

# Save the watts, turn green

India has the potential to emerge as a key global player in renewable energy by shifting the focus of its energy policy to renewable energy sources. The country also needs to explore innovative options to gain momentum in this direction



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**E**nergy has always been a major concern with barely a little over a billion people, or 20% of the world's population in the industrialised countries, consuming 60% of it. Whereas, over five billion people in developing countries consume the rest.

Disparities apart, the paradox with energy is that it is needed for development. However, unplanned development is affecting the environment leading to pollution, climate changes and rapid depletion of fossil fuels.

An improvement in the energy economy has to be through better energy efficiency, use of renewable sources of energy, carbon dioxide (CO<sub>2</sub>) capture and sequestration (CCS) on a massive scale and the development of carbon-free transport.

Stabilising CO<sub>2</sub> emissions in the 445-490 parts per million (ppm) CO<sub>2</sub> equivalent, which should correspond to an increase of 2-2.4 °C above the pre-industrial temperature through decarbonisation, has to be done on a priority basis.

Use of low carbon footprint biofuels and improvements in the efficiency of vehicles will cut down carbon emissions in the transportation sector.

Decarbonisation in the consumer sector includes the design of environment-friendly green buildings (depending on the region's climate), heat pumps, solar heating, use of high efficiency appliances and lighting (CFL- compact fluorescent lamps, LED- light-emitting diodes) and shifting to renewable energy (solar, wind, hydro, bio-energy), low-carbon electricity, etc. An energy resource renewed by nature and whose supply is not affected by the rate of consumption is often termed as renewable energy.

India has the potential to emerge as a key global player in renewable energy by shifting the focus of the energy policy to renewable energy sources. Domestically speaking, the country currently has about 5,200 mega watt (MW) of installed renewable energy accounting for 3.8% of the total capacity.

For instance, an annual energy of 1.5 x 10<sup>18</sup> kilowatt hour (kWh) is obtained from the Sun. This is about 10,000 times larger than the current annual energy consumption of the world. India receives solar energy equivalent of over 5,000 trillion kWh per year, which is far more than its total annual energy consumption. The daily average global radiation is around 5 kWh per m<sup>2</sup> per day with the sunshine hours ranging between 2,300 and 3,200 per year.

Karnataka has a gross potential of about 20,000 MW. Wind energy, if properly harnessed, has got great potential in India. From an initial estimation of 20,000 MW, wind power potential has been re-assessed to 45,000 MW, assuming there is 1% of land availability for wind power generation.

Of this, Karnataka has a gross potential of about 10,000 MW. Out of the 600 projects sanctioned in the state with a generation of 8,000 MW, 428 projects adding up to 1,500 MW in capacity have already been commissioned.

Besides wind energy, hydropower plants are also an upcoming source of renewable energy.



**AIR IN MOTION** From an initial estimation of 20,000 MW, wind power potential has been re-assessed to 45,000 MW, assuming there is 1% of land availability for wind power generation.

Their capacity can vary from a few KW to thousands of KWs depending upon their classifications — micro (up to 100 KW), mini (up to 3 MW) and small (up to 25 MW) plants.

The small hydropower plants (SHP) are set to attain a commercial status in the country and will become economically viable with appropriate systems for evacuation/ utilisation of power generated by them. In India, over 4,215 small hydropower plant sites have been identified with a total capacity of 10,279.71 MW. India has an estimated SHP potential of about 15,000 MW.

To date, 453 SHP projects with an aggregate installed capacity of 1463 MW have been installed. Besides this, 199 SHP projects with an installed capacity of 538 MW are being commissioned. Karnataka has so far cleared SHPs in 320

locations to be set up by private developers with a combined capacity of 2100 MW.

Bioenergy is another source that has been tried for some time now in India. The country has a bioenergy potential of about 19,500 MW, including 3,500 MW of exportable surplus power from bagasse-based co-generation in sugar mills and 16,000 MW of grid quality power from other biomass resources.

The total installed capacity in the country as of December 31, 2002, was 468 MW and projects with a total capacity of 530 MW are in various stages of implementation. Biomass gasifier capacity totalling 55.105 MW has so far been installed, mainly for stand-alone applications.

In fact, energy conservation to the tune of 42% is possible by using improved stoves while the fuel crisis can be overcome through sustainable management of energy plantations, and optimal use of biomass gasifier and biogas technology.

Apart from the known sources of renewable energy, innovative methods will have to be used to augment the potential. Urban waste, for instance, is a huge opportunity for generating energy. Greater Bangalore, for example, generates about 1200 MLD of liquid waste and about 2800 tonnes of solid waste every day.

Untreated wastes are contributing to green house gases in the system and also to global warming. Viable technologies are available to convert this to energy. For instance, an algae photo-bioreactor grows algae in municipal wastewater to produce biofuel.

This bioreactor won't compete with agriculture for land, fertilizer, or freshwater. Similarly, technologies are available to handle the organic fraction of municipal waste (which constitutes

## Milking algae for biodiesel

Compared to oil seeds planktonic algae can make 10-200 times more oil

**I**n the face of increasing CO<sub>2</sub> emissions from conventional energy (gasoline), and the anticipated scarcity of crude oil, a worldwide effort is underway for cost effective, renewable and alternative energy sources.

The Energy Research Group at the Indian Institute of Science (IISc) in collaboration with Dr Richard Gordon of the University of Manitoba, Canada, is developing gasoline secreting diatom solar panels to produce gasoline from diatoms. Diatoms are the major group of planktonic algae. They are used in a sustainable manner, for the production of biofuel, by using diatom-based solar panels. Studies have shown that diatoms can produce 10 to 200 times oil per hectare compared to oil seeds.

Biofuel is still generated by growing bioresources artificially, crushing them to collect lipids and then filtering it to collect the oil used as biofuel. But the IISc technique does not involve crushing the biomass for extracting oil. The approach also looks at reducing the cost of oil extraction.

Studies done by the institute have resulted in some unusual findings. It was found that some diatoms secrete more lipid content when subjected to unfavourable environment or culture conditions, such as nutrient starvation or extreme temperatures.

Unlike crops, diatoms multiply rapidly. Some diatoms can double their biomass within an hour to a day's time. Since each diatom creates and uses its own gas tank, it is estimated that diatoms are responsible for up to 25% of global carbon dioxide fixation.

Hence, while diatoms can be cultivated for oil extraction, they can automatically reabsorb carbon dioxide in the process. We propose to manipulate cells in diatoms that spread over panels so that they actively secrete oil.

Therefore, diatoms may have a major role to play in the coming years with regard to the mass production of oil.

60-70% of Bangalore's municipal waste). However, for innovative sources of renewable energy to gain momentum, there needs to be a major policy shift, political will and active participation of local communities to see that these technologies are in place before it is too late.

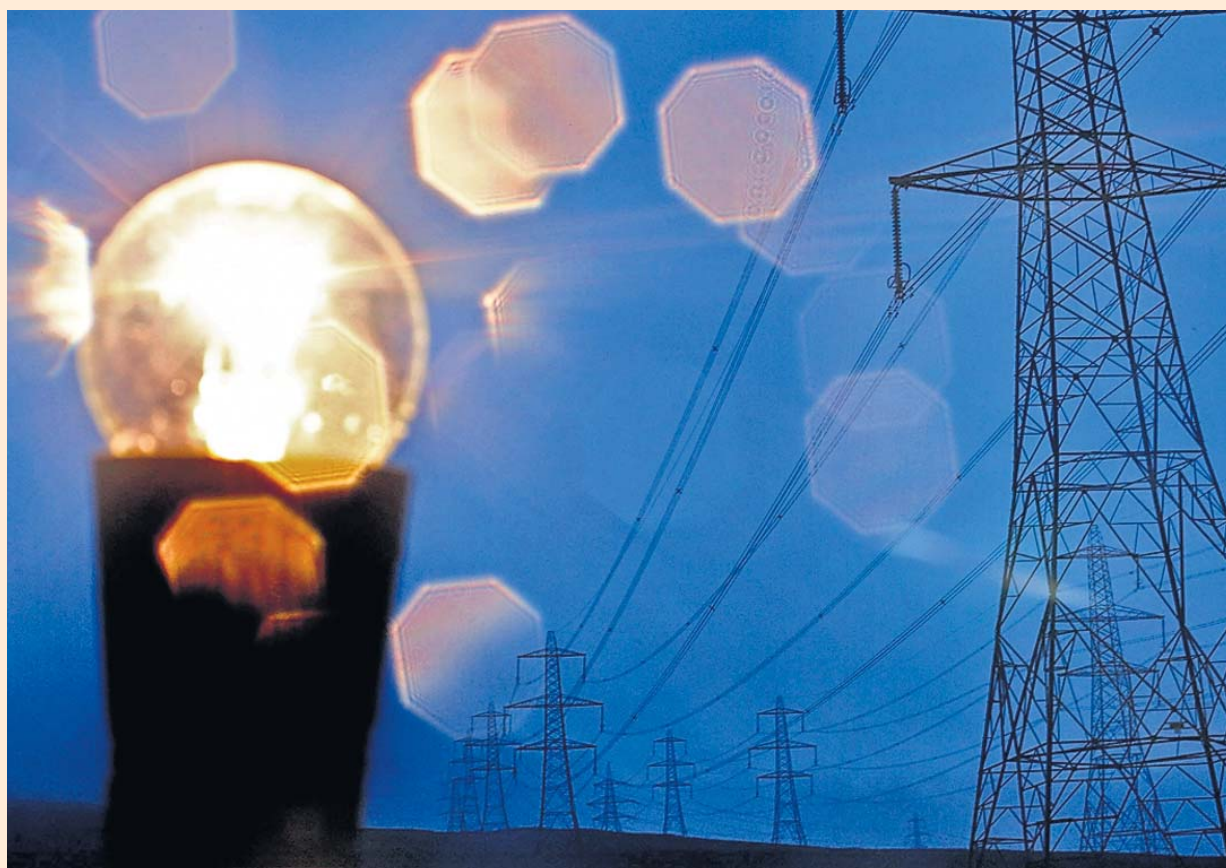
## ALGAE POWER

Greater Bangalore generates about 1,200 MLD of liquid waste and about 2800 tonnes of solid waste everyday

An algae photo-bioreactor grows algae in municipal wastewater to produce biofuel

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## Bangalore in line for India's first smart grid project



A futuristic electricity network is slated to come up in the Electronics City covering 2000 establishments in a pilot project costing Rs 66 crore

C CHITTI PANTULU & S SENTHALIR

**I**f you forget to turn off the light or your TV on the way out, or for that matter, if you are consuming (or wasting as the case may be) more electricity than you should, very soon the Bangalore Electricity Supply Company (BESCOM), will be able to hit the off button without your consent. Welcome to the smart grid! The government utility will soon kick off the country's first smart grid pilot project in Bangalore's Electronics City. The pilot project costing Rs 66 crore will cover 2,000 establishments in the IT hub.

Smart grids, not only include intelligent monitoring systems to keep track of electricity flow, but also allow the integration of alternative sources of power such as solar and wind. Another significant feature of the smart grids is that they are two-way systems that allow users not only to draw power from the network, but also feed power back into it from either their rooftop solar systems or the wind turbines that they may own.

What is more interesting is that smart grids, apart from controlling power consumption, make possible smart and variable pricing mechanisms for peak and off-peak charges, and also incentivise consumers for saving electricity. Going forward, the new concept has the potential of not only carrying electricity, but also computer data.

Two-way communication nodes will be placed in each installation including residences, commercial buildings and transformers to monitor and control power consumption.

"The implementation of this project would ensure increased reliability and lower costs. We have written to the government of India asking permission to implement the project," said Tushar Girinath,

managing director, BESCOM.

The BESCOM will float tenders for expression of interest from companies later this month. "A workshop is being planned, where companies could make presentations on smart grid," the BESCOM MD added.

It would take less than two years to implement the project, he said, adding many IT companies including Infosys have shown interest in the project.

A senior official with the government utility said that the smart grid would help control load.

Instead of cutting power to manage load, alerts would be sent from the control room to cut down on unnecessary power consumption.

## POWER MATRIX

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**It would take less than two years to implement the Bangalore project**

**The concept** has the potential of not only carrying electricity, but also computer data and driving communications