

# CHILE'S STRATEGY FOR CLEAN ENERGY AND MOBILITY

## SOLAR ENERGY – LITHIUM – HYDROGEN

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Gobierno  
de Chile

# THE ECONOMIC DEVELOPMENT AGENCY



Our Mission is to improve the competitiveness and the productive diversification of the country by encouraging investment, innovation and entrepreneurship, strengthening in addition the human capital and technological capabilities to achieve a sustainable and territorially balanced development.



- Innovation grants
- R&D contract research grants
- R&D tax incentive



- Seed Capital
- Incubators
- Co-Works
- Start Up Chile



- Guarantees for financing SMEs
- PE & VC Funds
- Early Stage VC Funds



- SMEs programs
- Labor skills
- Smart Specialization programs

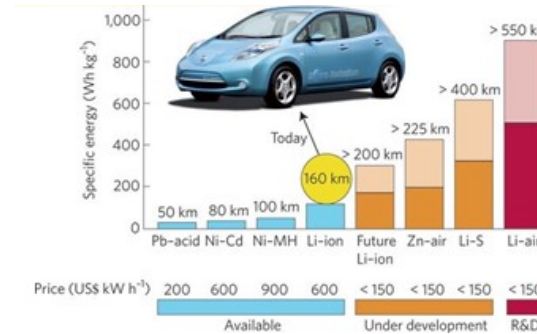


- Technology centres
- R&D Consortia
- Tech transfer (TTOs and Hubs)

# CLIMATE CHANGE: A DRIVER FOR INNOVATION

## ELECTROMOBILITY

- By 2035 there will be an annual production of 20-40 millions of electrical vehicles.
- Increasing demand of lithium.
- This will require additional 2 - 4 millions tons of low emission copper (10-20% of world production).



## SOLAR ENERGY

- Last power purchase bidding process in Chile (no subsidies):  
PV ~30 USD/MWh; CSP ~63 USD/MWh
- Technology development (PV for high radiation, storage with lithium/molten salts for CSP) could reduce the combined LCOE PV/CSP to 50 USD/MWh in 2025 and 40 USD/MWh in 2035.



## HYDROGEN

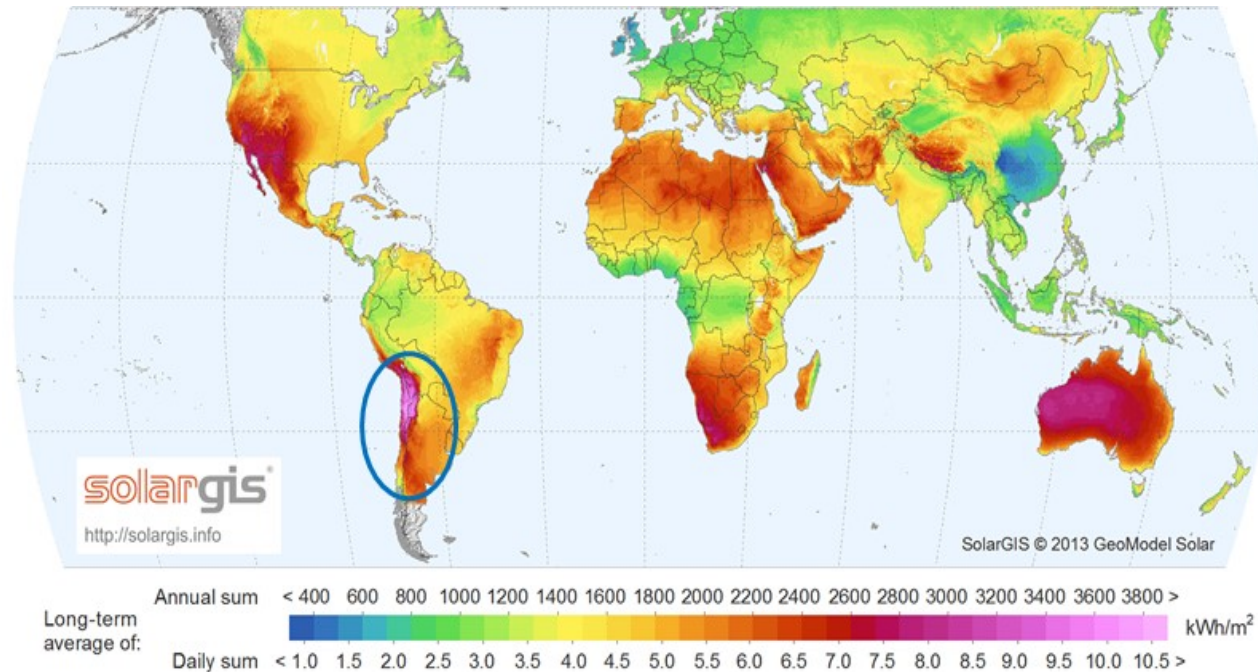
- Currently only 5% of H<sub>2</sub> production is based on electrolysis.
- The CAPEX for electrolyzers is foreseen to decrease to USD 5.000/kW by 2020.
- Germany, Japan and other countries are looking for overseas supply of zero-emission hydrogen.



# A UNIQUE OPPORTUNITY: GLOBAL TRENDS + LOCAL SINGULARITIES

## Atacama Desert singularities

- **Highest solar potential**  
>3.500 kWh/m<sup>2</sup>  
>3.000 sun hours/year
- **Biggest metallic mining district in the world**
- **Strong position in non metallic mining** -1rst in lithium production and natural nitrates (energy storage)



## Opportunities for Chile

- **Global trend:** exponential growth of electromobility and hydrogen-based economy
- At 2030 there will be 20-40 millions of electrical vehicles.
- It will need a production of additional 2 - 4 millions tons of low emission Copper (10-20% of world Production).

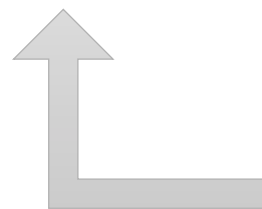
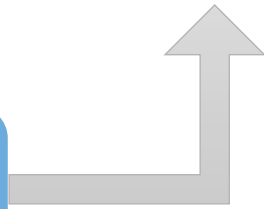


# INNOVATION STRATEGY: VISION 2025

**Chile: leading supplier of lithium and low-emission copper for the electric car industry**



World's leading lithium producer



World's largest low emission copper producer

Long term supply of lithium carbonate/hydroxide (battery grade)

Lithium added value products (cathodes, others)

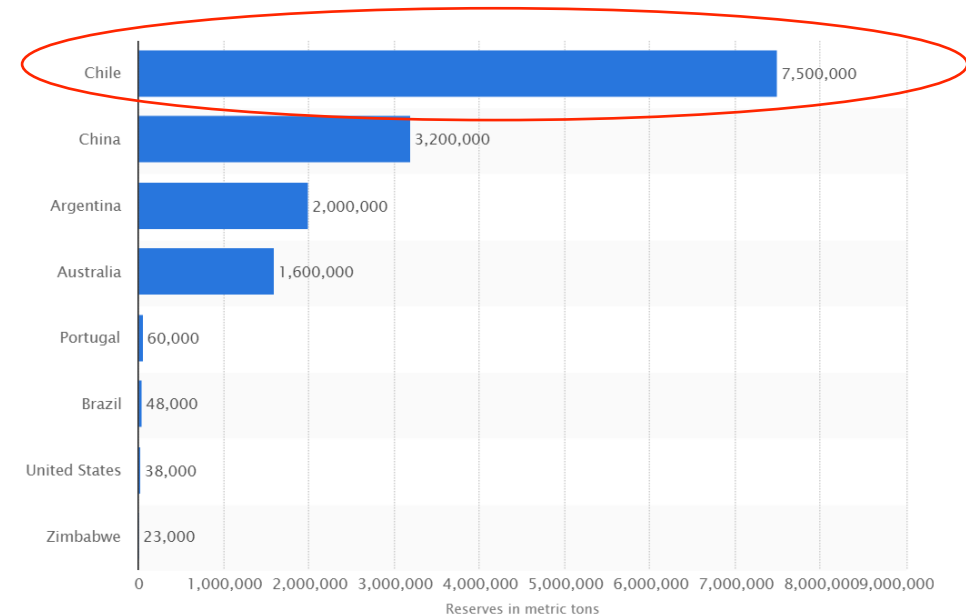
Solar energy for continuous electricity supply (mix PV/CSP) at average cost of 50 USD/MWh

Fossil fuels substitution  
Hydrogen and Synthetic fuels based on circular economy approach



# NATIONAL STRATEGY FOR LITHIUM DEVELOPMENT

- The Chilean government owns the lithium resources in the Atacama salt flat through Corfo, the Economic Development Agency. Albermarle and SQM are currently exploiting the mineral.
- Chile is expanding the production capacity through a recently signed agreement with Albermarle (ex Rockwood Lithium).
- Chile has the lowest production cost (evaporation of brines vs ore).
- Chile owns more than 50% of the world reserves.

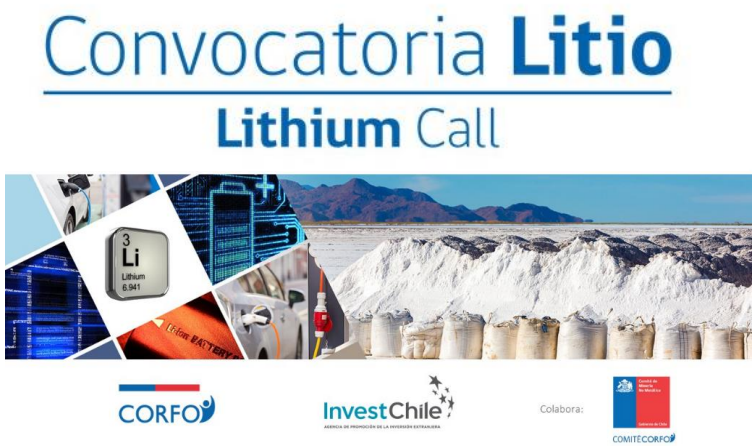


World Lithium Reserves  
Source: STATISTA 2016



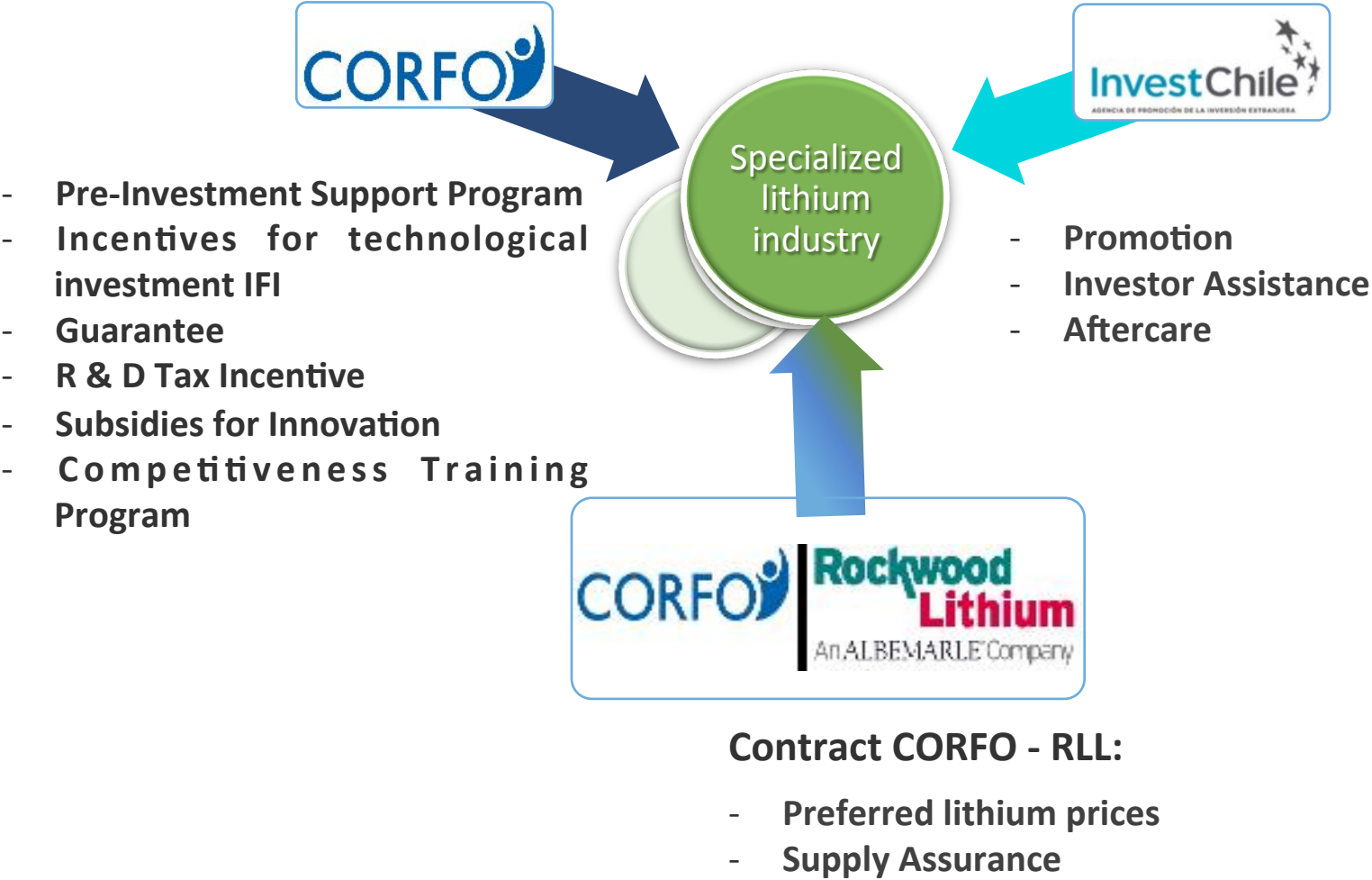


# CALL FOR INVESTMENT IN LITHIUM ADDED VALUE PRODUCTS



Call for expression of interest for installing manufacturing capacities in Chile – closes June 30.

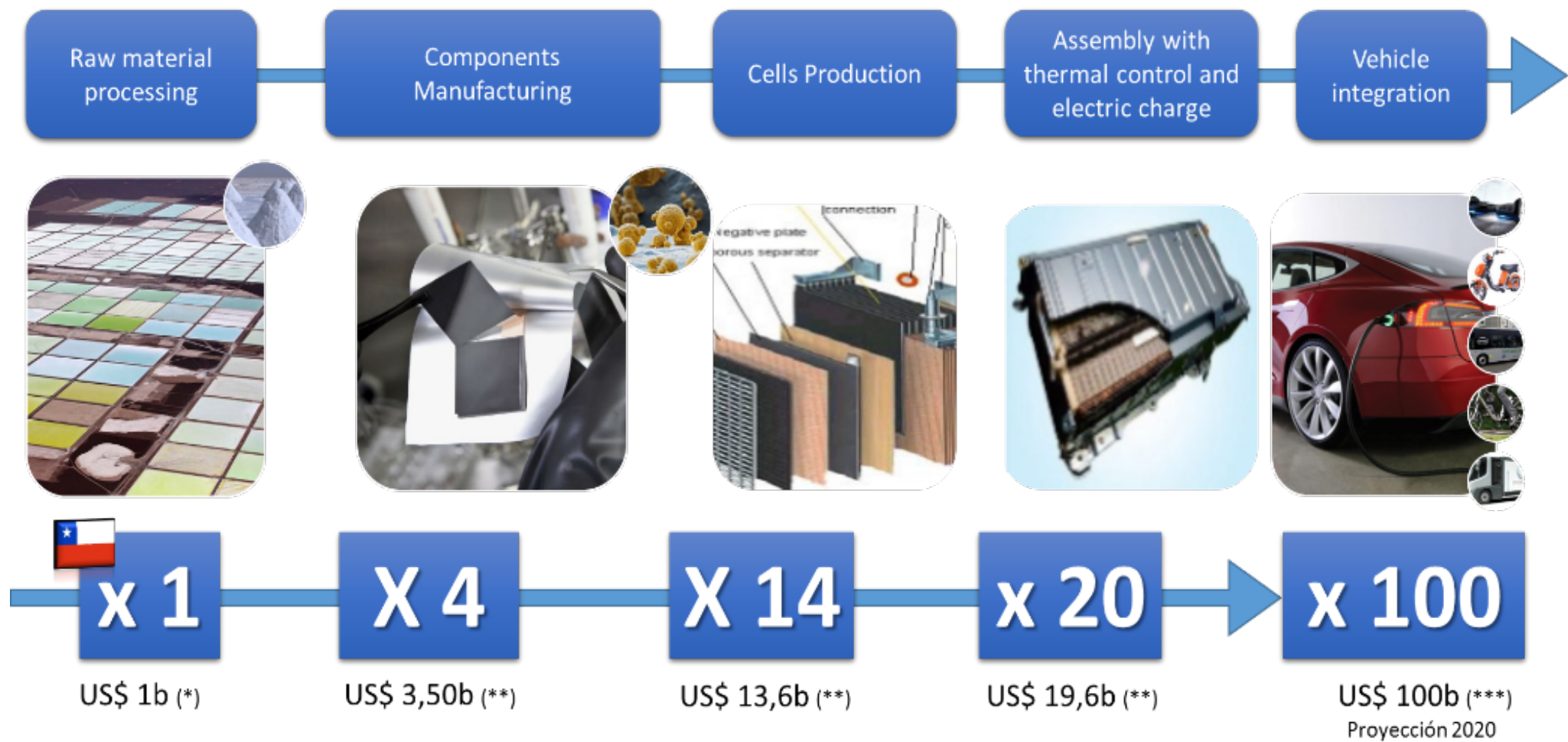
Roadshow: Frankfurt, Germany; May 18th







# CALL FOR INVESTMENT IN LITHIUM ADDED VALUE PRODUCTS



# SOLAR ENERGY PROGRAM 2016-2025

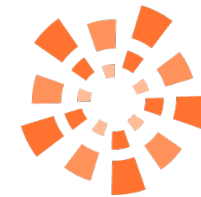
The Chilean Government has developed a collaborative process through CORFO (Chilean Economic Development Agency) and the Ministry of Energy to draft a 2025 Roadmap called Strategic Solar Program, which included participation by over 100 government, corporate, academic and civil society entities.

A common vision and a technology roadmap was developed.



More than 170 stakeholders

1380 HH workshops



PROGRAMA  
**ENERGÍA SOLAR**

100 INSTITUTIONS

More than 50 Initiatives



**Sociedad Civil**



**Gobierno**



**Industria**



**Empresas eléctricas**



**Ciencia y Tecnología**

# SOLAR ENERGY PROGRAM 2016-2025



PROGRAMA  
**ENERGÍA SOLAR**

This Roadmap seeks to take advantage of the Atacama Desert's unique features to develop a national solar power industry with technological capabilities and export-oriented. To this end, an initial portfolio of 50 initiatives was identified, with a total budget of US\$800 million.

## TECHNOLOGICAL DEVELOPMENT

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- Photovoltaic systems for desert application
- Solar mining and metallurgy program
- CSP and Thermal energy storage system program
- Solar desalination
- Solar fuels program
- Advanced human capital program

## INDUSTRIAL DEVELOPMENT

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- Open innovation platform
- Innovation challenges financing
- High-tech investment attraction program

## REINFORCING QUALITY INFRASTRUCTURE AND HUMAN CAPITAL FOR INDUSTRY

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- Climate characterization
- Metrological network
- Standards
- Conformity assessment schemes
- Certification of labor competencies program

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Solar Corridor “Cuenca del Salado”

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Solar Technological District

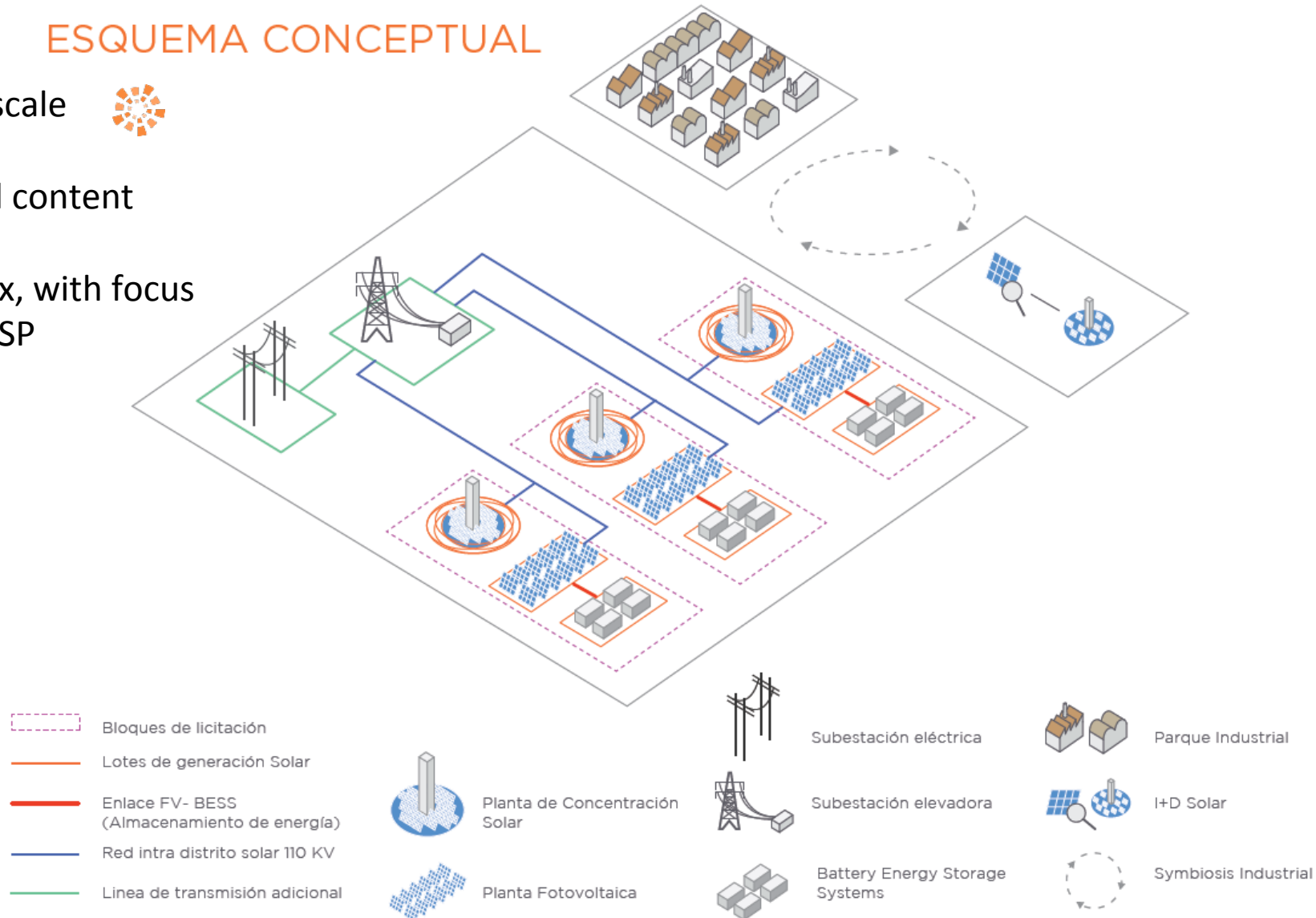


# SOLAR TECHNOLOGICAL DISTRICT – 1 GW

## Integration with Industrial-Symbiotic Park

### ESQUEMA CONCEPTUAL

- Economies of scale 
- Increased local content
- Technology mix, with focus on improved CSP



### POTENTIAL INDUSTRIAL DEVELOPMENT

Lithium products

Solar Fuels

Energy Storage

Solar Metalurgy

Water treatment

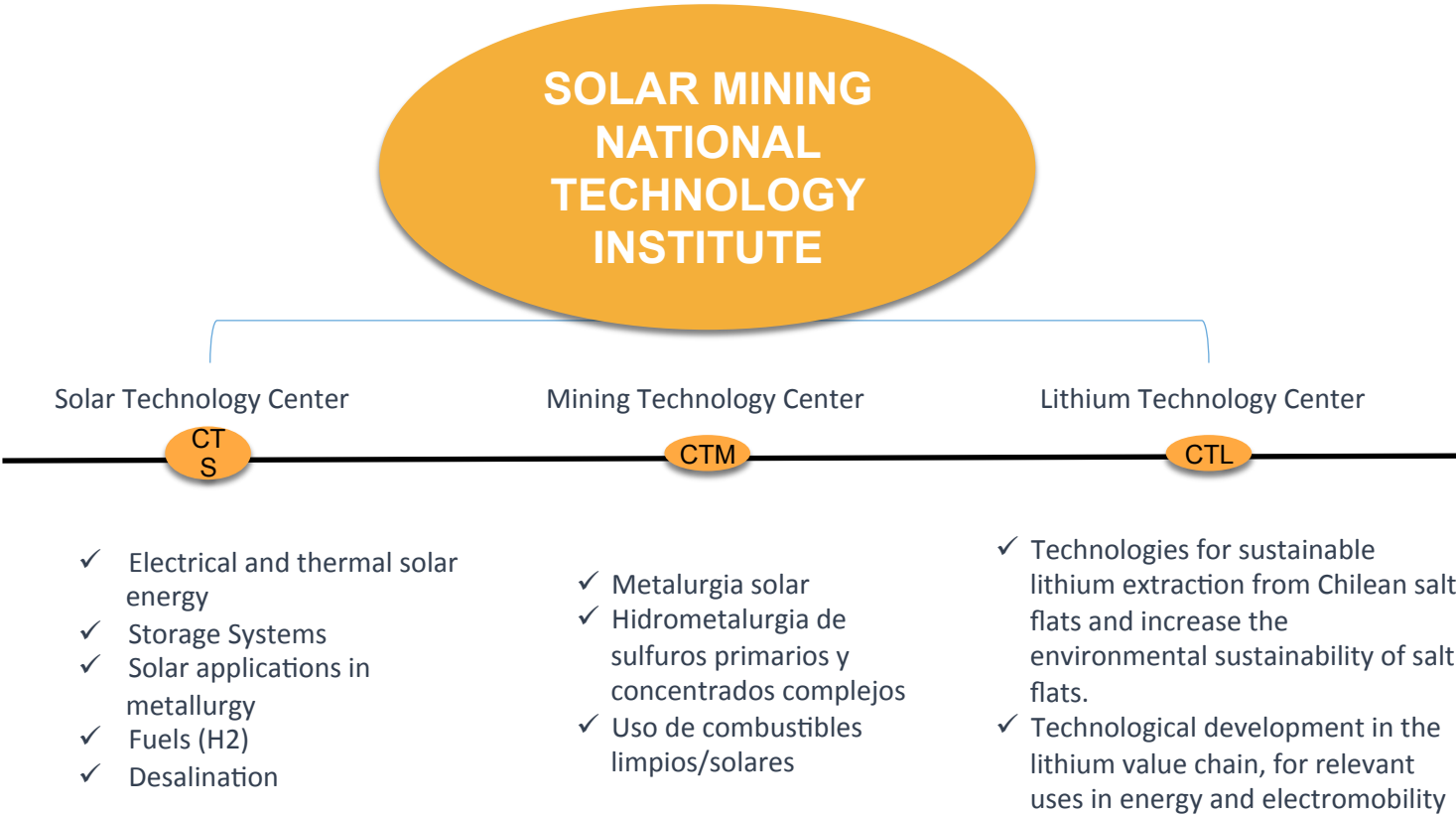
PV modules assembly

Metalmechanic Industry

# SOLAR MINING NATIONAL TECHNOLOGY INSTITUTE

Currently under creation

## AREAS OF SPECIALISATION



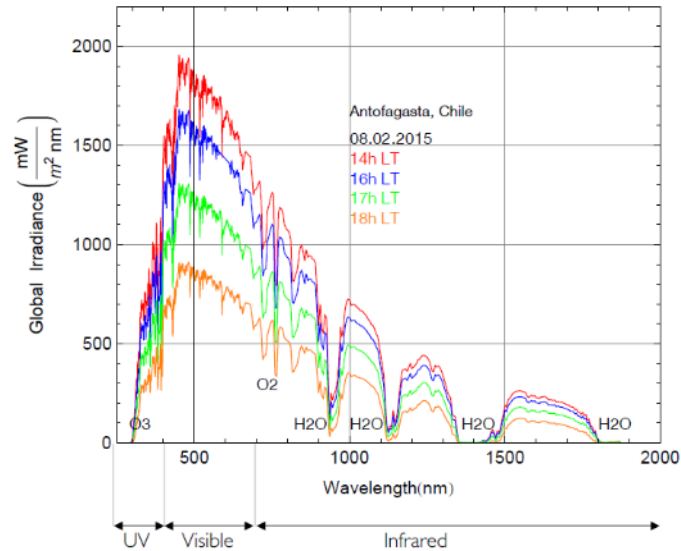
## ROLES AND SERVICES

- R&D&i: own strategic lines with technology transfer models (sale or licensing, spin offs)
- Contract Research and Technological Development contracts with Industry
- Piloting and Technology validation services
- Specialized Technological Services
- Broad technological diffusion and extensionism
- Training of advanced human capital – in alliance with Universities

# TECHNOLOGY CONSORTIUM FOR PV TECHNOLOGIES ADAPTED TO HIGH RADIATION IN DESERT CLIMATES

To adapt and/or develop solar photovoltaic power technologies that respond better to the unique conditions in desert and high-radiation regions in terms of their durability and expected performance that lowers the **levelized cost of energy to a target of US\$25/MWh by 2025** and placing special emphasis on the development and strengthening of local suppliers to create a sophisticated industrial network aimed at supplying goods and services in both Chile and abroad.

Call closed  
May 16th,  
2017



	Condiciones estándar (STC)	Desierto de Atacama
AM (air mass)	1.5	1.17
Irradiancia	1000 W/mt2	> 1100 W/mt2
Radiación UV		35 - 65 % UV-B más que en Europa
Temperatura de la celda	25 °C	> 60°C
Módulo tipo	250 Wp	± 30% (200 – 300 Wp)



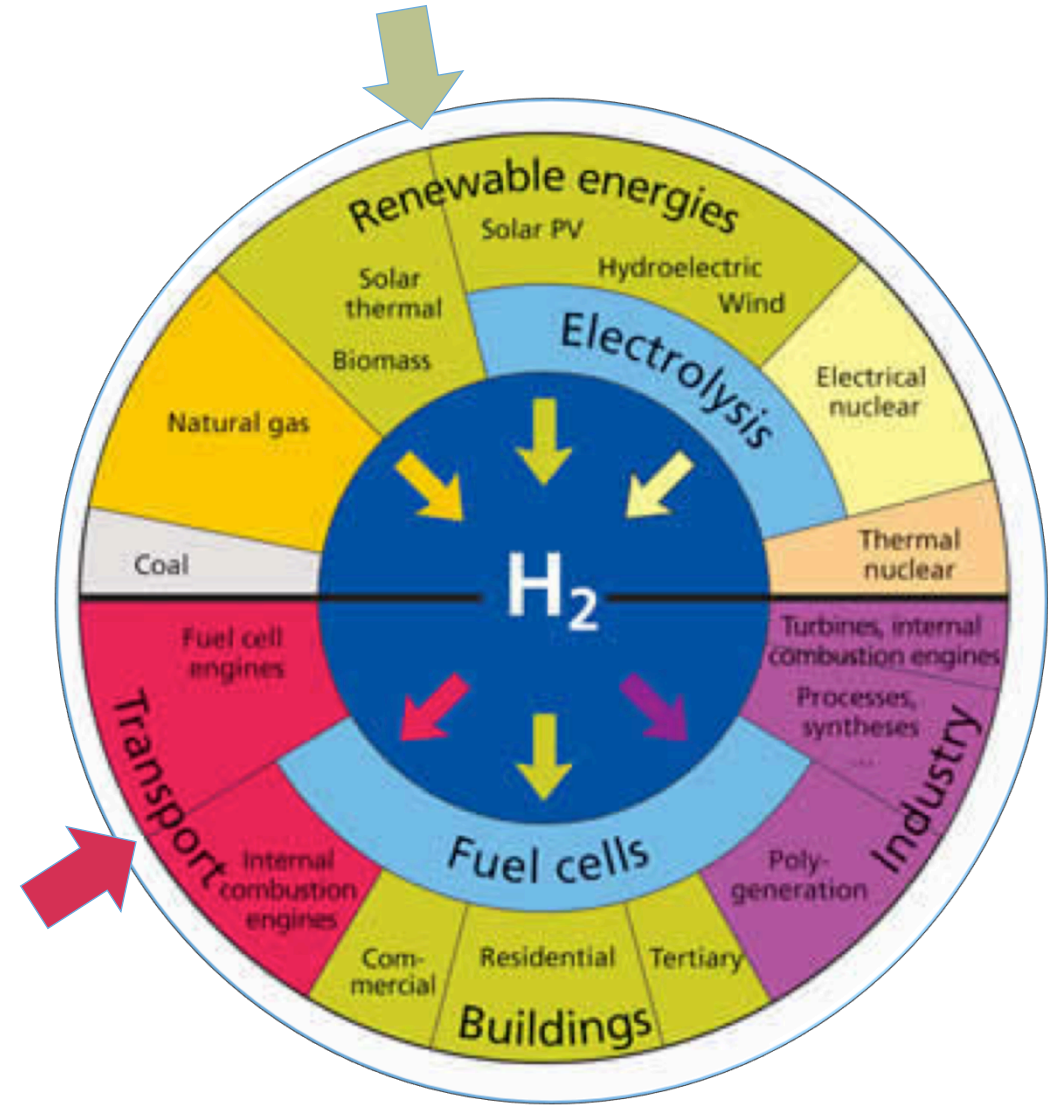
Source: Estudio Caracterización del Espectro Solar – Programa Solar



# HYDROGEN POTENTIAL

Chile has conditions to become a privileged site for zero-emission hydrogen production

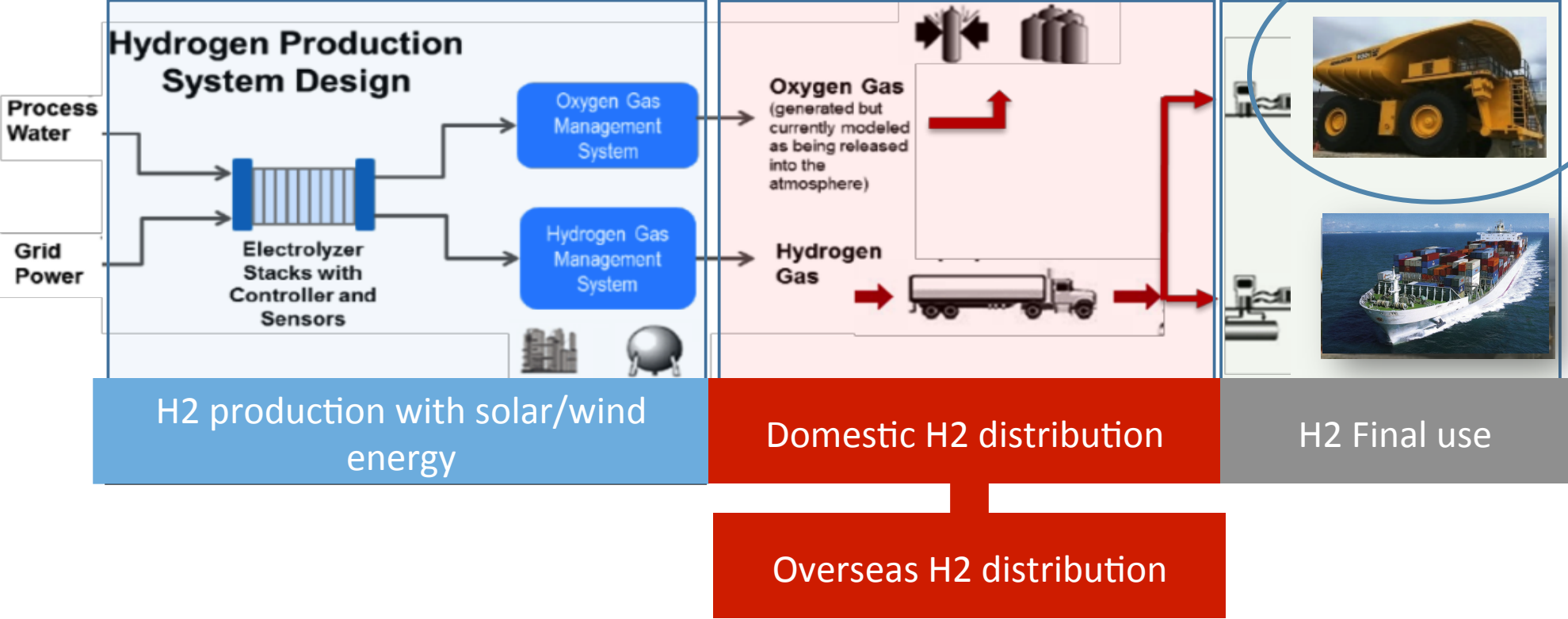
- Solar energy prices: PV/CSP at average price of:
  - **USD 50/MWh by 2025**
  - **USD 40/MWh by 2035**
- Local consumption for mining and maritime transport
- International demand



# HYDROGEN STRATEGY 2035

Technology Consortium for piloting dual  
hydrogen-diesel combustion for mining trucks

Call will  
open May  
2017







WELCOME EUREKA TO JOIN THIS GLOBAL OPPORTUNITY  
@CORFO

