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Innovative technology solutions for sustainability

Dispatchable Solar Power: Perenjori Study

ASTRI Symposium, Brisbane
February 2015

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Our solar plants in operation

Abengoa Solar CSP plants in commercial operation		
Spain	**MW**	
Solnova 1,3,4	3x50	Trough
PS10	11	Tower
PS20	20	Tower
Ecija Solar Complex	100	Trough
Carpio Solar Complex	100	Trough
Extremadura Solar Complex	200	Trough
Castilla-La Mancha Solar Complex	100	Trough
Algeria		
ISCC Hassi R'mel, Algeria	150	ISCC
Abu Dhabi		
Shams-1	100	ISCC
USA		
Solana, Arizona	280	Trough
Mojave, California	280	Trough
Total CSP in operation	**1,491**	

PV Plants in operation	
Spain	**MW**
Sevilla PV	1.2
Casaquemada PV	1.9
Las Cabezas PV	5.7
Copero PV	1
Linares PV	1.9
Total PV in operation	**11.7**

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Our solar plants in construction & pre-construction

Abengoa Solar CSP Plants in construction		
South Africa		
Khi Solar One	50	Tower
Kaxu Solar One	100	Trough
Chile		
Project in Atacama Desert	110	Tower
Total in construction	260	

Abengoa Solar CSP Plants in pre-construction		
South Africa	**MW**	
Xina Solar One	100	Trough
Israel		
Project in Ashalim of Negev Desert	110	Trough
Total in pre-construction	210	

Technology as a competitive advantage for Abengoa

R&D → Pilot Plant or Real Test → Commercial Project

- +150 in-house researchers
- R&D center in Denver, CO
- R&D center in Seville, Spain
- Abengoa Research
- Collaboration with key research institutions and companies worldwide

NREL National Renewable Energy Laboratory — Innovation for Our Energy Future

Ciemat — Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas

DLR

Fraunhofer

Sandia National Laboratories

CSIRO

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Perenjori Dispatchable Solar Thermal Power Plant

- 20 MW net capacity
- 7 hours molten salt storage
- ca. 230,000 m2 heliostat field
- ca. 92 GWh production per yr
- 24 - 30 month construction period
- 25 year operation period

Perenjori Dispatchable Solar Thermal Power Plant

The Challenge

- **Replicability**

  Potential for the widest possible replicability and relevant learnings for future CSP project applications.

- **Plant Capacity**

  Logical minimum capacity for a CSP plant to minimize requirement for Government support whilst maintaining relevance for future development.

- **Dispatchability**

  The Project should include a thermal energy storage (TES) system which will allow the CSP plant to generate electricity when needed, and to provide the benefits of firm capacity to the local transmission network.

- **Pathway to Cost Reduction**

  Select state-of-the-art technology which offers the highest potential for cost reduction of the three compared technologies: parabolic trough, linear fresnel and tower.

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Perenjori Dispatchable Solar Thermal Power Plant

- **ARENA**
  - Funding support for Perenjori project preparation activities / feasibility study

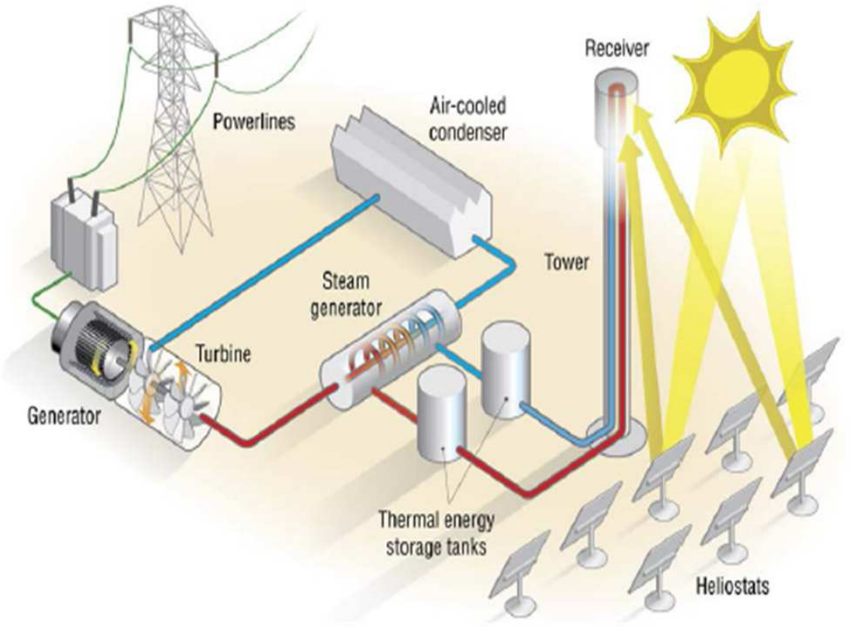
- **The Project Partners**
  - Abengoa Solar Power Australia
  - Abengoa Solar, SA
  - CSIRO
  - WestGen / National Power
  - Institute for Sustainable Futures (UTS)

Perenjori Dispatchable Solar Thermal Power Plant

The Technology

Molten salt tower overview

- Provides dispatchable renewable energy.
- Offers unique flexibility since the energy collection and energy delivery processes are decoupled.
- Energy is collected when the sun is shining, but only converted into electricity when it is demanded.
- No round-trip losses associated with storing the energy for later use.
- Higher temperature increases efficiency and reduces storage costs.



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Perenjori Dispatchable Solar Thermal Power Plant

Rationale for Site Selection

- **Ideal site** for the proposed plant, including world class direct solar irradiation;
- **Fringe of grid** connection will provide significant network benefits;
- Proposed **off-take arrangements** include a combination of electricity retailers and a large iron ore mining operation;
- **WA Government** and **local community** are supportive of such activity;
- **Strong demand** for peak and especially shoulder generation;
- Excellent prospects for **further roll-out of solar thermal power** generation with storage in end of grid and off-grid applications, with an emphasis on powering the mining sector.

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Perenjori Dispatchable Solar Thermal Power Plant

What did the feasibility study test?

- Solar radiation resource
- CSIRO heliostat design compared with Abengoa
- Optimum storage capacity
- Socio-economic, environmental and network benefits
- Cost to install a CSP plant in a remote area of Australia
- Pathway to cost reduction
- Feasibility of implementing the project

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Perenjori Dispatchable Solar Thermal Power Plant

- **What were our findings?**
  - World class DNI
  - Abengoa heliostat design has commercial maturity, CSIRO design has optical benefits
  - Storage capacity increased from 3 to 6 and finally 7 full load hours
  - Lack of awareness by grid operator of characteristics / benefits of CSP with storage
  - Cost to install a CSP plant in a remote area of Australia
  - Pathway to cost reduction – project learnings, pipeline, supply chain, and increased capacity lead to competitive LCOE
  - Potential to be a feasible project

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Perenjori Dispatchable Solar Thermal Power Plant

What are our recommendations to reduce costs?

- Create a baseline - build the first project
- Encourage market demand (through combination of RET, and ARENA/Government programmes)
- Facilitate a pipeline of projects to create a local supply chain; local technical, project and financial expertise; leading to lower costs
- Increase plant scale from 20MW to 100MW+
- Focus on value creation as well as reduced cost

Thank You!

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