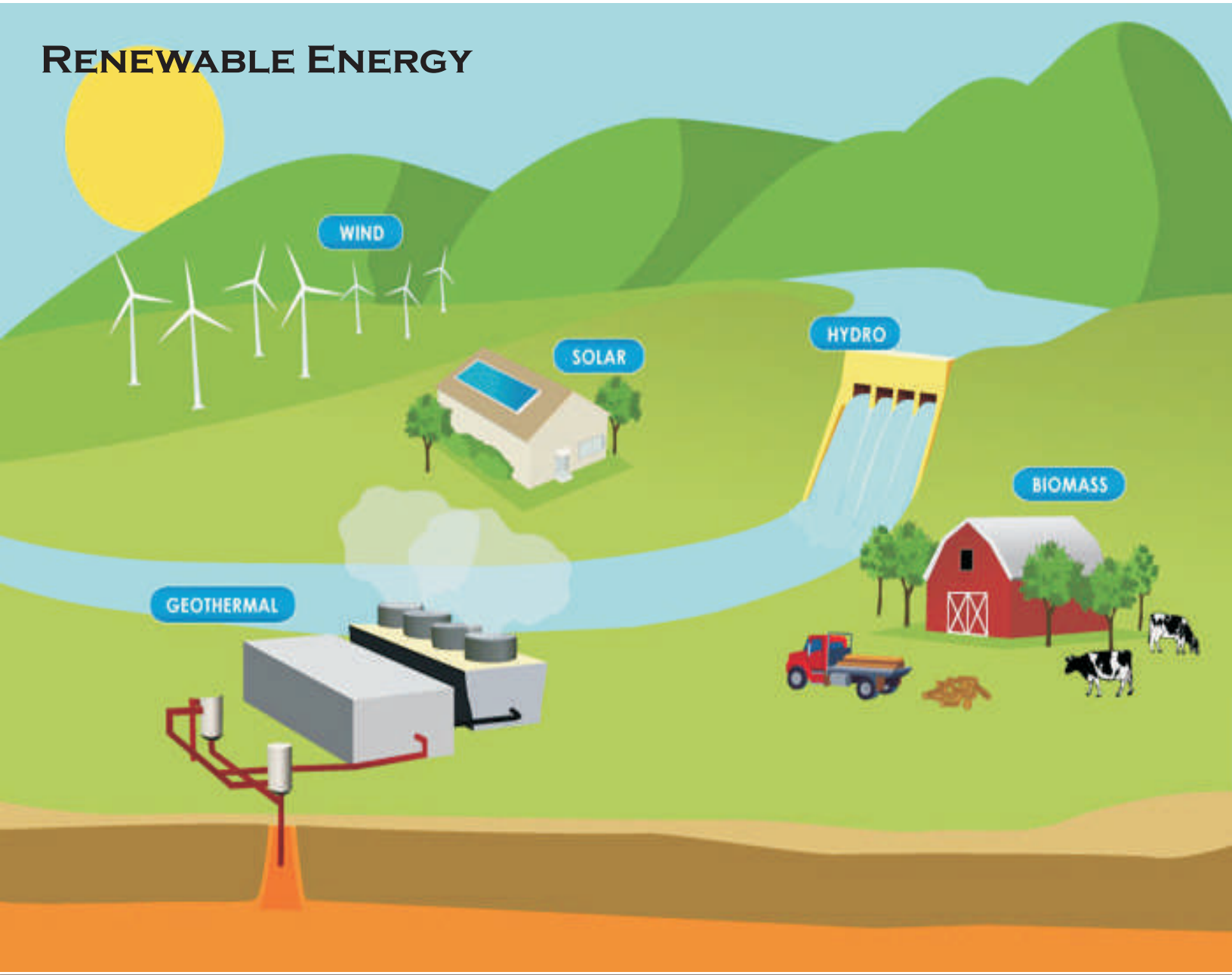
Vol. IV - No. 1 January - June, 2017

Climate *SAR* सार

Climate Science And Research



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FROM EDITOR

"Nature cannot endure a sudden change, without great violence"

- F. Rabelais, 1534

For combating manmade climate change we need to find scientific & technological solutions. Application of these would demand economic and political actions. India's Nationally Determined Commitments (NDCs) agreed in the Summit held in the Paris during December 2015, demand that 40% of the electricity installed capacity should be met from renewable energy sources by 2022.

In this issue I describe renewable energy sources and systems including solar, wind, biomass and others, which can reduce carbon footprints during generation of electricity. India's targets and achievements in solar and wind energy are briefly discussed.

Climate Change Research Institute has started this Bulletin of Climate Science and Research – 'Climate SAR' for wider dissemination of information about climate change and environmental education. In this issue you learn about the alternative sources of energy for meeting our future energy demand.

Happy reading and send your feedback to contactus@ccri.in

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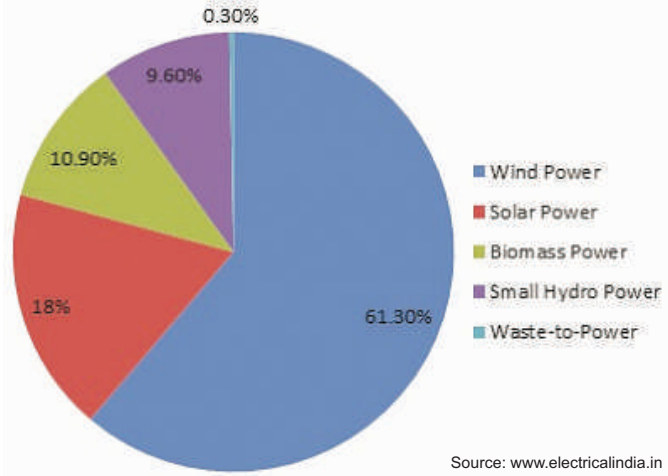
Installed Grid Interactive Renewable Power Capacity in India as of July 31, 2016 (RES MNRE)



Source: www.electricalindia.in

WHAT IS RENEWABLE ENERGY?

Electricity extracted from natural resources like Sun, Wind, Biomass and others that are eternal or replenished quickly is called Renewable Energy. Solar energy, wind energy, geothermal energy, hydro energy, ocean energy and biomass energy are the examples.

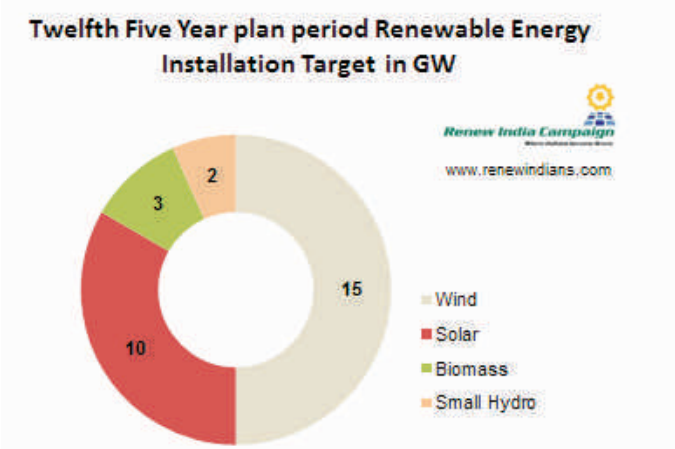
The first and foremost in exploring the promise of renewable energy sources is in utilizing energy from the sun. In 2014, the world relied on solar energy capacity of 185 GW, while renewables accounted for almost 22% of global electricity installed capacity. The IEA Medium-Term Renewable Energy Report 2015 foresees that this share becoming at least 26% in 2020. Germany, China, Japan, USA and Italy are five top solar PV countries.

INDIA'S POTENTIAL TARGETS

As part of its national climate change policy India's ambitious target for 2022 is to achieve 175 GW of renewable energy capacity.

India has an estimated renewable energy potential of about 900 GW from commercially exploitable sources viz. Wind – 102 GW (at 80 meter mast height); Small Hydro – 20 GW; Bio-energy – 25 GW; and 750 GW solar power, assuming 3% wasteland (PIB 18-December-2016). India currently has an installed power capacity of around 308 GW, with over 46 GW of renewable energy capacity, contributing around 14% to the installed capacity. Total installed capacity is expected to reach 850 GW in 2030.

The target is to achieve 40% power generation capacity based on renewable energy technologies by 2022. This could mean around 350 GW by 2030.



RENEWABLE ENERGY

There are many forms of renewable energy. Most of these renewable energies depend in one way or another on sunlight. Wind and hydroelectric power are the result of differential heating of the Earth's surface which leads to air flows causing wind. Changes in precipitation occur as the air is lifted in the regions of higher temperature.

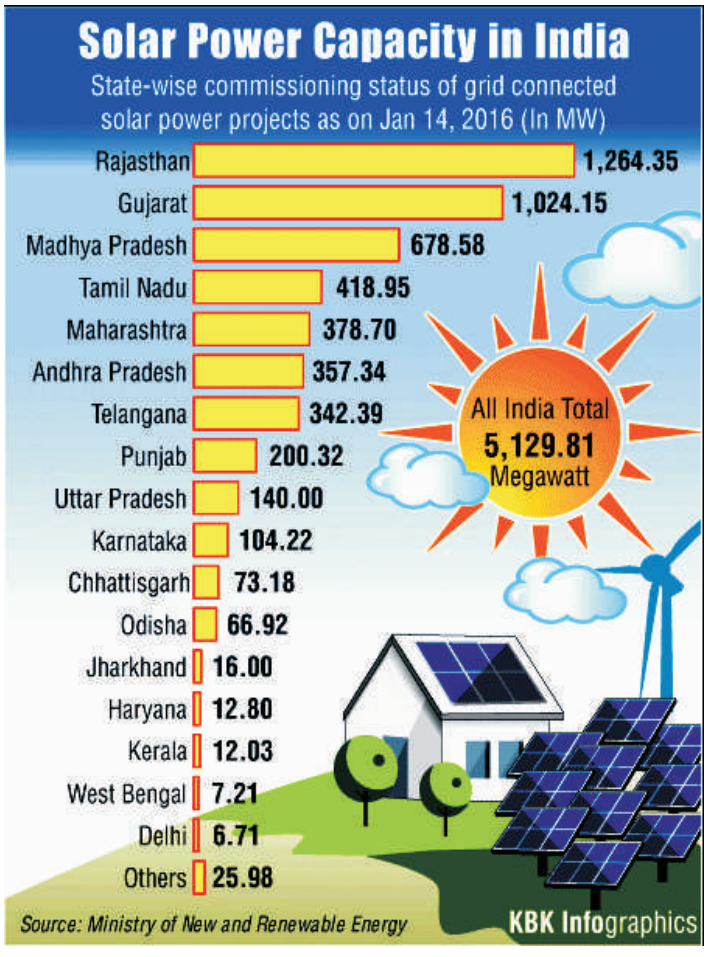
DIRECT SOLAR ENERGY

Solar energy is the direct conversion of sunlight into electricity and heat. The sun's energy is enormous and can be collected and converted in different ways. The range is from solar water heating with solar collectors for domestic and industrial use to the complex technologies of direct conversion of sunlight to electrical energy using photovoltaic (PV) cells or mirrors and boilers. According to BP Statistical Energy Survey world's installed capacity of solar energy was 185GW in 2014 requiring an investment of 316b$ US.

Solar electricity in India

Solar electric power in India is a fastest growing industry, the solar grid has reached a cumulative capacity of 8,626 megawatts (MW) in December 2016. The states of Rajsthan, Gujrat, Tamil Nadu and Andhara Pradesh are the leading states in Solar PV installations. Rapid growth in deployment of solar power is recorded and updated monthly on the Ministry of New and Renewable Energy (MNRE) website. Government has set a target of 100 GW solar installed capacity which included 40 GW from Solar PV Rooftop by 2022.

In addition to large-scale grid connected solar PV initiative, India is continuing to develop the use of off-grid solar power for localized energy needs. During 2015 - 118,700 solar home lighting systems were installed and 46,655 solar street lighting installations were provided.



INDIRECT SOLAR ENERGY

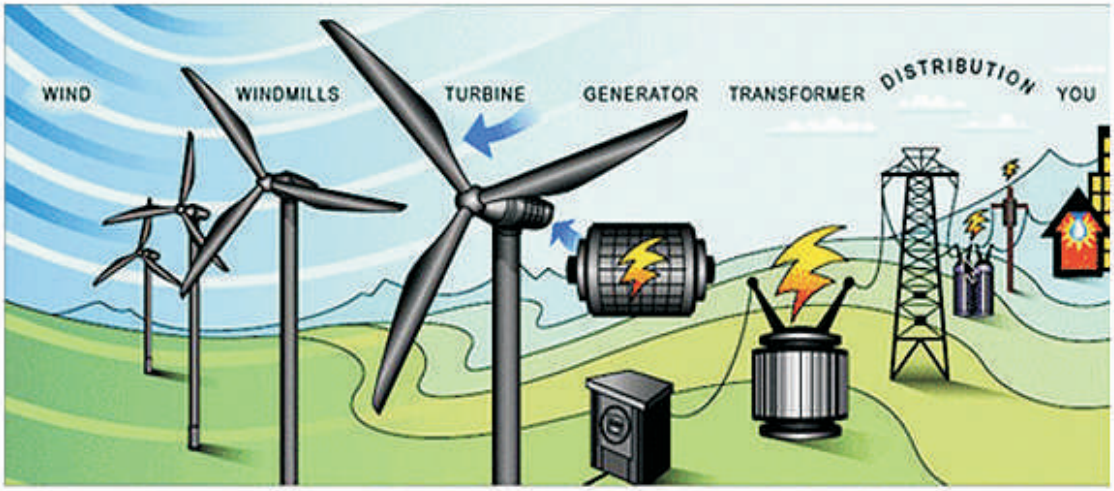
Wind Energy is indirect solar energy. When exposed to sunlight the movement of air is caused by differences of temperature at the Earth's surface and due to varying temperatures at different heights. Wind energy has been used to pump water in ancient times and for grinding applications. In modern times wind energy is mainly used to generate pollution free electricity.

Big wind machines of two megawatt capacity on land and bigger offshore machines of more than six megawatts are being developed to produce significant amounts of electricity.

The First wind farms in India were set up in coastal areas of Maharasahtra (Ratnagiri), Gujarat (Okha) and Tamil Nadu (Tuticorin) with 55 kW Vestas wind turbines in early 1990s. The current capacity has crossed 28,000 MW, with India becoming the fourth largest installed wind power capacity in the world after China, USA and Germany. The potential for wind farms in the country has been reassessed from 49,130 MW to 302,000 MW at 100m Hub height. In the year 2015, the MNRE has set the target for Wind Power generation capacity to reach 60,000 MW by the year 2022.

Offshore Wind Policy has been announced in 2015 and presently weather stations and LIDARs are being set up by The National Institute of Wind Energy (NIWE) for wind monitoring at different heights at some locations.

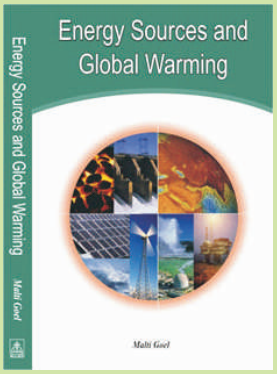
Wind Machines



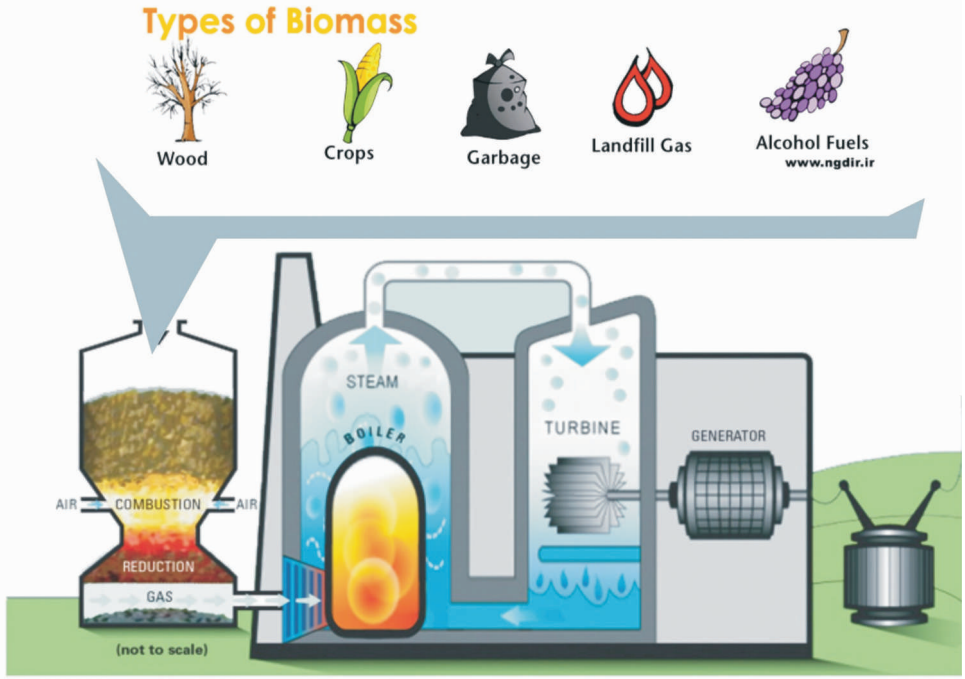
Biomass Energy is the term for energy derived from wood, plants or other waste materials. Energy in this form has been very commonly used throughout the world. Unfortunately the direct burning of dry wood for cooking and warmth is not environmentally friendly as it releases copious amounts of carbon gases into the atmosphere and is a major contributor to unhealthy air. More modern forms of biomass energy are; methane gas generation or steam turbine cycle for fueling electric power plants, and production of ethanol for automobiles.

Source of this biomass can be from agricultural and forestry residues, industrial wastes or crops grown solely for energy purposes. New technologies of Thermo-Chemical Conversion and Bio-Chemical Conversion have been developed for control of greenhouse gas emissions.

Direct combustion technology is the simplest and most common method of capturing the energy contained within biomass. In such power plants, biomass is burned to produce steam that runs a turbine to produce electricity as well as heat. Biochemical Conversion takes place at room temperature.



In the midst of uncertainties about climate change, the international community has assigned energy as the highest priority for its role in global warming. It is becoming obvious that whatever is the magnitude of human induced climate change in future, the resource base of the earth is in danger and energy is deeply connected with the resource base. The book has 16 chapters in 4 sections.



OTHER FORMS OF RENEWABLE ENERGY

Energy from hydro potential, ocean tides, ocean temperature & waves, and from the thermal gradients inside the earth are other forms that can be used to generate pollution free electricity.

Hydroelectric Power

Hydroelectric energy uses the gravitational potential of elevated water. Dams or reservoirs are constructed at river sites and water is made to fall from a certain height to generate electricity. Depending on the size of storage and penstock we can have large, small and micro hydel plants.

India has a hydro potential of 150 GW electricity capacity. Much of it is yet to be achieved. Technologies are well understood but on-site problems and difficult terrains pose great challenges.

Ocean Electricity

Tidal energy is extracted from the ocean tides. Tidal waves have regular periodicity of 12 hrs 25 minutes. According to moon position relative to earth, two high tides and two low tides (705 in one year) occur at a given point on the earth. To harness the energy of tidal waves, low head axial turbines are required in large number.

Ocean thermal energy is harnessed from the difference in temperature of water at different depths. Solar energy heats the upper layers of water. At a depth of 1km, temperature may fall by 20°C or more. Ocean thermal energy conversion (OTEC) relies on conversion of this heat energy into electricity. India has built a one MW OTEC plant along the southern coast of Tamil Nadu.

Ocean wave energy is the energy released by ocean waves caused by their movement. Depending on the amplitude or range of a wave the amount of electricity can be generated. The energy flux can vary from 50 to 70 kW/m for a wave of amplitude 2-3 m and periodicity of 10 sec.

Geothermal Power

Earth is hot inside, with temperature increasing 20-30°C per km below earth surface in the Crust. In certain areas the geothermal gradient (increase in temperature with depth) is high enough to exploit it to generate electricity. However this is possible only at a few locations on the Earth.

When the temperature gradient is small, geothermal energy can be used as heat with the help of heat pumps to heat a building in winter and cool it in summer. It can also be used for other small scale industrial applications. When temperature gradient is higher, electricity generation unit can be built.

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