Hydrogen Financing in Developing Countries and Emerging Markets

Water Law Committee

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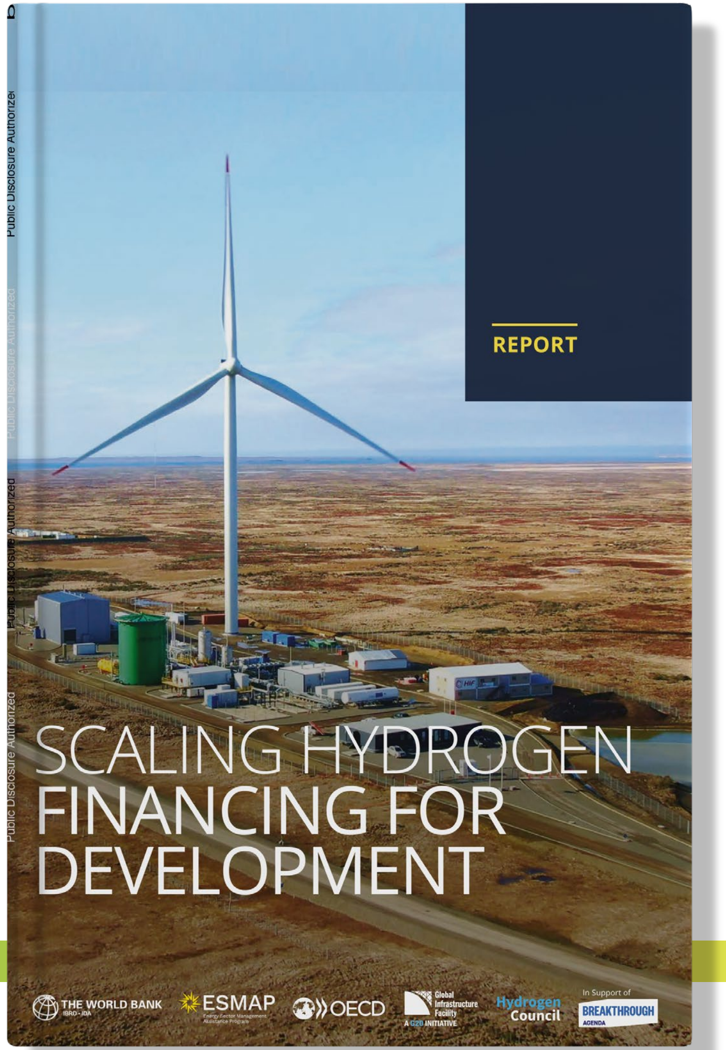

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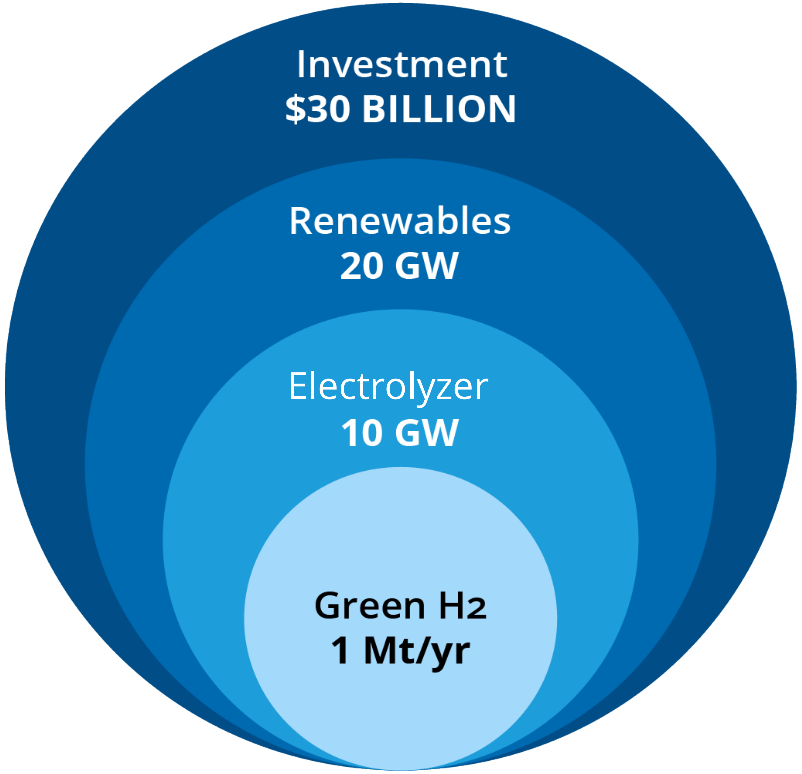
Clean hydrogen is a capital-intensive industry and the financing gap for EMDCs is between $10 to $40 billion per year between now and 2030

1 → 10 → 20 → 30



Total annual EMDC financing needs until 2030: $100B/yr.
Annual EMDC financing gap until 2030: $10B-$40B/yr.

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SEMDCs: Emerging Markets Developing Countries
Source: World Bank – Scaling Hydrogen Financing for Development (2024)

Challenges faced for clean hydrogen bankability in EMDCs

1 High Costs

- **2-3x** cost of grey hydrogen
- First movers need **subsidies**

2 Construction Risks

- **Complex** project execution
- Many **interface** risks

3 Power Intermittency

- **Intermittency** of renewables creates integration issues
- **Transmission** capacity often limited

4 Infrastructure Needs

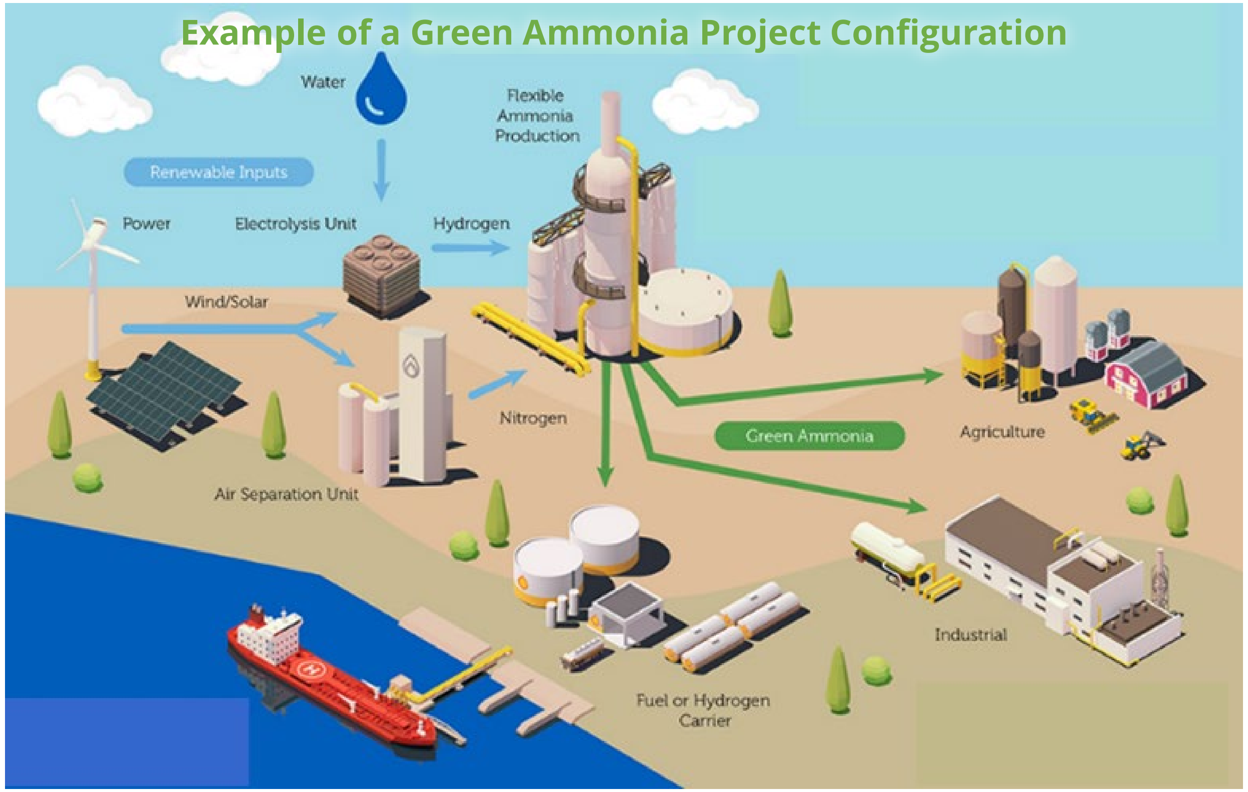
- **Cost of new port / pipeline** for export projects

5 Electrolyzer Tech

- Performance unproven **at scale** over long periods

6 Water Supply

- **Sustainable supply** critical
- High water **quality** essential



7 Need for Offtake

- Need **long term** (10+ years) **offtake** with price certainty
- Investment grade **counterpart**

8 Big E&S Footprint

- Large land area required
- **Biodiversity** key focus

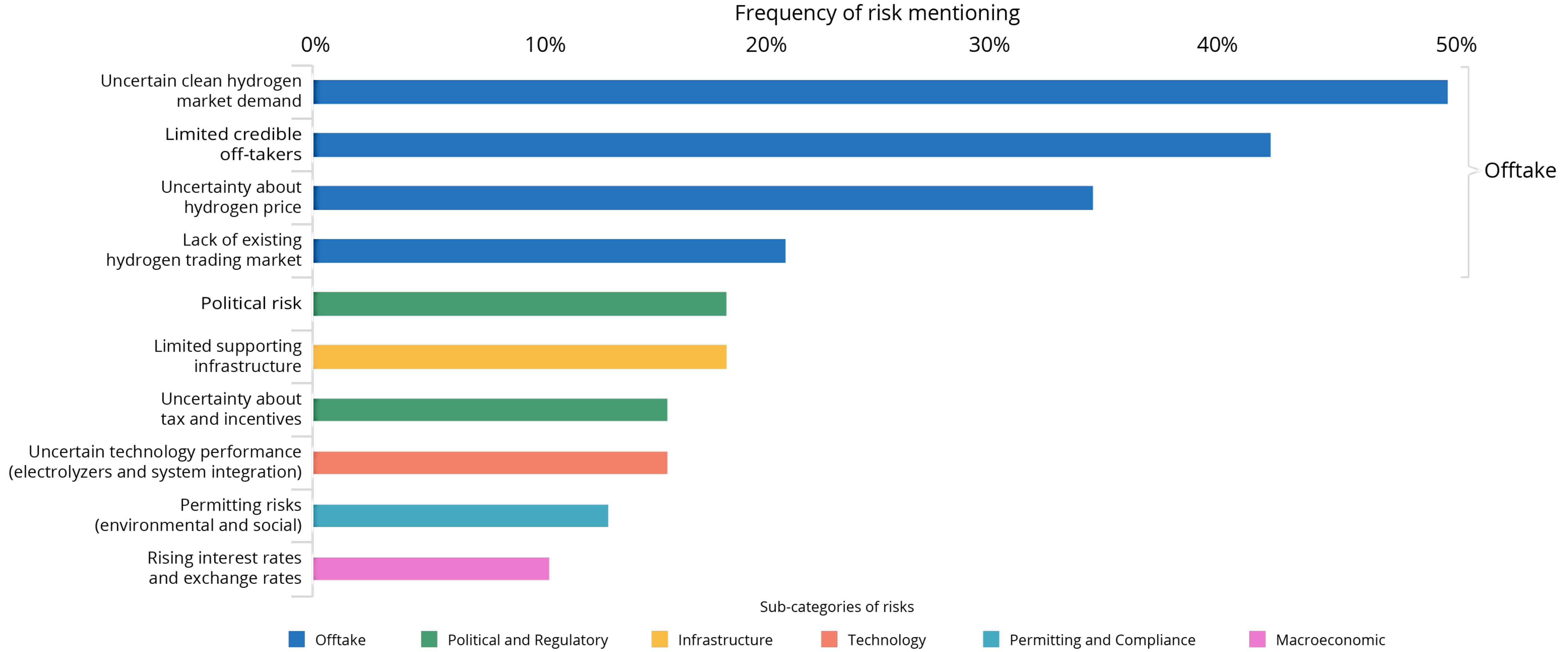
9 Regulatory Changes

- **Changes** in regulation or subsidies is key risk (including in importing or **other exporting countries)**

10 Bank Liquidity

- **Limited availability** of long-term debt in some markets

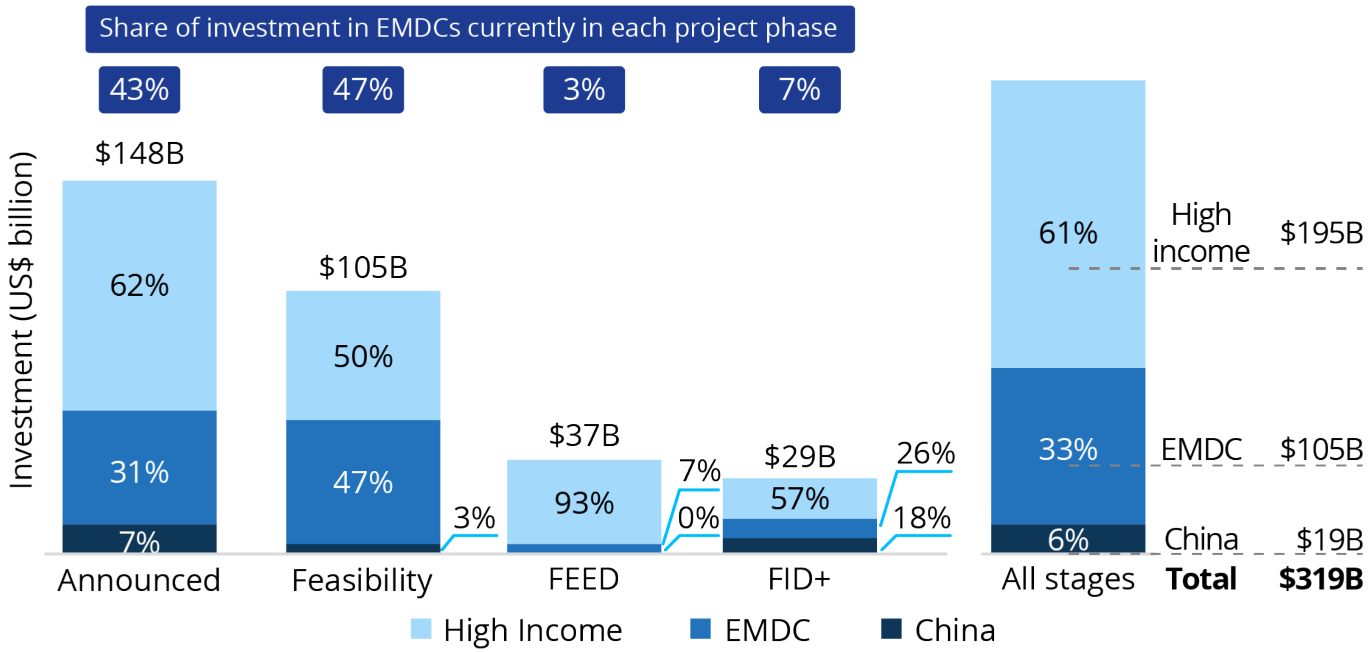
Six sub-categories of risks in EMDCs that, if mitigated, would enable clean hydrogen projects to secure financing



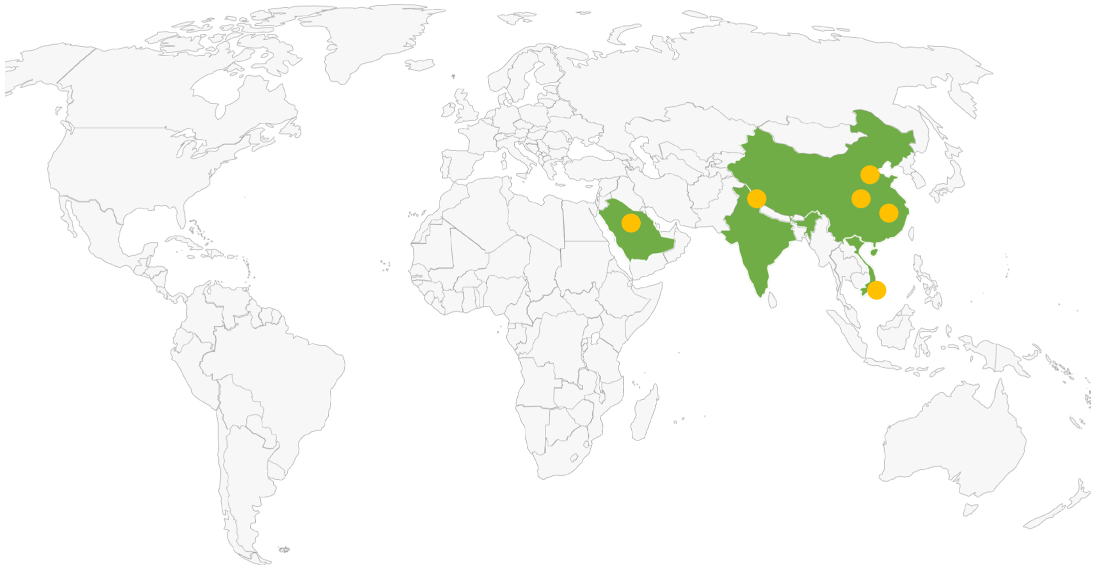
Source: World Bank – Scaling Hydrogen Financing for Development (2024)

Projects in developing countries are delayed: many announcements, but few projects move forward

Announced Projects by Stage - as of May 2023 (*)



Six renewable hydrogen projects (>100 MW) in EMDCs have reached the FID



Source: Hydrogen Insights Report, Hydrogen Council, McKinsey & Company, May 2023
Note: (*) Investment numbers exclude the renewable power component. FID+ refers to any project at or beyond the FID stage

Water for the hydrogen economy

- Water is required as an **input for production** and as a **cooling medium** for all types of hydrogen production.
- **Proton exchange membrane (PEM) electrolysis** has the lowest water consumption intensity at about **17.5 liters per kilogram of hydrogen (L/kg).**
- **Alkaline electrolysis** has a water consumption intensity of **22.3 L/kg**.
- Unconventional sources of water, through **desalination and reuse** and primarily **fueled by renewable energy**, provide a potential solution for hydrogen production.
- The process of desalinizing seawater would add **USD 0.02-0.05** to the cost of a kilogram of hydrogen.
- There are **15,906 operational desalination plants** producing around **95 million m3/day of desalinated water** for human use, of which **48% is produced in the Middle East and North Africa region**.
- Photovoltaic-powered **reverse osmosis** plant can produce water at a cost of **$1.213/m3**, while for the moment, the cost of producing desalinated water with energy from a fuel-fired power plant oscillates between **$1.118 and $1.555 /m3**.
- The Al Khafji plant in Saudi Arabia **produces 60,000 m3 of desalinated water every day** by reverse osmosis using photovoltaic panels.

Source: World Bank – Scaling Hydrogen Financing for Development (2024)

Water for the hydrogen economy

- ✓ Water supply systems designed specifically for hydrogen production could extended to meet other users' water needs and provide cross-sector benefits, for example, **clean drinking water** and **sanitation**, with **minimal additional costs** for hydrogen production.
- ✓ The **main direct environmental impact on the marine environment** is caused by **(1)** intake and outlet facilities and **(2)** elevated content of salinity, temperature, and residual treatment chemicals in the plant discharge.
- ✓ The **indirect environmental impact** of desalination plant operations is the relatively high carbon footprint when heat or electricity produced by conventional fossil-fuel generation is used.

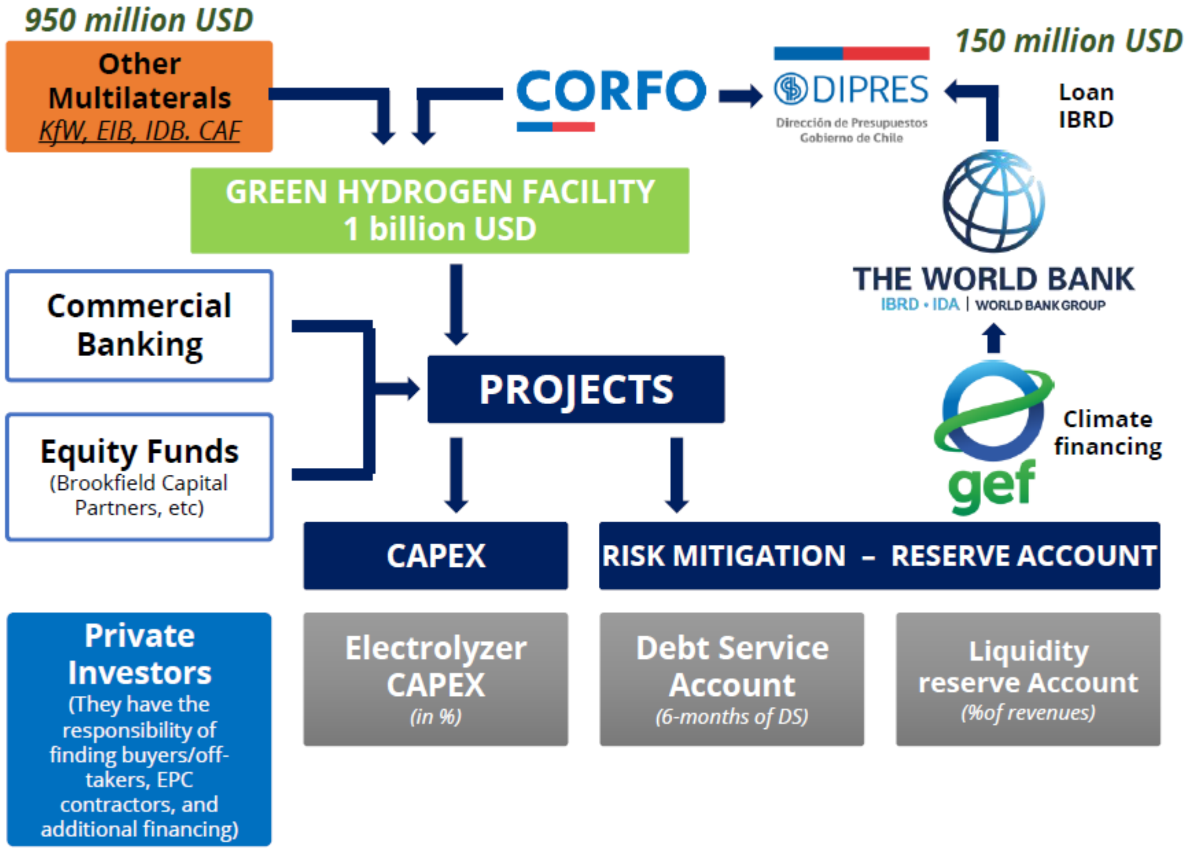
Concentrate disposal method	Disposal construction cost (US$/m³/day)
New surface discharge (new outfall with diffusion)	50-750
Colocation of desalination plant and power plant discharge	10-30
Codisposal with wastewater treatment plant discharge	30-150
Sanitary sewer discharge	5-150
Deep/ Beach well injection	200-625
Evaporation ponds	300-4,500
Spray irrigation	200-1,000
Zero liquid discharge	1,500-5,000

Source: Voutchkov 2018; World Bank 2012; Christos Charisiadis 2018.

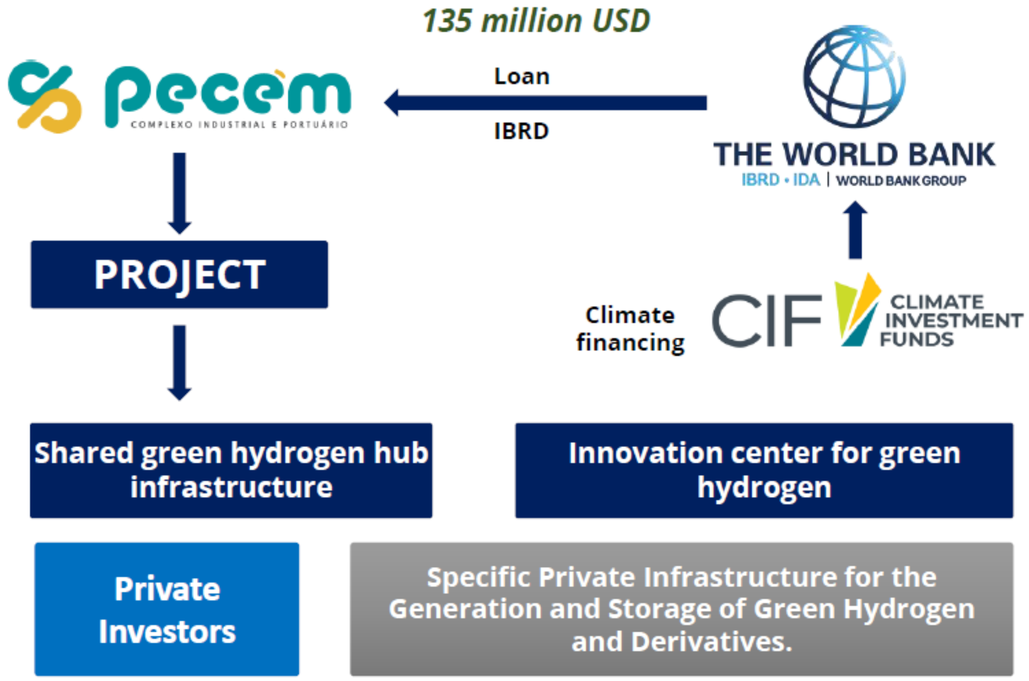
Source: World Bank – Scaling Hydrogen Financing for Development (2024)

WB lending projects: water considerations

CHILE - ELECTROLYZER FOCUS (230 MW)



BRAZIL - INFRASTRUCTURE FOCUS (2.4 GW)



Thank You!

Contact

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