

SolarReserve Comments on Draft IRP 2016



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SolarReserve Overview

Leading global integrated solar power business with a high quality development pipeline, differentiated proprietary technology and a proven track record of success

Development



- **Development pipeline of over 10 GW**
- Long-term power contracts for **456 MW representing \$2.5 billion** of project capital, with an additional **2,000 MW of projects under award**
- **Global presence** with HQ in California and 7 international offices strategically located in Africa, the Americas, the Asia-Pacific region, the Middle East, and Europe

Technology



- **Commercialized world's most efficient and lowest cost CSP with integrated storage**
- Proprietary technology allows solar to operate at **baseload, mid merit and peaking modes** at a fraction of other storage technologies
- Portfolio of **108 U.S. and global patents and patent applications**, plus in-house 'know how' protects technology lead
- Ownership of technology enables **equipment supply opportunities and development advantage**

Operations

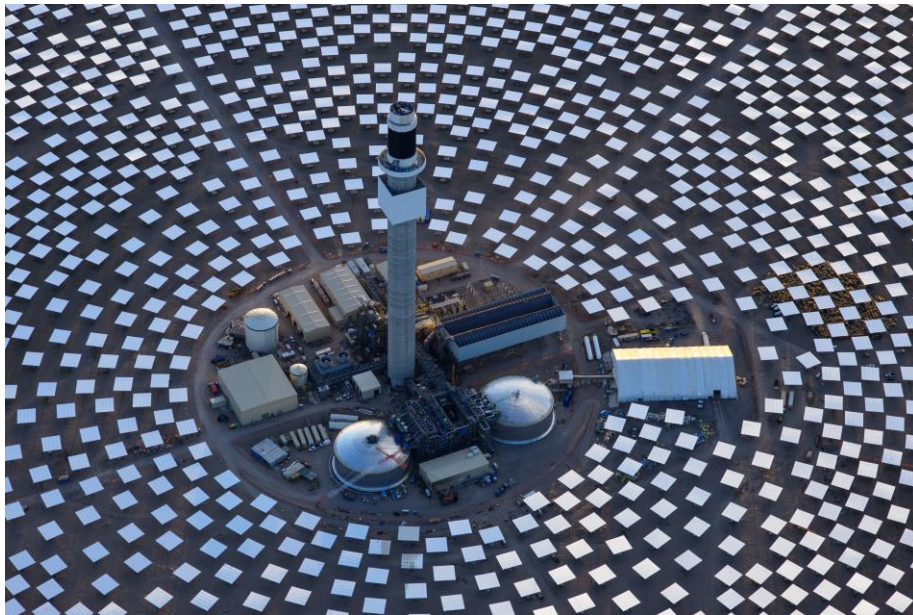


- More than **\$1.8 billion of projects in operation globally**
- **Flagship 110 MW Crescent Dunes CSP project** in Tonopah, Nevada with 10 hours of storage
- Company has been **awarded 346 MW of projects in South Africa**, with 246 MW currently operating
- Full **asset management capabilities**

South African success story

SolarReserve CSP Central Receiver Technology

Concentrated solar power (CSP) technology uses sun tracking mirrors (heliostats) to concentrate the sun's energy on a **solar thermal receiver**. Liquid molten salt is used both as the **heat transfer fluid** and the **storage medium**, which allows it to separate energy collection from electricity generation. Molten salt is passed through a heat exchanger to generate **steam**, which then is used to drive a conventional power **Steam Turbine Generator**, which generates electricity.



CSP Technologies

- **Molten Salt Power Tower with storage**
- Linear Freshnel
- Parabolic Troughs
- Stirling Dish

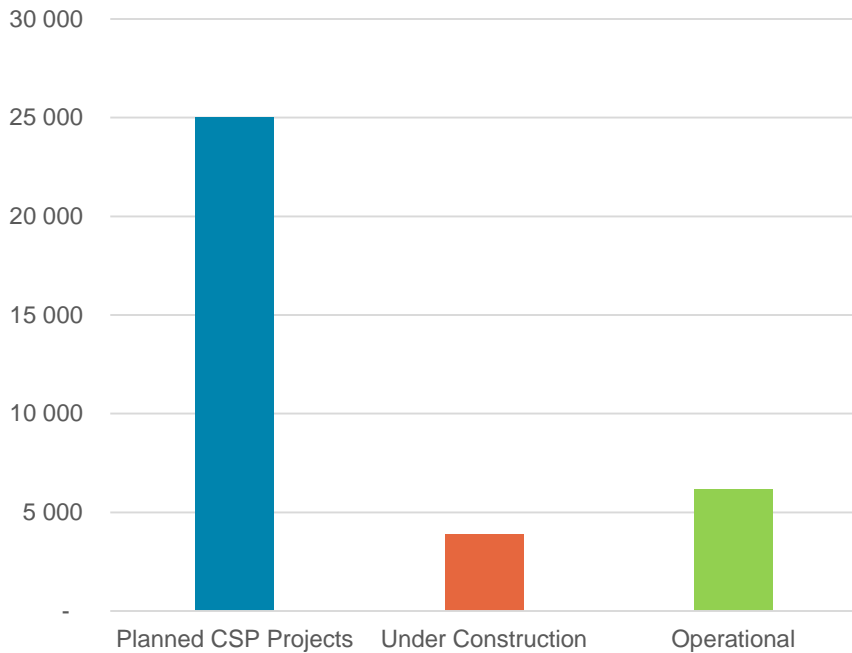
Benefits

- Job creation
- Local content
- Local investment
- Inward investment
- Local Spend: Economic Development
- Black Empowerment Equity

- Fuel – no FX risk – no commodity risk
- NO carbon emissions
- Distributed Generation
- Energy Security
- CSP Storage provides a dispatchable plant capable of dispatching power in baseload, mid-merit and peaking modes

Commercialisation of CSP around the world

CSP Projects around the world

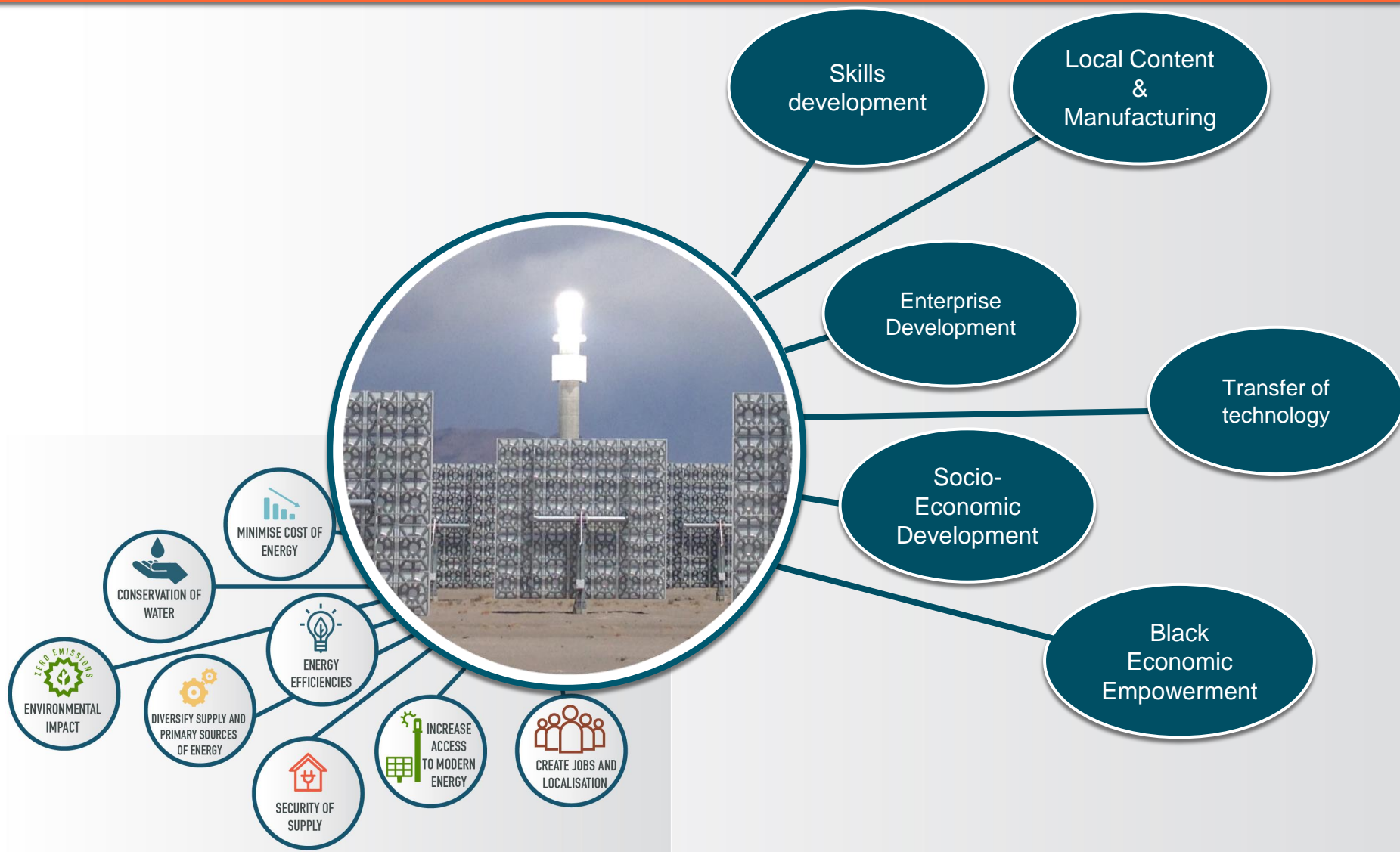


 Algeria	 Australia	 Canada	 Chile	 China
 Egypt	 France	 Germany	 India	 Israel
 Italy	 Kuwait	 Mexico	 Morocco	 Oman
 Saudi Arabia	 South Africa	 Spain	 Thailand	 Turkey
 UAE	 USA	 Greece		

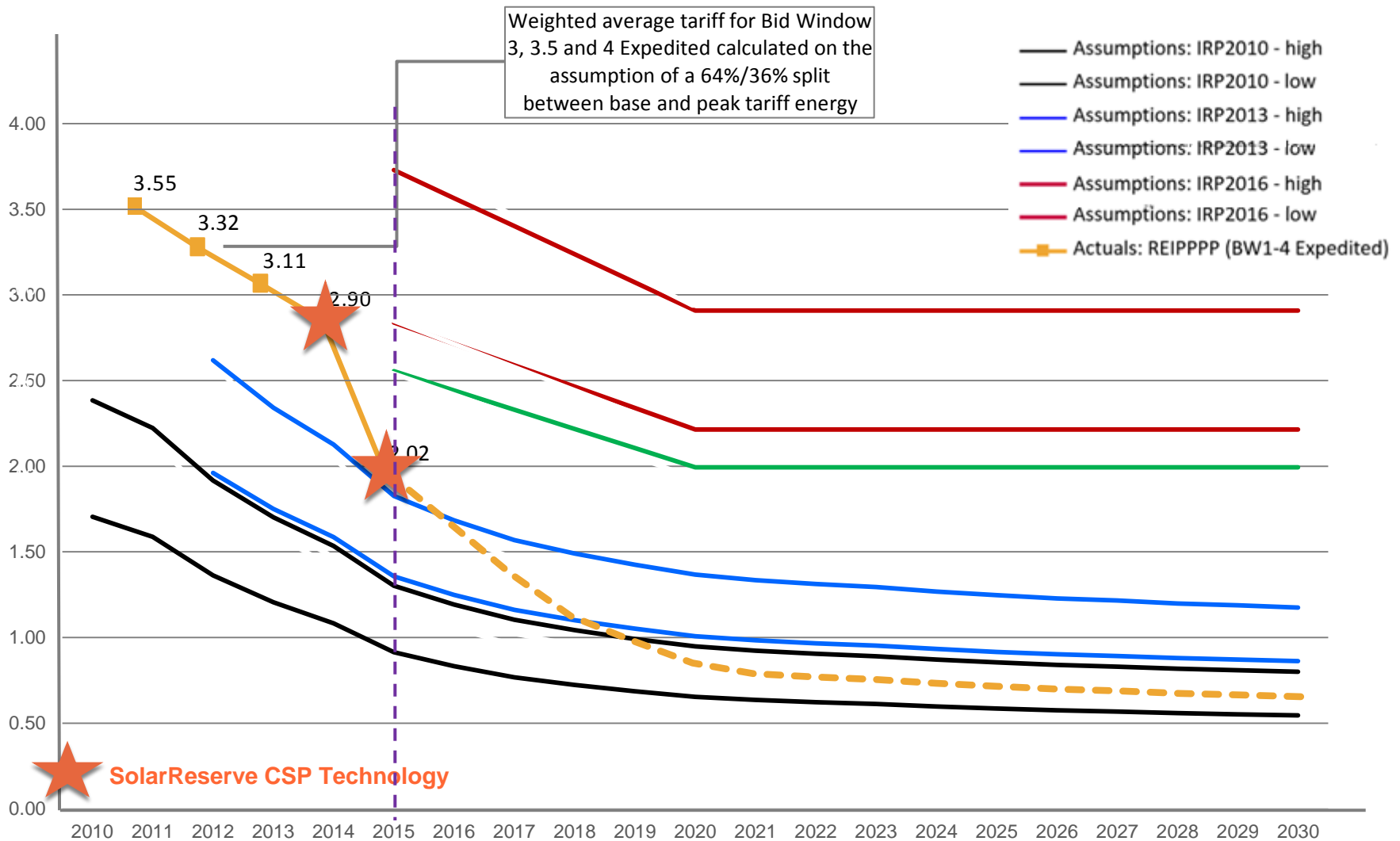
SolarReserve's CSP Technology Aligns with the 8 IEP Objectives



CSP Benefits beyond the 8 IEP Objectives



Energy Pricing for CSP is incorrect - IRP 2016 is Overstated



Assumptions: CPI used for normalisation to Apr-2016-Rand; LCOE calculated for IRP 2010 and 2013 with 8% discount rate (real), 25 yrs lifetime, cost and load factor assumptions as per relevant IRP document; LCOE for IRP 2016 straight from IRP document; "IRP Tariff" then calculated assuming 90% of total tariff to be LCOE EPC costs, i.e. divide the LCOE by 0.9 to derive at the "IRP Tariff" Sources: IRP 2010; IRP 2013; IRP 2016 draft as of November 2016; <http://www.energy.gov.za/files/renewable-energy-status-report/Market-Overview-and-Current-Levels-of-Renewable-Energy-Deployment-NERSA.pdf>; CSIR analysis

Project Cost Roadmap Driving LCOE Reductions



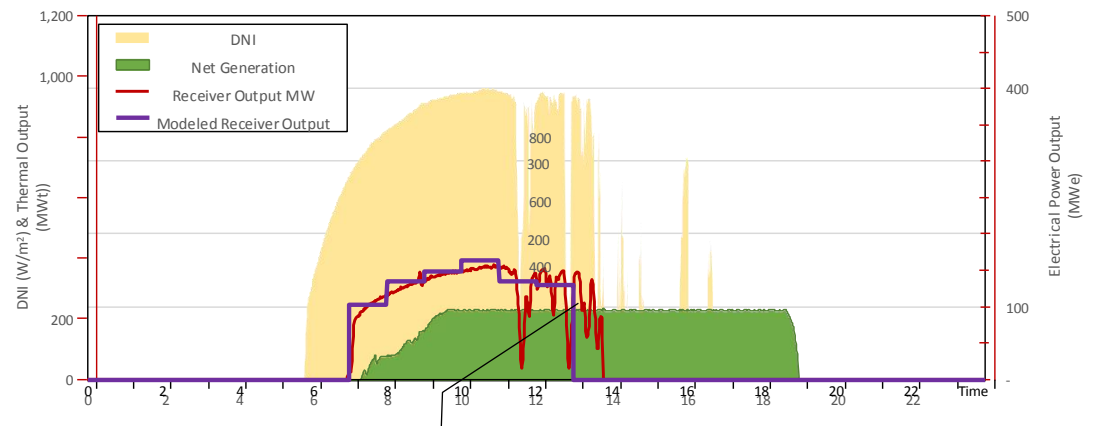
LCOE reduction is due to –

- Economies of scale
- Increased technology awareness and operational experience
- CAPEX Cost reductions
- Reduction of soft costs through de-risking
- Increased plant and technology performance
- Lower cost and alternative Financing Structures
- O&M Costs through familiarization, economies of scale & more efficient contracting
- Advancement in technology
- Optimum configuration of plant (baseload, mid-merit & peaker) in order to displace less cost effective technologies

Operational modes of SolarReserve CSP Technology



Baseload
Mid-merit
Peaking



Collection sustained throughout highly transient weather conditions

Integrated Resource Plan Update 2016

Assumptions, base case results and observations.

<p><i>Government Gazette no.40445, dated 25 November 2016</i></p> <p>“RESULTS AND OBSERVATIONS FROM THE BASE CASE</p>	<p>SolarReserve Response</p>
<p>The Base Case is produced by updating the IRP model with the latest assumptions.</p> <p>The new generation capacities called for in the Ministerial Determinations that are not yet committed (no procurement has started) are allowed to lapse. This means that only procurement up to bid window 4.5 for renewables (expedited including smalls) and coal 900MW are considered committed.</p> <p>The Base Case maintains a number of policy positions imposed in the IRP 2010-30 in particular an annual build limit of new capacity for wind (1600 MW) and photovoltaic (1000 MW).</p>	<p>We support any base case scenario that includes all committed projects up to the Expedited Bid Round (4.5)</p> <p>In order to maintain the Bid Tariff, we suggest signing of Power Purchase Agreements (PPA) on a timely basis and announcement of the Preferred Bidders in the Expedited Round (4.5)</p>

Current IRP modelling – CSP Allocation to SOE

Table 0-1: Assumed split of build by technology type

Technology type	SOE built	IPP built	Import built
Nuclear	100%		
Coal	70%	30%	
Gas – CCGT and OCGT	70%	30%	
CSP	70%	30%	
Solar PV		100%	
Wind		100%	
Landfill biomass		100%	
Imported hydro, coal and gas			100%

Figure 0-1 shows the assumed proportion of new capacity by the SOE vs IPPs based on the above split.

Source: *Integrated Energy Plan, Department of Energy (2016) p.158*

We do not agree with the rationale that 70% of CSP must be SOE Built based on current trends in South Africa. Majority of CSP Projects should be built by IPPs.

Integrated Energy Plan 2016

Assumptions, base case results and observations.

Integrated Energy Plan, Department of Energy, 2016	SolarReserve Response
<p>Page 165</p> <p>Large scale CSP projects with proven thermal storage technologies and hybridisation/industrial steam application projects should be incentivised in the short to medium term. In the long term the existing incentives could be extended to promote locally developed CSP technology storage solutions and large scale solar fuel projects.</p>	<p>Agreed.</p> <p>The CSP technology benefits include</p> <ul style="list-style-type: none"> • Economies of Scale • High Job creation • Increased Local content • Increased Local investment and manufacturing • Local Spend: Economic Development
<p>Page 165</p> <p>Investments should be made to upgrade the grid in order to accommodate increasing solar and other renewable energy contributions.</p>	<p>Agreed - this is common across all power generation projects.</p>

Integrated Energy Plan 2016

Assumptions, base case results and observations.

Integrated Energy Plan, Department of Energy (2016)	SolarReserve Response
Reference Page 172	
<i>“CSP creates the most jobs in terms of capital investment and operating expenditure.</i>	Agreed. Also creates jobs during the development period.
<i>The technology is still, however, relatively expensive and without storage does not provide a stable source of baseload power.</i>	The presentation proves a massive decrease in CSP costs with storage to date and beyond. CSP flexibility in its operational modes makes it a complimentary technology to all other renewable energy projects.
<i>In addition, depending on where CSP plants are located, there could be a requirement for significant investment in additional transmission lines to densely populated areas.</i>	Transmission infrastructure is common across all power generation projects.
<i>As a result, installing CSP alone, or for that matter any technology with these same constraints, would not be cost effective for South Africa’s economy.”</i>	These constraints are not unique to CSP technology.

Integrated Energy Plan 2016

Assumptions, base case results and observations.

Integrated Energy Plan, Department of Energy, 2016,	SolarReserve Response
<p>Page 181</p> <p>The most common technologies for distributed generation include micro-turbines, fuel cells, storage devices, photovoltaics, concentrated solar power (CSP), wind turbines, hydroelectric power, hybrid power and microgrids. These technologies have the added advantage of not emitting greenhouse gases or other pollutants during operation.</p>	<p>Agreed.</p> <p>The IEP confirms that CSP is one of the most common technologies with the environmental advantage of no emissions during its operational lifecycle.</p> <p>CSP technology should be considered and investigated as and when the scenarios are assessed.</p>
<p>Page 183</p> <p>Research and development</p> <ul style="list-style-type: none">- Explore innovations that can aid in the reduction of the cost of CSP.	<p>Cost reduction is due to –</p> <ul style="list-style-type: none">▪ The collector field has the largest potential for cost reductions through serial production and scale economies▪ Overall soft costs decline further as a result of capex cost reductions▪ Mechanical and Electrical equipment▪ Receiver▪ Financing▪ EPC Costs and Contract▪ Advancement in technology

Conclusions and Recommendations

- We support the Base Case that includes all committed projects up to the Expedited Bid Window (4.5).
- With emissions taken into account CSP pricing is on par with other technologies.
- The CSP assumptions must be updated to reflect accurate market data.
- The modelling needs to account for CSP's ability to operate in different modes: Base load, Mid-merit & Peaking.
- The learning curves used in the modelling are incorrect and underestimated.

DoE's scenarios to be tested must include CSP's overall benefit under the following scenario's:

1. **carbon budget** as an instrument to reduce greenhouse gas emissions;
2. primary **fuel price tipping point** (coal, gas and nuclear);
3. **regional options** (hydro, gas);
4. **unconstrained renewable energy**;
5. **new technology (storage)**;
6. **electricity network implications**

1000MW of CSP should added to the IRP Update 2016.



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