IMPULSO AL HIDRÓGENO VERDE EN CHILE

Agenda

Capítulo 1 — Asociación Chilena de Hidrógeno

Capítulo 2 — Hidrógeno Verde y Usos

Capítulo 3 — Economía del Hidrógeno Verde

Capítulo 4 — Proyectos, Aplicaciones y Alianzas

Asociación Chilena de Hidrógeno

H2 Chile – Nuestro Logo, Identidad de Chile

H2 Chile
Asociación Gremial

Misión

Acelerar la transición hacia una Economía del Hidrógeno en Chile

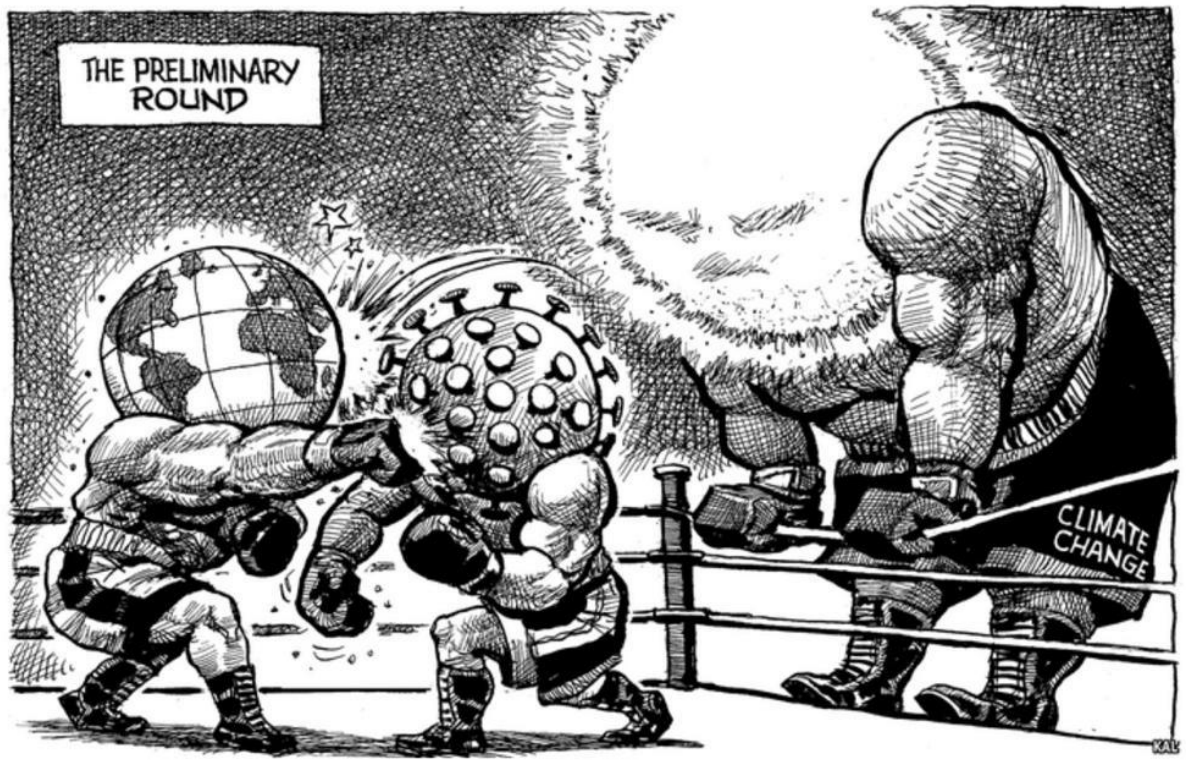
H2 – Chile Nuestros Socios

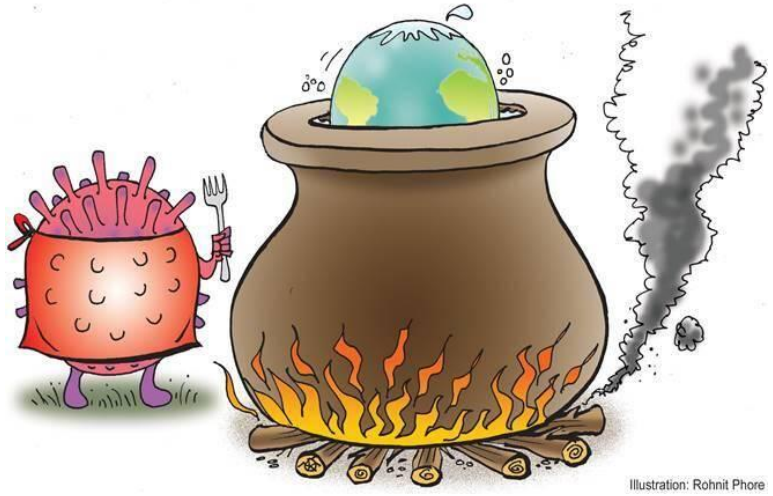
FRV FOTOWATIO RENEWABLE VENTURES
AUSTRIA ENERGY
Colbun
enagas
TCI GECOMP
Air Liquide
ARCADIS
ABB
SPHERA ENERGY
antuko
ENGIE
ANTOFAGASTA MINERALS
SIEMENS energy
H2 GRUPO ENERGY LANCUYÉN
Sumitomo Corporation (Chile) Limitada
Enriching lives and the world
TECHINT Ingeniería y Construcción
acciona
AES Gener energía confiable
Cummins Chile
Pronor green energy
TRACTEBEL ENGIE
AXINNTUS
RWE
INTERENERGY
PrimeEnergía
BUSSO GROUP
andes SOLAR ENERGÍAS RENOVABLES
IVM Infante Valenzuela Molina Abogados
SOLEK
COPEC Primera en servicio
enex
enel Green Power

H2 Chile ASOCIACIÓN CHILENA DE HIDRÓGENO

Hidrógeno Verde y sus Usos

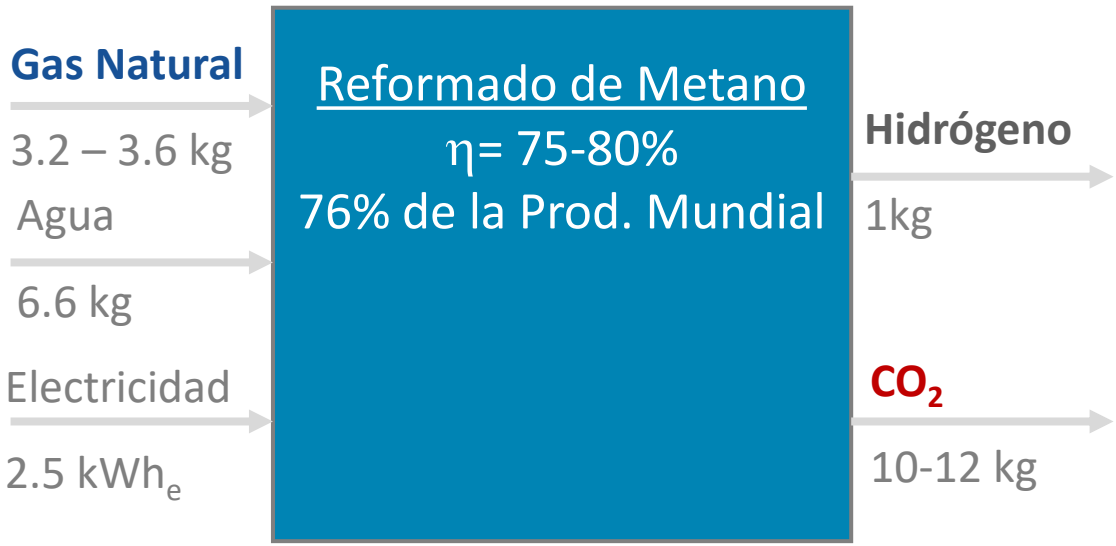
¿POR QUÉ HABLAMOS DE HIDRÓGENO VERDE?



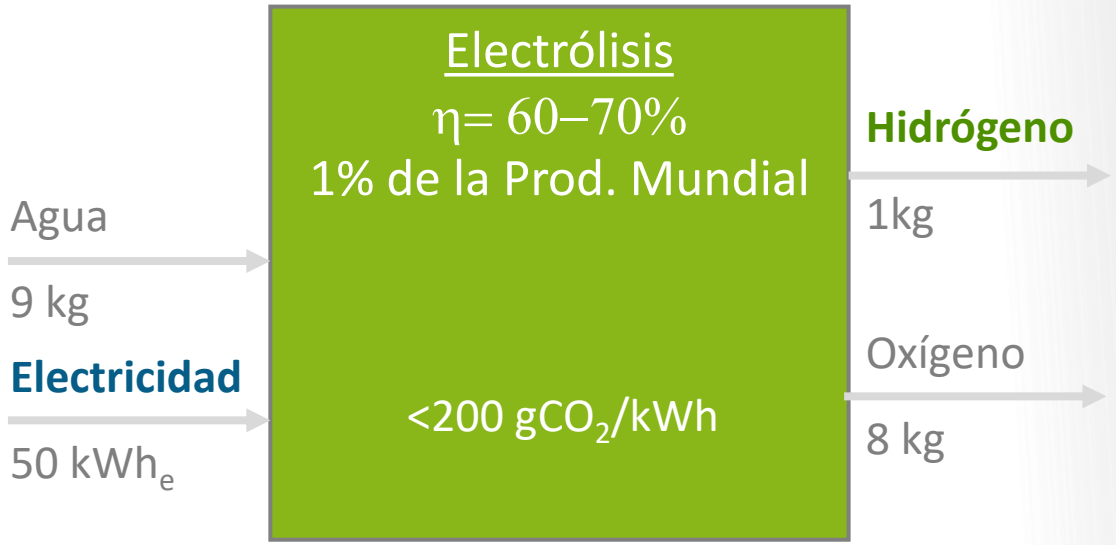


Debemos reducir las emisiones de gases de efecto invernadero

¿Cómo se produce el Hidrógeno?



Hidrógeno Verde es producido con Electricidad Renovable



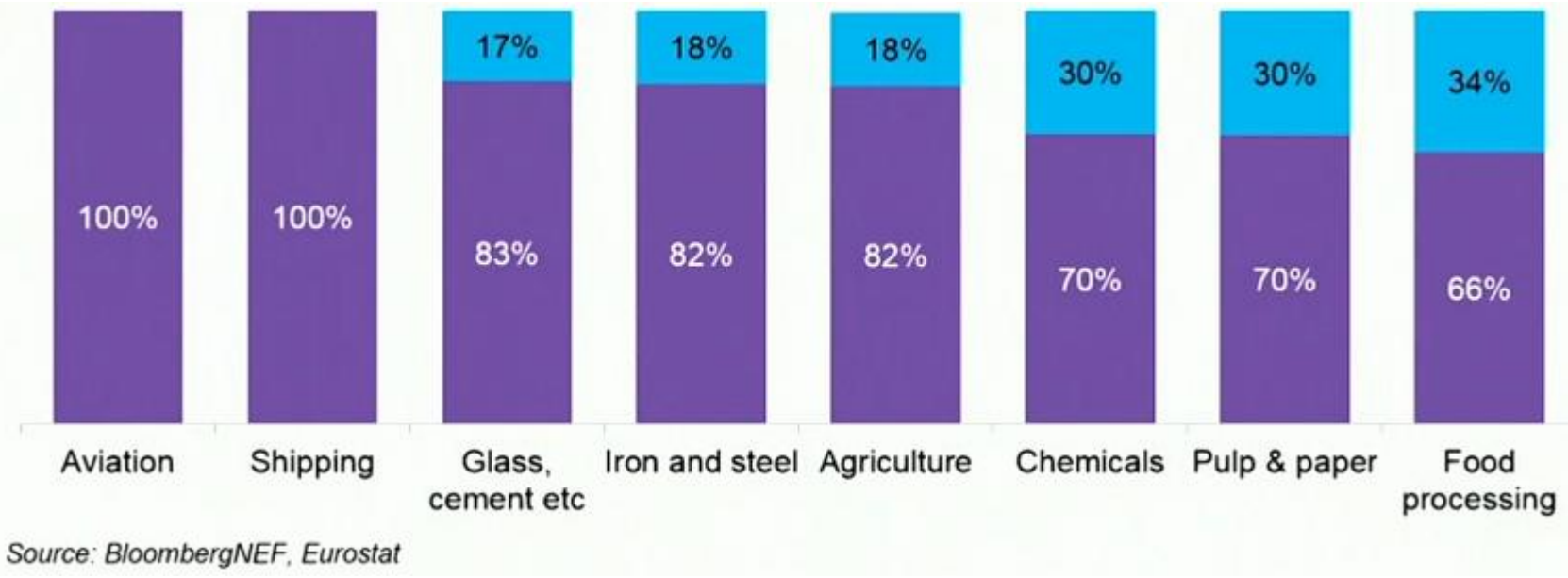
53.2 Mt H_2 mediante Reformado de Metano:

- 530 Mt CO_2/año (1.5% de las emisiones Globales)

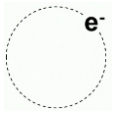
Producción Mundial Anual: 70 Mt = 8.4 EJ

¿POR QUÉ HABLAMOS DE HIDRÓGENO VERDE?

Consumo Final de Energía en Europa por Sector (2015)



Source: BloombergNEF, Eurostat



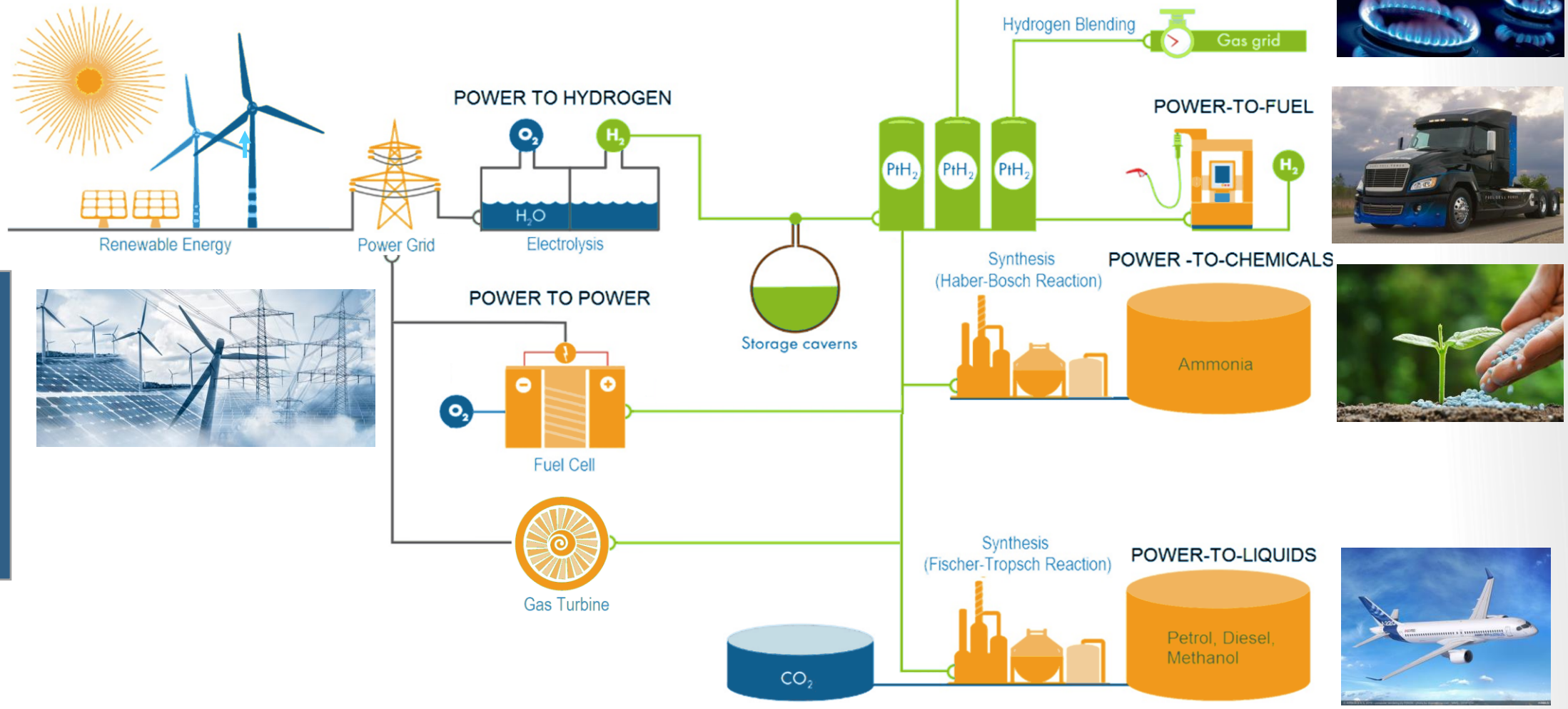
Sectores difíciles de descarbonizar

El mundo necesita combustibles!

Combustibles que al usarse no emitan CO2!

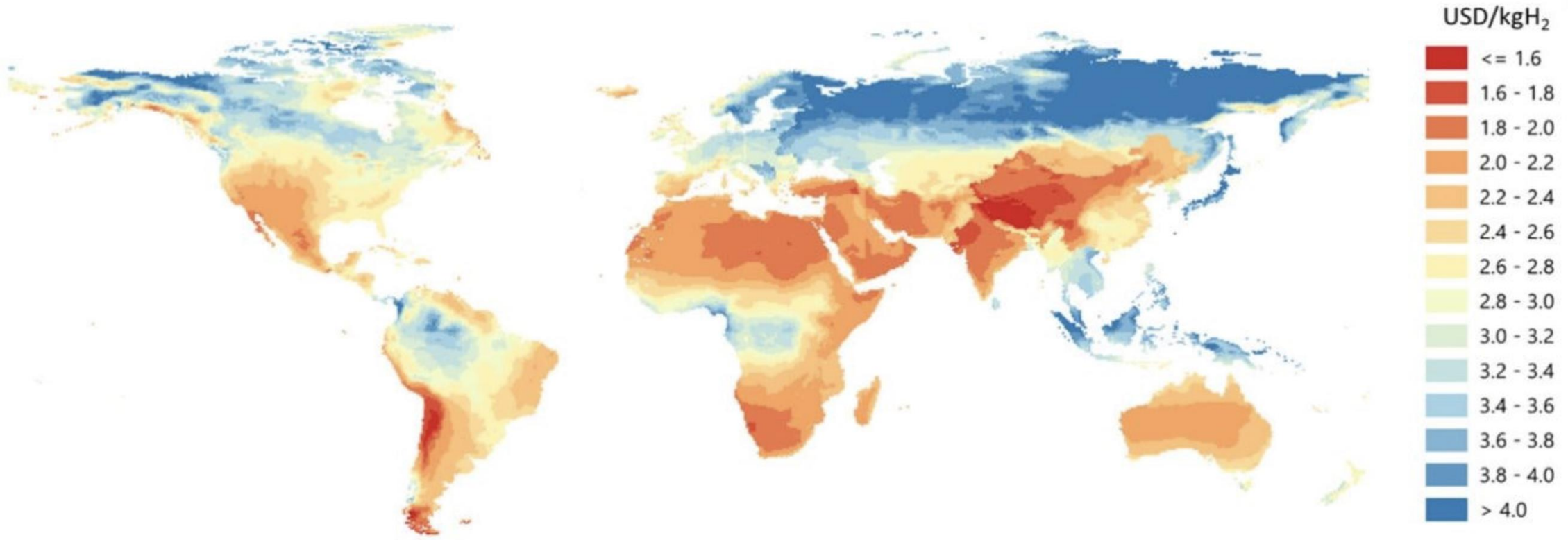
Hidrógeno Verde – Usos (Sector Coupling)

El hidrógeno verde permite reducir las emisiones de GEI en aplicaciones no electrificables



Economía del Hidrógeno Verde

Estimación del LCOH para distintos territorios



(Source: *IEA, The Future of Hydrogen, 2019*)

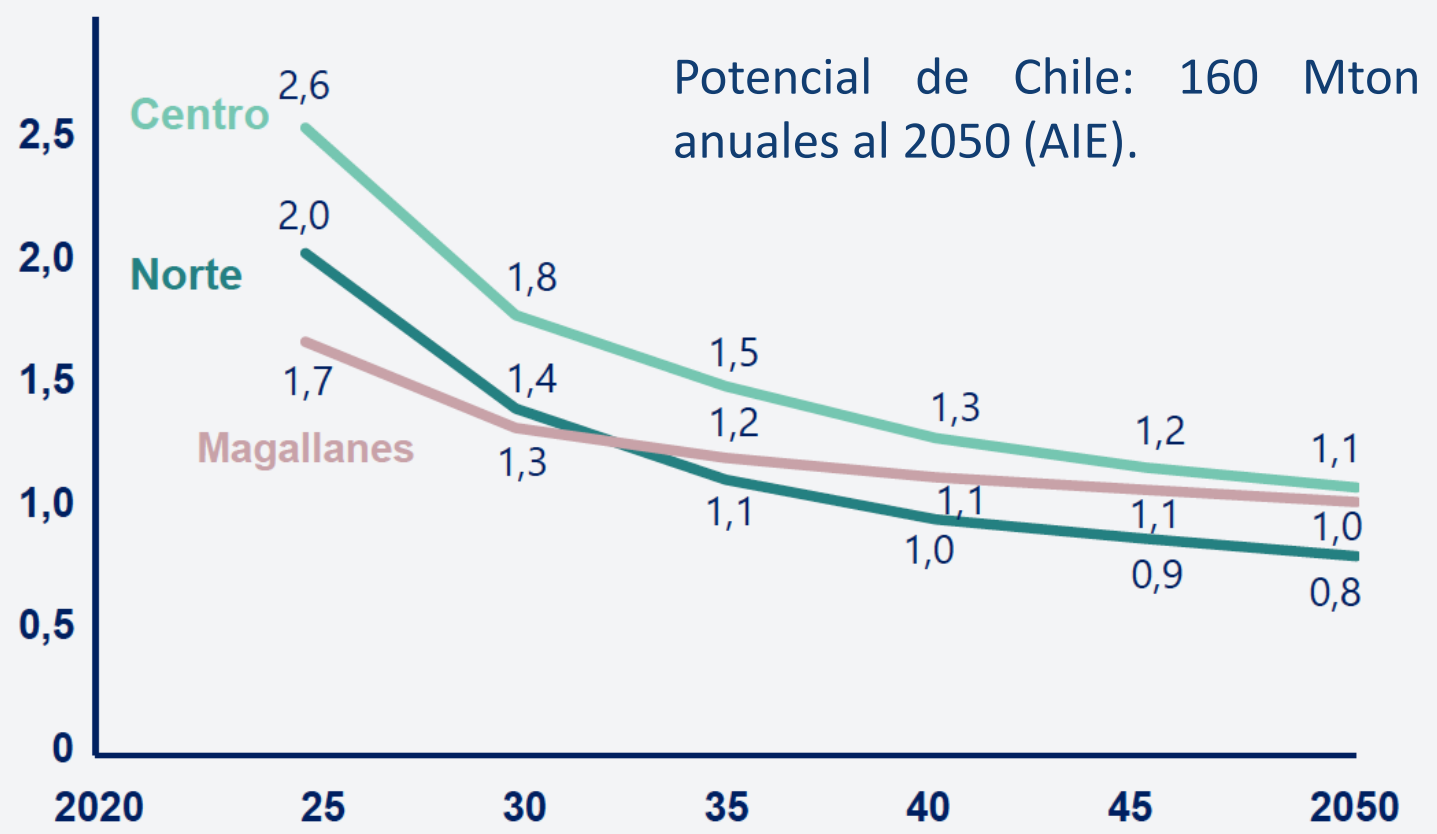
Campeón Oculto

Figure 2 Types of possible PtX producers/exporters and selected example country

Type	PtX motivation and readiness	Selected example
Frontrunners	▪ PtX already on countries (energy) political radar ▪ Export potential and PtX readiness evident ▪ Uncomplicated international trade partner ➢ Especially favourable in early stages of market penetration	Norway
Hidden Champions	▪ Fundamentally unexplored RES potential ▪ Largely mature, but often underestimated, (energy) political framework with sufficiently strong institutions ➢ PtX could readily become a serious topic if facilitated appropriately	Chile
Giants	▪ Abundant resource availability: massive land areas paired with often extensive RES power ▪ PtX readiness not necessarily precondition, may require facilitation ➢ Provide order of PtX magnitudes demanded in mature market	Australia
Hyped Potentials	▪ At centre of PtX debate in Europe with strong PtX potential ▪ Energy partnerships with Europe foster political support ➢ Potential to lead technology development; may depend strongly on solid political facilitation	Morocco
Converters	▪ Global long term conversion from fossil to green energy sources ▪ PtX to diversify portfolio as alternative long-term growth strategy ➢ Strong motivation for PtX export technology development; may requires political facilitation and partnership with the EU/DE	Saudi Arabia
Uncertain Candidates	▪ Partially unexplored RES potentials, possibly paired with ambitious national climate change policies ▪ PtX export in competition with growing national energy demand ➢ PtX export motivation and potential unclear – may drive PtX technology development, however export uncertain	China

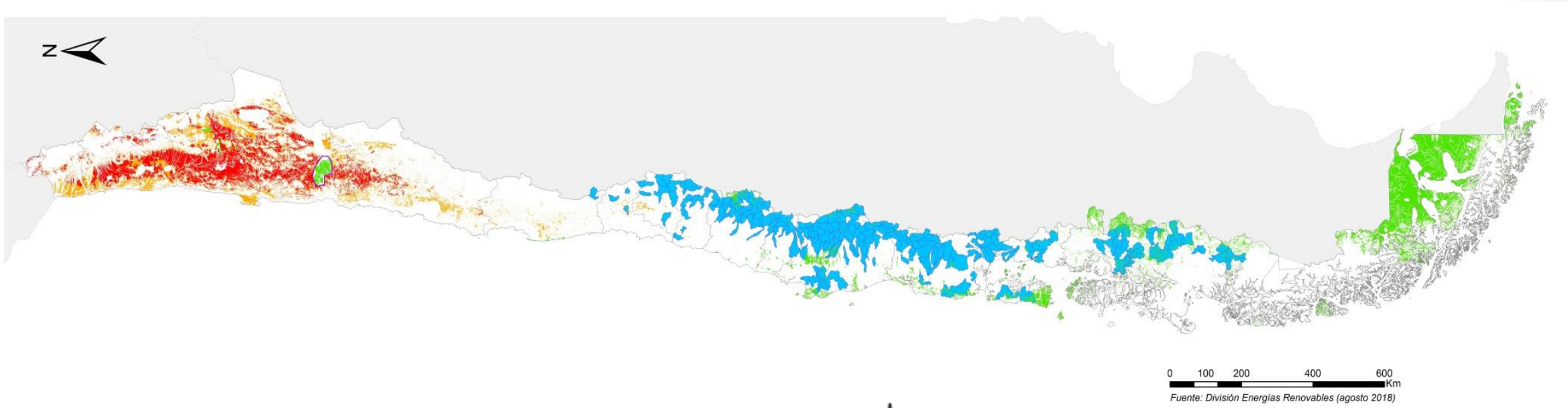
Source: Frontier Economics.

Estrategia-costo nivelado de H2 verde (USD/kg H2)



Fuente: Estrategia Nacional de Hidrógeno verde, Ministerio de Energía, basado en estudios de McKinsey &Co 2020.

Potencial renovable de Chile es superior a 70 veces la capacidad eléctrica instalada actualmente en el país



587 Concentración solar

879 Fotovoltaica

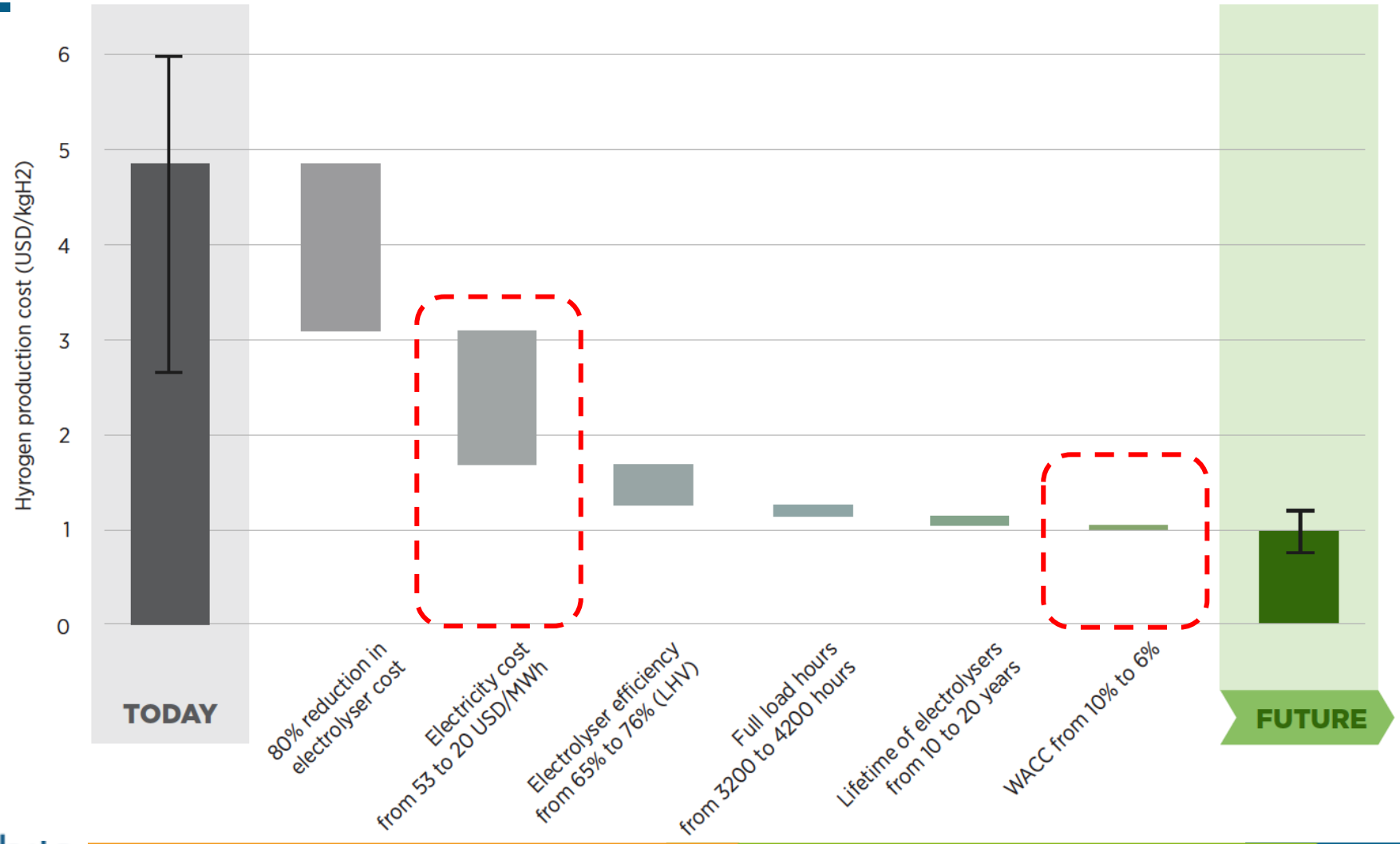
295 Eólica

15 Hidro

= 1800 GW

Source: Ministerio de Energía, Chile

IRENA Costo hidrógeno verde – 80% reducción (L/P)



Note: 'Today captures best and average conditions'. 'Average' signifies investments of USD 770/kW, efficiency of 65% (LHV)), an electricity price of USD53/MWh, full load hours of 3200 (onshore wind, and a **WACC of 10%** (relatively high risk).
'Best' signifies investment of USD130/kW, efficiency of 76% (LHV), electricity price of USD 20/MWh, full load hours of 4200 (onshore wind) and a **WACC of 6%** (similar to renewable electricity today).

Fuente: IRENA Analysis on "Green Hydrogen Cost", 2020.

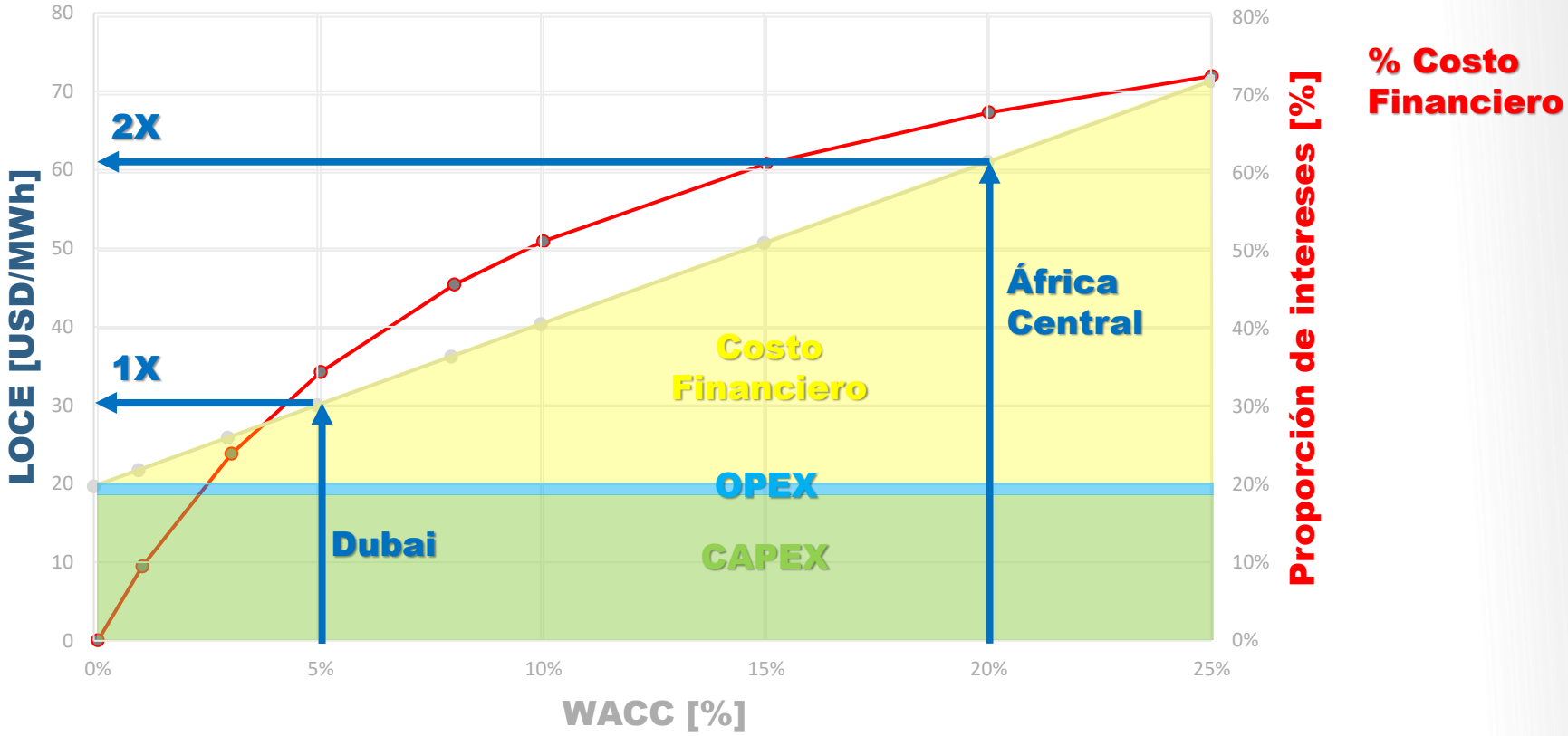
Costos de Financiamiento

Costo de financiamiento de proyectos de largo plazo, p.ej. a 20 años

Reducir los costos financieros es clave para el desarrollo de proyectos de largo plazo

Impacto del **costo de capital [%]** (WACC)
en el **costo nivelado de electricidad** [USD/MWh] (LCOE)

Los riesgos de mercado y regulatorios pueden aumentar el costo promedio ponderado del capital y minar la competitividad de las energías renovables



Fuente: Hemi Bahar, Medium Term Report iea, 2015

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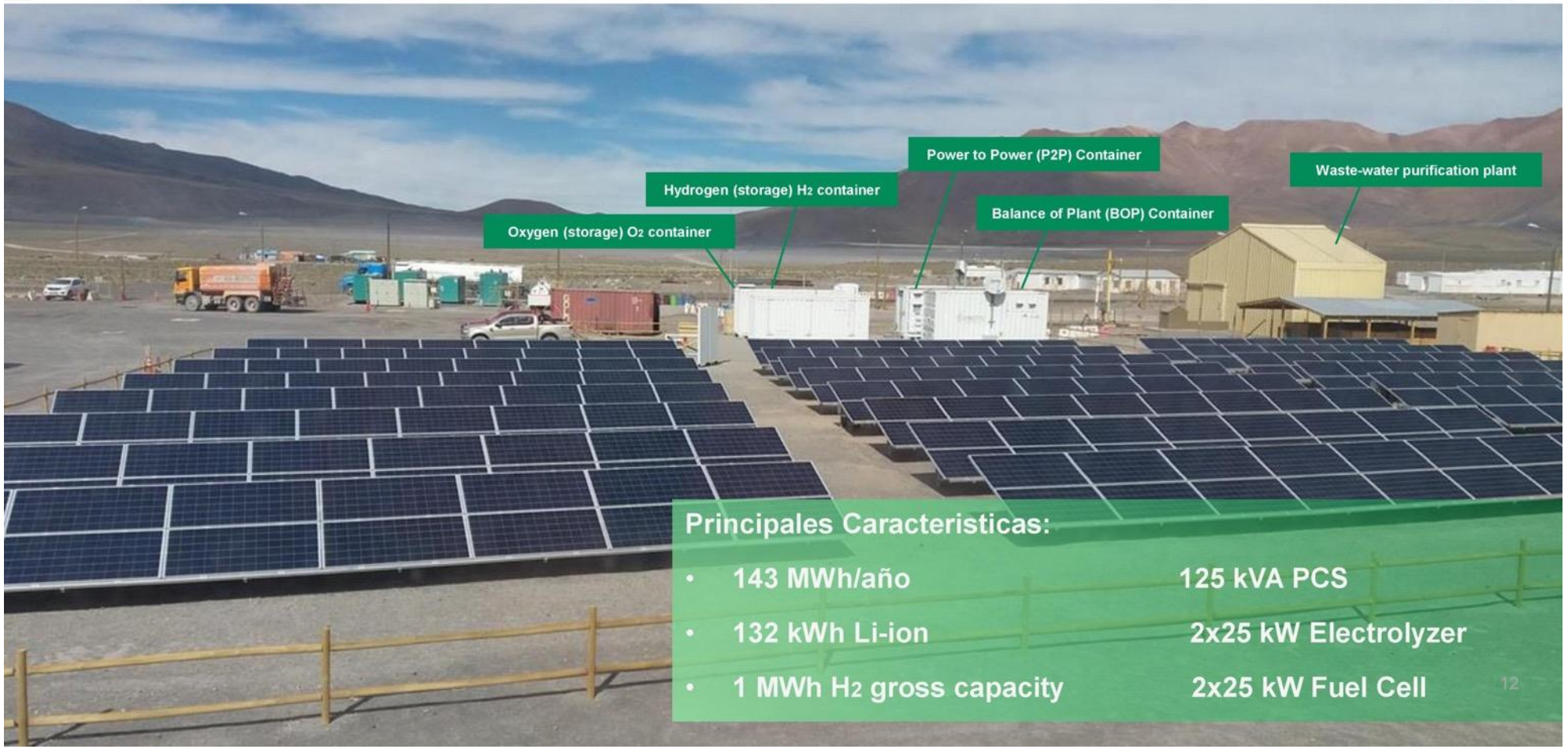
Proyectos, Aplicaciones y Alianzas

1) ENEL Green Power, Cerro Pabellón

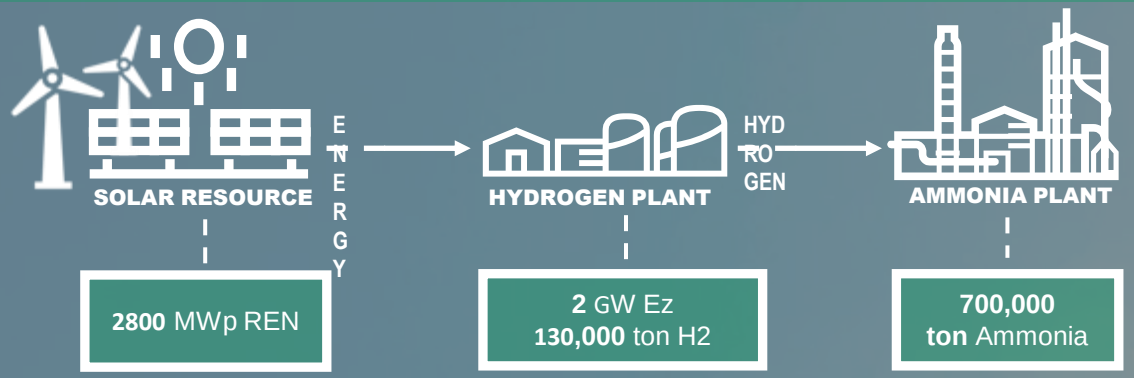
Descripción de la Planta

Principales Características



2) HYEX, THE GREEN AMMONIA IN CHILE

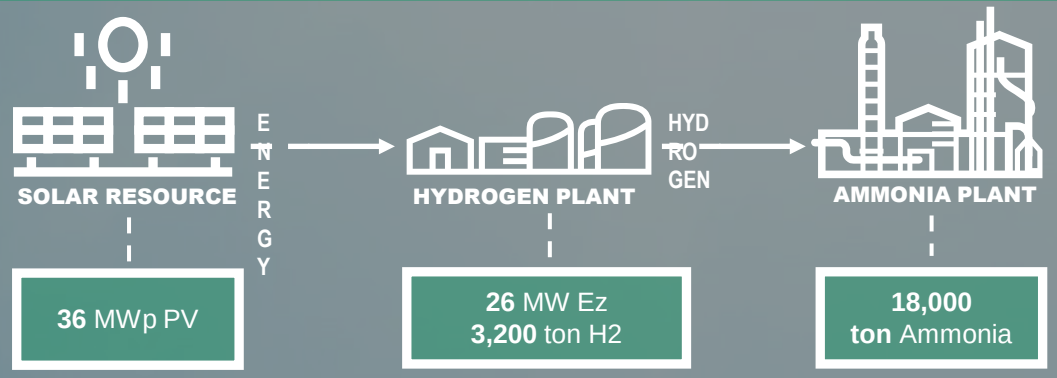
UNIQUE OPPORTUNITIES FOR A WORLD SCALE PROJECT IN CHILE: THE HYEX PROJECT



Reducing **~1 million** ton of CO2 per year*

- World's best solar resource
- No local Ammonia production, would replace imports. Already existent demand for Hydrogen
- Perfect location, at a strategic distance from best **Solar** radiation, **Port** and **Hydrogen** consumption
- Support Chile's "**Green Copper**" initiative
- Would enable and accelerate a new industry and job creation based on local renewable resources
- **Using Existing** infrastructure for ammonia storage and export and water
- Local Ammonia production for **other uses** (**as a fuel, as an energy vector**)
- Unique opportunity for an emblematic project in size and characteristics that can position Chile as a Green Hydrogen leader
- Advanced conceptual analysis performed for the world scale project

A REAL AND SHORT TERM FIRST PHASE IN CHILE: THE INDUSTRIAL PILOT



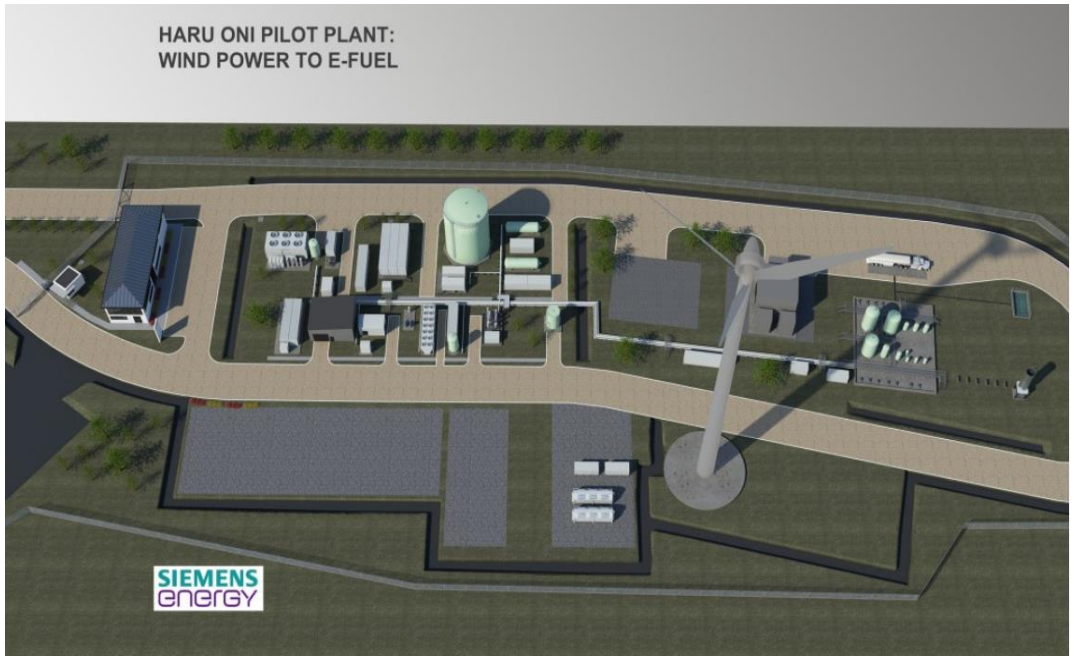
Reducing **~30.000** ton of CO2 per year

- **Short term** investment of **industrial pilot.** We want to act now for the climate change!
- The pilot is an opportunity to prepare **the human capital** of the region in this new sector
- It is a proof of concept for the integration of the technologies. **Testing** of the performance and safe operation of the supply chain below **intermittency** and tough condition prior the huge investment.
- It will allow to celebrate the construction of a first phase that will trigger the **stakeholder's interest** for the large scale (Financing Institutions, Offtaker, Lenders, Techno providers, Authorities)
- Advanced **Pre-Feasibility Study** already done for the Industrial Pilot

* Equivalent to a reduction of ~80,000 cars

ENGIE Enaex

3) Project HIF o Haru Oni



- Proyecto piloto de **producción de hidrógeno verde + captura de CO2**, produciendo metanol verde (combustibles sintéticos).
- Parque eólico en Cabo Negro, Región de Magallanes.
- AME (Andes Mining & Energy).
- Cooperan Siemens, Porsche, ENAP, Sinopec , ExxonMobile y Global Thermostat.
- Ingresó al SEA en noviembre de 2020.

Aplicaciones en logística: grúa horquilla

Aplicaciones en logística:Puertos

H2Ports General Overview

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

H2 PORTS

H2 Chile ASOCIACIÓN CHILENA DE HIDRÓGENO

Aplicaciones de H2 en equipos portuarios

Port Terminal Equipment kg/day H_2

RTG Crane
45 kg/day

Forklift
5 kg/day

Straddle Carrier
46 kg/day

Container Handler
56[L] 25[E] kg/day

Reach Stacker
33 kg/day

Yard Tractor
21 kg/day

Nuvera® Fuel-Cell Engine

Battery (Li-Ion)

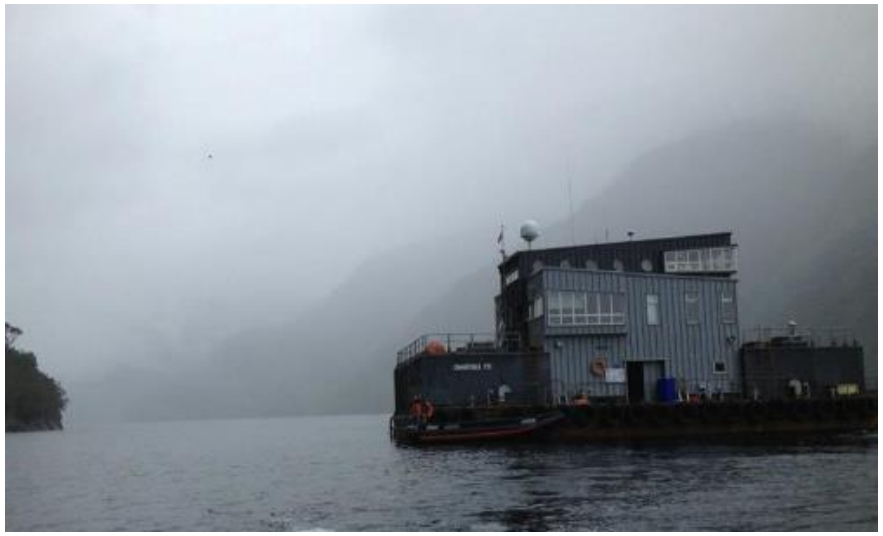
Laden Container Handler Applications

Duty Cycle*	Average Power	Fuel Cell Range Extender Power
Mild	55-70 kW	1 x 50 kW / 2 x 30 kW
Heavy	70-85 kW	2 x 30 kW / 3 x 30 kW
Severe	85-110 kW	3 x 30 kW/ 2 x 50 kW

* Duty cycle assessments based on load monitoring of terminal operator at Port of LA

Fuente: https://www.energy.gov/sites/prod/files/2019/10/f68/fcto-h2-at-ports-workshop-2019-viii3-steele.pdf

Aplicación: Reemplazo diesel-pontones de las salmoneras



Aplicación: Minería

SOLAR AND ENERGY INNOVATION COMMITTEE

TECHNOLOGICAL CONSORTIUM – HYDROGEN IN MINING TRUCKS

FUEL CELLS FOR MINING FLEETS, ON UNDERGROUND MINING

UNIVERSIDAD TECNICA FEDERICO SANTA MARIA, Linde, BALLARD, Fraunhofer CHILE, NEL HYDROGEN, AChEE, ENGIE, CODELCO

5-year budget: MMUSD 2.2
(MMUSD 1.1 CORFO contribution)

DUAL HYDROGEN-DIESEL COMBUSTION FOR MINER EXTRACTION TRUCKS

ALSET, BHP, CAP, NTT DATA, AngloAmerican, ENGIE, acciona, HYDROGENICS

5-year budget: MMUSD 20
(MMUSD 5.8 CORFO contribution)

HYDRA – Camión Minero CAEX con Celdas de combustible

mining3 TRANSFORMINGMINING, CAT CATERPILLAR, DYNO Dyno Nobel, ENGIE, CSIRO Chile, KOMATSU

Alianzas Internacionales

Alianzas Internacionales

SCOTTISH Hydrogen & Fuel Cell ASSOCIATION

FUNDACIÓN PARA EL DESARROLLO DE LAS NUEVAS TECNOLOGÍAS DEL HIDRÓGENO EN ARAGÓN

AEH2 ASOCIACIÓN ESPAÑOLA DEL HIDRÓGENO

AUSTRALIAN HYDROGEN COUNCIL

CertifHy

H2 Chile ASOCIACIÓN CHILENA DE HIDRÓGENO

Alianzas Internacionales

GREEN HYSLAND IN MALLORCA, THE FIRST GREEN HYDROGEN PROJECT IN A MEDITERRANEAN COUNTRY DUE TO GET EUROPEAN FUNDING

Madrid, 19 October 2020

The Fuel Cells and Hydrogen Joint Undertaking (FCH JU) of the European Commission has selected the project Green Hysland in the Balearic Islands to start negotiations for an EU grant agreement valued at 10 million EUR what would constitute the second largest grant by this European Commission body to a green hydrogen project and the largest grant ever offered to a Mediterranean country.

In line with the new EU Hydrogen Strategy, Green Hysland will be the first Southern European Flagship project and it will create a 'green hydrogen ecosystem' in the Balearic Islands. Green Hysland will generate, distribute and use at least 300 tonnes of renewable hydrogen locally per year, produced from solar energy on the island of Mallorca. The project is also part of the "Hydrogen Road Map: a commitment to renewable hydrogen" recently approved by the Spanish Government, which will boost Spain as a technological benchmark in the production and use of renewable hydrogen, with a production capacity of 4 GW by 2030 and an estimated total investment of 8.9 billion EUR.

Mallorca is ideally positioned to develop the first hydrogen hub in Southern Europe, while becoming Europe's first example of an integrated island economy based on green hydrogen. The project will also include the development of business models for replicating the project to other EU islands and beyond.

- H2 Chile forma parte del consorcio que fue adjudicado con 10 millones de euros por la FCH JU. El Propósito es crear un ecosistema de hidrógeno verde en Mallorca.
- H2 Chile obtiene financiamiento para estudios de prefactibilidad para explorar la posibilidad de replica el proyecto en la isla de Chiloé u otros lugares insulares de Chile.

Nuestros Objetivos para el 2021 – El año de la acción

Financiamiento: Instrumentos Finanacieros que permitan cubrir el alto costo de los proyectos H2 en etapas temparanas (Grantts, etc.)

Capital Humano: Formar los especialistas necesarios encargados de construir, operar y mantener las infraestructuras H2.

Trabajo cercano con el sector público: Apoyar en la creación de políticas públicas y regulatorias que promuevan el uso del hidrógeno verde y abran las puertas a un mercado del hidrógeno en Chile.

Proyectos Pilotos: **Promoción de tecnología y creación de la demanda.**

Programa de matchmaking entre empresas nacionales e internacionales: facilitar el canal de comunicación en busca de sinergias.

Crecimiento Organizacional: **Busqueda del ¨offtaker¨ y empresas interesadas en invertir en la cadena de valor del hidrógeno**

https://www.linkedin.com/company/h2chile

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www.h2chile.cl

GRACIAS

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