Enabling Concentrating Solar Power in India

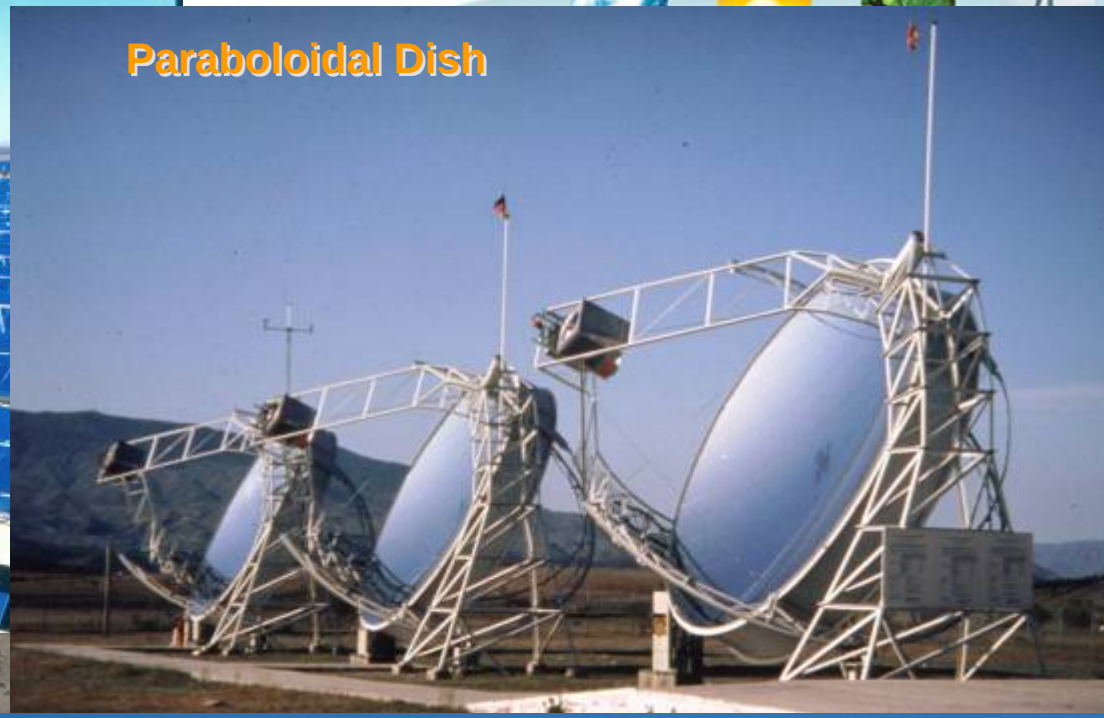
Keith Lovegrove, Head – Solar Thermal, IT Power

www.itpau.com.au

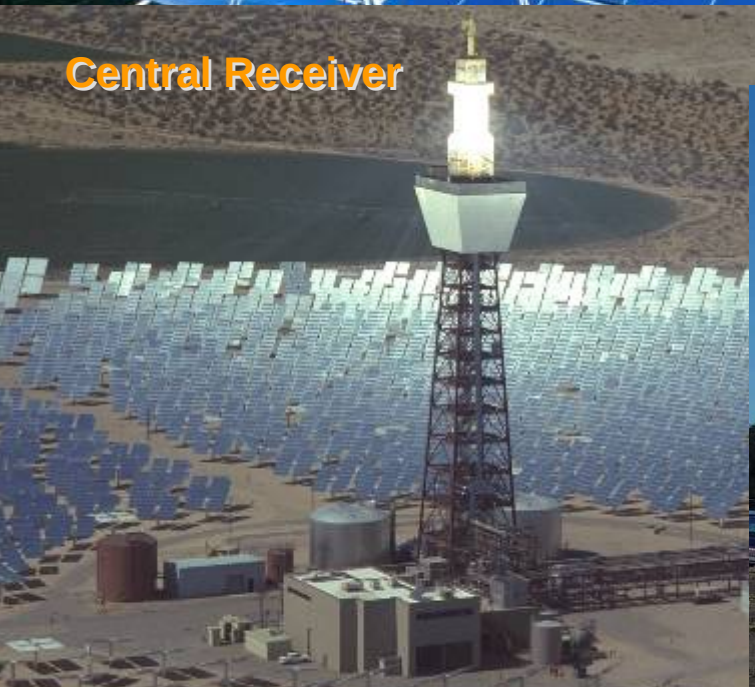
Concentrating Solar Thermal Power is:

Parabolic Trough

Paraboloidal Dish



Central Receiver



Linear Fresnel

Enabling the deployment of Concentrating Solar Power in India

- An Ausaid “Public Sector Linkages Project” conducted by Aust Department of Climate Change and Energy Efficiency
- Outcomes:
  - CSP in India report (to assist Indian policy makers and tech experts)
  - Technical exchanges at RE conferences
  - Workshops
- Associated benefits
  - Links and exchange of knowledge
  - Closer cooperation between MNRE (India) and DEWHA/DCCEE/ DRET etc (Aus)
  - Establish networks of stakeholders
  - Cross pollination of policy ideas

IT Power is the subcontractor for the CSP in India report (Keith Lovegrove, Joe Wyder). Key contact at DCCEE is Helen Hawke

About IT Power

- Leading international Renewable Energy and Climate Change consultants
- Its roots trace back to the 1960s; Incorporated in 1981 as an independent entity
- Headquartered in UK with offices across the globe
  - Offices in UK, India, China, Australia, Africa, Latin America and the Pacific
  - Strong teams in India and Australia
  - Major shareholder is Indian based
- Team with wide ranging experience across regions
- Clients include Corporates, Banks, PE Funds and Governments in over 100 countries

Keith's other hat: leading the Australian National University group that designed and built the Generation II Big Dish

- http://engnet.anu.edu.au/DEresearch/solarthermal/
- Supported by REDI (AusIndustry)
- Worlds largest solar dish
- Engineered for mass production
- Aperture 494m^2 , focal length 13.4m
- Now offered commercially by Wizard Power

India and Australia compared

	India	**Australia**
Population	1100 million	20 million
Electricity Installed cap.	160GW	49GW
Land area	3.29 million sq km	7.7 million sq km
Primary energy	27,000 PJ/a	5,500 PJ/a
Net energy flow	importer	exporter
Policy drivers for Solar	Solar mission:	Solar Flagships:
	1,000MW_e by 2013	1,000MW_e by 2015
	20,000MW_e by 2022	(20% renewable by 2020)

Investment needed for India's 20GW$_e$ solar mission – AUD $70 Billion??

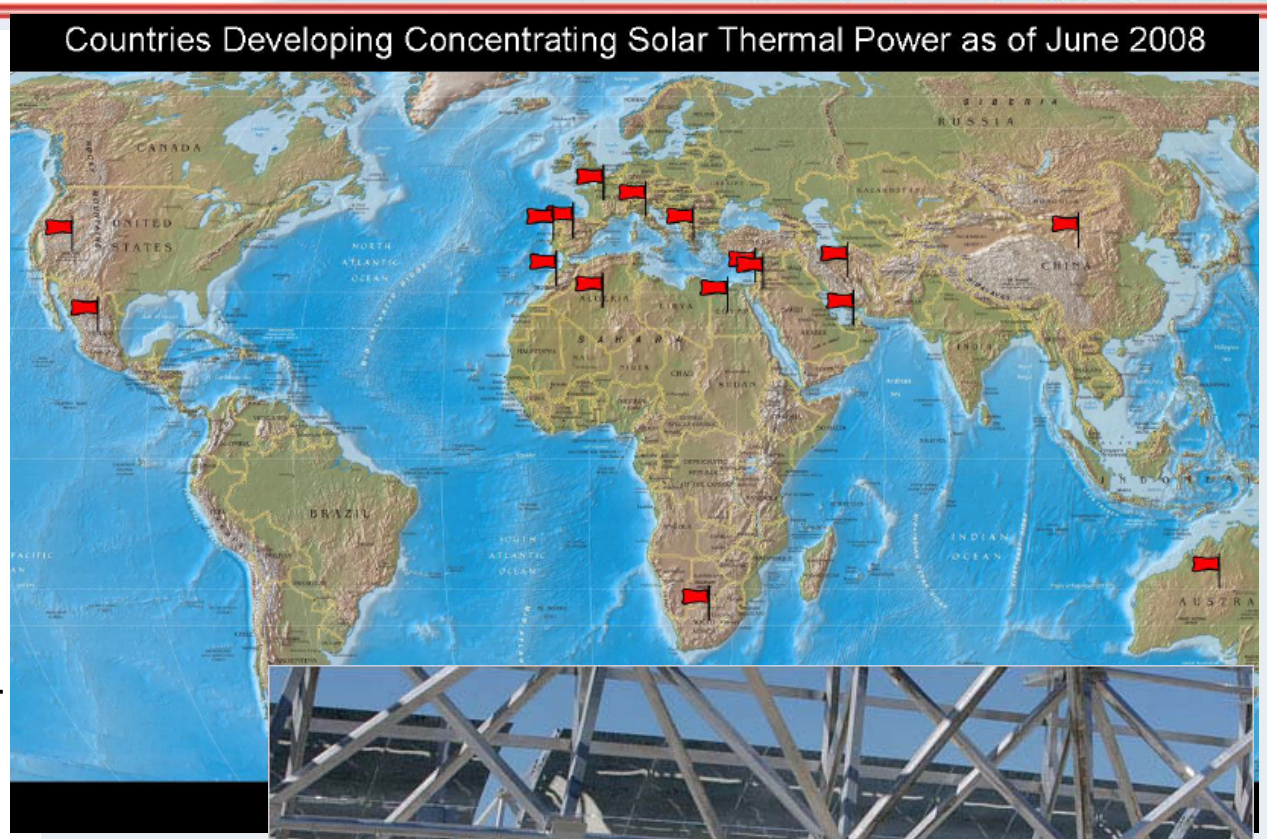
Investment needed for Australia's 1GW$_e$ solar flagships – AUD $4.5 Billion

Budget for Enabling CSP in India PSLP project AUD $250k!!!!!!

Small ball bearings help big wheels turn!

New wave of CSP since 2006

- 20 year track record with Californian SEGS plants
- New wave from Spanish FIT and USA RPOs
- Approx. 1000MWe currently in operation
- Greenpeace / SolarPACES reports 23GW planned
- IEA: Looking for 20GW/yr CSP installation,
- Lots of troughs in Spain, US is generating more innovative approaches
- Beginnings of construction in Nth Africa



Trough systems


Solargenix


EuroTrough


SenerTrough


AlbiasaTrough

- Least technical risk, used in most current construction
- All copies of the Californian SEGS plants
- Approx 6 companies offering large trough systems, all 5m apertures.
- 2 (3) market providers of evacuated tube receivers, 2 (3) providers of the glass facets


Solel´s design

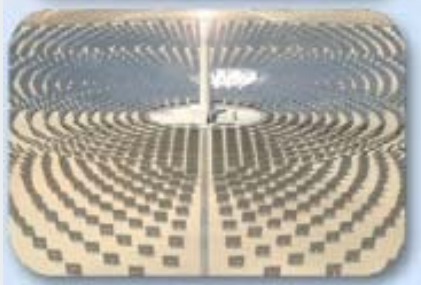

Schott´sdesign


Pics from Zarza, SolarPACES 09

Archimedes Solar´s design

Tower systems

- Several serious players building large scale prototypes
- More innovation than troughs
- Higher temperatures = higher efficiency



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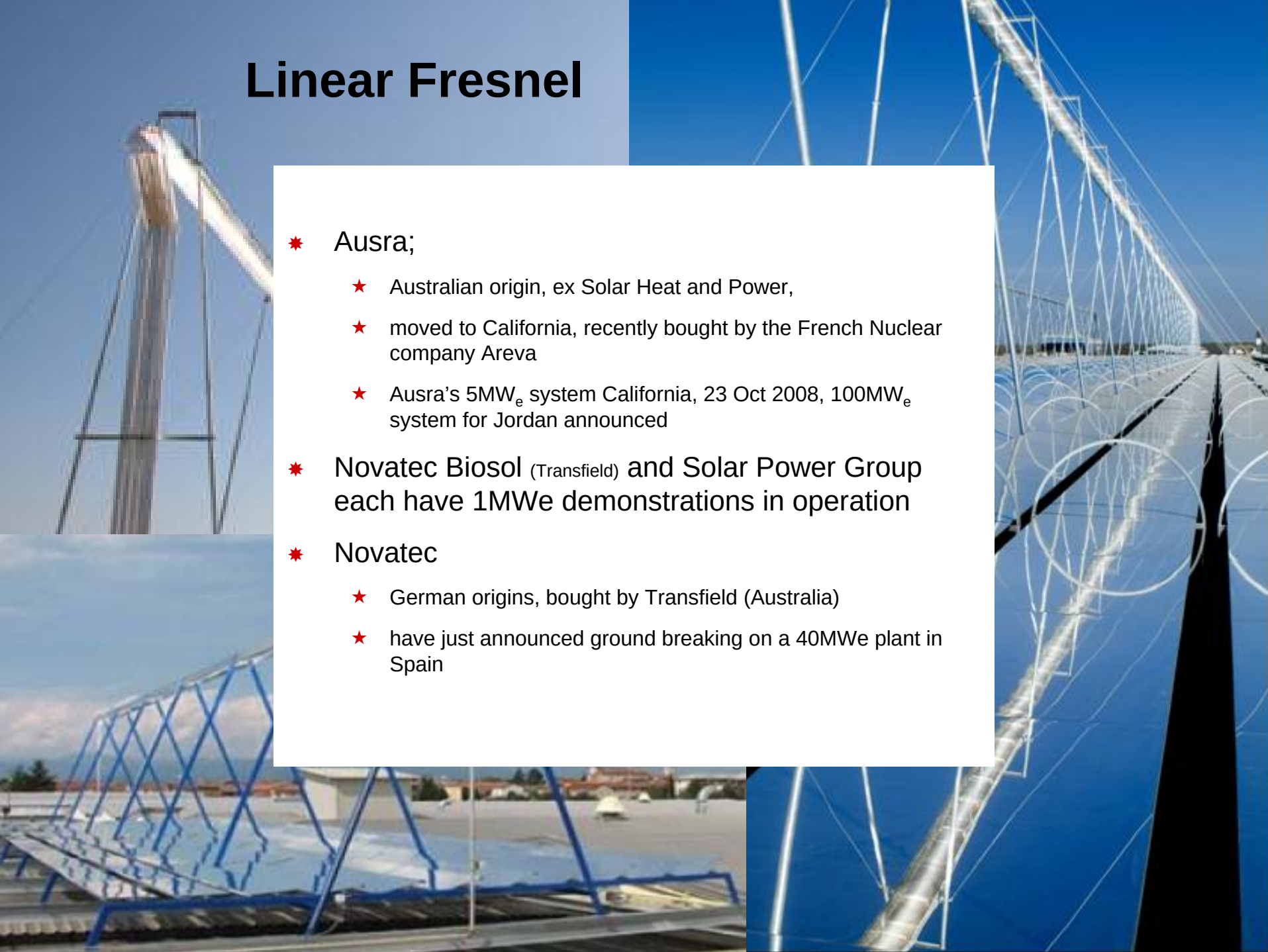

- Ausra;
  - Australian origin, ex Solar Heat and Power,
  - moved to California, recently bought by the French Nuclear company Areva
  - Ausra's 5MW_e system California, 23 Oct 2008, 100MW_e system for Jordan announced
- Novatec Biosol (Transfield) and Solar Power Group each have 1MWe demonstrations in operation
- Novatec
  - German origins, bought by Transfield (Australia)
  - have just announced ground breaking on a 40MWe plant in Spain

Dish systems?

Least commercially mature of the 4 approaches

- R&D around Eurodish units
- Stirling Energy Systems (SES) have big systems of Dish Stirling proposed but…?
- Infinia a new player with 3kW dish Stirling
- Solar Systems dish PV in Australia – now owned by Silex
- ANU dish offered commercially by Wizard Power

Renewable Energy and Power Workshop
12 February 2010

Venue: Solar Energy Centre, Gwalpahari, Gurgaon

Welcome and introduction	Dr. B. Bandyopadhyay, Advisor, MNRE & Head, SEC
Session 1: Renewable Energy Policy Overview	
• Australia: Update on Renewable Energy policies • Indian Renewable energy policies • Questions and discussion	Denis Smedley, Counsellor Designate, Aust. High Commission Dr. Ashvini Kumar, Director, MNRE
Session 2: Renewable Energy Technologies	**Speaker**
• Australia - Concentrating Solar Power - Solar Thermal Tower - Solar Thermal Dish - PV • Questions and discussion	Steve McEvoy (CSIRO) Dr Keith Lovegrove (ANU) Prof. Andrew Blakers (ANU)
Session 2: Renewable Energy Technologies continued	
• India - Concentrating Solar Power - Indian Perspective - Solar Thermal Tower - Decentralized Solar Thermal Power - PV	Mr. Shirish Garud, TERI M/s ACME Telepower, Gurgaon M/s. Thermax, Pune Mr. Deepak Kelkar, Square Engg, Pune
Session 3: CSP Round table	**Chair**


Field Development – Heliostats and Control System
Initial Field Heliostats were underperforming
Control System was unreliable / under engineered


Bisle
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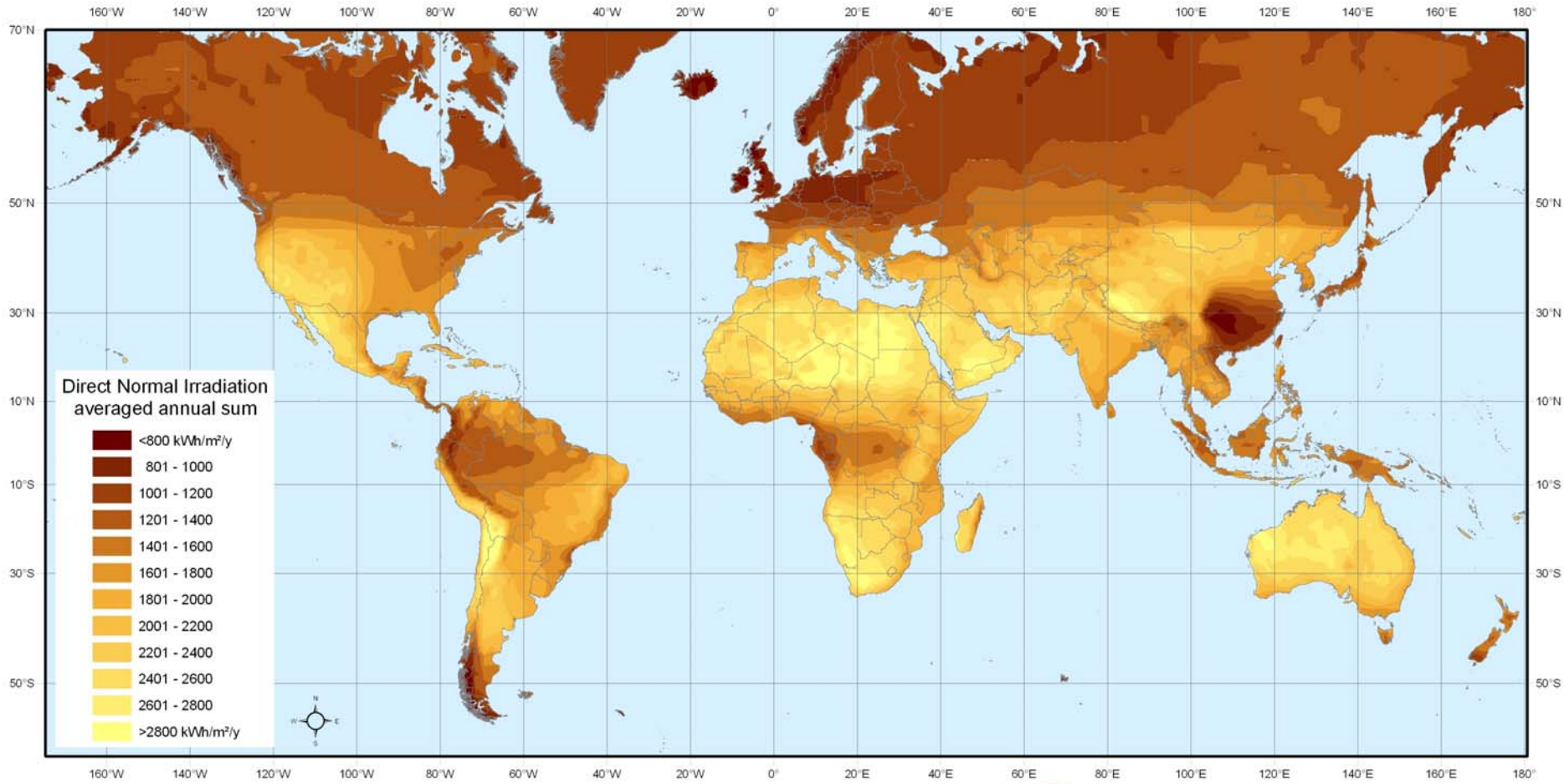
DINING HALL


India's SWOT analysis
Strengths
Weakness
Dependence on few technology providers Lack of experience
Lack of serious R & D program and long term R & D goals
Lack of long term consistent policy and

CSP In India Report

- India’s solar resources.
- Barriers to the deployment of CSP technologies.
- Overcoming the barriers.
- Existing enablers for CSP deployment.
- Developing expertise, research exchanges and secondments.
- Recommended options for two CSP pilot plants.

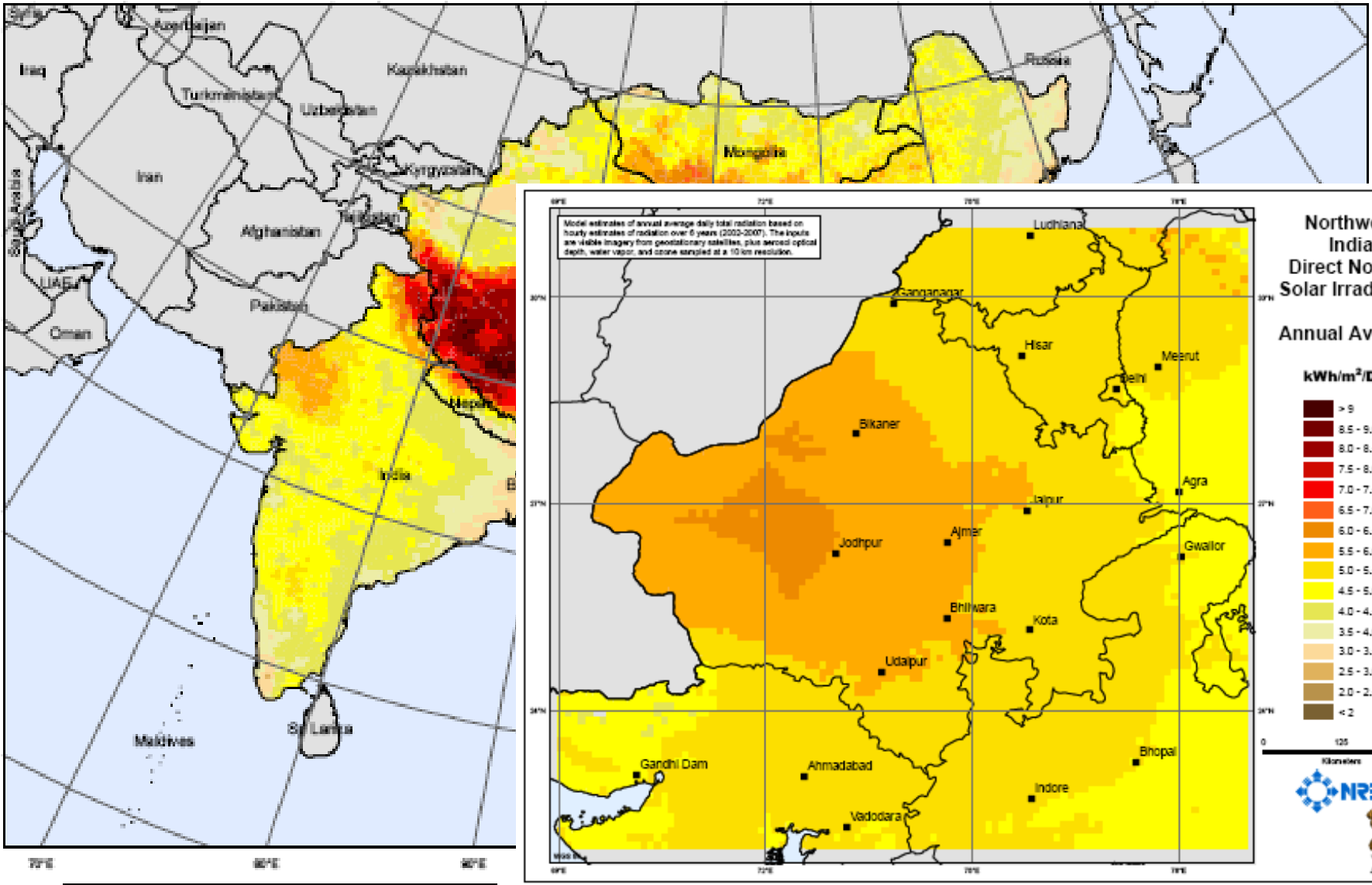
Direct Normal Irradiation (DNI)



Data based on SSE 6.0 dataset for a 22-year period (July 1983 - June 2005)
(http://eosweb.larc.nasa.gov/sse/)

Map created and map layout by DLR 2008
(http://www.dlr.de)

Selected Asian Countries - Direct Normal Solar Radiation



kWh/m²/day

> 9	7.0 - 7.5	5.0 - 5.5	3.0 - 3.5
8.5 - 9.0	6.5 - 7.0	4.5 - 5.0	2.5 - 3.0
8.0 - 8.5	6.0 - 6.5	4.0 - 4.5	2.0 - 2.5
7.5 - 8.0	5.5 - 6.0	3.5 - 4.0	< 2

Model estimates of monthly average daily total radiation using inputs derived from satellite and surface observations of cloud cover, aerosol optical depth, precipitable water vapor, albedo, atmospheric pressure and ozone sampled at a 40km resolution.

NREL

UNEP

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IT Power team working on the CST in India report..

- Working from Indian (Delhi) and Australian (Canberra) offices

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- Want to talk to Indian and Australian stakeholders on all the topics, particularly barriers and enablers
- Will be at
  - Delhi International Renewable Energy Congress October 2010
  - Australian Solar Energy Society conference, Canberra, December 2010

Photo E Lupfert