Green Hydrogen in Developing Countries

California Fuel Cell Partnership
December 4, 2020

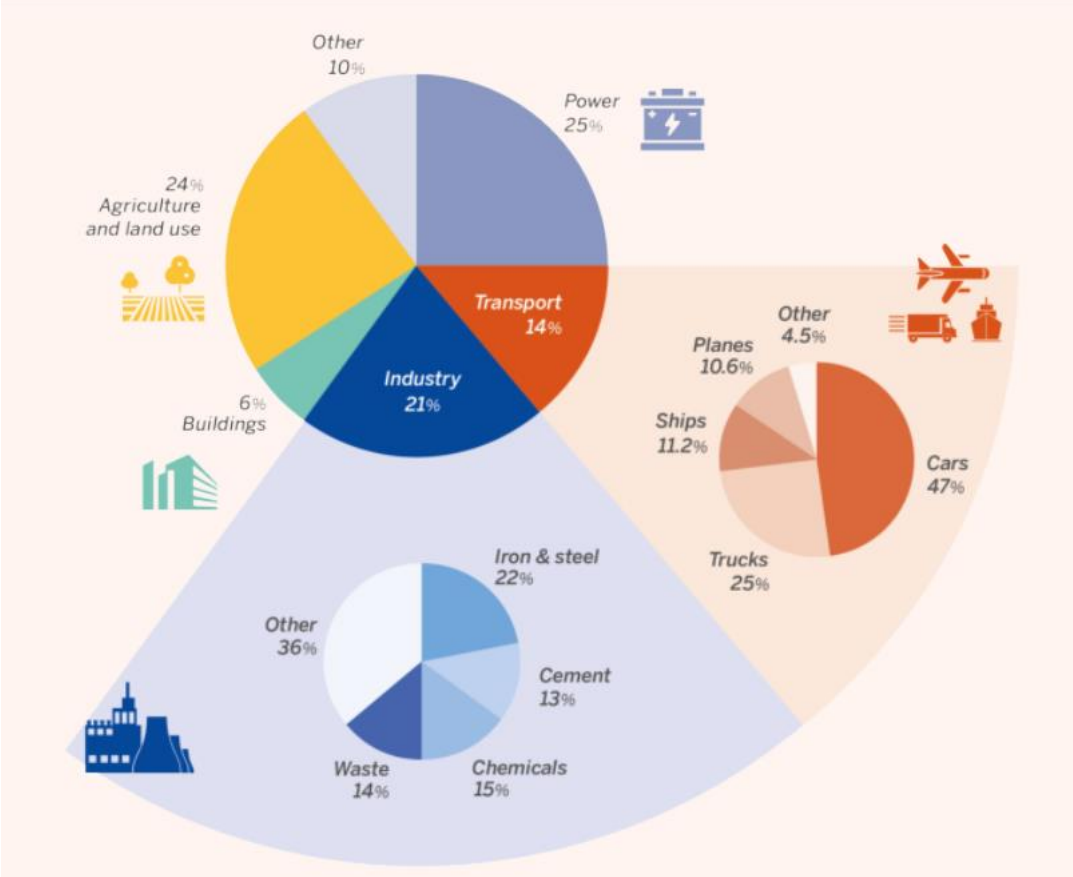
WORLD BANK GROUP
THE WORLD BANK IBRD • IDA
IFC International Finance Corporation

ESMAP
Energy Sector Management Assistance Program

The world is not on track to deliver climate change goals

- ✓ About 75% of global GHG emissions are generated by sectors outside of power
- ✓ Deeper actions are needed to decarbonize across sectors

Global Emissions by Sector



Source: Energy Transitions Commission based on IPCC data

Green hydrogen: the opportunity of a clean flexible energy vector

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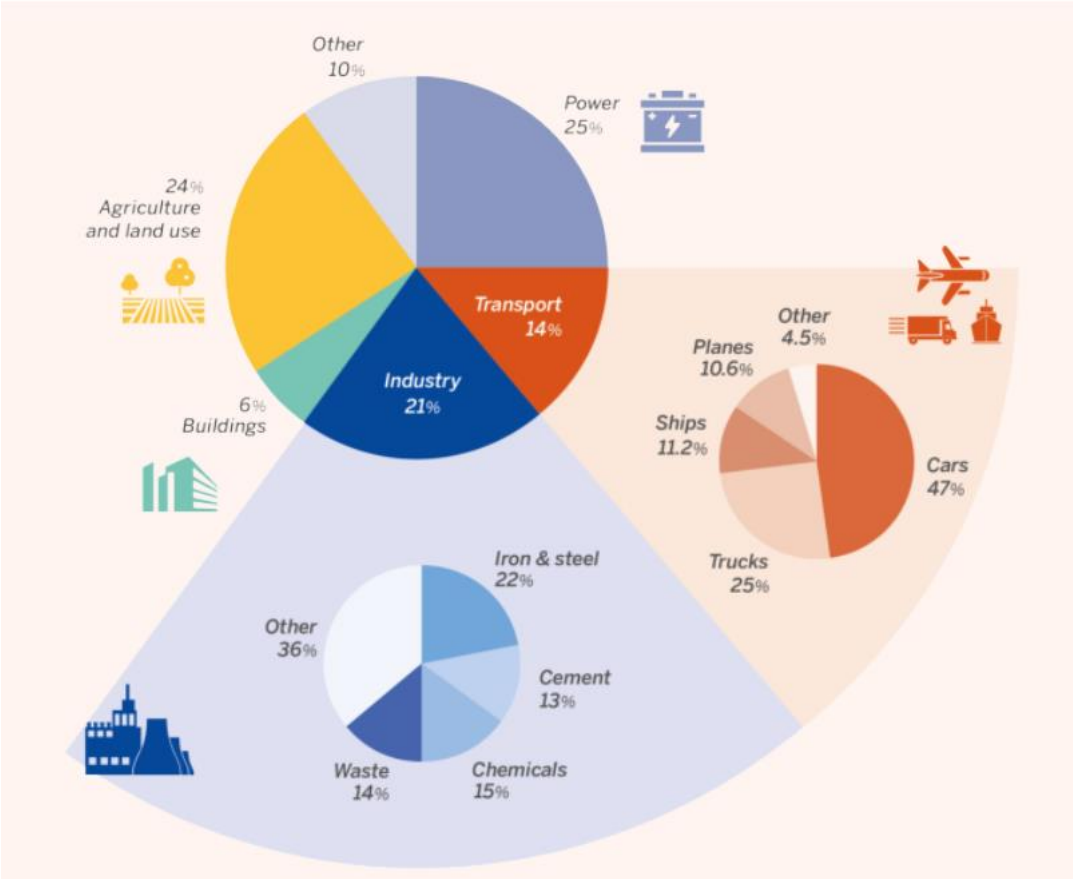


Source: Energy Transitions Commission based on IPCC data

- **Electrolyzers and fuel cell solutions are cheaper today**—with costs halved in the last ten years—, and are more efficient and have longer commercial lifetimes
- The **rapid decline in renewable costs** increases the potential for green hydrogen to be cost competitive with fossil sources in certain geographies and applications
- Domestic hydrogen production from renewables could contribute to:
  - ✓ **Decarbonizing** industry, transport and buildings
  - ✓ **Offering long-term energy storage** for mini grids, and island locations
  - ✓ **Reducing reliance** on expensive imported fuels
  - ✓ **Producing "future fuels"** (e.g., ammonia, methanol) to decarbonize maritime transport
  - ✓ **Mitigating the seasonal variability** of renewables
  - ✓ **Providing reliable power** for critical infrastructure (e.g., telecommunication towers)

Deployment challenges

- Specific **knowledge and capabilities** are required to ensure the safe production, storage, transport, and use of hydrogen.
- There is a **shortage of qualified engineers** who can install, monitor, operate, and maintain integrated fuel cell and hydrogen systems.
- Hydrogen technologies are **capital intensive**, and further cost reductions and efficiency gains are needed to scale-up.
- Water-energy nexus and **desalination requirements** need to be factored-in to sustainably procure water needs to projects.
- **Strategic infrastructure decisions** will require deciding between pipeline infrastructure or maritime transportation of ammonia across multiple locations.
- **National strategies** are needed to identify a pathway toward meeting the infrastructure needs and the sectors where green hydrogen solutions could become commercial.

Background image: operators of green hydrogen pilot project by Ad Astra in Costa Rica

Near-term opportunities: heavy-duty transport and freight

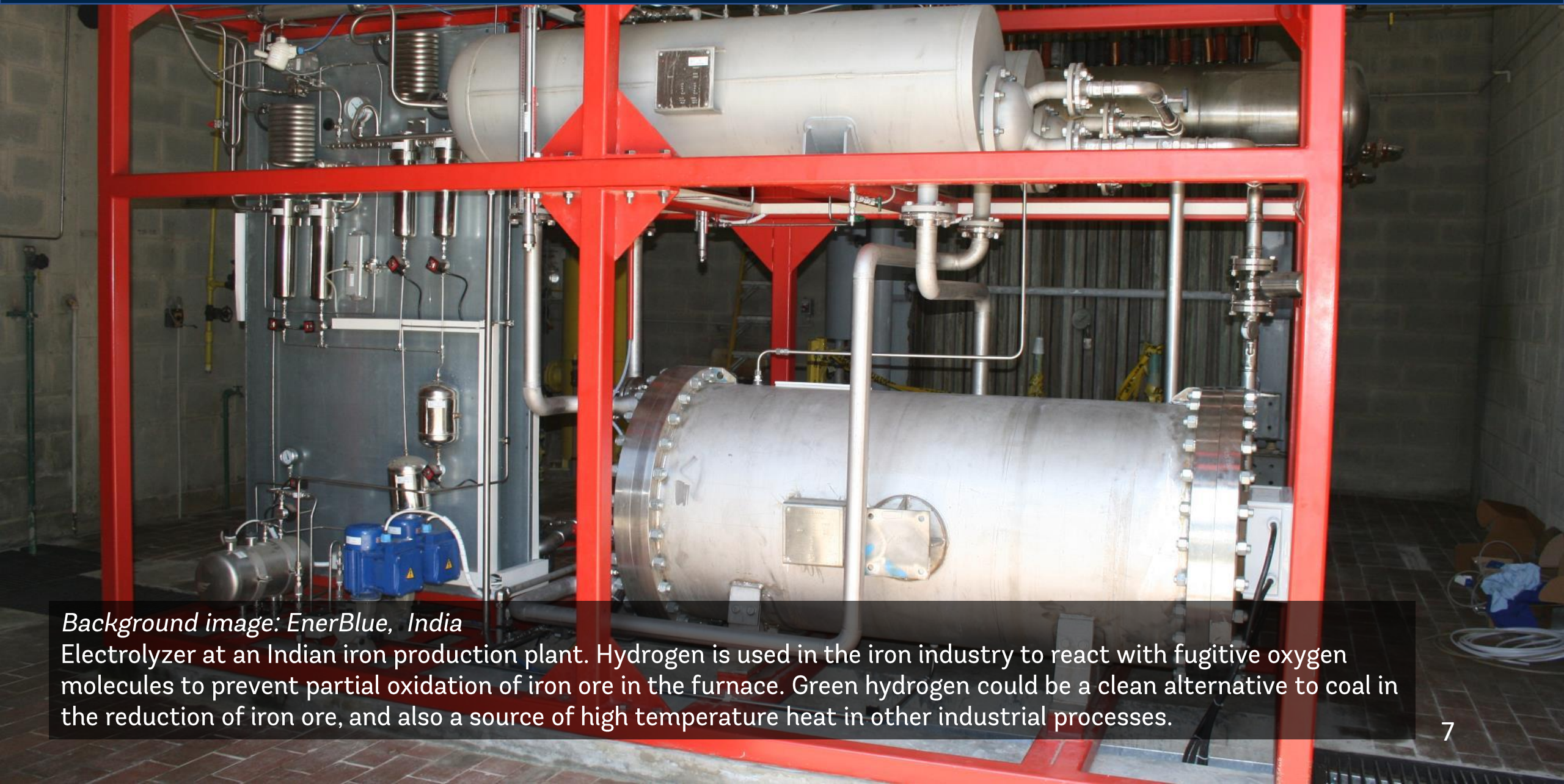
Background image: Ad Adstra, Costa Rica

The first fuel cell electric bus (FCEB) in Central America deployed in 2018. Solar PV and electrolyzers are used to generate green hydrogen on-site for its two refueling stations. Further analysis is needed to better understand the incremental costs of hydrogen business models in transport.

Near-term opportunities: decarbonizing maritime shipping

Viking Energy will run on FC with Ammonia

Near-term opportunities: industrial processes



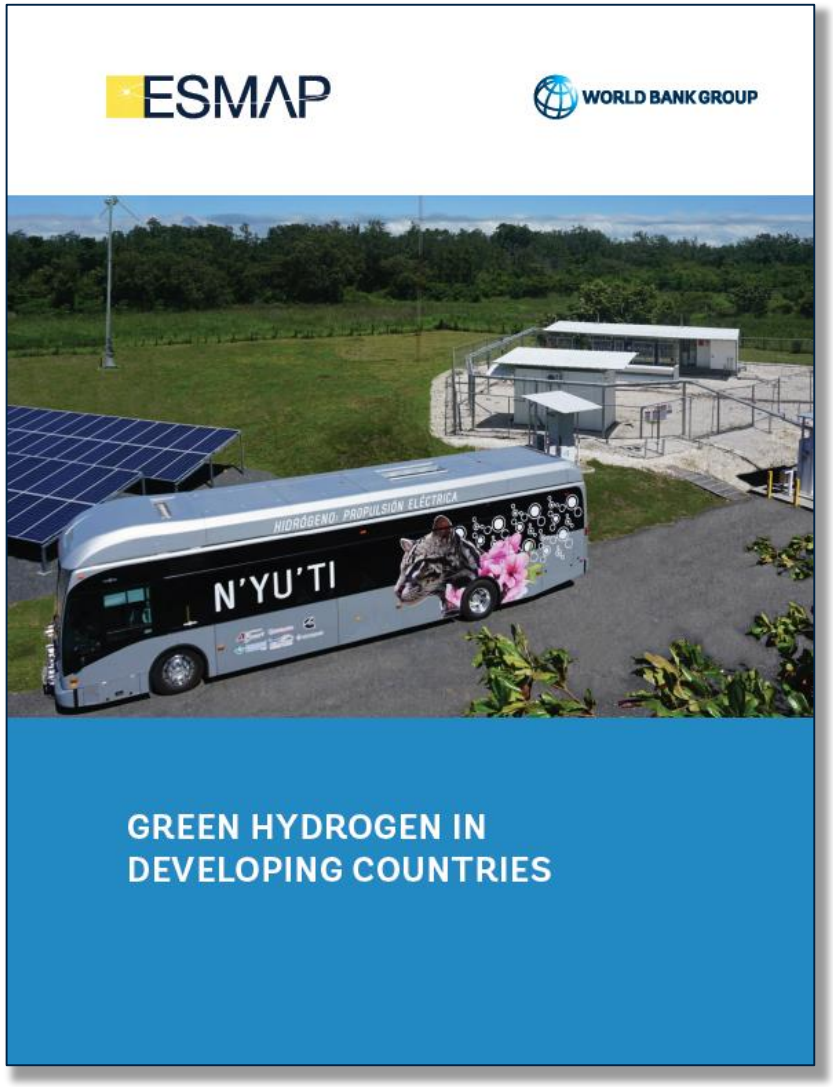
Background image: EnerBlue, India
Electrolyzer at an Indian iron production plant. Hydrogen is used in the iron industry to react with fugitive oxygen molecules to prevent partial oxidation of iron ore in the furnace. Green hydrogen could be a clean alternative to coal in the reduction of iron ore, and also a source of high temperature heat in other industrial processes.

Green hydrogen in developing countries

To learn more about **green hydrogen** opportunities and challenges in **developing countries**…

"Island locations, remote communities, countries with existing gas infrastructure, areas with poor air quality, and areas with excellent renewable resources or with severe seasonal renewable variability could offer the most attractive opportunities for near-term deployments of green hydrogen and fuel cell projects"

Download here: https://www.esmap.org/green-hydrogen-in-developing-countries



THANK YOU!

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