

Business Response to Climate Change

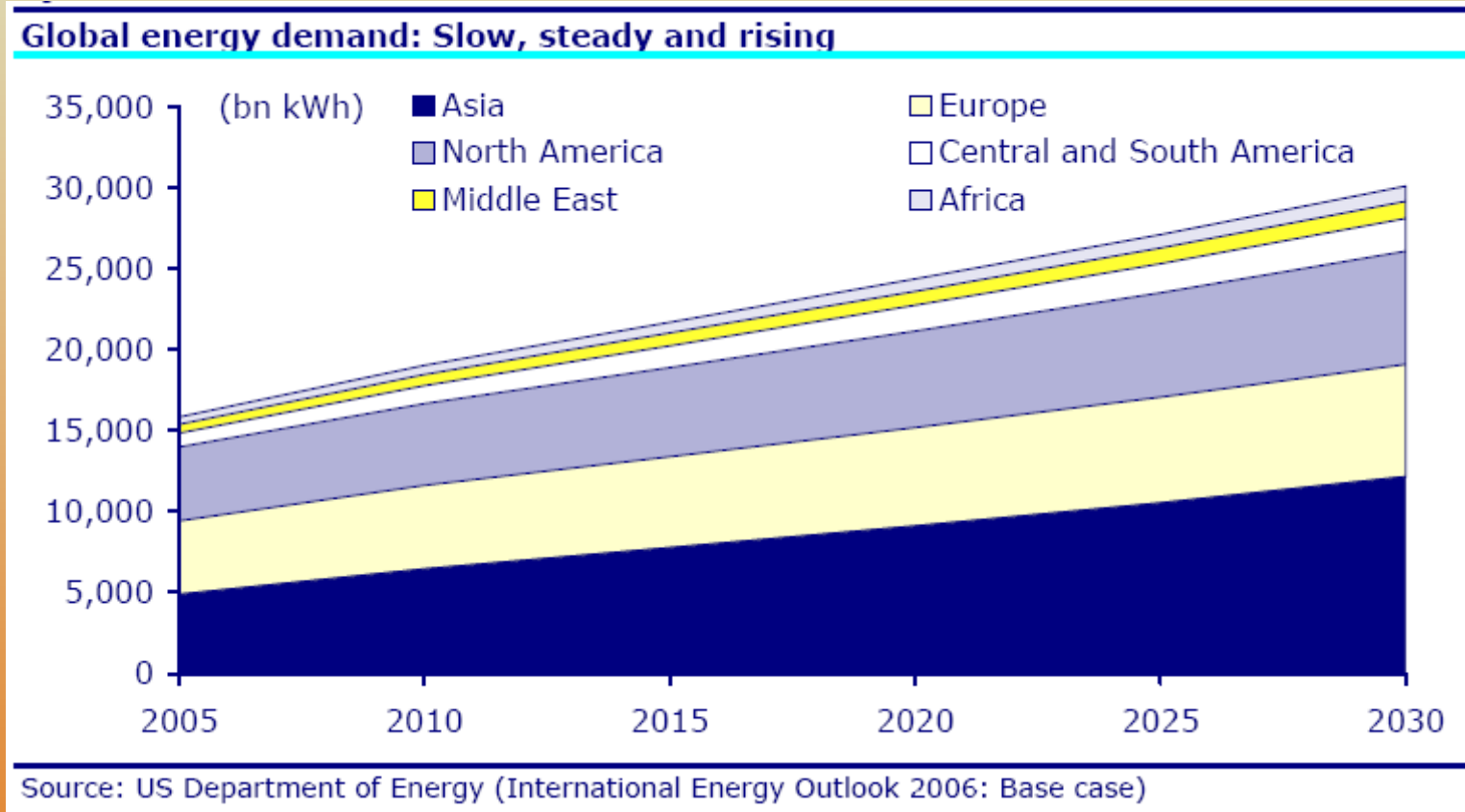
16th March, 2009

CII-ITC Center of Excellence for Sustainable Development

Energy Challenges for Sustainable Development

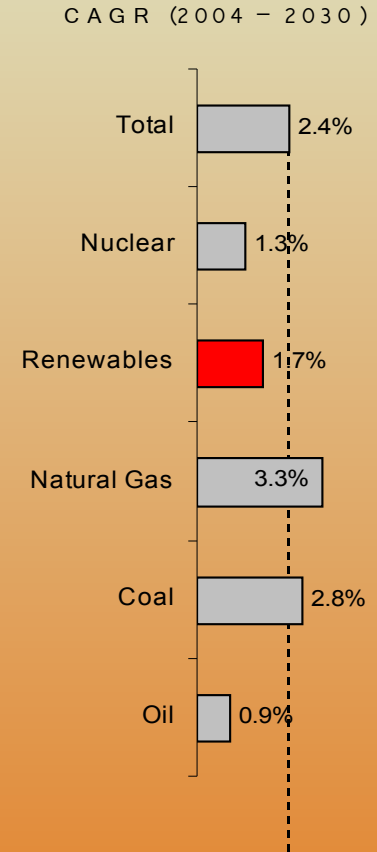
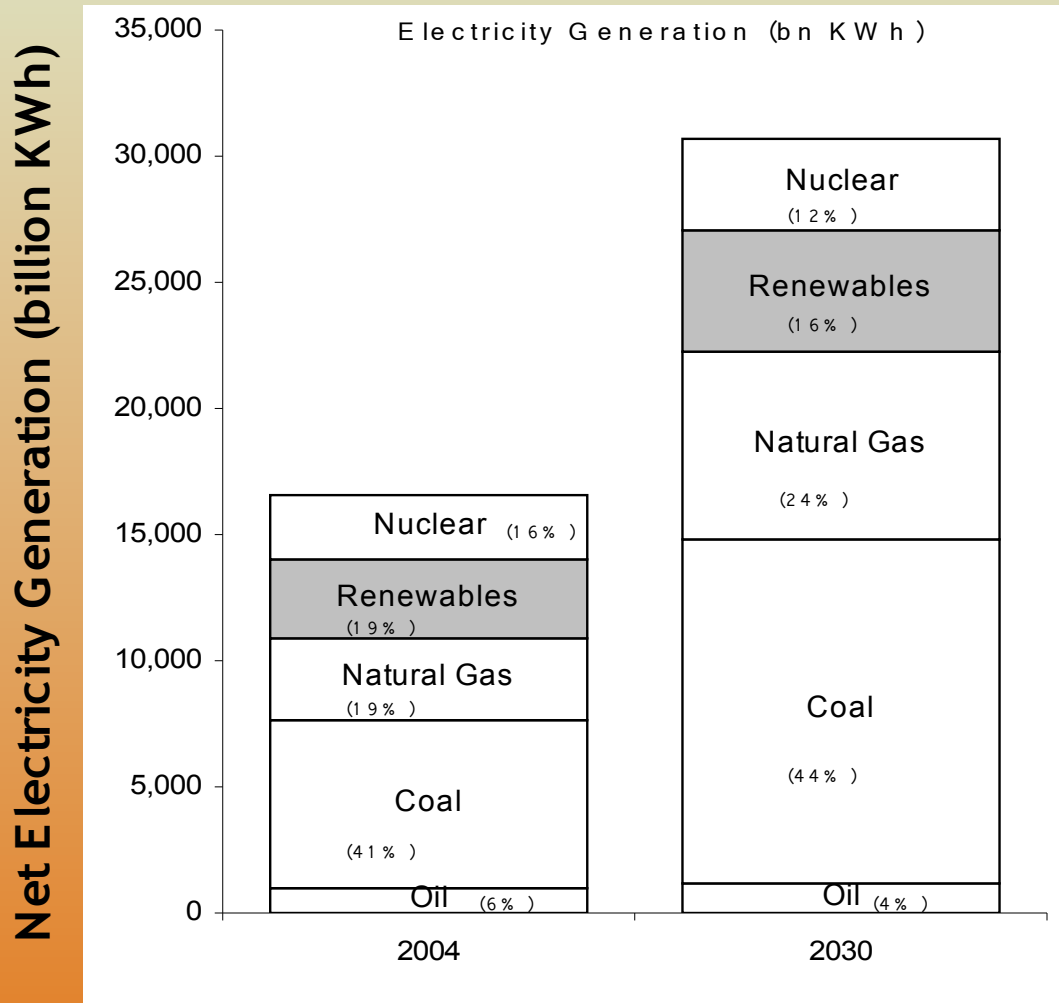
**Gagan Vermani
Head - PV Systems
Moser Baer Photo Voltaic**

Worldwide energy needs are expected to double over the next 20 years



- 3% CAGR driven primarily by emerging markets
- Expected spending US \$10 tn

This growth is likely to be driven primarily by fossil fuels...

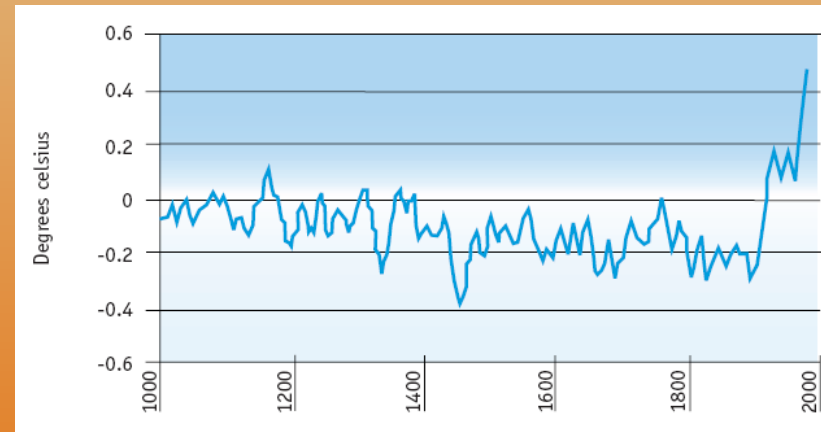
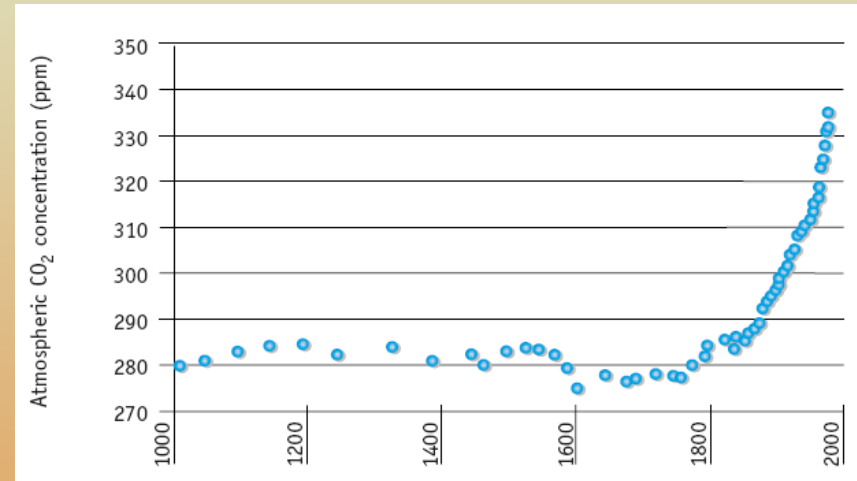


Source: US DOE Website, Ventions

Demand for coal has been growing faster than any other energy source & is projected to account for more than a third of incremental global energy demand to 2030

Burning of fossil fuels result in CO₂ emissions with disastrous consequences

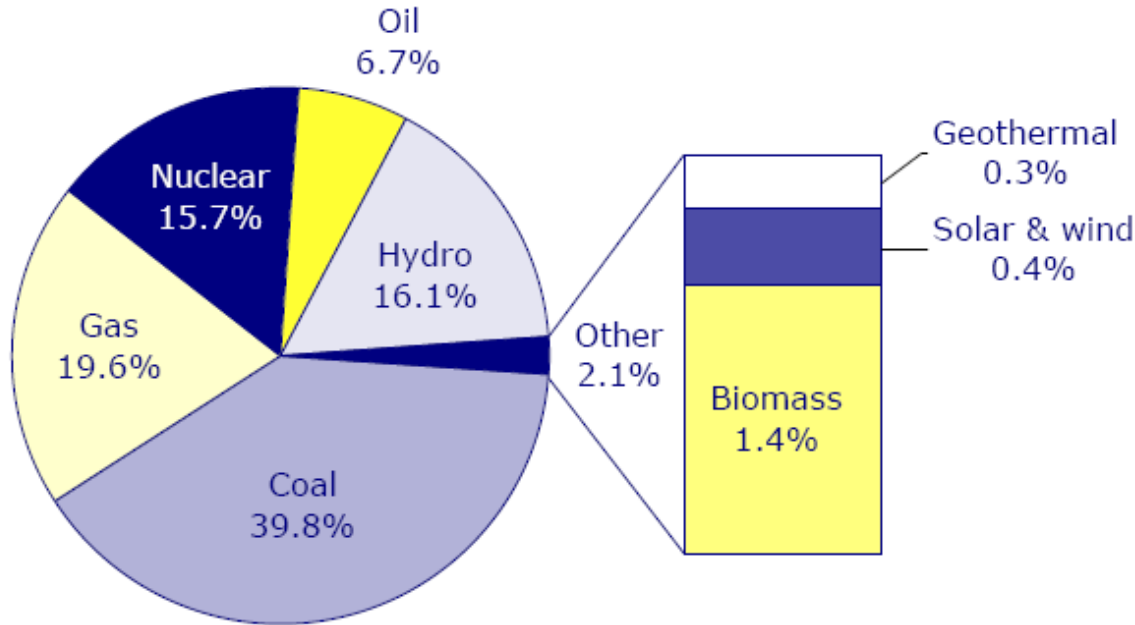
- Over the last 200 years
 - ✓ Level of CO₂ has risen rapidly from 280 ppm to 370 ppm.
 - ✓ Climate is warmer by 0.8 degrees C
- If annual emissions remain at today's level, it would result in temperature increase of 3-5°C by 2050 resulting in glaciers melting, sea levels rising, tropical storms, floods, droughts, wild fires, etc.



Does rapid energy consumption necessarily have to result in a “Carbonized” World??

Reducing Energy Consumption is not the answer but **increasing share of renewables** is the solution...

Solar's place in the global electricity generation mix



Source: IEA (2004)

Share of renewables in the total energy pie negligible

Unabated use of fossil fuels will raise global temperature by 6°C by 2100

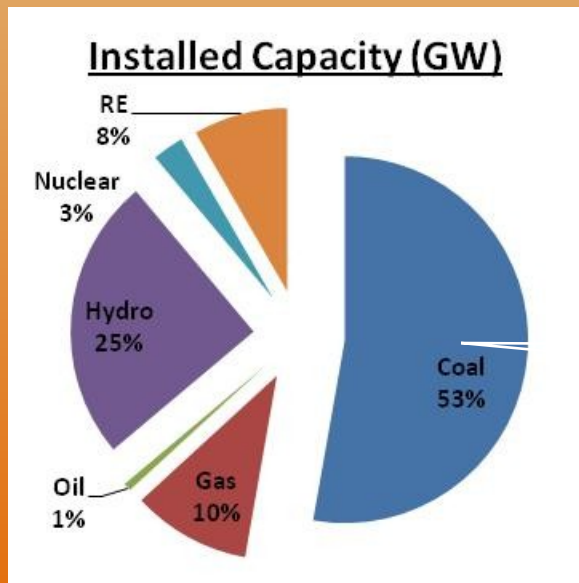
Decarbonising power is the answer

Rationale of Renewable Energy

- Emission halving requires significant fuel switching, CO₂ capture and storage
- In order to meet the goal of CO₂ halving and yet meeting the growing energy needs, following measures are suggested in the IEA 2008 report for decarbonisation of the power sector starting 2010 until 2050:
 - ✓ Carbon capture and sequestration of 55 fossil based power plant/year
 - ✓ 32 nuclear power stations every year
 - ✓ 17500 large wind turbines per annum
 - ✓ 215 million square meter of solar panels every year
- Total additional investment needs for the period 2010-2050, on top of the business-as-usual-scenario, amount to USD 45 trillion

Environment Concerns of India

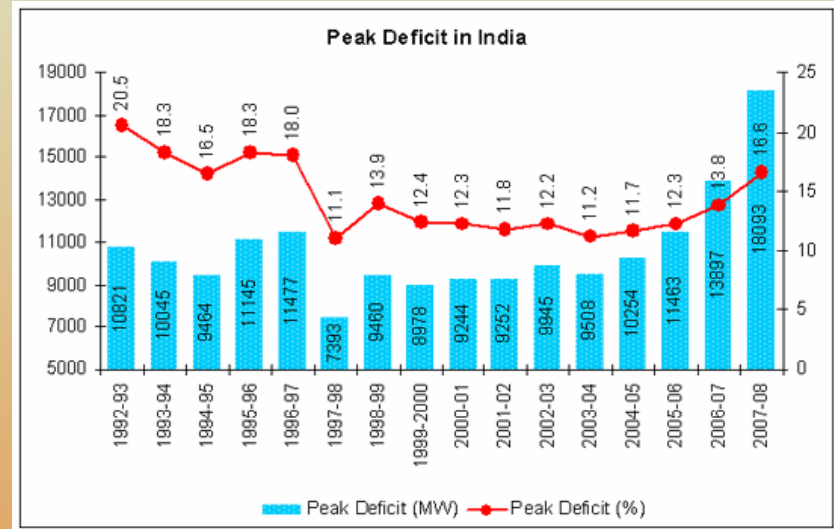
- A large percentage of population lives below poverty line
- Over 50% population do not have access to electricity and 70% household use biomass for cooking
- India is at the early stages of industrialization and the economic development – convergence in per capita income level, energy consumption and CO₂ emission would happen as development reaches the level of OECD countries
- Coal, which has the major share in the power production, is the worst pollutant followed by diesel and petrol
- Power sector contributes to 87% of CO₂ emission



High presence of coal in energy mix compared to world average of 39%

India Energy Scenario

- With 16% of world's population, India has only 0.6% of global oil reserves and 7% of coal reserves
- Rapidly growing economy (2003-07) 8.2%
 - ✓ To grow 7~9%+ per annum
 - ✓ Energy requirement to grow exponentially
- Indian Power Sector (As on 31st May,2008)
 - ✓ Installed Capacity – 144 GW (Per capita 631 kWh)
 - ✓ Target to add 78 GW in 2007-2012 (Per capita 1000 kWh)
- Needs 300GW incremental capacity over next 10 years
- Challenges
 - ✓ India among top 10 oil-guzzling nations; High import bill
 - ✓ 800,000 Villages (only 40% people) with electrification
 - ✓ Current peak shortages in the range of 16%
- 'Renewables' answer to India's needs; Potential to reach 25-30% from 8% today
 - ✓ GOI target for RE – 12.5% by 2012 and 20% by 2020



India Renewable Energy Scenario

Grid-Interactive Renewable Power (As on 31st March, 2008)

Source	Existing Capacity (MW)	Estimated Potential (MW)
Biomass	606	16,881
Wind	8,757	45,195
Small Hydro	2,181	15,000
Cogen	801	5,000
Waste	56	2,700
Solar	2	600,000

Source –Ministry of New and Renewable Energy



Largest Growth Potential

- Wind, so far, has largest installations, but is site-specific
- Biomass is energy in-efficient and generates CO₂
- Potential of other alternatives in not significant
- Average Solar energy incidence 4 – 7 kwh/m²/day
 - ✓ This translates into a potential of 600GW
- Multiple sites with solar irradiation > 1800Hrs/year

Energy Independence via Renewables should be National Agenda with multiple stakeholders playing key roles

Government

- ✓ Mandatory renewable energy mix in energy portfolio of respective State governments
- ✓ Mandating usage of renewables in commercial establishments, rural applications
- ✓ Incentivize private sector participation (Feed-in-Tariffs, manufacturing incentives, R&D grants, etc.)
- ✓ Recognizing usage of Renewables – rewarding end users appropriately

Impact

- Manage the Co₂ emissions at a national level, lesser dependence on fossil fuels
- Utilizing renewables which are available bountiful (Sun, Water & Wind)

Private Sector/ Business

- ✓ Adopt the most viable technology suited for Indian context
- ✓ Create sustainable projects.
- ✓ Avoid misuse of government support
- ✓ Adopt renewables in energy consumption
- ✓ Innovate on perfecting and “customising” technologies
- ✓ Develop appropriate products / applications based on Renewables (Solar based applications – fans, TV’s, DTH etc)

Impact

- Generate employment
- Manufacturing investments.
- Appropriate products
- Research & Development – IP creation

NGO’s/Community

- ✓ Generating awareness of renewable energy products / applications – Solar Lamps, Solar Water Pumps etc.
- ✓ Community / cluster energy projects – meeting the requirements of a small community

Impact

- Communication and Outreach programs possible
- Feedback to the system
- Nodal agencies for reach

Worldwide Examples of Government Response to Climate Change at Policy Level

US Stimulus Package

- National Commitment: \$43Bn expd.; \$22 Bn – tax incentives
- Key Initiatives:
 - ✓ Thrust to renewables
 - ✓ Mandatory RPS
 - ✓ ITC – 30%
 - ✓ Manufacturing incentives
 - ✓ Incentives for roof top applications
- Private Sector Contribution :
 - ✓ Large scale grid connected power generation – 20GW CSP plants in next 3 years.
 - ✓ 60,000 employment generation
- Impact
 - ✓ Reduce dependence on fossil fuels

Abu Dhabi Clean City

- National Commitment: \$22Bn; Worlds first clean/ green city
- Key initiatives:
 - ✓ Carbon-neutral, zero-waste
 - ✓ Free Zone clean-tech cluster for offices, research centers & other operations
 - ✓ **100% Energy from renewable Energy**
- Private Sector Contribution:
 - ✓ Large scale grid connected power generation – 20GW CSP plants in next 3 years.
 - ✓ 60,000 employment generation
- Impact:
 - ✓ **Several global MNC's innovating on how to develop products, processes and applications**
 - ✓ **World's future under demonstration. A global model in the making**

Worldwide Examples of Government Response to Climate Change at Policy Level

Spain – Renewable Energy

- One of the first countries to have put in place a policy framework to provide FIT and incentives for Renewable energy – \$\$ Mn in incentives.
- Key Initiatives:
 - ✓ FIT of 45 Euro cents (around Rs.30 per KWh)
 - ✓ Manufacturing incentives
- Private Sector Contribution :
 - ✓ > 1GW solar farms in operation.
 - ✓ Employment generation
 - ✓ Spain cos today are world's leading contractors for Solar Thermal Plants
- Impact
 - ✓ Reduce dependence on fossil fuels
 - ✓ Become global leaders in solar farms technology development and components manufacturing.

Brazil – Bio Fuels

- Brazil is considered to have the world's first sustainable biofuels economy and the biofuel industry leader, a policy model for other countries
- Key Initiatives:
 - ✓ Mandatory Ethanol usage since 1970's
 - ✓ Invest in agri-processing technologies
 - ✓ Create National Missions for R&D
 - ✓ Incentivising farmers to support Biofuel Industry
- Private Sector Contribution :
 - ✓ Large scale contract farming operations – employing several thousands of farmers
 - ✓ World's largest, advanced and least cost manufacturing facilities
- Impact
 - ✓ 50% of the fuel requirement is met from biofuels

Worldwide Examples of Government Response to Climate Change at Policy Level

- Japan
 - 1994 - 'Basic Guidelines for New Energy Introduction'
 - 1980 - Law Concerning the Promotion of Development and the Introduction of Oil Alternative Energy (Alternative Energy Law)
 - 1997 - "Law Concerning Special Measures for Promotion of New Energy Use, etc. (New Energy Law)"
 - 2003 - Renewable Portfolio Standard
 - 2006 - Science and Technology Policy
 - Technology for innovative efficiency improvement and cost reduction to disseminate Photovoltaic power generation to the world
 - 2008 Low Carbon Technology Plan
 - Photovoltaic electricity generation is regarded as one of the key technologies to enhance the efficiency of reducing GHG emissions.
 - 2008 Fukuda Vision
 - Aims to install PV on 70% of all newly build homes by 2020

Few examples of opportunities for energy independence in India

Grid connected solar power generation	
MNRE target for installed capacity of solar energy installation by 2012	500 MW
Grid Based Soar PV Capacity (assumed @ 50%)	250 MW
CO ₂ emissions saved per MW	700 tons
CO₂ saving capacity by 2012	175,000 tons

Source: ISA NMCC 2008 Research

Solar Lamps	
Number of Households using Kerosene Lamps	65 million
Number of lamps used per year	100 million
Kerosene used per lamp per month	6-7 liter
Kerosene usage per year	6 bn liter
CO₂ saving potential of Solar Lantern per year	20 mn tons
Annual cost to exchequer of kerosene subsidy for 1 lantern	Rs 3950
Cost of solar lantern	Rs. 3,500

Source: TERI / World Bank NGO

Telecom Towers	
Expected number of telecom towers by 2012	350,000
Average Diesel Consumption by a Tower	2.4 ltr/hr
Total Diesel used per hour	840,000 liter
CO ₂ emission per liter of diesel	2.821 kg
CO₂ saving potential by 2012, if solar back-up is used	2,370 tons/hr

Source: Economic Times, RRG Engineering Technologies

Rural Electrification	
Target number of villages to be electrified by 2012	80,000
Number of Remote Villages	18,000
Number of villages to be electrified through Solar PV (assumed @ 25%)	4,500
Total Load per Village per day	66.8 kW
Total Annual Solar power required for 4,500 villages	110 GW
CO ₂ emissions saved per MW	700 tons
CO₂ saving capacity by 2012 (notional savings because these village don't have electricity)	76, Mn tonns

Source: ISA NMCC 2008 Research

Few examples of opportunities for energy independence in India

Solar Cooker	
Potential Demand	10 million
Current Production capacity of 40 manufacturers	75,000
LPG Cylinder saved per year (Assuming 3.5 per solar cooker)	225,000
Total LPG saved per year (assuming 14.4 kg/cylinder)	3,240,000
CO₂ emissions saved (assuming 2.95 kg/ kg of LPG)	9,564 tons

Source: India Solar; Engineering ToolBox

Domestic Solar Water Heaters	
Domestic Solar Water Heaters installed per year	20,000
CO ₂ saved per year per heater	2.5 tons
CO₂ emissions saved per year	50,000 tons

Source: India Development Gateway; India Solar

Residential Power Back-up	
Total number of diesel/kerosene gensets required by 2012	0.514 million
Total Power requirement per hour (assuming a genset of 2.5kW)	1,285 MW
Potential for PV market per hour (assuming @ 25%)	321 MW
CO₂ saving per hour (assuming 800 gm/kWh)	257 tons

Commercial Roof Top	
Additions to Office Space by 2012	270 mn sq ft
Area likely to be used for Solar PV installation (assumed @ 6%)	16.2 mn sq ft
Additions to Retail Space by 2012	96 mn sq ft
Area likely to be used for Solar PV installation (assumed @ 10%)	9.6 mn sq ft
Additions to Logistics Space by 2012	51mn sq ft
Area likely to be used for Solar PV installation (assumed @ 10%)	5.1 mn sq ft
Total Commercial Area likely to be used for Solar PV	30.9 mn sq ft/ 2.9 mn sq mtr
Capacity per 1 square meter of area	0.1 kW
Roof Based Solar PV Potential	287 MW
CO₂ saving per hour (assuming 800 gm/kWh)	230 tons

How is Moser Baer addressing this challenge?

Photovoltaic Manufacturing

- Established in 2006
- Built 80MW Facility for Crystalline Silicon PV Cells / Modules; 50MW Thin Film modules; 10MW concentrators
- Investments of US\$ 700Mn
- Manufacturing near New Delhi.
- Establishing worlds largest integrated PV site in Chennai.
- Committed investments of US\$ 2Bn over next 3 years.
- Unique and differentiated strategy
 - » Total capacity of 680MW by 2010
 - ✓ Crystalline Silicon (280 MW)
 - ✓ Thin film (260 MW)
 - ✓ Concentrator (140 MW)
- Venture/Strategic investments of \$200Mn



Manufacturing Value Chain



Silicon

Wafers

Cells

Modules

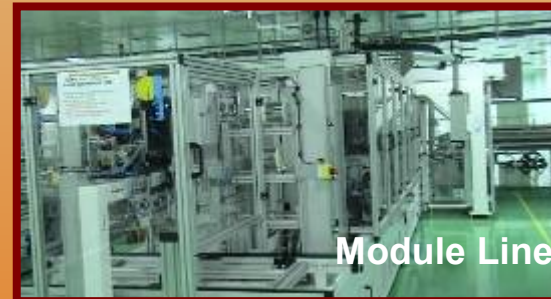
Systems

Investment in Solarvalue for Solar Grade Polysilicon

Agreements and contracts with wafer suppliers

80 MW cell line is operational

80 MW module line is operational



Strategic tieup

MOSERBAER



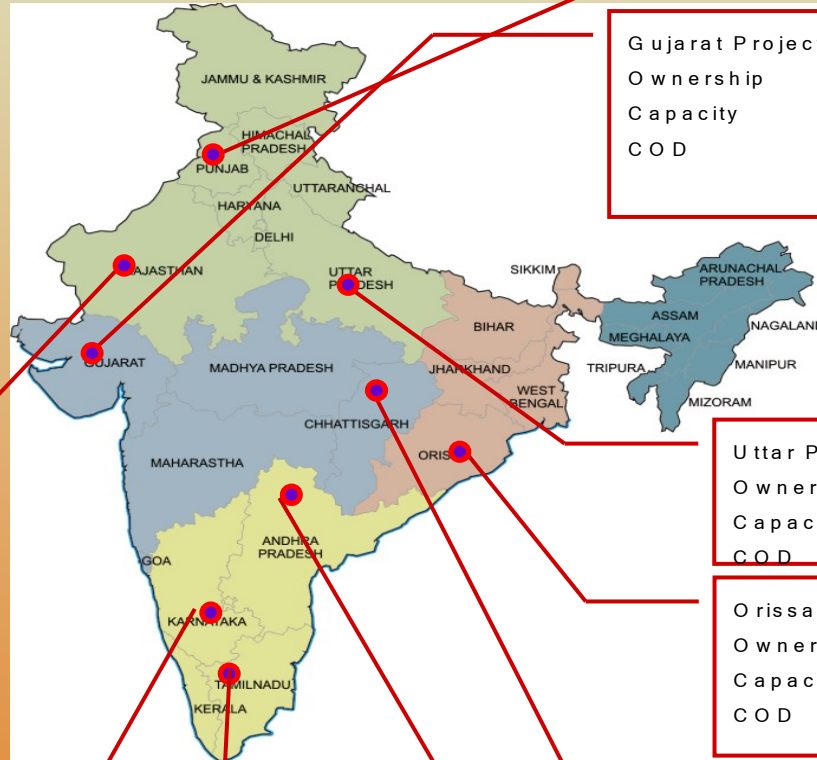
Regional Participation

50 M W amorphous silicon thin film line and 5 M W high concentration panel assembly lines are in addition to the crystalline silicon capacity

Solar Farms

Punjab Project *	
Ownership	100%
Capacity	5 MW p
COD	4th Q tr 09

Gujarat Project *	
Ownership	Tax Equity Structure
Capacity	600 MW p
COD	By FY 2011 in phased manner



Uttar Pradesh Project *	
Ownership	100%
Capacity	5 MW p
COD	4th Q tr, 2009

Orissa Project *	
Ownership	100%
Capacity	50 MW p
COD	By 3 rd Q tr, 2011 in phased

Chhattisgarh Project *	
Ownership	100%
Capacity	10 MW p
COD	4th Q tr, 2009

Andhra Pradesh Project *	
Ownership	100%
Capacity	10 MW p
COD	4th Q tr, 2009

Rajasthan Project *	
Ownership	100%
Capacity	5 MW p
COD	4th Q tr 09

Karnataka Project *	
Ownership	100%
Capacity	50 MW p
COD	3rd Q tr, 2011

Tamil Nadu Project *	
Ownership	100%
Capacity	5 MW p
COD	4th Q tr 09

- 7 projects for 730 MW p in pipeline
- Approval received from State Nodal Agencies for all the Projects.
- First Phases of projects are scheduled to achieve commissioning by December 2009
- 100% of power to be sold to State Electricity Utilities to obtain benefit of special tariff
- As per MNRE (Ministry of New & Renewable Energy), solar projects are eligible for subsidy

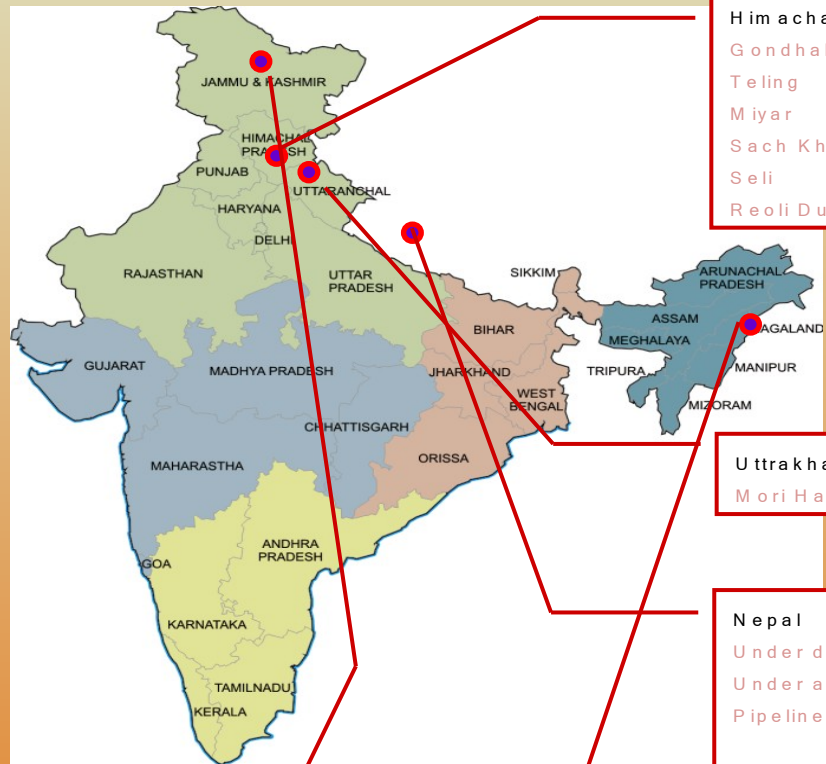
Notes:

* Denotes projects in pipeline

Projects – Generation Plants

Hydro Projects

- ▶ 1,237 MW projects already locked-in in Himachal Pradesh
- ▶ 300 MW projects are under active evaluation in Nagaland – consultants carrying out detailed studies
- ▶ 180 MW under development and 3,150 MW under application in Nepal
- ▶ First Project to go on stream by 2013 – in Uttaranchal / Himachal
- ▶ Number of projects in pipeline
 - 3000+ MW of projects under consideration with bid technical evaluation under process in Himachal Pradesh, Nepal, J&K and Sikkim



Himachal Pradesh – 1,192 MW
 Gondhala
 Teling
 Miyar
 Sach Khas
 Seli
 Reoli Dugli

Uttarakhand – 70 MW
 Mori Hanol

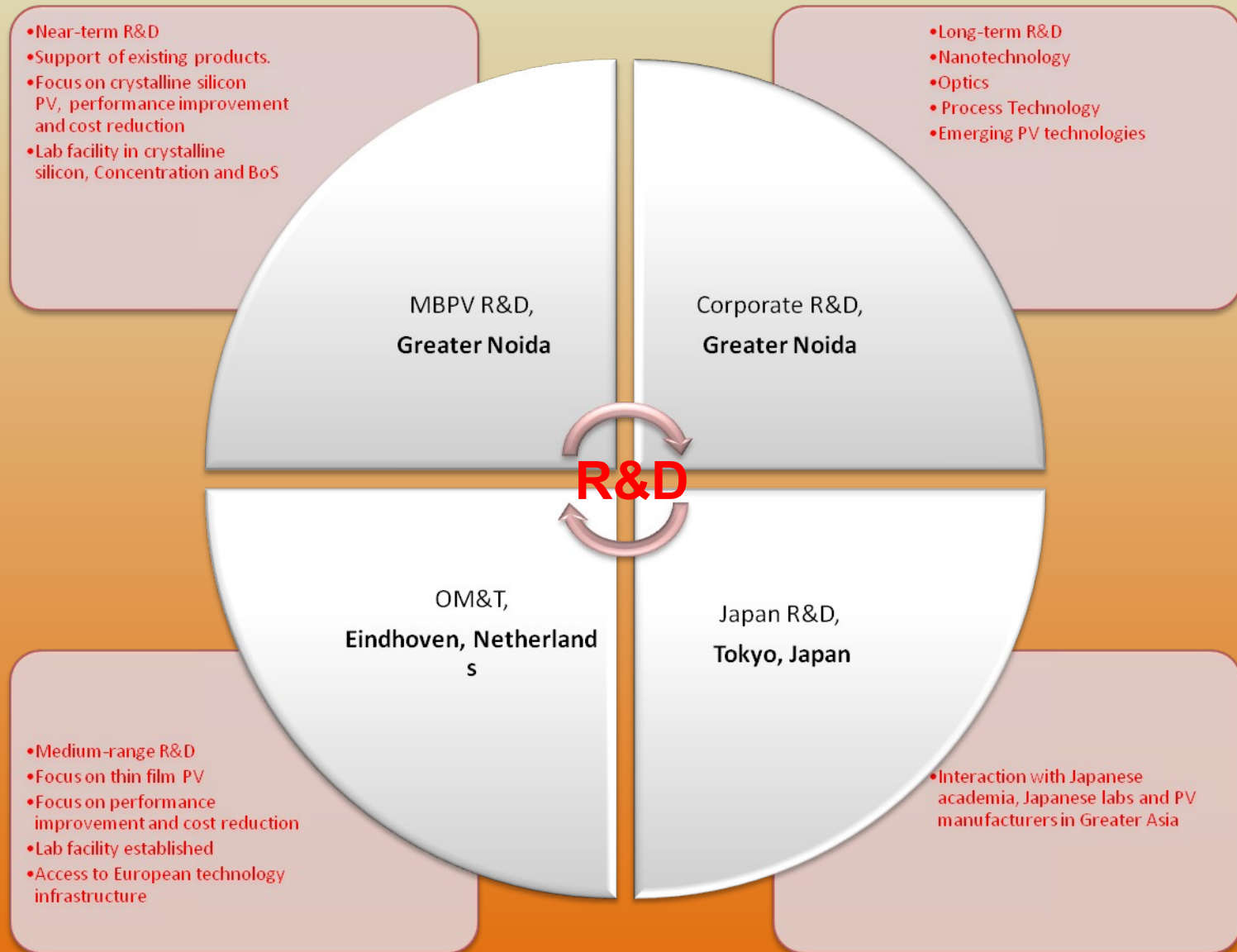
Nepal
 Under development – 180 MW
 Under application – 3,150 MW
 Pipeline – 1,800 MW

Nagaland
 Awarded – 300 MW
 Three projects

J&K
 Qualified for Bidding – 690 MW
 Chenab River Project

● Projects – Generation Plants

Global Collaborative R&D program to drive industry towards grid parity



Thank You