

The Electric Power System

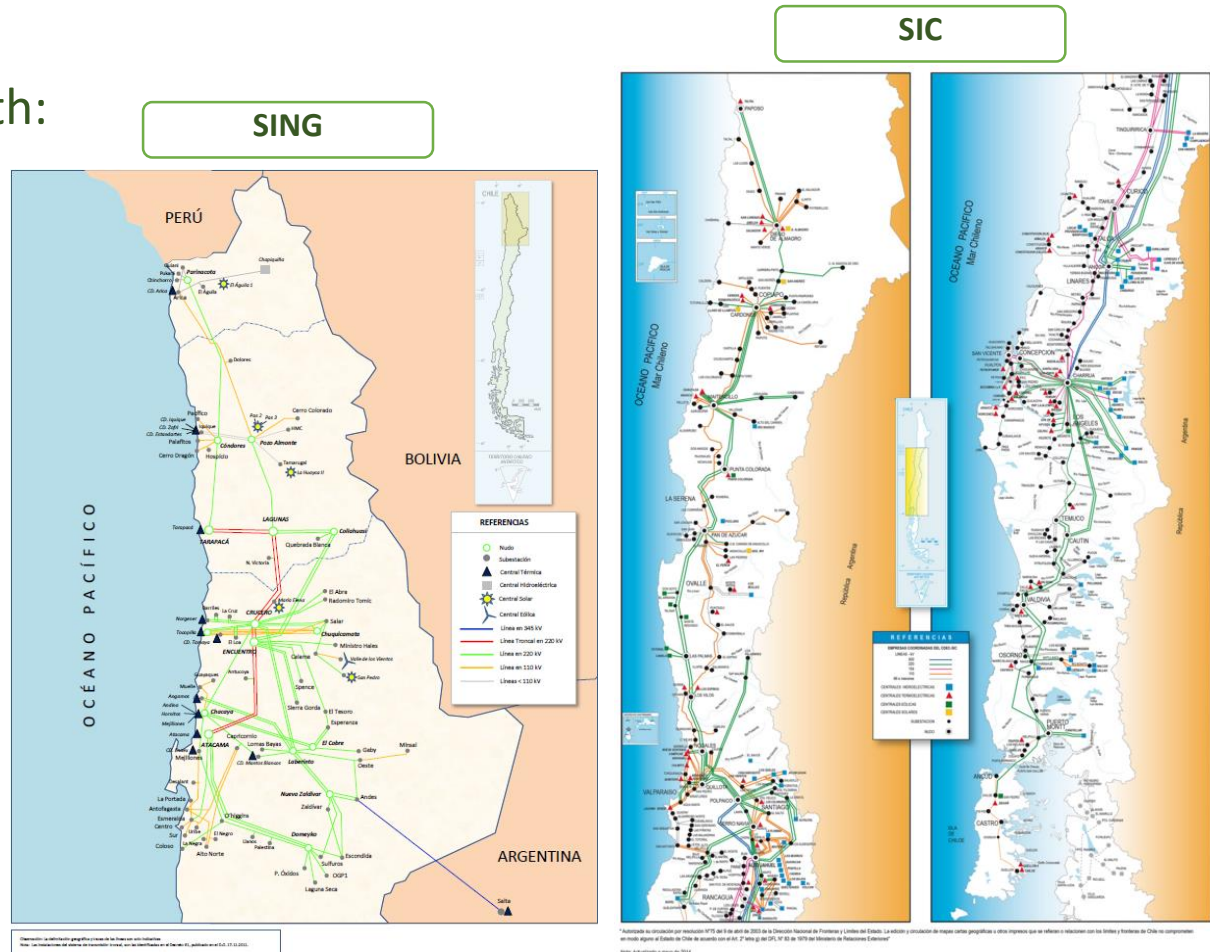
- Chile -

Basic facts

- ❑ Area: 756,102 km²
- ❑ Population: 17.6 Million (2013)
- ❑ Number of electricity consumers: 51 (SING); 213 (SIC)
- ❑ Number of ISOs: 2
- ❑ Number of DSOs: 0
- ❑ Peak load: 7,547 MW (SIC); 2,361 MW (SING)
- ❑ Average interruption of electricity: 496 hours (SIC); 197 hours (SING)

Global map of the grid and of its interconnections

- Interconnectors with:
 - Argentina (SADI)





Grid facts and characteristics

□ SING

The Greater North Interconnected System of Chile (SING) includes the installations for electrical generation, transmission and consumption encompassing the territory that spans the regions of Arica – Parinacota, Tarapacá and Antofagasta, which is equivalent to 24.5% of the country's continental territory.

□ SIC

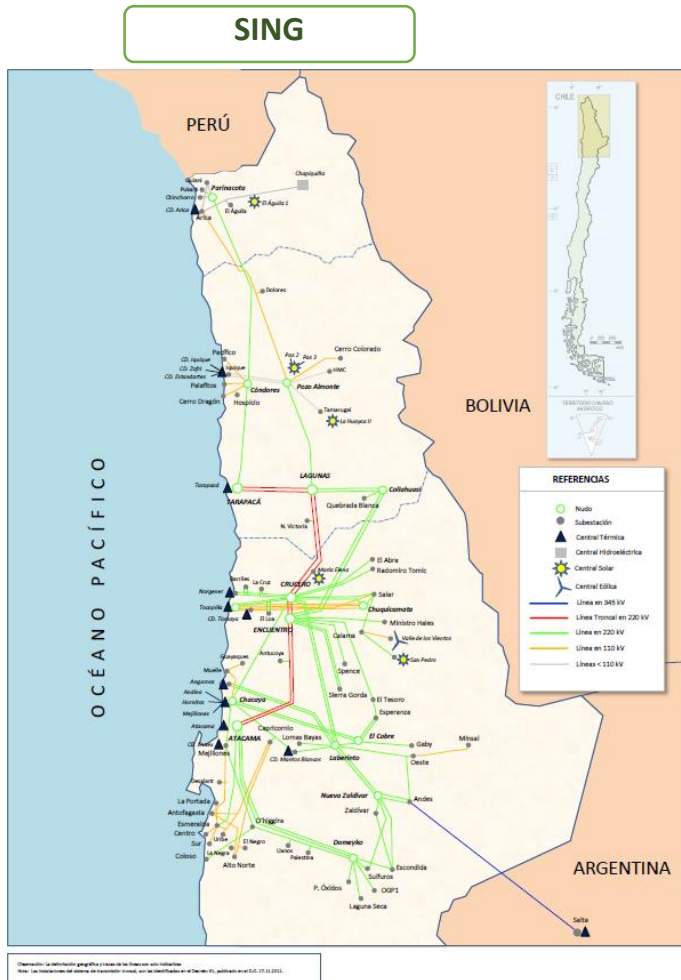
The Central Interconnected System of Chile, consists of transmission systems and power plants that operate interconnected from the Second Region (North) to the Tenth Region (Isla Grande de Chiloé, South). This system is the largest and provides electrical energy to the Chilean territory, with an installed capacity through of 15,179 MW, and a supply coverage that reaches about 92.2% of the population.

Structure of electrical power system

The Interconnected System of the Greater North Region (SING) functions along with the Central Interconnected System (SIC) in Chile as well as the Electrical System of Aysen and Magallanes.



Map of the high voltage grid



Information on ISOs

| | <u>SING</u> | <u>SIC</u> |
|---|--|--|
| <input type="checkbox"/> Name: | CDEC - SING | CDEC - SIC |
| <input type="checkbox"/> Network length (km): | 7,890 | 16,609 |
| <input type="checkbox"/> Served area (km ²): | 185,109 | 330,460 |
| <input type="checkbox"/> Annual transmitted energy (TWh): | 17.7 | 52.3 |
| <input type="checkbox"/> website: | www.cdec-sing.cl | www.cdecsic.cl |



Cooperation of ISO and DSOs

- Currently there are no DSOs in Chile.

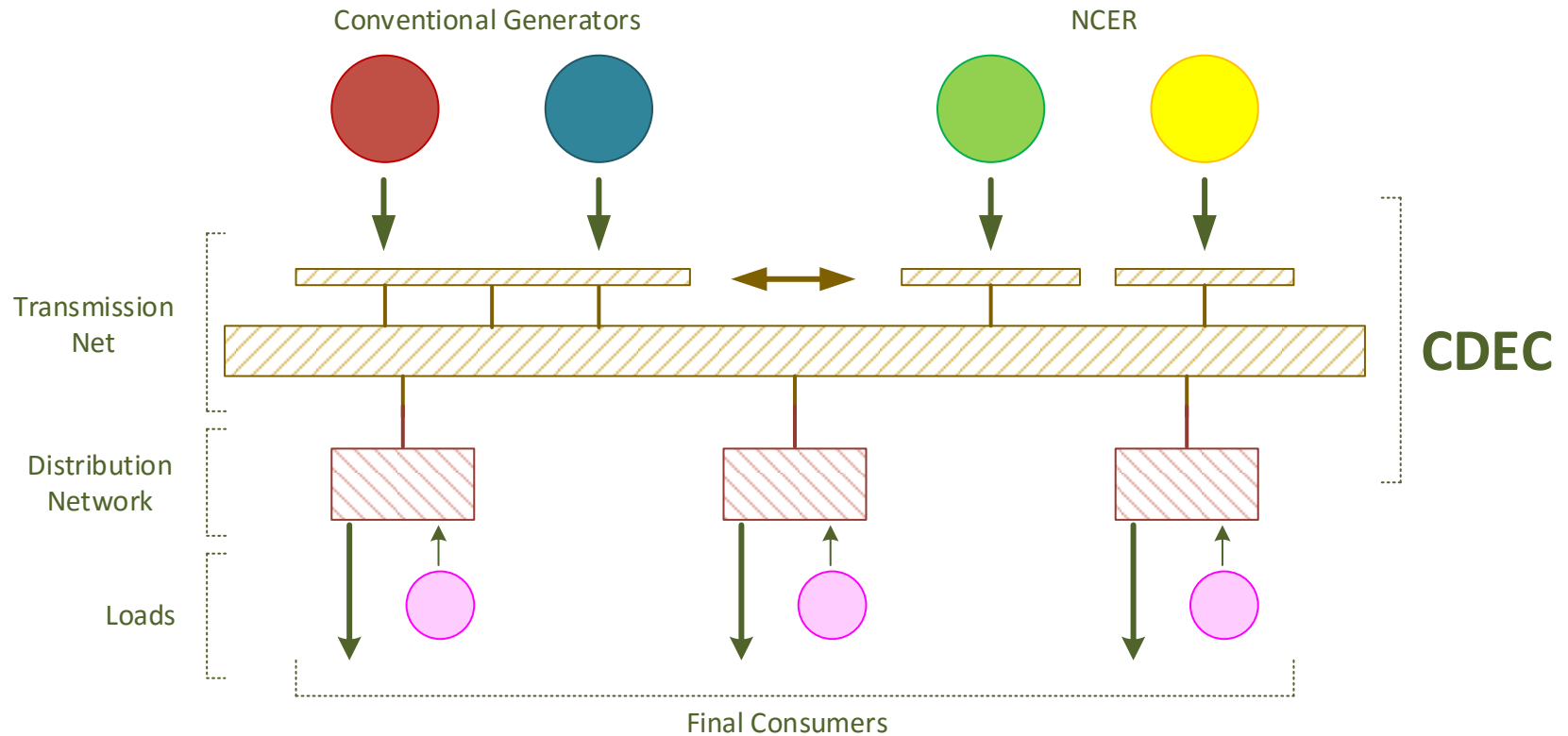


Responsibilities of ISOs

□ SING – SIC

- Preserve the security of service in the electrical system.
- Ensure the most economical operation for all the facilities of the electric system.
- Ensure open access to the grid.

Power structure of the country



Installed capacity with reference to primary resources

☐ Installed capacities (GW), Year 2014

| Primary Resources Installed Capacity [GW] | | | | | | | | | |
|---|------|---------------------|------|-------------|---------|-------------|------------|-------|--------------|
| System | Coal | Oil | Gas | Hydro Power | Nuclear | Solar Power | Wind Power | Other | Total |
| SING | 2.10 | 0.36 ^(*) | 1.47 | 0.015 | 0 | 0.025 | 0.09 | 0.018 | 4.08 |
| SIC | 2.42 | 2.49 | 2.62 | 6.37 | 0 | 0.20 | 0.65 | 0.45 | 15.18 |

(*) The sum of installed capacity of Diesel and Fuel Oil

Energy production with reference to primary resources

□ Electricity generated (TWh), year 2014

| Primary Resources Energy Production[TWh] | | | | | | | |
|--|-----------------|-------------|---------|-------------|------------|-------|--------------|
| System | Coal, Oil & Gas | Hydro Power | Nuclear | Solar Power | Wind Power | Other | Total |
| SING | 17.16 | 0.09 | 0 | 0.09 | 0.21 | 0.12 | 17.67 |
| SIC | 27.22 | 23.46 | 0 | 0.38 | 1.21 | 4.53 | 56.79 |

Development of generation capacity since 2010

| Installed Capacity [MW] | | | | | | |
|-------------------------|------------------|-------|-------|-------|-------|----------------------|
| System | Tecnology | 2010 | 2011 | 2012 | 2013 | 2014 |
| SING | Renewable | 0 | 0 | 1 | 1 | 115 |
| | Hydro | 15 | 15 | 15 | 15 | 15 |
| | Coal | 1,216 | 2,100 | 2,100 | 2,100 | 2,100 |
| | Gas | 2,112 | 2,112 | 2,112 | 2,112 | 1,469 ^(*) |
| | Oil | 358 | 358 | 358 | 362 | 365 |
| SIC | Renewable | 166 | 196 | 196 | 300 | 1,187 |
| | Hydro | 5,355 | 5,840 | 5,919 | 5,972 | 6,368 |
| | Coal & Gas & Oil | 6,626 | 6,680 | 7,471 | 7,858 | 7,968 |

(*) The drop in gas during the year 2014 is due to the withdrawal of the unit in Salta (SADI, Argentina)

Consumption per customer groups

| Customer Group | SING | SIC |
|----------------|---------------------|---------------------|
| | Clients Sales [GWh] | Clients Sales [GWh] |
| Petrochemical | 0 | 1,077.5 |
| Forestry | 0 | 2,008.1 |
| Siderurgy | 0 | 1,420.3 |
| Copper | 12,885.1 | 9,354.6 |
| Cement | 0 | 440.8 |
| Other | 634.8 | 636.7 |
| Distributors | 1,896.5 | 34,039.0 |
| TOTAL | 15,416.4 | 48,977.0 |



Location of renewable energy sources

□ SING - SIC

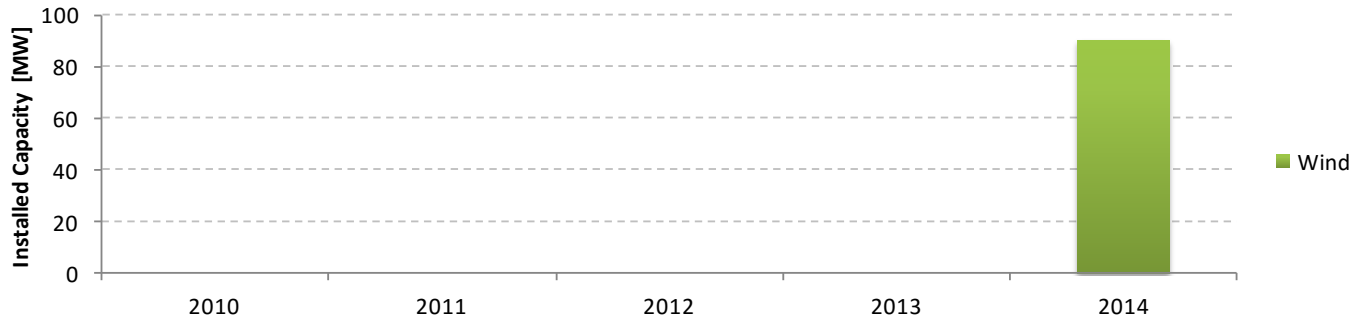
Renewable energy in Chile is a fast growing sector that in 2014 provided 9% of the country's electricity.

Chile has solar and wind energy, which are located mainly in The Third Region and Fourth Region respectively.

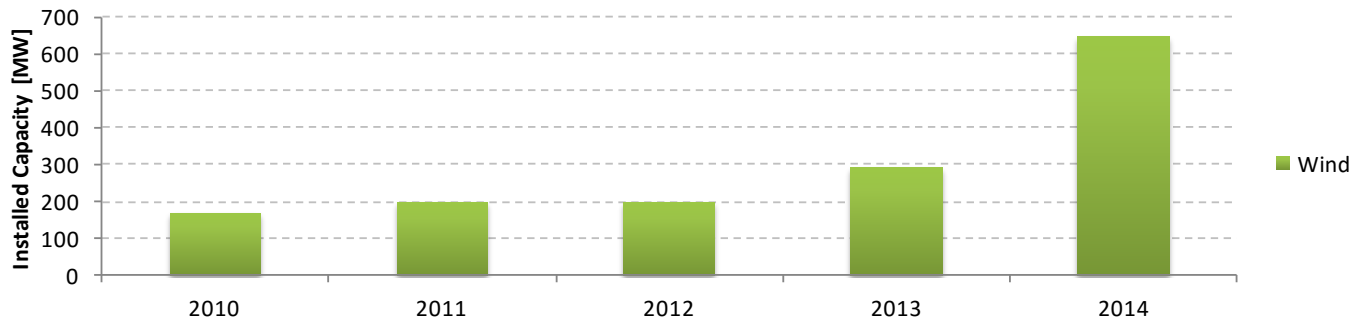
There is great growth potential for solar energy in the Atacama Desert, that is shown in the large number of new projects that want to be develop in the area, reaching 242 MW in 2015 and adding 640 MW in 2016 and 173 MW in 2017.

Development of wind power

Development of Wind Power - SING
Since 2010

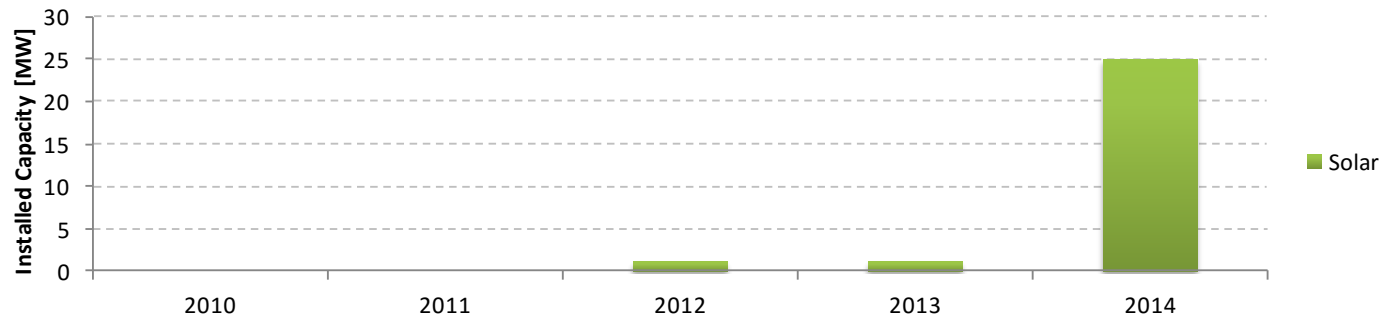


Development of Wind Power - SIC
Since 2010

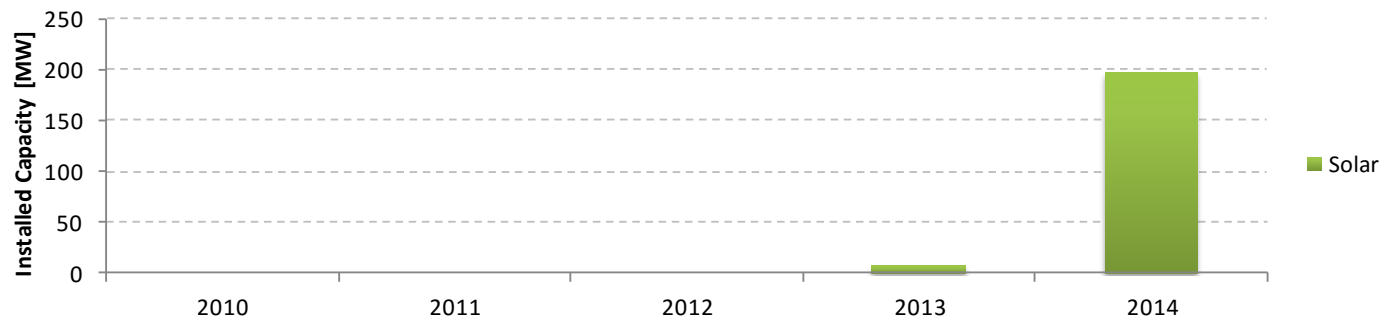


Development of photovoltaic power

Development of Solar Power - SING Since 2010



Development of Solar Power - SIC Since 2010





RES installed capacity and production since 2010

| RES Installed Capacity [MW] | | | | | | |
|-----------------------------|-------|------|------|------|------|------|
| System | RES | 2010 | 2011 | 2012 | 2013 | 2014 |
| SING | Hydro | 15 | 15 | 15 | 15 | 15 |
| | Solar | 0 | 0 | 1 | 1 | 25 |
| | Wind | 0 | 0 | 0 | 0 | 90 |
| SIC | Hydro | 0 | 0 | 0 | 0 | 228 |
| | Solar | 0 | 0 | 0 | 7 | 197 |
| | Wind | 166 | 196 | 196 | 293 | 645 |

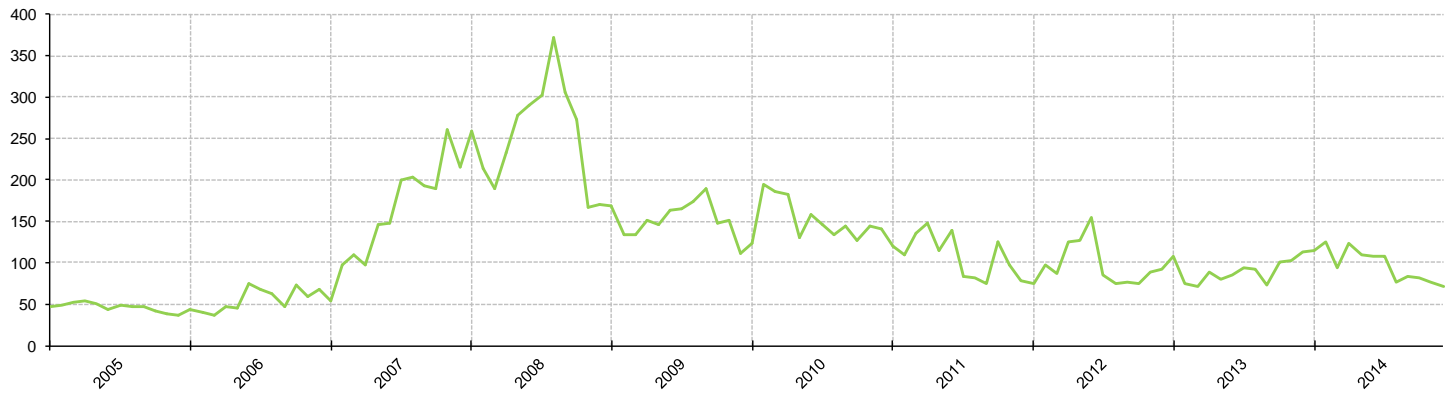
| RES Energy Production [GWh] | | | | | | |
|-----------------------------|-------|------|------|------|------|-------|
| System | RES | 2010 | 2011 | 2012 | 2013 | 2014 |
| SING | Hydro | 60.5 | 71.3 | 81.4 | 78.1 | 80.8 |
| | Solar | 0 | 0 | 0.5 | 4.5 | 90.6 |
| | Wind | 0 | 0 | 0 | 0 | 215.3 |
| SIC | Hydro | 0 | 0 | 333 | 314 | 1,212 |
| | Solar | 0 | 0 | 0 | 3.3 | 371 |
| | Wind | 326 | 325 | 390 | 548 | 1,180 |



Price development for industry consumers

Market Spot Prices (USD/MWh)

Monthly Average Marginal Costs of Energy in Crucero Node - SING (US\$/MWh)

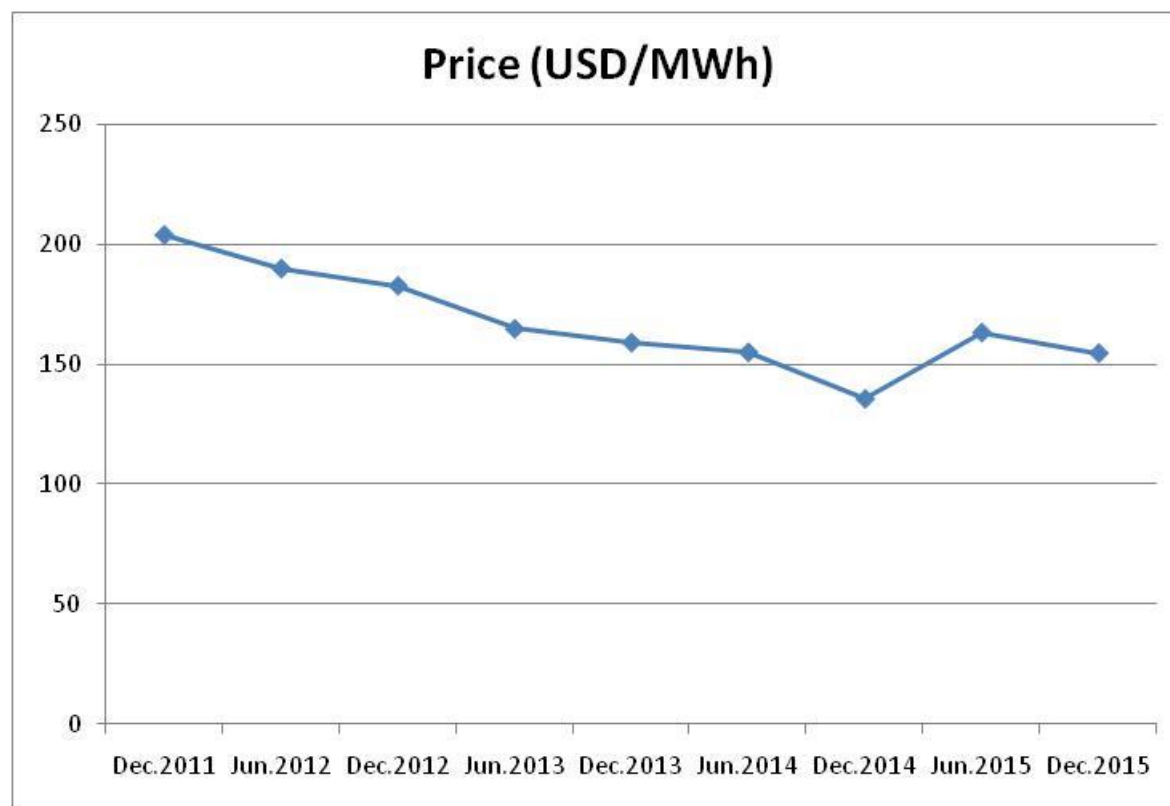


Monthly Average Marginal Costs of Energy in Quillota Node - SIC (US\$/MWh)

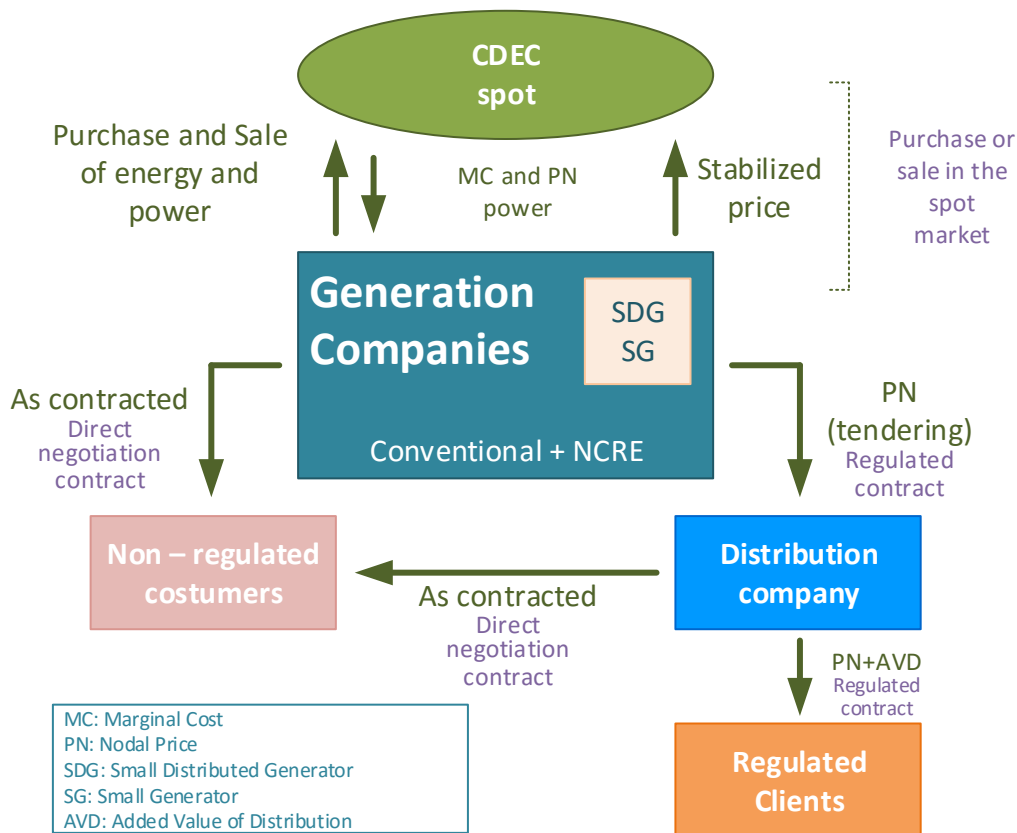


Price development for households

Average Tariff in Santiago (2011-2015)



Electricity market organisation



Open Access in Transmission Net

Regulated Payment of Toll

3 Segments: Trunk, Subtransmission and Additional

Power balance in 2014

| | <u>SING</u> | <u>SIC</u> |
|--|-------------|------------|
| <input type="checkbox"/> Generation (TWh) | 17.67 | 56.79 |
| <input type="checkbox"/> Consumption (TWh) | 15.71 | 48.98 |
| <input type="checkbox"/> Imports (TWh) | 0.0 | 0.0 |
| <input type="checkbox"/> Exports (TWh) | 0.0 | 0.0 |
| <input type="checkbox"/> Losses (TWh) | 0.53 | 3.27 |

Energy exchanges in 2014

Commercial flows

| | Commercial Flows[MMCLP] | | |
|--------|-------------------------|--------------------|----------------|
| System | Injection [MMCLP] | Withdrawal [MMCLP] | Losses [MMCLP] |
| SING | 27,876 | 27,876 | |
| SIC | 44,516 | -45,236 | 0.72 |

Physical flows

| | Physical Flows[MW] | | |
|--------|--------------------|-----------------|-------------|
| System | Injection [MW] | Withdrawal [MW] | Losses [MW] |
| SING | 467 | 467 | |
| SIC | 9,631 | -9,518 | -113,24 |

Specific aspects of the electricity market

- ❑ Chilean Market operates as pool
 - ➔ There are no bilateral markets

- ❑ By using Locational Marginal Prices (LMP), the congestion management is not an issue
 - ➔ Therefore, this is not applicable