

# ABENGOA

Innovative Solutions for Sustainability



## ABENGOA

### The Sun Shines Bright on Concentrating Solar Power ("CSP")

Santiago Seage  
Executive VP

**Analyst and Investor Day**

April 2011

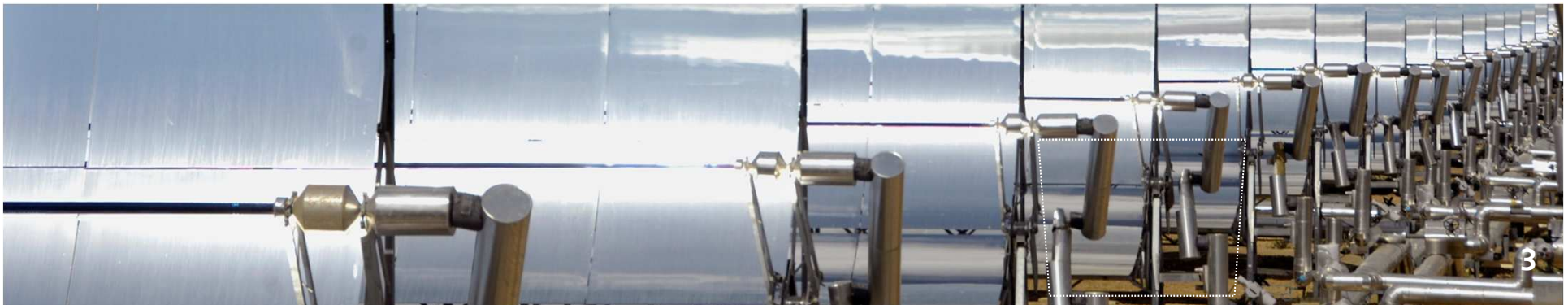
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CSP market is growing

The CSP advantage is based on dispatchability, cost reduction potential and choice of preference for utilities

Abengoa's leadership lies on integrated business model of Technology & Project Developer + Asset Operation

Asset portfolio of 3.5 GW



1

**Business Description. Our Capabilities**

2

**Future Opportunities**

# ABENGOA

What is CSP?

Solar Tower

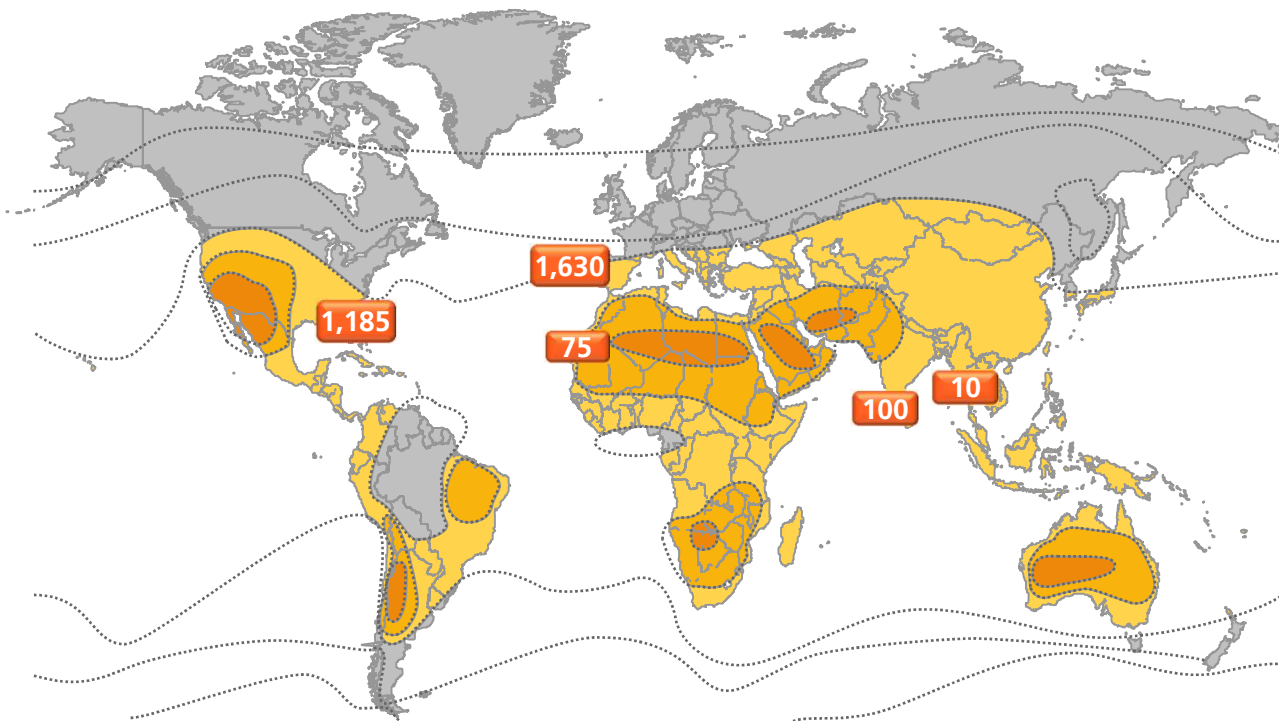


Solar Trough



Abundant resources and growing opportunity in more geographies

The world's sunbelt offers highly attractive resources with the long-term potential to meet as much as 25% of global electricity needs.

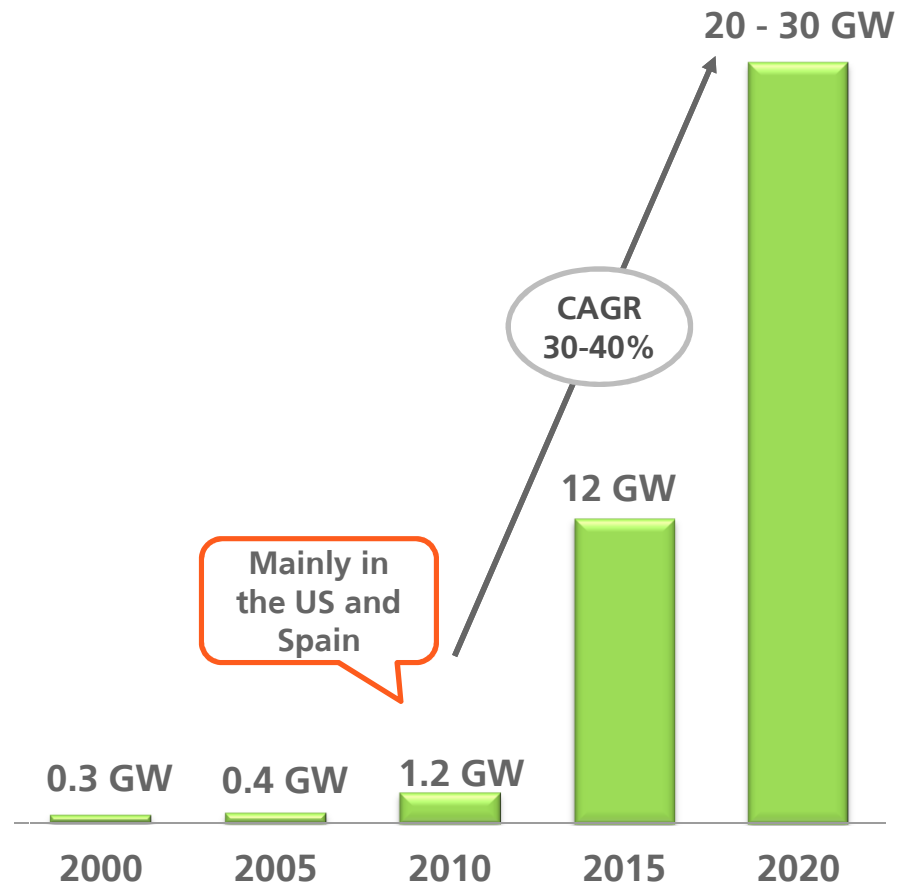


### Great Potential for CSP

- As of today, over 3.0 GW in operation or under construction
- Potential to meet up to 7% of the world's projected electricity needs in 2030
- And potential for 25% by 2050

Average yearly irradiation: ■ Very good ■ Good ■ Satisfactory ■ Not sufficient  
CSP capacity in operation and under construction in 2010 (MW) ■

CSP demand is growing rapidly from a low base...



2010-2020  
Potential



### Phase 1

Spain is a pioneer in the CSP sector

4-5 GW



### Phase 2

US will contribute to consolidate CSP

10-15 GW



### Phase 3

CSP will become global

10-15 GW

..supported by regulatory frameworks



### Feed in tariff

- **Special regime for CSP**, reconfirmed in December 2010
- Right to sell all the energy produced at any time and at a certain tariff or premium over the pool price



### Renewable Portfolio Standard (RPS):

- **Obligation for utilities** to produce a specific fraction of their electricity from renewable energy sources with solar carve outs in some cases
- To ensure compliance with RPS, **local utilities sign PPAs** with renewable energy companies
- **Government incentives:** Tax Credit + Grants + Loan guarantees in some cases



- **Feed-in tariff markets**
- **"Ad hoc" projects**
- **Tenders, specific grants, etc.**



CSP has fundamental advantages over other renewable alternatives

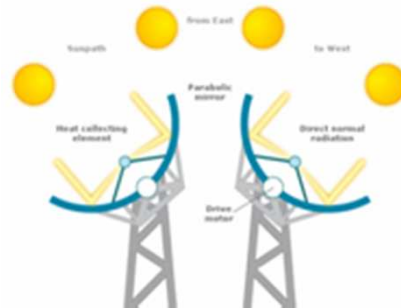
- 1 Mature & commercially **viable technologies**
- 2 High **cost reduction potential**
- 3 **Dispatchable** renewable energy source
- 4 **Hybridation with conventional power**
- 5 **Utility-scale** power generation



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### CSP: commercially proven technology

#### Parabolic Trough



#### Description

- Parabolic Trough reflectors concentrate the sunlight to a receiver where the Heat Transfer Fluid (HTF) is circulated

#### Track record

- 30 years

#### Key Feature

- Modular

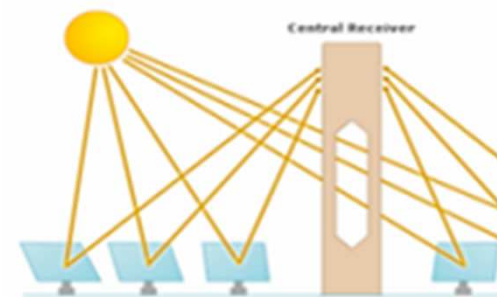
#### ABG presence

- 150 MW operating / 0,9 GW under construction

#### 2010 Global Market Share (~1 GW)

- 95%

#### Tower



- Heliostats follow the sun to reflect the sunlight to the top of a tower where the HTF is heated

- 4 years

- High temperatures

- 31 MW operating

- 3%

### 2 CSP will meet costs of conventional sources in the mid term

#### Cost reduction potential

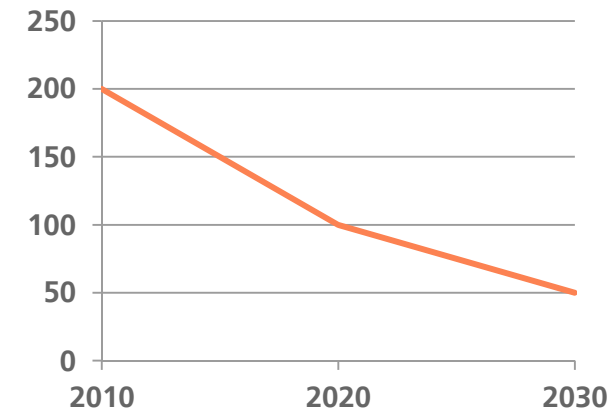
- “Low hanging fruits”
  - Increased competition in **supply chain**
  - **Economies of scale**
  - **E&C experience** curve
- Technological innovation

#### Like for like comparison with conventional sources

- **CO<sub>2</sub> costs**
- Investment in **transmission infrastructure**
- **Back up generation** and storage for intermittent sources



Project LCOE in USD/MWh (IDN 2600)

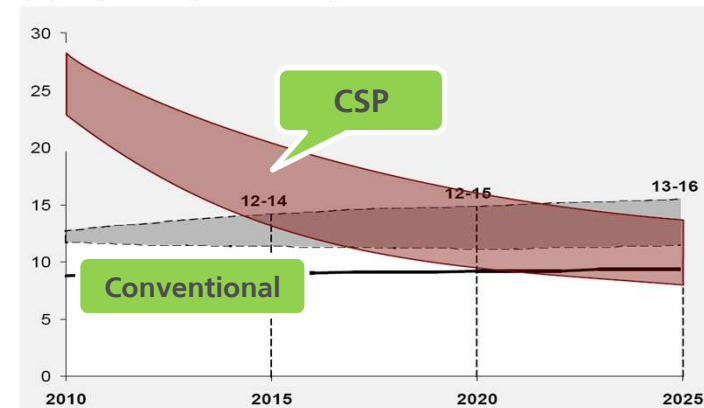


Source: BCG



Estimated LCOE in €/kWh in Spain

(Spain, LCOE, in €/kWh)



Source: AT Kearney

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CSP is the only dispatchable renewable



CSP



PV



Wind

Dispatchability	High thermal inertia, hybridization and storage	None	None
Forecasting	Average/high predictability	Average/low predictability	Low predictability
Security of supply	High	High	High

### Advantages of CSP as Dispatchable Energy

#### Energy targets

- As renewable target deadlines approach, renewable energies represent a higher proportion in the generation mix

#### Intermittent renewables issues

- Exerts pressure to the transmission network, necessary upgrade investments
- Not a reliable energy source for periods of peak demand

#### Few dispatchable renewables options

- Hydro capacity mostly capped
- Security of supply issues for biomass (volume and price)

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**CSP is the only dispatchable Renewable**

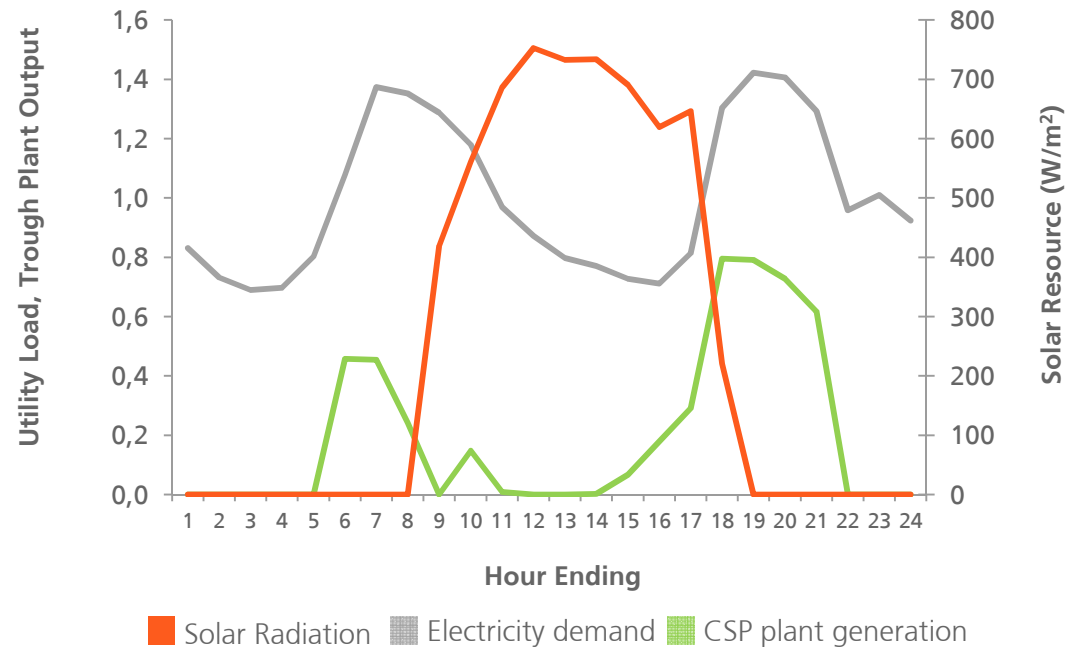
### Heat storage

- 6-8 hours of energy can be released at later point in time



### Solar Radiation vs. Demand vs. Generation

Solar plant with storage vs/ utility system load - Winter Period



**CSP technology adds value to utilities by generating energy on demand**

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CSP can be integrated with conventional generation, and become a back-up for other renewables

ISCC

- A solar field is integrated with conventional combined-cycle
  - Higher efficiency
  - Lower emissions

Retrofitting  
of coal and  
gas power  
plants

- Allows for:
  - Higher efficiency
  - Lower emissions



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### Utility-Scale power generation

#### The case of PV

##### PV Characteristics:

- Ideal for isolated generation
- SME players
- Limited technical complexity



PV Tracker - Sevilla

#### The case of CSP

##### CSP Characteristics:

- Large utility / complex installations
- Limited number of players
- Well capitalised companies



Parabolic Trough - Solnova 1

### Technology & Project Developer + Asset Operation



#### Develop technology and key components for internal and third-party use

- Technology development is key to be competitive in the mid-term in an emergent industry like CSP
- Key to secure good partners
- Incremental value creation by sale of technology and key components to third parties
- Additional profitability in own projects



#### Develop, own and operate a large diversified portfolio of CSP plants

- In-house development teams in 12 key markets
- Diversified by geography
- Selected partner of choice by large international players
- Own and operate, divesting selectively when it maximizes value
- Project by project approach



Abengoa's advantage lies on technology

### R&D

- Collaboration with key research institutions and companies worldwide
- 100 in-house researchers
- Denver, Colorado
- Seville, Spain



### Pilot Plant or Real Test

- Build large scale pilot
- Operate
- Learn



Eureka superheated pilot plant

### Commercial Project



PS 20 commercial plant

Abengoa is a technology leader in the three key areas within CSP



Tower

- Proprietary designs
- Proprietary heliostats (18 m<sup>2</sup>, 120 m<sup>2</sup>, 140 m<sup>2</sup>)
- Proprietary receivers, in some cases with partners
- Extensive operational know-how
- 25 patents <sup>(1)</sup>

- Only 2 commercial towers worldwide
- One of only 3 superheated demonstration towers
- Building pilot molten salt plant



Trough

- In-house designs
- Proprietary trough designs (ASTRØ, E2, Phoenix)
- 29 patents <sup>(1)</sup>
- JVs in several elements

- 13 utility-scale commercial trough plants in operation or construction
- Only direct steam generation demonstration plant worldwide



Storage

- Dedicated laboratory scale facilities
- Molten salt storage pilot plant since 2008
- 2 patents <sup>(1)</sup>

- Commercial towers have one hour storage
- Building first trough plant with storage in the U.S. (Solana)

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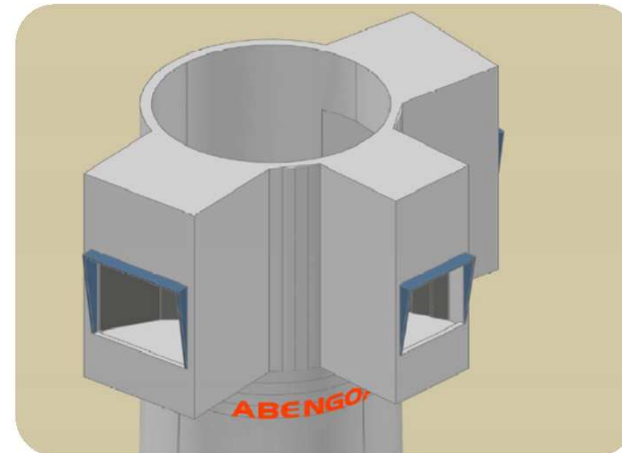
### Superheated tower is our next step at commercial scale

#### Pilot design (2007-2010)



- Built pilot superheated tower (Eureka) in operation since 2009 working at a higher temperature
- Designed and tested improved new heliostats, new storage system and improved other key technologies
- Designed new receivers

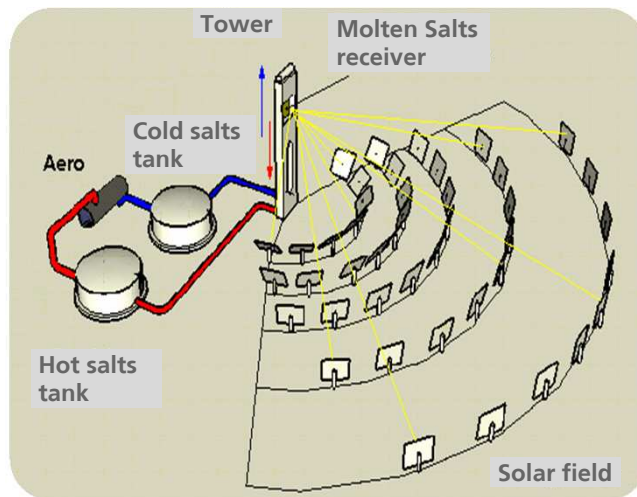
#### Expected commercial design



- New Technology ready with lower cost, storage and less water consumption
- Several projects under development using this more efficient technology

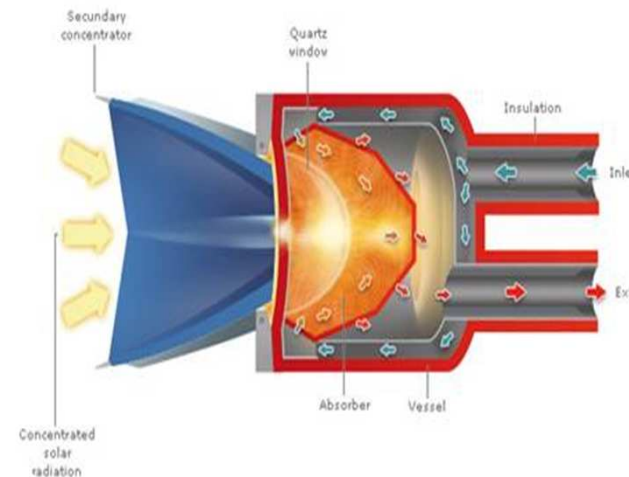
Working also on new concepts

### Molten salts tower



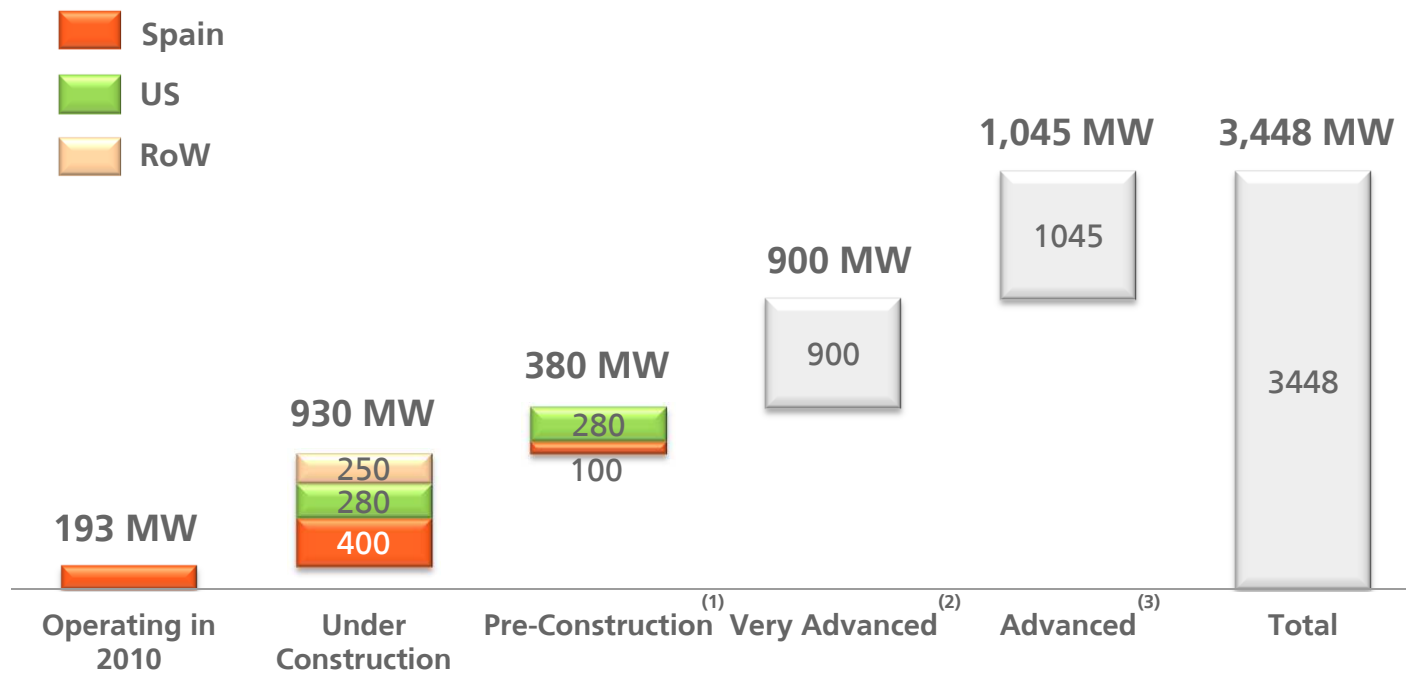
- Storage without heat exchanger
- Increased efficiency

### Air tower



- Higher efficiency cycle (combined cycle)
- Very high temperature



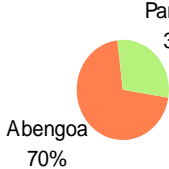


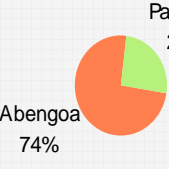



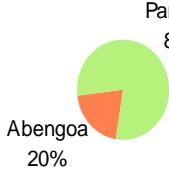


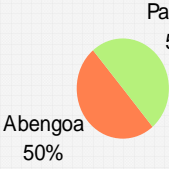


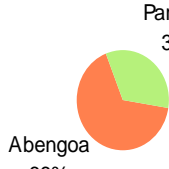
3.5 GW in different stages



Note: (1) Permitting complete, sale of power secured  
 (2) key permits, grid access and land secured  
 (3) Land, grid access

# ABENGOA

## Asset Portfolio: Partner of Choice

Partner	Date	Location	Project Type / Size	Partner's Equity
	Dec. 2010	 Extremadura, Spain	2x50 MW trough plants	 Partners 30% Abengoa 70%
	Sept. 2010	 Córdoba, Spain	2x50 MW trough plants	 Partners 26% Abengoa 74%
 	May 2010	 Abu Dhabi	100 MW trough plant	 Partners 80% Abengoa 20%
	Nov. 2009	 Ecija, Spain	2x50 MW trough plants	 Partners 50% Abengoa 50%
	Jan. 2007	 Algeria	150 MW solar-combined cycle hybrid plant 20 MW parabolic trough	 Partners 34% Abengoa 66%

### How much a CSP MW is worth

#### Case Study: 50 MW CSP plant in Spain

	<u>Low</u>	<u>Base Case</u>	<u>High</u>	<u>Net Impact</u>
WACC: +/- 0,5%	6.53 M €/MW	6.87 M €/MW 7.0%	7.25 M €/MW	5.4%
Hours: +/- 5%	6.50 M €/MW	2,270 <sup>(1)</sup>	7.25 M €/MW	5.4%
EBITDA Margin: +/- 5%	6.83 M €/MW	80%	6.91 M €/MW	0.6%
Pool price: +/- 25%	6.57 M €/MW	2011-15: Company estimates 2016-onwards: Poyry estimates	6.96 M €/MW	4.3%
Life of Asset		30 years		

Potential upsides: inflation, pool price

(1) Gross hours of operation



Location	Operation Name	Installed Capacity	Technology	COD	Revenue	Storage	Ownership (%)	Partner (%)
<b>Spain</b>								
<b>In Operation</b>								
Solúcar, Seville	PS 10 PS 20	11 MW 20 MW	Tower	2007 2009	Feed-in tariff *	Yes	100%	0%
Solúcar, Seville	Solnova 1, 3 & 4	150 MW (50MW each)	Parabolic trough	2010	Feed-in tariff *	No	100%	0%
Several	Several	12 MW	PV	2008	Feed-in tariff **	No	100%	0%
<b>Total In Operation</b>		<b>193 MW</b>						
<b>Under Construction</b>								
Écija, Seville	Helioenergy 1 & 2	100 MW (50MW each)	Parabolic trough	E Q4 2011	Feed-in tariff *	No	50%	50%
Ciudad Real	Helios 1 & 2	100 MW (50MW each)	Parabolic trough	E Q4 2012	Feed-in tariff *	No	100%	0%
Córdoba	Solacor 1 & 2	100 MW (50MW each)	Parabolic trough	E Q2 2012	Feed-in tariff *	No	74%	26%
Extremadura	Solaben 2 & 3	100 MW (50MW each)	Parabolic trough	E Q4 2012	Feed-in tariff *	No	70%	30%
<b>Total Under Construction</b>		<b>400 MW</b>						
<b>Pre-Construction</b>								
Extremadura	Solaben 1 & 6	100MW (50MW each)	Parabolic trough	E Q3 2013	Feed-in tariff *	No	100%	0%
<b>Total Pre-Construction</b>		<b>100 MW</b>						

**Total Spain (In Operation, Under Construction and Pre-Construction): 693 MW**

\* Feed-in tariff with inflation and pool upside

\*\* Feed-in tariff 30 years with inflation upside

Location	Operation Name	Installed Capacity	Technology	COD	Revenue	Storage	Ownership (%)	Partner (%)
<b>US</b>								
<b>Under Construction</b>								
Arizona	Solana	280 MW	Parabolic trough	E Q3 2013	30-yr PPA with APS	Yes	100%	0%
<b>Total Under Construction</b>		<b>280 MW</b>						
<b>Pre-Construction</b>								
California	Mohave	280MW	Parabolic trough	E Q2 2014	25-yr PPA with PG&E	No	100%	0%
<b>Total Pre-Construction</b>		<b>280 MW</b>						

**Total US (Under Construction and Pre-Construction): 560 MW**

Location	Operation Name	Installed Capacity	Technology	COD	Revenue	Storage	Ownership (%)	Partner (%)
<b>Other Regions</b>								
<b>Under Construction</b>								
Abu-Dhabi	Shams	100 MW	Parabolic trough	E Q3 2012	25 yr PPA with ADWEC inflation adjusted	No	20%	80%
Hassi-R'mel (Algeria)	SPP1	150 MW	ISCC	E Q2 2011	25 yr PPA	No	66%	34%
<b>Total Under Construction</b>		<b>250 MW</b>						

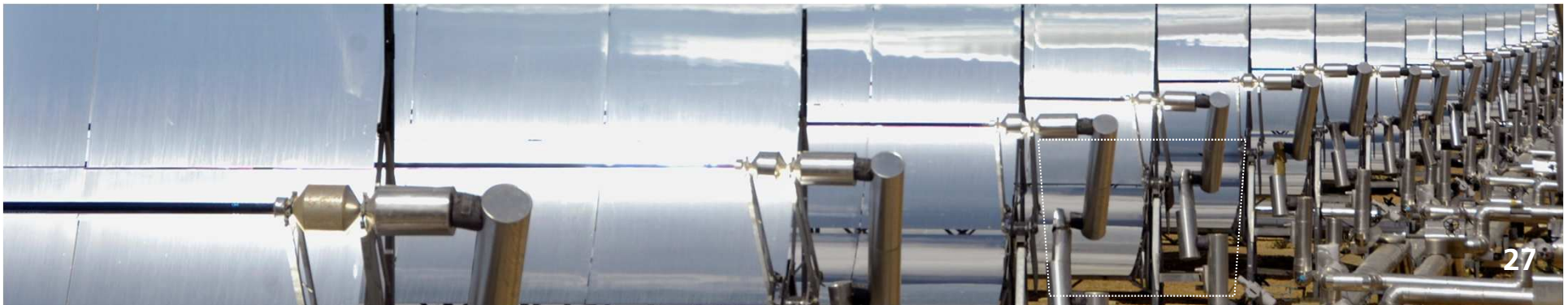
**Total Other Regions (Under Construction): 250 MW**

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Asset portfolio of 3.5 GW



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# Thank you

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