

Innovative Technology Solutions for Sustainability



# ABENGOA

### "Chile, changing the energy matrix"



Completing Transformation 9th Annual Analyst and Investor Day

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### The Chilean Electric Market









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# The Chilean electric market



### **Chilean electricity systems as of December 2014**

		1	Gross Capacity (MW)	Electricity Generation (GWh)	Maximum demand (MW)	Population (%)
<b>SING</b> Sistema Interconectado Del Norte Grande		Arica y Parinacota Tarapacá Antofagasta	4,255 21.8%	17,688 25.2%	2,372	5,7%
Taltal SIC Sistema Interconectado Central	III V AM VII VII X X V X V X X X X X	Atacama Coquimbo Valparaiso Región Metropolit Lib. Gral. Bdo. O'h Bío-Bío Araucanía Los Ríos Los Lagos	15,085 77.4%	52,207 74.3%	7,547	92,6%
Chiloé SEA Sistema de Aysén	2. / XI	Aysén	50 0.3%	136 0.2%	22	0,6%
<b>SAM</b> Sistema de Magallanes	X	Magallanes	100 0.5%	239 0.3%	42	1,1%

Source: CDEC, 2015



**Opportunities for Abengoa** 

### **Chilean electric market**



#### Installed capacity and energy mix SING + SIC, as of December 2014

Technology	Capacity (MW)	%
Thermal	10,939	58,0%
LNG	3,988	21,2%
Coal	3,541	18,8%
Diesel	2,582	13,7%
Other Thermal	828	4,4%
Hydro	6,129	32,5%
ROR	2,096	11,1%
Dam	4,034	21,4%
NCRE	1,784	9,5%
Wind	829	4,4%
Biomass	309	1,6%
Solar	271	1,4%
Mini ROR Reservoir	259	1,4%
Other NCRE	116	0,6%

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### **Opportunities for Abengoa**



### Forecast of the demand, SIC and SING

The SING and the SIC will have an CAGR of 4.7%

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The largest copper producers drive future energy demand







### The government's energy agenda

Promotion of NCRE	<ul> <li>Law 20,257, NCRE will represent 20% of the generation by the year 2025</li> <li>Tax carbon emissions</li> </ul>			
Innovation in energy	<ul> <li>Incentives in the research and development of renewable energy</li> <li>Corfo's bid including subsidiy and financial support</li> </ul>			
Increase competition between generators	<ul> <li>Transmission system strengthening</li> <li>New rules for electricity supply tenders (PPA), including renewables, in a bid to attract new investment from renewables developers</li> </ul>			

"We aim to a safe, efficient, reasonably priced energy development, and to take advantage of our renewable resources in a sustainable and non-polluting environment."

**Opportunities for Abengoa** 

### Market size for solar development in the Atacama Desert



- The Atacama desert, the driest in the world, is located in the north of Chile, covering the regions of Arica and Parinacota, Tarapacá, Antofagasta y northern Atacama.
- It covers an area of approximately 105,000 km<sup>2</sup>, equivalent to 10,500,000 hectares (25,946,065 acres).
- > Abengoa's 110 MW CSP plant occupies 700 hectares.

If we use onlye 1% of the Atacama Desert, we would have approximately 16.000 MW

### CSP technology adds value to the Chilean electric market

### Market Challenges

**Constant demand** that will **increase** in the following years.

Long term **price uncertainty** due to indexation to fuel prices.

Environmental concerns.

Fuel supply risk.

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Progressive introduction of **intermittent facilities** (solar pv, wind).

Renewable energy regulatory requirements.

### **CSP** solutions

Capacity to produce energy 24 / 7, and **always dispatched**.

Ability to structure **long term PPA with fixed prices** – Certainty for Offtakers.

Solar clean energy in the location with the **highest solar resource in the world**.

Abundant natural **non-intermnitent** resource.

Conventional dispatchability thanks to **energy storage** capacity.

Renewable energy **attributes**.



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# Status of current projects



### Strong backlog and pipeline of projects in Chile

	Technolog	gy	Location	COD	MW	GWh/ year	Status
Atacama 1	CSP	Junk	María Elena, Antofagasta	2017	110	850	Under Construction
	PV		María Elena, Antofagasta	2017	100	300	Under Construction
Atacama 2	CSP	Junk	Sierra Gorda, Antofagasta	2018	110	850	Pre-Construction
	PV		Sierra Gorda, Antofagasta	2018	100	300	Pre-Construction
Future Projects	Atacama 3	Junk	TBD	2019e	300	2,320	Pipeline
	Atacama 4	Jue the	TBD	2020e	300	2,320	Pipeline

Abengoa is undertaking the projects using its integrated technology, engineering & construction, and O&M capabilities worldwide.

### **ABENGOA SOLAR**

### Status of current projects

### **Molten Salt Central Receiver Technology**

### **Basic Operation of a Molten Salt Tower**

1. Cold Salt is pumped at 290°C up to the solar receiver, previously preheated with the heliostat field.

2. Molten salts flow through the panels of the receiver, reaching 565°C

3. Hot salt flows back down to the Steam Generation System through the hot salt storage tank.

4. The cold salts are directed back to the cold tank, while the superheated steam at 550°C runs the steam turbine





#### **Advantages:**

- Molten salt is heated up to 565°C in the receiver at very low pressure
- The high temperature salt exchanges thermal energy with water and steam in a steam generator to produce superheated steam at 550°C
- Possibility of storage, fully dispatchable power, capable for 24h operation

### Solar concentration design Atacama 1



Watch Video

### Solar concentration Atacama 1 progress



Status of current projects

1<sup>st</sup> Heliostat





**Status of current projects** 

### **Advantages of the CSP technology**



Considering the energy market situation in Chile, mining companies are finding CSP a very compelling proposition



### CSP technology plans to be a major player in the market



With the current and future projects, Abengoa has a potential capacity of 1020MW and wil produce **7,400 GWh** per year, representing the **10.6%** of the generation in the Chilean electric market.





# Main Takeaways



Abengoa's CSP technology adds value to the Chilean electric market, by reducing dependency from fuel imports, diversifying energy matrix, and matching demand 24 hours.



Atacama CSP 1 Corfo awarding project validates and promotes Abengoa's technology capabilities within Chilean market.

Abengoa's technology proves to be competitive, securing PPAs with power distributors for 950 GWh per year for 15 years.

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Abengoa's technology has the capacity to expand and become a relevant player in the market.



The Atacama 1 STE plant awarded with the Climate and Environment Project of the Year - Infrastructure 360 Awards 2015 - by the Inter-American Development Bank (IDB) on March 27, 2015, for its commitment to the environment.



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# **ABENGOA**

Thank you

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