STATUS AND SCOPE OF BIOMASS ENERGY RESOURCES IN INDIA

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DEVELOPMENT OF DOCUMENTATION CENTRE

CONTACTS WITH OTHER INSTUTIONS

SSS-NIRE AT A GLANCE
(Centre of Excellence on Bio-Energy)

R&D DIVISIONS

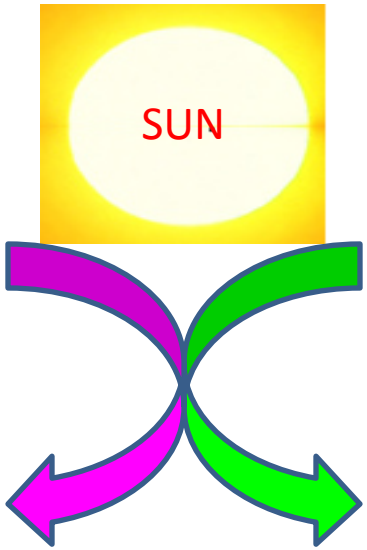
- Biomass & Energy Management Division
- Thermo-chemical Conversion Division
- Bio-chemical Conversion Division
- Chemical Conversion Division
- Electro-chemical Processes

TRAINING

COMMERCIAL UTILIZATION OF LAB FACILITIES

CONSULTANCY

BIOMASS ENERGY



PLANT CONVERTS SOLAR ENERGY INTO CHEMICAL ENERGY IN BIOMASS VIA PHOTOSYNTHESIS BY CO_2 FIXATION

BIOMASS

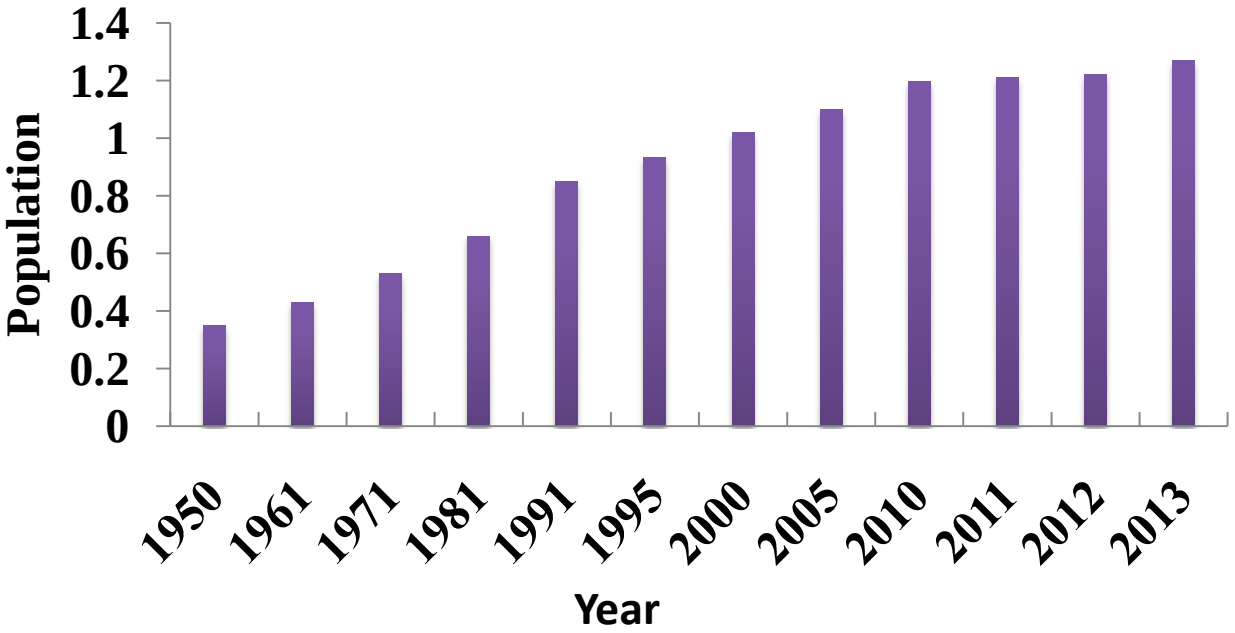
- **PLANT RESIDUE**
- **FOOD GRAINS, VEG., FRUITS ETC.**

The photosynthetic activity stores 17 times as much energy as is consumed by all nations put together.

India at a Glance

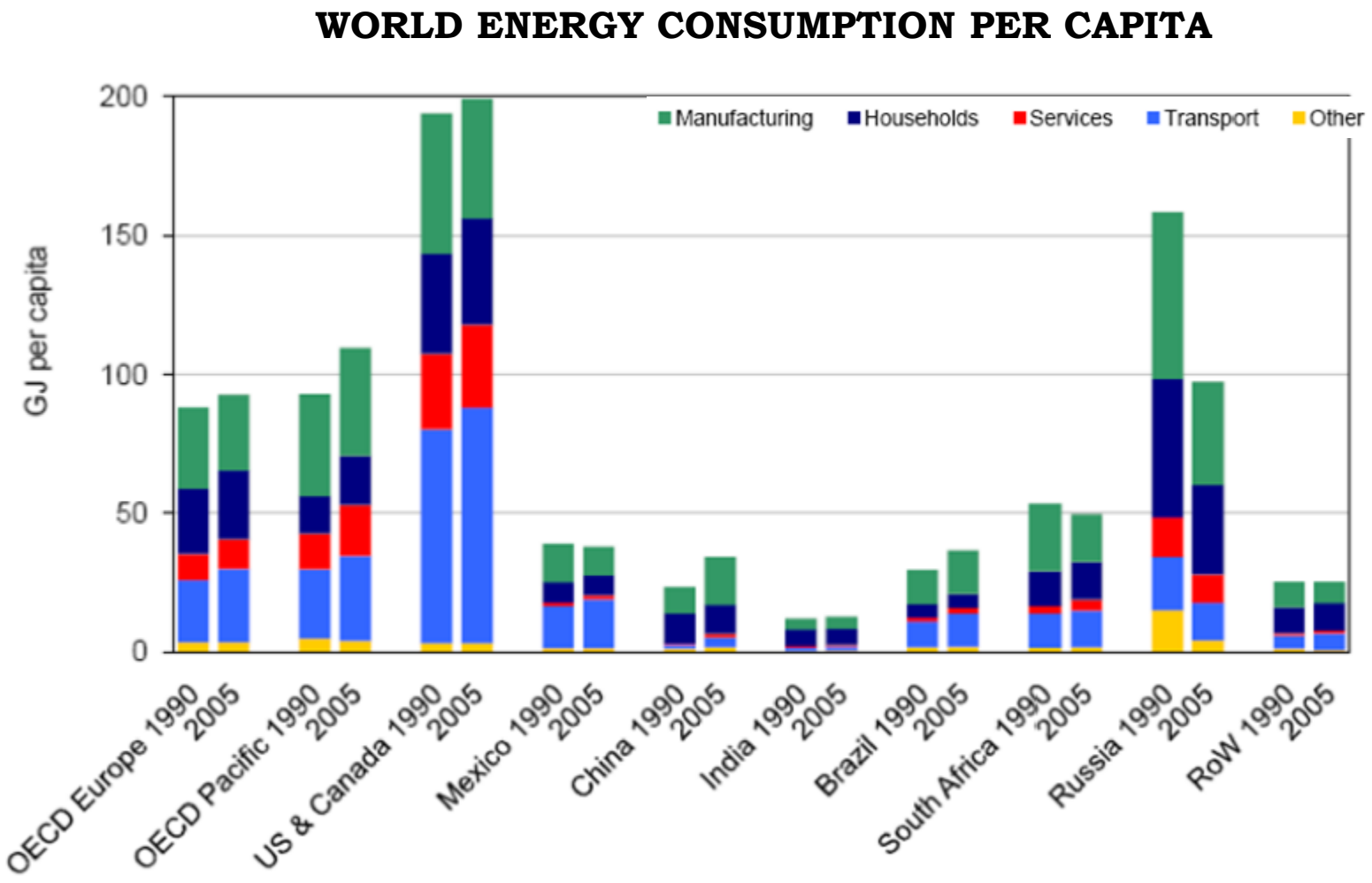
Population

2.4 % of the geographical area supporting 18% of the world population.



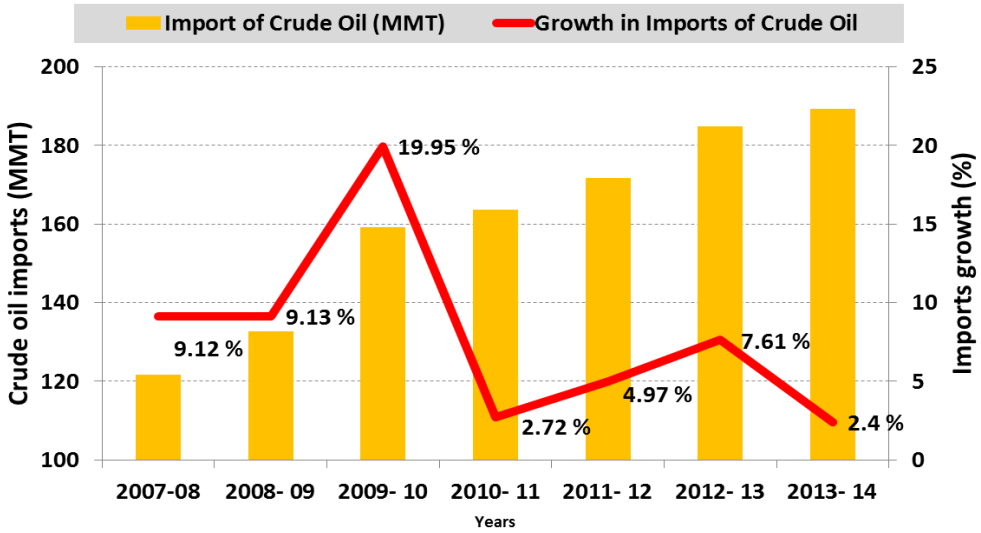
- **Population in 1947 was 350 Million and increased to 1202 Million in 2011-2012.**
- **Total geographical area of India is 3.29 M. Sq.km. (2011-2012)**
- **36 % population is below poverty line.**
- **About 24 % have daily income below 1$/d.**
- **Literacy rate is 74% and population density 382/km^2**

WORLD ENERGY CONSUMPTION



(Source: IEA, 2009)

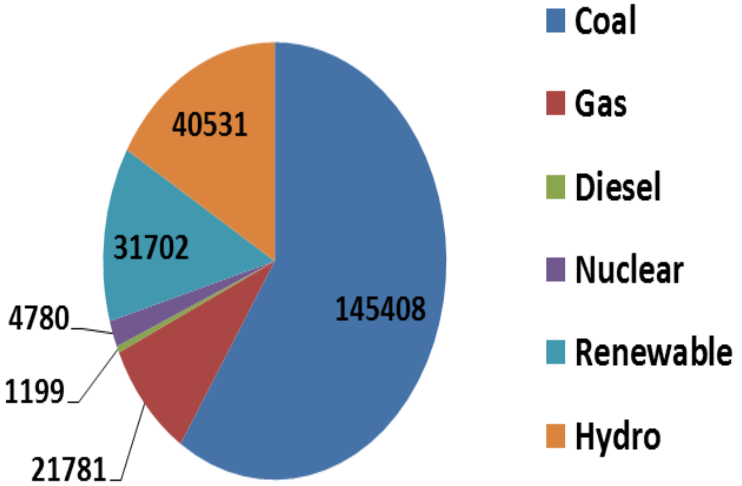
ENERGY STATUS IN INDIA



India imports about 80% of its oil.

Energy needs are severed
- ~ 59% by coal
- ~ 2% by nuclear
- ~ 0.5% by diesel
- ~ 13% by renewables
- ~ 16.5% by hydroelectric projects

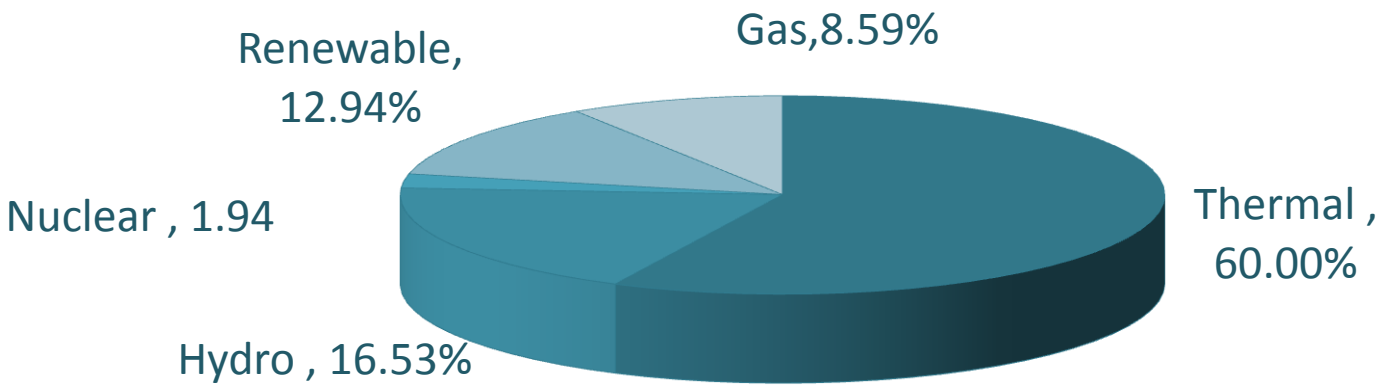
Energy supply by different sources - India installed capacity (MW)



(Source: Annual Report MNRE, 2015)

Indian Power Sector at a Glance

Total installed capacity : 2,50,989 MW



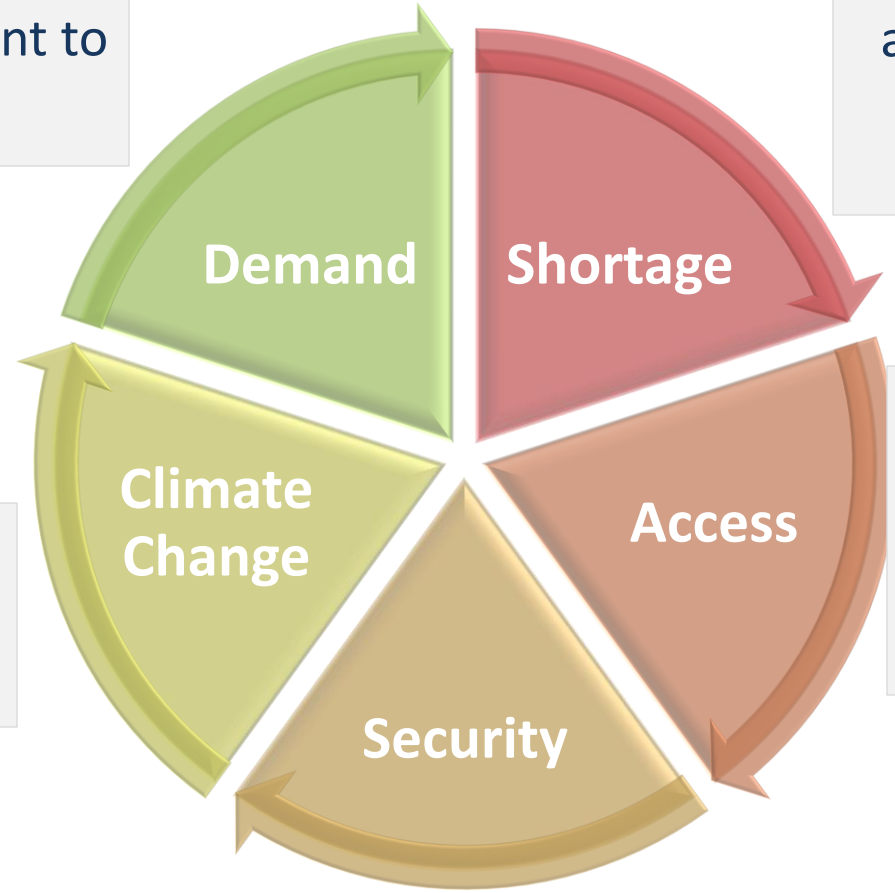
Thermal	Hydro	Gas	Renewable	Nuclear
1,50,379	40,798	22,607	32,425	4780

- **Renewable contributes 32,425 MW – 12.94%**
- **If we take large hydro under RE – 30%**

India's Energy Challenges

In next 12 years India's electricity requirement to grow 2.5 times

Peak shortage of 2% and energy shortage of 5.1% is expected (2014-15)*



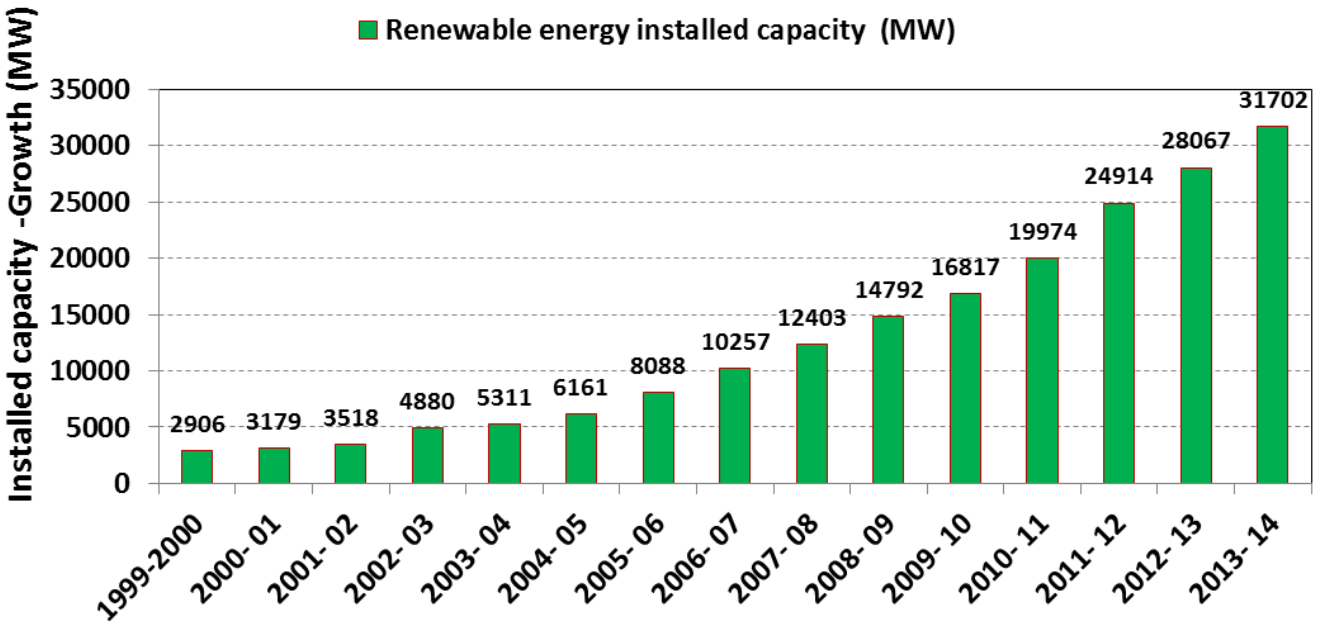
300 Million people did not have access to electricity as per the 2011 census *

Climate Change is also an important issue

India was dependent on oil imports for 71% of its demand in 2012*

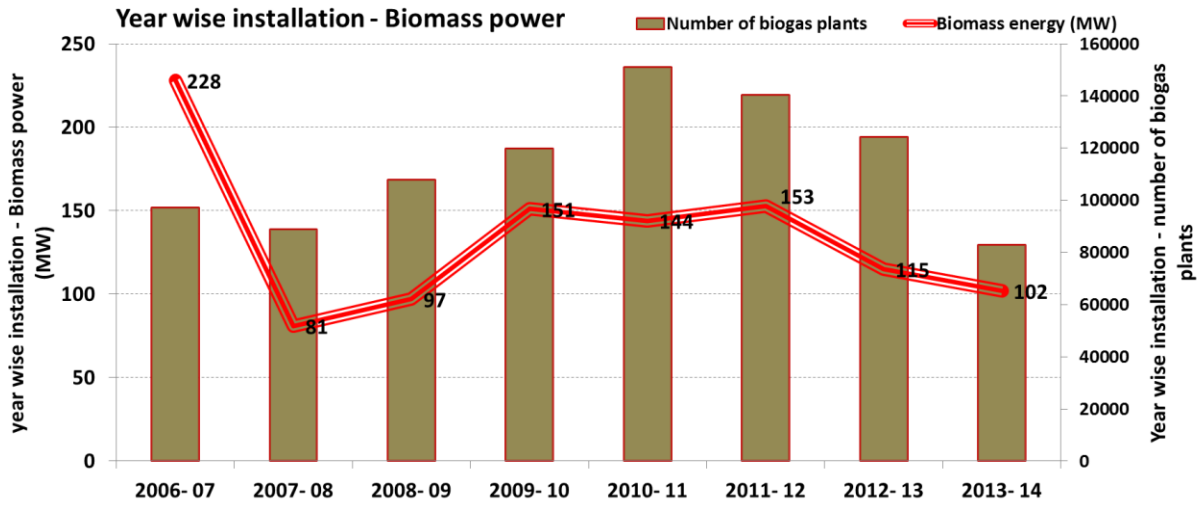
*Source: http://www.eia.gov/countries/cab.cfm?fips=in; **Source: http://www.cea.nic.in/reports/yearly/lgbr_report.pdf

RENEWABLE ENERGY STATUS IN INDIA



Large contributions from wind and solar energy

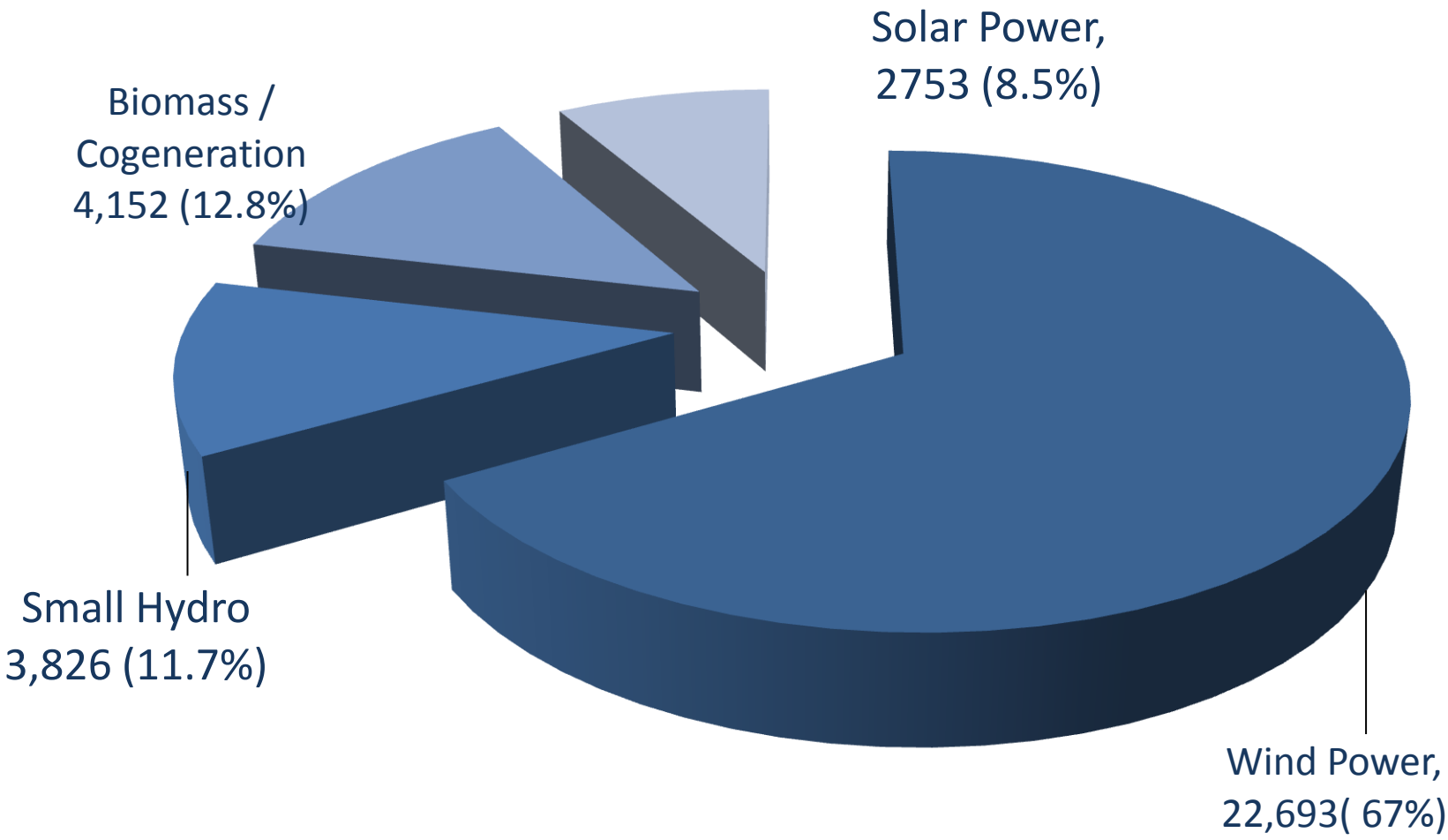
BIOMASS ENERGY YEAR WISE INSTALLED CAPACITY



(Source: Annual Report MNRE, 2015)

Present Status-Renewable Energy

Total Installed capacity 32,425 MW



Renewable Energy: Credentials

- **Harnessed 11% of the estimated potential**
- **5th Position in overall RE Capacity Installations world-wide**
- **5th largest Wind installed capacity world-wide**
- **2nd largest number of installed Biogas plants**
- **6 million decentralized systems in use**
- **Renewable is the second largest source of power generation after thermal.**

Government Support for Renewable energy Projects

- Favorable policy frameworks set by central and state governments to facilitate RE projects, such as:
  - **Provisions in the Electricity Act 2003**
- **Open access to grid for RE power**
- **Preferential tariffs by State regulators**
- **RE Power Obligations**
- **Captive generation decontrolled**
  - FDI up to 100% permitted in RE generation and distribution projects under the automatic route
  - Transfer of foreign technologies encouraged
  - Incentives offered:
    - Capital subsidies, including for biomass and small hydro projects
    - Preferential tariffs, Feed-in-Tariffs (FiTs)
    - Generation-based incentives and tax benefits
    - Payment security mechanisms

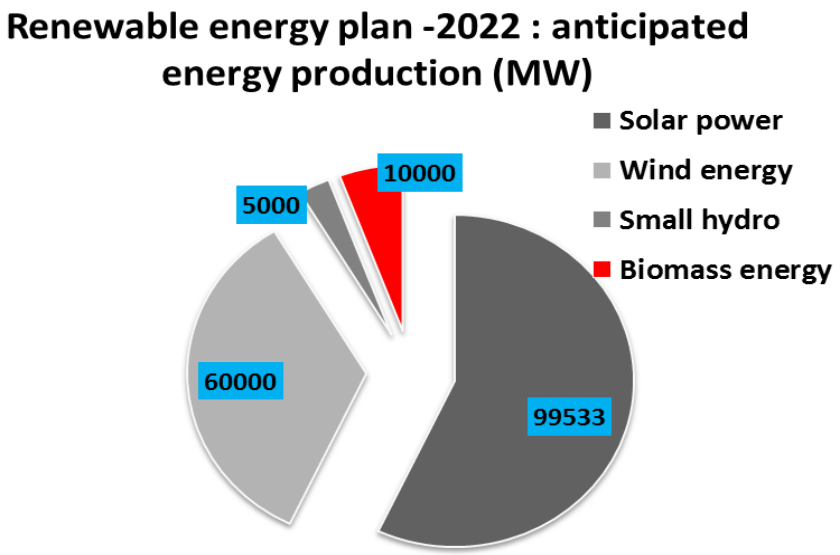
NATIONAL INITIATIVES FOR RENEWABLE ENERGY

RENEWABLE ENERGY PLAN – 2022

Target - 1,75,000 MW

99533 MW(~57%) - solar
60000 MW (~34%) - wind energy
5000 MW (~3 %) - small hydro
10000 MW (~6%) Biomass Energy

(Source: Annual Report MNRE, 2015)



Biomass potential (Crop residue), Million Ton

Available - 686
Surplus - 234

Source: Hiloidhari *et al.*, 2014

RENEWABLE ENERGY INSTITUTIONS IN INDIA
under
Ministry of New and Renewable Energy, Govt. of India

NATIONAL INSTITUTE OF SOLAR ENERGY

- R&D institution in the field Solar Energy

NATIONAL INSTITUTE OF WIND ENERGY

- R&D institution for wind energy sector

SARDAR SWARAN SINGH NATIONAL INSTITUTE OF RENEWABLE ENERGY

- R&D institution marching towards development into a centre of excellence in the biomass and bio-energy

ALTERNATE HYDRO ENERGY CENTRE

- to promote power generation through Small Hydropower projects

INDIAN RENEWABLE ENERGY DEVELOPMENT AGENCY

- Financial Institution under MNRE for providing term loans for renewable energy and energy efficiency projects

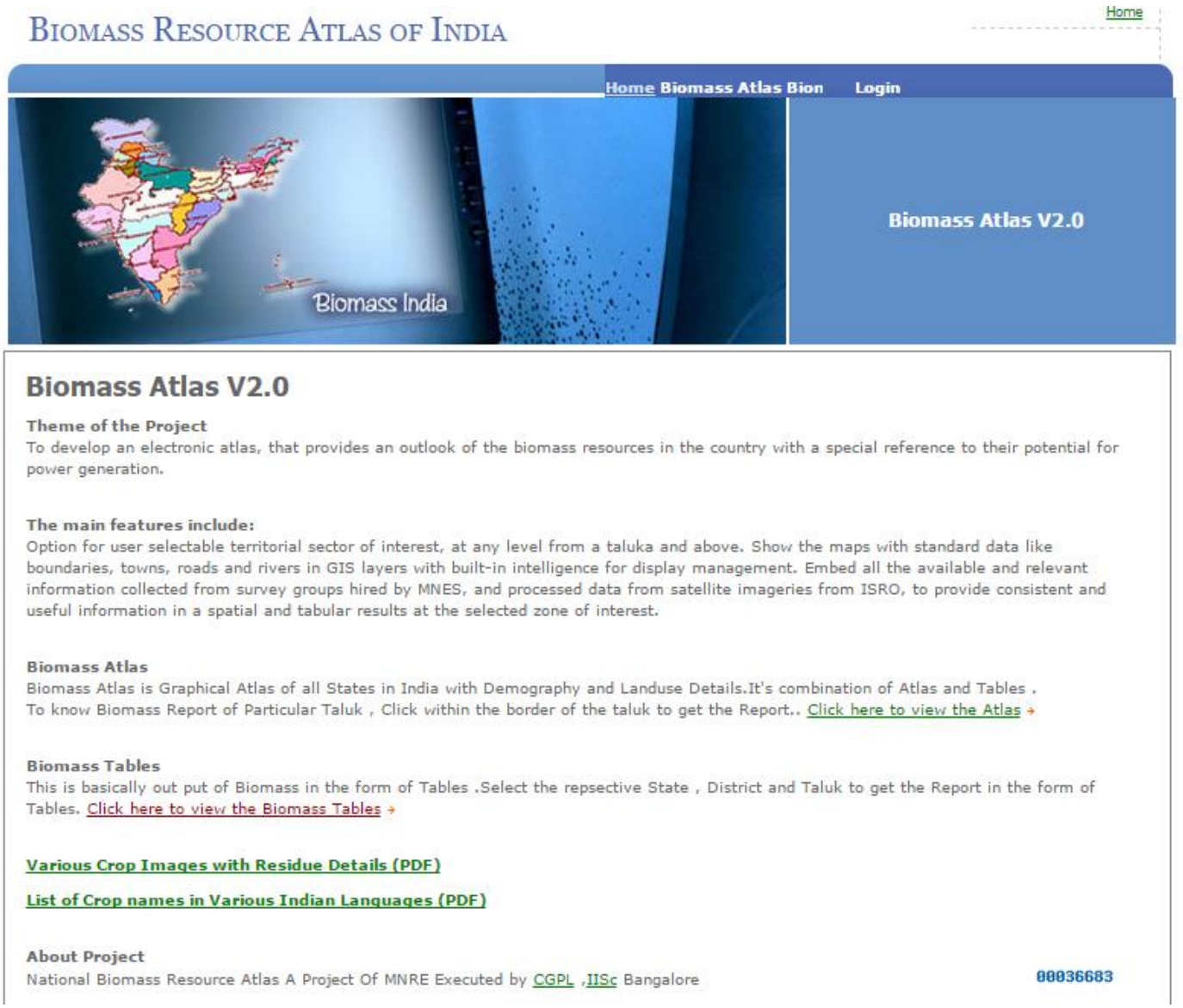
SOLAR ENERGY CORPORATION OF INDIA

- Research and Development including solar resource assessment

The Biomass Assessment Programme

- To develop a digital biomass atlas for at National level to get an estimate on the Biomass Resources and its potential for Power Generation to be used by:
  - Energy Consultants, Investors & Entrepreneurs
  - Administrators & Financial Organizations
- Mapping of Biomass from Agro, Forest & Wasteland with an advanced feature of recognizing Biomass Surplus concentration centers using an image generated for each district with a predefined color gradient based on the Energy-useful Biomass Production index generated.
- To enable access of the atlas and data for users on internet for quick look.

Biomass Resource Assessment in India



Remarks on Biomass Atlas

- The mapped biomass resource atlas is hosted on a internet site and is available for an end user to access from his end anywhere.
- The usage of the atlas has been reasonable both by the power plant entrepreneurs and administrators in decision making.
- Expansion of the data sets and features are on the way for a better usage in the time to come.

Biomass from Forest & wasteland In India

State	Area (kHa)	Biomass Generation (kT/Yr)	Biomass Surplus (kT/Yr)	Power Potential (MWe)
Andhra Pradesh	3623.9	5151.6	3484.4	487.8
Arunachal Pradesh	5467.4	8313.1	6045.3	846.3
Assam	2676.8	3674.0	2424.2	339.4
Bihar	906.0	1248.3	831.9	116.5
Chhattisgarh	8762.1	13592.3	9065.8	1269.2
Goa	153.4	180.7	119.3	16.7
Gujarat	9030.3	12196.3	8251.8	1155.2
Haryana	294.7	393.3	259.6	36.3
Himachal Pradesh	2259.8	3054.6	2016.0	282.2
Jammu & Kashmir	9838.0	11461.7	7564.7	1059.1
Jharkhand	3506.8	4876.6	3249.8	455.0
Karnataka	6993.7	10001.3	6600.8	924.1
Kerala	1235.4	2122.1	1429.1	200.1
Madhya Pradesh	12802.2	18398.2	12271.2	1718.0
Maharashtra	13177.4	18407.1	12440.4	1741.7
Manipur	1260.9	1264.0	834.2	116.8
Meghalaya	1532.6	1705.9	1125.6	157.6
Mizoram	1638.8	1590.9	1050.0	147.0
Nagaland	786.4	843.8	556.9	78.0
Orissa	6265.0	9370.2	6084.8	851.9
Punjab	229.1	398.5	263.0	36.8
Rajasthan	14135.0	9541.6	6297.5	881.6
Sikkim	372.8	531.5	350.8	49.1
Tamilnadu	3187.2	4652.4	3070.6	429.9
Tripura	831.0	1035.5	683.4	95.7
Uttar Pradesh	3856.5	5478.4	3672.0	514.1
Uttaranchal	2885.5	4559.2	3055.3	427.7
West Bengal	1113.9	1430.7	949.0	132.9
Total	**118822.9**	**155474.0**	**104047.4**	**14566.6**

(Source: Biomass Resource Atlas of India, 2000-04)

Agriculture based Biomass In India

State	Area (kHa)	Biomass Generation (kT/Yr)	Biomass Surplus (kT/Yr)	Power Potential (MWe)
Andhra Pradesh	9983.2	43893.2	6956.4	863.3
Arunachal Pradesh	208.5	400.4	74.5	9.2
Assam	3460.3	11443.6	2346.9	283.9
Bihar	7348.7	25756.9	5147.2	641.1
Chhattisgarh	4758.2	11272.8	2127.9	248.5
Goa	154.2	668.5	161.4	20.9
Gujarat	8007.6	29001.0	9085.5	1224.8
Haryana	5707.3	29034.7	11342.9	1456.9
Himachal Pradesh	788.3	2896.9	1034.7	132.6
Jammu & Kashmir	749.4	1591.3	279.6	37.1
Jharkhand	1850.3	3644.9	890.0	106.7
Karnataka	9683.6	34167.3	9027.2	1195.7
Kerala	2306.8	11644.3	6352.1	864.4
Madhya Pradesh	13167.3	33344.8	10329.3	1373.3
Maharashtra	18851.5	47624.8	14789.6	1983.7
Manipur	340.8	909.4	114.4	14.3
Meghalaya	174.4	511.1	91.6	11.3
Mizoram	19.0	61.1	8.5	1.12
Nagaland	179.6	492.2	85.2	10.0
Orissa	6667.6	20069.5	3676.8	429.3
Punjab	6993.5	50847.6	24842.9	3172.2
Rajasthan	14851.4	29851.3	8645.7	1126.7
Sikkim	58.0	149.5	17.8	2.29
Tamilnadu	4165.1	22507.6	8900.0	1160.0
Tripura	9.5	40.9	21.1	2.94
Uttar Pradesh	15950.9	60322.2	13737.9	1746.2
Uttaranchal	1015.7	2903.2	638.4	80.9
West Bengal	6090.2	35989.9	4301.5	529.3
Total	**143540.9**	**511041.0**	**145026.6**	**18728.7**

(Source: Biomass Resource Atlas of India, 2000-04)

Biomass Resources in India


Agro residue


Agro-Industrial residue

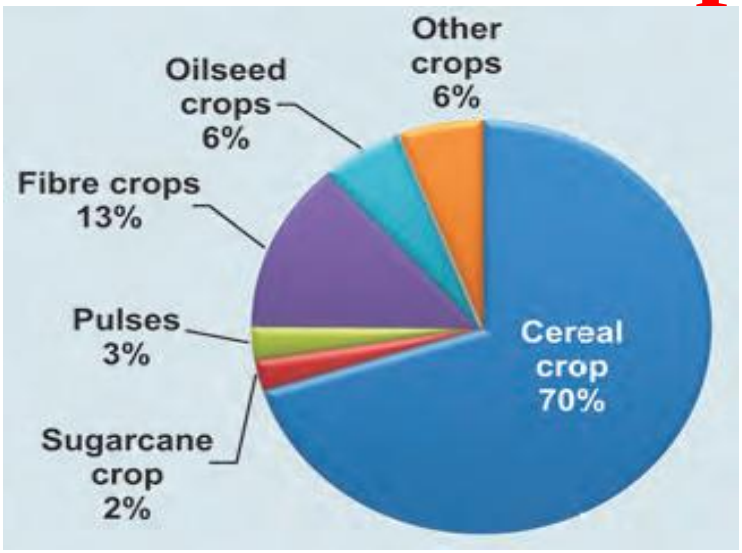

Energy Plantation


Forest residue

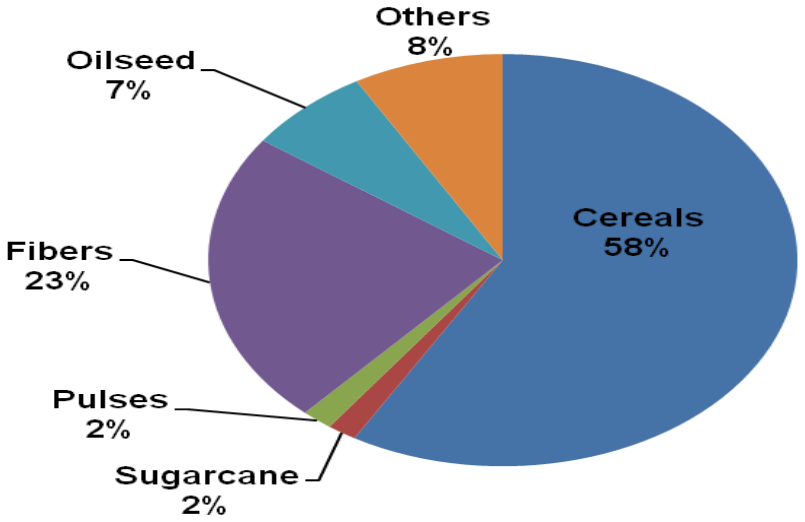
Dimensions of Bio-energy

- Surplus biomass: 200 MT/Year biomass + bagasse + urban and industrial wastes
- Bio-energy potential: 17000+5000+4000 MW
- Value of biomass: Rs 1500 to 2000 / tonne
  (Processed biomass offers even more)
- Benefit to rural economy : Rs 1.50 to 2.00 cr/MW
- Employment - About 200 M man-days / Year

Crop Residues



Residue generation by different crops in India (MNRE report, 2009)



Surplus of various crop residues in India (MNRE report, 2009).

➢ **Production of agricultural crop residues: 650MT/Annum**

- **Wheat straw**
- **Rice straw**
- **Sugar cane trash**
- **Cotton stalks**
- **Mustard stalks**

Total: 92.81 MT Burnt

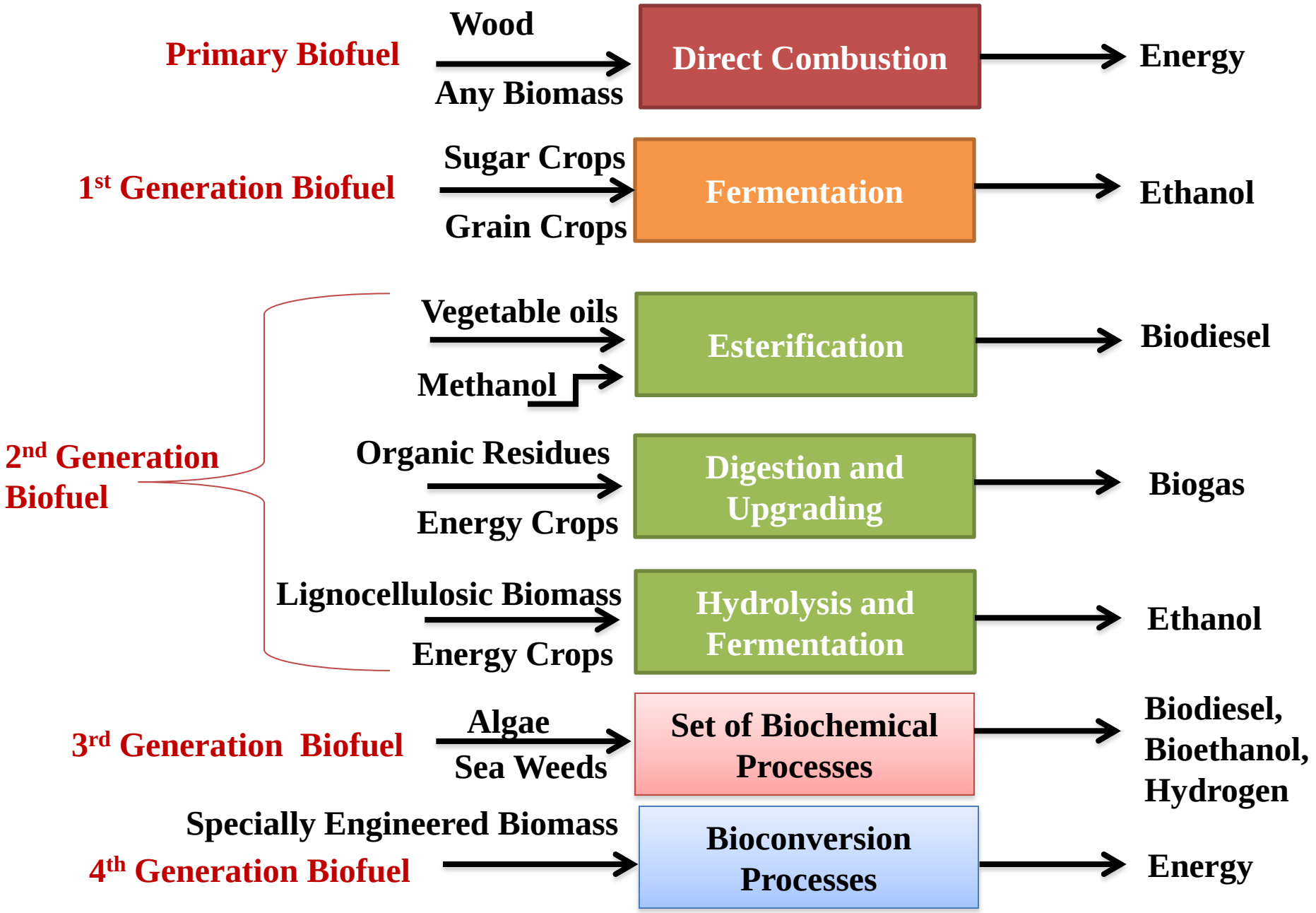
Uncontrolled burning of rice straw (Punjab)

The smoke screen (Pb)

The charred field (Pb)

Cotton stalks on fire (Gujarat)

Biomass Utilization Spectrum



Biomass: A Competitive Fuel

Biomass has several advantage but it is a competitive fuel

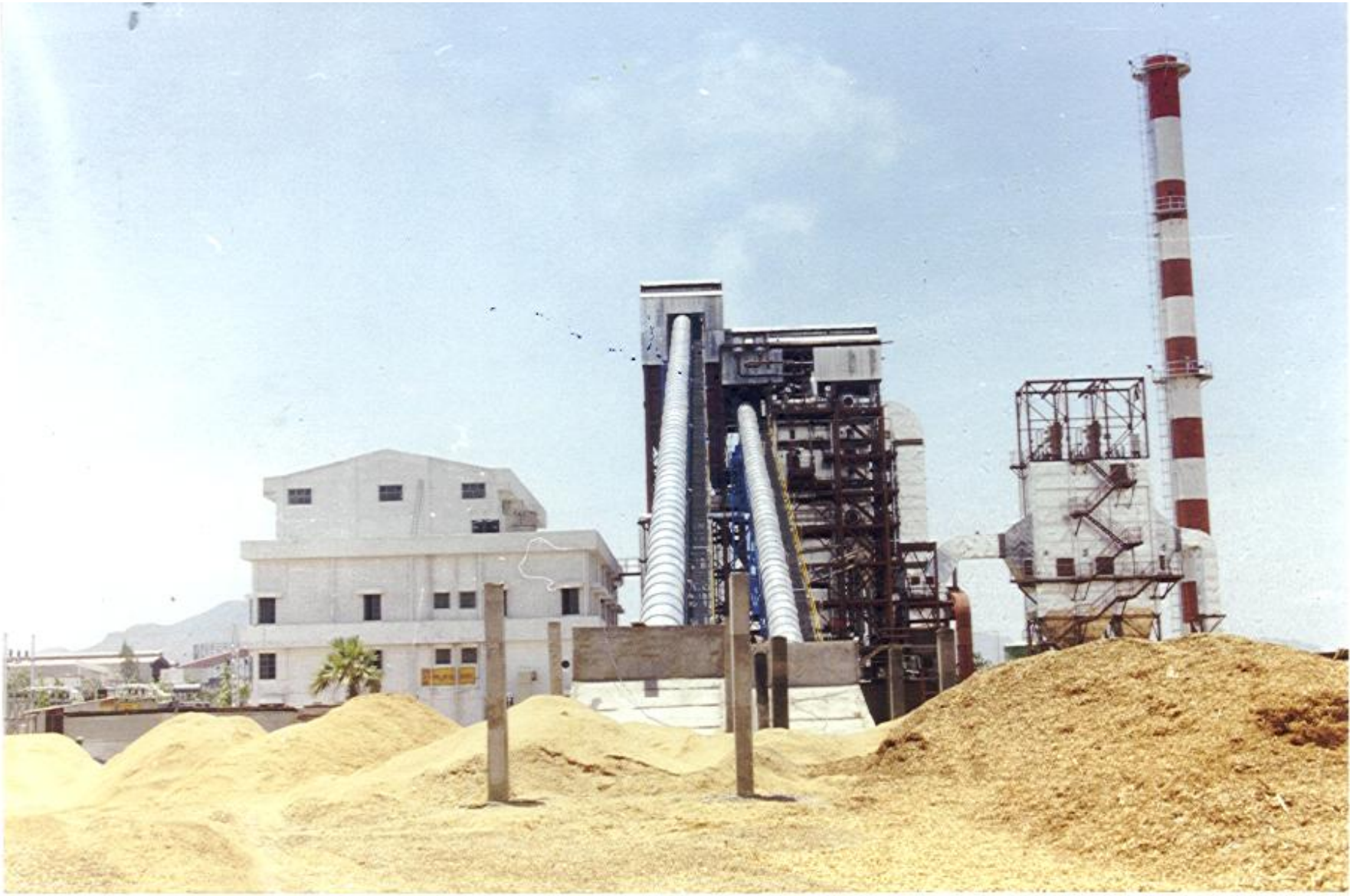
It requires necessary planning

Barriers to the promotion of biomass energy use are:

The lack of an efficient and cost-effective supply chain system (harvesting, transportation, and delivery of biomass resources)

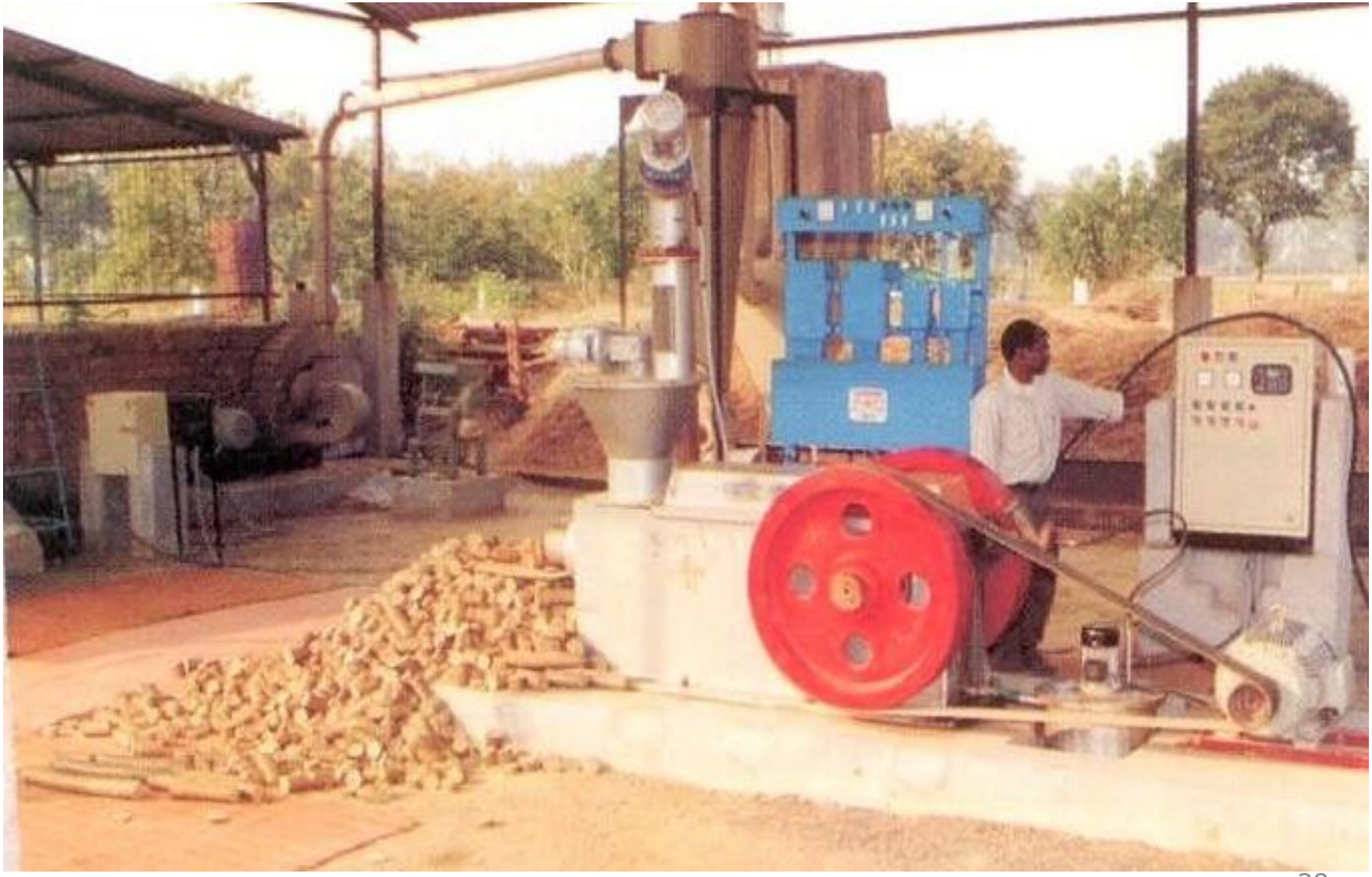
If each step of bioenergy chain is not optimised the final cost of produced energy may not result to be competitive in comparison with energy from traditional fossil fuel.

Biomass Power Project In A.P.



24 MW Bagasse Cogeneration Project In Karnataka

Biomass Briquetting

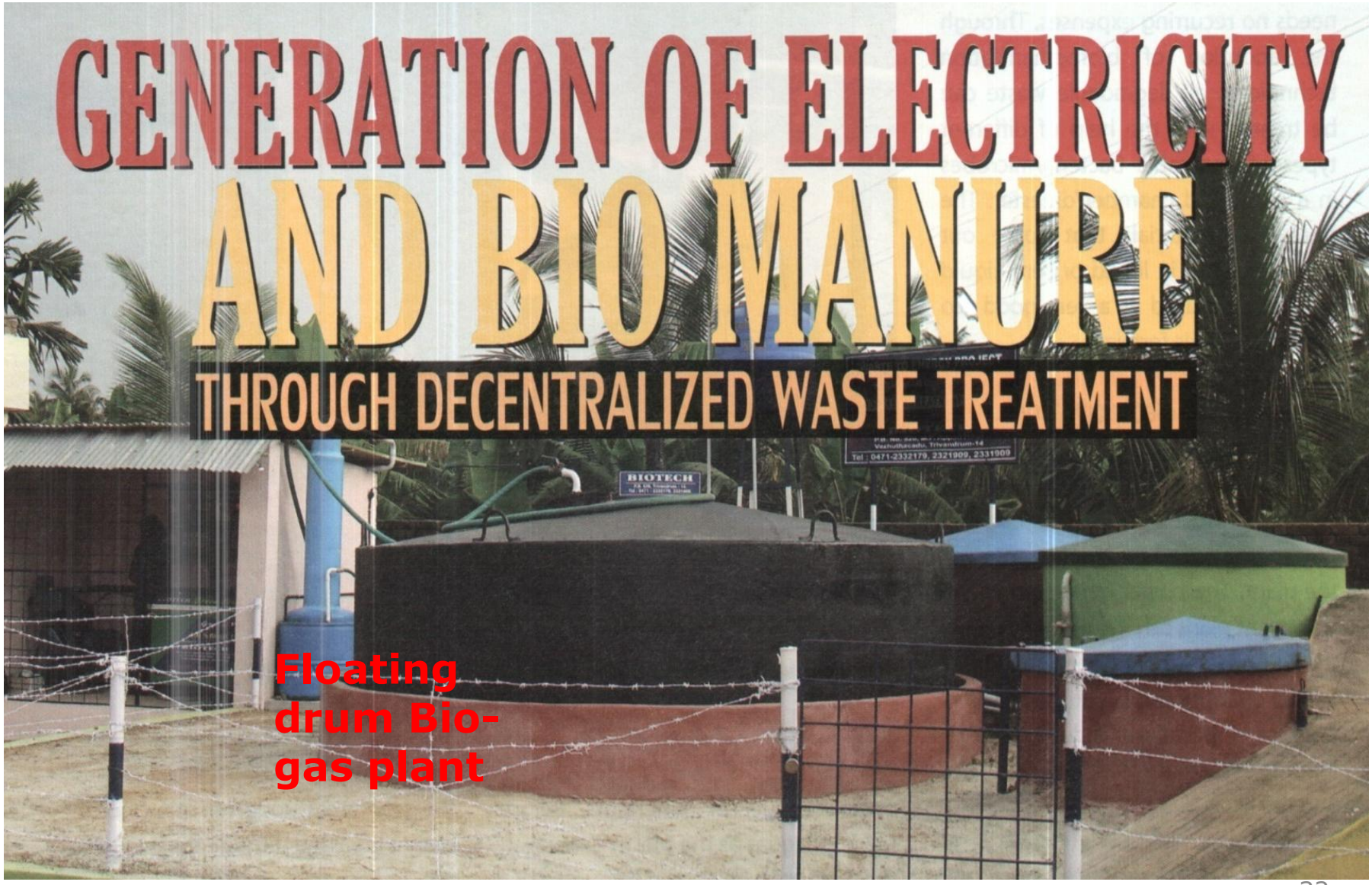


Gasifier for Village Electrification

Thermal applications of gasifiers in industries

1.0 MW power project based on cattle dung at a Dairy Complex Ludhiana, Punjab

Solid Waste Based Bio-gas Plant



Various Bio-crudes and Distillates Fractions

Biocrude

Liquid bio-fuel distillates obtained from Hydroprocessing of vegetable oils and TBP distillation.

Gasoline

Aviation turbine Fuel

Diesel

Lube oil

Wax

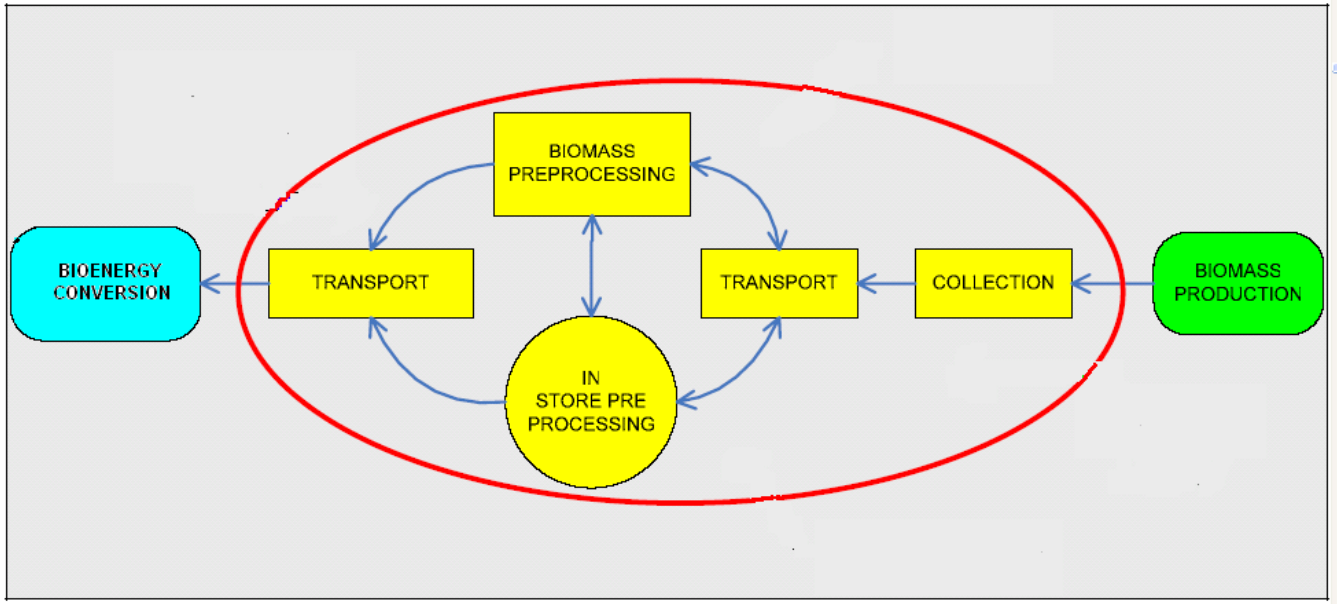
Bitumen

Supply Chain Assessment

The supply biomass chain is constituted by a sequence of activities from biomass resource to energy conversion.

The activities are:

- Harvesting
- Transportation
- Storage
- Pre-processing
- Transportation
- Energy conversion



Careful supply chain planning and logistics management will be of central importance to the success of the biomass industry.

Planning Biomass Energy Resources

Biomass resource assessment

- **Identify how much total biomass, how much surplus biomass is available, where it is located, its characteristics and the cost**

Supply chain system assessment

- **Establish a supply chain to deliver biomass to final use in a efficiently and economy way**

Best locations for a potential biomass conversion to energy site

- **Correct plant dimension must be considered according to the demand and the supply in the area**
- **Logistics chains are established to link energy demand and biomass supply**

Evaluate the economical and environmental impacts of biomass use

Analyze the different biomass energy technologies

Challenges of Biomass Energy in India

- Periodic and limited availability
- Enhancing capacity for growth
- Managing the environment
- Markets for efficiency and inclusion
- Decentralization, Empowerment and Information
- Technology and innovation
- Improved access to Quality Education
- Rural Transformation and Sustained Growth of Agriculture
- Securing the energy future for India

NEED

Policy decisions

- **to earmark surplus biomass for producing biofuels**

Research and Development

- **to culminate in the design, construction and implementation**
- **to expertise and experience in relevant aspects**
- **to ensure an end to end approach.**

Technological Advancement

- **Biomass to biofuels**

Comprehensive evaluation

- **to guide, coordinate and monitor**
- **costs and energy balance**

Improving Indian Bioenergy Sector

Strategies

- Government framework that incentivises supply chain measures for sustainable biomass production and utilization of crop residues
- Comprehensive policy approach and support mechanisms like incentives/subsidies

Research and Development

- R&D for better water resistant biomass varieties and moderate establishment costs considering geo-climatic features of the country
- Need to research investments to develop multiple feed stock, energy efficient technologies
- More research efforts are required through demonstration plants outside controlled lab environment.

Improving Indian Bioenergy Sector

Finance and administration

"Fast Track" system should be in place of to deal with regulatory and administrative concerns

Better financial services to support industries & co-ordination at different administrative levels to support this bioenergy sector.

Regulations

Need stringent regulations for newly installing agro-industries to avoid landfill and to use agro-industrial residues as a biomass source to produce energy

Policymakers should carefully consider about regional fodder stock and buffer stocks of biomass for animals before authorising biomass based industries at local scale

Proper calculation on regional availability of agricultural residue before authorising new electricity generating plants

Improving Indian Bioenergy Sector

Encouragements

Stringent framework policies to be there to encourage waste-to-energy plants with state-of-art conversion approach

Mechanism to separate biodegradable fraction of municipal and industrial waste across urban areas and industrial locations

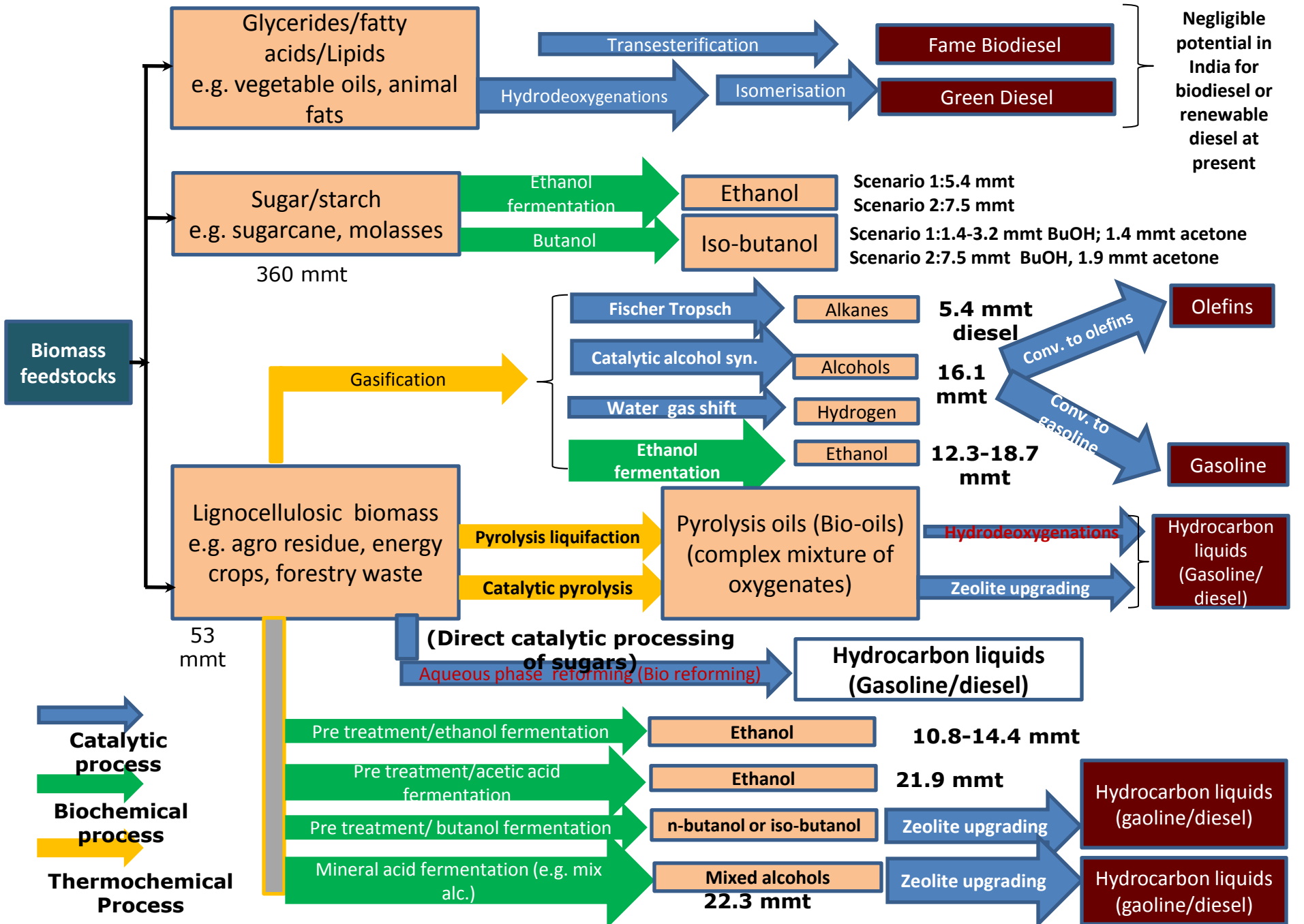
Private sector involvement to tackle technological challenges in straw-based and crop residue supply chain

Society

It is high time for urban areas to move on from the ‘dumping sites’ and landfills to notion of source separation of MSW and anaerobic digestion at community level

Needs to change its mind set on municipal waste disposal

ROAD MAP FOR BIOREFINERY



Sun is the only giant source of all forms of energy in the solar system, and renewable energy is the only sustainable energy in our globe which is solely dependent on sun and can save the earth and environment.