



COMITÉ SOLAR
E INNOVACIÓN ENERGÉTICA



CORFO

CSP SUMMIT 2019

CSP in the Chilean electric market



Source: Cerro Dominador, 2019

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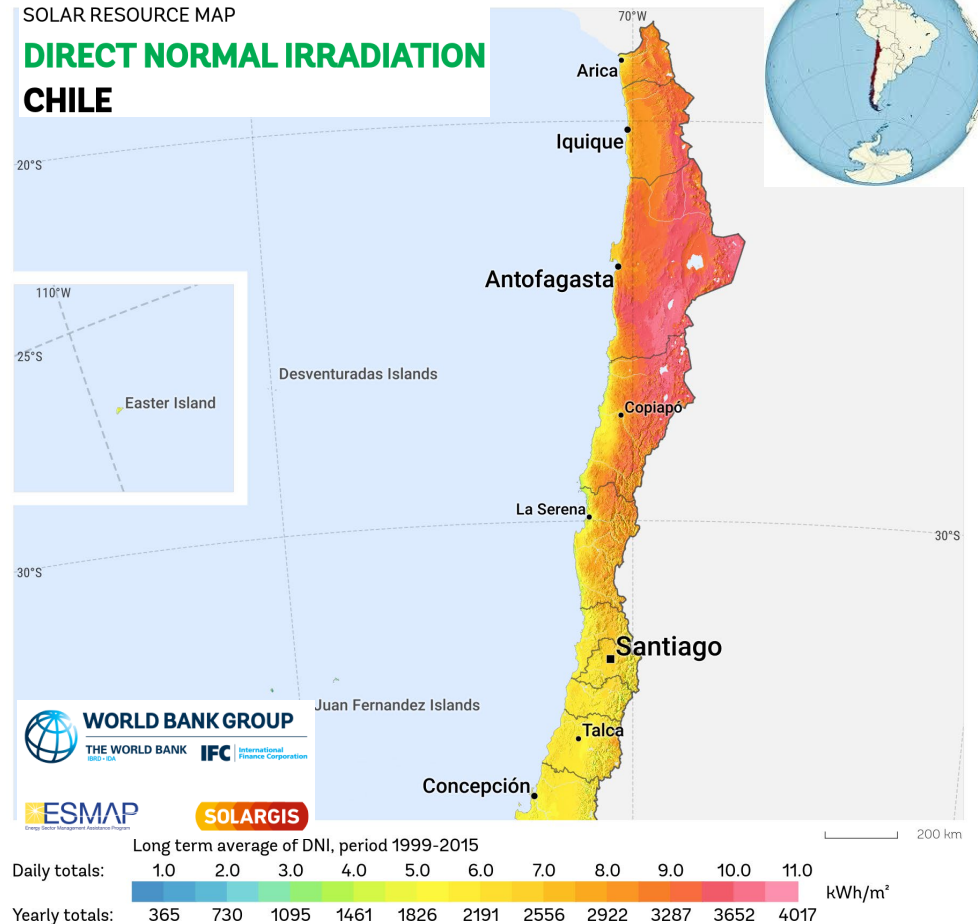
3. Strategies

- ISO Forecasting and decarbonization plan
- New Association of CSP (ACSP)
- INTERNATIONAL CALL Chilean Clean Tech Institute



1. SOLAR RESOURCE

- Quantity
 - **1,800 GW (1,300 GW PV, 500 GW CSP) estimated solar resource**
- Quality
 - DNI over $\sim 3,200$ kWh/m² per year (mainly in Antofagasta region)
 - Over $\sim 4,000$ hours of sunshine per year
 - Excellent conditions of atmospheric attenuation. There is an exceptional visibility in the Atacama Desert, which usually exceeds 70 km \rightarrow more efficient operation for CSP tower technology
 - GHI over $\sim 2,400$ kWh/m² per year
 - PVOU over $\sim 2,200$ kWh/kWp per year





1. SOLAR RESOURCE

- 200 GW solar power plants could supply 30% of South America power demand to 2030 (surface of 6.000 km²)

Source: SERC Chile

- 2.5 GW power estimated as necessary for supplying of 30% of Japan hydrogen demand

Source: Comité Solar Universidad Sapienza de Roma, 2018.

- Chilean power demand to year 2046 would require

- 25 GW (FV+CSP) non decarbonization (PELP)
- 30 GW (FV + CSP) decarbonization scenarios (ISO)

Source: Ministerio de Energía, PELP 2017 y CEN, 2019.

- **Adding, we are talking of 12,9 % of 1,800 GW of solar potential**

Power grids interconexions in Latinameric

Source: Comisión de Integración energética Regional (CIER,





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1. CHILEAN ELECTRICITY MARKET



Ministry of Energy – National Energy Commission – Electricity Superintendence

CEN (ISO)



Private, technical and independent
organization regulated by Law

Generation



Private, Free
Energy Prices

Transmission



Private, Regulated
Prices

Distribution



Private, Regulated
Prices

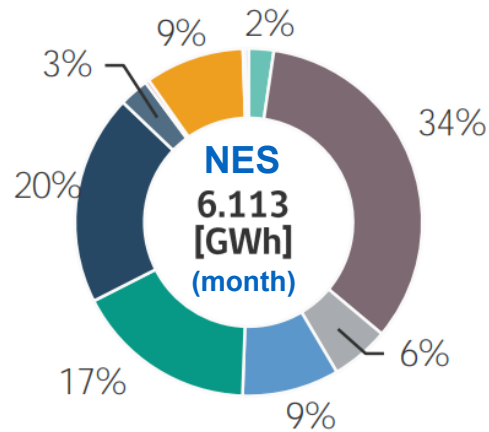
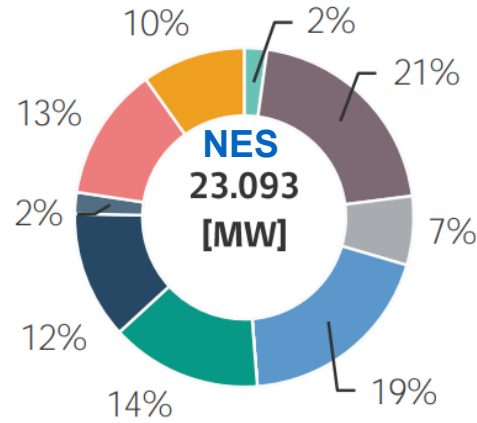
Clients













Non-regulated and
Regulated (<5 MW)



1. ELECTRIC SYSTEM



-  Wind
-  Diesel
-  Coal
-  Biomass
-  Natural Gas
-  Solar Photovoltaic
-  Run-of-river
-  Hydroelectric Dam
-  Small Run-of-river (< 20 MW)
-  Geothermal

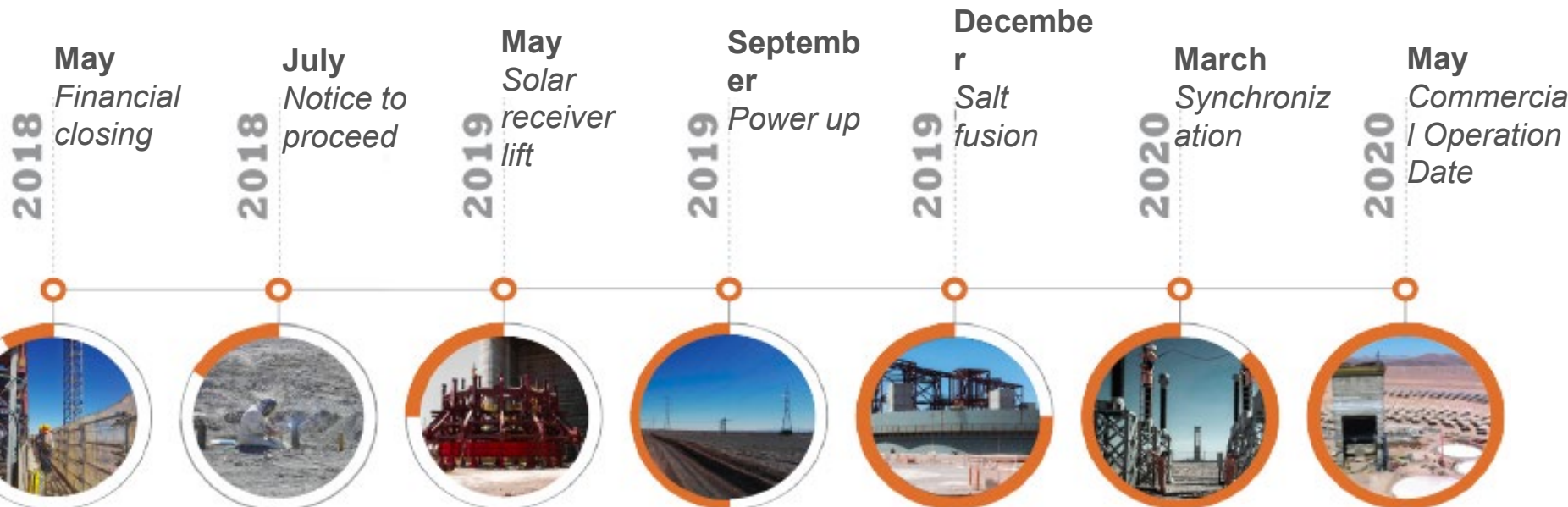


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2. STATUS OF FIRST CSP POWER PLANT IN CHILE



- 100 MWp PV Power Plant grid connected from 2018
- CSP Power plant 110 MW and 17.5 hours of storage, schedule 2019 - 2020



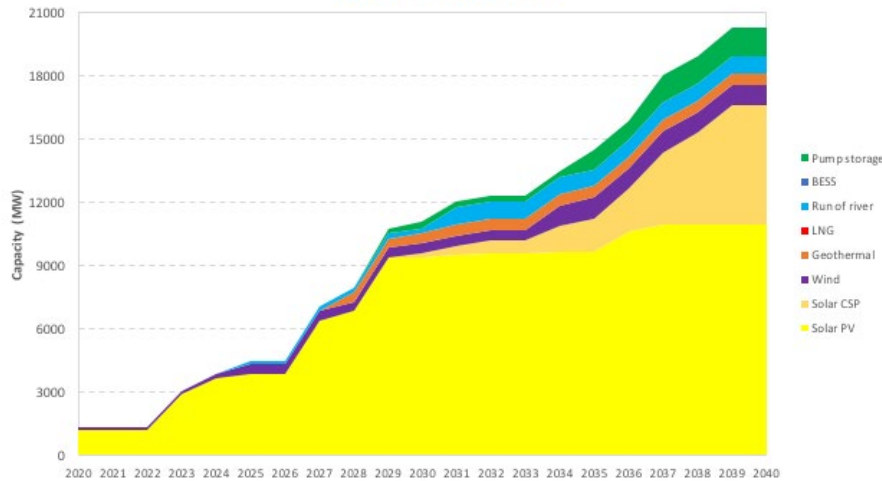
3. STRATEGIES – ISO FORECASTING AND DECARBONIZATION PLAN

- Currently there are ~ 5 GW of coal plants in operation (27 plants, 67% in the north of Chile, 43% power generation)
- Since June 2018 the Ministry of Energy and the 4 companies that own the coal plants are preparing a Decarbonization Plan, which will be announced during 2019
- Decarbonization Plan considers several aspects, such as:
 - Security in the operation of NES.
 - Environmental, labor and social impact.
 - Operating and investment costs in generation and transmission projects.
- In November 2018, the National Electric Coordinator (ISO) made a long-term projection, to determine the impact of the progressive removal of coal plants
 - The replacement of coal plants is projected with CSP (mainly), wind, geothermal, run-of-river and hydraulic pumping technologies, since year 2027 onwards



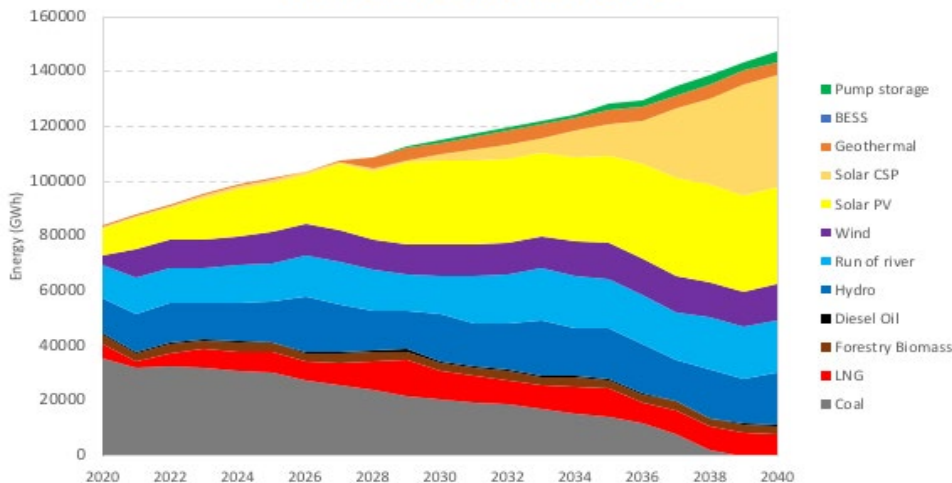
3. STRATEGIES – ISO FORECASTING AND DECARBONIZATION PLAN

Power installed - AM01a



- Solar PV and CSP are the expansion technologies
- **CSP** starting on 2030, it was modeled as **baseload** technology replacing coal power plants
- **5 GW capacity is required for replacing coal power plants**

Energy Generated for Scenario AM01a



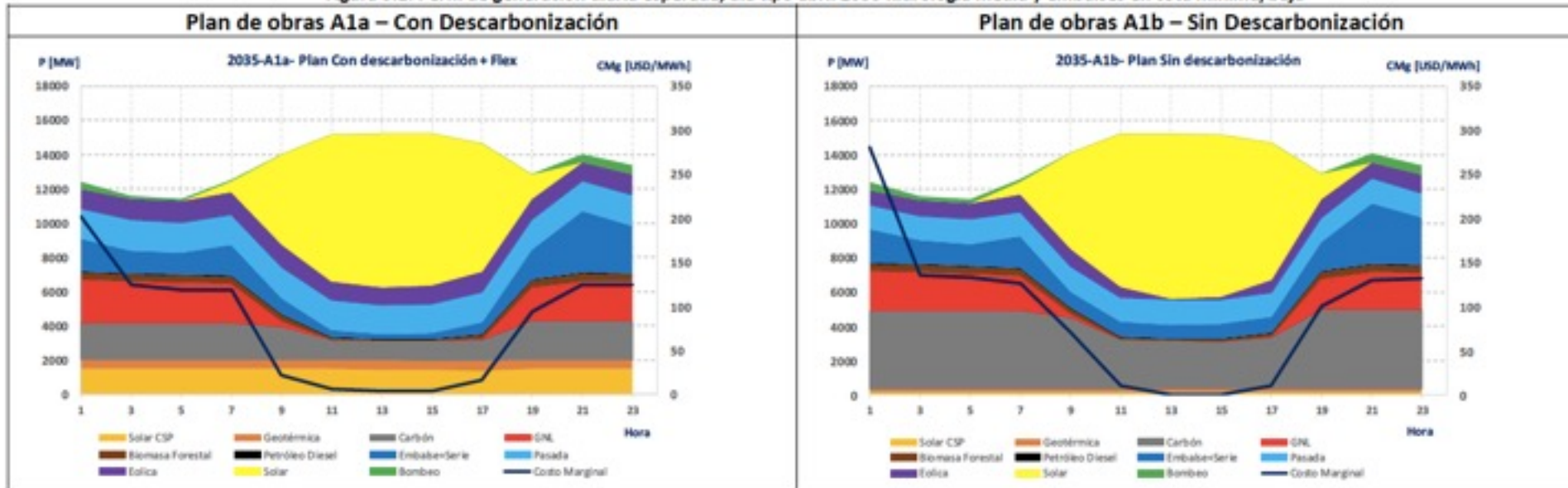
- PV plants would be the third generation source in 2019 (instead of natural gas), and after coal plants and hydroelectric plants
- CSP Energy generated increase from 2.321 GWh (2030) to 40.735 GWh (2040)
- **52% solar energy** (24% FV and 28% CSP) to 2040
- **36% of variable generation (wind and solar PV) to 2030**, supported by hydro if transmission systems are expanded accordingly



3. STRATEGIES – ISO FORECASTING AND DECARBONIZATION PLAN

Generation profile for a day on April 2035, media hydrologie and dumps in minimum/low

Figura 5.1: Perfil de generación diaria esperada, día tipo abril 2035 hidrología media y embalses en cota mínima/baja



- CSP was modeled as base load, flexible attributes have not been considered
- Part of the capacity of coal-fired plants is replaced by new generation capacity based on CSP plants, and by a greater insertion of wind
- With or without decarbonization marginal costs will be zero during daily hours and those of high costs operates at minimum technics



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3. STRATEGIES - ASSOCIATION OF CSP (ACSP)

- ACSP was created October 18th, 2018
- The goal is to promote the development of CSP technology in Chile



- Seminar “CSP: A key option for the energy transition in Chile” Santiago, Chile on April 25th, 2019



3. STRATEGIES - ASSOCIATION OF CSP (ACSP)

FLEXIBILITY LAW

Deliver technical information to regulators in order to achieve in the regulation to deliver a correct recognition and remuneration to the CSP

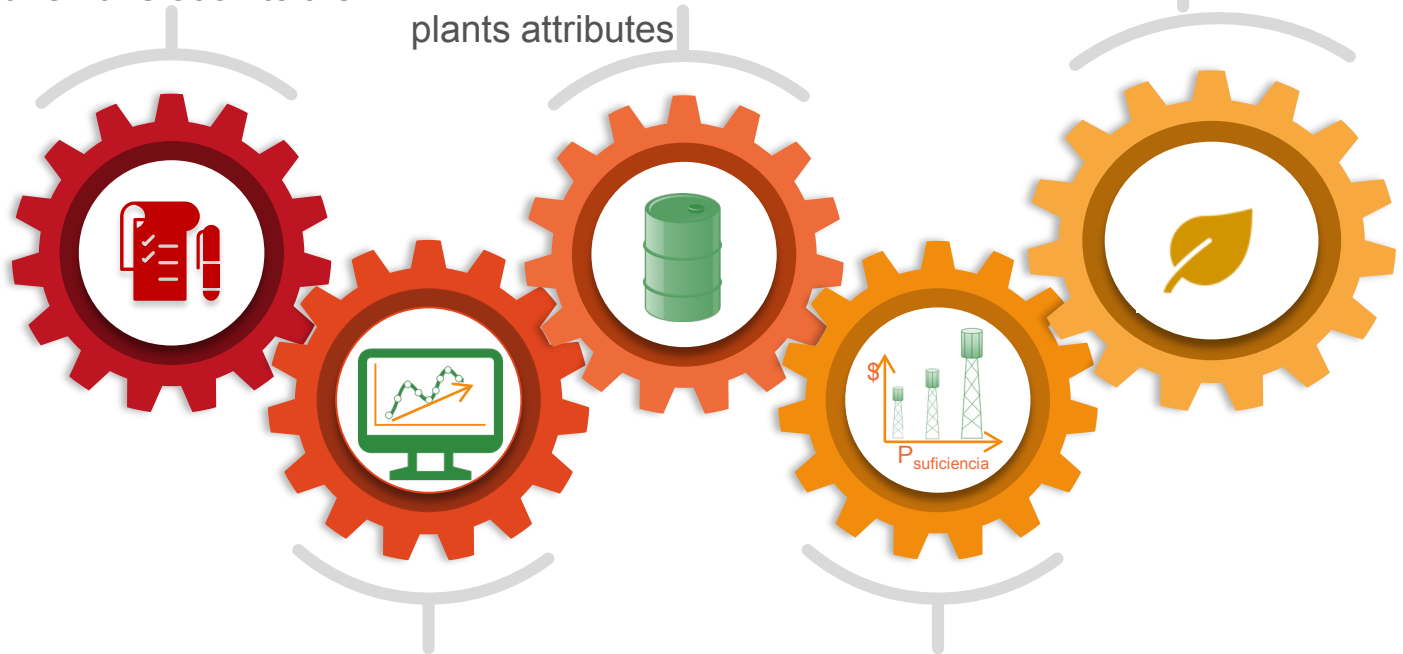
DISPATCH

Review of coordination and operation methodology to maximize the use of CSP plants attributes

ENVIRONMENTAL

Recognize contribution to reduction of local (PM, NO, SO2) and global (CO2) pollutants

Estimated LCOE:
61 and 66 USD/MWh if energy incomes or energy plus capacity incomes are considered



MODELING: LONG TERM ENERGY PLANNING (PELP) & DECARBONIZATION PLANS

To include adjusted CAPEX & OPEX and base load, flexible or peaker CSP plants (not just one type)

FIRM POWER

To ensure that CSP technology receives the right incomes

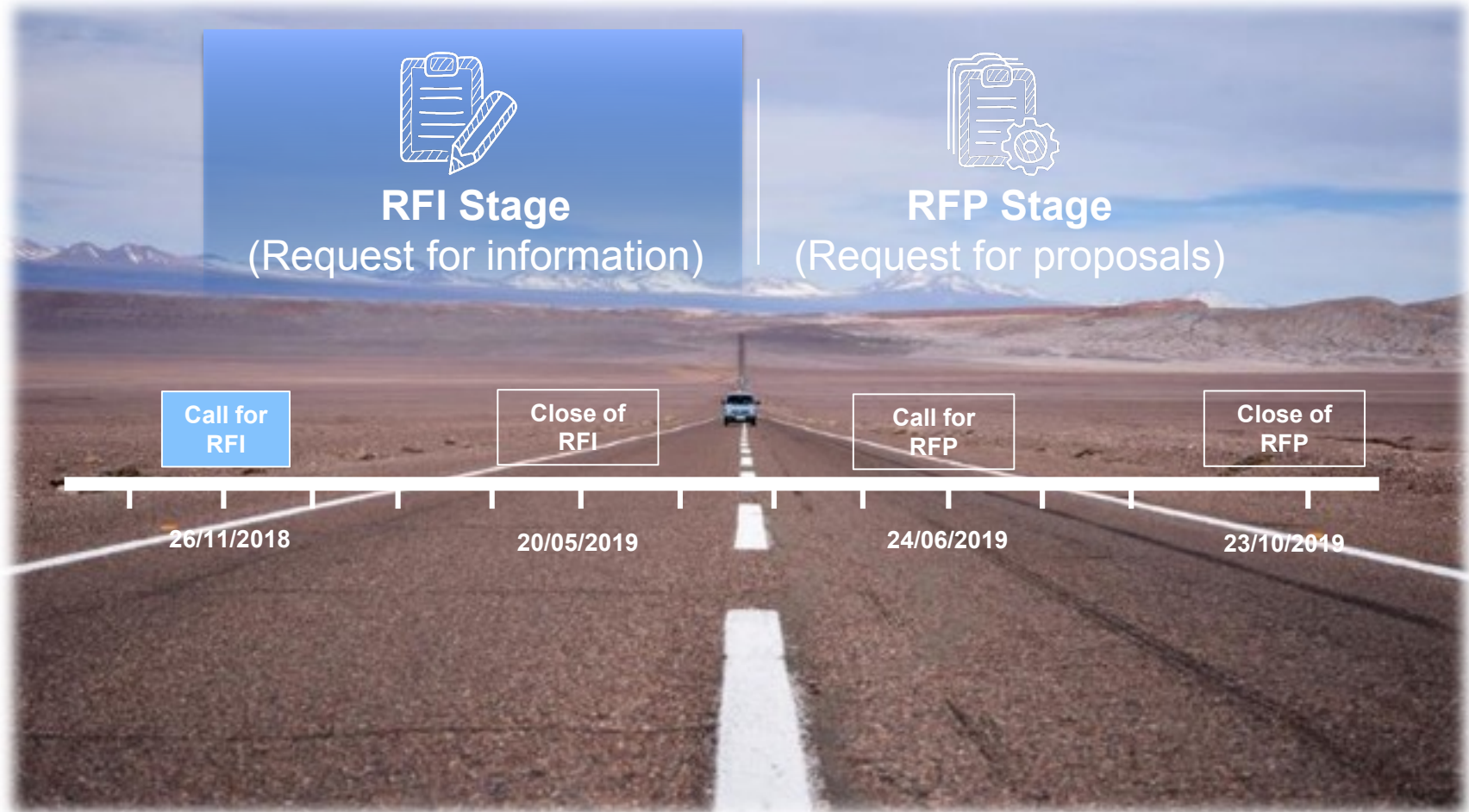


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4. STRATEGY – CHILEAN CLEAN TECHNOLOGY INSTITUTE

International call for CHILEAN CLEAN TECH INSTITUTE

Focus on Solar energy, low emission mining and advanced materials of lithium and other minerals





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4. STRATEGY – CHILEAN CLEAN TECHNOLOGY INSTITUTE

Subsidy

Up to USD 193,000,000 over a
period of 10 years.

With a minimum of 30% of
private co-financing.



Antofagasta

The Institute will have an infrastructure that allows, technology test sites (testbench), industrial pilot plants and laboratories for applied research.

RFI stage Term of References in

https://www.corfo.cl/sites/cpp/convocatorias/instituto_tecnologico_de_energia_solar



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4. STRATEGY – CHILEAN CLEAN TECHNOLOGY INSTITUTE



- Development and integration of solar fuels.
- Innovations to integrate solar heat in mining and industrial processes.
- Desalination and water treatment.
- Solar electricity and storage technologies.

- A circular economy approach and the reduction of the carbon footprint in metal and non-metal mining.
- New low emissions mining-metallurgical processes.
- Innovations for the traceability of greenhouse gases emissions.

- Innovations in advanced materials based on lithium, salts and other strategic minerals.
- Development of technologies to extract and concentrate scarce products used in batteries and storage, such as cobalt, more efficiently.



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Thanks for your attention

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