SOLAR AND ENERGY
INNOVATION COMMITTEE

CORFO

Chile

Hydrogen Valleys - CHILE

Mission Innovation Workshop 26-27 March
Antwerp, Belgium

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@Comite_Solar

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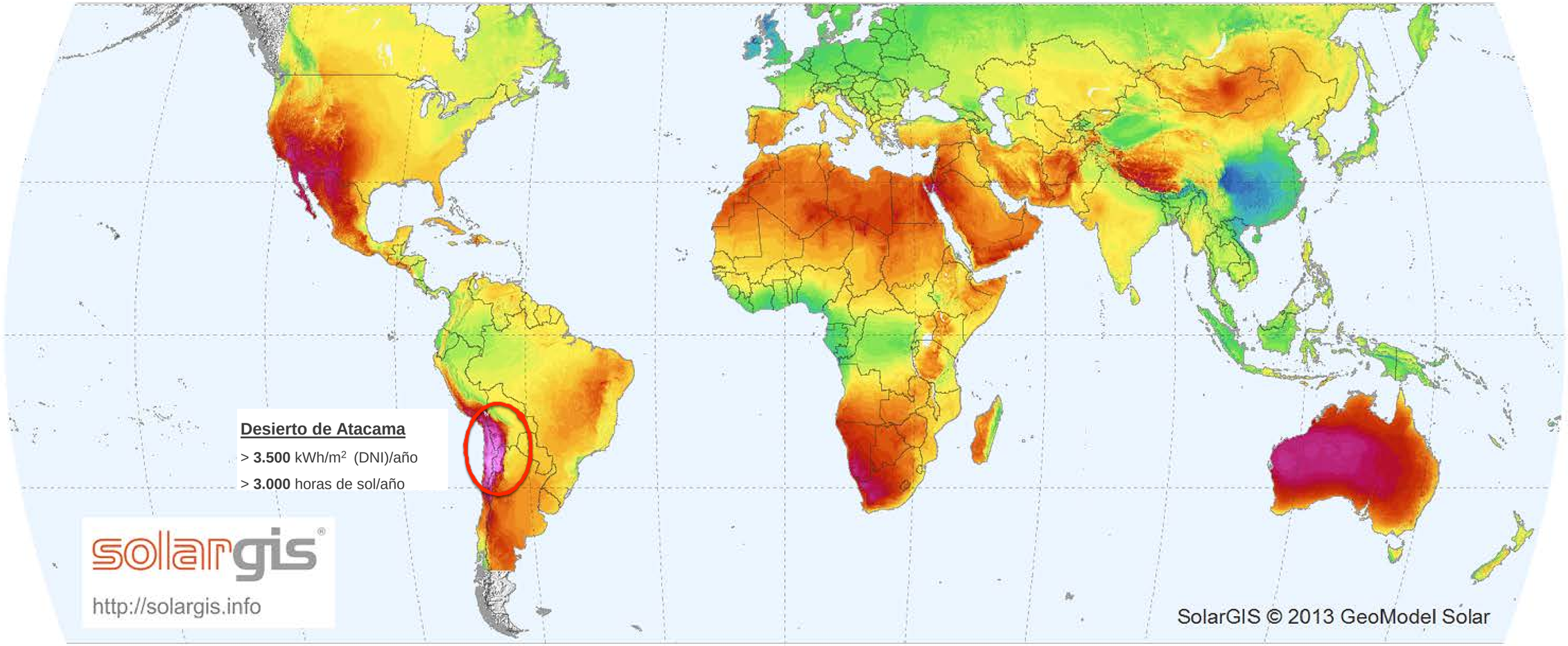
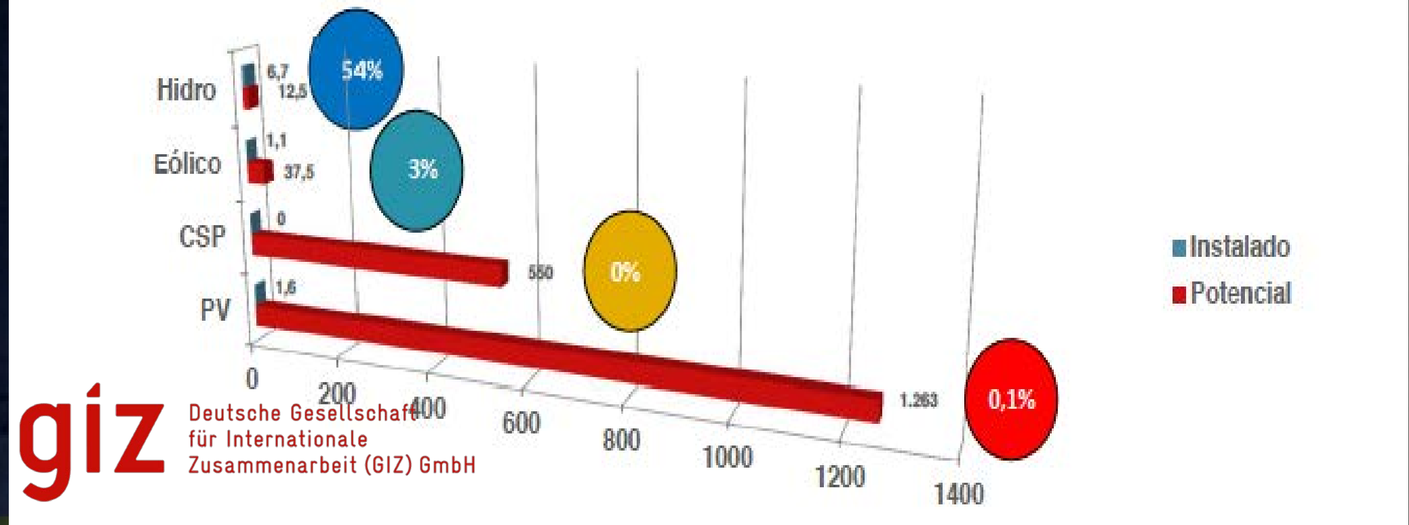
THE OPPORTUNITY OF CHILE FROM THE SOLAR REVOLUTION

Chile



Chile

1.800 GW
Solar Energy Potential



giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

~~one of~~ The best natural resources in the world

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Chile

Green Mining Industry

As the catalyser of a green hydrogen economy for the country (…and the world)

THE VISION 2025

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Chile

Chile: leading in low-emission mining

World's leading Lithium producer

World's largest low emission copper producer

Long term supply of lithium carbonate/hydroxide	Lithium and copper added value products	Solar energy for continuous electricity supply (mix PV/CSP)	Hydrogen as a fossil fuels substitution

CHILE'S INNOVATION STRATEGY – GREEN HYDROGEN

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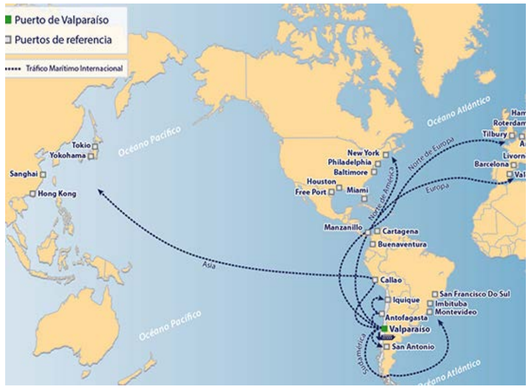
- **1st consumption:**
  - **Introduce green hydrogen in the industrial customers (Feedstock, Power and Heating)**
  - **Fuel cells and Dual Combustion in Mining fleets (shipping fleets and public transport)**
  - **Energy Storage**
- **2nd Define a National Green Hydrogen Strategy (mid 2019)**
- **3rd Long term ➡ supply international demand**

Local Consumption

Export



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TECHNOLOGICAL CONSORTIUM – HYDROGEN IN MINING TRUCKS

FUEL CELLS FOR MINING FLEETS, ON UNDERGROUND MINING

UNIVERSIDAD TECNICA FEDERICO SANTA MARIA

Linde

BALLARD
PUTTING FUEL CELLS TO WORK

Fraunhofer CHILE

Centro Nacional del Hidrógeno

NEL HYDROGEN

ENGIE

CODELCO

AChEE
Agencia Chilena de Eficiencia Energética

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

DUAL HYDROGEN-DIESEL COMBUSTION FOR MINER EXTRACTION TRUCKS

ALSET
HYDROGEN MOBILITY

BHP

CAP

ENGIE

NTT DATA

AngloAmerican

acciona
Energía

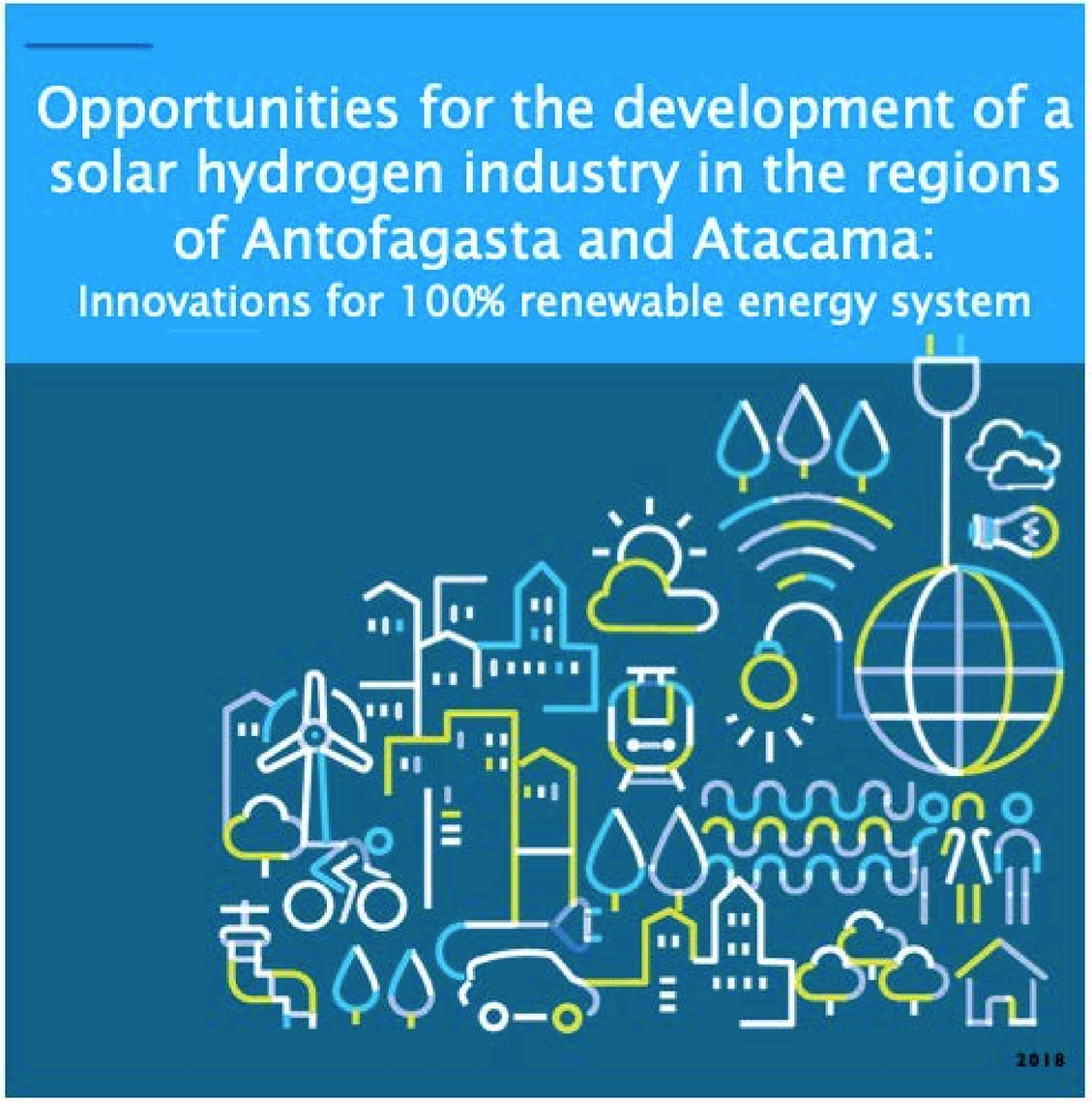
Pontificia Universidad Católica de Chile

UdeSantiago de Chile

HYDROGENICS
SHIFT POWER | ENERGIZE YOUR WORLD

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

HOW TO INCREASE THE AMBITION?



Tractebel, 2018. Oportunidades para el desarrollo de una industria de hidrógeno solar en las regiones de Antofagasta y Atacama: Innovación para un sistema energético 100% renovable. , Solar Committee, Chile

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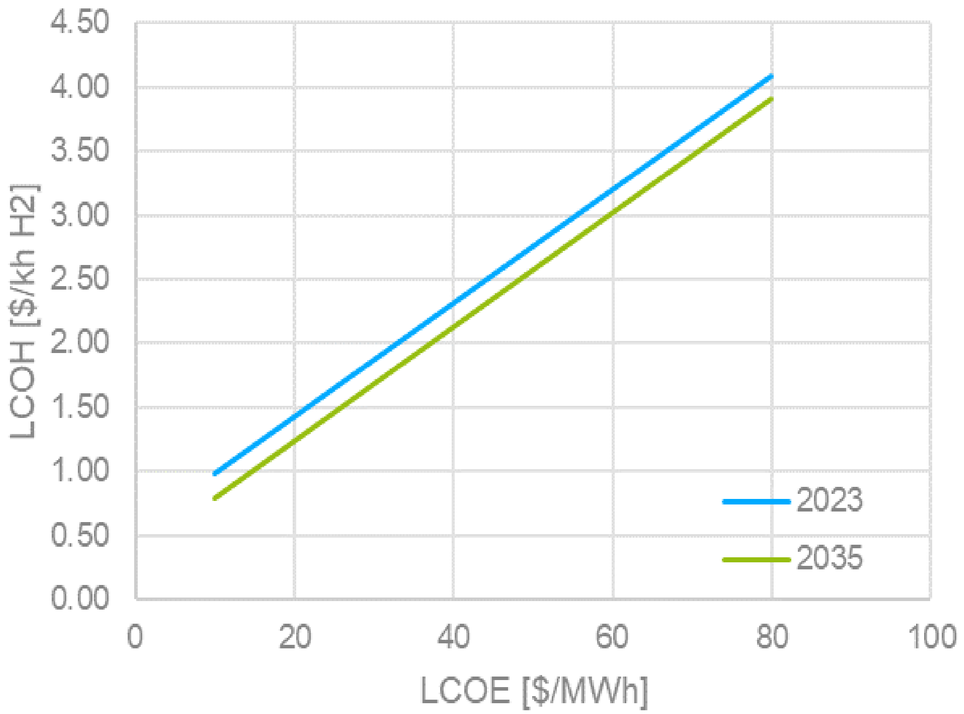
OPPORTUNITIES FOR THE DEVELOPMENT OF A SOLAR HYDROGEN INDUSTRY

TRACTEBEL ENGIE



Chile has the opportunity, even by 2023, to produce hydrogen at a competitive price due to the low cost of PV energy

LCOH [$/kg$_{H2}$]	100 % RES - 2023	100 % RES - 2035
$LCOH_{bajo}$ basado en $LCOE_{H2,\ bajo}$	**1.80**	**1.30**
$LCOH_{alto}$ basado en $LCOE_{H2,\ alto}$	**3.03**	**2.86**

Tractebel, 2018. Oportunidades para el desarrollo de una industria de hidrógeno solar en las regiones de Antofagasta y Atacama: Innovación para un sistema energético 100% renovable. , Solar Committee, Chile

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Why the North of Chile?, The Competitive Advantages

TRACTEBEL
ENGIE

• Production	• Transportation and Storage	• Consumption
• Highest solar generation potential in the world with a horizontal global irradiation (GHI) greater than 2800 kWh/m^2 and a direct normal irradiation (DNI) higher than 3800 kWh/m^2.	• Solar and water resource in the same place of potential consumption (eg Mining)	• Large number of potential direct consumers concentrated in the same region (Mining, Industries, cities, ports, airports, trains, heavy transport, etc.).
• Good wind resource, associated with certain high potential sites.	• Existing infrastructure of gas pipelines	• Imminent need for energy storage for integration of solar and wind energy.
• Existence of geothermal resource.	• Existing power distribution and transmission infrastructure.	• High demand for Ammonium Nitrate for explosives (manufactured from Ammonia)
• Existing Water Desalination plants due to mining activity	• Existing water infrastructure, pumping from the coast to the mountains.	• Pressure in the mining sector to achieve a Green Mining (Massive consumption of diesel)
• Desert area with less impact on communities	• Existing rail and port infrastructure.	

Tractebel, 2018. Oportunidades para el desarrollo de una industria de hidrógeno solar en las regiones de Antofagasta y Atacama: Innovación para un sistema energético 100% renovable. , Solar Committee, Chile

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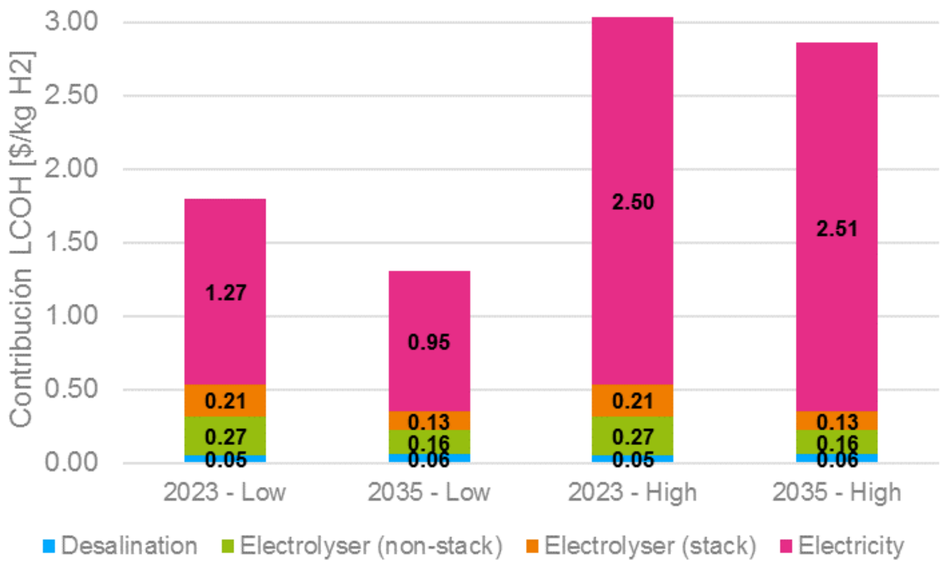
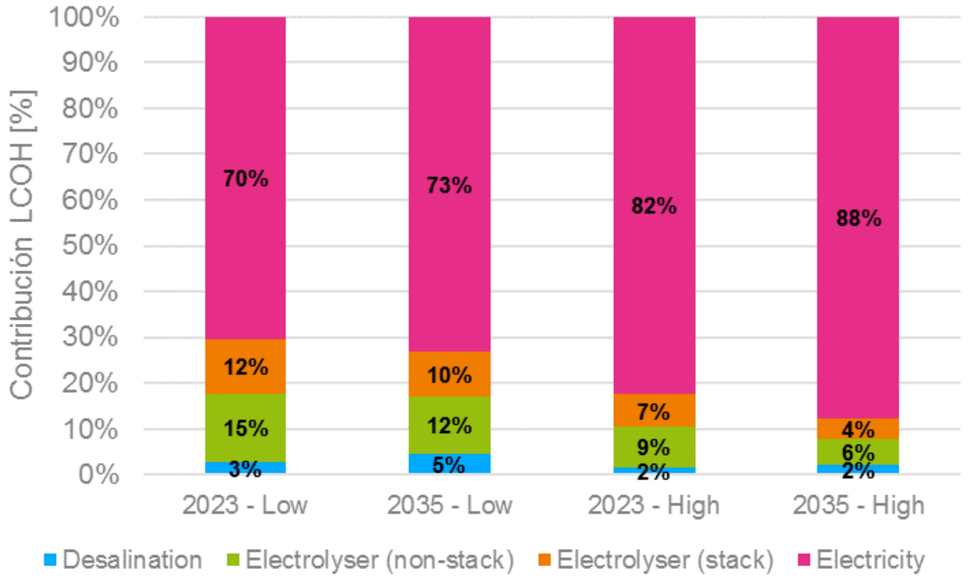
Costs for the production of green hydrogen





Contribution of the upstream building blocks of the hydrogen value chain for $LCOH_{high}$ and $LCOH_{low}$ in 2023 and 2035.

Tractebel, 2018. Oportunidades para el desarrollo de una industria de hidrógeno solar en las regiones de Antofagasta y Atacama: Innovación para un sistema energético 100% renovable. Solar Committee, Chile

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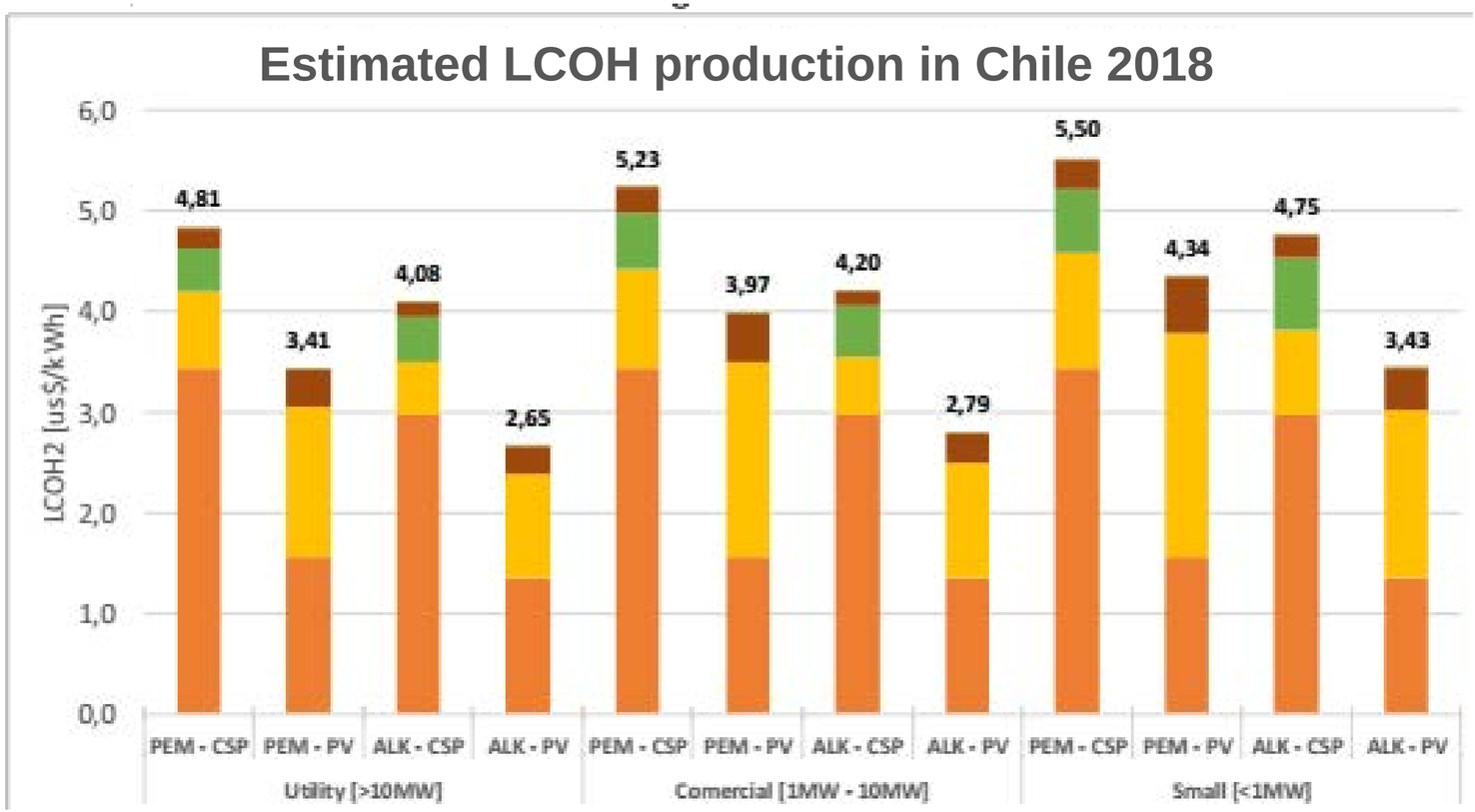
COST ANALYSIS OF PRODUCTION OF HYDROGEN IN CHILE



The results indicate that the most efficient production mechanism in terms of LCOH is through the supply of FV (8-18h) for both electrolysis technologies (PEM and Alkaline)

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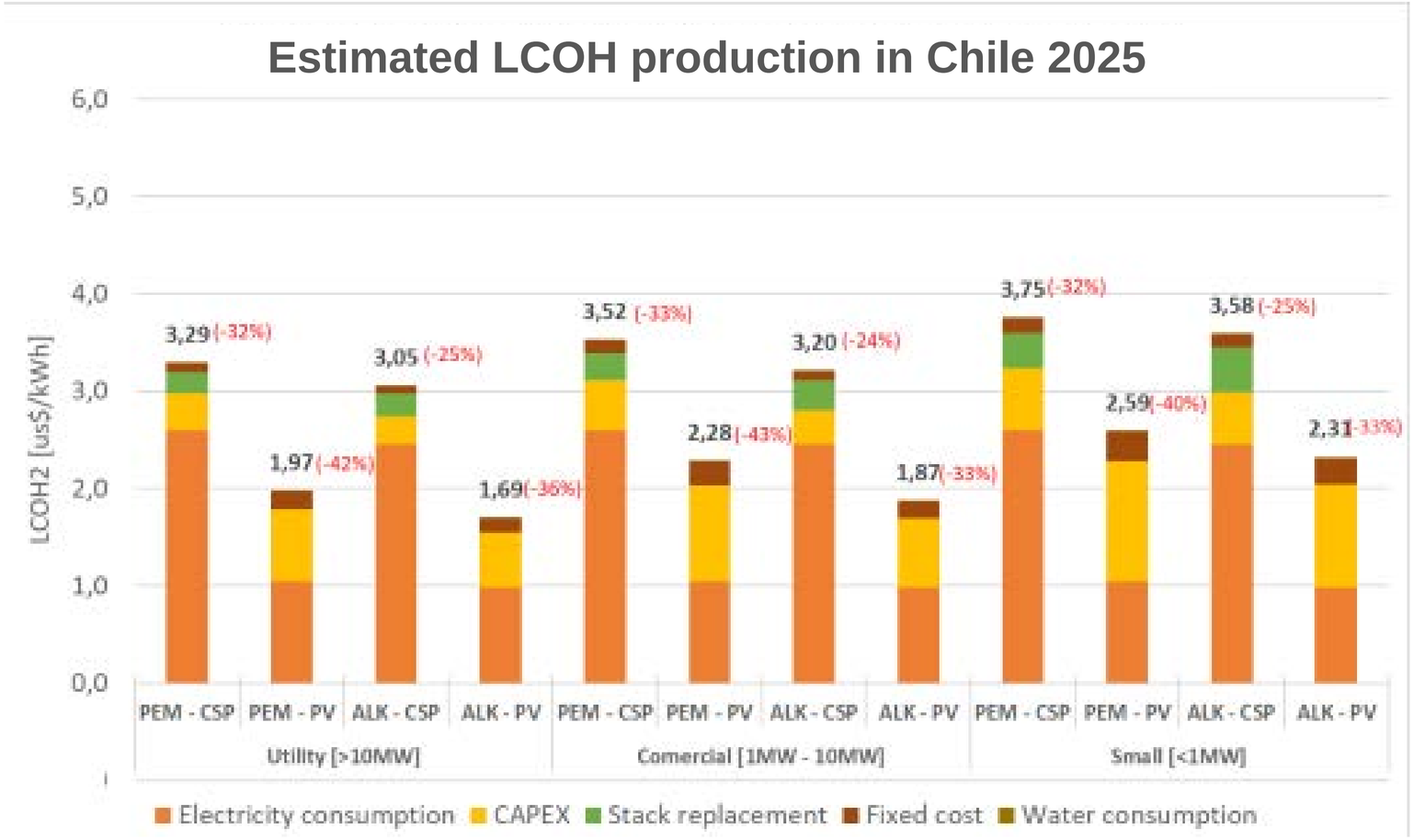
COST ANALYSIS OF PRODUCTION OF HYDROGEN IN CHILE



The alkaline electrolyser is more competitive for this case study (on - grid) with 2.65 US$/kg for 2018 and 1.69 US$/kg for 2025.

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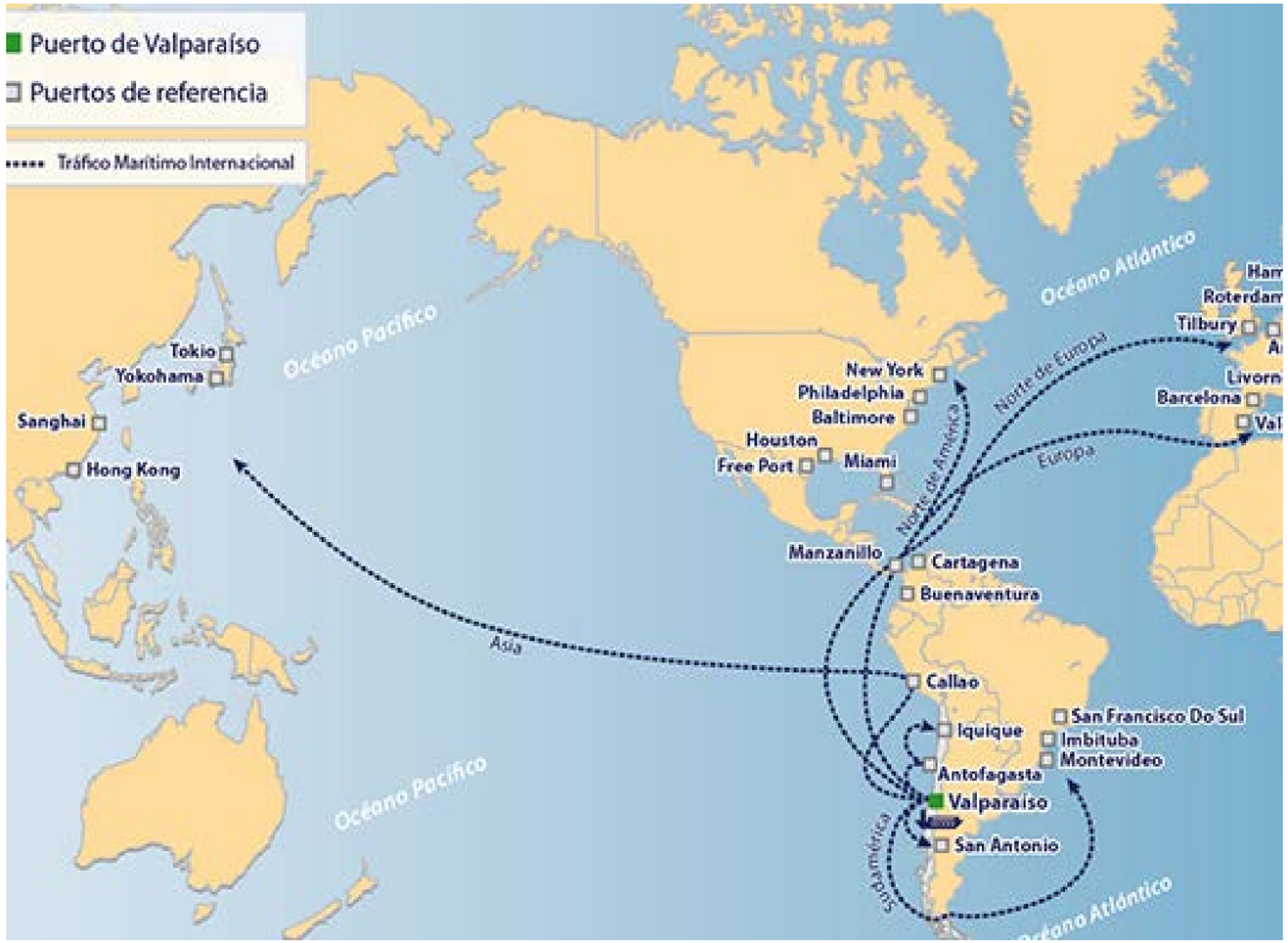

The hydrogen global market is estimated by 2023:

US$200 billions/y

CHILE CAN CAPTURE A SIGNIFICANT PROPORTION, GIVEN THE LOW COSTS OF SOLAR ENERGY.

1.- https://globenewswire.com/news-release/2018/03/27/1453296/0/en/Global-Hydrogen-Market-Will-Reach-USD-183-34-Billion-by-2023-Zion-Market-Research.html

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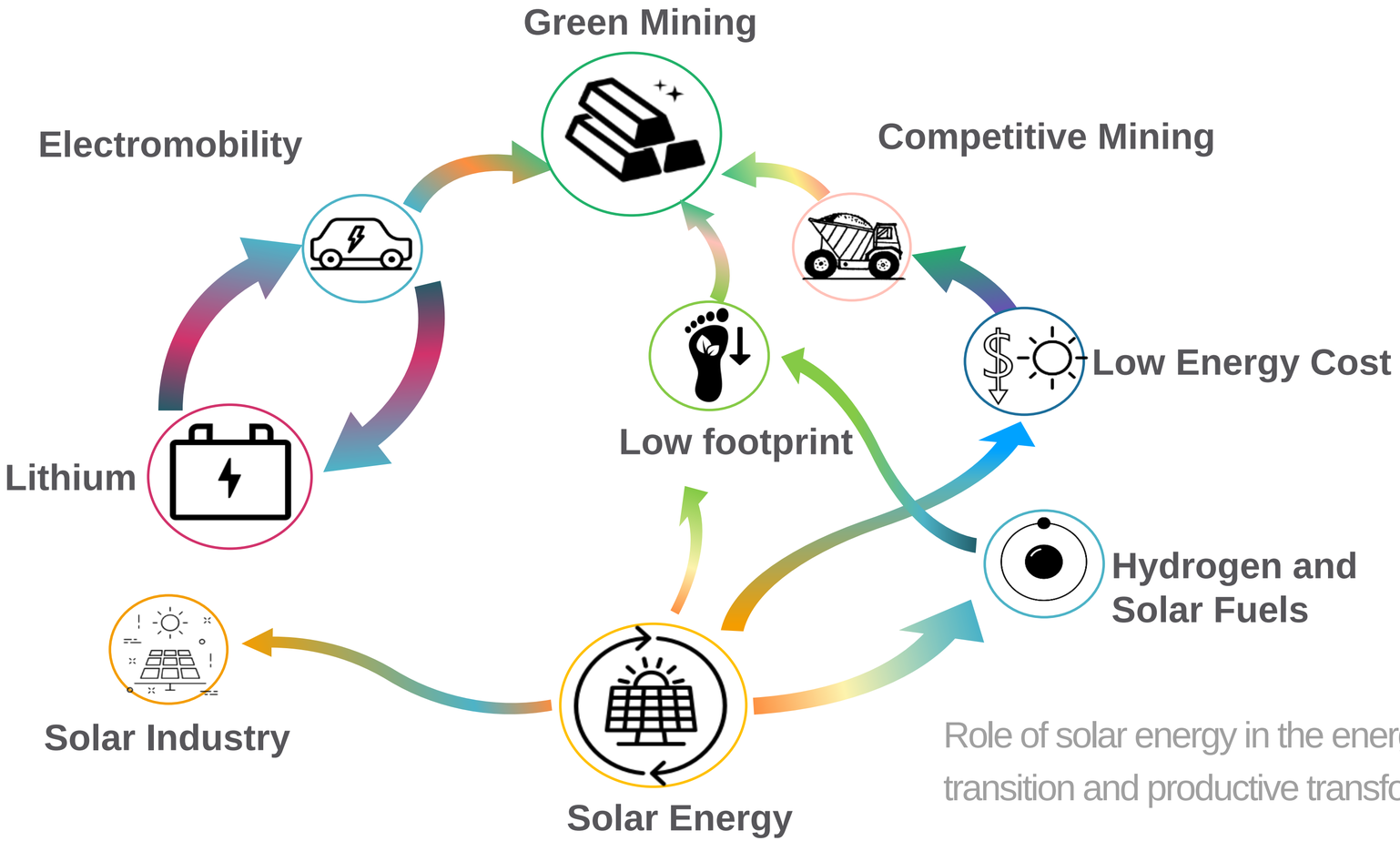
THE DREAM



Role of solar energy in the energy transition and productive transformation

HYDROGEN VALLEY IN CHILE - SUPPORTERS

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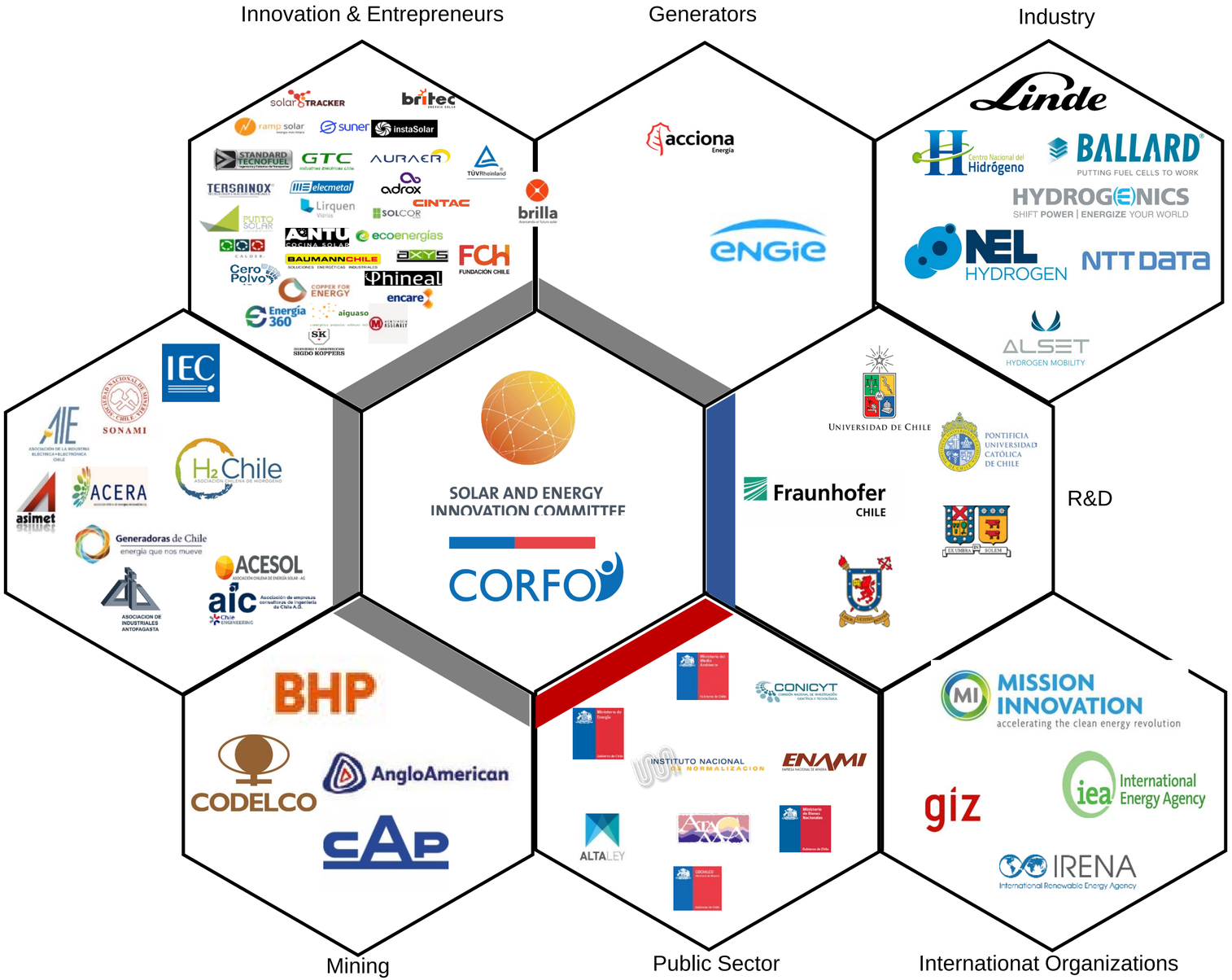
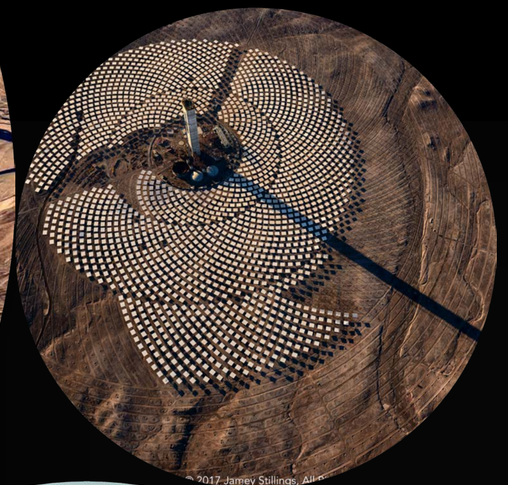


Private Sector

R&D

Public Sector

WE HAVE TWO OPTIONS



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