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Carbon Markets and Green Hydrogen: Synergies to Reach Decarbonization

VIRTUAL

Tue 2 Nov
13:30 -15:00 GMT

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Por encargo de:

Ministerio Federal de Medio Ambiente, Protección de la Naturaleza y Seguridad Nuclear

de la República Federal de Alemania

Ministerio de Energía

Gobierno de Chile

CARBON MARKETS AND GREEN HYDROGEN: SYNERGIES TO REACH DECARBONIZATION

5 min	**Opening** • Rainer Schröer – Director of the Renewable Energy and Energy Efficiency Program in Chile of the GIZ
20 min	**Presentation of National Green Hydrogen Strategy of Chile: Opportunities and Challenges** • Mr. Carlos Barría – Head of Studies and Policies Division, Ministry of Energy, Chile
15 min	**Presentation of the Study** **"Potential of Article 6 to promote the use of Green Hydrogen in the steel, cement and mining industries"** • Constanza Montes – Technical Advisor of Global Carbon Market in Chile, GIZ
25 min	**Panel Discussion: The Role of Article 6 in Promoting the Use of Green Hydrogen in the Energy Transition** • Moderator: Ms. Katie Sullivan – IETA • Mr. Juan Pedro Searle – Chief of Climate Change Unit of Ministry of Energy, Chile • Ms. María Paz de la Cruz – CEO Chilean Hydroge Association (H2 Chile) • Mr. Phillip Hauser – Agora Energiewende
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Ministerio de Energía

Gobierno de Chile

National Green Hydrogen Strategy of Chile: Opportunities and Challenges

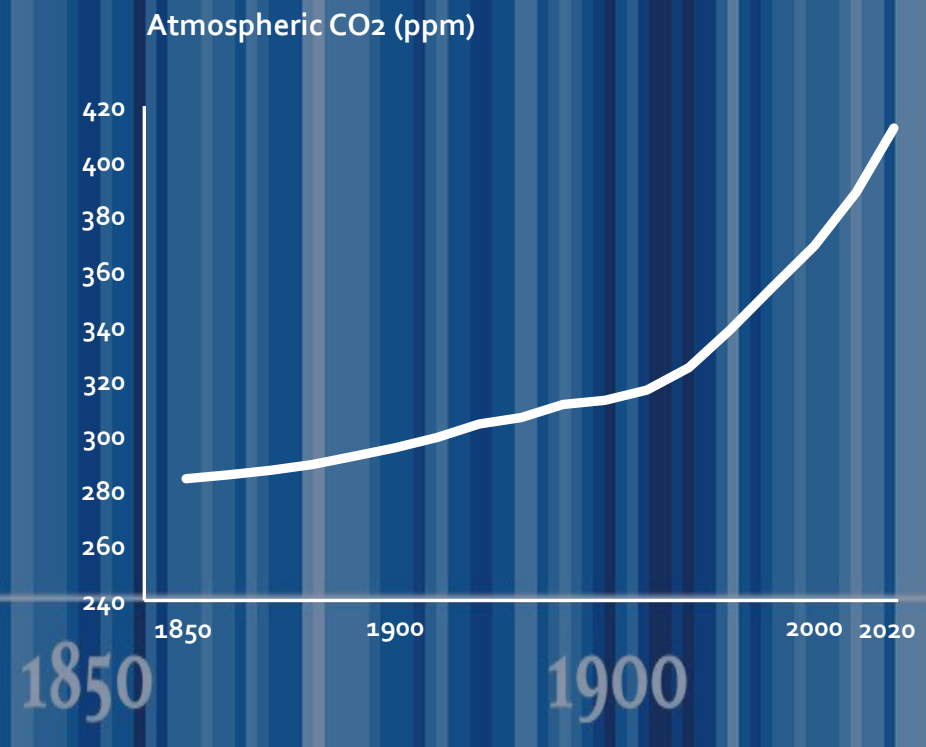
Carbon Markets and Green Hydrogen: Synergies to reach decarbonization

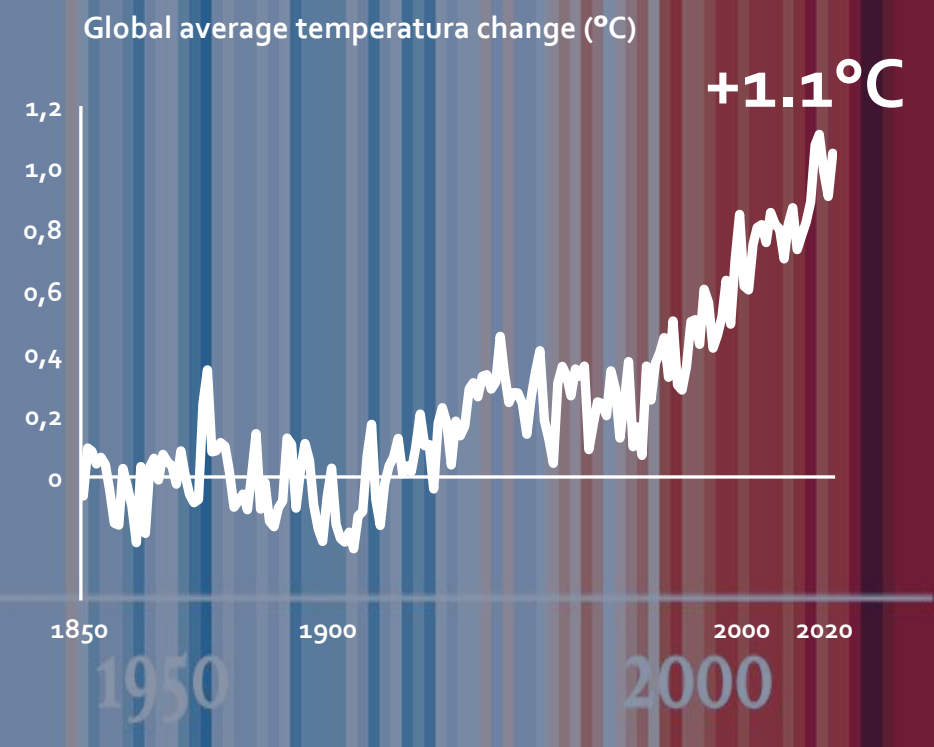
GIZ Virtual Side Event COP26

Glasgow

November 2th, 2021

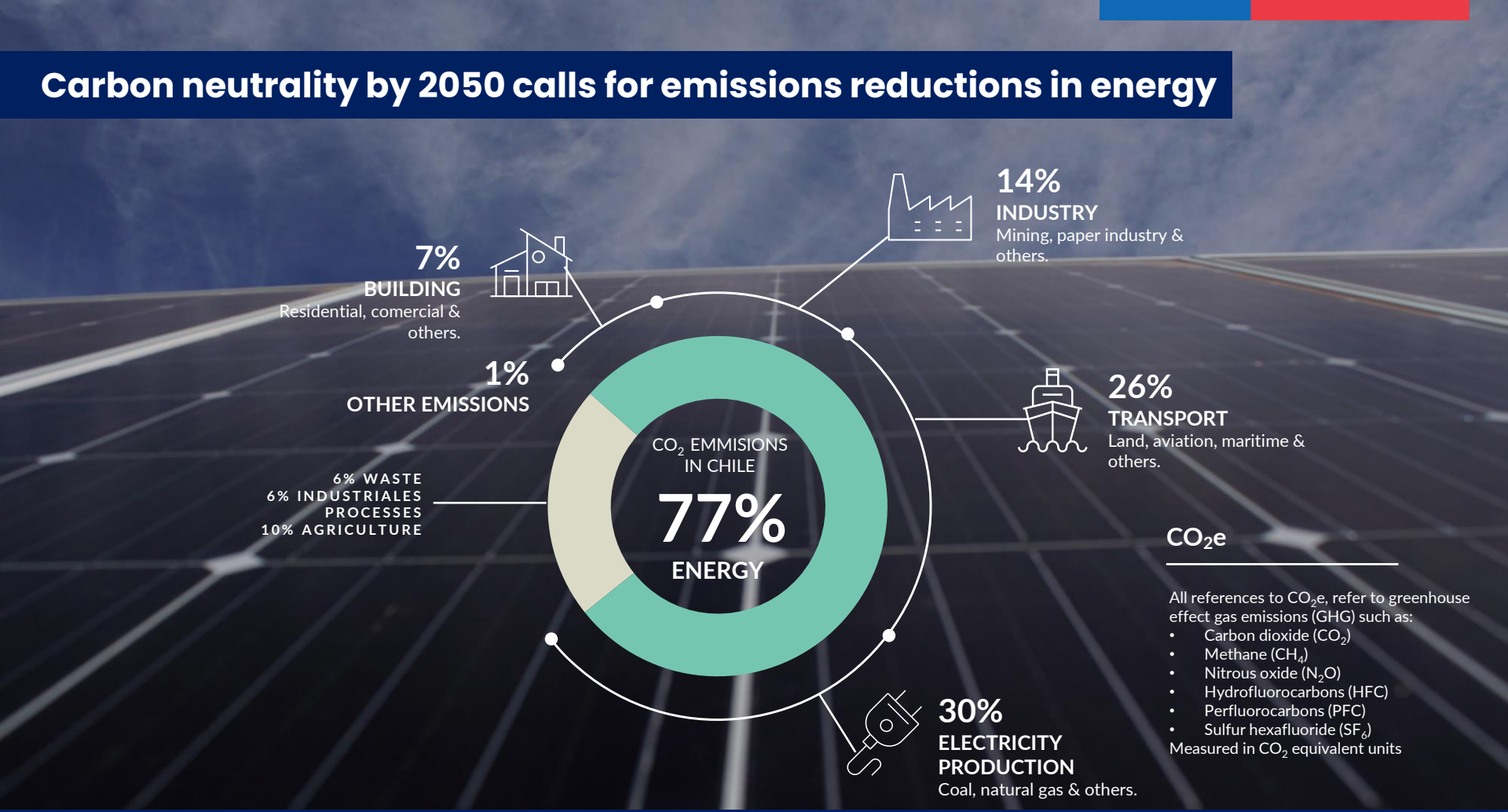
Emissions have grown steadily, leading to accelerated global warming





Source: World Meteorological Organization

Carbon neutrality by 2050 calls for emissions reductions in energy



CO_2e

All references to CO_2e, refer to greenhouse effect gas emissions (GHG) such as:

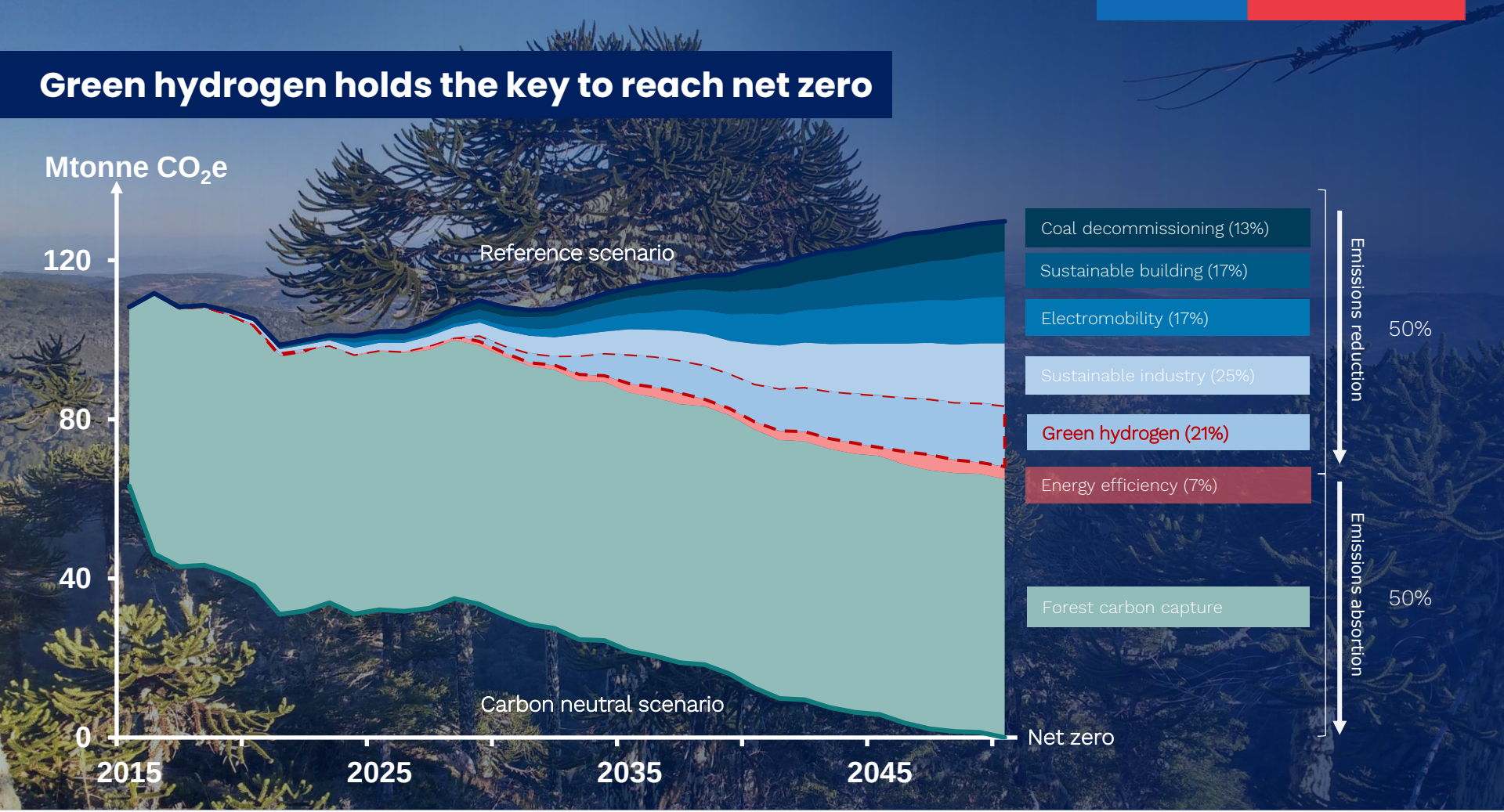
- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Hydrofluorocarbons (HFC)
- Perfluorocarbons (PFC)
- Sulfur hexafluoride (SF_6)

Measured in CO_2 equivalent units

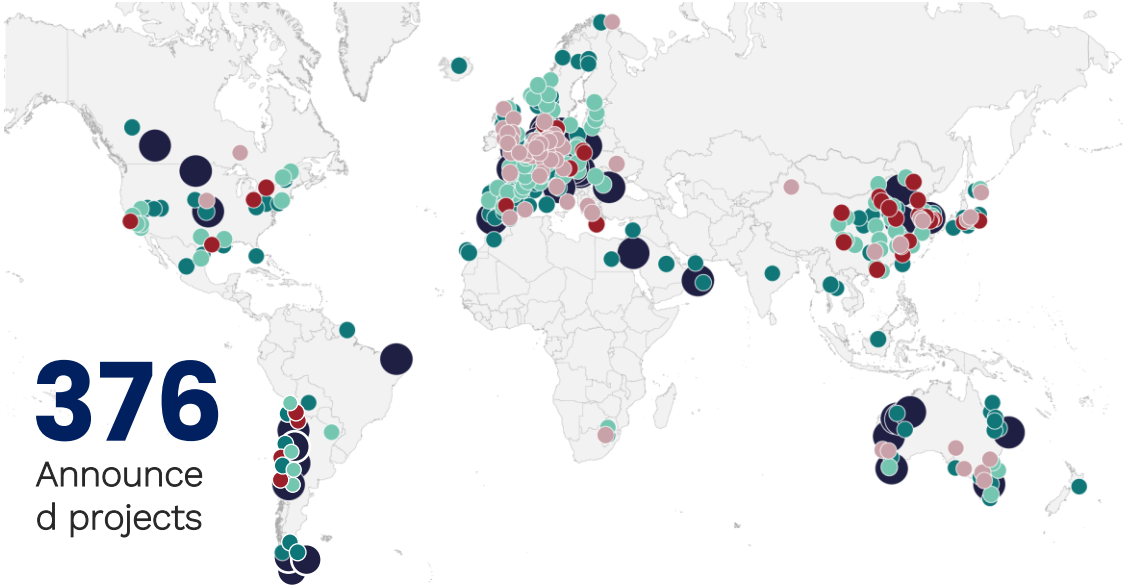

In 2021: We are doubling our solar & wind capacity
+ 6 GW


We are phasing-out all coal power plants by 2040
65% by 2025

Green hydrogen holds the key to reach net zero



The green hydrogen economy is building momentum



146 Large-scale industrial usage: refinery, ammonia, power, methanol, steel and industry feedstock

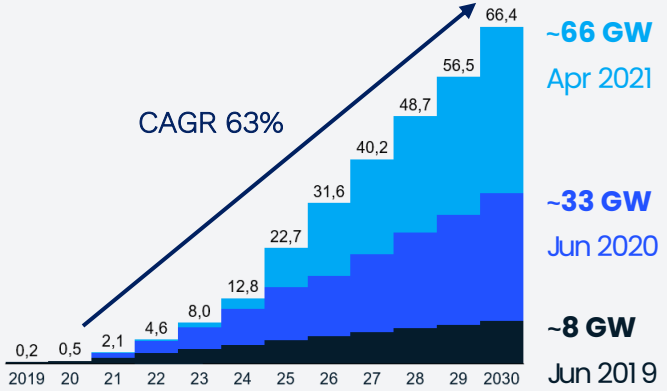
100 Transport: trains, ships, trucks, cars and other hydrogen mobility applications

60 Integrated H_2 economy: cross-industry, and projects with different types of end-uses

32 Giga Scale production: renewable H_2 projects > 1 GW and low-carbon H_2 projects >200 kt/year

38 Infraestructure projects: H_2 distribution, transportation, conversión and storage

Projected electrolyser capacity (GW)



Our renewable potential is

+80 times our current

installed capacity

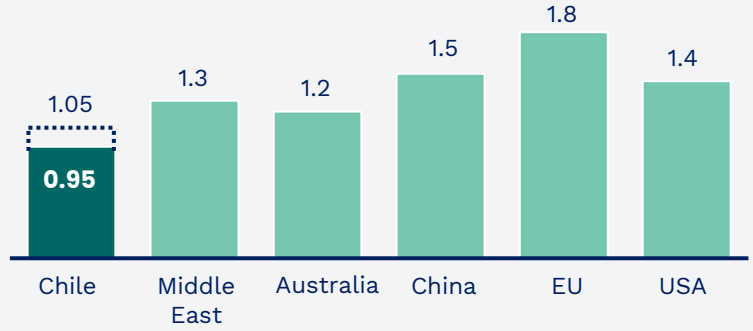
Chile is the most competitive producer

Capacity factors per country in best areas (%)

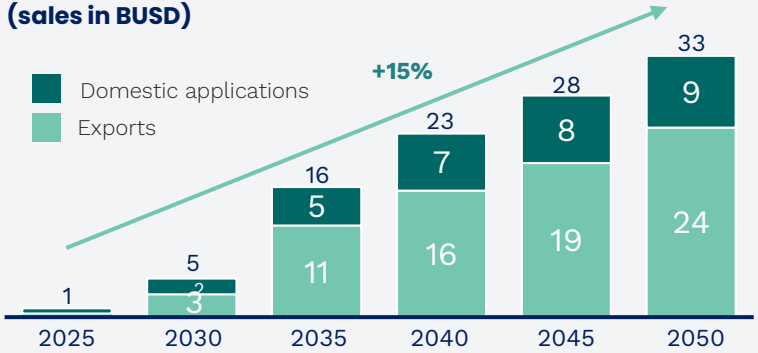
Solar PV	37%	~30%	~30%	20-25%	~25%
Wind	Off shore >75%			50-55%	40-45%
	On shore 70-75%		30-35%		40-50%

Green hydrogen levelized cost of production by 2030 (USD/kg H_2)

Does not consider conditioning, transport, storage nor distribution costs



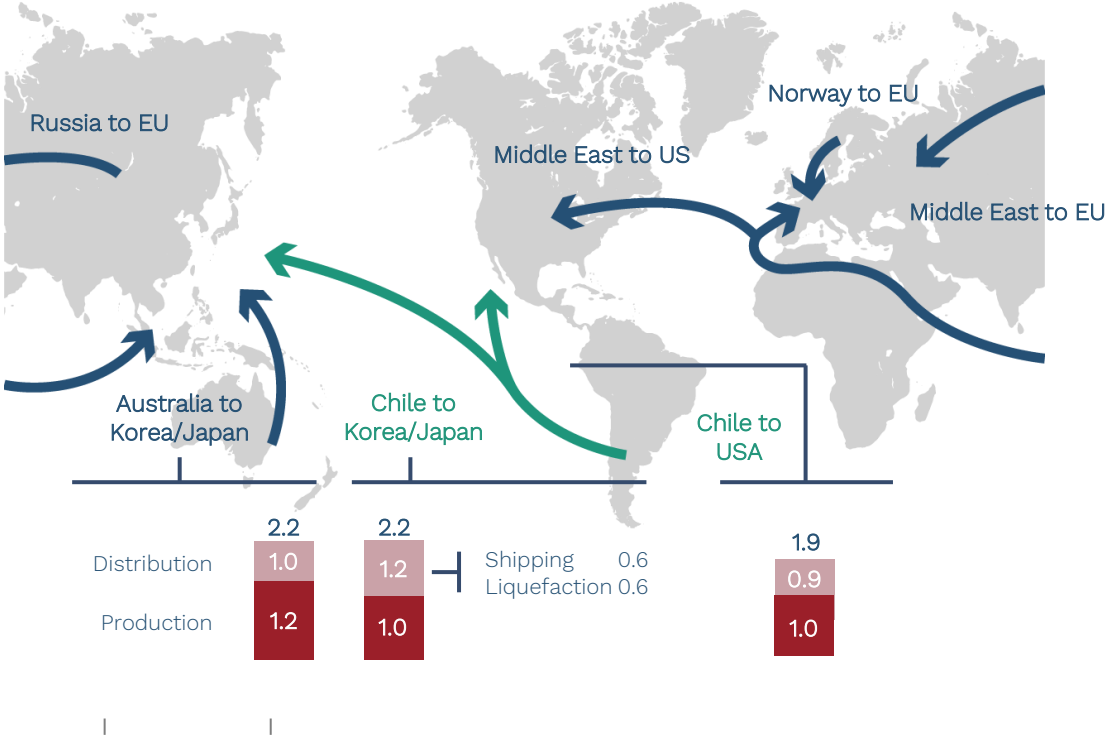
Projection of Chilean markets for green hydrogen and its derivatives (sales in BUSD)



	2025	2030	2035	2040	2045	2050
Associated renewable capacity (GW)	5-8	40	145	200	250	300
Cumulative necessary investment (MUSD)	8	45	150	220	270	330

Despite distance to markets, Chile remains on top

Cost of liquid H2 at port of destination, 2030 (USD/kg H_2)



Renewable energy carriers

- LH_2 Liquid hydrogen
- NH_3 Green ammonia
- CH_3OH Green methanol / eFuels
- Cu Green copper and other green exports

National Green Hydrogen Strategy

2025

5 BUSD

Top destination for green hydrogen investment in LATAM

5 GW

Electrolysis capacity operating and under development

200 ktonne/year

Production in at least 2 *hydrogen valleys* in Chile

2030

Leaders in export of green hydrogen and derivatives

2.5 BUSD/year

The cheapest green hydrogen on the planet

<1.5 USD/kg

Leaders in production of green hydrogen via electrolysis

25 GW

And we have defined 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.

60+ projects have sprung in Chile already

+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

Source: Ministry of Energy

HyEx Project

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

Atacama Hydrogen Hub Project

Large-scale electrolysis facility with export potential and hydrogen fuel cell powered freight train

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

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Potential of Article 6 to promote the use of Green Hydrogen in the steel, cement and mining related appliances

Constanza Montes – Global Carbon Market

GIZ | November 2021

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Workstream

Potential of Article 6 to promote the use of Green Hydrogen in the steel, cement and mining industries

Context

Why Green H2 in Chile?

- Promising economic sector and a way to promote energy transition
- Capabilities to produce Green H2 due to its high RE potential and at low cost
- High contribution to the NDCs (21%) and raise its level of ambition

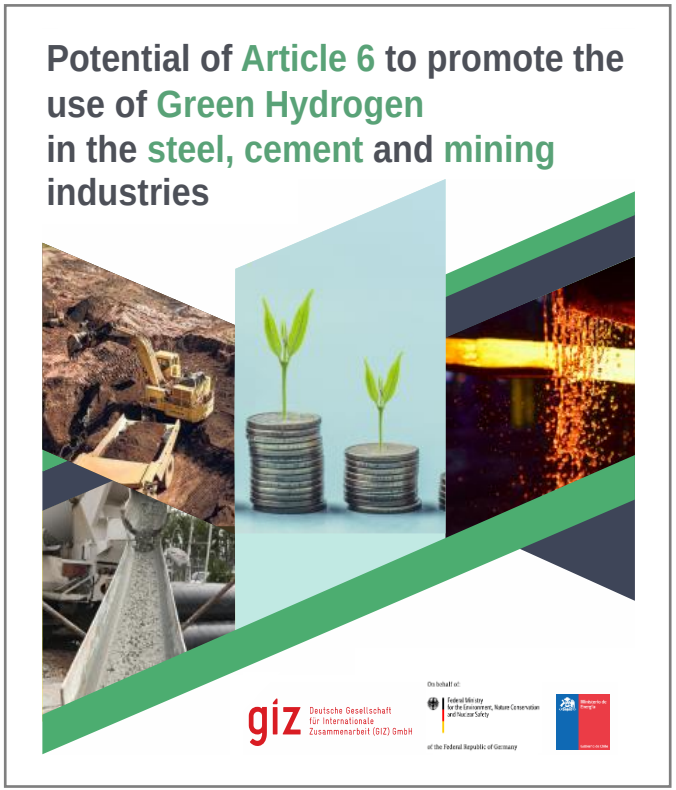
Why Article 6 for financing Green H2 projects?

- A way to reward the contribution to emissions reduction
- Possibility of increasing and complementing traditional forms of financing
- Possibility to attract international funds: reach a wide variety financing offer

Why support emission-intensive, trade-exposed (EITE) sectors?

- Highly exposed to the low emissions-transition-risks
- Commodity sectors face high (cost) barriers for investments in transformational technologies
- Safeguarding competitiveness = Safeguarding avoidance of carbon leakages

Objective



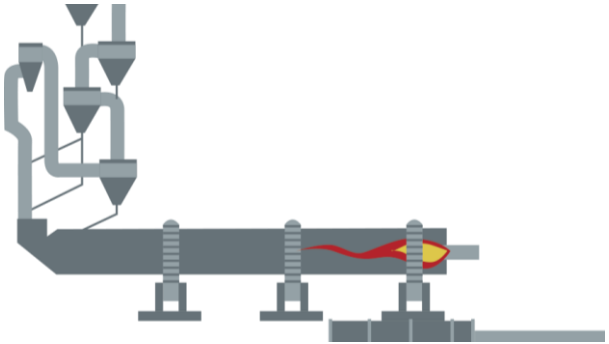
To advance **climate finance pilots (with focus on Art.6)** for Green H2 projects applicable to vulnerable industries in Chile

Three GHG emission reduction projects based on Green H2 in the cement, steel and mining related appliances.

Case Studies of Green H2 appliances

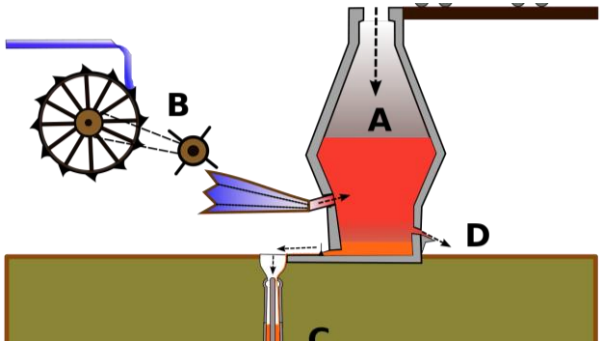
CEMENT

Replacement of 10% (energy) of the petcoke consumption in the clinker furnace by Green H2



STEEL

Partial replacement of coke by Green H2 in the blast furnace. Use of 27.5 kg Green H2 / ton pig iron



MINING

Replacement of 10 diesel buses by fuel cell buses to transport passengers in mining operations

Methodology

STEP 01	STEP 02	STEP 03	STEP 04	STEP 05	STEP 06	STEP 07
						
Technical-Economic Analysis of Green H2 industrial applications and LCOH estimation considering different scenarios	Expected profitability and gap to viability of the projects, identifying the main variables that affect each initiative	Emissions reduction estimation of each project based on the adaptation of international methodologies	The price that the certificates should have to overcome the economic viability gap of the projects is determined	Contrast with what could be accessed in reality based on historical and projected carbon prices	Evaluation of carbon markets contribution and determine gaps after the sale of emission reductions	Proposal of financing schemes based on carbon markets

Methodology

STEP 01

Technical-Economic Analysis of Green H2 industrial applications and LCOH estimation considering different scenarios

STEP 02

Expected profitability and gap to viability of the projects, identifying the main variables that affect each initiative

STEP 03

Emissions reduction estimation of each project based on the adaptation of international methodologies

STEP 04

The price that the certificates should have to overcome the economic viability gap of the projects is determined

STEP 05

Contrast with what could be accessed in reality based on historical and projected carbon prices

STEP 06

Evaluation of carbon markets contribution and determine gaps after the sale of emission reductions

STEP 07

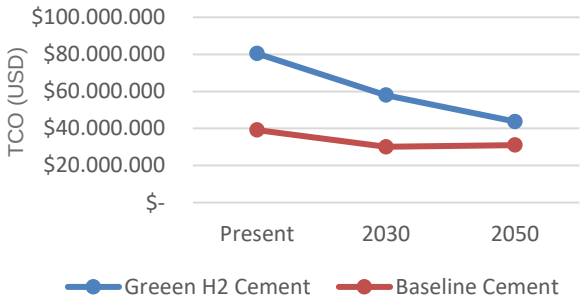
Proposal of financing schemes based on carbon markets

Case Studies

CEMENT

Replacement of 10% (energy) of the petcoke consumption in the clinker furnace by Green H2

- Petcoke price
- Electrolizer CAPEX



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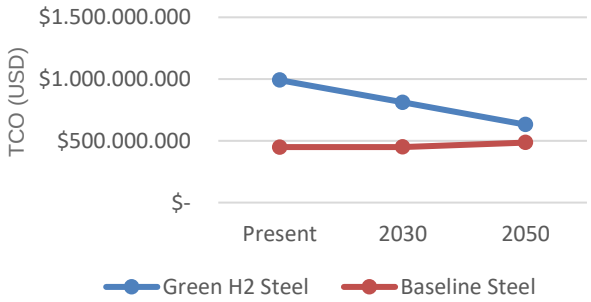
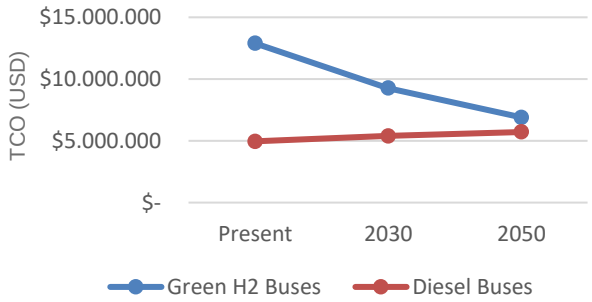
- Coque price
- Nozzles CAPEX



MINING

Replacement of 10 diesel buses by fuel cell buses to transport passengers in mining operations

- Buses CAPEX
- HRS CAPEX



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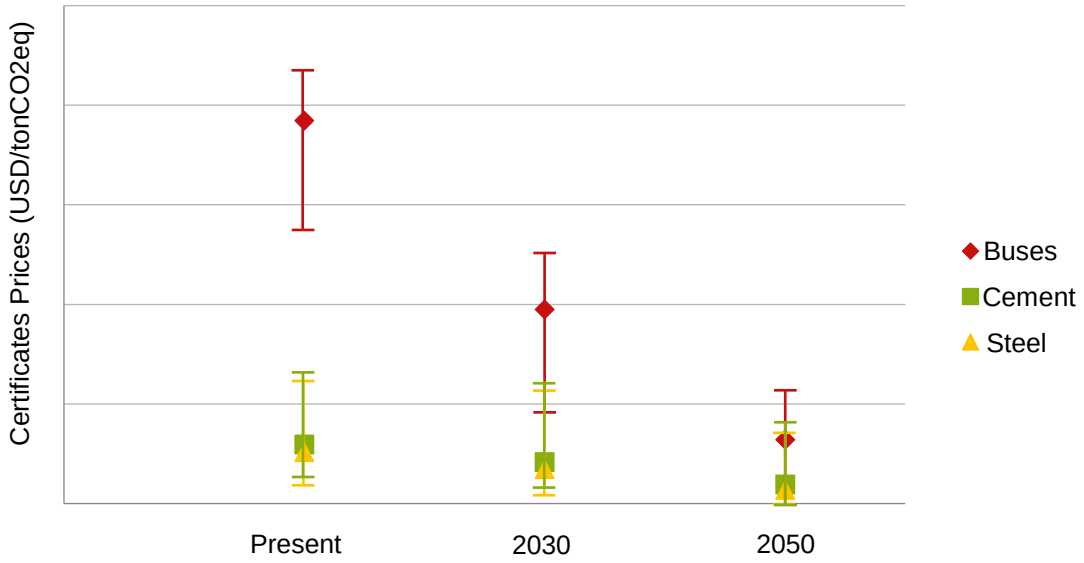
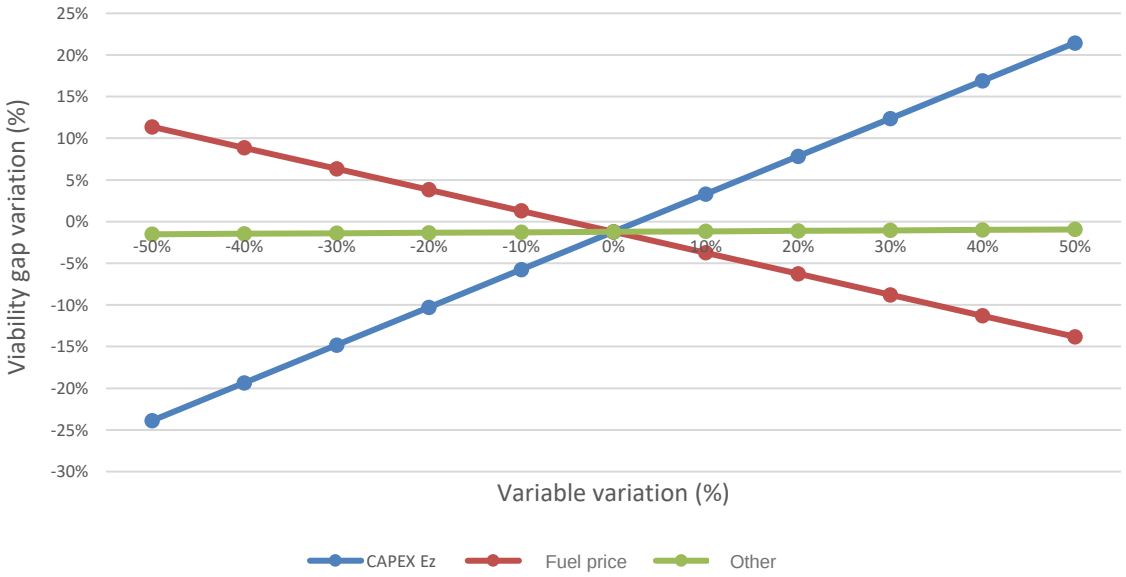
Case Studies: Carbon pricing to close the viability gap

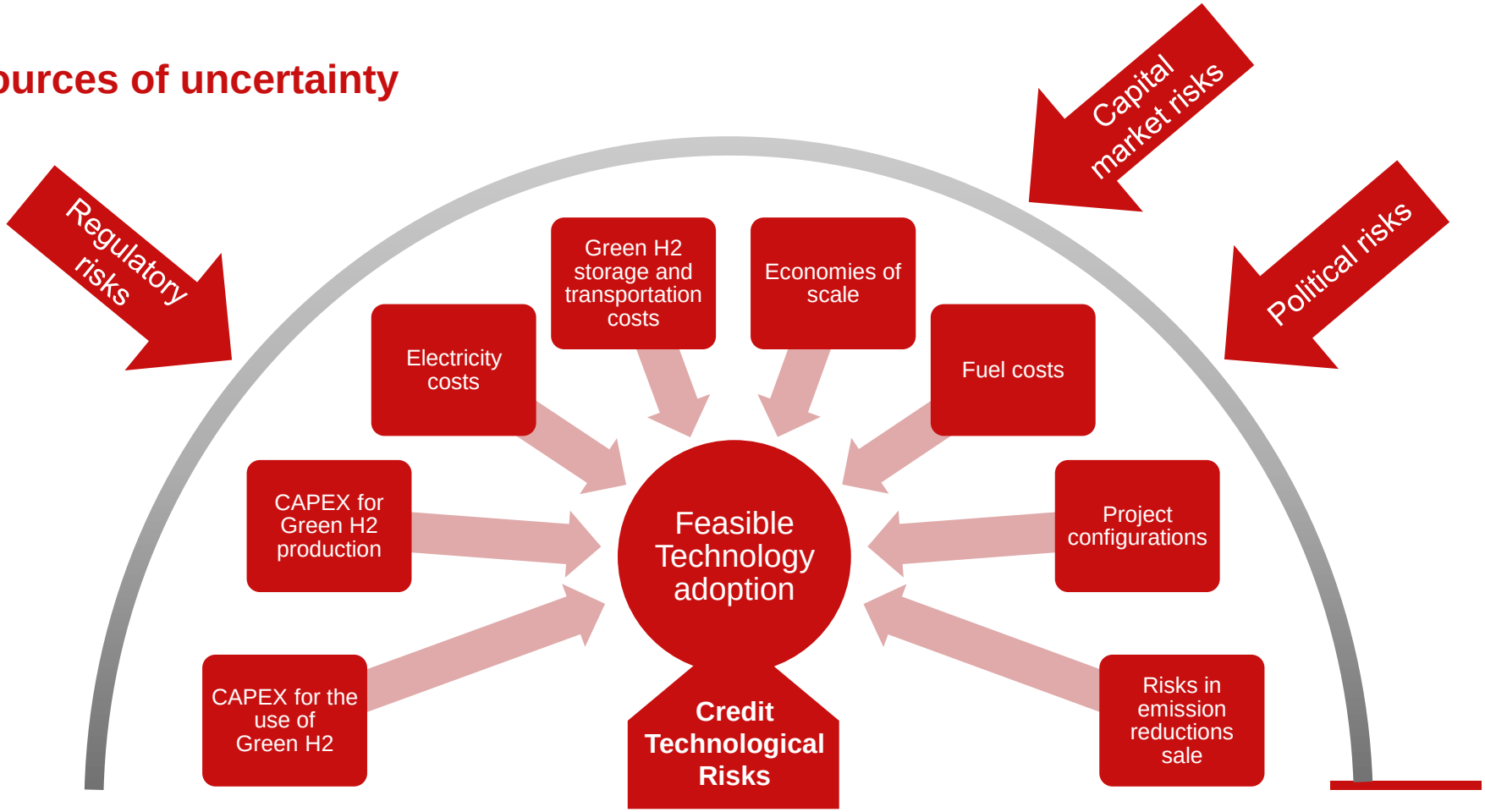


Trajectory scenarios	Present	2030	2050
Low prices	$10	$38	$52
High prices	$51	$62	$83

Case Studies: Sensitivity analysis



Sources of uncertainty



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Gap to cover after the sale of emission reduction certificates for steel case, in present value

	Present	2030	2050
Viability Gap (USD)	$ -429.192.255	$ -251.290.119	$ -24.458.137
Certificate Price that achieves viability (USD/tCO2e)	$ 205	$ 120	$ 12
Low Certificate Price (USD/tCO2e)	$ 10	$ 38	$ 52
Top Certificate Price (USD/tCO2e)	$ 51	$ 62	$ 83
Gap to cover (5 years)	$ -416.975.550	$ -204.866.641	$ 39.068.728
Gap to cover (5 years)	$ -366.887.060	$ -175.546.549	$ 76.940.514
Gap to cover (10 years)	$ -322.464.317	$ -121.542.430	$ 149.236.351
Gap to cover (10 years)	$ -408.265.208	$ -171.767.342	$ 84.362.506
Gap to cover (15 years)	$ -402.054.855	$ -148.167.999	$ 116.656.343
Gap to cover (15 years)	$ -290.791.515	$ -83.038.239	$ 200.782.283

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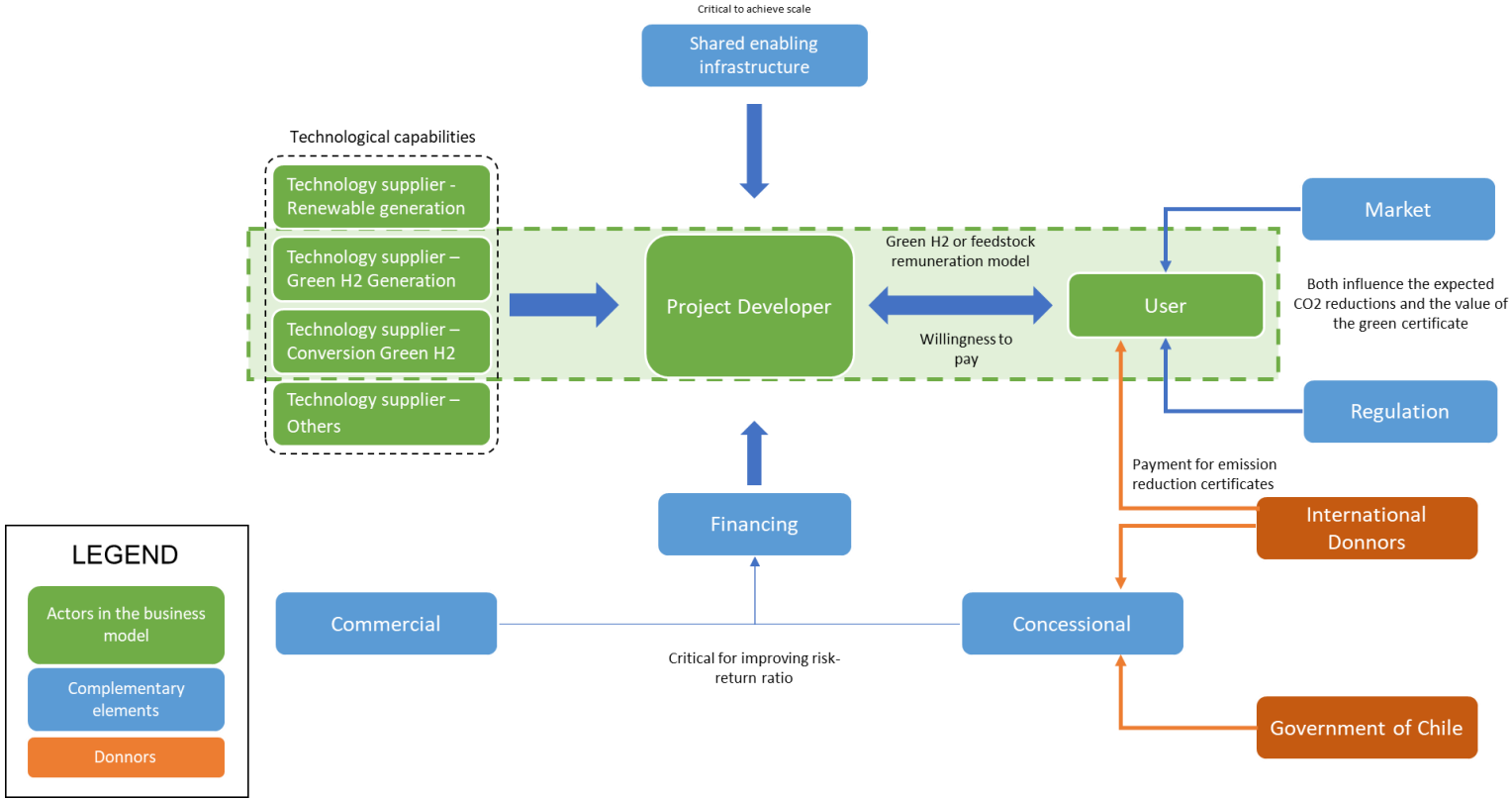
General architecture for the development of Green H2 projects in Chile



Conclusions

- Green H2 → strategic market within national energy and economic development policies
- But still faces barriers due to the immaturity of its value chain for the studied appliances
- These applications can trigger a Green H2 local demand which contributes with the maturity of the value chain, the transformational effect on public policy and the ability to deliver a market signal
- With private sector projects still in their pre-comercial phase, the growth and competitiveness of the Green H2 sector in Chile will depend on its business model and its access to a variety of international and domestic financing instruments
- Levelized Costs of Green H2 will probably fall faster than expected given intensified interest in hydrogen fuels globally, as well as carbon prices should increase under Article 6 instruments
- Article 6 cooperative approaches offer an important opportunity to attract international funding for Green H2 projects, increasing and complementing traditional forms of financing
- The level of policy uncertainty should be minimized, and clear market signals should be given to enable more sustainable business models to be configured with a long-term outlook

Potential of Article 6 to promote the use of Green Hydrogen in the steel, cement and mining related appliances

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Moderator

Katie Sullivan

IETA

Managing Director

Panelist

Juan Pedro Searle

Ministry of Energy Chile

Chief of Climate Change Unit

Panelist

María Paz de la Cruz

H2 Chile

CEO

Panelist

Phillip Hauser

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