The Future of CH_2LE: Green Hydrogen !

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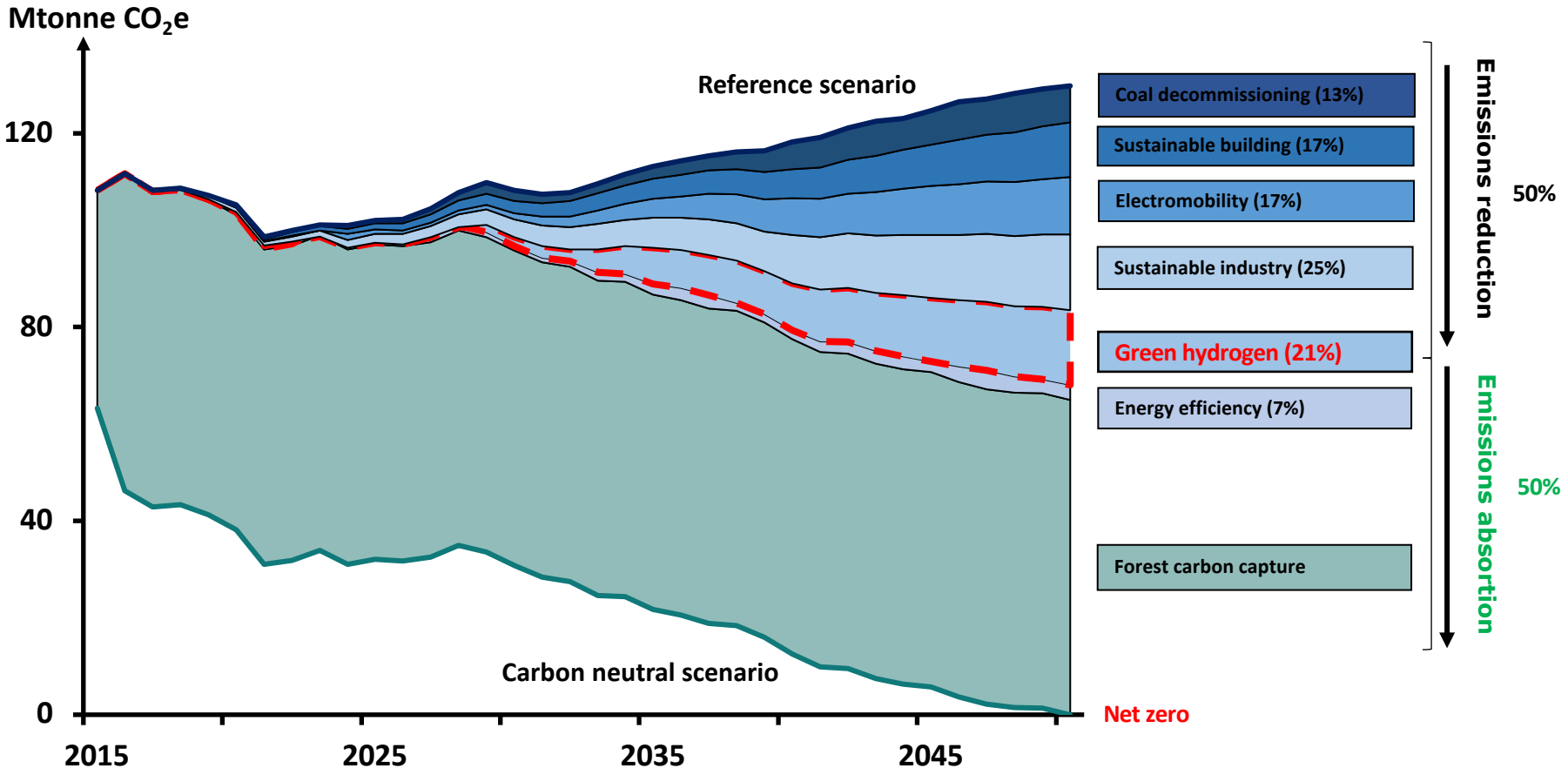
1. Chile's Green Hydrogen Strategy

(Source: Mins. of Energy and Mining of Chile, July 2021)

Green hydrogen: the key to attain zero net GHG emmissions



Sources: Ministries of Energy and Mining of Chile (July 2021).

CH2LE

National Green Hydrogen Strategy

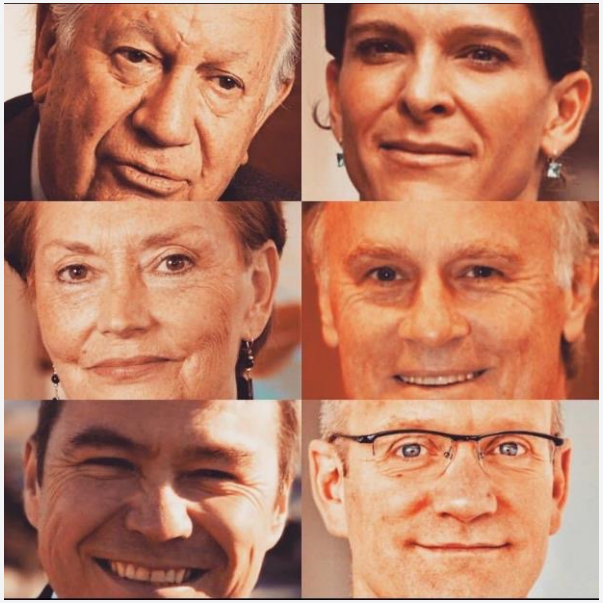
Published November 2020

"I believe that water will one day be employed as fuel, that hydrogen and oxygen which constitute it, used singly or together, will furnish an inexhaustible source of heat and light, of an intensity of which coal is not capable"

Jules Verne, 1874

A long-term strategy with broad political support

Advisory board



Ricardo Lagos
Former President of Chile
Vivianne Blanlot
Former Head of Energy Regulator
Marcelo Mena
Former Minister of the Environment

Jeannette von Wolfersdorff
Economist
Klaus Schmidt Hebbel
Former Chief Economist of the OECD
Gonzalo Muñoz
COP25 High Level Climate Action Champion

Green hydrogen 'ambassadors'

Sources: Ministries of Energy and Mining of Chile (July 2021).

An action plan to cover 8 key fronts

1 Strategy and targets

Establish a vision and mission to align public and private stakeholders.

Drive action and commitment by investors, developers, regulators, and civil society towards defined goals.

2 Regulation and permits

Develop a clear, stable, and coherent regulation on markets and safety issues, so uncertainty is reduced and projects are accelerated. Streamline permitting to accelerate deployment of technologies.

3 Coordination and alliances

Reduce market failures: information assymetries, high transaction costs, barriers for new entrants. International cooperation to overcome technological capability gaps, commercial, regulatory and cultural challenges together.

4 Value chain development

Enable the development of manufacturing and services to capture increased shares of the market value domestically.

5 Incentives and financing

Help in bridging the remaining cost gap relative to fossil solutions, especially reducing the cost of capital.

6 Infrastructure

Plans for developing adequate and coordinated port, electrical, and distribution infrastructure to foster the growth of hubs.

7 Research & development

Deploy technologies and solve local implementation issues, in order to reduce costs, unlock markets, and increase competition in the sector.

8 Human capital

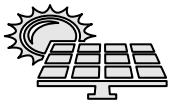
Develop local talent and technical capabilities to accelerate project deployment and generate green jobs.

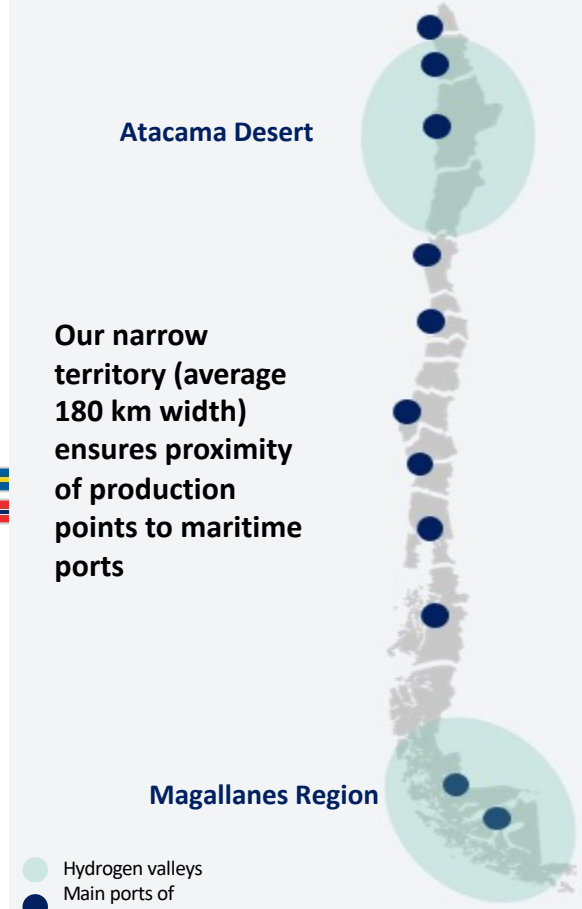
Sources: Ministries of Energy and Mining of Chile (July 2021).

Chile is poised to become the leading producer of green H2

Capacity factors per country in best areas (%)

Solar PV		37%	~30%	~30%	~25%	20-25%
Wind	Off shore	>75%			40-45%	50-55%
	On shore	70-75%	30-35%		40-50%	

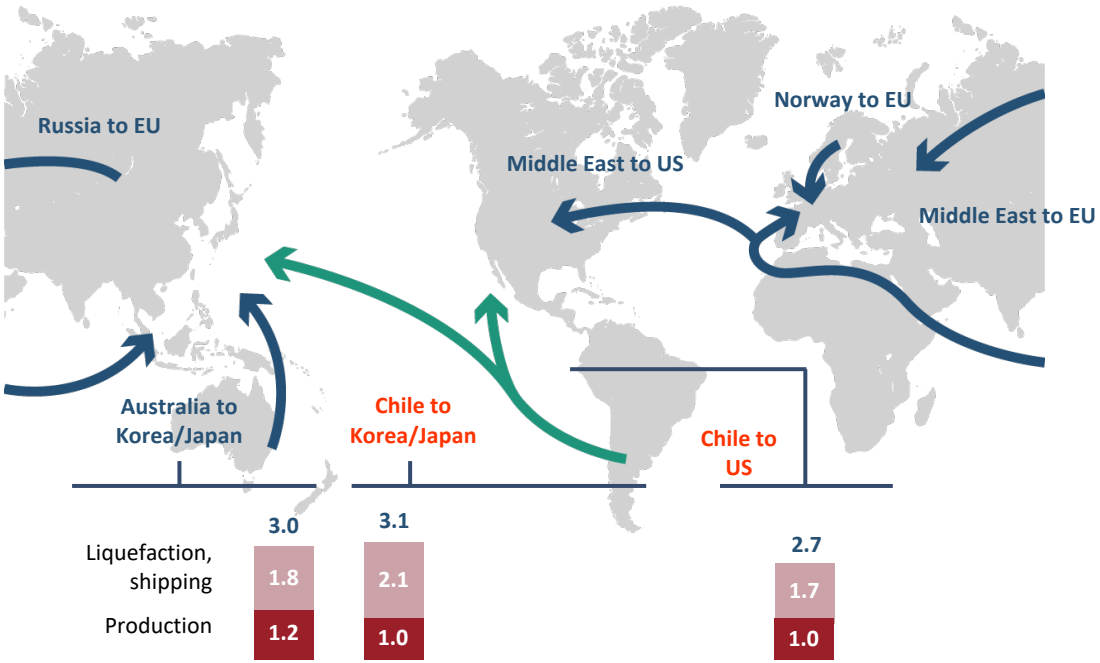




Sources: Ministries of Energy and Mining of Chile (July 2021) and McKinsey & Co.

Despite distance to markets, Chile remains competitive in H2

Cost of liquid H_2 at port of destination, 2030 (USD/kg H_2)



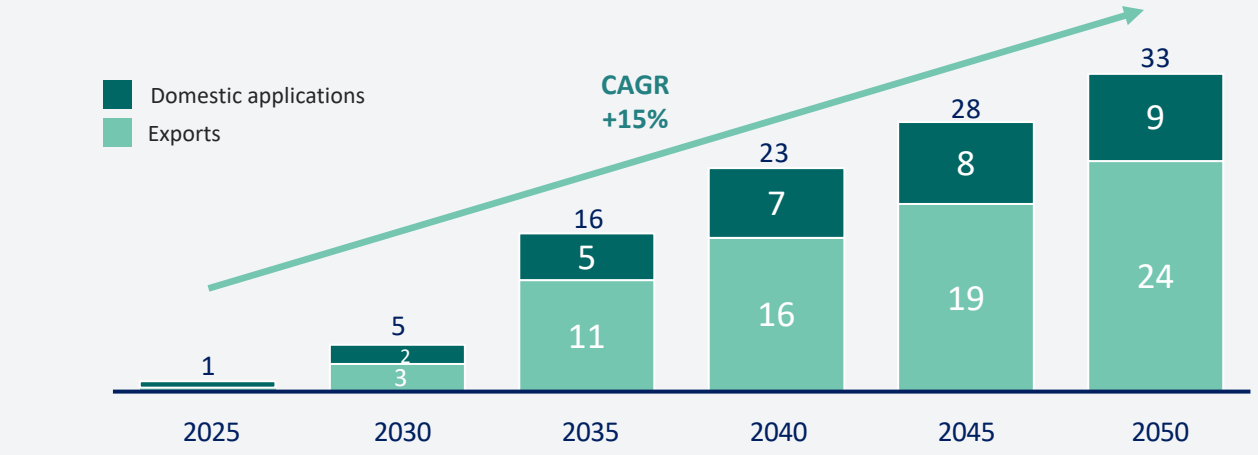
Renewable energy carriers considered by developers and investors

- LH2 — Liquid hydrogen
- NH3 — Green ammonia
- CH3OH — Green methanol / eFuels
- Cu — Green copper and other green exports

Sources: Ministries of Energy and Mining of Chile (July 2021) and McKinsey & Co.

A unique opportunity: green hydrogen could be a clean industry as big as our mining sector

Projection of Chilean markets for green hydrogen and its derivatives, 2025 - 2050 (BUSD)

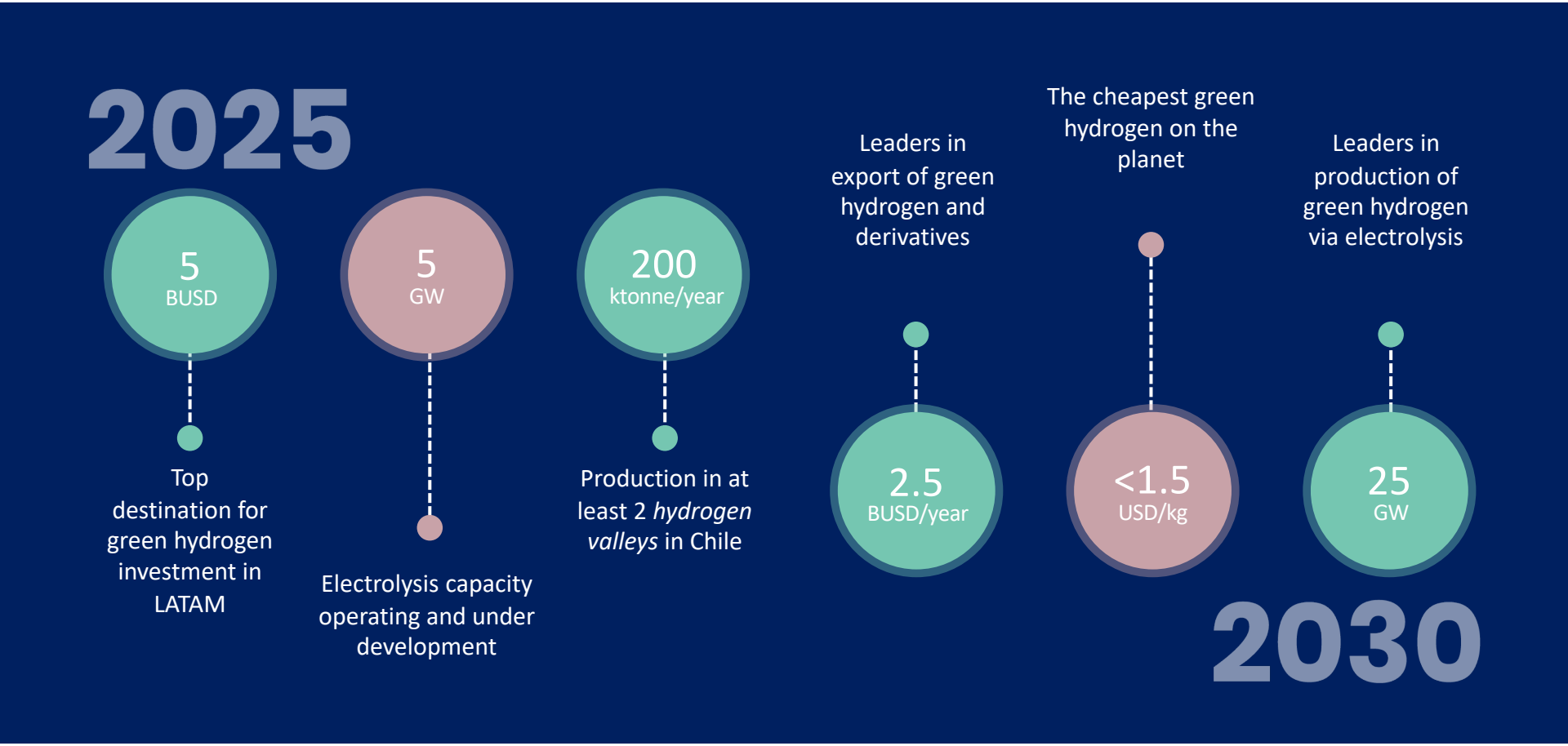


The competitiveness of Chile in renewable energy production and the global need for clean energy carriers will open the door to the creation of an economic sector that could rival the size of the Chilean mining sector

If timely and effective action is taken, the use of green hydrogen in domestic applications will generate an industry prepared to compete in international export markets. Investment in green hydrogen will lead to significant national capabilities and the creation of dynamic economic ecosystems throughout the country

Sources: Ministries of Energy and Mining of Chile (July 2021) and McKinsey & Co.

We have set clear goals to lead the way



Sources: Ministries of Energy and Mining of Chile (July 2021).

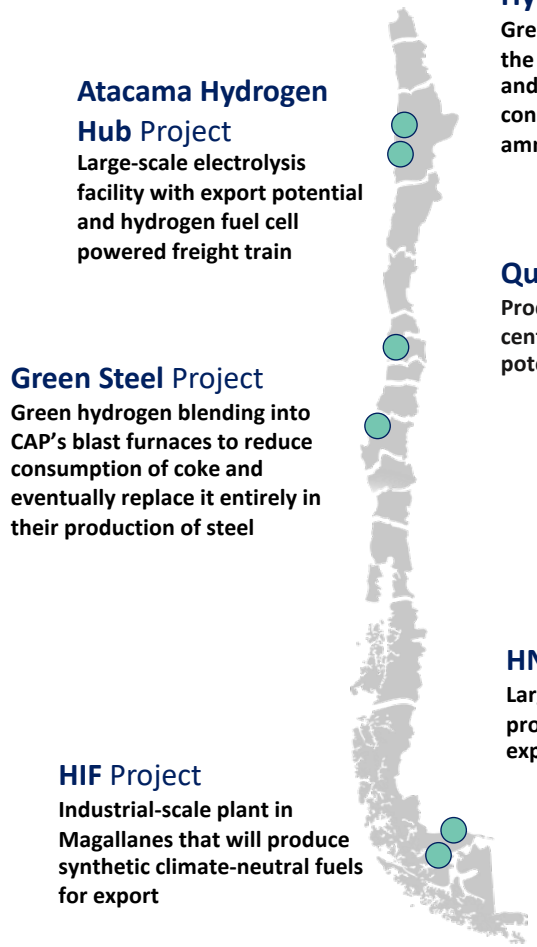
40+ projects have already sprung in Chile

+15
USD billion projected investment by 2030

+1,200
kTonne H2 projected yearly production by 2030

+500
kTonne H2 projected yearly local consumption by 2030

+15
Projects have already defined their operations start date



Atacama Hydrogen Hub Project
Large-scale electrolysis facility with export potential and hydrogen fuel cell powered freight train

HyEx Project
Green ammonia production in the north of Chile for domestic and international consumption, replacing ENAEX ammonia imports

Quintero Bay H_2 Hub Project
Production of green hydrogen in the central zone of Chile, close to potential offtakers

Green Steel Project
Green hydrogen blending into CAP's blast furnaces to reduce consumption of coke and eventually replace it entirely in their production of steel

HNH ENERGY Project
Large scale green ammonia production in Magallanes for export

HIF Project
Industrial-scale plant in Magallanes that will produce synthetic climate-neutral fuels for export

Sources: Ministries of Energy and Mining of Chile (July 2021).

2. The HIF Project

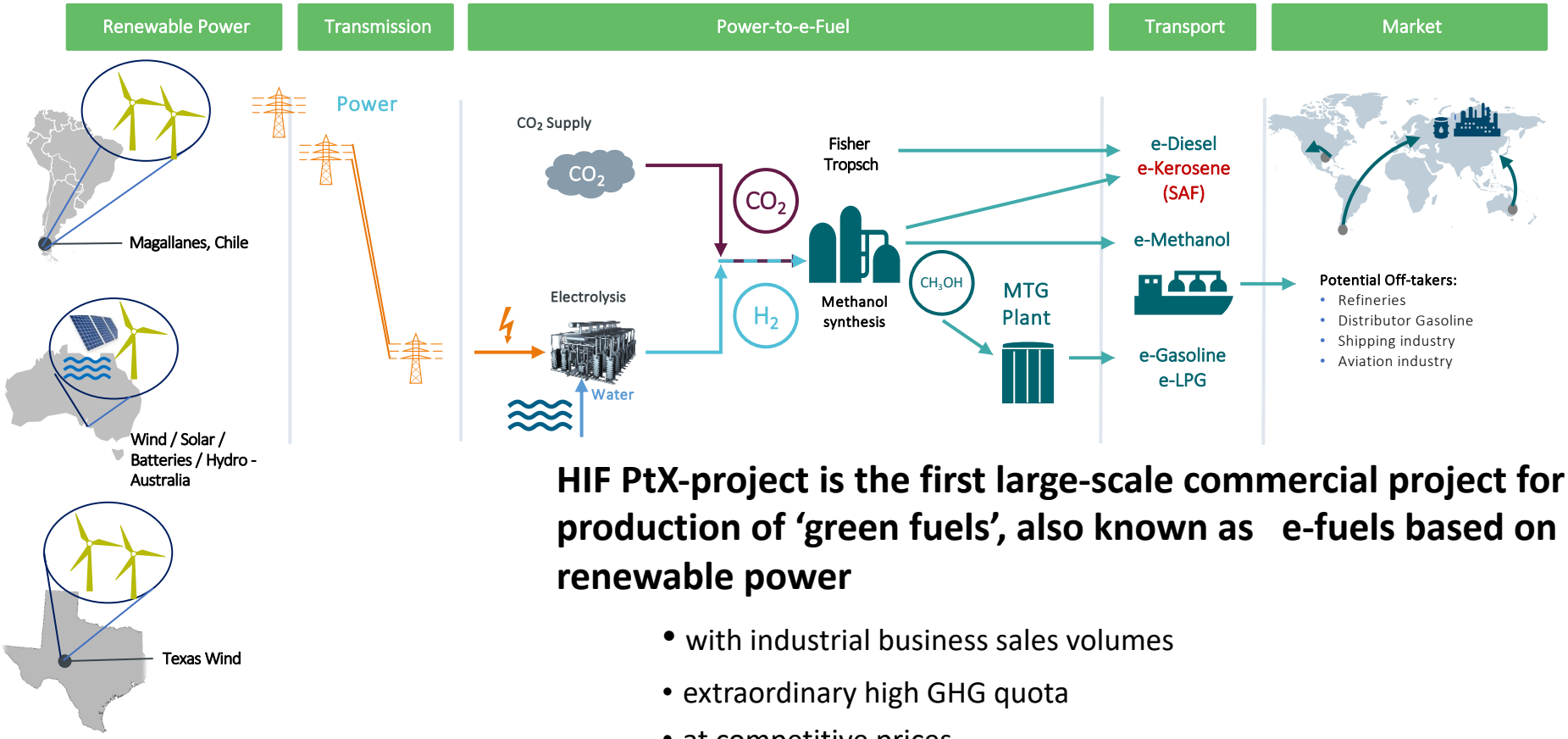
(Source: J.J. Gana: “HIF Project Overview”, June 2021)

The HIF Project

- **Electrification is not enough;** a solution is needed to **replace fossil fuels** with renewable energy
- HIF, a subsidiary of AME (the fifth largest IPP company in Chile) has been developing a project since 2016 to take advantage of one of the **world's best wind resources located in the south of Chile**
- HIF's vision is to be the world's first **internationally based, industrial scale, carbon neutral e-fuel company**
- HIF's project in Chile adopts a phased approach: a demonstration plant, to start operation in 2022, a first commercial scale plant operation in 2024, and successive phases of world scale commercial plants starting in 2026
- In mid 2020, HIF initiated development of similar large-scale e-fuels projects in Australia and Texas, with targeted COD in 2024.

Source: J.J. Gana: "HIF Project Overview" (June 2021).

e-fuel Production Process



HIF PtX-project is the first large-scale commercial project for production of 'green fuels', also known as e-fuels based on renewable power

- with industrial business sales volumes
- extraordinary high GHG quota
- at competitive prices
- high up-scaling capability

Source: J.J. Gana: "HIF Project Overview" (June 2021).

Chile: the world's best renewable resource

World's best onshore wind resource

- **HIF has signed long term leases for over 200,000 ha of the best renewable energy resources the world has to offer. The tip of South America enjoys the world's best onshore wind conditions due to the Coriolis effect**
- **Plant factors in the range of 70%: low expected energy prices, $0.01 – 0.02 /kWh**
- **Constant wind profile allows to have nearly continuous operation**
- **Location of extensive grazing lands, with a long history of petroleum exploration and production, well removed from sensitive tourism locations or nature reserves**
- **Direct electrical connection to the chemical plant, no need to be connected to the main grid, which allows for significantly lower transmission costs**

Leveraging of existing infrastructure

- **Lease in final negotiation with ENAP for construction of commercial facilities in the Cabo Negro port area to provide access to existing under-used port infrastructure**
- **Medium sized town (Punta Arenas) able to provide qualified workforce, accommodation, and services**
- **Potential to capture CO2 from nearby industrial facilities**

Access to markets

- **Chile is an investment grade country**
- **Free trade agreements in place with most export destinations**
- **Low-cost export to Europe (US$40/tonne of gasoline), with access to export to Pacific markets without needing to pass through the Panama canal**
- **Strong track record for attracting international investment in mining and energy sectors: high liquidity, attractive margins**
- **Government and broad political support for development of hydrogen-based exports**

HIF Demonstration Plant: World Class Project Team

Porsche: off-taker

AME: owner and lead developer

ENEL: partner in wind park and H2 production

Siemens: technology provider and integrator

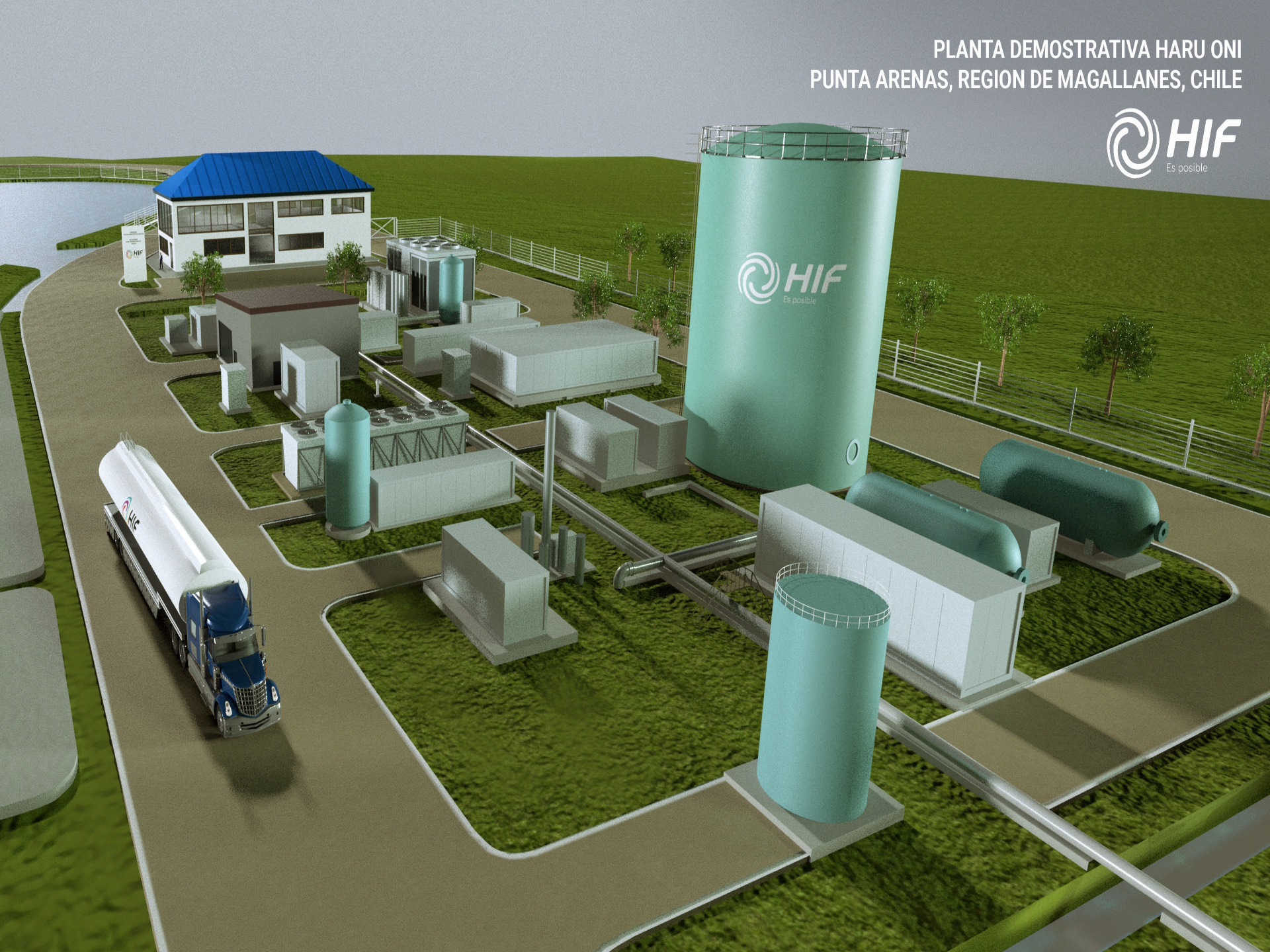
ENAP: infrastructure and port service provider

GASCO: user of LPG output for I+D and product development

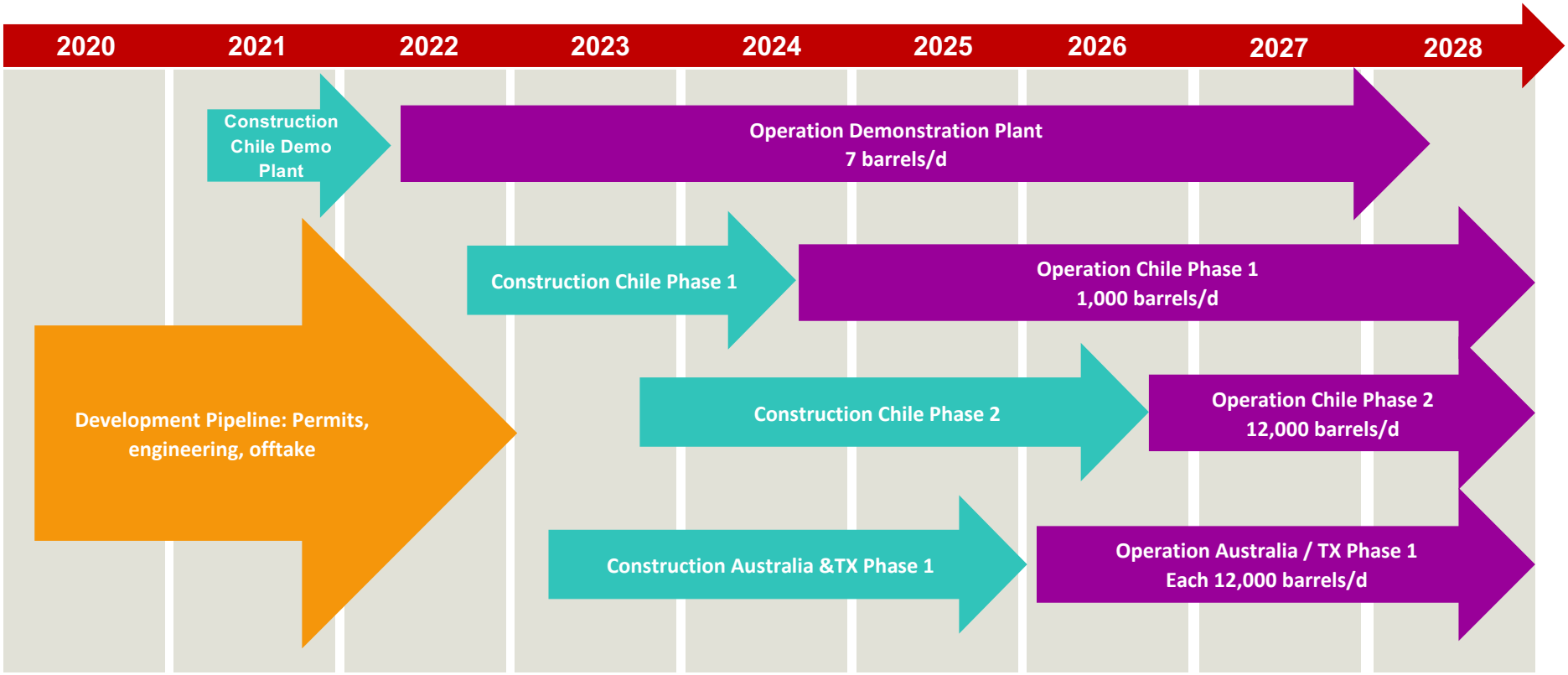
Source: J.J. Gana: “HIF Project Overview” (June 2021).

PLANTA DEMOSTRATIVA HARU ONI
PUNTA ARENAS, REGION DE MAGALLANES, CHILE

HIF
Es posible



Progressive roll-out of commercial phases



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