

INDIA'S SOLAR PV

Rays of Hope

With great solar potential, India's solar mission allows the country to make a long-term commitment to controlling carbon emissions, contributing to a greener world, while sustaining economic growth.



Don Christensen

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BY DON CHRISTENSEN



An Indian villager works on a typical solar photovoltaic installation.



Solar panels provide power to a typical village dwelling.



The sun offers rays of hope for the Indian people.

With high rates of economic growth and over 15% of the world's population, India has become a significant consumer of energy resources.

However, the South Asian country lacks sufficient domestic energy resources and India imports much of the energy it needs. To meet its energy requirements, India has announced a vastly ambitious plan to tap the power of the sun to generate clean, renewable electricity.

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India's bold and ambitious solar initiative was approved in principle by the Prime Minister of the Republic of India, Manmohan Singh, on August 3, 2009. The plan aims not only to cover the country's daily energy shortfalls (several hours per day), but also to support India's economic development and its ever growing worries on the climate front. Even though the Indian economy has the second fastest rate of increase in GDP in the world, today 487 million Indians have no electricity. The 20 GW of installed solar capacity would help spark India's development and help end the energy shortfalls that plague the nation. The sun literally offers several rays of hope for the Indian people.

India's Energy Sector

India's ability to produce a reliable supply of solar energy to ensure its energy security will be one of the most important factors in the country's future development. India ranks sixth in the world in terms of total energy consumption and the country needs to accelerate the development of its energy sector to meet its growth aspirations. According to India's Central Electricity Authority, the country's peak energy demand in 2008 was 120 GW of power, while only 98 GW of power could be supplied.

India is not only experiencing an electricity shortage, but is also increasingly dependent on oil imports to meet its energy demands. In 2006, India was the sixth largest oil consumer in the world. Though rich in coal and abundantly endowed with renewable energy in the form of solar, wind, and hydro, India has only 0.4% of the world's hydrocarbon reserves. As a net importer of energy, more than 30% of the country's primary energy needs are met through import.

In the near term, energy imports are expected to rise as India develops and its en-

Photo by GEI

India's 'National Solar Mission' aims at expanding the nation's solar capacity from the current 3 MW to 20 GW by 2020.



The sun sets behind an Indian mausoleum.

ergy demands increase. In terms of end-use, energy demand in the transport sector is expected to be particularly high, as vehicle ownership, particularly of four-wheel vehicles, is forecast to increase rapidly once the global economic crisis abates and domestic spending levels normalize. The average electricity consumption in India is still among the lowest in the world at just 630 kWh per person per year. However, this figure is expected to increase to 1,000 kWh within the next 5 years.

More than half of India's total electricity consumption is accounted for by coal, followed by oil, which comprises 31% of the country's total energy consumption. Natural gas and hydroelectric power account for 8% and 6% of consumption, respectively.

Although nuclear power currently comprises a very small percentage of India's total energy consumption, it is expected to increase due to recent international civil nuclear energy cooperation deals. Solar

power is virtually nonexistent and is mainly found in small pockets across India, with scattered, limited use of solar cookers, solar water heaters, solar street lighting and solar lanterns for homes.

However, India has great solar resources. The Indian government reported the country receives 5,000 trillion kWh of energy from the sun, per day. The potential for solar photovoltaic installations in the State of Rajasthan, with its vast area of sunny desert, is unlimited. India has many more States states with great solar potential. India's Prime Minister Manmohan Singh said the sun would occupy the "center stage" in the country's climate strategy and that the success of the country's solar endeavor would "change the face" of India.

Ambitious Solar Plan

India's 'National Solar Mission' aims at expanding the nation's solar capacity from



India's 'National Solar Mission' may be as ambitious and admirable as India's universally admired architectural jewel, the TajMahal.



The potential for solar photovoltaic installations in the deserts of the State of Rajasthan is unlimited.



An 8.7 kW solar power plant in Rampura village in Jhansi. Installed at a cost of Rs 31.5 lakh, it provides electricity to all 69 houses in the village which previously had no power.

the current 3 MW to 20 GW by 2020. The solar mission will form the centerpiece of India's National Climate Change Strategy and will cost an estimated US\$20 billion to implement. With worldwide installed solar generation capacity currently totaling just 16.5 GW, the plan has attracted considerable attention for its scale and ambition.

The 'National Solar Mission' has a "near term" target of 100 MW and is a three-phased plan that hopes to generate 1-1.5 GW of solar power by 2012, 6-7 GW by 2017 and the remainder by 2020. Initially, for the 2009-2012 phase, the plan indicates rapid solar deployment may be achievable through the installation of solar technology on approximately three million square meters of rooftop space on 2,000-3,000 government buildings. Long-term goals of 100 GW by 2030 and 200 GW by 2050 have been established by India's government. The country's solar mission aims to lower the production costs of solar panels and



The Thar Desert, also known as the "Great Indian Desert", in the State of Rajasthan



The sun sets on the Thar Desert in the State of Rajasthan.



A grid-connected solar photovoltaic installation.

spur domestic manufacturing. Solar funds will be spent on incentives for production, installation and research and development.

Once implemented, India's 'National Solar Mission' will ensure large-scale deployment of solar generated power for both grid-connected as well as distributed and decentralized off-grid provisions of commercial energy services. Solar-powered equipment and applications will be mandatory for hospitals, hotels and government buildings. Villages and small towns will be encouraged to participate with micro financing. India will promote solar heating systems and will use 40-50 million square meters of area to install solar collectors in domestic, industrial and commercial sectors. The country's solar mission also outlines a system of paying households for any surplus power generated by solar panels that is fed back into the national grid.

The government would also like to provide 3 million households with access to solar lighting by 2012 and install an estimated 20 million solar lights in homes by 2020. The 20 million solar lights could save 1 billion liters of kerosene per year. Solar power could also replace the 20-25 GW of electricity currently generated from diesel that is used to meet peak powers. India's government believes its 'National Solar Mission', in total, could cut about 42 million tons of carbon dioxide emissions.

The solar mission is part of India's overall climate change plan. If the country's solar energy goals are met by 2020 and the predicted carbon emissions are offset, 100,000 trained specialists may be re-

quired to install, manage and maintain the solar infrastructure. The government plans to collaborate with universities that would offer bachelors, masters, and doctorate degrees in solar engineering and solar technology. The government would like to establish solar energy courses at the Indian Institutes of Technology and create a fellowship program to train 100 Indian scientists a year in world-class institutions. An autonomous solar energy authority will be created to execute the solar mission. India's existing solar energy center near New Delhi will be upgraded into an 'apex research institute' to coordinate solar research centers across the country and promote foreign collaboration.

The Road Forward

Foreign collaboration will be crucial to the success of India's 'National Solar Mission' since financial constraints are one of the main problems that India is facing in achieving its established solar energy goals. Currently, India's domestic solar energy companies do not receive any substantial incentives. There is low demand for solar energy systems within India, which is why the country's domestic solar companies derive the majority of their revenues from exports.

North Delhi Power Limited, a joint venture between the government and a private company, has proposed a feed-in tariff scheme for India's capital region. Nonetheless, substantial subsidies will be required to attract home owners to buy solar panels. In addition, the electric grid will have to be engineered and upgraded in

order to accept the electricity thousands of homes will feed back into the grid. Pilot projects have been installed to remedy these technical issues but without the adequate financial resources to implement India's solar mission the plan will never meet its ambitious objectives.

Indian government officials are eyeing international financial help either through bilateral carbon offsetting agreements or those run by the United Nations in order to implement their ambitious plans. India's 'National Solar Mission' should be one of the main topics of discussion at the Copenhagen climate talks. The success or failure of India's solar plan could be largely dependent on the terms of the next international climate treaty. For now, India's solar mission will be pushed forward by a mixture of policy and regulatory measures. These measures include feed-in tariff programs, making it mandatory for existing thermal power plants to generate at least 5% of their capacity from solar power and a 10 year tax holiday for solar energy projects. Other solar industry measures include the duty-free import of raw materials and priority bank loans. The government also plans to create a solar fund with an initial investment of US\$1.1 billion and to increase the fund by taxing fossil fuels and the power generated from fossil fuels. Indian solar photovoltaic project developers have taken notice of the policy and regulatory measures. More than 3 GW of solar project proposals have been submitted. Clearly, many developers recognize India's long term potential with its ever-increasing GDP.

India's 'National Solar Mission' is certainly admirable, forward thinking and feasible with the support of not only the Indian government, but also developed countries. International funding will be required along with external technology inputs from the world to implement India's solar climate mitigation plan and to meet the ambitious renewable energy target established by the Indian government. The country's solar mission allows it to make a long-term commitment to controlling carbon emissions while sustaining economic growth. International cooperation and shared commitments to meet climate change challenges can make India's 'National Solar Mission' a reality and will contribute to a greener world. **IV**

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