

## CHAPTER - 3

# NON-CONVENTIONAL ENERGY

### AFRICA (WARM)

#### HYDRO POWER IN INDIA

##### Overview

- India has one of the world's largest potential for hydro electric power. The hydro power potential in India is around 84,000 MW at 60% load factor (installed capacity 148,000 MW). However, less than 20% of this has been harnessed so far.
- Currently, hydro power contributes about 24% of total installed generation capacity in the country.
- The oldest hydro electric power plant in Asia is the Sidrapong Hydel Power Station in Darjeeling. Its installed capacity was 130 kW and was commissioned in 1897.
- The largest hydro electric power project in India is the 2000 MW Subansiri Lower Hydroelectric Project (Assam- Arunachal Pradesh border). Located across the Subansiri river, the project is currently under construction and is expected to be commissioned in 2012.
- The Brahmaputra river basin has the largest possible capacity for hydro power in India (66,000 MW)
- The advantages of hydro power include
  - Non polluting
  - Long life of projects
  - Low cost of operation and maintenance
  - Ability to start and stop quickly ot meet load demand
  - Much higher efficiency than thermal power

##### Possible hydro power generation by river basins

River Basin	Potential installed capacity (MW)
Indus Basin	33,832
Ganges Basin	20,711
Brahmaputra Basin	66,065
Central Indian river System	41,152
Western flowing rivers of peninsular India	9,430
Eastern flowing rivers of peninsular India	14,511
Total	1,48,701

##### National Hydroelectric Power Corporation (NHPC)

- Established 1975, headquarters Faridabad
- The NHPC functions under the Ministry of Power
- Primary objective of the NHPC is to plan and promote efficient development of hydroelectric power in the country.

- The NHPC has also diversified into other energy sources such as geothermal, wind, tidal etc
- The NHPC has been conferred Mini Ratna Category I status by the Ministry of Public Enterprises
- In addition to executing 13 projects in India, the NHPC has also commissioned two projects in Nepal and Bhutan
- Currently, 11 hydro power projects are under construction in India by the NHPC

#### Important Hydro Power Projects

S. No.	Project	River	State	Capacity
1.	Birla Siul	Baira, Siul, Bhaledh (All tributaries of Ravi)	Himachal Pradesh	180 MW
2.	Chamera I	Ravi	Himachal Pradesh	540 MW
3.	Chamera II	Ravi	Himachal Pradesh	300 MW
4.	Dhauliganga	Dhauliganga (tributary of Sharda)	Uttrakhand	280 MW
5.	Dulhasti	Chandra (Tributary of Chenab)	Jammu and Kashmir	390 MW
6.	Indira Sagar	Narmada	Madhya Pradesh	1000 MW
7.	Loktak	Loktak lake	Manipur	90 MW
8.	Omkareshwar	Narmada	Madhya Pradesh	520 MW
9.	Rangit	Rangit	Sikkim	60 MW
10.	Salal	Chenab	Jammu and Kashmir	690 MW
11.	Tanakpur	Sharda	Uttarakhand	120 MW
12.	Teesta V	Teesta	Sikkim	510 MW
13.	Uri I	Jhalum	Jammu and Kashmir	480 MW
14.	Baglihar	Chenab	Jammu and Kashmir (Doda dist.)	450 MW
15.	Nathpa Jhakri	Sutlej	Himachal Pradesh	1530 MW

#### Hydro power Projects under construction

S.No.	Project	River	State	Capacity	Expected Commissioning
1.	Chamera III	Ravi	Himachal Pradesh	230 MW	2010
2.	Chutuk	Suru	Jammu and Kashmir (Kargil dist.)	44 MW	2011
3.	Kishanganga	Kishanganga (tributary of Jhelum)	Jammu and Kashmir (Baramulla dist.)	330 MW	2016
4.	Nimmo Bazgo	Indus	Jammu and Kashmir (Leh dist.)	45 MW	2010
5.	Parbati II	Parbati	Himachal Pradesh	800 MW	2013
6.	Parbati III	Parbati	Himachal Pradesh	520 MW	2010
7.	Sewa II	Sewa (tributary of Ravi)	Jammu and Kashmir (Kathua dist.)	120 MW	2009

8.	Subansiri (Lower)	Subansiri	Arunachal Pradesh	200 MW	2012
9.	Teesta III	Teesta	West Bengal (Darjeeling dist.)	132 MW	2011
10.	Teesta IV	Teesta	West Bengal (Darjeeling dist.)	160 MW	2011
11.	Uri II	Jhelum	Jammu and Kashmir (Baramulla dist.)	240 MW	2011

#### Policy on Hydro Power Development

- The Policy on Hydro Power Development was launched 1998
- The main objectives on the Policy include
  - Meeting current targets for capacity addition
  - Accelerating use of hydroelectric potential at a faster
  - Promoting small and mini hydro electric projects
  - Strengthening the role of PSUs/SEBs for taking up new hydro projects
  - Increasing private investments
- The nodal agency for implementing the Policy is the Ministry of Power

#### RENEWABLE ENERGY IN INDIA

##### Overview

- Renewable energy in India currently contributes around 7.7% of total electricity generation in the country. The installed capacity is around 13,000 MW
- India was one of the first countries in the world to establish a separate ministry for non-conventional energy resources (1980s) however, progress has been slow
- Renewable energy in India comes under the purview of the Ministry of New and Renewable Energy.
- The largest contributor to renewable energy in India is Tamil Nadu (about 33%), largely from wind power
- India ranks first in the world (along with USA) in annual solar power generation. It also ranks fifth in wind power generation.

#### SOLAR POWER IN INDIA

##### Overview

- India (along with USA) ranks number one in solar power generation in world. However, it still only contributes about 0.4% of total electricity generation in the country.
- India's high population density and high solar insolation provide an ideal combination for solar power india.
- Solar insolation is a measure of the solar energy received on a given surface area in a given time. It is usually expressed in W/Sq. m.
- In 2009, the Government unveiled a plan to generated 20,000 MW of solar power by 2020. Under the plan solar powered equipment and applications would be mandatory in all government buildings
- Presently solar power is primarily advocated in villages for water pumps, replacing the millions of diesel powered water pumps. Since the villages are not integrated into the power grids, stand-alone solar units are especially helpful
- About 35,000 sq km of the Thar Desert has been set aside for solar power projects.

### Annual insolation

- With about 300 clear sunny days per year, India has among the highest solar insulations in the world
- India receives about 600 TW of solar energy on its land area every year.
- The daily average solar insolation is 4-7 kWh/sq m, which is far more than current total energy consumption
- With such a high solar insolation, even with just 10% conversion efficiency, solar energy will be thousand times greater than electricity demand by 2015
- Rajasthan receives the highest annual solar radiation and the north eastern states receive the least
- 35,000 sq km of Thar Desert has been set aside for solar energy. The first solar power project in the area is under construction by Astonfield Soare Pvt. Ltd. It is expected to be commissioned in 2010

### Applications and Challenges

- Solar power is primarily used in stand-alone applications in rural areas, which are not connect to the power grid
- Solar power is used for rural electrification, for water pumping, harvest processing, refrigeration of produce, water heaters etc
- The biggest challenges to the growth of solar power in India include
  - Prohibitive cost: solar power is still prohibitively expensive, especially the manufacture of photovoltaic cells that convert light energy into electrical energy.
  - Land scarcity: large scale solar energy generation requires large areas of land dedicated to the installation of solar photovoltaic panels. This could be challenging in urban areas with high population densities

## WIND POWER IN INDIA

### Overview

- India has the fifth largest installed wind power generation capacity in the world
- Wind power accounts for about 6% of total electricity generation in the country (about 11,000 MW). It is expected that a further 6000 MW of installed capacity will be added by 2012
- Tamil Nadu contributes the maximum wind power generation (about 4000 MW)
- Suzlon Energy, based in Pune, is the largest wind turbine manufacturer in Asia and the fifth largest worldwide
- Among the advantages of wind power include the short gestation periods and increasing reliability and performance of wind turbines

### Wind power in various states

State	Capacity	Main wind farms	Notes
Tamil Nadu	4301 MW	Tirunelveli Dist.	Muppandal wind farm is largest in Asia Tamil Nadu Generates maximum wind power in India
Maharashtra	1942 MW	Satara Dist.	
Gujarat	1565 MW	Kutch Dist. Rajkot dist.	
Karnataka	1340 MW	Chitradurga Dist Gadag dist	

## Challenges

- Challenges faced by wind power include greater capital cost than conventional energy sources, noise produced by rotor blades, television interference etc.
- Wind power is also restricted geographically and is not usually feasible in urban areas

## BIOFUELS IN INDIA

### Overview

- Biofuel development in India is primarily focused on *Jatropha* plant seeds
- The *Jatropha curcas* is a flowering plant whose seeds contain about 35% oil. This oil can be processed to obtain high quality biodiesel for use in regular diesel engines
- The use of *Jatropha* for biodiesel generation has multiple benefits
  - *Jatropha* is easily grown in dry and non-agricultural lands, thereby allowing villagers to use non-farmland for income generation
  - It reduces the nation's dependence on fossil fuels. This is especially important because India needs to import a vast majority of fossil fuels from abroad
  - Since *Jatropha* is carbon-neutral it helps the country achieve better carbon emissions targets
  - Since no producing farmland is needed for *Jatropha* (unlike corn or sugarcane ethanol or palm oil diesel), it is considered the best option for biodiesel generation
  - *Jatropha* has no known negative impact on the production of food crops. Other biodiesel crops (like corn ethanol) have caused serious price increases in basic food crops since they take up valuable agricultural land

### Application of biodiesel

- Biodiesel based on *Jatropha* already meets EU norms for biodiesel quality, without any extra processing
- *Jatropha* biodiesel has been used as aviation fuel on an experimental basis by Air New Zealand in 2008
- The Indian Railways has started using *Jatropha* biodiesel to power its diesel engines on an experimental basis. Currently, the diesel locomotives in the Tranjore Nagore, Trichy-Lalgudi-Dindigul-Karur sections run on a blend of *Jatropha* and diesel oil

## GOVERNMENT BODIES IN RENEWABLE ENERGY

All bodies function under the Ministry of New and Renewable Energy unless otherwise noted

### Solar Energy Centre (SEC)

- Established 1982; located Delhi
- The SEC serves as an interface between the Government and institutions and industries for the development of solar energy
- Functions of the SEC include
  - Research and development
  - Technology evaluation, testing and standardisation
  - Advisory and consultancy services

### Centre for Wind Energy Technology (C-WET)

- Established 1998, location Chennai
- The C-WET serves as the technical focal point for wind power development
- Functions of the C-WET include
  - Offer services and solutions for wind power harnessing
  - Research and development
  - Testing and evaluation

### **Sardar Swaran Singh National Institute of Renewable Energy (SSS-NIRE)**

- Currently under construction
- Location Kapurthala (Punjab)

### **Indian Renewable Energy Development Agency (IREDA)**

- Established 1987, located New Delhi
- The main objective of the IREDA is to provide financial support to projects and schemes for electricity generation using reneration using renewable sources

### **POLICIES AND PROGRAMMES**

All schemes implemented by the Ministry of New and Renewable Energy unless otherwise moted

#### **National Policies on Bifuels**

- Approved in Dec 2009
- Implemented by the Ministry of New and Renewable Energy
- Salient features of teh policy include
  - By 2017, 20% of diesel consumption to be met by biofuel blends (includes bioethanol and biodiesel)
  - Biodiesel production to be taken up in waste/non-agricultural lands
  - Biodiesel plantations on community/government waste lands to be encouraged. Plantations on agriculutal lands to not be encouraged
  - Minimum Support Price (MSP) to be announced for biodiesel oil seeds
  - No taxes or duties to be levied on biodiesel
  - National Biofuel Coordination Committee chaired by the Prime Minister to be created. Biofuel Steering Committee to be chaired by Cabinet Secretary to also be created

#### **Remove Village Electrification Programme (RVEP)**

- The RVEP is a programme that times to provide electricity for remote villages through renewable sources
- The programme covers those remote villages and hamlets which are not covered under the Rajiv Gandhi Gramin Vidyutikaran Yojana (RGGVY). These are usually remote areas where grid connectivity is either not feasible or not cost effective
- The RVEP is a component of the Rural Electrification Policy, which seeks to provide electricity to all households by 2009
- The scheme covers multiple technology for electrification of these remote areas
  - Small hydro power plants
  - Biomass power generation
  - Vegetable oil based engines
  - Biogas based engines
  - Solar energy

#### **National Biogas and Manure Management Programme (NBMMP)**

- Established in 1982
- Aims to facilitate setting up of family type biogas plants
- The objectives of the NBMMP include
  - Provide fuel for cooking purposes and organic manure to rural households through family type biogas plants

- To mitigate drudgery of women and reduce pressure on forest resources
- To improve sanitation in villages by linking sanitary toilets with biogas plants
- The programme is implemented by the Khadi and Village Industries Commission (KVIC) in conjunction with state governments
- A total of 3.93 million family type biogas plants have been set up in the country against an estimated potential of 12 million

#### **Akshay Urja Shops**

- The Akshya Urja Shops is a programme to establish commercial shops for sales and service of renewable energy devices and systems
- So far 297 Akshay Urja Shops have been established in various states
- The programme initially started as the Aditya Solar Shops and covered only solar power but has now been expanded to include all renewable energy (and name change accordingly)
- The primary objective of the scheme is to make renewable energy products easily available and provide after sales service and repair
- The scheme provides financial assistance to entrepreneurs for establishment of shops by means of loans and grants.