

Investment patterns & incentives from emerging economies Challenges and opportunities in India

Dr. M.R. Anand

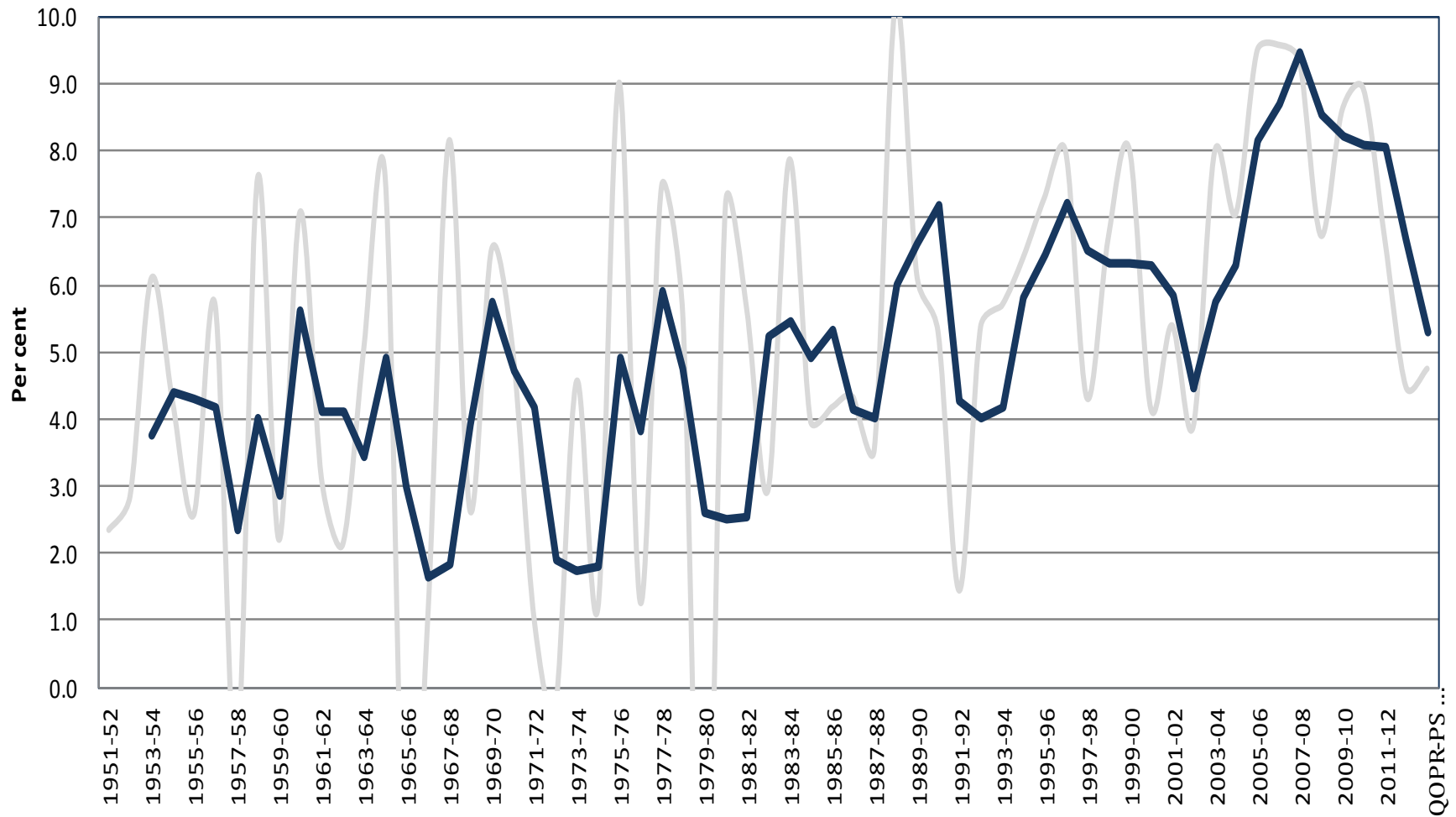
Views Expressed are strictly personal

Investment patterns & incentives from emerging economies

- India's Growth & investment trends (1990-2014)
- Energy supply & demand
- Material use
- Investing in Green tech & Renewable energy
- Policy initiatives
- Critical challenges
- Innovative solutions
- Concluding observations

India's Growth (1990-2014)

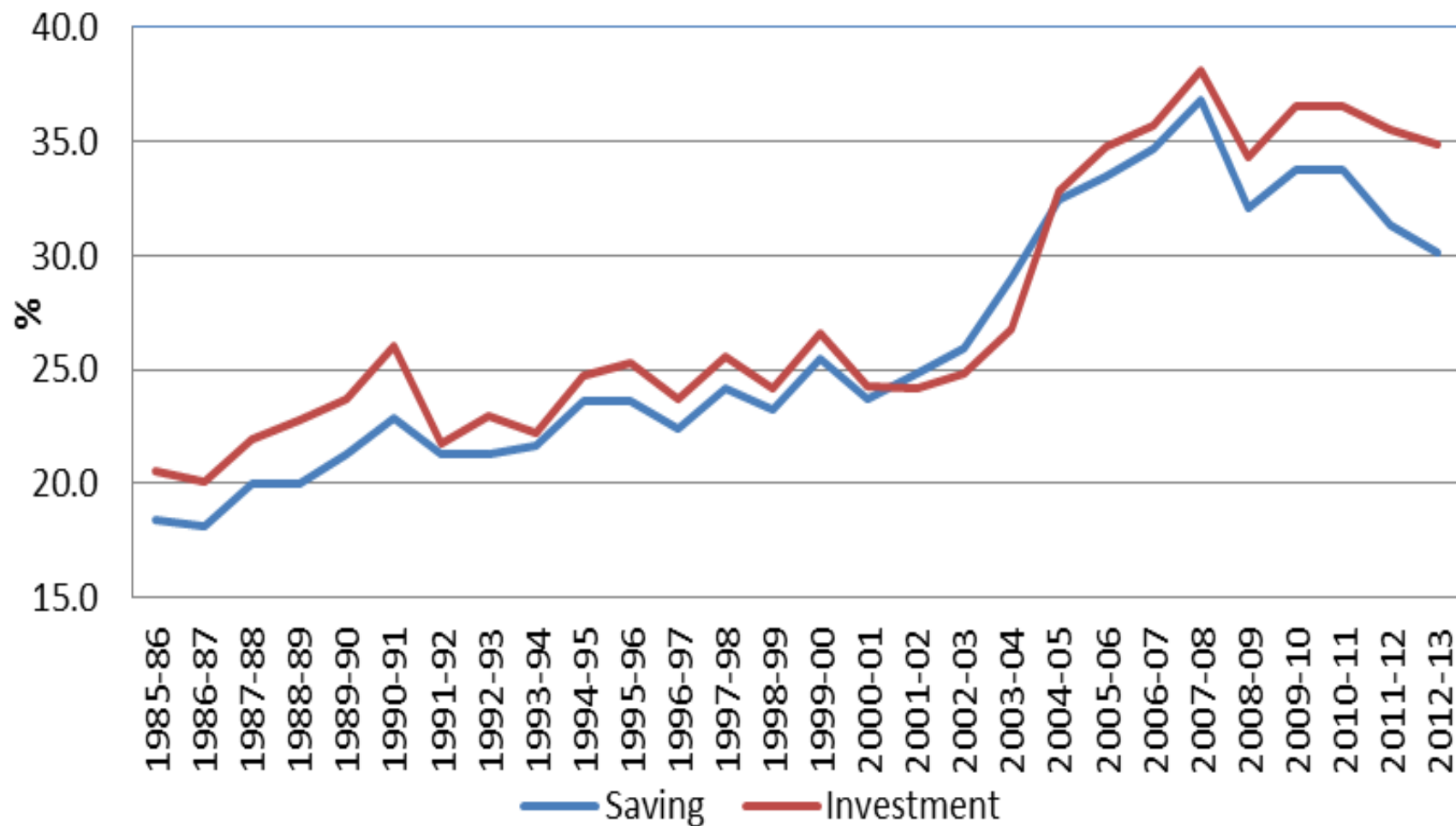
Trend - India's GDP growth (1950-2014)



India - Sector Composition of GDP %

Sector	1990-2000	2000-10	2010-2013
Agriculture, forestry & fishing	26.6	19.1	14.3
Mining & Quarrying	3.3	2.7	2.1
Manufacturing	15.3	15.5	16.1
Elect. Gas & water supply	2.2	2.1	1.9
Construction	6.6	7.4	7.7
Trade, hotels & restaurant*	13.4	15.9	16.4
Transport	5.8	6.4	6.6
Communication	0.5	1.8	4.0
Banking & insurance	4.8	6.3	8.8
Real estate & business services	8.3	9.0	9.3
Community, social & personal services	13.4	13.7	12.8
GDP at factor cost	100	100	100

Gross Domestic capital formation & Savings rates (% of GDP)



Energy

- India is the fourth largest primary energy consumer after China, USA and Russia
- Accounts for 4.6 % of global energy consumption.
- India is also fifth largest producer of electricity
- Domestic Energy production projected to reach 669.6 MTOE in 2016-17 & 844 MTOE by 2021-22.
- This will meet 71 % of energy consumption in 2016-17 and 69 % in 2021-22

Trends in energy consumption , per capita consumption and energy intensity

Year	Energy Consumption	Per-Cap energy	Energy intensity
	Bill KWH	KWH	(KWH) / Rupee
1	2	3	4
1970-71	664	1204	0.13
1975-76	841	1362	0.14
1980-81	1013	1471	0.15
1985-86	1478	1929	0.17
1990-91	1903	2233	0.16
1995-96	2437	2594	0.16
2000-01	3154	3048	0.16
2005-06	3909	3498	0.14
2010-11	7342	6211	0.15
2011-12	7689	6420	0.15

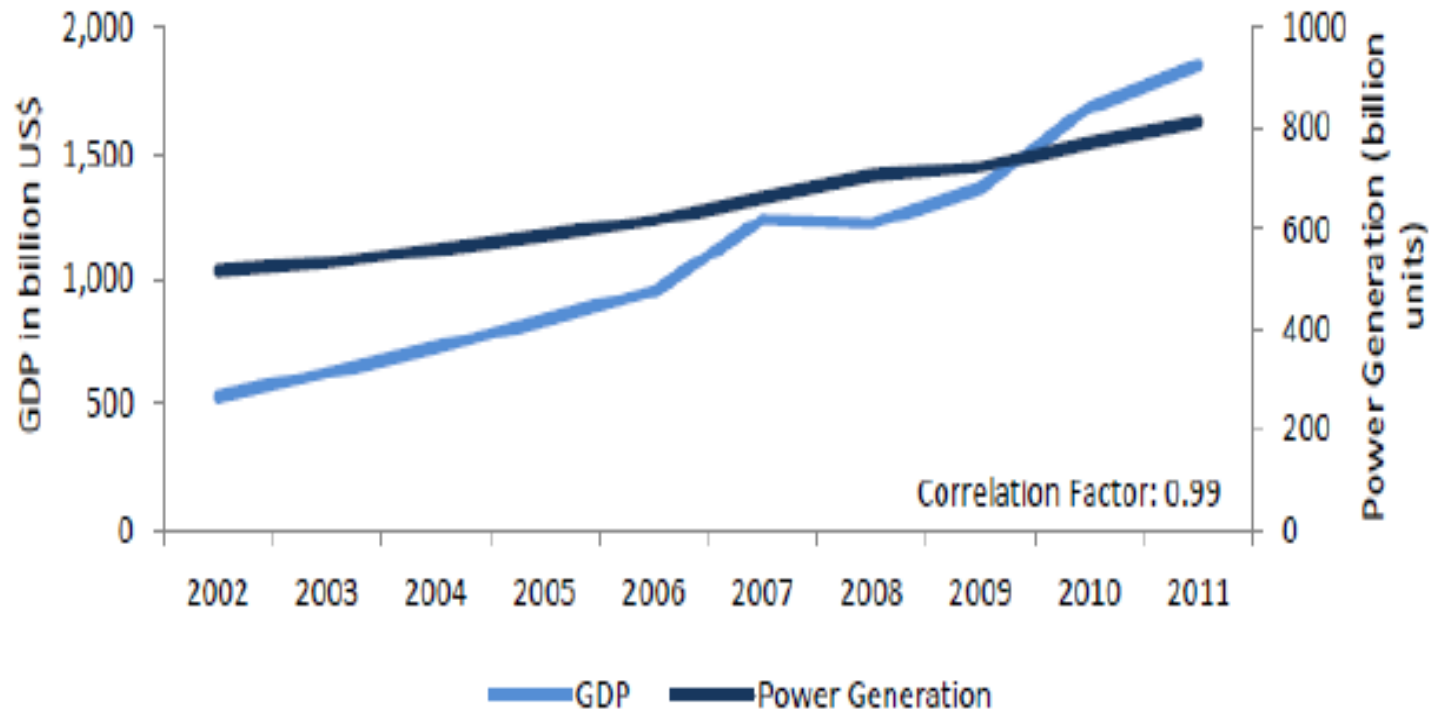
India's energy basket is a mix of resources

- India's energy basket is a mix of resources
- Coal dominates: Accounts for over 50 % of primary energy supply
- 54 % of Power generation capacity coal based
- 70 % of electricity generated from coal based plants.
-
- Renewable - Wind, solar, hydroelectric improving share.

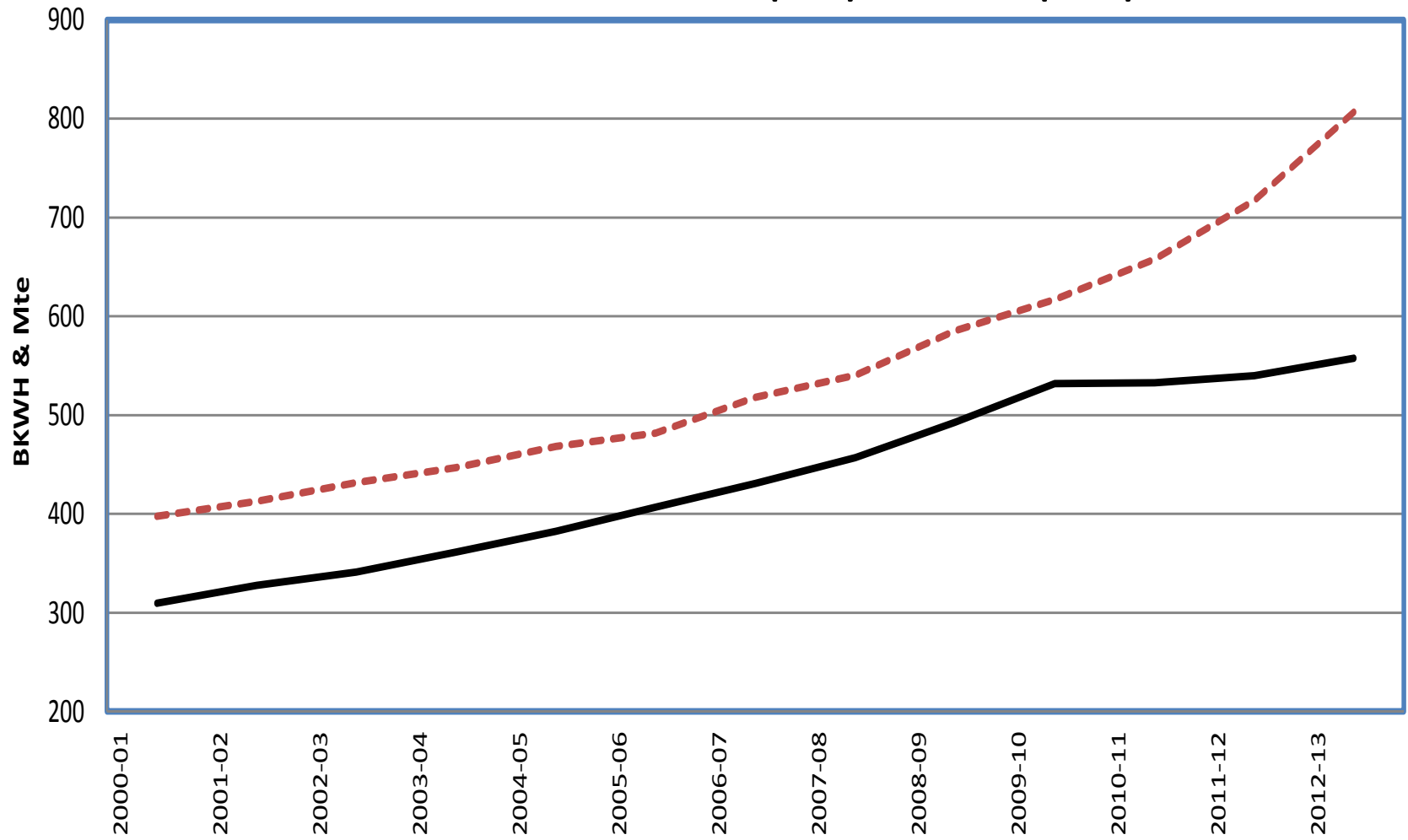
Strong correlation - Energy & Eco. growth

- **Degree of association depends on stage of growth**
- **India remains energy deficit - Oil, Coal, Gas and Power**
 - Power generation capacity has increased .
 - But demand has outstripped supply
- **As economy grows overall energy demand will rise**
- **Strategy for economic growth will need to address this**

GDP and Power Generation - India



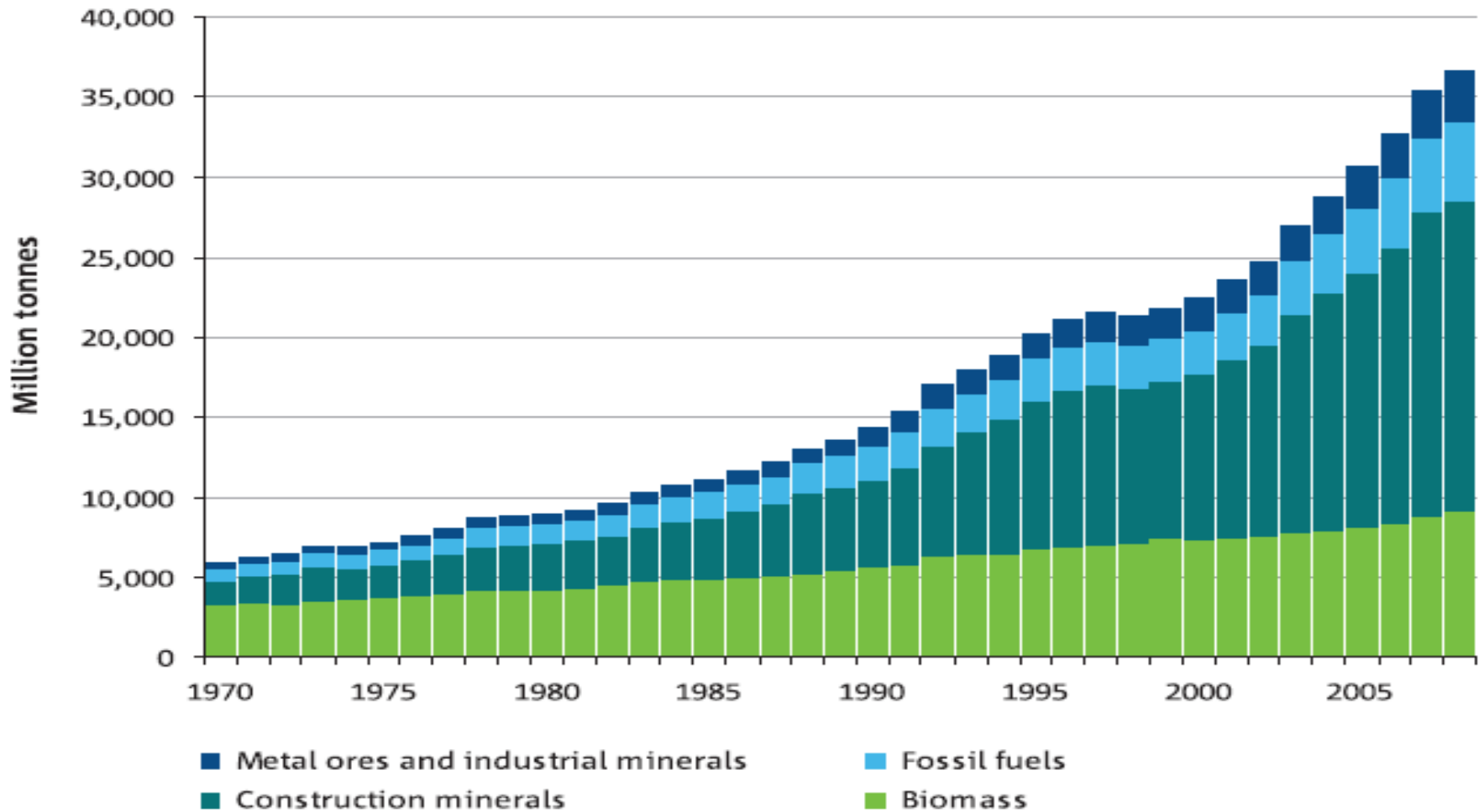
Production of Power (MU) and Coal (Mte)



Material intensity

- **The UNEP (2013)** study shows that material intensity is a driver of extractive pressure
- **Growing affluence** is also an important driver of increasing use of materials
- **Population pressure** in use of materials is not as important as the above two

Resource consumption by major category of materials 1970–2008 (Asia-Pacific)



Share of domestic materials consumed (Asia-Pacific) 1970–2008

Item	1970	1980	1990	2000	2008
<u>Biomass (Mt)</u>	54.0	45.0	38.0	32.0	25.0
Primary crops	19.0	16.0	14.0	12.0	10.0
Crop residues	17.0	14.0	12.0	10.0	8.0
Grazed biomass	8.0	7.0	7.0	7.0	6.0
Wood	11.0	8.0	5.0	3.0	2.0
<u>Fossil fuels (Mt)</u>	16.0	16.0	17.0	14.0	15.0
Coal 0.1	10.0	10.0	11.0	8.0	10.0
Petroleum products	6.0	6.0	5.0	4.0	3.0
Natural gas	0.2	0.5	1.1	1.1	1.1
<u>Metal & Minerals</u>	6.0	7.0	8.0	9.0	9.0
Iron ores,concentrate, iron	3.0	3.0	3.0	3.0	4.0
Non ferrous metal ores,	2.0	3.0	4.0	6.0	4.0
Industrial minerals	0.8	1.0	0.8	0.6	0.4
<u>Const. Minerals</u>	23.0	32.0	36.0	44.0	51.0

Imports of energy

Currently over 75-80 % oil is imported.

Import of gas is 19%, marked to grow to 28%.

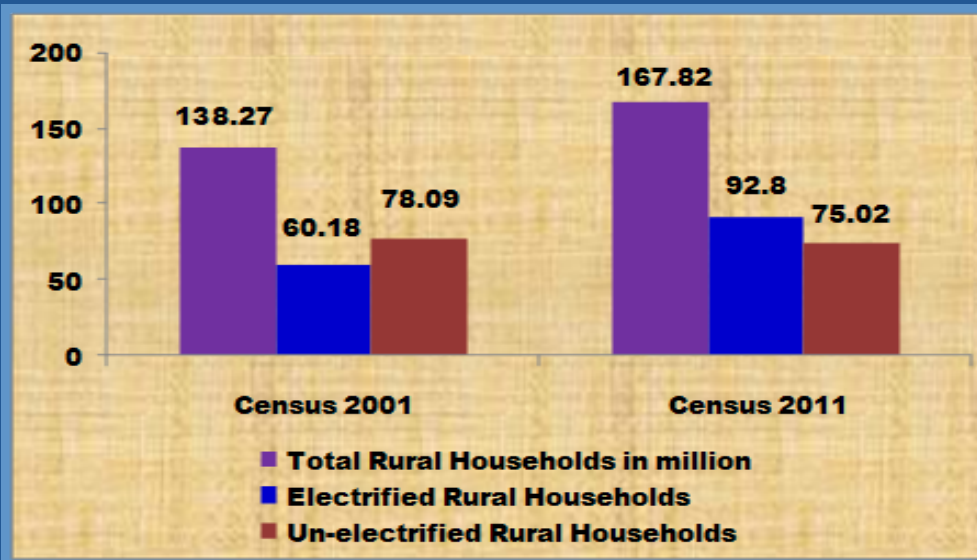
Coal import is over 23% (168 Mt).

With growing economy energy requirements there is pressure on Fossil fuels

Hence, renewable energy sources are the way to go

Energy Access

- In Indian Context: 92% of Urban Households and only 55% of rural households use electricity for lighting (despite 95% villages being electrified).**



About 55 million un-electrified households are in 6 states in eastern and central part of India

About 70 million households use kerosene for lighting

In 2011, on average 67% households in India and 86% rural households used traditional biomass for cooking

Green technology based growth

- Green Materials – Non polluting materials
- Green Products – Safe to use & recycle
- Green Energy -- Renewable energy

Sustainable growth

Economic activity

Determines Material use

Energy supply and demand

Demands on Air and Water

Scale of activity

Structure of economy

Technology changes and impact

What can be done ?

How = Legal, fiscal & Mkt based instruments

Policy framework

Policy Organizations

- **Government Ministries – Energy related**

- *Ministry of Power*
- *Ministry of Coal*
- *Ministry of Non-Conventional Renewable Energy Sources*
- *Ministry of Petroleum and natural Gas*
- *Ministry of Environment and Forests*

Regulatory authorities

- *Central Electricity Regulatory Commission*
- *Central Electricity Authority*
- *Central pollution control board (and State boards)*

Energy conservation, Standards setting and Promotion of Renewable energy sources

Bureau of energy efficiency (BEE), Delhi	To assist developing policies & strategies with thrust on self-regulation & market principles, within framework of Energy Conservation Act, 2001 with objective of reducing energy intensity .
Petroleum Conservation & Research organization, Delhi	Measures for efficiency in use of petroleum products
Indian Renewable Energy Development Agency Limited (IREDA)	Extend financial assistance for RE, Energy Efficiency/ Conservation Projects.
National Institute of Solar Energy, Gurgaon	Develop technologies on Solar resource utilization / technology
National Institute Wind Energy, Chennai	Complete solutions for wind energy
Alternate Hydro Energy Centre (AHEC) Roorkee.	Development of decentralized energy systems (Hydro) with other renewable energy sources
SSS- National Institute of Renewable Energy, Punjab	R & D, Design, Develop, testing, standards, commercialization. Hybrid / integrated energy
Solar Energy Corporation of India (SECI), New Delhi	Company not for profit: Implementation of the Solar mission

Legal framework

The Electricity Act 2003

- Aimed at promoting competition in Power sector.
- Enabling efficiency in generation, transmission & distribution
- Bring in transparency in pricing
- Give consumers a choice of source
- Each State to purchase minimum RE Power as per (RPO)

Tariff Policy 2006

- Quantity-based instruments
- Greater participation of private sector
- Prescribes purchase share of renewable energy power

Energy Conservation Act, 2001

Issues remain for electricity markets

- Overall - fuel (coal) shortage is a constraint
- Constraints in Transmission & Distribution
- Electricity markets segmented - various reasons
- Trades are below potential,
- Open access - still limited
- Generators cannot easily sell outside
- Consumer choice limited
- Industries continue to use expensive DG sets
- High Transmission and Distribution losses
- RPO compliance needs to be improved

RE - Policy framework

The 12th Five Year plan's strategy aims to develop the RE sector through capacity addition in wind power, small hydro power, solar power, and bio-power

Renewable Grid based power

- Development of wind farms
- Solar farms
- Biomass Power Generation

Off Grid power sources –Solar, Bio gas etc.

Renewable Non Electric Energy sources

- Biogas Programme
- Domestic Solar Water Heater
- Off-grid Solar Applications
- Hydrogen Energy

National Clean Energy Fund (NCEF)

National Clean Energy Fund announced in 2010 (through a levy of Clean Energy Cess of Rs. 50 / T on coal produced domestically and imported), serves as main mechanism for channeling public finance for funding research & innovative projects in clean energy tech. (Cess now increased to Rs 100)

For NCEF funding, eligibility scheme include:

- **Resources assessment: upfront grant-subsidy**
- **Project implementation: risk guarantee fund (foreign exchange risk ,weather risk management, risk sharing), gap finance, upfront grant-subsidy, soft loan-interest subsidy**
- **For tech. incubation: equity, venture capital, soft loan-interest subsidy, upfront grant-subsidy**
- **For technology demo.: upfront grant-subsidy, soft loan-interest subsidy,**
- **For technology development: upfront grant-subsidy.**

NCEF assistance does not exceed 40% of project cost. Participating organisations must put financial commitment of 40%.

Strategy for RE Development

Policy Framework, includes Supply Side

- Feed-in-tariffs (FiTs)
- Tax Benefits/Tax Holidays/AD Benefits
- Capital/Interest Subsidies
- Generation-Based Incentives (GBIs):
- Concessional Finance/Refinance for RE projects
- Inclusion of ECB Transactions in Automatic Route
- Viability Gap Funding through NCEF

Demand Side

- Renewable Purchase Obligations (RPOs) and RE Certificates (RECs).
- Inclusion of loan to install off grid RE Projects/ Applications in priority sector lending.

Grid Connected Power

- Wind power, biomass, small hydro and solar
- Mainly private investment driven,
- Favorable tariff policy regimes by State Regulatory Commissions

Wind Power: Generation of competitively priced grid-interactive wind power. Programme covers R & D and survey and assessment of wind resources.

Bio-power: Four sets of programmes being implemented to generate competitively priced bio power / heat from agricultural, agro-industrial residues and plantations and urban & industrial wastes.

- Biomass power / bagasse cogeneration
- Non-bagasse cogeneration
- Biomass gasifier
- Urban & Industrial wastes

Small Hydro :- Generate competitively priced Small hydro (< 25 MW).

Solar Power :- Generate competitive Solar Thermal & Photovoltaic Power.

National Solar Mission

The Mission has ambitious target of Solar parks deploying 20,000 MW of grid connected solar power by 2022

Aims at reducing cost of solar power through

- large scale deployment
- R&D;
- Producing critical raw materials, components /products,
- Achieve grid tariff parity by 2022.

Other initiatives: Use of Canal banks and Rooftops,

INSTALLED ELECTRICITY GENERATION CAPACITY (UTILITIES) MODEWISE

(MW)

Year	Hydro	Coal	Gas	Diesel	Thermal	Nuclear	RES	Total
2002-03	24.8	59.3	10.8	1.1	71.2	2.5	1.5	100
2003-04	26.2	57.6	10.5	1.0	69.2	2.4	2.2	100
2004-05	26.1	57.2	10.1	1.0	68.3	2.3	3.2	100
2005-06	26.0	55.1	10.2	1.0	66.3	2.7	5.0	100
2006-07	26.2	53.7	10.3	0.9	65.0	2.9	5.9	100
2007-08	25.1	53.1	10.3	0.8	64.2	2.9	7.8	100
2008-09	24.9	52.5	10.1	0.8	63.3	2.8	8.9	100
2009-10	23.1	52.8	10.7	0.8	64.3	2.9	9.7	100
2010-11	21.6	54.1	10.2	0.7	65.0	2.8	10.6	100
2011-12	19.5	56.0	9.2	0.6	65.8	2.4	12.3	100
2012-13	17.7	58.3	9.0	0.5	67.8	2.1	12.3	100
2013-14	16.7	59.9	8.8	0.5	69.2	2.0	12.1	100

Source CEA

Renewable Energy

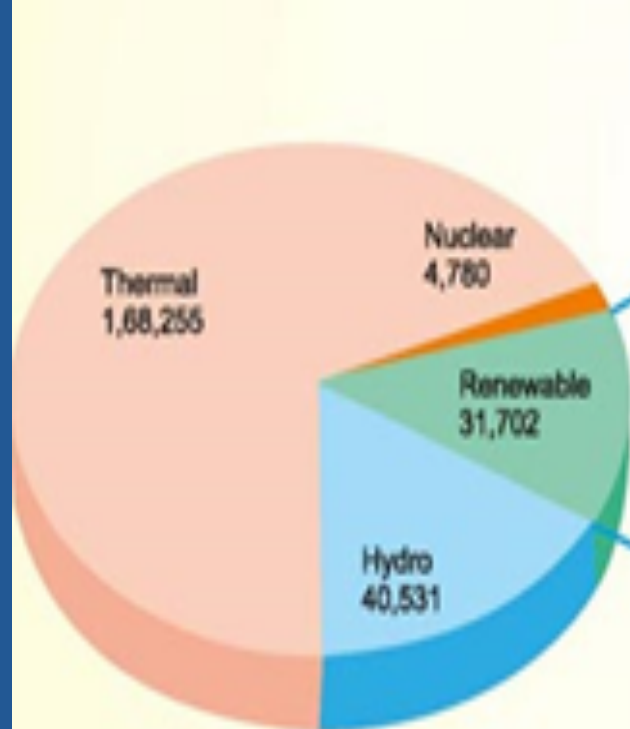
India is likely to remain one of fast growing economies;

- Despite slower growth in the last 2 years
- Energy / Power capacity will have to increase.

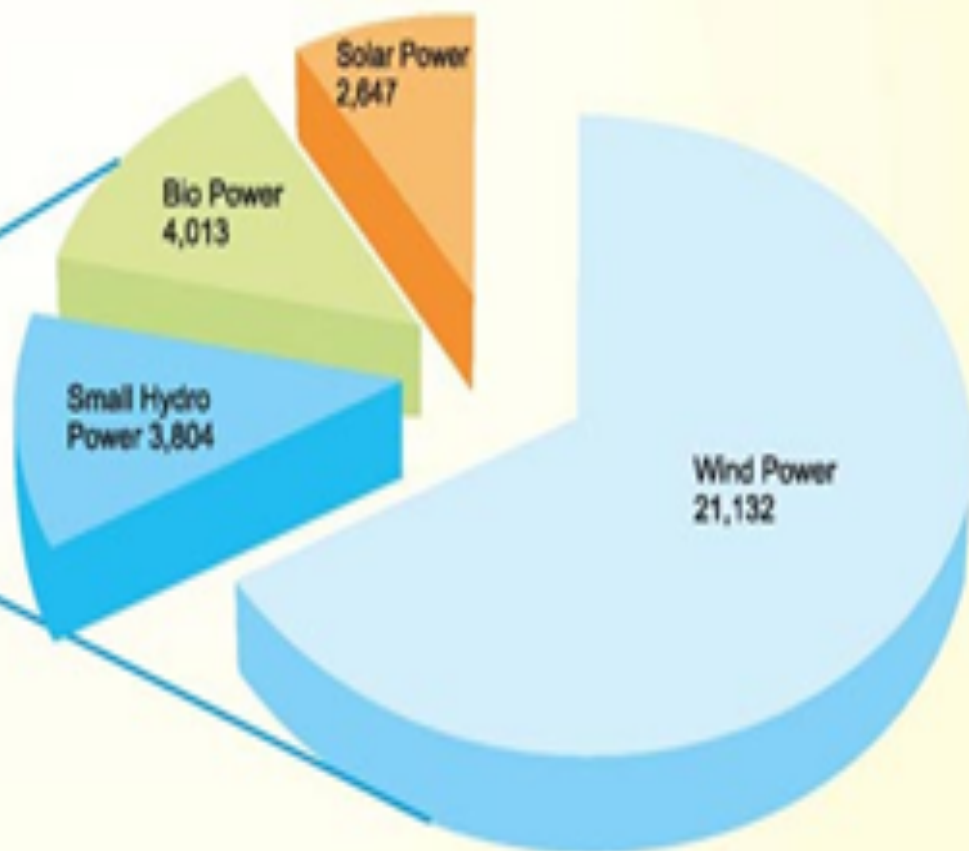
Renewable sector has immense potential and has advantages

- Mitigates energy price volatility.
- Every GW of renewable energy reduces CO2 emissions
- Help mitigate adverse effects of climate change
- Diversifying supply implies reduced import dependence
- RE can increase energy security
- RE is becoming an important part of India's energy mix
- RE is an opportunity for India.

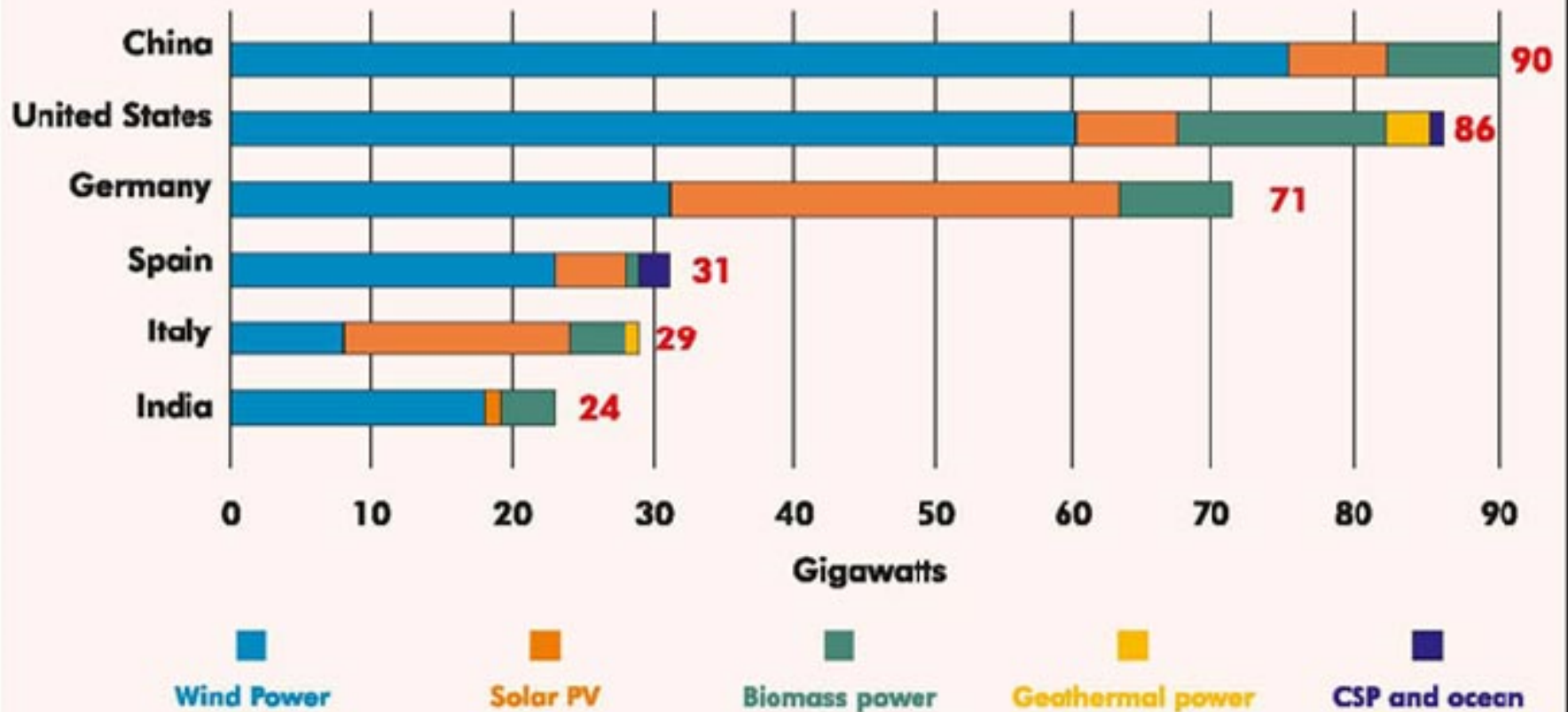
All India Power Installed Capacity (MW)



Renewable Power Installed Capacity (MW)



India's Global Position in Renewable Installed Capacity



*not including hydro power

Source-REN21 Report 2013

Issues and challenges

Drivers of RE & GT

- Energy security
- Health considerations
- Environment
- Climate change
- Opportunity – Growing Market

Based on life-cycle approach net CO2 emissions from RE is significantly lower

LCA Emissions (g CO2 equivalent/kWh)	Wind	Solar	Nuclear	Coal CFB
Implementation	13.7	37.5	1.2	3.6
Operation	4.7	12.0	12.4	918.8
Decommissioning	0.6	0.5	0.4	52.2
Total	19.0	50.0	14.0	975.3

Inhibitors to the transition

- Inhibitors / barriers
- Sunk costs and lock in S / D
- Cost in use
- Price sensitive market
- Breaking Imitative patterns - S / D

Need for strategies to deal with --

- **Price barriers and Critical mass - D/ S / D**

Local competence, know how & why – S

Design and Creating a market vs catering to an existing one

Frugal engineering use of local materials

Sachet models

Policy instrument and their mix

Regulation

Enforcing Standards

Market based instruments

Role of International cooperation -mutual benefit

Reliability, Affordability and Sustainability (RAS) of Energy Options

- **Renewable Energy Systems sustainable in long run**
 - **Being dependent on local conditions, reliability depends on:-**
 - Appropriate design,**
 - Correct installation practices, and**
 - Proper after-sales service.**
- These call for trained human resources at different levels**
- **First costs of RE systems are high,**
 - **They work out cheaper over operational lives,**
 - **The question of affordability is a question of how to**
 - **Defray higher, first costs of RE Systems**
 - **Reduce cost of financing large projects**

Issues specific to RES

- RES capacity is concentrated in five states of country,
 - Rajasthan, Gujarat, Maharashtra, Karnataka and Tamil Nadu.
- Need for greater spread of RES
- Need to balance variability of such generation.
- Imperative to work out large scale integration of variable RES keeping in view grid security
- Need for improved forecasting techniques of conditions

Environmental and socio-economic impacts of RE projects

- At current capacity, RE projects have minimal social & environmental impacts.
- Due to rapid growth, the sector may also need to deal with issues of land (& water)
- Water requirement of large solar projects for maintenance may be a cause of concern for communities sharing same resource
- Dealing with waste from **PV** needs be addressed

Policy focus on 24 X 7 power to all

This is to be achieved by:-

- Careful Assessment of demand and supply
- Augmenting all sources of energy- Coal, RE and other
- Strengthening of transmission and distribution
- One nation, one grid and one frequency
- Addressing sustainability issues – Efficiency, AT&C etc
- IT applications- ERP, Smart meters, Smart Grids.
- Completion of coal projects and rail links
- Focus on quality of coal
- Agriculture to be provided regulated but reliable power

24 X 7

- Development of hydro power
- Setting up of a Green Energy corridor
- Setting up of RE management Centres
- Focus on training and capacity building in energy
- Energy efficiency- National mission on EE
- Regulatory reforms

Other focus areas

- Seamless integration in decision
- Power ,coal and MRNRE under one Minister
- Partnership with States
- Finding long term Solutions
- Focus on outcomes
- Minimize impact on environment
- Using conventional fuels more efficiently
- Make in India (FDI)

FDI Policy

Objective: It is the intent & objective of Government of India to attract & promote foreign direct investment to supplement domestic capital, technology and skills, for accelerated economic growth.

FDI Policy: Government has Consolidated FDI Policy, which is updated every year

Most sector open to FDI. A non-resident entity can invest except in those sectors/activities which are prohibited

Areas with restrictions are mentioned

Some Examples of Green applications

Some Examples of Green applications

- **Architecture**
- **Mass transit**
- **Drinking water**
- **Fuel use**
- **Cooling and Refrigeration**

Architecture



Laurie Baker designs

- Local materials
- Low cost & Functional
- Amenable for scaling up
- Simple but aesthetic designs
- Low impact on energy use and environment

Delhi Metro (urban mass transit)

- More efficient than individual cars.
- Cheap
- Model being replicated in other cities Bangalore, Hyderabad
- Challenge: local government support is needed.



<http://www.epcworld.in/epcnews/hooda-laid-foundation-stone-extension-delhi-metro.aspx>

<http://www.indiatvnews.com/news/india/delhi-metro-rides-to-get-costlier-pc-hike-proposed-20044.html>

Clean Drinking water

- **Low-cost purifier** for those not having access to safe drinking water.
- Purification using rice husk ash impregnated with nano silver particles for purifying water and destroy bacteria/ germs / organisms.



Water ATMs bring clean water to Delhi
BBC: 25 July 2014

Authorities in Delhi are piloting scheme for clean drinking water to residents. Water ATMs dispensers use pre-paid smart cards and allow people to fill containers for a small fee. Pilot has proved successful. Govt. is looking to expand it.

Efficient energy use of biomass

Traditional Chulahs (Stove)

- Energy inefficient
- Incomplete burning of material
- Smoke and soot; health hazard

Portable Energy Efficient Wood Stove



Source: NIF:Stove designed by V Jayprakashan, **District & State:** Kozhikode , Kerala

Washing Machines

Developing countries have electricity and water deficit. Conventional washing machines are not an option. Doing laundry in open streams add to water pollution

A human-powered machine could be an option

MIT students & Residents of Ventanilla, Peru work on bicilavadora, an inexpensive bike/washing machine.



Refrigerator

Mitti Cool

**Does not require electricity.
Made of clay.
Developed by Manshuk Lal,
Works on evaporation.**

**Weights 20 kg (18.5''X11'').
Water from upper chambers
drips down taking heat from
inside as it gets evaporated,
leaving the chambers cool.**



Source: <http://www.mitticool.in>

Refrigerator

ChottuKool

Launched by Godrej, a tiny refrigerator means 'Little Cool' in Hindi.

Storage capacity i43 litres, - more than enough for 4-member family.

Fridge is simple and elegant in design.

Weights 8.9 kgs and attractive.

Operates between 5oC to 15oC

Makes no ice, but it provides chill to store milk, vegetables and food for a day or two.

Has high end insulation which keeps food cool for 2-3 hours even during power cuts.



Challenges

- **Different path vs following set patterns**
- **Adopting, adapt and /or leap frog**
- **Re defining Green technologies**

How much is enough ?

Thank You

FDI Policy - Energy sector

100% FDI allowed in Power sector.

100% FDI allowed in Renewable energy.

FDI up to 100% in Oil & Natural gas

Exploration,

Infrastructure for marketing petroproducts,

LNG & petro product pipelines.

FDI up to 49% in Petroleum refining (private sector).

FDI in Mining -Provisions

Mining and Petroleum & Natural Gas

6.2.3	Mining		
6.2.3.1	Mining and Exploration of metal and non-metal ores including diamond, gold, silver and precious ores but excluding titanium bearing minerals and its ores; subject to the Mines and Minerals (Development & Regulation) Act, 1957.	100%	Automatic

FDI in Mining -Coal

6.2.3.2	Coal and Lignite		
	(1) Coal & Lignite mining for captive consumption by power projects, iron & steel and cement units and other eligible activities permitted under and subject to the provisions of Coal Mines (Nationalization) Act, 1973.	100%	Automatic
	(2) Setting up coal processing plants like washeries subject to the condition that the company shall not do coal mining and shall not sell washed coal or sized coal from its coal processing plants in the open market and shall supply the washed or sized coal to those parties who are supplying raw coal to coal processing plants for washing or sizing.	100%	Automatic

FDI Petroleum and Gas

6.2.4	Petroleum & Natural Gas		
6.2.4.1	Exploration activities of oil and natural gas fields, infrastructure related to marketing of petroleum products and natural gas, marketing of natural gas and petroleum products, petroleum product pipelines, natural gas/pipelines, LNG Regasification infrastructure, market study and formulation and Petroleum refining in the private sector, subject to the existing sectoral policy and regulatory framework in the oil marketing sector and the policy of the Government on private participation in exploration of oil and the discovered fields of national oil companies.	100%	Automatic

FDI Petroleum refining

Sl. No.	Sector/Activity	% of Equity/ FDI Cap	Entry Route
6.2.4.2	Petroleum refining by the Public Sector Undertakings (PSU), without any disinvestment or dilution of domestic equity in the existing PSUs.	49%	Automatic

FDI in the Energy Sector

- FDI inflows in renewable energy industry from April 2000 – February 2013 was \$ 2,518.31 million.
- FDI of \$ 5,379.28 million from April 2000 – February 2013 in petroleum & natural gas industry