



FINANCIANDO EL COMBUSTIBLE DEL FUTURO EN ESPAÑA Y AMÉRICA LATINA: EL HIDRÓGENO VERDE

**Cinco cosas que debemos de saber sobre el desarrollo
del hidrógeno verde en América Latina**

25 de October, 2021

IDB Vision 2025

To promote growth opportunities for all in a sustainable manner.

Goals: reactivate the productive sector, promote social progress, and strengthen good governance

**Commercial
integration of the
LAC region**



**Promote digital
economy through
policy and new
investments**



**Support SMEs with
financing and new
regulatory
frameworks**



**Committed with
gender equality
and diversity**



**Promoting actions
to fight climate
change**

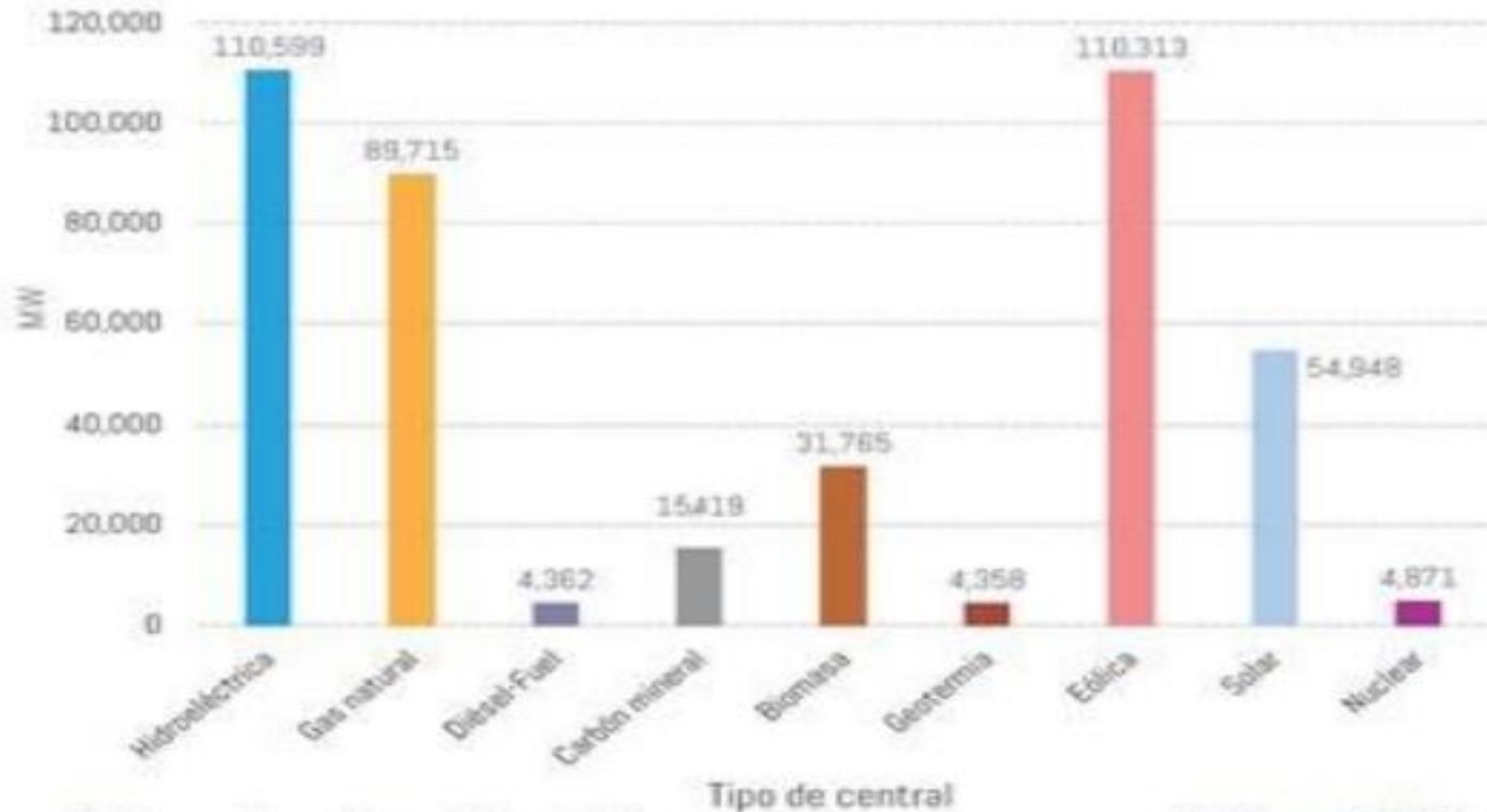


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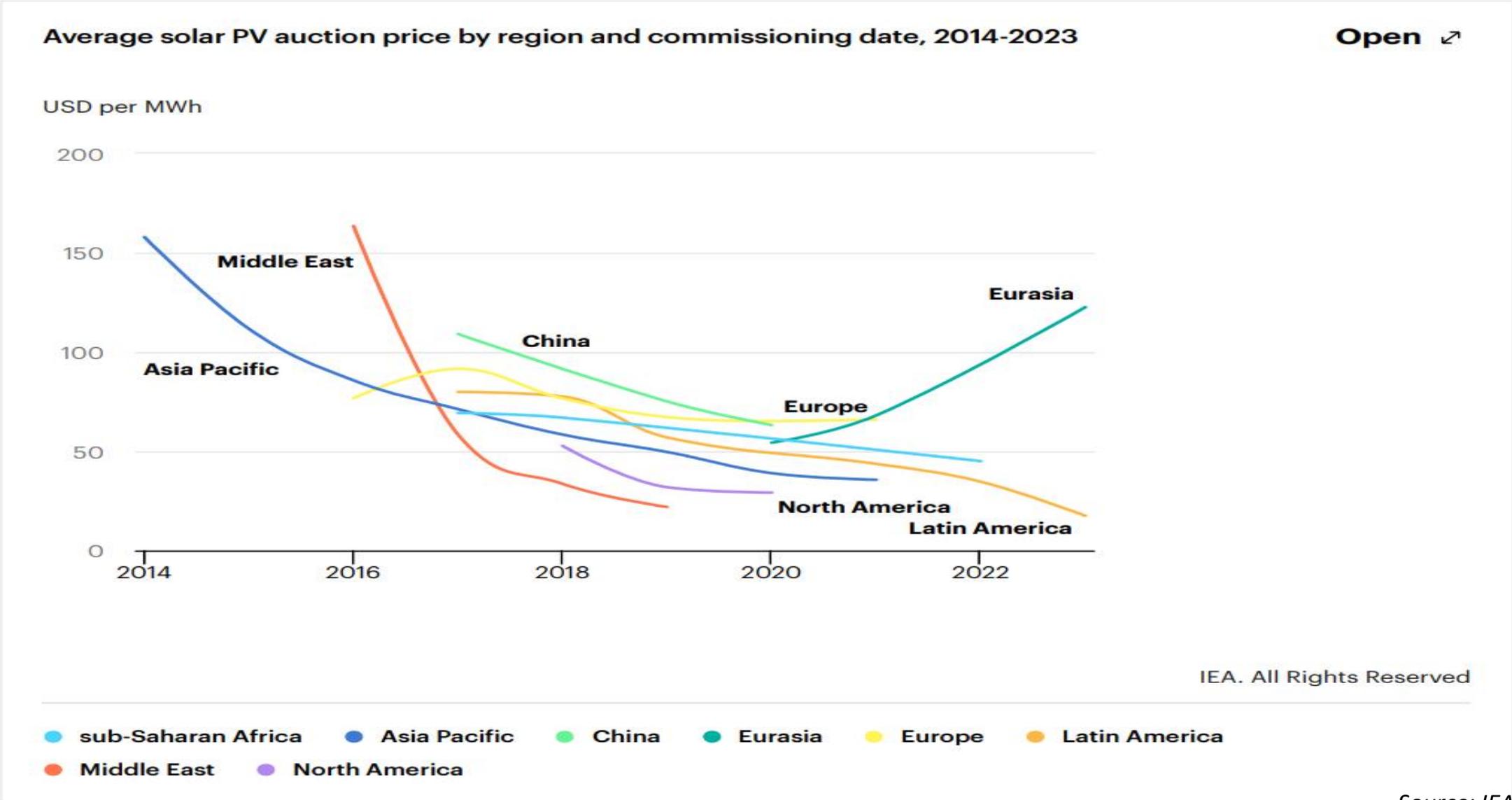
**Latin America and the Caribbean
could produce highly price-competitive
green hydrogen**

In Latin-America and the Caribbean, 56% of the power generation already comes from renewable sources. And it is just expected to grow in the next decades.

Expected new generation capacity by technology until 2040 in LAC

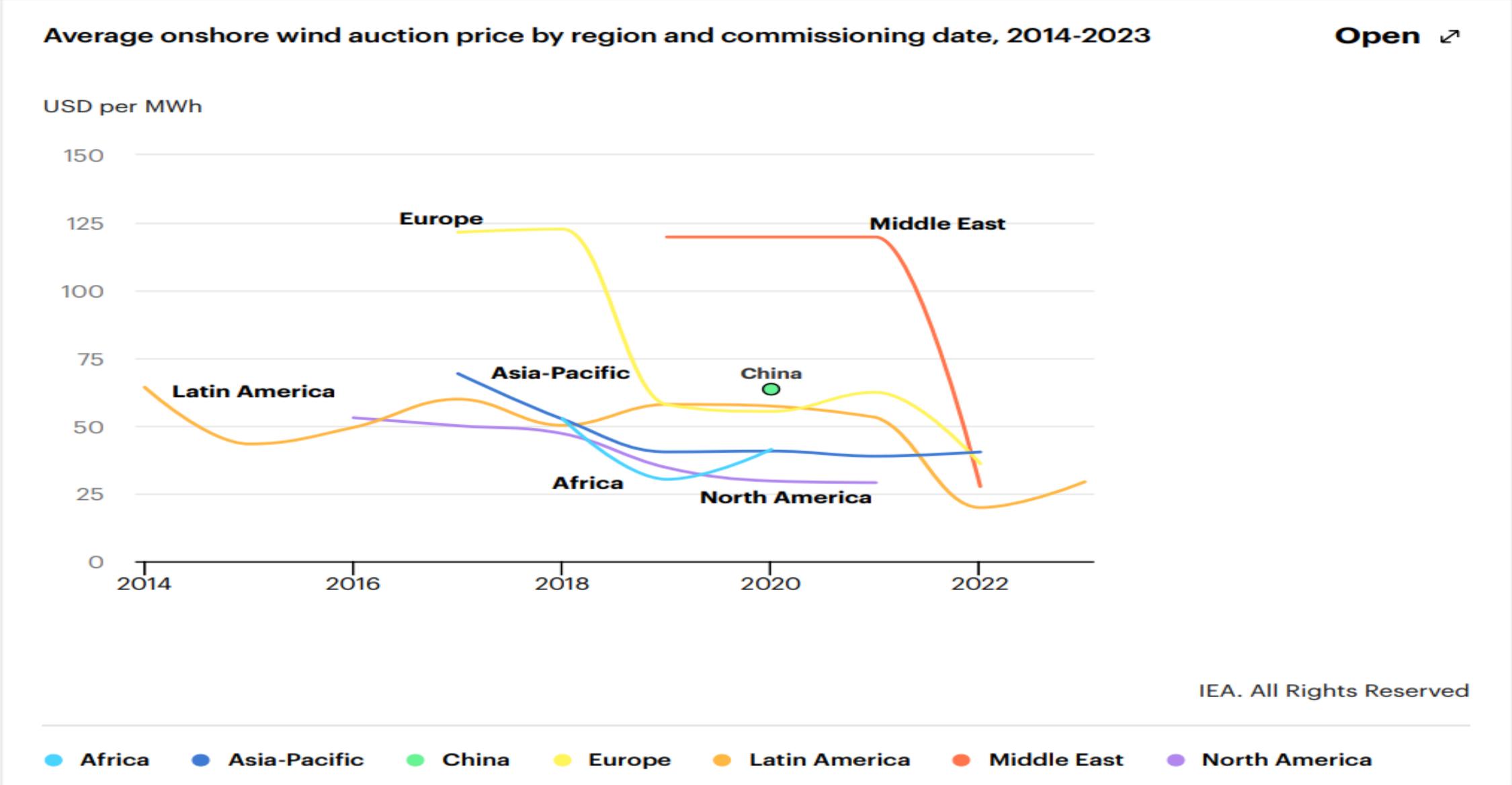


Besides, the region is expected to have the lowest costs from solar PV in the next years



Source: IEA, 2020

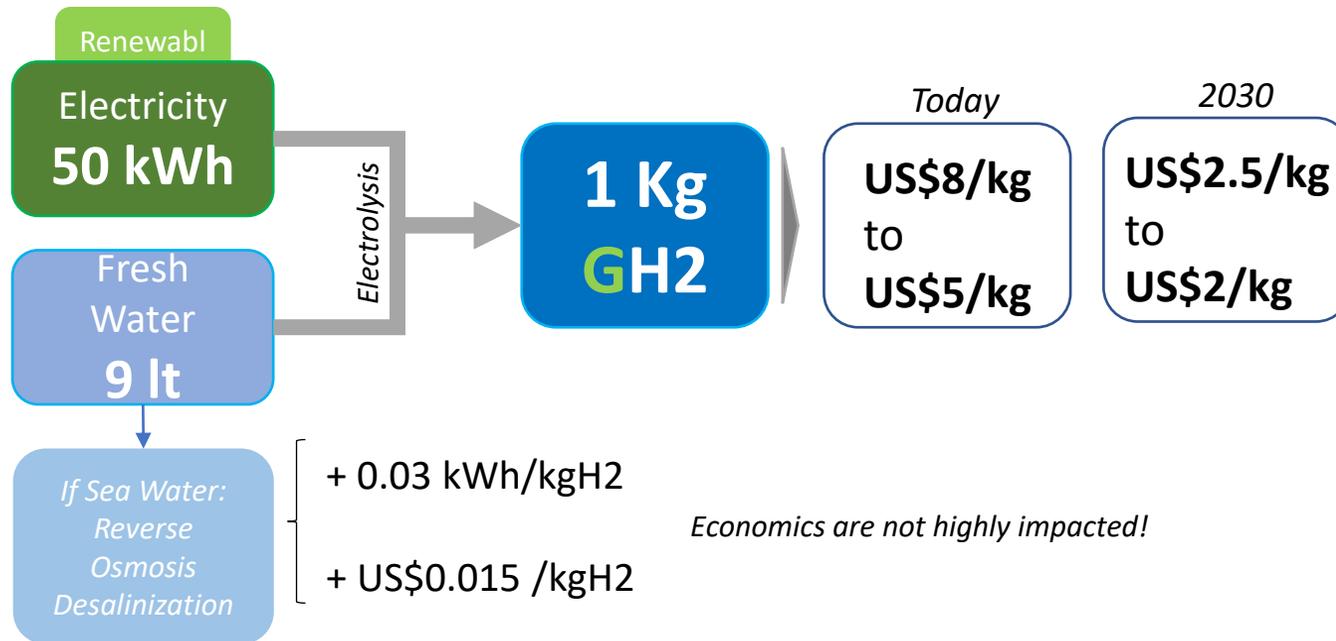
Besides, the region is expected to have the lowest costs from wind generation in the next years



Source: IEA, 2020

Hydrogen H2: a product with multiple applications

- Hydrogen is a product widely used today: 94% of it used in the petrochemical **refining processes** and for the production of **ammonia and methanol**. Nevertheless, 98% is grey
- Hydrogen is a **clean fuel** with high energy content:
 - **1kg of H2 = 1 gallon of gasoline= 50 kWh**

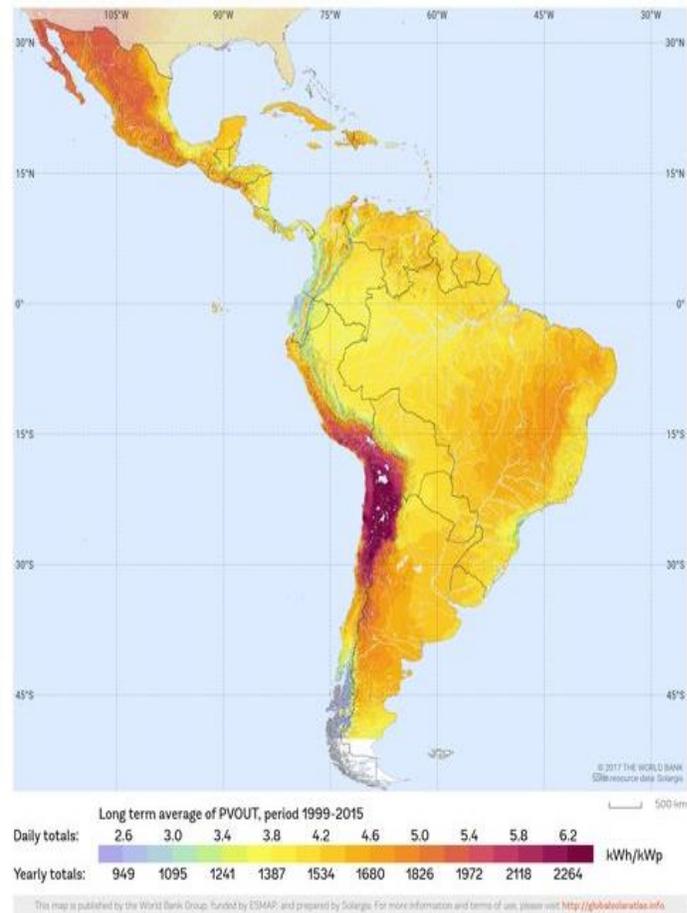


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**GH2 can bring long distance market opportunities
to now locked renewable resources in LAC**

LAC has huge solar, wind and geothermal renewable resources, GH2 can allow international demand from them

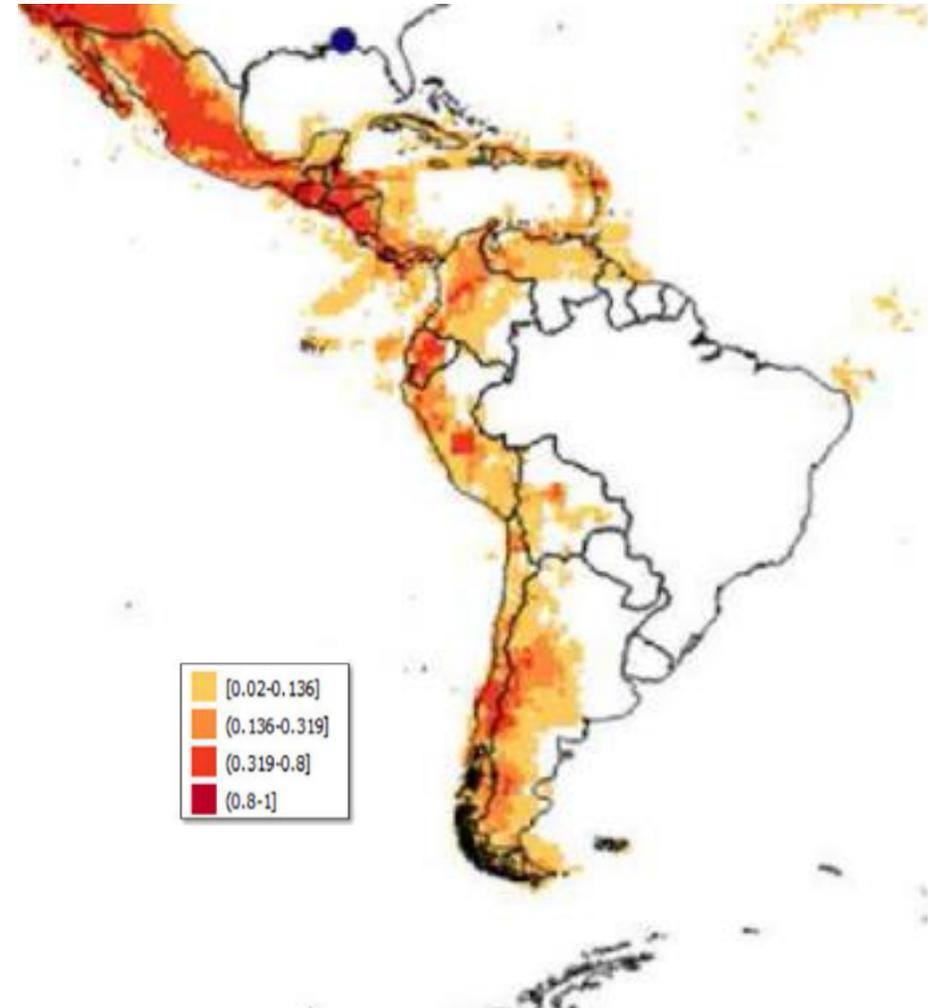
Solar potential in LAC
(source: ESMAP)



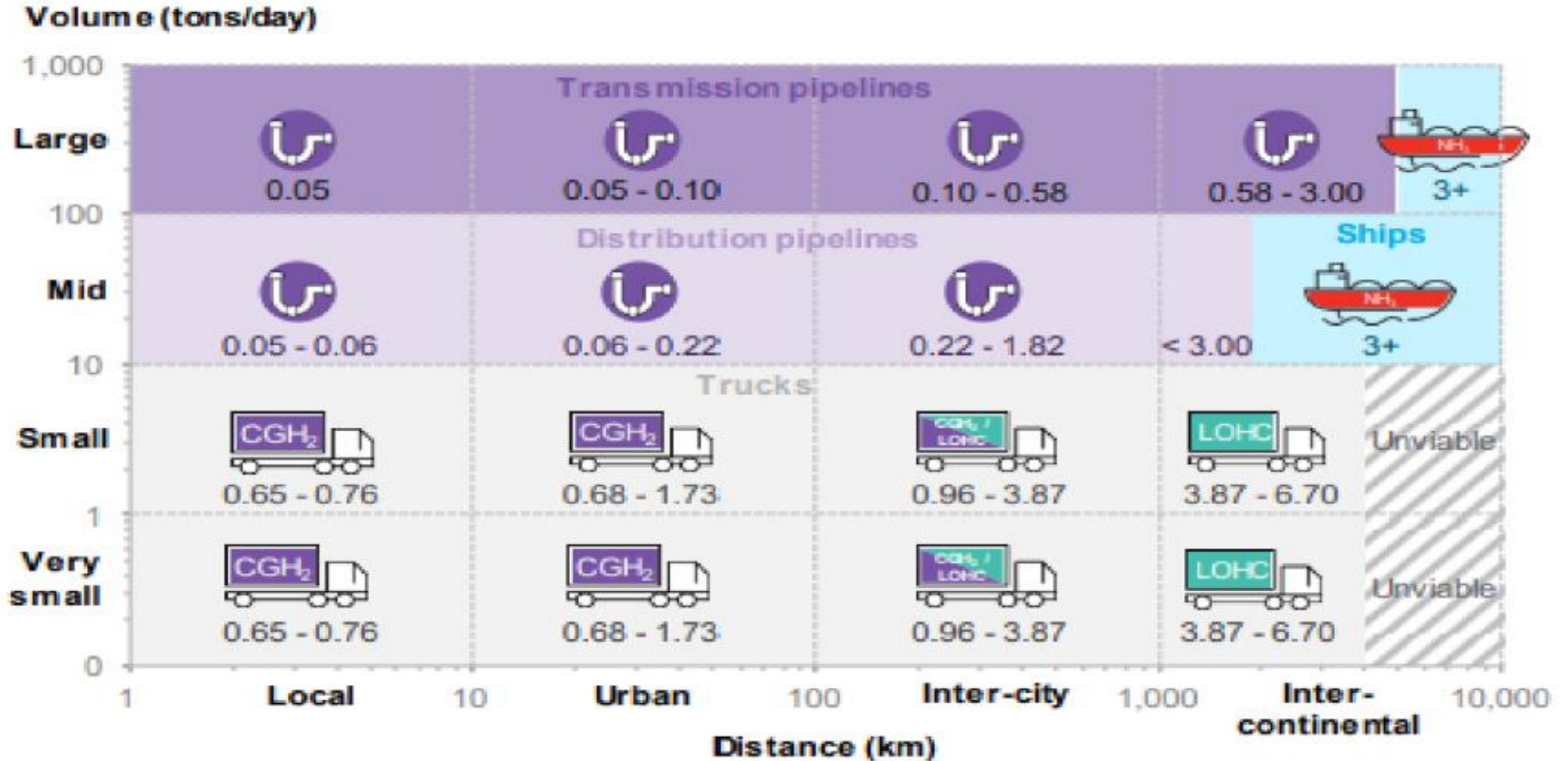
Wind Speed in LAC
(source: ESMAP)



Geothermal Potential (source: Coro and Trumphy)



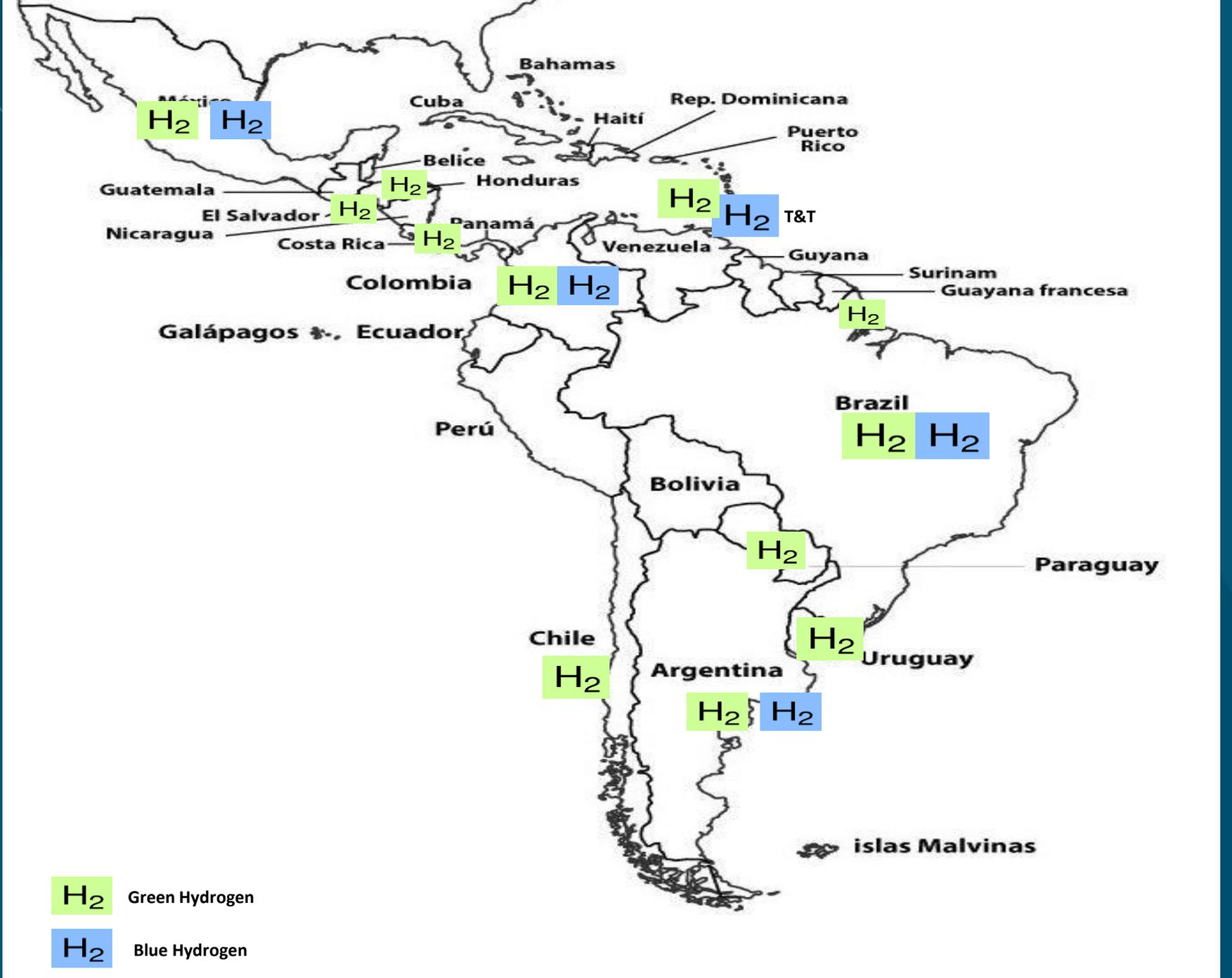
And this international demand may not be satisfied directly with hydrogen, but with other energy carriers



Legend: Compressed H₂ Liquid H₂ Ammonia Liquid Organic Hydrogen Carriers

Hydrogen transport costs based on distance and volume (US\$/kg) Source: BloombergNEF, 2020

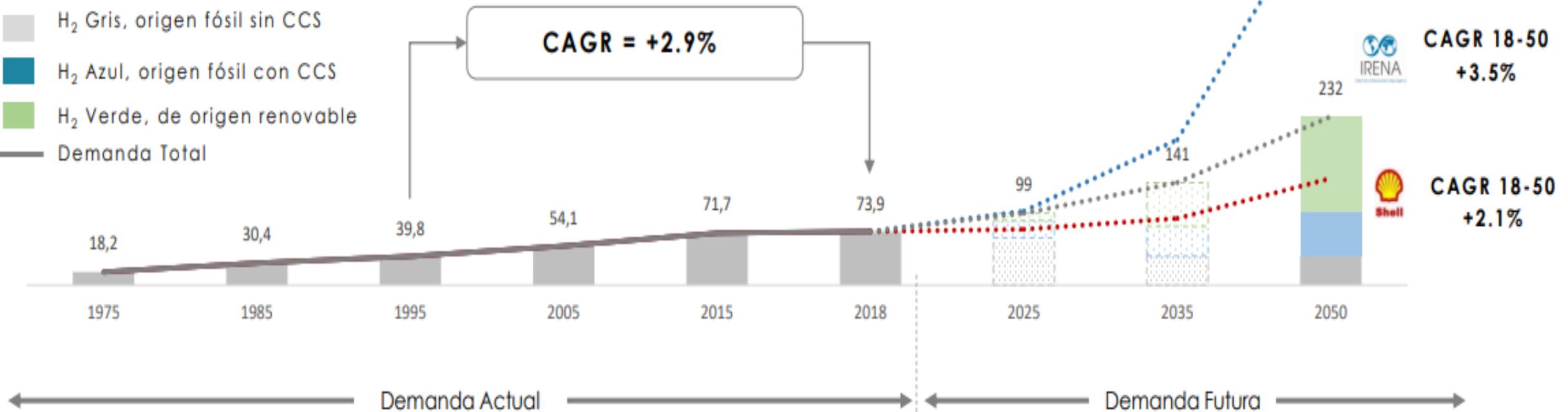
LAC region is rich in renewable energy sources (hydro, solar, wind and geothermal) to produce and export H₂



The global demand for Hydrogen is expected to multiply between 3 and 7 times from current values by 2050, out of which 60% is expected to be green hydrogen

Demanda Global de Hidrógeno puro^{1,2,3,4}
MtH₂

- H₂ Gris, origen fósil sin CCS
- H₂ Azul, origen fósil con CCS
- H₂ Verde, de origen renovable
- Demanda Total



CAGR: Compound Annual Growth Rate

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**Price of GH2 depends on renewable prices...
...but also on the capacity factor of the supply**

With energy prices at around US\$30/MWh, still it is necessary capacity factors above 40% to offer prices below US\$3/kgH2

LCOH of European Hydrogen considering electricity price, electrolyser CAPEX & load factor (USD/kg)**

■ < USD 2/kg
 ■ USD 2-3/kg
 ■ USD 3-4/kg
 ■ > USD 4/kg
 Viable medium-term (<2030)

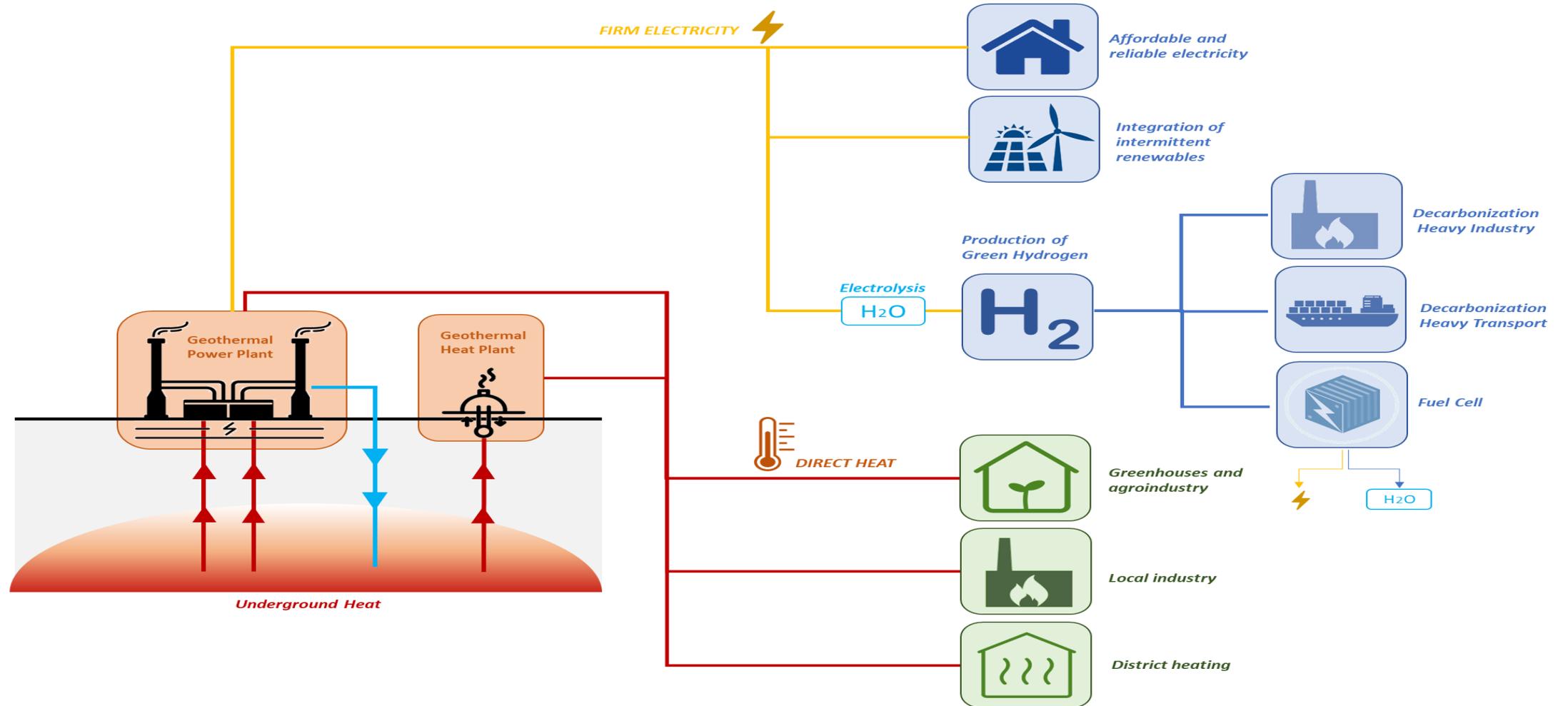
LCOE	Capex electrolyser					Capex electrolyser					Capex electrolyser				
	USD 750/kW					USD 500/kW					USD 250/kW				
	10%	20%	30%	40%	50%	10%	20%	30%	40%	50%	10%	20%	30%	40%	50%
USD 0/MWh	5.7	2.8	1.9	1.4	1.1	4.2	2.1	1.4	1.1	0.9	2.8	1.4	0.9	0.7	0.6
USD 10/MWh	6.1	3.3	2.4	1.9	1.6	4.7	2.6	1.9	1.5	1.3	3.2	1.9	1.4	1.2	1.0
USD 20/MWh	6.6	3.8	2.8	2.4	2.1	5.2	3.0	2.3	2.0	1.8	3.7	2.3	1.9	1.6	1.5
USD 30/MWh	7.1	4.2	3.3	2.8	2.5	5.6	3.5	2.8	2.5	2.2	4.2	2.8	2.3	2.1	2.0
USD 40/MWh	7.5	4.7	3.8	3.3	3.0	6.1	4.0	3.3	2.9	2.7	4.6	3.2	2.8	2.6	2.4
USD 50/MWh	8.0	5.2	4.2	3.7	3.5	6.5	4.4	3.7	3.4	3.2	5.1	3.7	3.2	3.0	2.9
USD 100/MWh	10.3	7.5	6.5	6.1	5.8	8.9	6.7	6.0	5.7	5.5	7.4	6.0	5.6	5.3	5.2
Load factor	10%	20%	30%	40%	50%	10%	20%	30%	40%	50%	10%	20%	30%	40%	50%

SOURCE: McKinsey

(Source: McKinsey, 2020)

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**some other renewable technologies
may find in GH2 an interesting business option**



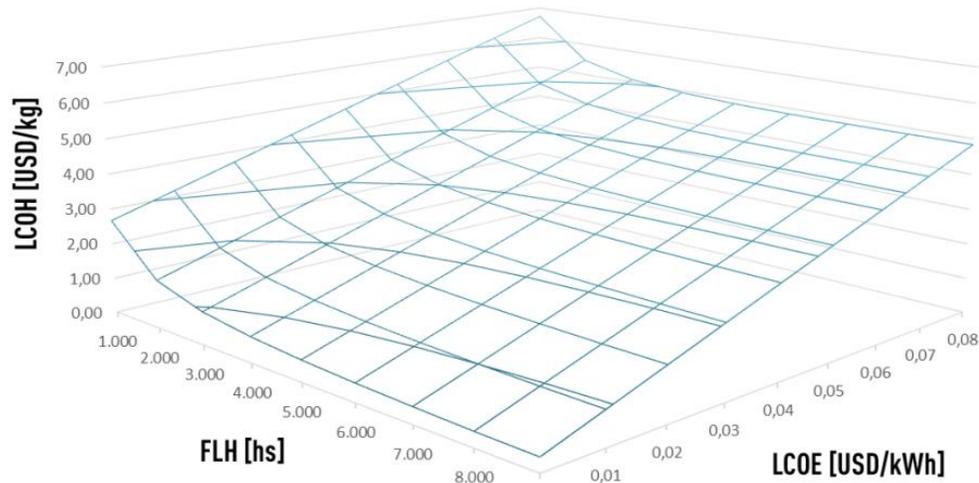
Geothermal energy: key for clean fuels production?

- Green hydrogen, ammonia and methanol are sought as key players in the decarbonization efforts. The **global demand for Hydrogen is expected to multiply between 3 and 7 times** from current values by 2050, out of which 60% is expected to be green hydrogen
- With lowering prices in electrolyzers, the key elements in the reduction of price of green hydrogen are the **cost of electricity** and the **capacity factor of supply**.
- **Geothermal energy** provides **capacity factor of 90%**, which may allow producing cost-competitive green hydrogen.

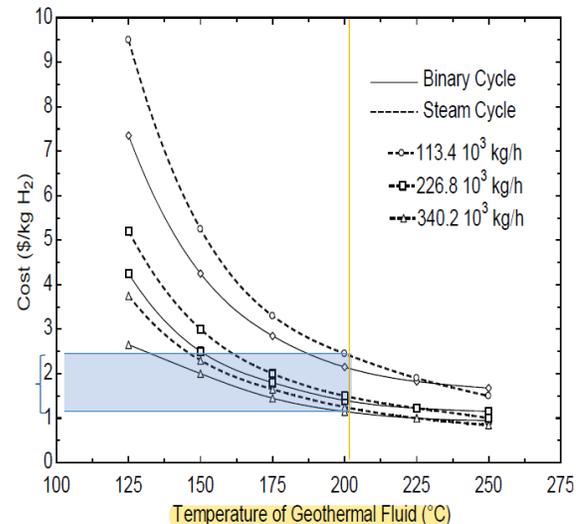


Mokai Geothermal project in New Zealand is already exploring the possibilities of producing green hydrogen from geothermal energy

Estimated relation between LCOE, Capacity Factor and LCOH (i-deals, 2021)



Geothermal for H2 production (Busra Sen et al, 2019)

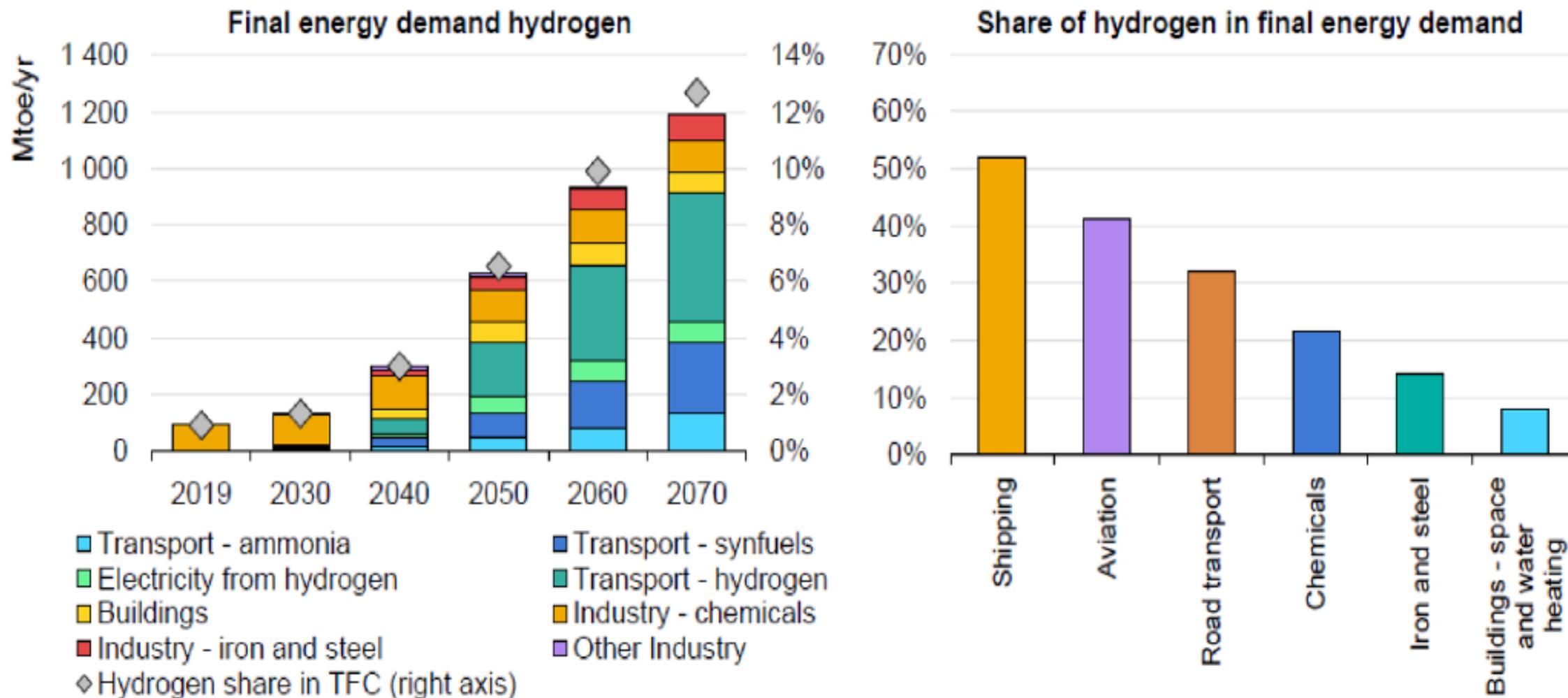


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**Hydrogen is both a fuel and a chemical reactant
that can be key for industrial decarbonization**

Important opportunities in transport and the heavy industry activities

Hydrogen Applications (IEA, 2020)



Synergy with the cement industry: decarbonization and resiliency



- **Decarbonization of cement industry:** Hydrogen can be used as direct fuel for the kiln or as an improver of heat rate of biomass fuel



Iron and Steel

Hydrogen can be used as a reductant of Iron ore and as clean fuel for furnaces



Chemical and Petrochemical

Hydrogen can be used as fuel for chemical crackers

Hydrogen can be used for the production of green ammonia, for fertilizers or synthetic fuels.

Hydrogen can be mixed with natural gas (~15%) to reduce emissions



Transport

Ammonia or synthetic fuels produced from green hydrogen can be a cleaner substitute of fossil fuel in large ships



Energy Storage

Hydrogen fuel cells or direct storage can be used as a source of flexibility to the power systems and for long distance energy exchange

Thank You

Christiaan Gischler

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