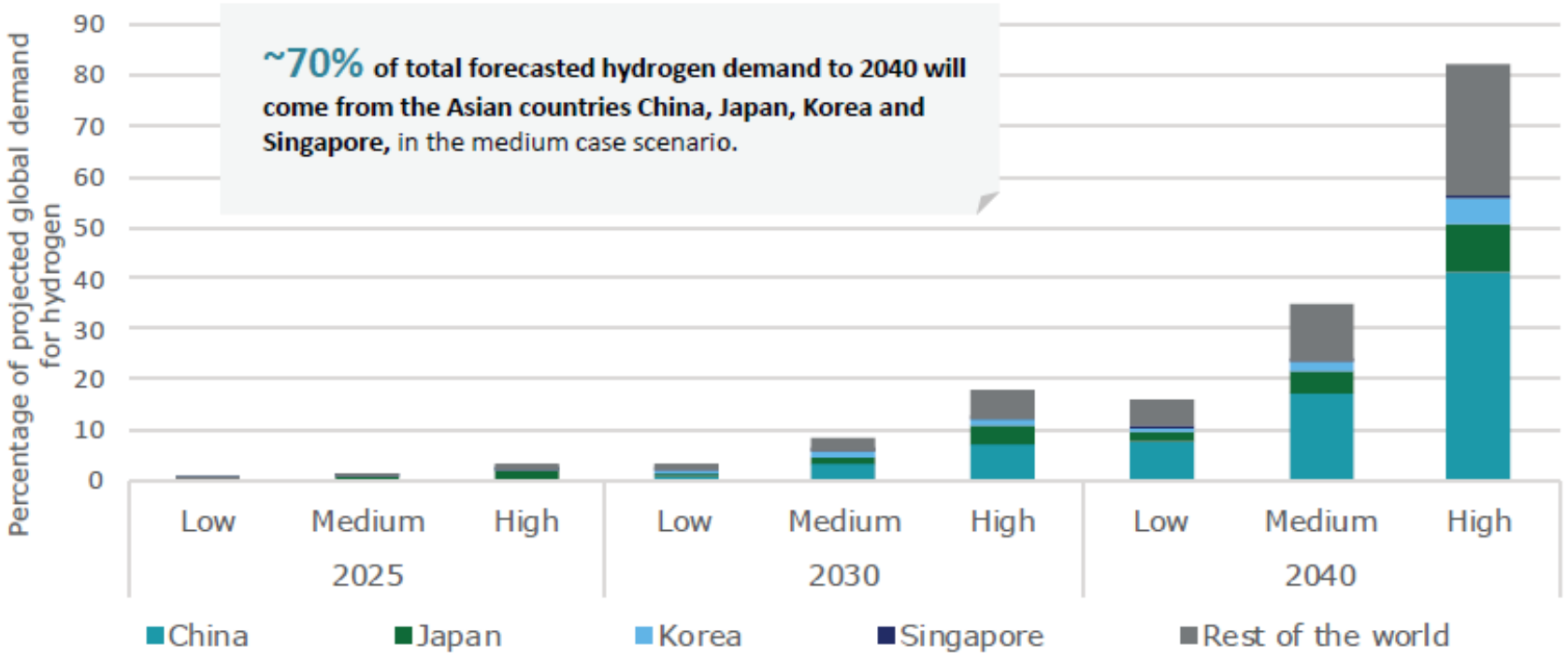
Figure 4. Announced low-emission hydrogen production projects



Source: IEA, 2023

Demand outlook

Figure 5. Hydrogen policies and sectoral decomposition



Source: IEA, 2019

Demand outlook

Figure 6. Hydrogen policies and sectoral decomposition

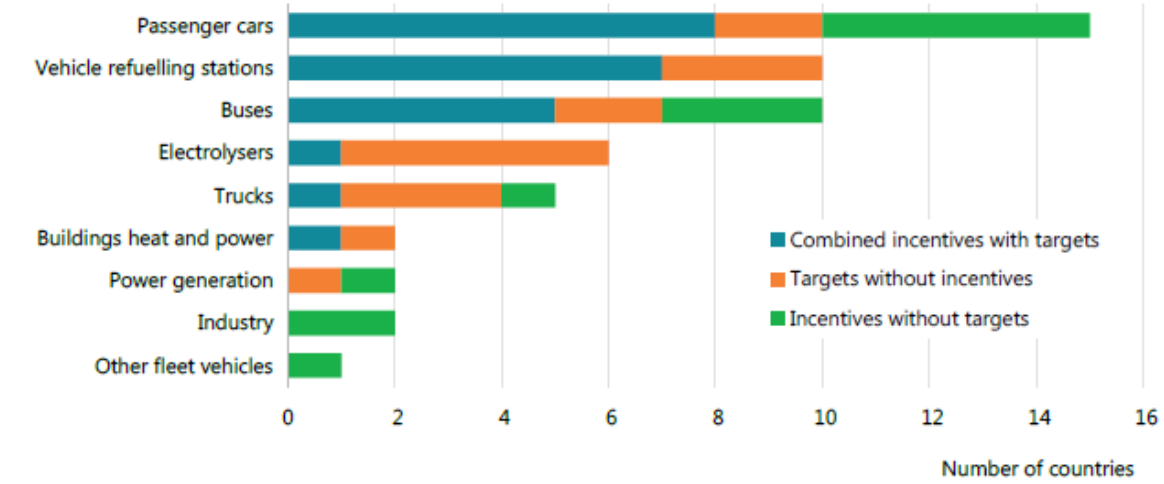
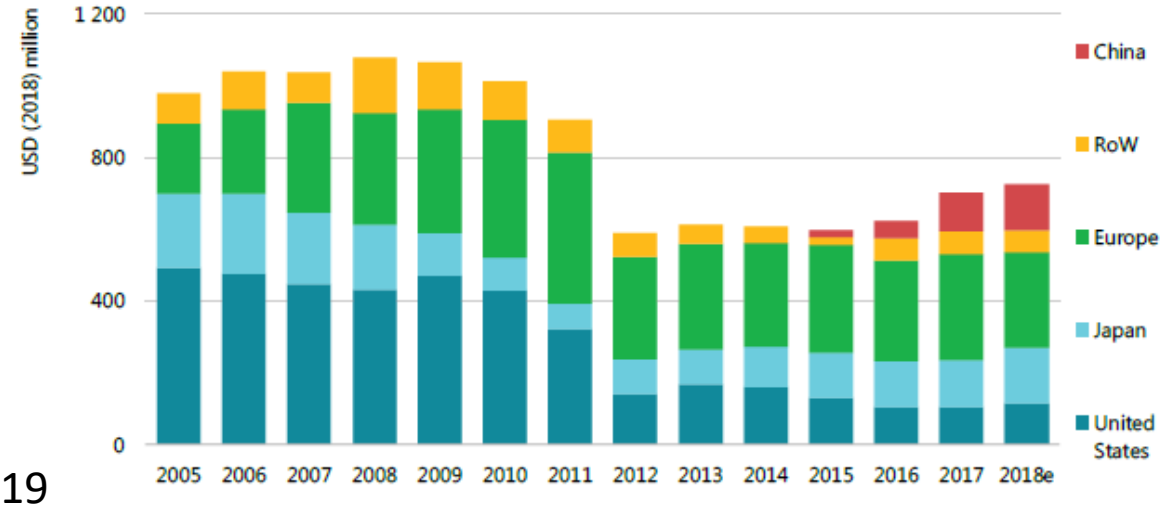


Figure 7. R & D budgets for hydrogen and fuel cells



Source: IEA, 2019

Demand outlook - Japan

- Seen as a key export destination beginning from 2030
- Policy outlook contained in Strategic Roadmap for Hydrogen and Fuel Cells (2014) and Basic Hydrogen Strategy (2017)
- Roadmap sets updated targets on basic technology specification and costs; interventions for achieving these targets; and expert working group to review the implementation status of the Roadmap
- By 2030 Japan intends to import 300 000 t/annum of green hydrogen with a staged ramping up to 5-10 million t/annum beyond 2030
- Rising demand fueled through market development in FCVs and power generation
- Substantial investments into reducing investment recovery time on PEM and SOEC systems

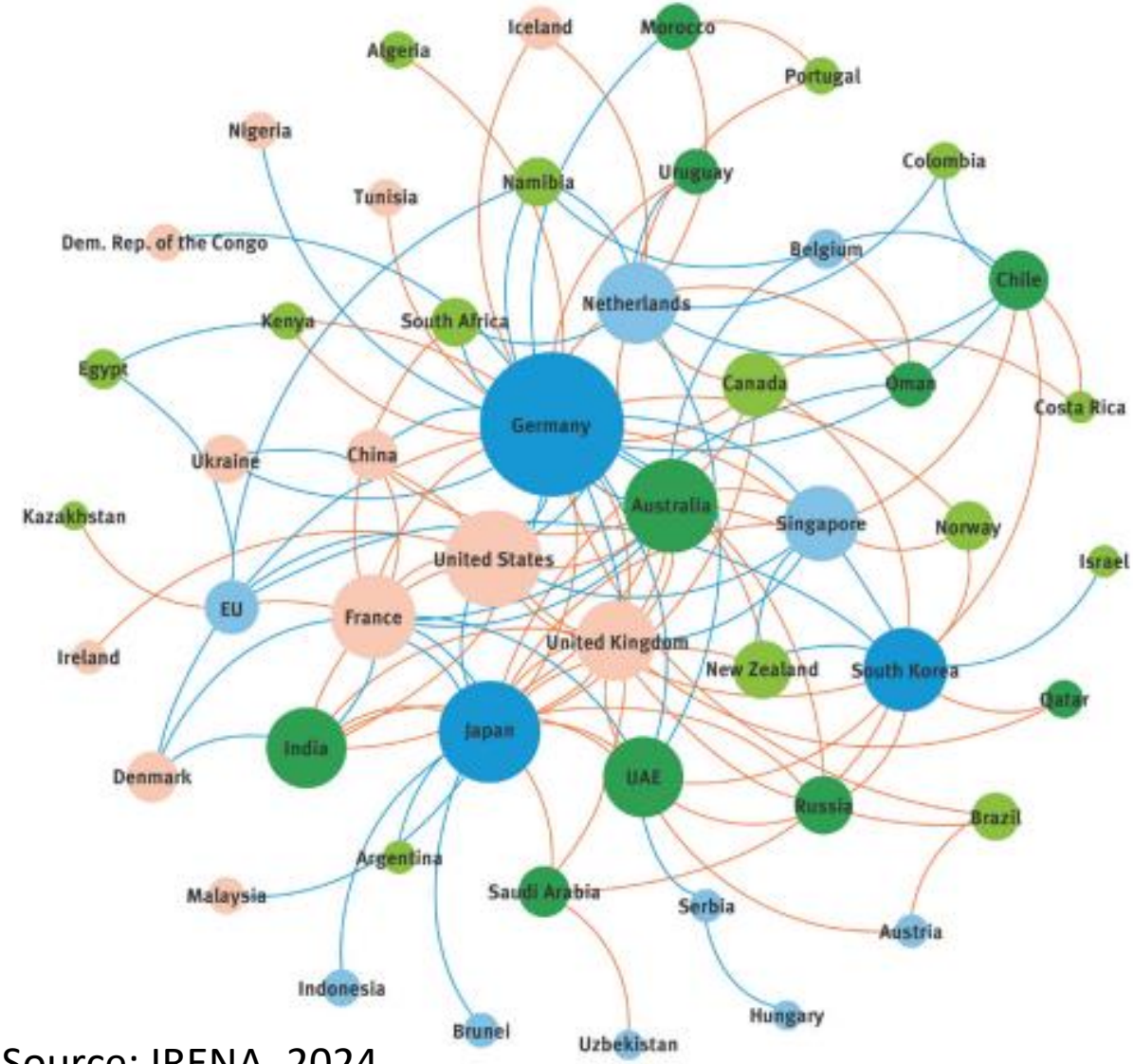
Demand outlook – South Korea

- National Basic Plan for New and Renewable Energies (2014) made provision for US$2bn investment in hydrogen infrastructure, manufacturing and technology.
- National Roadmap of Hydrogen Technology Development (2019) plans for the development of fuel cell technologies and hydrogen in South Korea
- The import of hydrogen is seen as an opportunity beyond 2030, to stabilise the domestic hydrogen prices and saving resources related domestic investment in hydrogen production infrastructure.
- Import demand anticipated to be ~300 000 t/annum by 2030 and ~1 million t/annum by 2040

Demand outlook – EU

- EU Hydrogen Strategy (2020) aims to decarbonise industrial processes and economic sectors where reducing carbon emissions is both urgent and hard to achieve.
- Makes provisions for the promotion of new opportunities for cooperation on clean hydrogen with countries and regions, to contribute to their clean energy transition and foster sustainable growth and development.
- Strategy makes provision for the import and development of hydrogen economy globally through partnerships, including Africa as a supply destination through
- Roadmap plans to set out a cooperation process on renewable hydrogen with the African Union in the framework of the Africa-Europe Green Energy Initiative.
- Political discussions also underway with covid potentially accelerating green aviation fuel (e.g. Air France state support for covid linked to carbon reduction)

Greater interconnectedness



- Increasingly countries are establishing relationships with each other (e.g. MoUs)
- Demand high in Germany, Japan and South Korea
- These countries have formed partnerships with potential exporters

Source: IRENA, 2024

Policy developments

- **SA Hydrogen Society Roadmap (2021):** Important policy document tracking SA's progress and a 2050 vision
  - Decarbonisation of transport sectors
  - Decarbonisation of energy-intensive industry
  - Creation of an export market for South African hydrogen
  - Centre of Excellence in Manufacturing for hydrogen products and fuel cell components
  - Green and enhanced power sector
  - Hydrogen generation, storage and distribution

Policy developments

- **Green Hydrogen Commercialisation Strategy (GHCS)**
  - Approved by Cabinet in 2023
  - Assesses demand (domestic + export)
  - Value chain assessment
  - Infrastructure (ports, pipelines)
  - Hub development
  - Roadmap of catalytic projects and required actions
  - Regulatory requirements and policy support
  - Emphasis on Just Transition

Policy developments

- In 2022, Minister de Lille gazetted nine GH2 projects as Strategic Integrated Projects in line with Infrastructure Development Act

  - The Prieska Power Reserve in the Northern Cape
  - The Ubuntu Green Energy Hydrogen Project in Northern Cape
  - Boegoebaai Green Hydrogen Development in the Northern Cape
  - Atlanthia Green Hydrogen in the Western Cape
  - Upilanga Solar and Green H2 Park in Northern Cape
  - Sasolburg Green Hydrogen 60MW in the Free State
  - SASOL HySHiFT (Secunda) in Mpumalanga
  - HIVE Ammonia in the Eastern Cape
  - The Hydrogen Valley Programme of Anglo-American and their JV Partners includes 9 projects alone along the Limpopo, Gauteng to KwaZulu-Natal Corridor

Policy developments

- A key financing source: **JET-IP (2023-2027)**

  - Provision of ZAR 319 bn for GH_2 development
  - Allocations split into project feasibility and capital costs
  - Funding inputs across the value chain and includes improving infrastructure (e.g. ports)
  - Countries include EU, France, Germany, US, UK
  - In 2023, Denmark, the Netherlands and Spain also pledged funding increasing the overall support from $8.5 bn to $11.8 bn

Current research work

- Stockholm Environment Institute (SEI) examining the interplay between GH2 and JT
  - Uses gazetted projects as a sample
  - Understand how project developers are integrating JT elements into GH2 projects
    - What constitutes a JT activity
    - Where and how are decisions made
    - How are stakeholders consulted
    - What JT tools are materializing in the project space

Thank you!

Trade and Industrial Policy Strategies

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Link to full hydrogen report: https://www.tips.org.za/research-archive/sustainable-growth/green-economy-2/itemlist/tag/Green%20hydrogen