



Leading Through Innovation



Energy
Generation



Energy
Generation



Energy
Conservation



Energy
Management

CSE Solar Thermal Conference

4th Feb 2016

Outline

Topics

- Indian DNI Characteristics
- Performance of CSP Technologies in India
- Addressing the Challenges for CSP in India
- CSP in India - Addressing the challenges
- CST in India - Controlling carbon emissions

CSP challenge in India

Indian DNI Characteristics

Solar Resource for CSP in India

Low Yearly Average DNI : 4.5 kWh/m²/day (vs. 7)

Typical DNI values : 400 to 700 W/m²

Effect of Monsoon : 2 very cloudy months

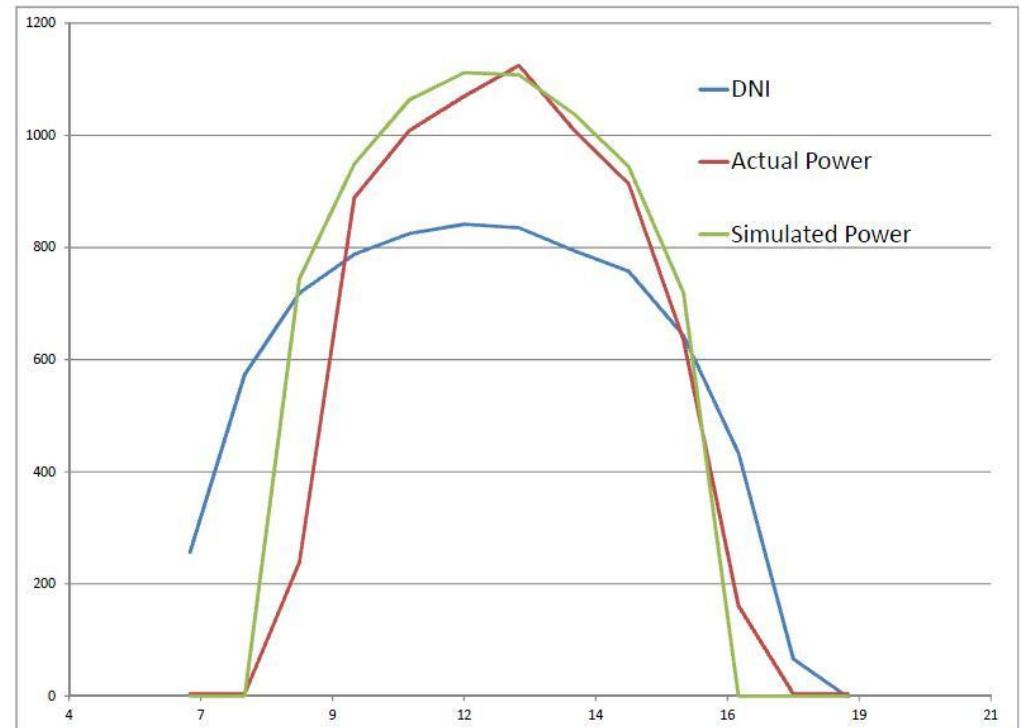
Few Location with good DNI

CSP challenge in India

Performance of CSP Technologies in India

CSP Performance in Indian conditions

Parabolic Trough and
Central Tower
Modular technology
proven against
simulation models



Addressing the Challenges in India for CSP - 1

Cost / Value Challenge

Cost Competitiveness

CSP - radically lower prices via hybridization
Power Block cost are shared
Make in India

Create extra value

Thermal storage and dispatchability
Benefits of hybridization

Potential for Hybridization of CSP with Coal - A

Solar Steam without Thermal Storage

Re.	Injection Point	Energy of total steam (%)	Solar Steam %	Solar without thermal storage CUF%	Carbon Saving Potential
1	Steam Inlet of LP Feed Water Heaters and de-aerator	15%	100%	25%	3.75%
2	Steam Inlet of LP Steam Reheater	55%	70%	25%	9.6%
3	Steam Inlet of HP Superheater	70%	70%	25%	12.2%

Potential for Hybridization of CSP with Coal - B

Solar Steam with Thermal Storage

Re.	Injection Point	Energy of total steam (%)	Solar Steam %	Solar with thermal storage CUF%	Carbon Saving Potential
1	Steam Inlet of LP Feed Water Heaters and de-aerator	15%	100%	60%	9%
2	Steam Inlet of LP Steam Reheater	55%	70%	60%	23%
3	Steam Inlet of HP Superheater	70%	70%	60%	29.4%

Addressing the Challenges in India for CSP - 2

Performance in Low DNI environment

Low DNI due to aerosols

Use median DNI value for field design

Higher Soiling

Shorter cleaning cycle and efficient cleaning systems

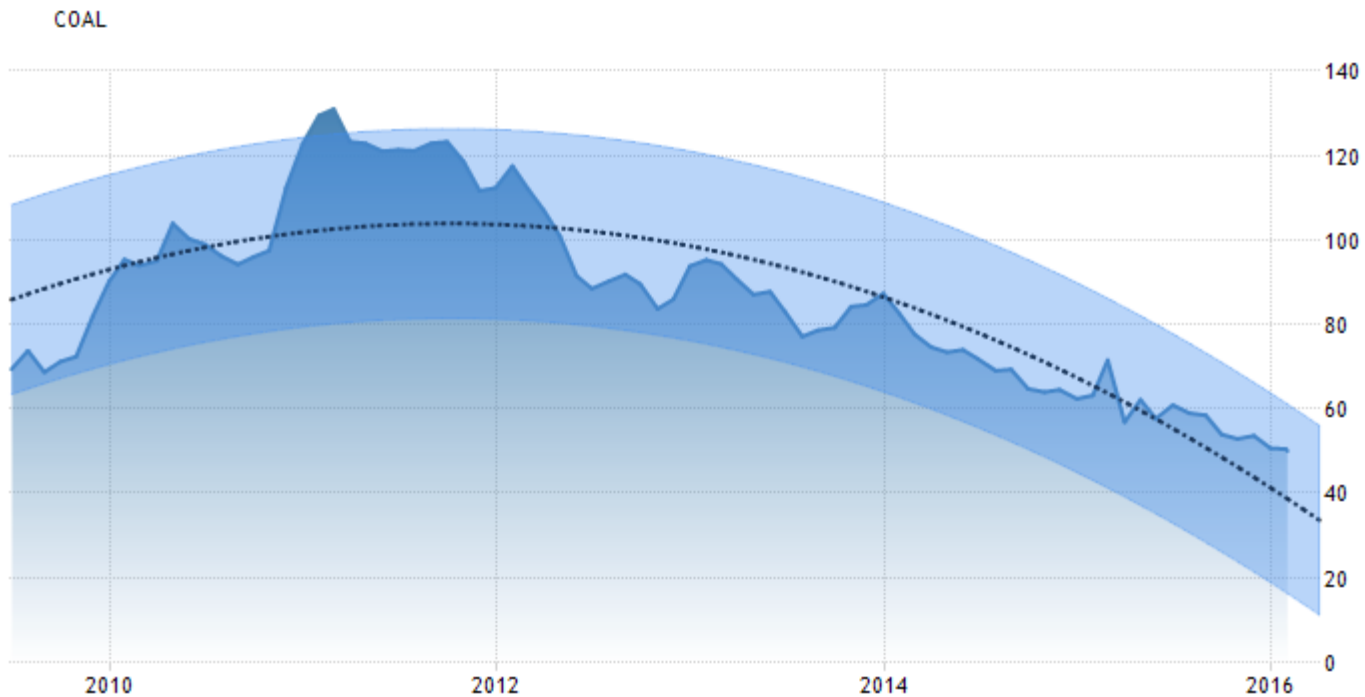
Cloud intermittent events

High Inertia systems, storage

Hybridized, low inertial systems

CST for India – the challenges

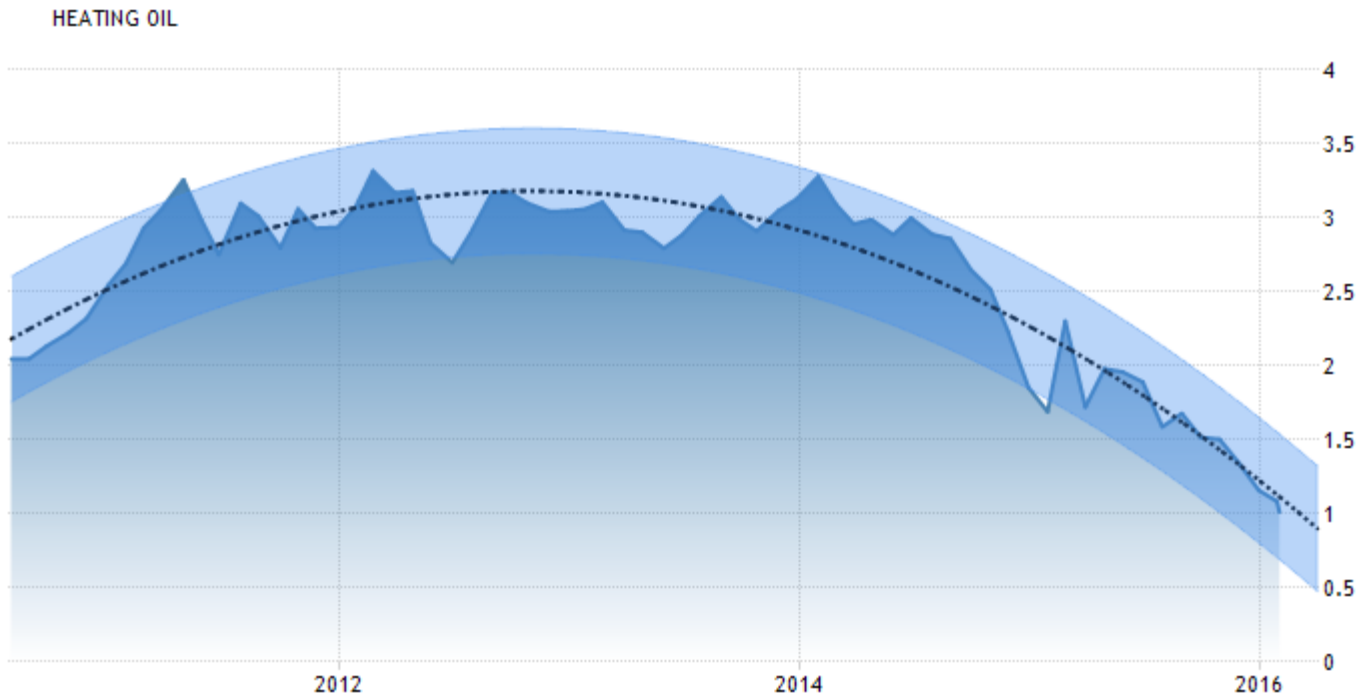
Low prices of carbonaceous fuels - Coal



SOURCE: WWW.TRADINGECONOMICS.COM | ICE

CST for India – the challenges

Low prices of carbonaceous fuels - FO



SOURCE: WWW.TRADINGECONOMICS.COM | NYMEX

CST for India – the way forward

Carbon offsets the only way

*Harsh Reality – Coal and Oil prices are low
and likely to go lower*

Furnace Oil today is cheaper than bottled water

Carbon offset only way to promote CST / CSP
(2 year payback possible with FO@Rs. 50)

Cogeneration of power and heat



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Thank you