CHILEAN EXPERIENCE IN DEVELOPING ELECTRIC POWER INFRASTRUCTURE

Ministerio de Energía

Gobierno de Chile

1st Workshop for APEC Initiative for Enhancing Quality of Electric Power Infrastructure

August 26th - 27th , 2015

On behalf of Chilean Ministry of Energy, The National Energy Commission and my own, I would like to express our gratitude to the organized committee, to METI, KPMG, APEC, APERC and Japanese government for the opportunity to participate in this APEC Workshop.

The Chilean electric power grid is organized in four independent systems. From north to south, they are the Northern Interconnected System (SING), the Central Interconnected System (SIC), and two medium size systems in the extreme southern region.

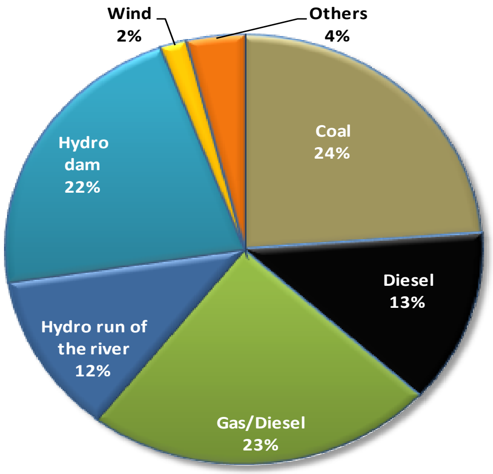
System	Regions	Gross Capacity Dec-2014	Generation 2014	Max. Demand 2014
SING	Arica y Parinacota Tarapacá Antofagasta	4,461 MW Share: 22.8%	17,762 GWh 2.70%	2,362 MW 6.33%
SIC	Atacama Coquimbo Valparaiso Región Metropolitana Lib. Gral. Bdo O'Higgins Bio Bio Araucanía Los Ríos Los Lagos	15,141 MW Share: 76.4%	52,243 GWh 2.66%	7,536 MW 3.56%
Aysén	Aysén Palena General Carrera	50 MW Share: 0.25%	157 GWh 3.70%	27.3 MW 12.3%
Magallanes	Punta Arenas Puerto Natales Porvenir Puerto Williams	112 MW Share: 0.56%	297 GWh 2.36%	52.7 MW 1.90%

SING and SIC systems are the most relevant, as they concentrate near 99.1% of the installed generation capacity. SING system is almost 100% thermal (99.6% thermal and 0.4% hydraulic), while SIC system is hydrothermal with a mix of 42.7% hydroelectric, 55.0% thermoelectric and 2.3% of wind generation capacity. The other two medium size systems in the southern region of the country have approximately 165 MW of installed capacity.

- SIC system is located between Taltal and the Chiloé Island, covering an extension of 326,412 km^2. It supplies more than 90% of Chile's total population and has an installed gross capacity of 15,141 MW as of december 2014. Maximum demand in the year 2014 was 7,536 MW. In this system, almost 70% of the generation is consumed by regulated customers through distribution companies.

- SING system is located between the cities of Arica and Antofagasta covering an extension of 185,142 km^2. It has an installed gross capacity of 4,461 MW as of December 2014. Maximum demand in year 2014 was 2,243 MW. It provides energy mainly to large non-regulated customers as mining and industrial customers which represent near 90% of the total system demand

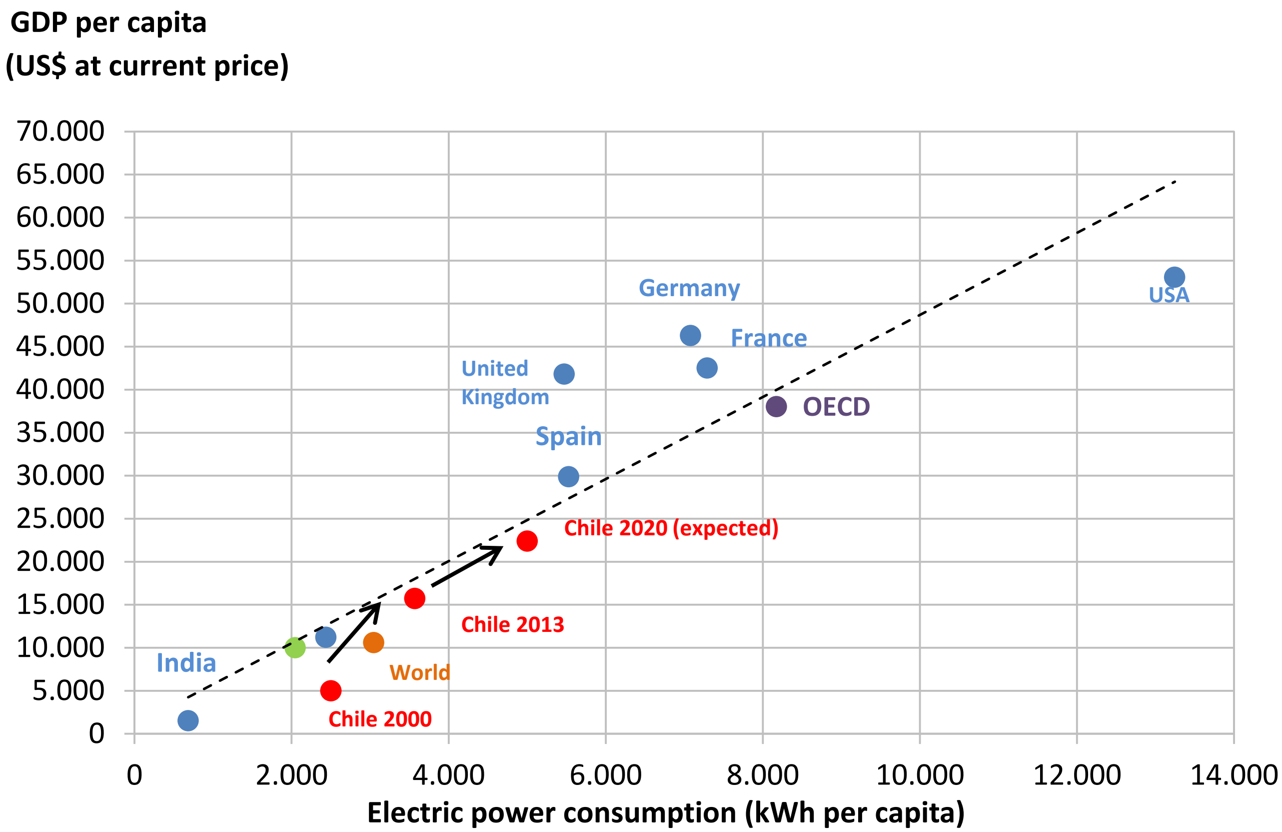
Chilean electricity structure is based on a competitive market with a private efficiently investment in generation and regulated private investment in Transmission & distribution sector.



Installed gross capacity in both SIC and SING interconnected systems per fuel type as of Dec 2014 Source: CNE

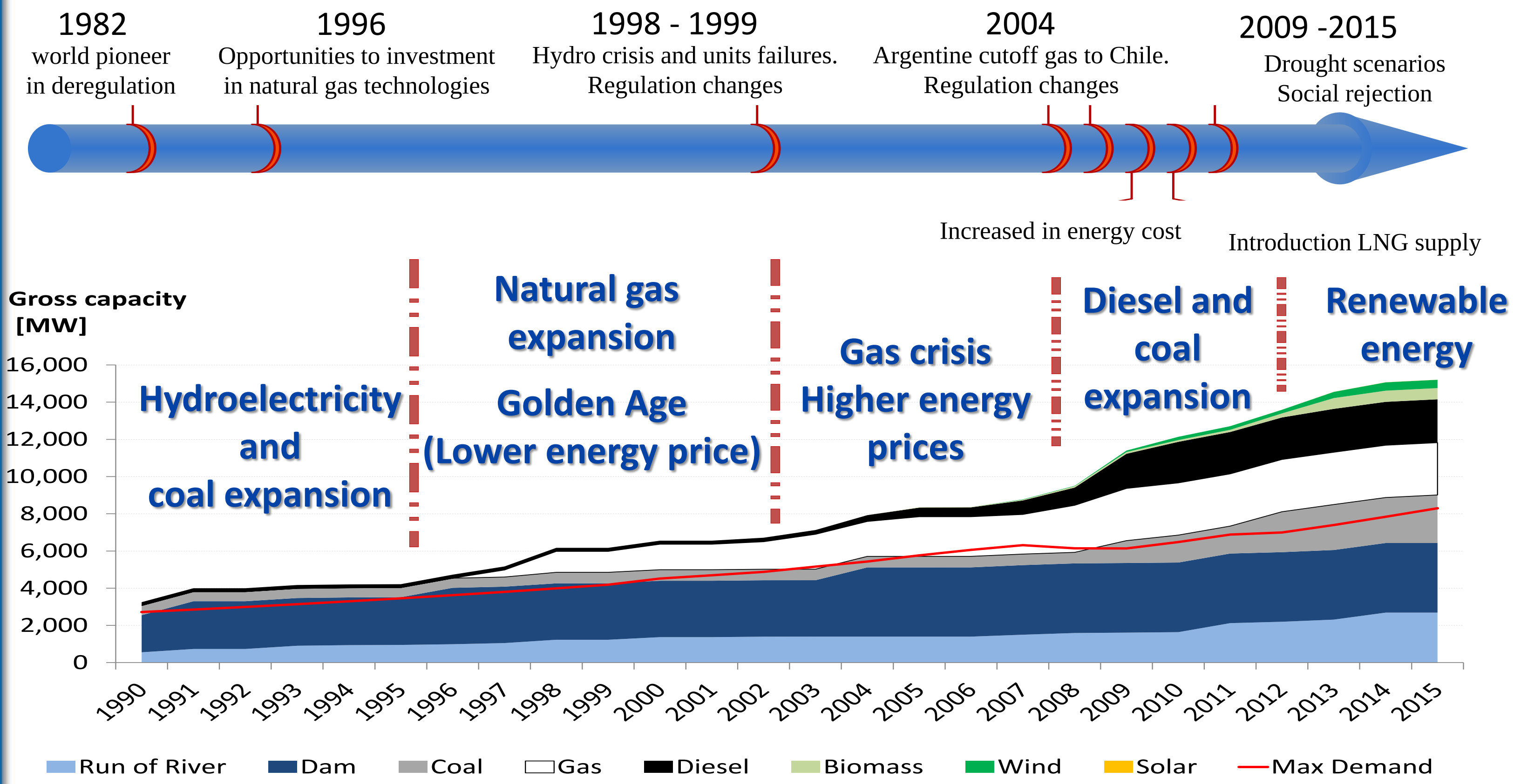
- Generation developers decide upon private assessment what, where, when and how much new capacity is needed.
- Technology neutrality except for renewable quota (20%)
- Must comply with environmental regulation by applying for license.
- Little or no land use regulation.

GDP vs. Energy Consumption (2014)



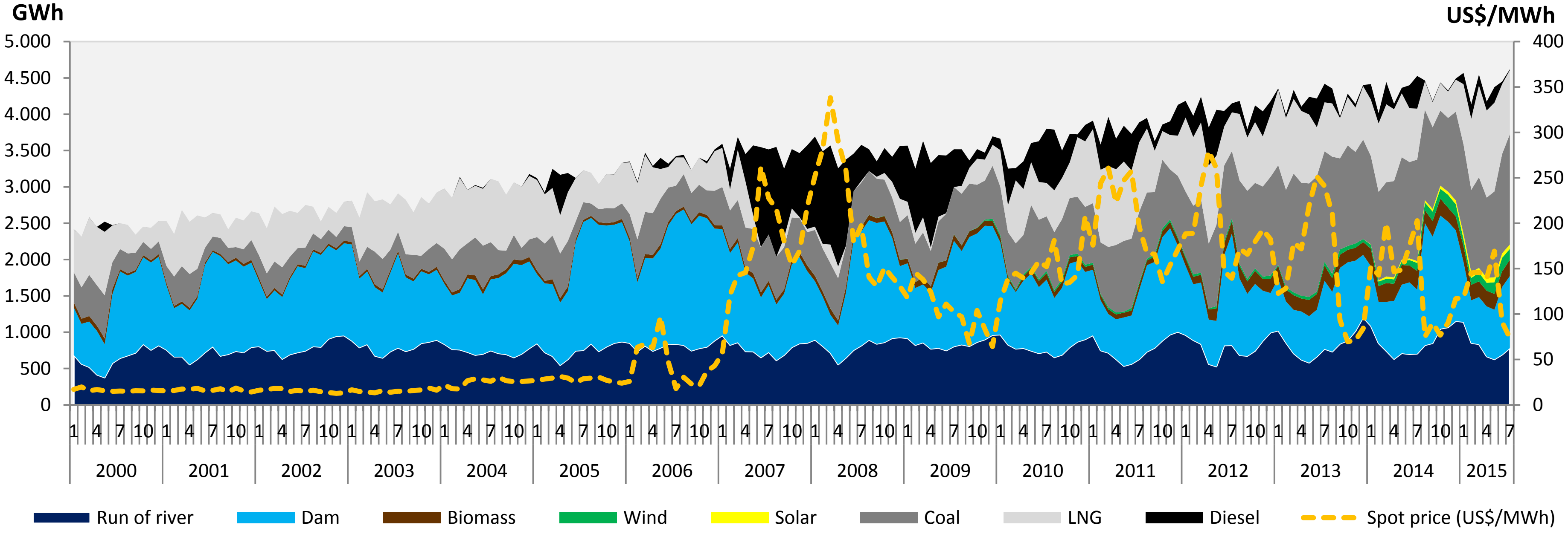
Source: World Bank, Jan 2015

Milestones in the Chilean electricity system



Gas crisis, earthquake and dry hydrology.

High energy prices for the past seven years. Perfect storm or market failure?



High availability of Argentinian gas | diésel | earthquake | 4 ½ drought years

Gas crisis | New LNG Terminals

Source: CDEC-SIC, Own eleboration

On the last decade Chile has been facing a several natural disasters events; indeed, just in the last year we facing volcanic eruptions, earthquakes, even storms in the middle of the dessert; and this one was the major storms in the last hundred years

- For all those scenarios, electric power infrastructure has been able to respond appropriately in a quite range of expected quality and safety. However distribution networks has shown several weaknesses especially in terms of resistance to rain, wind, storms and others climate events. These weaknesses have led to the recovery times of service has been higher than expected than according to the rules and standards of quality of service defined by law. In this way, we have some challenges in order to enhance and facilitate the coordination between utilities, ISO and end customers.

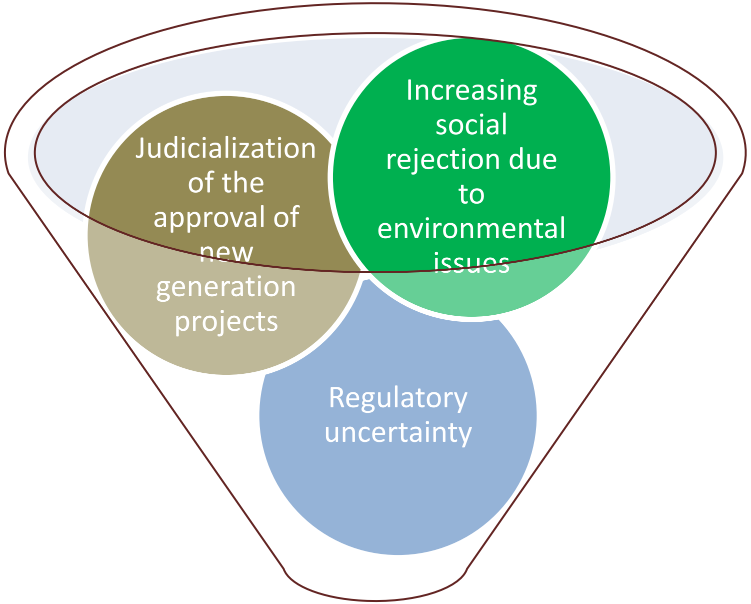
- We have stringent earthquake policy regulation for any facility and this design has demonstrated to be effective in our country. However, further progress is still needed in terms of land management plans and in the design of priority infrastructure in tsunami risk areas.

In Chile there has been a kind of perfect storm

- 5 consecutive drought years,
- gas supply restrictions,
- high penetration of non-conventional technologies mainly wind and solar,
- a strong social rejection both generation projects as well as transmission lines,

consequences:

- **higher power supply costs and**
- **congestion in transmission networks.**



Uncertainty in future generation expansion

Energy cost?

- **Social Rejection:**
  Not in my backyard effect
- **Judicialization**: Environmental permit processes normally end in court
- **Regulatory uncertainty**:
  Changes in the market rules
  New energy policy to under discussion

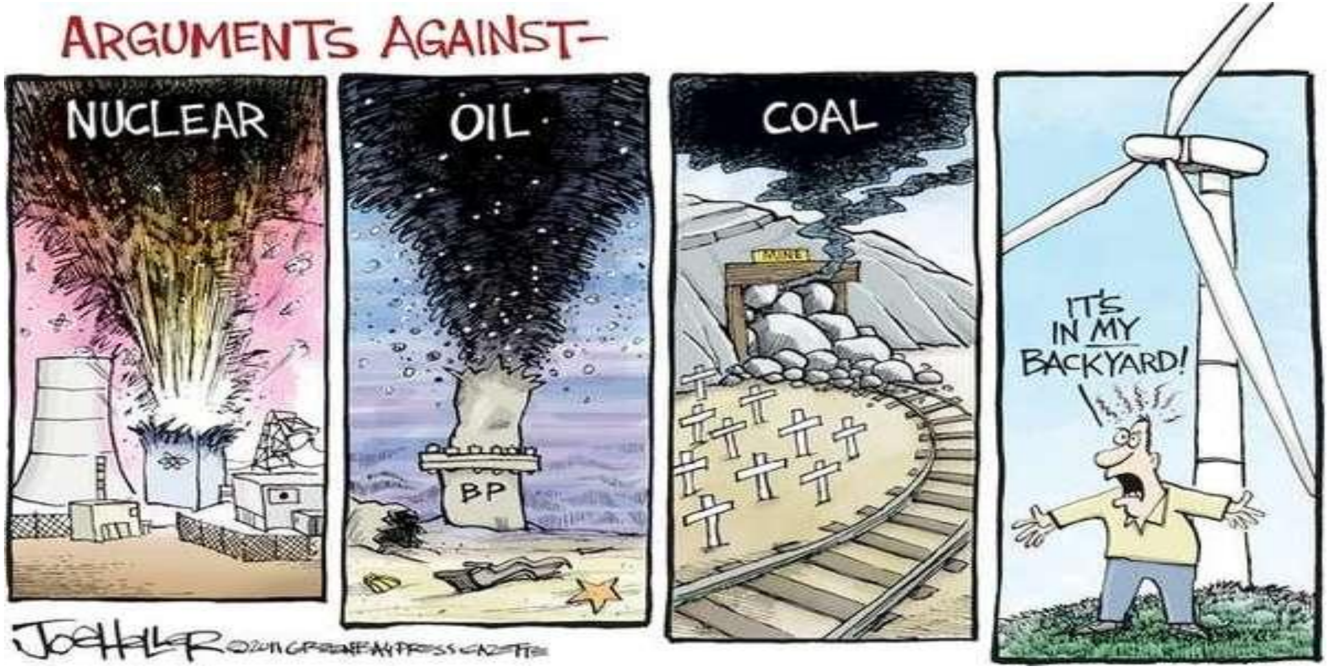
As a consequence, nowadays **there is uncertainty regarding the future energy prices and its associated risks, not being evident the expansion technology that will prevail in the future.**

For the main Transmission system, stakeholders play a role in the planning process and make influence to reduce it payment against reliability increasing their market influence.

- For sub-transmission system, which is defined as those lines to supply the utility companies and secondary transmission systems, the rate is determined by tariff studies based on the expected use of the network.
- Nevertheless, the expansion plans are not mandatory, existing high rates of unavailability in this segment (an average 15 hr./yr./customer).

As consequence of this issues and those mentioned before, **we are facing congestion scenarios in relevant transmission lines across each interconnected system.**

Chile's development is challenged
NIMBY reached developing countries



How to face this trend ??

In this way, Chile have at least three major challenges in the energy sector

- Improve the grid development through a real long-term energy planning to facilitate competition in generation, help the development of transmission and improve the design of distribution networks considering the technological advances in smart grids, distributed generation and quality of service, and
- to strengthen the empowerment of civil society giving binding solutions as mandatory like a contract between society, government and utilities, and
- design appropriate policies to deal with natural disasters.

As a government we have made significant progress in regulatory framework, looking accomplish these objectives

- Redesign of the tender's process to supply regulated customers in order to increase competition in generation sector.
- A new transmission law (currently in discussion by Senate): which establishes a new electric transmission system and create an independent coordinator for national electrical system. The main characteristics are:
- Strengthening the role of ISO to ensure open access and encourage competition in generation.
  - Long term energy planning made by the Ministry of energy (at least 30 years) is incorporated. With citizen participation and considering environmental and territorial restrictions.
  - Planning of the grid is performed at least 20 years, mandatory and designed with additional capacity for the future.
  - alternative outlines when necessary, are determined by the Ministry of Energy considered environmental assessment and sustainability of projects resilience disaster criteria
  - New tariff mechanism for recover investment of transmission facilities (stamp)

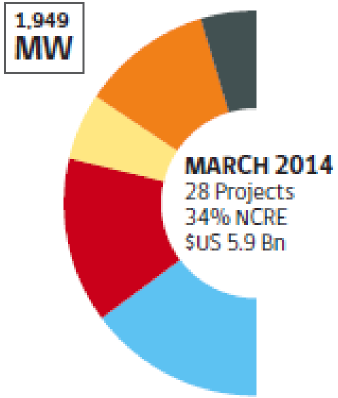
APEC assistance

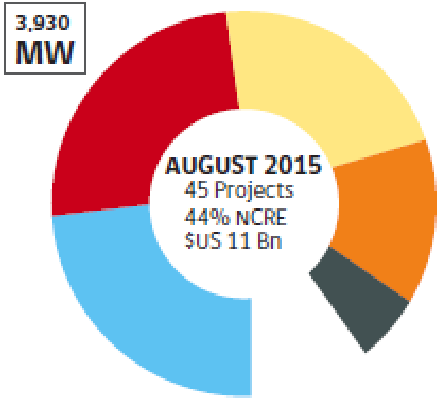
Chile is going moving forward to new and modern Power Market: our view aims at a reliable, sustainable, and inclusive energy development at reasonable prices. The kind of assistance from APEC does to Chile should be oriented to:

- **Discussion in order to exchange our experiences and shared the lessons learned based in each economy experience**
- **to facilitate enough discussion scenarios, and working group related with the main issues of Asia and Pacific power markets and propose solution based in this discussion and experiences**
- **To promote roadshows in order to invite to invest in our market. We believe now is the perfect time, and full of opportunities especially in the energy sector in Chile.**

GENERATION PROJECTS UNDER CONSTRUCTION (SIC + SING) – AUGUST 2015

HYDRO · THERMAL · SOLAR · WIND · OTHER NCRE





MAIN PROJECTS

- **Cerro Pabellón:** 40 MW
- **San Juan:** 186 MW
- **Laberinto:** 146 MW
- **Luz del Norte:** 141 MW
- **IEM U1:** 375 MW
- **Kelar:** 517 MW
- **Cochrane:** 472 MW
- **Los Cóndores:** 150 MW
- **Alto Maipo:** 531 MW

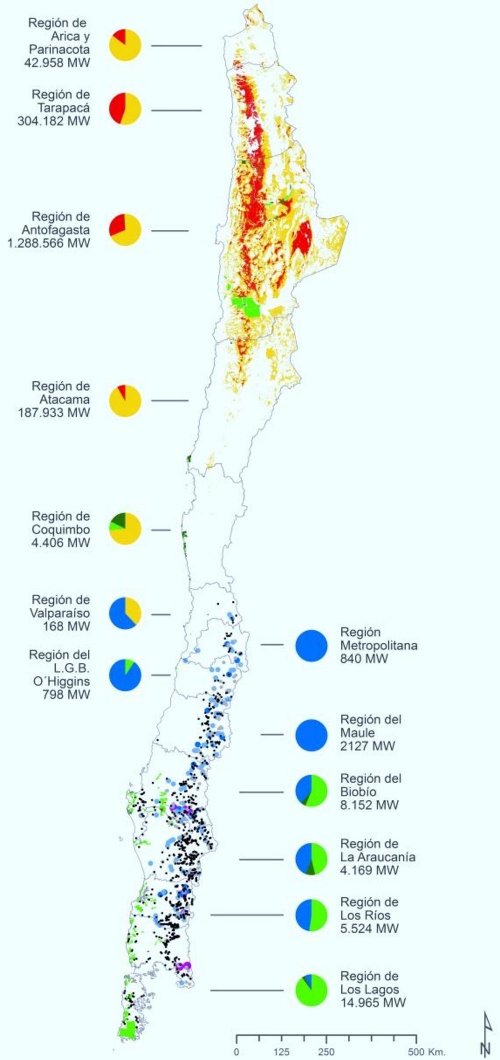
	MARCH 2014 28 Projects 34% NCRE $US 5.9 Bn	**AUGUST 2015** 45 Projects 44% NCRE $US 11 Bn
Hydro	653	1,011
Thermal	632	1,364
Solar	223	1,162
Wind	350	298
Other NCRE	91	96
TOTAL	**1,949**	**3,930**

Energy Agenda

"...to tackle barriers for NCRE in Chile, compromising that at least 45% of the electricity generation to be installed in the country between 2014 and 2025 come from such sources..."

Commitment of 20% NCRE at 2025

Solar, Wind and Hydro energy potential by technology



Technology	Installed Capacity [MW]	Under construction [MW]	Approved [MW]	Potential* [MW]	PF	Under Assessment [MW]
Small hydro	368	57	337	7,951	0.63	215
Wind	832	165	5,513	37,477	0.34	1,960
Large hydro	6,017	1,021	1,352	4,521	0.61	611
Solar-PV	452	748	8,173	1,263,407	0.33	4,792
Solar -CSP	0	110	760	548.478	0.52	370
Geothermal	0	0	120	16,000	0.85	0
Total	**7,669**	**2,101**	**10,478**	**1,840,394**	**-**	**7,948**

Source: SEIA, CNE, Min Energia, CDEC, Jan 2015

* This is only a technical and probabilistic potential without taking account technical-economics key variable..

Thank you

For more information please visit our website:

www.minenergia.cl

www.cne.cl

Contact info:

Víctor J. Martínez vmartinez@minenergia.cl

Fernando Flatow fflatow@cne.cl