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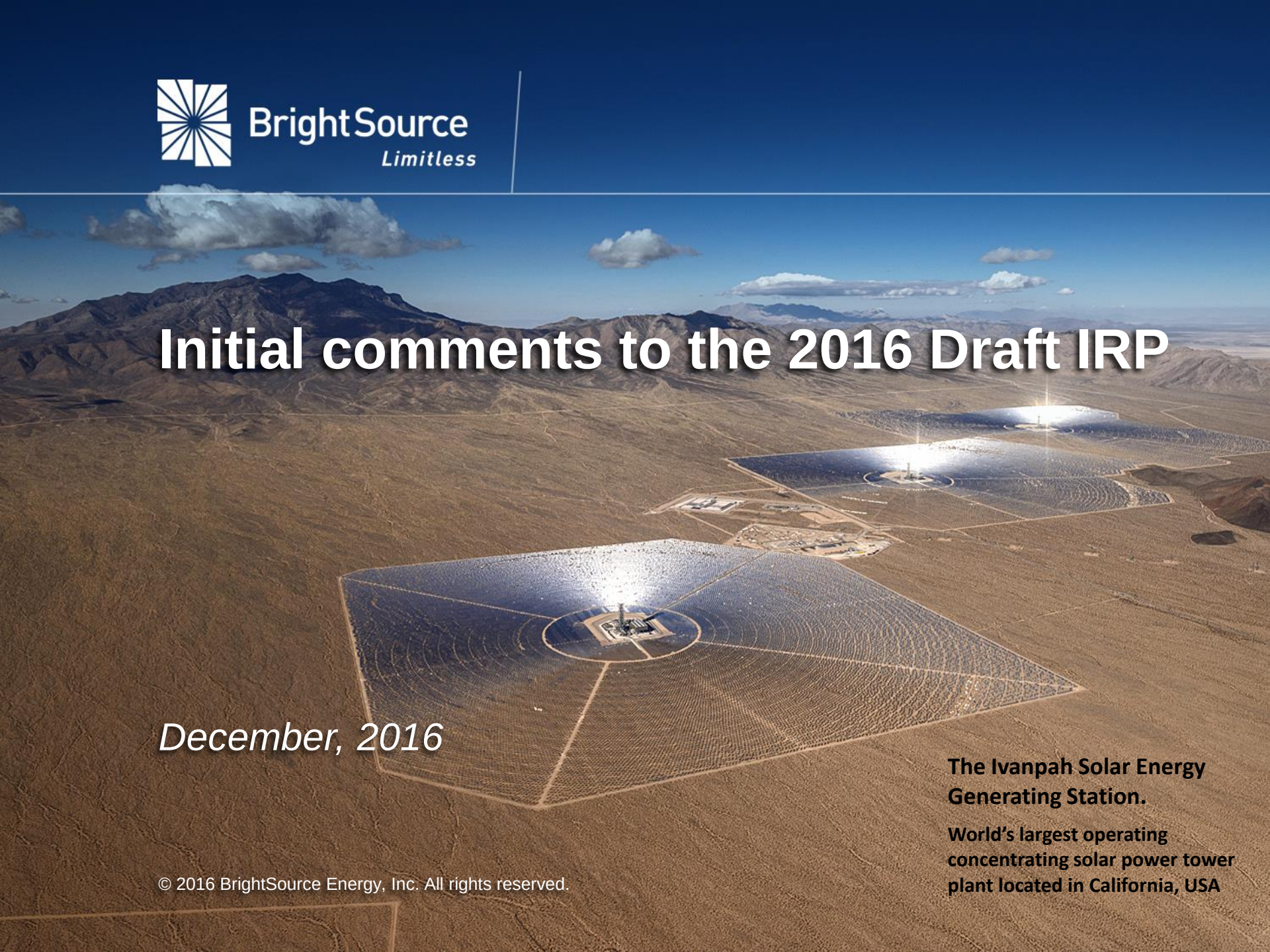
Initial comments to the 2016 Draft IRP

December, 2016



The Ivanpah Solar Energy Generating Station.

World's largest operating concentrating solar power tower plant located in California, USA

BrightSource is the World Leader in Concentrating Solar Power (CSP) Tower Technology

Proven Track Record

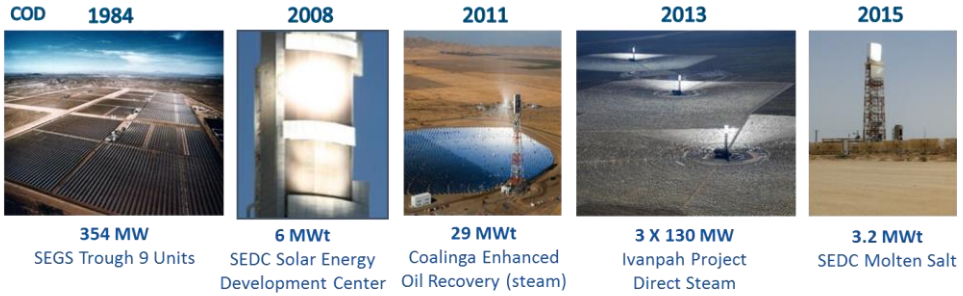
Unparalleled solar thermal technical expertise combined with project development and power plant operating experience

Strong IP Portfolio

More than 100 patents and patent applications covering solar thermal technologies, with majority related to solar field and control systems, including many utility model patents in China

Comprehensive Engineering & Technical Support Services

- Conceptual Design of Power Plant
- Solar Field Design
- Solar Field Control System
- Solar Receiver Conceptual Design
- Commissioning and Start-up



Ashalim, the world's tallest power tower plant (240m), now under construction in Israel's Negev desert.

Initial comments to the draft IRP

- **The timelines are very challenging** with information such as scenarios and appendices yet to be issued, making it difficult to effectively comment
- **The input assumptions** appear to be dated and do not reflect the latest Expedited Bid Round CSP costs, CSP learning rates and LNG prices for CCGT and OCGT
- **CSP dispatchability needs to be accounted for within the IRP analysis.** CSP with thermal storage can substitute baseload, mid merit and peaking plant
- **The IRP base case does not recognise the social, environmental and wider economic benefits** such as:
  - zero carbon generation,
  - Localisation and jobs especially in the Northern Cape region
  - South African energy independence
- **With above adjustments CSP Tower can be competitive vs. CCGT levelised cost right now, using EPRI Modelling**

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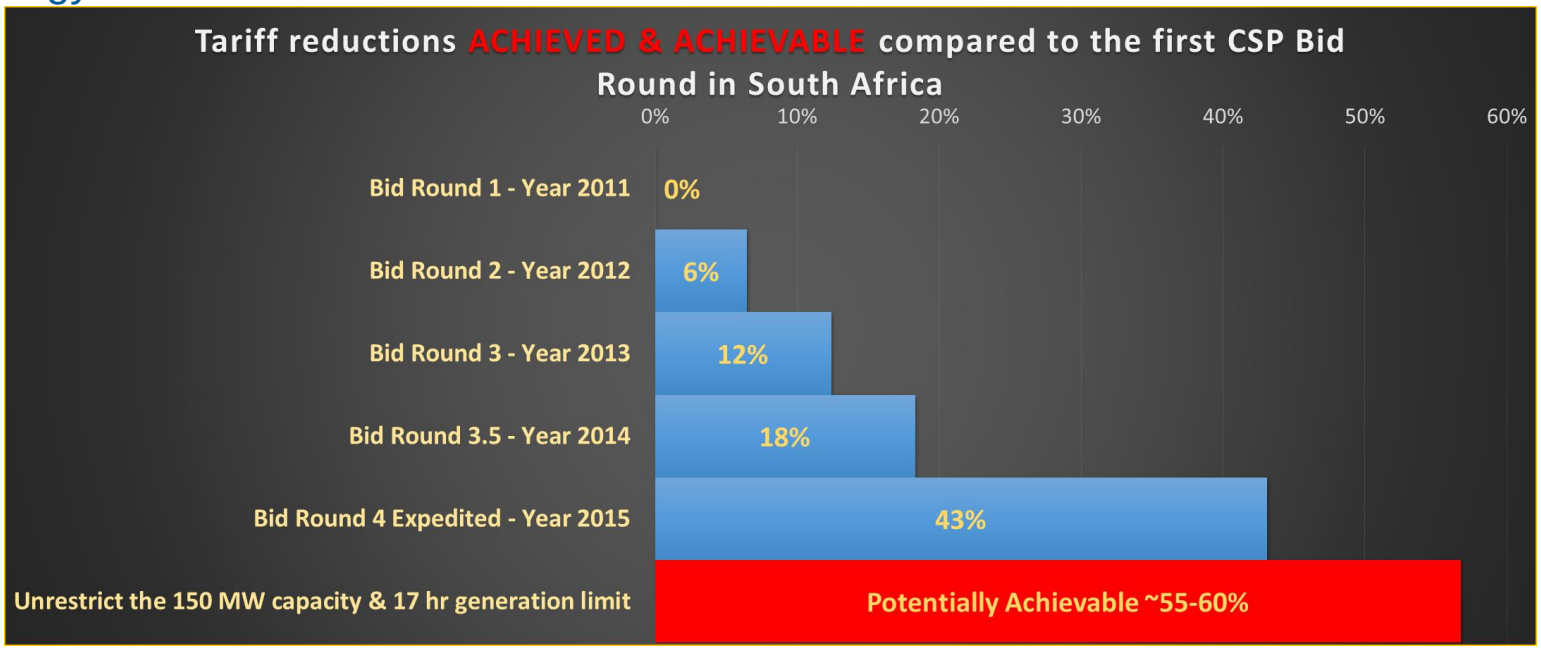
Input Assumptions of the IRP need amending

IRP Base Case cost assumptions need updating

- EPRI Capex assumptions for CSP Tower appear to be dated, and do not reflect numbers used in the Expedited Bid round
- CSP learning rates achieved have been impressive. We should expect further leaning curve benefits as more capacity is installed
- There is more potential for scale benefits and PPA structure, even with existing CSP technology



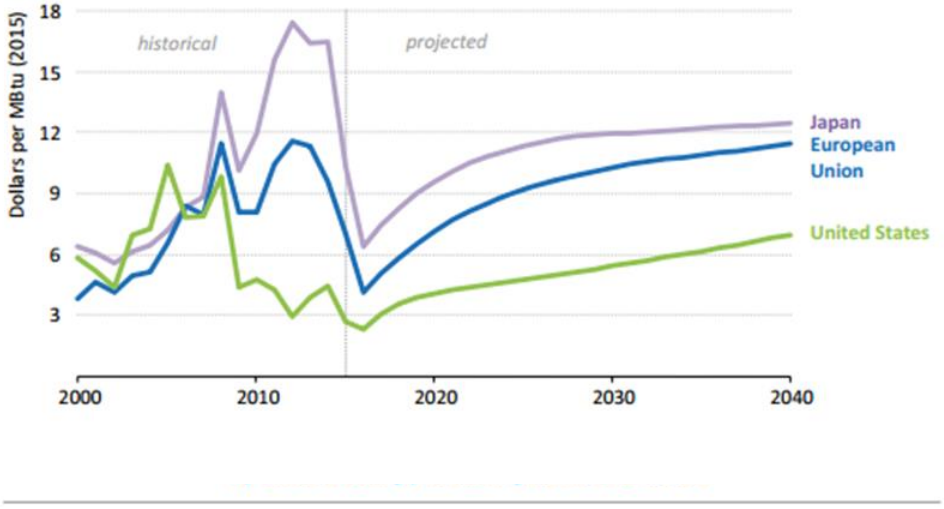
Source: Data for bid rounds 1,2,3,3.5 and 4 are based on CSIR report "Comparison of IRP assumptions with actual IPP tariffs." Potentially achievable figures based on BSE analysis, all at 2016 prices

IRP Base Case gas assumptions could be underestimating CCGT and OCGT Levelised Cost

- EPRI modelling assumes gas prices to remain at 2015 prices for the next 35 years at R115.5/GJ

- The IEA considers that the current price is a historic low at R150/GJ and expect real terms increases in gas as follows

Figure 1.5 ▷ **Natural gas prices by region in the New Policies Scenario**



Notes: US price is a wholesale price; other prices are average import prices.

Source: IEA WEO 2016, page 49

- Gas priced in US$ and future price likely to be volatile

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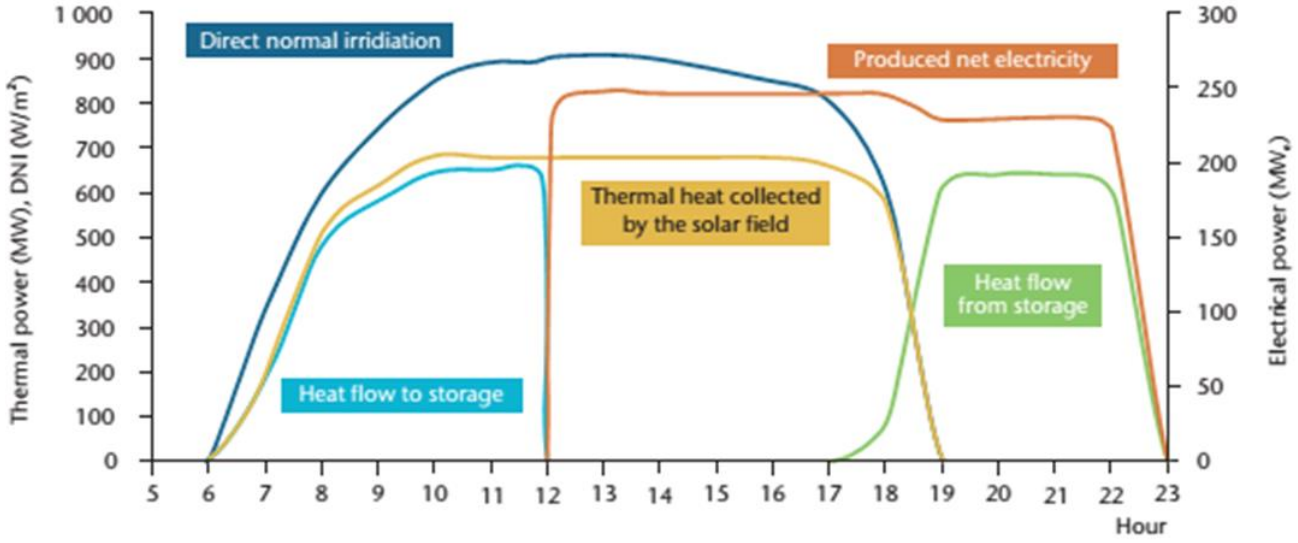
CSP dispatchability needs to be accounted for within the IRP analysis

Additional benefits of CSP not accounted for in the IRP Base Case

- Thermal Energy Storage (TES) provides CSP a dispatchable capability and improves grid flexibility by providing firm system capacity with a high ramp rate and acceptable part-load operation

- With TES CSP can generate electricity on demand (peak hours) – under unrestricted operating schedule it can operate in base load and also backup PV/Wind variations avoiding integration costs (i.e. ancillary services) and the need for some CCGT capacity



Source: Technology Roadmap EIA 2014

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The IRP base case does not recognise the social, environmental and wider economic benefits

Additional benefits of CSP not accounted for in the IRP

- Carbon costs in the IRP are considered to be zero which penalises CSP
- The IRP and EPRI model assumptions don't take account of the environmental, health and wider social costs associated with fossil fuel pollution
- CSP has no fuel costs which removes commodity price risk, foreign exchange risks and should save South African foreign reserves that would be needed to import LNG
- CSP provides more localisation, job creation and other economic multipliers especially in the Northern Cape region – IEP 2016: *"CSP creates the most jobs in terms of capital investment and operating expenditure"*
- In an uncertain future including CSP in the technology mix has "option" benefits for South Africa

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CSP Tower could be competitive vs. CCGT levelised cost right now, using EPRI Modelling

LCOE of CSP Tower could be competitive vs. CCGT, using EPRI Modelling

- Once the CSP plant capacity and generation constraints are removed we expect CSP could be competitive with LNG fed CCGT in South Africa

- Unlike wind and PV, CSP with storage is dispatchable and does not require firming backup. CSP as a standalone technology can efficiently substitute some of the considerable growth in capacity from wind, PV and CCGT

- With the continued technology learning rates, CSP cost should continue to fall unlike other more mature technologies

- Initial modelling suggests:

  - Making the above changes to CSP cost assumptions and adding in known learning benefits reduces CSP levelised cost from 2.3 R/kwh to between **1.7- 1.3** R/kWh. Future learning likely to bring further cost reductions.

  - Updating gas prices increases CCGT levelised cost from 1.2R/kWh to 1.7R/kWh

- **Hence we believe CSP can compete with CCGT**

Summary

- **The timelines are very challenging** with information such as scenarios and appendices yet to be issued, making it difficult to effectively comment

- **The input assumptions** appear to be dated and do not reflect the latest Expedited Bid Round CSP costs, CSP learning rates and LNG prices for CCGT and OCGT

- **CSP dispatchability needs to be accounted for within the IRP energy analysis.** CSP with thermal storage can substitute baseload, mid merit and peaking plant

- **The IRP base case does not recognise the social, environmental and wider economic benefits** such as:
  - zero carbon generation,
  - Localisation and jobs especially in the Northern Cape region
  - South African energy independence and Option value

- With above adjustments **CSP Tower can be competitive vs. CCGT levelised cost right now,** using EPRI Modelling and should be included in the IRP 2016 Energy Mix

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