

Topic- Energy and Environment

Class room Lecture series -5

Paper 7 (Urban Ecosystems)

By-

Dr. Chirashree Ghosh

Department of Environmental Studies

University of delhi

Date-16.3.2020

Energy Scenario in India

- To maintain growth rate, need rapid growth in energy sector
- 41% of electricity generation from thermal power plant

Energy scenario in India

- In 2016-2017, total domestic energy production of 670 million tons of oil equivalent (MTOE). This meets only 71% of the expected demand.
- As per the 2011 Census, 55.3% rural households had access to electricity
- Still most of the rural area has limited supply hours of electricity
- India ready to exploit renewable energy resources

Electricity ACT 2003

- Role of Government : National Electricity Policy and tariff policy
- Rural electrification
- Splitting the structure: Genco, Transco and Discos
- Consumer protection
- Trading and market development
- Formation of Central Electricity Authority (CEA)
- Restructuring of State Electricity Board (SEB)
- Measures against theft of electricity
- Renewable energy utilization

Energy Conservation Act 2001

- much-needed legal framework and institutional arrangement for embarking on an **energy efficiency drive**
- **Energy auditing for designated consumer** like energy intensive industry, railway, commercial building, Power Plant etc.
- Establishment of **Bureau of Energy Efficiency (BEE)**
- Role of BEE: standard and labels of appliances, undertake promotional activity, prepare building codes, maintain central energy conservation fund etc.

Future Energy Resources

- Current rate of fossil fuel usage will lead to an energy crisis this century
- Energy industry start inventing new ways to extract energy from renewable sources
- Due to lack of technology and economic consideration, total shift toward renewable energy is not possible
- Nuclear energy has a future
- Solar thermal plant, solar PV plant, wind energy play a crucial role to satisfy the energy demand

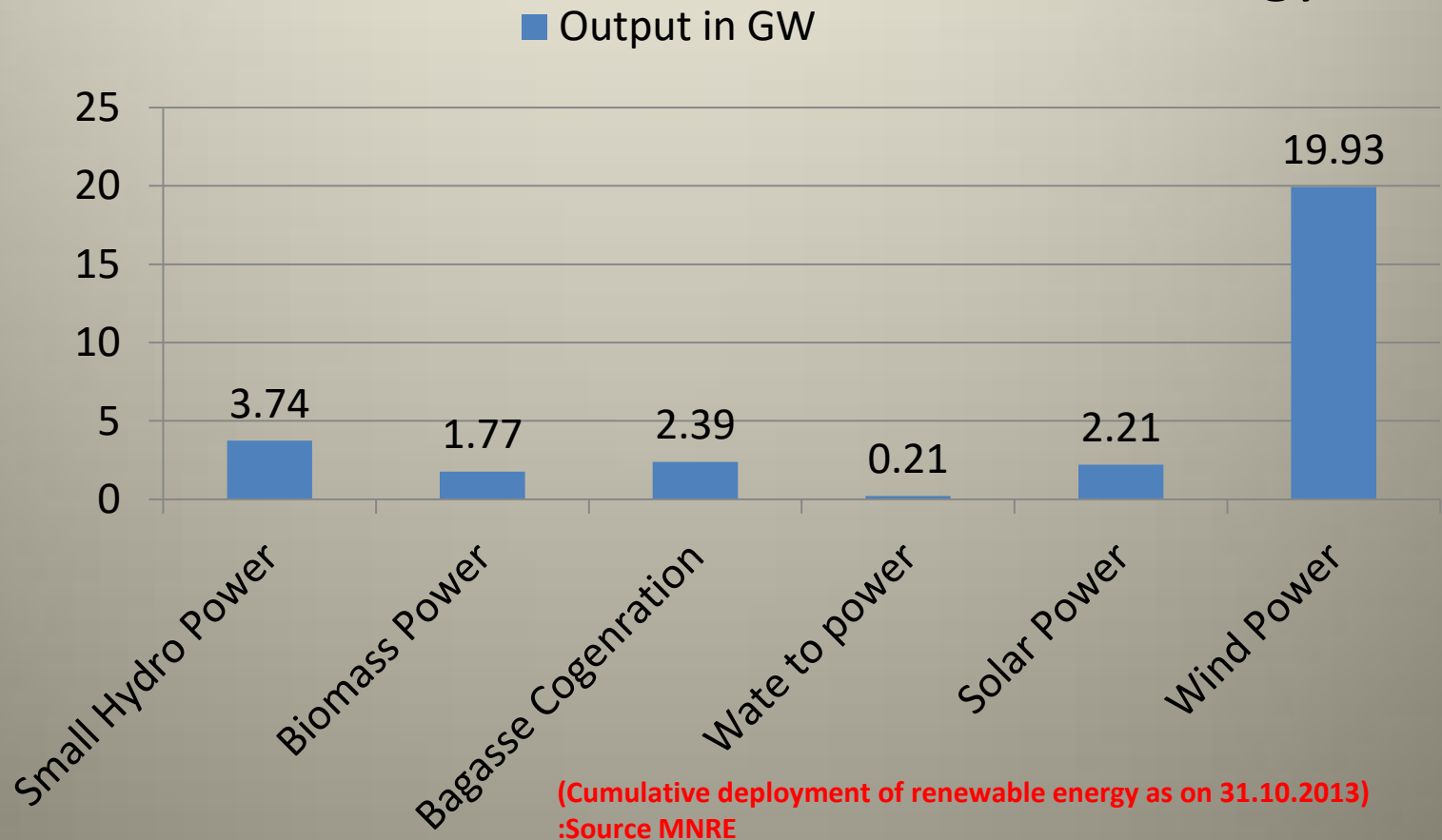
Renewable Energy and Sustainable Development

- Sustainable Development: “to meets the needs of the present without compromising the ability of future”
- Effect of conventional source of energy: air pollution, acid precipitation, ozone depletion, forest destruction, and emission of radioactive substances
- There is shortage of energy in near future

- more use of renewable energy sources and technologies is one of the solution
- Renewable energy is a **direct or indirect form of solar energy**
- Research is going on to make **renewable energy economical**
- Once technology develop in renewable energy field, it help in **national sustainable economic growth**

Renewable Energy in India

- Ministry of New and Renewable Energy (MNRE) come in picture in 2006
- It work to increase the share of renewable energy



Wind Energy

- India has a wind potential of 50 GW at 50m height
- Coastal region in southern part of India is one of the best site of wind energy
- India is a fifth largest wind power producer in world
- Wind energy sector is one of the fastest growing renewable energy sector
- Assessment of wind energy resource is done by C-WET (Centre for Wind Energy Technology)
- R&D and testing is done by C-WET

Biomass Power Program

- Objective of harnessing grid quality power from biomass
- Biomass material like bagasse, rice husk, cotton and jute waste, de oiled cakes etc. are used to produce energy
- Bagasse based cogeneration in sugar mill have a potential of 5000 MW
- Biogas based generation in village using animal waste

Small Hydro Plant

- Hydro plant of capacity less than 25 MW
- Estimated potential of small hydro plant is 20 GW
- It help to provide electricity in remote area
- Government plant to electrify boarder village of Arunachal Pradesh using small hydro plant
- AHEC (Alternative Hydro Energy Centre), IIT Roorkee is work to design international level R&D and testing facility

Solar Power

- With about 300 clear, sunny days in a year, India have abundant solar potential
- Daily average solar energy incident over India varies from 4 to 7 kWh/m²
- Technology advancement and drop in price of PV module make solar PV plant a good choice
- National Solar Mission launch to encourage solar energy
- Solar PV plant type:
 1. Grid connected solar PV plant
 2. Off grid (Stand alone) PV plant

Jawaharlal Nehru National Solar Mission

- Launched on 11 January 2010
- It aim:
 1. Deployment of 20000 MW of grid connected solar plant by 2022
 2. 2000 MW of off grid solar application including 20 million solar lights by 2022
 3. 20 million sq. meter of solar thermal collector area
 4. R&D and capacity building activities to achieve grid parity by 2022

Renewable Energy Policy Framework

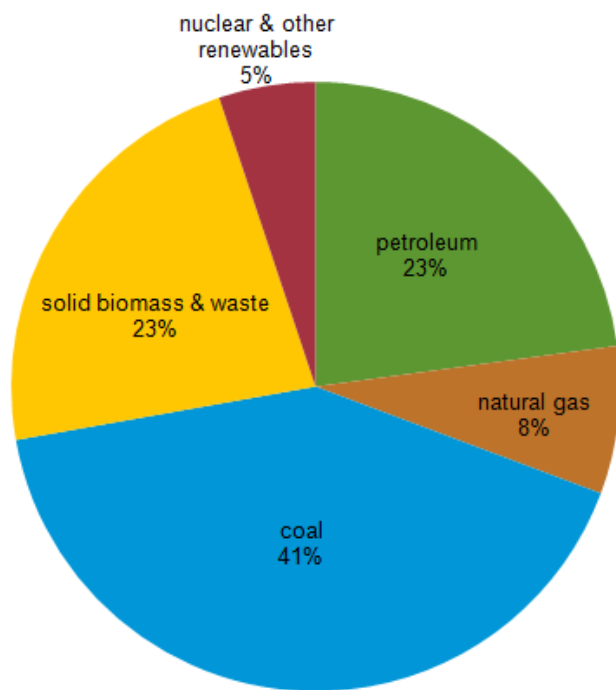
- Budgetary support for research, development and demonstration of technologies
- Financial Incentives, including for renewable energy applications in rural areas
- Promoting private investment through fiscal incentives, tax holidays, depreciation allowance and remunerative returns for power fed into the grid.
- Finance for renewable energy: IREDA

Research ORGANIZATION

- Solar Energy Centre
- Centre of Wind Energy Technology (C-WET)
- AHEC (Alternative Hydro Energy Centre)
- IREDA (Indian Renewable Energy Development Agency)
- SECI (Solar Energy Corporation of India)
- NCPRE (National Centre for Photovoltaic Research and Education), IIT Bombay
- Renewable energy centre in various IIT and NIT

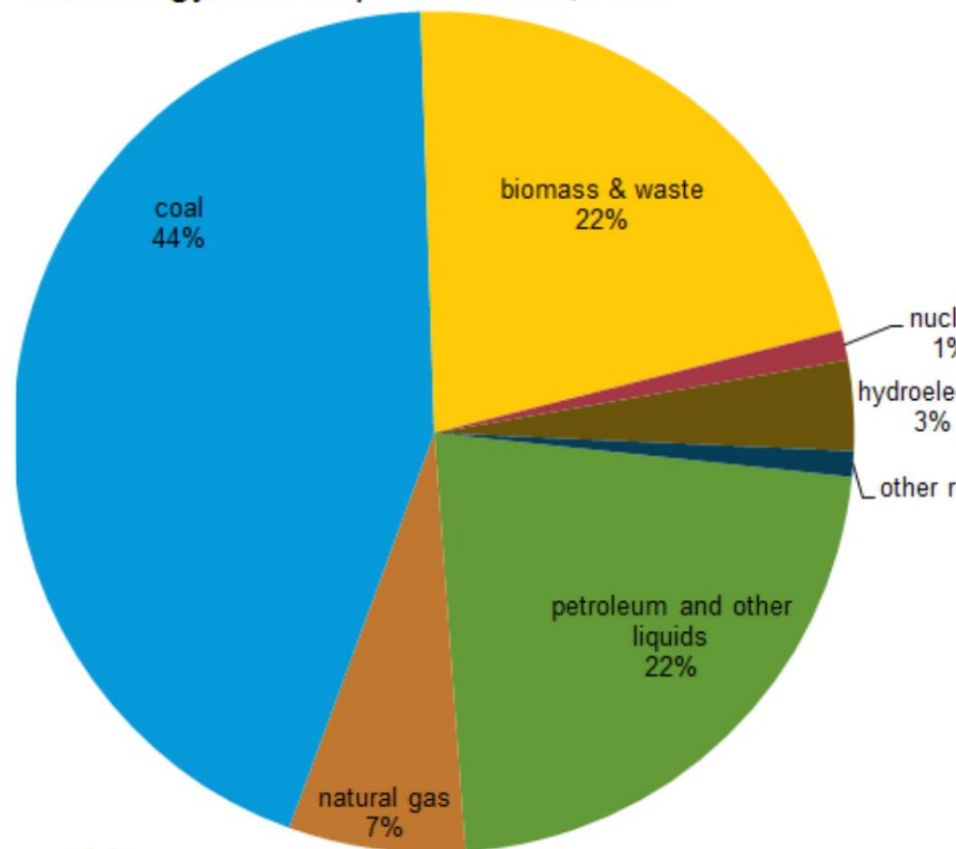
Energy Consumption

Total energy consumption in India, 2011



Source: U.S. Energy Information Administration, International Energy Statistics

Total energy consumption in India, 2012



Source: U.S. Energy Information Administration, International Energy Agency, BP Statistical Review

Energy Demand

- All India Per household per month energy consumption

Energy sources	Rural			Urban		
	Quantity	No. of sample HHs responding	Value (₹)	Quantity	No. of sample HHs responding	Value (₹)
Coke (kg)	69.78	262	224.7	60.7	298	250.13
Firewood and chips (kg)	118.02	49 221	307.57	89.42	12 448	281.07
Electricity (kWh)	60.35	49 022	176.04	124.62	40 013	435.29
Dung cake (unit)	-	-	155.8	-	-	149.78
Kerosene- PDS (litre)	2.8	40 891	44.41	3.27	14 750	49.89
Kerosene- other sources (litre)	2.3	13 301	65.96	4.72	7 097	161.8
Matches (box)	8.38	57 986	8.26	6.35	39 099	6.38
Coal (kg)	55.1	940	177.74	65.95	957	285.94
LPG (excl. conveyance, in kg)	8.69	20 354	259.39	12.37	30 396	363.76
Charcoal (kg)	21.35	595	141.22	17.29	561	170.24
Candle (number)	6.46	18 640	16.27	5.77	18 668	16.3
Gobar gas (kg)	-	-	284.83	-	-	95.64
Petrol (litre)	5.26	101	355.68	11.2	63	746.02
Diesel (litre)	3.03	121	127.48	3.73	53	155.36
Other fuel (kg)	-	-	94.73	-	-	65.79

HHs = Households; LPG = Liquefied Petroleum Gas; PDS = public distribution system

Source: MoSPI (2012)

- Distribution of households on the basis of energy source for electricity

Energy source	Census of India 2001		Census of India 2011	
	Per cent of rural HHs dependent on energy source	Per cent of urban HHs dependent on energy source	Per cent of rural HHs dependent on energy source	Per cent of urban HHs dependent on energy source
Electricity	43.6	87.6	55.3	92.7
Kerosene	55.6	11.6	43.2	6.5
Solar energy	0.3	0.2	0.5	0.2
Any other source	0.3	0.2	0.5	0.3
No lighting	0.3	0.4	0.5	0.3

HHs – Households

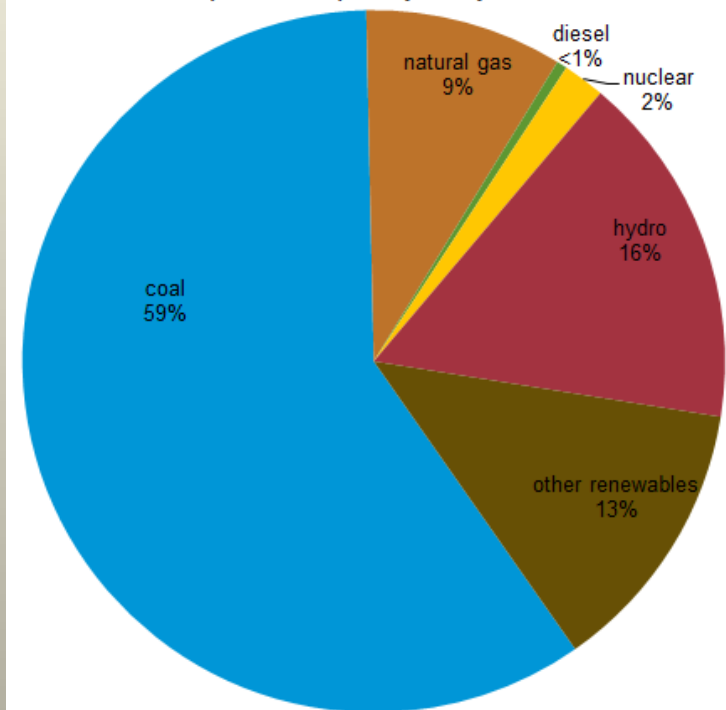
Note CensusInfo 2011 (version 2.0) reports 43.6% of rural households as dependent on electricity. However, the official Census website reports this figure as 43.5% households.

Source Census of India (2011a)

Electricity

- *India had 249 gigawatts of installed electricity generation capacity connected to the national network in early 2014,*
- *mostly coal-powered plants.*
- *Because of insufficient fuel supply and power generation and transmission capacity, the country suffers from a severe electricity shortage, leading to rolling blackouts.*

India installed power capacity, May 2014



Note: Includes utility-based power facilities, not captive power plants.
Source: U.S. Energy Information Administration, India's Central Electricity Authority.

Electricity

India Utility based installed power capacity

Source	Megawatt
Coal	147,568
Natural Gas	22,608
Petroleum and Other liquid	1200
Hydroelectricity	40,662
Nuclear	4,780
Other renewables	31,692
Total	248,509

Source: India's CEA

Electricity Consumption

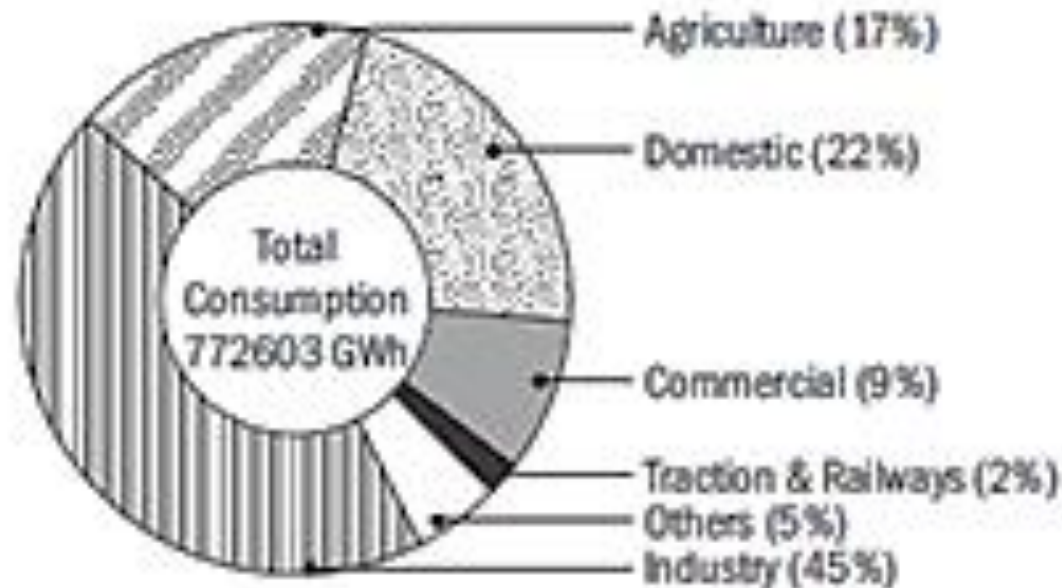


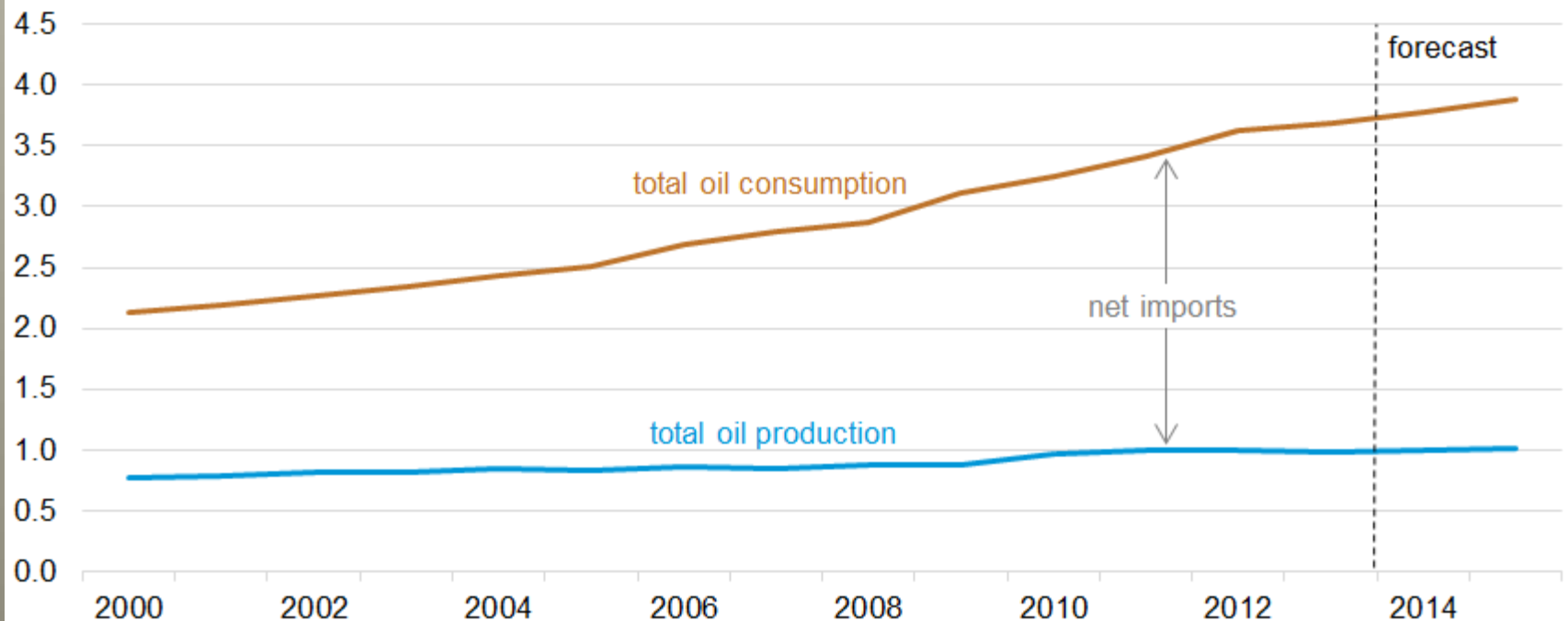
Figure 1 Consumption of electricity (utilities) during 2011–12

Source MoSPI (2013)

Petroleum

India petroleum and other liquids production and consumption, 2000-15

million barrels per day



Source: U.S. Energy Information Administration, International Energy Statistics and Short-Term Energy Outlook June 2014.

Petroleum

- India was the fourth-largest **consumer of oil** and petroleum products after the United States, China, and [Japan](#) in 2013
- It was also the fourth-largest **net importer** of crude oil and petroleum products.
- The gap between India's oil demand and supply is widening, as demand reached nearly 3.7 million barrels per day (bbl/d) in 2013 compared to less than 1 million bbl/d of total liquids production.

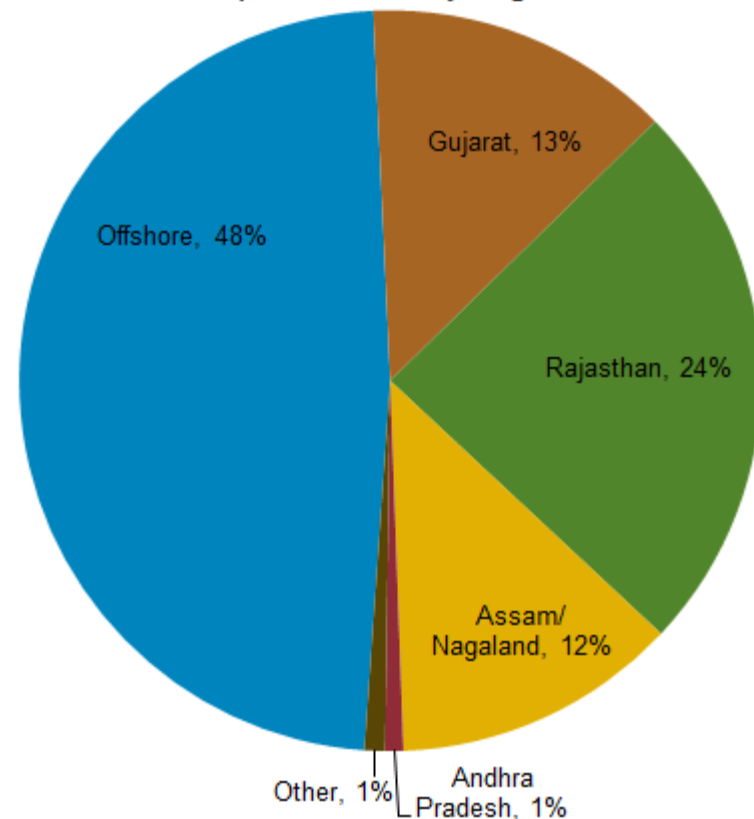
Natural Gas

- *Natural gas serves as a substitute for coal in electricity generation and fertilizer production in India.*
- *The country began importing liquefied natural gas from Qatar in 2004.*
- *increasingly relies on imports to meet domestic natural gas needs.*

Petroleum

- According to the *Oil & Gas Journal* (OGJ), India held nearly 5.7 billion barrels of proved oil reserves at the beginning of 2014.
- About 44% of reserves are onshore resources, while 56% are offshore.
- Most reserves are found in the western part of India, particularly the Western offshore area near Gujarat and Rajasthan.

India crude oil production by region, 2013

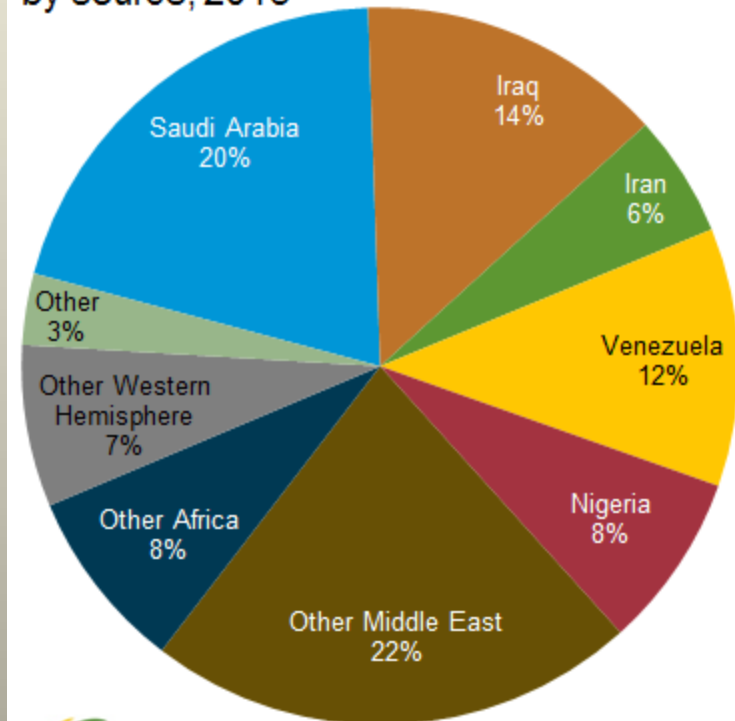


Sources: U.S. Energy Information Administration, India Ministry of Petroleum and Natural Gas.

Petroleum

- The refining industry is an important part of India's economy, and the private sector owns about **38% of total capacity**.
- Despite being a **net importer of crude oil**, India has become a **net exporter of petroleum products** by investing in refineries designed for **export**, particularly in Gujarat.
- The **Indian Oil Corporation (IOC)** controls and operates the **oil product pipelines** and supplies most of the oil products going to the domestic market.
- According to the **Ministry of Oil and Natural Gas**, India's crude oil pipeline network spans just under 5,900 miles and has a total capacity of 2.8 million bbl/d.

India petroleum and other liquids imports by source, 2013



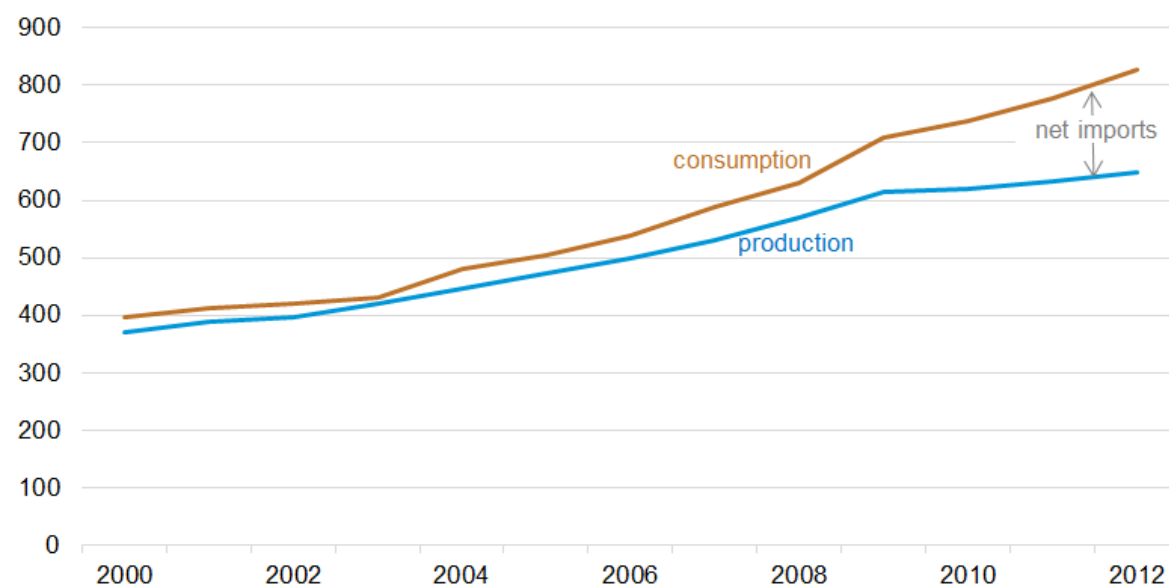
Source: U.S. Energy Information Administration, Global Trade Atlas.

Coal

- Coal is India's primary source of energy.
- The country has *the world's fifth-largest coal reserves, and ranked third largest in terms of both production and consumption in 2012.*
- India's government took control of the country's coal reserves with the **1973 Coal Mines Nationalization Act**, establishing **Coal India Limited (CIL)** in **1975** as the state-owned sole producer and aggregating coal production and investment.

India coal consumption and production, 2000-12

million short tons



Source: U.S. Energy Information Administration.

Coal

- Most coal reserves are located in the **eastern parts of the country.**
- Jharkhand, Chhattisgarh, and Odisha account for approximately **64% of the country's coal reserves**, according to the IEA.
- Other significant coal-producing states include **West Bengal, Andhra Pradesh, Madhya Pradesh, and Maharashtra**

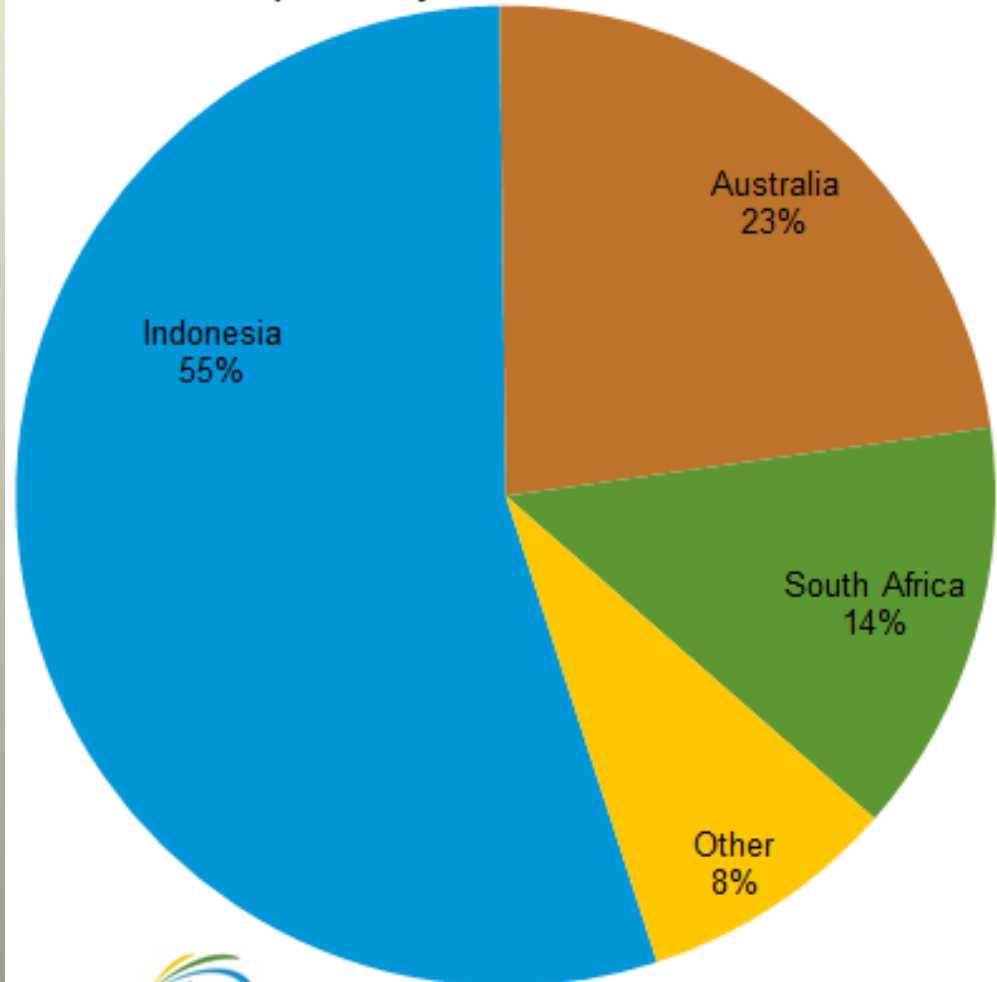
Energy Conservation

- Educating citizens about the economic benefits and methods of energy conservation. These messages can be transmitted through the media and NGOs.
- Encouraging the purchase of energy-efficient equipment. One method could be to persuade banks to provide loans under 'easier' conditions for such equipment.
- Promoting the construction of energy-efficient buildings.
- Actively promoting the use of energy-efficient appliances such as solar cookers and the use of solar heating, especially in B-class cities. The availability of electricity is low or very low in B or C class cities therefore promoting such concepts could lead to better living comfort.

Coal

- Demand grew more than 7% annually between 2007 and 2012, and reached 826 million short tons in 2012.
- Since coal production cannot keep pace with demand, India has met more of its coal needs with imports.

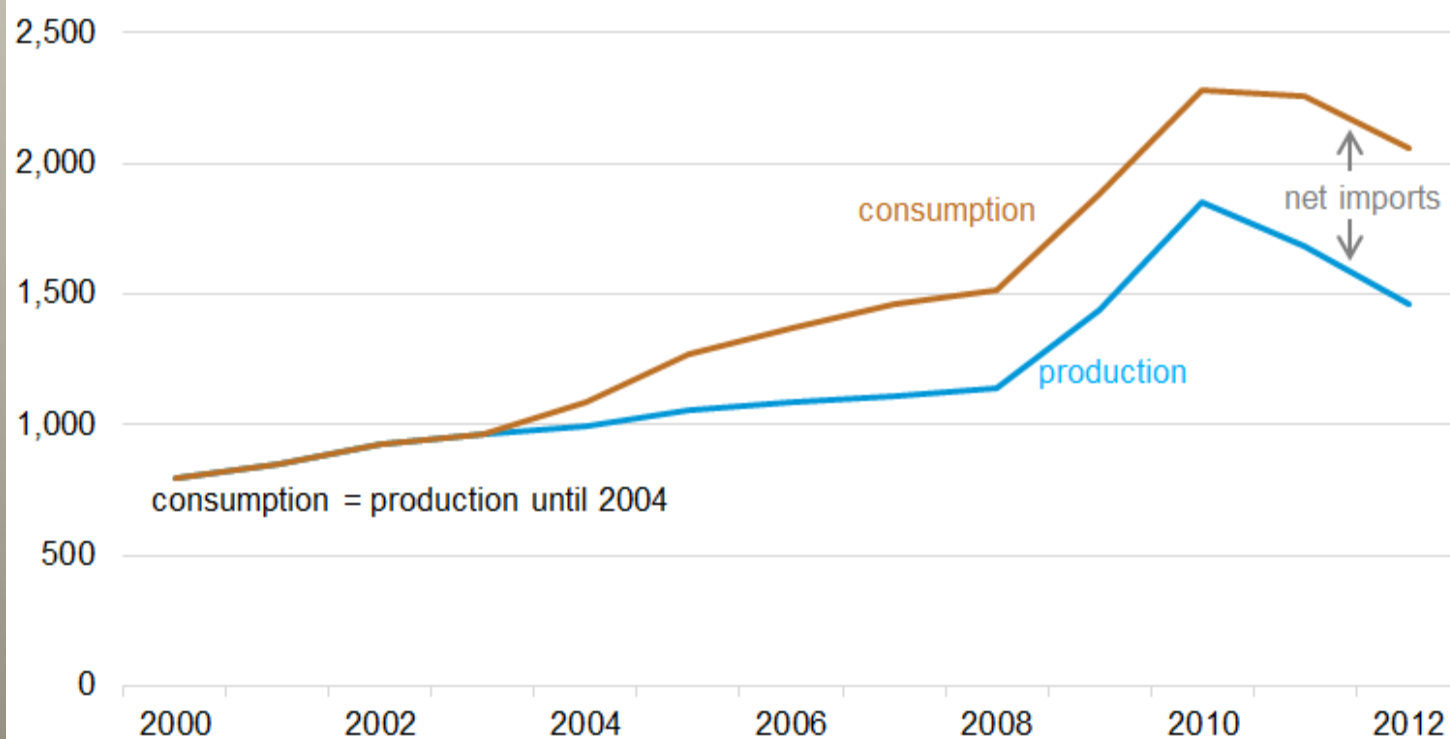
India coal imports by source, 2012



Natural Gas

India dry natural gas production and consumption, 2000-12

billion cubic feet



Source: U.S. Energy Information Administration.

Natural Gas

- *India had 47 trillion cubic feet of natural gas reserves at the beginning of 2014.*
- About 34% of total reserves are located onshore, while 66% are offshore.
- The two biggest state-owned companies, **ONGC and Oil India Ltd.**
- (OIL), dominate India's upstream gas sector. ONGC operates the Mumbai High Field.
- **RIL** is becoming a major upstream force because of natural gas discoveries in the **Krishna-Godavari basin.**

Natural Gas

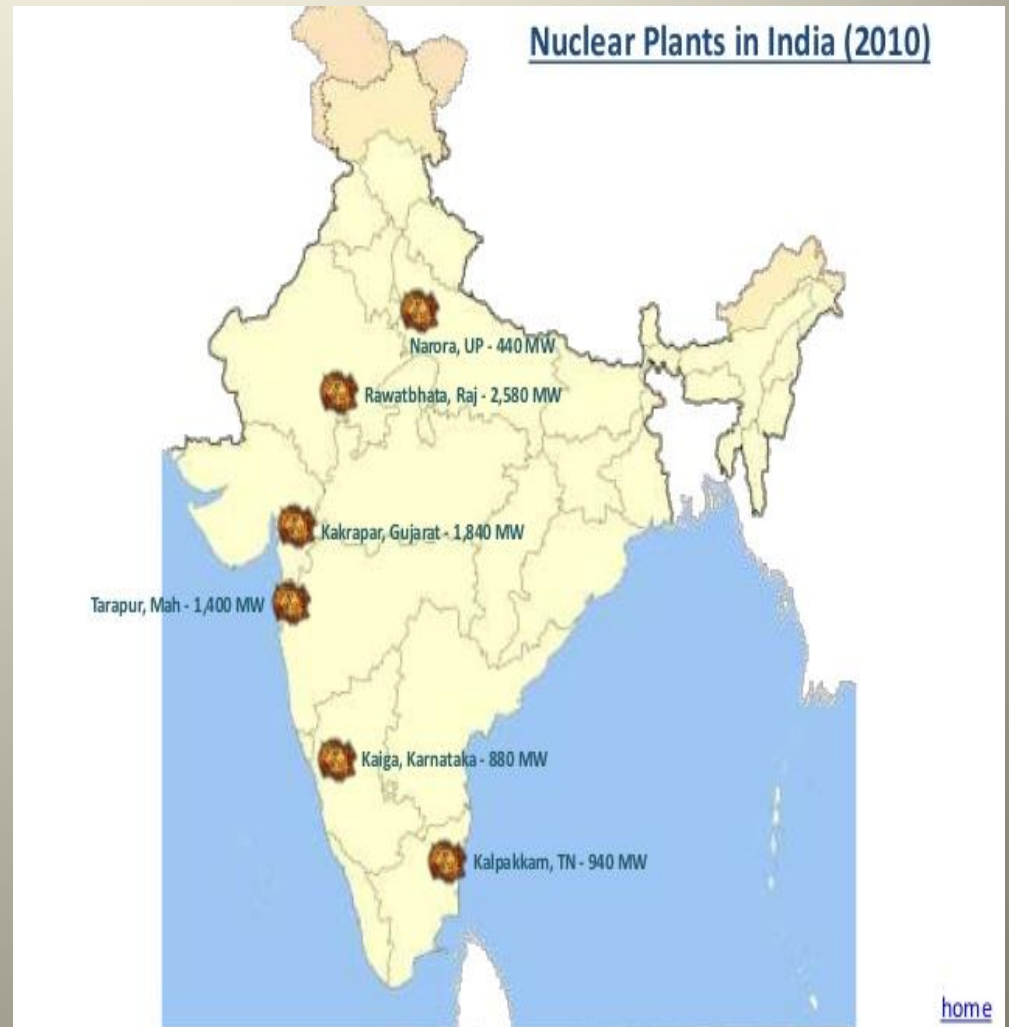
- The two most important companies operating India's large gas pipeline system are **GAIL and Reliance Gas Transportation Infrastructure Limited (RGTIL)**.
- the **Hazira-Vijaipur-Jagadishpur (HVJ) line** running from Gujarat to Delhi,
- and the **Dahej-Vijaipur (DVPL) line**

Hydroelectricity

- India was the world's seventh-largest producer of hydroelectric power in 2012, with 115 billion kilowatthours generated.
- Total utility-based installed capacity of hydropower in early 2014 was nearly 41 GW, according to the CEA.
- In particular, states with significant river systems such as Himachal Pradesh, Jammu, Kashmir, and Uttarakhand.

Nuclear

- India has 20 operational nuclear reactors at six nuclear power plants with a generation capacity of 4.8 GW.
- six additional reactors with a combined 4.3 GW of capacity constructed and initiated on 2017.
- Abundant thorium reserves that can power more sophisticated reactors. India's commitment to the thorium fuel cycle sets it apart from most nations with nuclear power programs.



Biomass and Waste

- The lack of electricity in some parts of India results in a substantial use of traditional biomass and waste products primarily for household uses in rural areas.*

India households by primary fuel used for cooking		Percentage		
Fuel Type	Total	Rural	Urban	
Firewood	49.0	62.5	20.1	
Crop residue	8.9	12.3	1.4	
Cowdung cake	7.9	10.9	1.7	
Coal, Lignite, Charcoal	1.4	0.8	2.9	
Kerosene	2.9	0.7	7.5	
Liquefied Petroleum Gases/Piped Natural Gas	28.5	11.4	65.0	
Electricity	0.1	0.1	0.1	
Bio-gas	0.4	0.4	0.4	
Any other	0.5	0.6	0.2	
No cooking	0.3	0.2	0.5	

Source: India Census 2011

- Ensuring that at least major energy consumers undertake regular energy audits.
- Requiring major energy consumers to commit to phased reduction in energy consumption.
- Reducing the demand for stolen electricity by making electricity available to consumers legally is a practical **alternative**. Improving access in the slums of Ahmedabad has reduced thefts substantially.
- Integrated Transport System

Policies, Programmes, and Regulations

- **Electricity Act, 2003**
- **National Electricity Policy, 2005**
- **Rural Electrification Policy, 2006**
- **Programmes**
- **Rajiv Gandhi Gramin Vidyutikaran Yojana**
- **Remote Village Electrification programme**

- **National Biogas and Manure Management Programme**
- **Jawaharlal Nehru National Solar Mission**
- **Akshay Urja shops**
- **Rajiv Gandhi Gramin LPG Vitaran Yojana**
- **Subsidy on superior kerosene oil allocated through public distribution systems and on domestic LPG**

Thank You