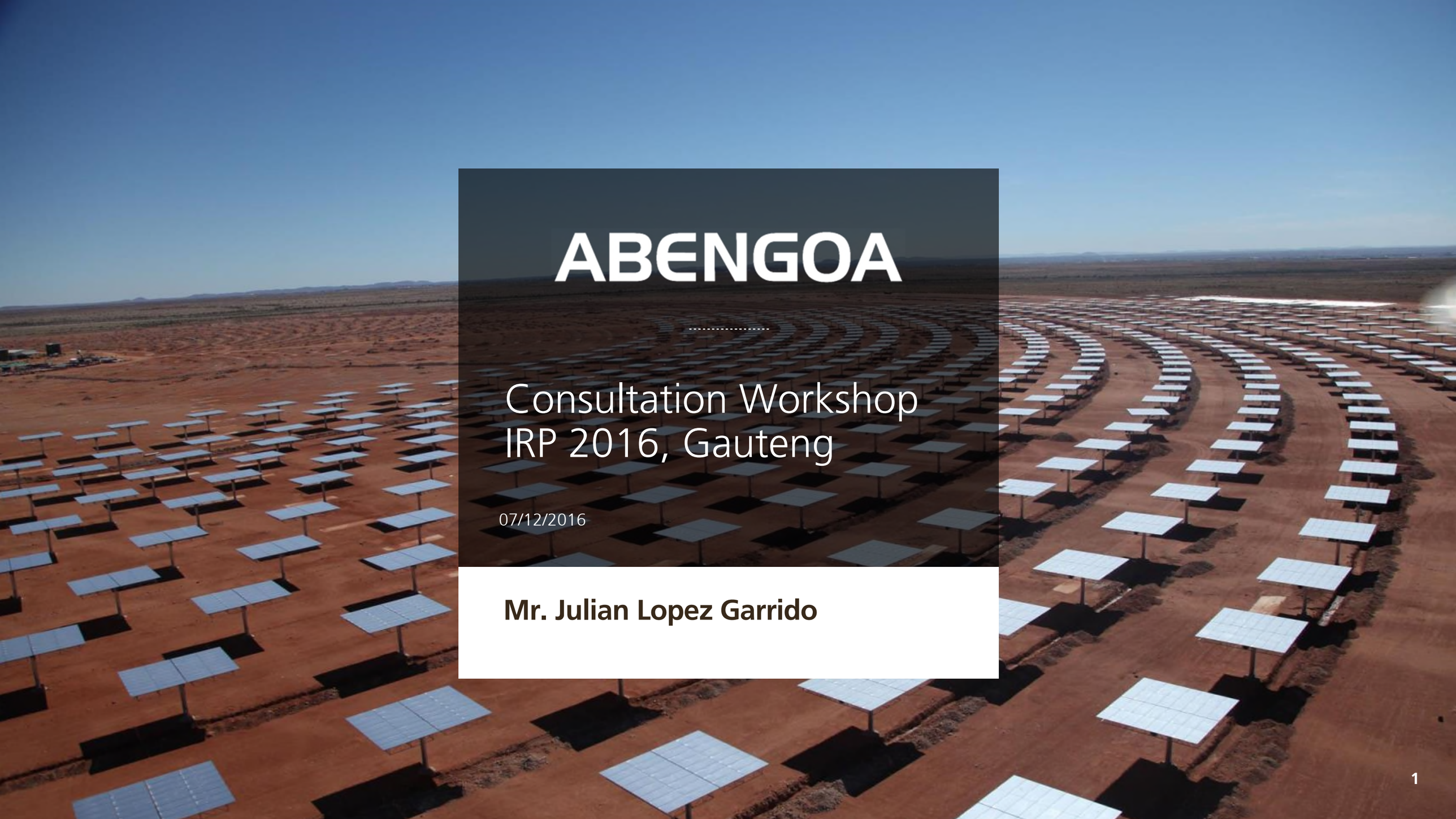

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Consultation Workshop IRP 2016, Gauteng

07/12/2016

Mr. Julian Lopez Garrido

What is CSP?

CSP does…

Wikipedia

- generate solar power by using mirrors or lenses to concentrate a large area of sunlight, or solar thermal energy, onto a small area. Electricity is generated when the concentrated light is converted to heat, which drives a heat engine (usually a steam turbine) connected to an electrical power generator or powers a thermochemical reaction.

Abengoa has…

- a portfolio of CSP plants in operation or under construction which reaches over 2,300 MW

CSP is in South Africa

- Kaxu Solar One 100 MW (operation)
- Khi Solar One 50 MW (operation)
- Bokpoort 50 MW (operation)
- Illanga 100 MW (construction)
- Kathu 100 MW (construction)
- Redstone 100 MW (pending FC)
- +1000 MW submitted bid 4.5 or development

More Info:

- http://www.abengoasolar.com/web/en/plantas_solares/plantas_propias/sudafrica/
- http://www.abengoasolar.com/web/en/multimedia/videos/
- http://www.stelaworld.org/

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Agenda

1 Current and potential benefits of CSP for South Africa

2 Technology Capabilities

3 Value Proposition

4 Conclusions

5 Scenarios

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Current and potential benefits of CSP for South Africa

Current benefits of CSP for South Africa

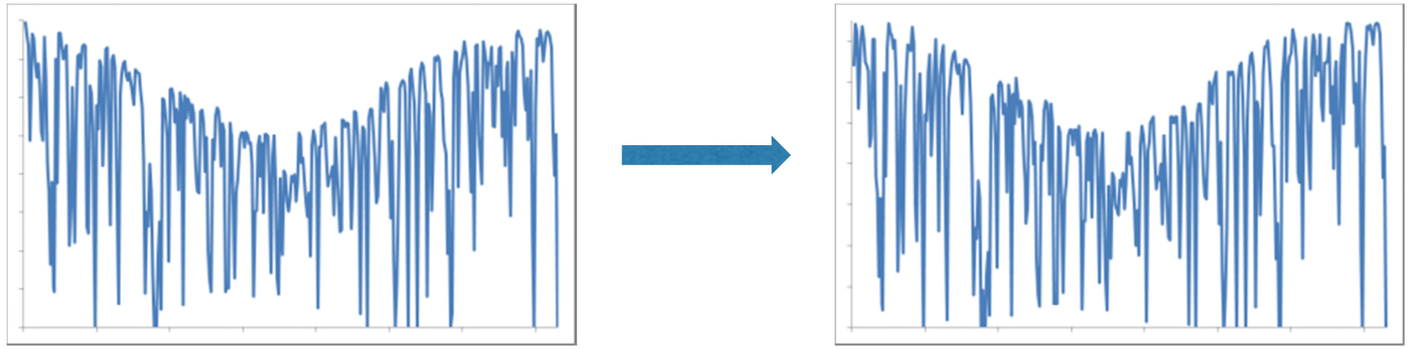
- 20 years PPA limits fuel volatility impact
- Self Dispatch provides 0 CO_2 stable energy
- Small contribution to RE penetration
- Two Tier Tariff constant along the year and along whole PPA period helps shaping the production profile

Potential benefits of CSP for South Africa

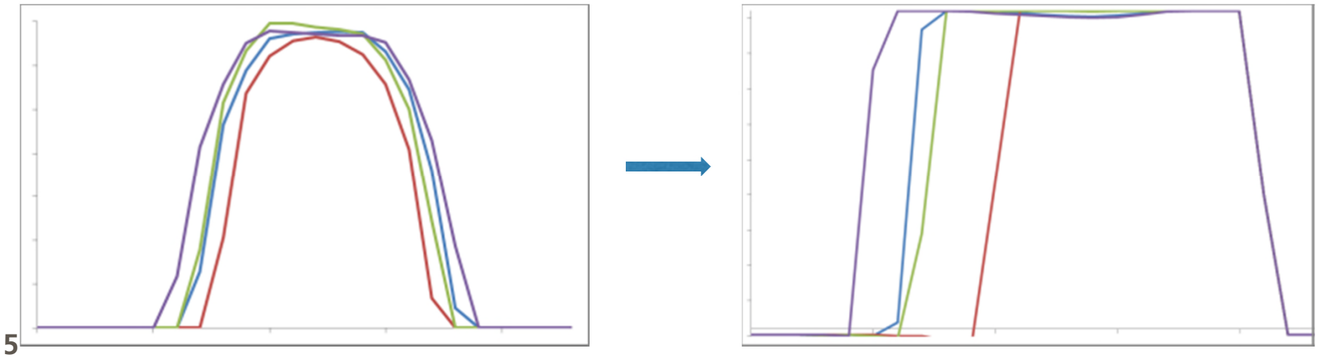
- 25+ years PPA provides long term infrastructure approach
- Interaction with System Operator
- Significant contribution to RE penetration and support through lower priority to intermittent RE sources such PV & Wind
- Multiple Tier Tariff variable along the year and potential to redistribute during PPA period increases flexibility
- Ancillary and Energy Storage services
- Grid and System Stability
- Complimentary to intermittent renewables in the Portfolio Mix planning

Technology Capabilities

- System Thermal Inertia provides Lag between energy collection and power generation which allows management of transients and accurate real-time production forecast
- System Mechanical Inertia allows for Voltage, Frequency and Load Control as well as Reactive Power contribution
- Storage System allows to decouple energy input from energy output, providing a buffer which allows for production to adapt to demand
- Seasonal energy source variation <30% Seasonal energy output variation <35%



- Consistency delivering on the most adding value production window regardless of the season



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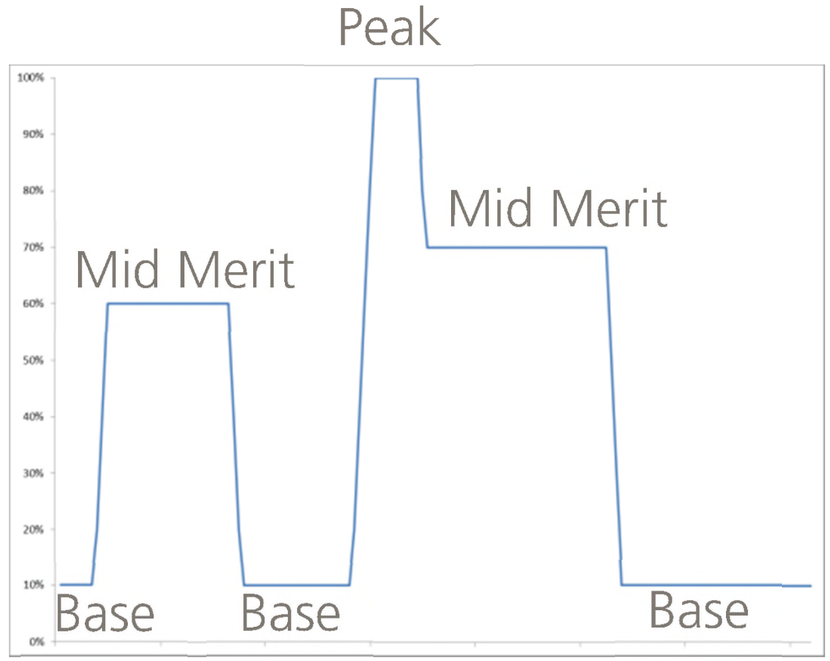
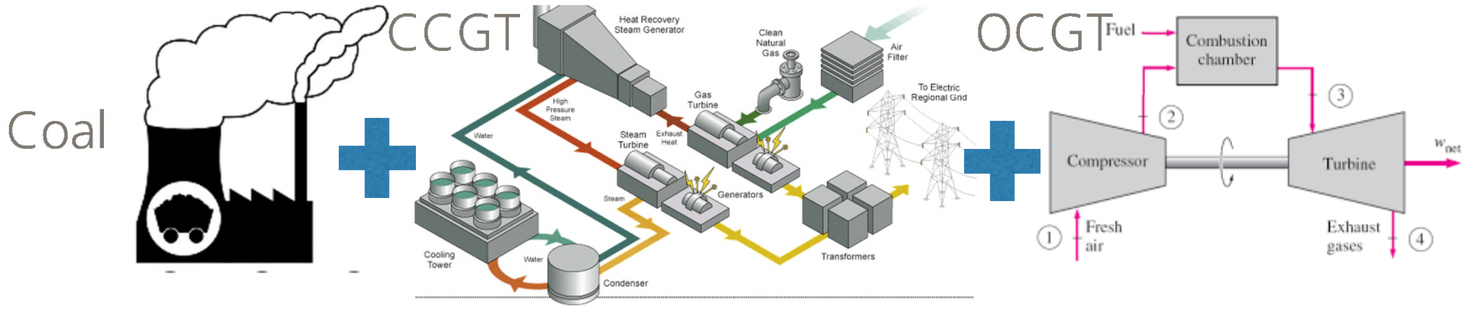
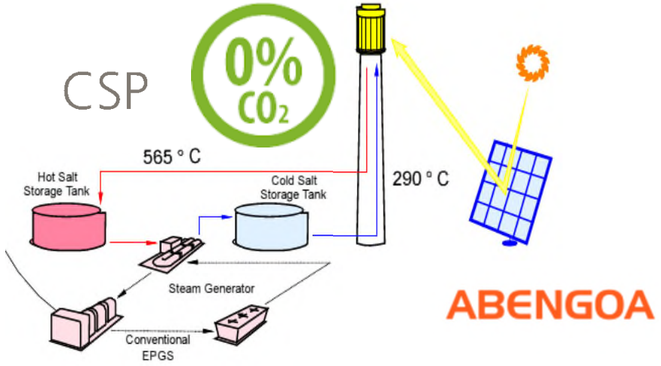
Value Proposition

- CSP fully dispatchable within a certain daily energy budget:
  - Provide Base and Peak Load at a daily Load Factor, as and when specified by the Client
  - Provide Mid Merit Load within daily energy available constrains as per Client needs
- Avoid duplicated and/or additional infrastructure within mix limitations
- Substitute fossil fuels & infrastructure with 0 CO_2 energy source
- Flexibility around future energy needs with quick turn around time
  - 3 years from Preferred Bidder to COD
- Competitive pricing via either FIT or IPPPP
- Full industrialization around CSP technology spread over the Country and contributing to grow economy and employment in the most depressed areas
  - Steel, Glass, Concrete and other equipment Industries to receive a boost
  - Wide range of Skilled Job Creation during construction and operation
  - Economy stimulation via Project Finance Scheme
  - Enhance of rural areas economy and empowerment

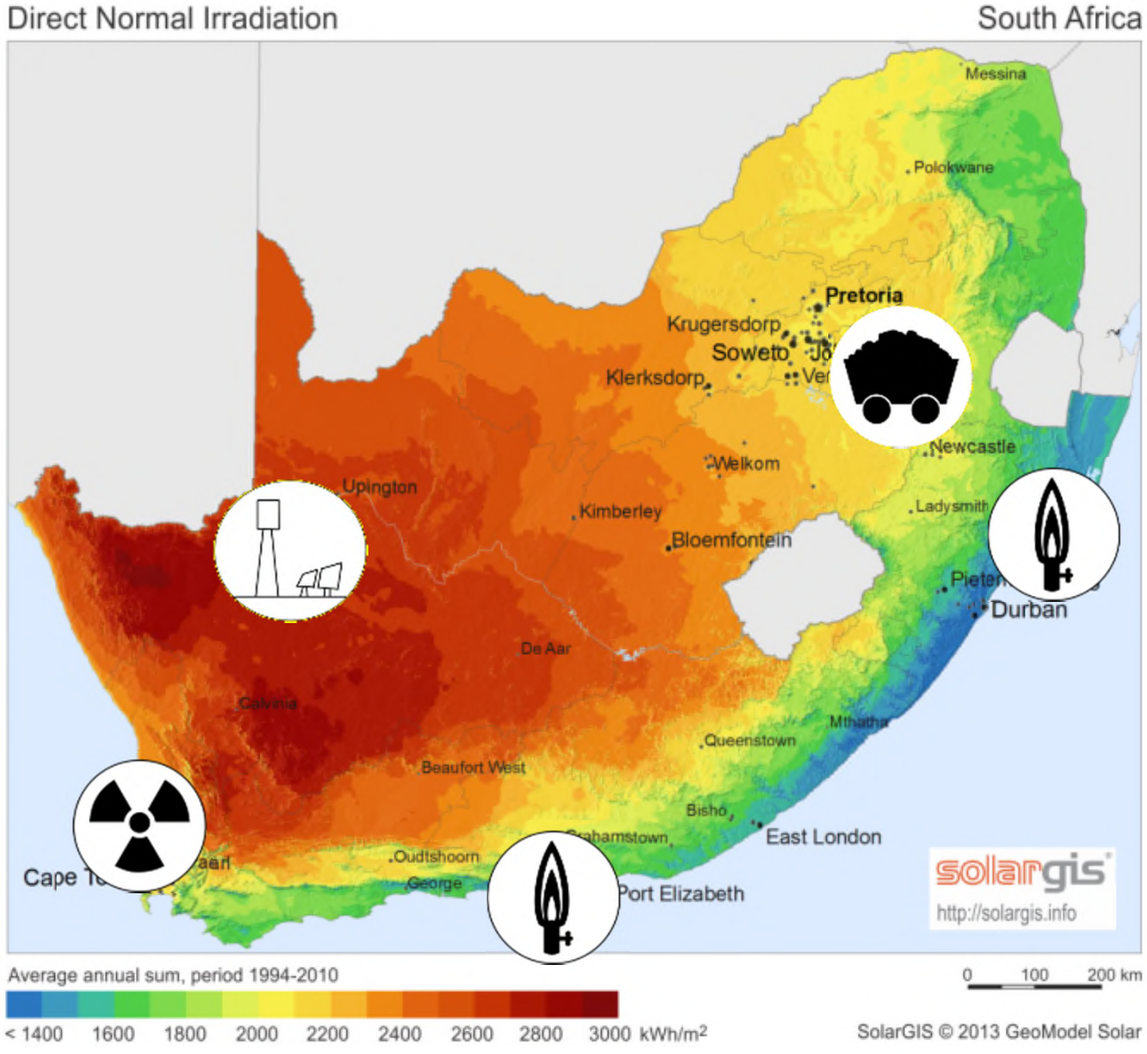






Conclusions

- Avoiding options will provide less flexibility for future mix planning and balancing, is recommended to establish brackets instead of fixed figures to absorb volatility and future events not included in the models and inputs for the scenarios studied
- CSP doesn't substitute PV & Wind but support its Grid penetration
- Keeping the open possibility to have CSP in the Energy Mix will provide the option to increase renewables penetration in the grid with the support of a dispatchable 0 CO2 energy source
- Studying new flexible retribution and energy management skills would be possible to extract full potential and value from CSP which currently is not yet unlocked
- The relatively smaller size of the CSP power plants will allow flexibility in Production management to follow demand and diversification to spread impact within the grid and unavailability
- Fixing the % over Nominal Capacity (NC) and daily Load Factor (LF) required to Base, Peak and Mid Merit Load will allow to confidently use CSP to stabilize the Grid and support the intermittent energy sources where Coal, Gas or Nuclear doesn't have access. Mid Merit load can accommodate for the seasonal variations.
- As per the Scenario 1, 1 GW CSP located in NC will be equal to install 100 MW Coal + 600 MW CCGT + 1 GW OCGT
- **Proposal: 1000 MW CSP for next rounds linked to targets on FIT cap and implementation with potential to grow beyond**



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Scenarios

Scenario 1	Base	Mid Merit	Peak	CSP
NC	10%	60%	100%	100%
LF	86%	36%	6%	36%

Scenario 2	Base	Mid Merit	Peak	CSP
NC	20%	60%	100%	100%
LF	86%	36%	6%	45%

Scenario 3	Base	Mid Merit	Peak	CSP
NC	30%	60%	100%	100%
LF	86%	36%	6%	53%

Scenario 4	Base	Mid Merit	Peak	CSP
NC	40%	60%	100%	100%
LF	86%	36%	6%	62%

Scenario 5	Base	Mid Merit	Peak	CSP
NC	10%	70%	100%	100%
LF	86%	36%	6%	40%

Scenario 6	Base	Mid Merit	Peak	CSP
NC	20%	70%	100%	100%
LF	86%	36%	6%	48%

Scenario 7	Base	Mid Merit	Peak	CSP
NC	30%	70%	100%	100%
LF	86%	36%	6%	57%

Scenario 8	Base	Mid Merit	Peak	CSP
NC	10%	80%	100%	100%
LF	86%	36%	6%	43%

Scenario 9	Base	Mid Merit	Peak	CSP
NC	20%	80%	100%	100%
LF	86%	36%	6%	52%

CSP (*)

Storage (h)	Annual LF	Summer LF	Aut/Spr LF	Winter LF
3	33%	50%	44%	34%
6	44%	67%	60%	45%
12	66%	100%	89%	68%

(*) Estimative figures based on MS Tower in Upington

Thank you

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