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Dear Reader

The recent 62nd report of the National Sample Survey Organization on Household Consumer Expenditure in India reveals the fact that in rural India, 74% of households continue to depend on firewood and chips as their major cooking fuel; about 9% use dung cake; and only 9% have access to LPG (liquefied petroleum gas). About 56% of the households in rural India use electricity for lighting purpose, while 42% use kerosene for lighting.

These figures are indicative of the fact that a large section of our society is still deprived of the basic amenity of energy for cooking and lighting. They depend on locally available biomass for cooking and kerosene for lighting. This has adverse effect on their quality of living. This also indicates that the major share of fossil fuel consumption remains in urban areas. In this scenario, renewable energy has a vital role to play in meeting the requirements of fuel for cooking and lighting through efficient systems and devices, which also are based on locally available natural resources, that is, biomass, wind, and energy from the sun.

In spite of the fact that a variety of renewable energy products and devices have been developed and are commercially available in the market, making them affordable to the common man remains a challenge. The use of renewable energy by people in their daily lives will reduce the indiscriminate use of fossil fuels. Awareness and motivation to adopt renewable energy is needed. The celebration of Rajiv Gandhi Akshay Urja Diwas on 20 August every year is an effort in this direction.

Renewable energy is also capable of providing energy security to the villages through the use of locally available resources. For example, the basic energy requirement of cooking, lighting, and automotive power can be met thorough biomass in a village. The technologies have matured and with community participation, this is possible. An effort to realize this fact is being made through village energy security pilot projects in the remote unelectrified villages by the ministry.

A report on the Rajiv Gandhi Akshay Urja Diwas celebrations this year illustrates the efforts towards awareness generations, and an article on village energy security through biomass shows the way to meet the energy requirements in villages.

I am sure that you will like Akshay Urja in a new design and with interesting material. Your contribution and valuable suggestions are quite encouraging and welcome.

With best wishes

ARUN K TRIPATHI
<aktripathi@nic.in>
I was happy to go through one of the copies of *Akshay Urja* published by the MNRE. It is in fact an updated information source for one and all starting from R&D personnel and entrepreneurs to consumers. The quality of the photographs is excellent, the matter is informative, and the news is updated. I am presently actively involved in the biomass energy generation and its R&D aspects. Here’s wishing the newsletter all success.

**Er. S Murali**
Scientist, Regional Research Laboratory (CSIR), Hoshangabad Road, Bhopal (muralishiramdas@yahoo.com)

I am sorry to write this letter in English! I was amazed to see such a nice magazine on such an advanced subject. All articles are very informative and up to the mark. If I want to write in your magazine what do I do? Here in US, I am witnessing a huge surge in renewable energy technologies, from wind energy to all electricity driven cars. I hope that in a decade, the world will be very different in the energy sector. Congratulations for editing such a nice magazine.

**Dr Utsawa K Chaturvedi**
Rochester, New York, USA

I am engaged in the promotion of renewable energy and energy efficiency/conservation measures in the state of Chhattisgarh. I have been through the latest issue of your magazine and find it very comprehensive and interesting. I would like to receive it on a regular basis since each issue presents a different perspective altogether.

**Sanjeev Jain**
Certified Energy Auditor, Raipur

We are one of the manufacturer/supplier of solar water heaters in India and are registered with MNRE. We went through *Akshay Urja* and found it to be very informative and interesting. We would like to set up a 25-kW solar power plant at UP and have primarily calculated the cost. We would now like to know whether we can get any assistance in the form of capital subsidy, interest subsidy, and would also like to have a project report for the said project. Kindly guide us accordingly.

**Samrat Laha**
Solace Power, Kolkata

I congratulate the Ministry on publishing *Akshay Urja*. The magazine is very useful to our institution. Information on renewable sources of energy should be spread among one and all. *Akshay Urja* helps in doing just that.

**Principal**
Kirodimal Institute of Technology, Raigarh, Orissa

Akshay Urja offers very good information on what is being done by the MNES. Most of the letters written to the editor are letters of appreciation. I would want to focus on some other aspects as well. My first observation is that most of those who write in the newsletter are government officers, and given their position they cannot be critical and may not express the real problems in pursuing research and development efforts. While going to my hometown, I happened to stop and see a wind energy system. I wanted to know the details of the same but I was told that people here do not know things because it is being done through a foreign collaboration.

I strongly feel that the Ministry should inspire people to think of various systems to meet the needs of the village society. What is needed is financial incentives and supervision of the village projects. While the newsletter as a whole is very informative and useful, I feel that more needs to be written about what is being done for the villages.

**R N Singh**
Ex-director of IT, BHG

I am a district advisory committee member of Nellore district, Andhra Pradesh. I received a copy of *Akshay Urja* and I would like to put forth some suggestions. In India, the people in rural areas need to be made more aware of the potential of RE (renewable energy) technologies. I think publishing *Akshay Urja* in all regional languages and disseminating the same to gram panchayats and block development offices would help in generating awareness on RE. It would make them discuss RE to a greater extent and thereby adopt RE technologies.

Another important issue is to educate the next generation about the need and importance of RE. Disseminating *Akshay Urja* to schools would ensure that children read about RE and thus, understand how RE will play a big role in meeting future energy requirements.

**Syed Zahed**
Chairman, AIMS and member, DAC, Nellore

Thank you very much for your encouragement. The editorial team of *Akshay Urja* will make every effort to make this newsletter highly informative and useful to all our readers. We welcome your suggestions and valuable comments to make further improvement in terms of content and presentation.

**Editor**
Akshay Urja
## RE NEWS

### National
- Rajiv Gandhi Akshay Urja Diwas 2008 ... 4
- 5400 small hydro power sites identified ... 12
- DLF proposes green housing project off Kolkata ... 12
- Maharashtra clears land for 100-MW windmills ... 12
- ATMs, mobile companies turn to solar energy ... 12
- Civic body wants solar power for parking lots ... 13
- MoU for renewable energy development programme ... 13

### International
- Solar device to suit your pocket ... 15
- Japanese town becomes a lab for clean energy ... 15
- Harvest the sun from space ... 16
- New way to store solar energy on a rainy day ... 17

### RE TECH UPDATE
Converting sunlight to cheaper energy ... 18

### FEATURE ARTICLE
- Energy security in villages through biomass ... 20
- Lighting up lives... solar energy shows the way ... 26
- Handing power to the villages ... 29
- Support schemes for renewable energy the case for feed-in tariffs ... 30

### CASE STUDY
Providing affordable solar systems to people ... 34

### FOCUS
Bringing light to villages the Aryavart Grameen Bank ... 37

### RE EVENTS
Renewable energy for a better tomorrow ... 40

### HIGHLIGHTS
Mission solar ... 42

### BOOK REVIEW
... 45

### BOOK / WEB ALERT
... 46

### FORTHCOMING EVENTS
... 47

### RE STATISTICS
... 48
With the world gradually moving towards sustainable energy use, RE (renewable energy) sources are becoming the order of the day. RE sources are those that can be replenished in a short period of time. India is blessed with a variety of RE sources, the main ones being biomass, biogas, the sun, wind, and small hydropower. The growing consumption of energy has resulted in the country becoming increasingly dependent on fossil fuels such as coal, oil, and gas. Increased use of fossil fuels causes environmental problems both locally and globally. The era of wood is almost nearing its end. The world energy forum has predicted that fossil-based oil, coal, and gas reserves will last for less than another ten decades. Therefore, the country needs to develop a sustainable path of energy development. Promotion of energy conservation and increased use of RE sources are the twin planks of a sustainable energy supply.

One of the many eminent people to have initiated several projects to bring economic prosperity to the people of the country was the late Shri Rajiv Gandhi, former Prime Minister of India. He wanted no house to remain unelectrified, for which, he laid emphasis on RE sources of energy. A lot of efforts have been made in this direction, and these efforts will be continued to spread awareness on the positives of using RE sources. Awareness campaigns need to be carried out in the country to apprise people about the efforts being taken by the government to electrify all villages including remote ones through non-conventional energy sources. 20 August, the birthday of Shri Rajiv Gandhi, is celebrated as the ‘Rajiv Gandhi Akshay Urja Diwas’ annually. On this occasion, mass rallies, human chains/runs, competitions such as essay writing, painting, quiz, and debates are – with the theme of new and renewable energy sources – are organized not only in the state capitals and other major cities but also in all the districts of the country. The world has already realized that the peace and prosperity of any nation is secure only when the rest of the world is also prosperous and at peace. Similarly, the energy consumption from renewable resources has to be maximized for all nations, if the world has to remain a liveable habitat for our future generations.

National-level functions have been organized in various parts of the country over the last couple of years. This year, the function was organized in Panchkula, Chandigarh on 20 August 2008. The function started with the Renewable Energy Pledge and moved on to many other activities such as a 21-km marathon, painting competition,
slogan writing, quiz competition, energy run, and renewable energy exhibition. Many district- and block-level activities will also be organized in different states during the same week to commemorate the occasion. Harayana chief minister Bhupinder Singh Hooda drove an electricity-driven vehicle to reach the parade ground, where he flagged off half marathon of 21 km for men and women and a rally of electricity-driven vehicles, including e-bikes, scooters and cars, projecting the significance of renewable energy was also taken out.

A six-member team of daredevils of the Indian Air Force led by Wing Commander R C Tripathi, exhibited their skydiving skills. A colourful cultural programme was presented by the schoolchildren of Chandigarh, Panchkula, and Mohali. About 18,000 students participated in it. Hero Motors awarded two electricity-driven two-wheelers to the both the first-prize winners of half marathon.

State-level function at National Bal Bhawan
Pledging its commitment towards addressing the physical, economic, and policy aspects of energy, environment, and resources TERI along with the MNRE, celebrated Rajiv Gandhi Akshay Urja Divas 2008 in the capital based on this year’s common theme Akshay Urja Se Desh Vikas, Gaon Gaon Bijli, Ghar Ghar Prakash.

Shri Vilas Muttemwar, Hon’ble Minister for New and Renewable Energy, Government of India, delivered a special address, along with Smt. Sheila Dikshit, Delhi Chief Minister, and Dr R K Pachauri, Director-General of TERI, who joined the dais for a special address to the 2500 school children present with teachers and civil society think tanks at National Bal Bhawan, Kotla Road, New Delhi.

Shri Muttemwar in his special address said, ‘Akshay Urja began in 2004 with the agenda to address the national problem of energy crisis and we believe that the children present here today are going to play a key role to propagate this programme. India is blessed with solar energy, and if harnessed efficiently we are capable of producing about 5 trillion-kilowatt of electricity. I feel that Akshay Urja will help in the development of the nation and I thank all the children across India who have participated in various competitions and supported our campaign.’

Delhi Chief Minister Ms Sheila Dikshit said, ‘Rajiv Gandhi Akshay Urja Diwas encourages the future, our students present here, to propagate the message of judicial use of electricity and promote the increasing use of renewable sources for leading a eco-friendly lifestyle.’

Cheering the children, Dr R K Pachauri, Director-General, TERI, said, ‘The future of our country and the world is in children’s hands. Akshay Urja defines the future of human race for creating world’s future in energy. Due to the abundant solar energy available to us, India has a great potential in utilizing renewable sources. Solar energy is extremely beneficial as its non-polluting and its generation can be decentralized. We need to come together and take initiatives to create technologies for a greater use of these sources to combat climate change by reducing greenhouse gases.’
Urja Diwas 2008: a snapshot

Photo courtesy: Anoop Singh, PS to the Minister
The nation celebrates Akshay Urja Diwas

Himachal Pradesh

About 1200 students participated in the Akshay Urja Diwas celebrations held in Himachal Pradesh. The students from various schools gathered at The Ridge, Shimla. Shri Ravinder Singh Ravi, Hon’ble I&PH Minister, Himachal Pradesh, flagged off the rally. The students marched shouting slogans and spreading the message of renewable energy. An exhibition on renewable energy technologies and devices was also organized at the Indira Gandhi Sports Complex with participation from about 8 renewable energy industries. A magazine called Hari Prerna was also brought out in collaboration with the WWF. The magazine carries articles by schoolchildren, teachers, and officials of HIMURJA and covers various aspects of renewable energy and energy conservation. In his address, the Hon’ble minister talked about the renewable energy programmes being implemented in the state. He said that awareness on renewable energy will help in maintaining the delicate balance between the environmental and developmental needs of the state. Prizes were also given away to the winners of the various competitions held.
Meghalaya

The state of Meghalaya celebrated the Rajiv Gandhi Akshay Urja Diwas 2008 with great enthusiasm. The celebration started with addresses by eminent guests present on the occasion. The dignitaries included Shri B K Dev Varma, IAS, Principal Secretary, Government of Meghalaya; Shri Conrad Sangma, Hon'ble Power Minister of Meghalaya; and Shri R Chatterjee, Chief Secretary, Government of Meghalaya. On this occasion, there were painting and essay competitions, as also debate and singing competitions.

Arunachal Pradesh

The celebrations at Arunachal Pradesh started with a marathon race by school children. This was followed by a mass gathering wherein there were various cultural programmes such as patriotic songs and cultural dances by students and troops. An essay writing competition was conducted at the higher secondary school level. More than 300 students participated in this competition. Other competitions included
extempore speech, and painting, which saw participation by more than 200 students. A community feast was organized for all those who participated in the competitions. Prizes were given away to winners in the evening.

Hyderabad

The state nodal agency of Andhra Pradesh, NEDCAP, organized the Rajiv Gandhi Akshay Urja Diwas with great zeal. Many activities were taken up as part of the function. The preparations for all competitions and other activities started one month in advance. More than 400 students participated in the competitions. About 1000 students from high schools and colleges participated in a rally organized on 20 August 2008 from L B Stadium. Shri Mohd Ali Shabber, Hon’ble Minister for Energy, Coal, and Minority Welfare, flagged off the rally. During the rally, students displayed placards, banners, and slogans on renewable energy. All in all, about 2500 students participated in the functions. Dr Y S Rajasekhara Reddy, Hon’ble Chief Minister of Andhra Pradesh, inaugurated the renewable energy exhibition at Ravindra Bharathi, Hyderabad.

Uttar Pradesh

In accordance with the guidelines from MNRE, NEDA (Non-conventional Energy Development Agency), Uttar
Pradesh initiated various programmes on 20 August 2006 in the state capital Lucknow as well as the entire state on the occasion of RGAUD. Within the ambit of the occasion, NEDA organized various functions in Lucknow. Following the inaugural ceremony, a painting competition for school children was conducted at the centre in which there was an enthusiastic participation by children. The programme concluded with a prize distribution ceremony.

West Bengal

WBREDA (West Bengal Renewable Energy Development Agency), like the last few years, celebrated the Akshay Urja Diwas this year as well. The programme was organized in two parts on the same day. The morning celebrations were restricted to schoolchildren while the programme in the evening was meant for all. Various competitions were held for the children. About 6000 students from close to 50 schools attended the function. The cultural programme in the evening was based only on RE. Renowned artists performed in the programme.
5400 small hydro power sites identified

The MNRE has reportedly identified small hydropower sites that need to be exploited at the earliest to generate more power using renewable, natural, and pollution-free sources. The government has so far identified more than 5400 small hydropower sites in the country with combined capacity of potentially generating 15,000 MW of power.

10 JULY 2008, DNA

DLF proposes green housing project off Kolkata

Real estate developers DLF and the Kolkata-based Siddha Group have approached WBREDA (West Bengal Renewable Energy Development Agency) to set up environment-friendly green residential clusters at Rajarhat near Kolkata. These two projects, with 400–500 units, involve an investment of about Rs10 billion each. The units would have solar panels on the terrace to generate power for residential use. Excess power, if any, would be sold to the state grid. The two proposals come close on the heels of WBREDA’s Rabi Rashmi Abasan project, India’s first commercial solar housing.

10 JULY 2008, INDO-ASIAN NEWS SERVICE

Maharashtra clears land for 100-MW windmills

According to the Maharashtra state agency, in the last six months, the directorate of industries has cleared land acquisition proposals for wind power generation capacity of over 100 MW spread over an area of 258 hectares while applications for about 150 MW are pending with the state. The projects include a 20-MW windmill at Sangli to be set up by Europe-based independent producer of renewable energies under its subsidiary Theolia Wind Energy.

Another is a 24-MW windmill to be set up near Solapur by Jaiprakash Associates. Reliance Innoventures Private Ltd, an ADAG-promoted company, is setting up a 45-MW project at Chandrapur while a 15-MW project by Naman Developers is to come up near Nashik. According to the department, once the permission is given, the companies have to apply to the Maharashtra Energy Development Agency, a state-government body for development of renewable energy and facilitation of energy conservation, for infrastructure and feasibility clearance.

12 JULY 2008, DNA

ATMs, mobile companies turn to solar energy

Refusing to let the power shortage play a spoilsport, technology now gets powered with solar energy. As the acute power shortage and escalating cost of captive power generation threatens to take the zing out of the technology-driven banking sector and mobile telephony, solar energy is now being used to run ATMs, bank branches, and mobile phone towers.

As financial inclusion becomes the new mantra for growth in the banking sector, and banks try to reach out to rural masses, they are increasingly turning to solar energy for powering their ATMs and branches in rural areas, especially in areas where there is no power supply. Mobile service providers, too, are now testing on how to run their towers on solar power, as the cost of captive power generation goes prohibitive because of high cost of diesel.

State Bank of India, PNB (Punjab National Bank), Bank of Maharashtra,
Indian Bank, and, Jammu and Kashmir Bank are not just running their ATMs on solar power, but are also running a number of bank branches on solar energy (along with the electricity supply). Idea and Airtel, too, are trying out the use of solar power for running their mobile towers. The twin towers of both companies are now trying to operate their twin towers near Joshimath on solar energy.

12 JULY 2008, TRIBUNE NEWS SERVICE

Civic body wants solar power for parking lots

The MCD (Municipal Corporation of Delhi) is going all out to encourage the use of solar energy. To start with, it will be made mandatory for all upcoming multi-level parking projects to use solar power. The civic body will include a clause on the use of solar energy in its terms and conditions of the parking projects. Also, the MCD will install solar water heaters and lighting free of cost in its colonies.

“We want to encourage the use of solar energy that will help cut green house gas emissions,” said Mayor Arti Mehra. The corporation will make it mandatory for multi-level parking projects to install solar panels. The mayor said the efficient use of environment friendly energy also fetched carbon credits.

Dr N P Singh, Adviser in the Ministry of New and Renewable Energy has been accorded the title of Senior Expert in the field of solar energy and biomass by UNIDO’s (United Nations Industrial Development Organisation) International Solar Energy Centre for Technology Promotion and Transfer. This certificate was conferred at the forum, which was organized recently at Lanzhou, China. At the forum the experts committee and consultants committee of UNIDO, International Solar Energy Centre for Technology Promotion and Transfer was organized, where 41 countries, leading in solar and wind power, participated.

Dr N P Singh’s contribution in the field of solar and biomass has been recognized internationally. He has been in the field of Silicon solar cell research for a number of years. He has also worked in the area of vacuum technology. He has co-authored a book titled ‘Essentials of Solar Cell’ in which he has presented a unified treatment of the solar cell including related semiconductor physics, characterization of semi conductor material as well as of the solar cell. It provides a simple review of the sunlight properties to system applications of the solar cell. This is a very popular book among engineering students.

25 JULY 2008, HINDUSTAN TIMES

MoU for renewable energy development programme

DFC Projects Ltd and IREDA (Indian Renewable Energy Development Agency) have signed an MoU (memorandum of understanding) to structure and implement a renewable energy development programme. The MoU envisages the establishment of renewable energy industrial

‘In case of underground parking, contractors will demarcate space in the corner of a park where they can install solar panels and lighting,’ said a senior MCD official. The MCD is also planning to install solar water heaters and lighting in its colonies free of cost. ‘The initial cost of installing solar water heaters, panels, air conditioners and lighting is costly but it can be recovered in two years,’ said the official. ‘Hence, we are encouraging people to use solar energy by providing them subsidy.’ However, conventional lights will be used as back up in all parking projects. Currently, the MCD is building 16 multi-level parking projects on a build-operate-transfer basis. The civic agency has identified 33 parking sites where underground parking will be created. Depending on the success of the project, the MCD plans to make the use of solar energy mandatory for all upcoming residential and commercial projects in the city. In fact, solar panels have already been installed at the Mayor’s house.

13
parks as well as the execution of renewable energy projects in the PPP (public–private partnership) format. The MoU, signed by Pradeep Singh, Vice Chairman and MD (Managing Director), IDFC Projects and Debashish Majumdar, Chairman and MD, IREDA, will be followed by the setting up of a joint working group which, in addition to executing the above plans, will also work towards building awareness on renewable energy among civil society.  

28 JULY 2008, HINDUSTAN TIMES

**Now, green autorickshaws for walled city roads**

Buoyed by the success of the battery-operated CNG buses introduced last year in the heart of national capital’s old walled city, the Delhi government has decided to ply solar-powered ‘green’ rickshaws in the area. If everything goes as per plans, on 2 October, on the occasion of birth anniversary of Mahatma Gandhi, Delhi Chief Minister Sheila Dikshit will inaugurate the ‘green’ solar battery operated rickshaws on the arterial roads of Chandni Chowk. Weighing 210 kg and having capacity to run at a speed of 15/20 km per hour, the ‘green’ vehicles would suffice for a 70-km journey, a senior official said.

Such a plan was presented by the Ministry of Science and Technology at a meeting where area MP Kapil Sibal was also present. The chief minister said that the vehicles would also go a long way in eliminating man-pulled rickshaws.

‘To meet charging requirement of the battery in the rickshaw costing Rs 17 000, a solar panel will be set up above the Delhi Metro station at Chandni Chowk. The battery would take five hours to be charged and the Delhi Metro is being approached us in this regard,’ the official said. These ‘green’ environment-friendly rickshaws are expected to ply within the three-kilometre radius from the metro station. The solar-powered rickshaws will be initially introduced as a pilot project in Chandni Chowk and later extended to other areas in the city, the official added.

PRESS TRUST OF INDIA, 22 AUGUST 2008

**AKSHAY URJA WELCOMES ITS NEW PATRON, SHRI DEEPAK GUPTA**

Shri Deepak Gupta, took charge as Secretary, Ministry of New and Renewable Energy on 1 July 2008. Before taking charge here, Shri Gupta was working as Special Secretary in the Ministry of Health and Family Welfare. He also worked in the Ministry of Human Resources Development, Water Resources, Commerce and Industry and Ministry of Textiles. Shri Gupta also worked with WHO (World Health Organisation). He belongs to 1974 batch and Jharkhand Cadre.

**Nagpur to have Asia’s biggest solar power project**

CHANDIGARH, AUG 19

Emphasising the need for adopting non-conventional energy resources, union minister for new and renewable energy Vilas Muttemwar said today that Nagpur would soon have Asia’s biggest solar thermal generation project of 10 MW which would help meet the rising demand for energy.

Speaking on the eve of Akshay Urja Diwas, celebrated on August 20 every year on former Prime Minister Rajiv Gandhi’s birthday, Muttemwar said a special economic zone housing industries making equipment for non-conventional energy products was in the making at Nagpur.

Addressing a joint press conference with Haryana Chief Minister Bhupinder Singh Hooda, the minister said India stood fourth in the world in terms of solar energy generation.

Praising Haryana’s initiative in the non-conventional energy sector, Muttemwar said 10 per cent of the total power generation budget was being spent on renewable energy by the state government. Hooda said Haryana was given three first prizes by the President of India for its solar urban programme, the solar cooker programme and the solar photovoltaic demonstration programme last year.
Solar device to suit your pocket

Using sheets of glass covered with organic dyes, scientists have devised an efficient and practical solar power device that they believe can help make this clean, renewable energy source more affordable. Experts eager for energy sources that do not involve the burning of fossil fuels often point to the promise of solar energy—harnessing sunlight to make electricity. But solar power so far has proven costlier than standard energy sources. Writing in the journal Science, Massachusetts Institute of Technology researchers describe the development of a new type of ‘solar concentrator’ that may provide a better way to extract energy from the sun.

They used glass sheets coated in organic dyes to concentrate light hitting the panes. The dyes absorbed the light and then emitted it into the glass, which carried the light to the edges of the pane much as fibre-optic cables transport light over distances, the researchers said. At the edges of the glass are located small solar cells that then transform the light into electricity. ‘It consists of just a piece of glass with a layer of paint on top of it,’ MIT electrical engineering professor Marc Baldo, who led the research, said.

‘The idea is the light comes in and hits the paint. The paint then bounces the light out to the edges of the glass. All you need is the solar cells on the edges. So we think we can use this to reduce the cost of solar electricity,’ added said. MIT researcher Jonathan Mapel, who also worked on the study, said the hope is that the use of this sort of technology can help bring the cost of solar power closer to the cost of conventional fossil fuel power sources such as coal. ‘One of the challenges with solar (energy) in general is that it’s just too high in cost. And what you’d like to do is reduce the price of solar electricity,’ Mapel said.

Japanese town becomes a lab for clean energy

In the mountains of northern Japan, wind, sun, and even cow dung are being turned into electricity as part of efforts to turn a whole town into an experiment in renewable energy use. The town is a sprawling laboratory for the whole of the archipelago, which has almost no fossil fuels of its own and is seeking to diversify its energy sources to reduce dependence on Middle Eastern oil. It was at the end of the 1990s that Kuzumaki, under its then-mayor Tetsuo Nakamura, made the push into clean energy. ‘Global oil stocks were getting scarce. Energy was going to become the issue of the 21st century’, Nakamura recalled.

The urgent task was to safeguard Kuzumaki’s finances in the face of rural depopulation. The mayor set three priorities: the forest industry, dairy farming, and clean energy. At that time, Kuzumaki had only three windmills, but it was also home to the biggest semi-public dairy farm in Japan with 3000 cows, as well as a wine-growing industry, launched by the city with help from private companies. Now even the cows are doing their bit as the town produces electricity in part from methane that comes from the manure of 200 of them. The 37 kW (kilowatts) of power the cows here help to produce is modest and costly but the goal, as with the windmills and solar power, is to test a technology fresh out of the laboratory.

The state provided half of the 5.7 billion yen ($53 million) investment for the town’s clean energy project, almost matching private companies. Kuzumaki invested 45 million yen ($420 000). The result: 12 additional windmills were constructed, raising the town’s wind
power to 22 200 kW—enough to supply 16 900 homes with electricity, far more than the 2900 households in the city.

‘Some said that the windmills would ruin the landscape. But it was the best possible choice, from both an economical and ecological viewpoint,’ said the former mayor.

Home to 8000 people, Kuzumaki is lucky enough to have a territory of 400 square kilometre, an area the size of Yokohama with its 3.6 million residents. Wind is not the only natural energy the town is seeking to harness—solar panels supply one quarter of the electricity used by a local school. Kuzumaki, which presents itself as ‘the city of milk, wine, and clean energy’, now attracts 500 000 tourists a year, helping to spread the message.

Harvest the sun from space

As we face $4.50 a gallon gas, we also know that alternative energy sources coal, oil shale, ethanol, wind, and ground-based solar are either of limited potential, very expensive, require huge energy storage systems, or harm the environment. There is, however, one potential future energy source that is environmentally friendly, has essentially unlimited potential, and can be cost competitive with any renewable source: space solar power. Science fiction? Actually, no—the technology already exists. A space solar power system would involve building large solar energy collectors in orbit around the earth. These panels would collect far more energy than land-based units, which are hampered by weather, low angles of the sun in northern climes and, of course, the darkness of night.

Once collected, the solar energy would be safely beamed to earth via wireless radio transmission, where it would be received by antennas near cities and other places where large amount of power is used. The received energy would then be converted to electric power for distribution over the existing grid. Scientists have projected that the cost of electric power generation from such a system could be as low as 8 to 10 cents per kilowatt-hour, which is within the range of what consumers pay now.

In terms of cost effectiveness, the two stumbling blocks for space solar power have been the expense of launching the collectors and the efficiency of their solar cells. Fortunately, the recent development of thinner, lighter, and much higher efficiency solar cells promises to make sending them into space less expensive and return of energy much greater. Much of
the progress has come in the private sector. Companies like Space Exploration Technologies and Orbital Sciences, working in conjunction with NASA’s public–private Commercial Orbital Transportation Services initiative, have been developing the capacity for very low cost launchings to the International Space Station. This same technology could be adapted to sending up a solar power satellite system.

Still, because building the first operational space solar power system will be very costly, a practical first step would be to conduct a test using the International Space Station as a ‘construction shack’ to house the astronauts and equipment. The station’s existing solar panels could be used for the demonstration project, and its robotic manipulator arms could assemble the large transmitting antenna. While the station’s location in orbit would permit only intermittent transmission of power back to earth, a successful test would serve as what scientists call ‘proof of concept’.

Over the past 15 years, Americans have invested more than $100 billion, directly and indirectly, on the space station and supporting shuttle flights. With an energy crisis deepening, it’s time to begin developing a huge return on that investment.

And for those who worry that science would lose out to economics, there’s no reason that work on space solar power couldn’t go hand in hand with work towards a manned mission to Mars, advanced propulsion systems and other priorities of the space station. In fact, in a time of some skepticism about the utility of our space programme, NASA should realize that the American public would be inspired by our astronauts working in space to meet critical energy needs here on earth.

28 JULY 2008, DECCAN HERALD

New way to store solar energy on a rainy day

A US scientist has developed a new way of powering fuel cells that could make it practical for home owners to store solar energy and produce electricity to run lights and appliances at night. A new catalyst produces the oxygen and hydrogen that fuel cells use to generate electricity, while using far less energy than current methods. With this catalyst, users could rely on electricity produced by photovoltaic solar cells to power the process that produces the fuel, said the MIT (Massachusetts Institute of Technology) professor who developed the new material. ‘If you can only have energy when the sun is shining, you’re in deep trouble. And that’s why, in my opinion, photovoltaics haven’t penetrated the market,’ Daniel Nocera, an MIT professor of energy, said.

‘If I could provide a storage mechanism, then I make energy 24x7 and then we can start talking about solar.’ Solar has been growing as a power source in the US. But it is still a tiny power source, producing enough energy to meet the needs of about 60 000 typical homes, and only while the sun is shining. Nocera said his development would allow people to bank solar energy as hydrogen and oxygen, which a fuel cell could use to produce energy when the sun was not shining.

2 AUGUST 2008, THE TIMES OF INDIA
Scientists are working to convert sunlight to cheap electricity at the SDSU (South Dakota State University). Research scientists are working with new materials that can make devices used for converting sunlight to electricity cheaper and more efficient. Assistant professor Qiquan Qiao in SDSU’s Department of Electrical Engineering and Computer Science said that the so-called OPVs (organic photovoltaics) are less expensive to produce than traditional devices for harvesting solar energy. Qiao and his SDSU colleagues also are working on OLEDs (organic light-emitting diodes).

The new technology is sometimes referred to as ‘molecular electronics’ or ‘organic electronics’—organic because it relies on carbon-based polymers and molecules as semiconductors rather than inorganic semiconductors such as silicon. ‘Right now the challenge for PV is to make the technology less expensive,’ Qiao said. ‘Therefore, the objective is find new materials and novel device structures for cost-effective PV devices. The beauty of OPVs and OLEDs is their low cost and flexibility,’ the researcher continued. ‘These devices can be fabricated by inexpensive, solution-based processing techniques similar to painting or printing.’

‘The ease of production brings costs down, while the mechanical flexibility of the materials opens up a wide range of applications,’ Qiao concluded. OPVs and OLEDs are made up of thin films of semiconducting organic compounds that can absorb photons of solar energy. Typically an organic polymer, or a long, flexible chain of carbon-based material, is used as a substrate on which semiconducting materials are applied as a solution using a technique similar to inkjet printing. ‘The research at SDSU is focused on new materials with variable band gaps,’ Qiao said. ‘The band gap determines how much solar energy the PV device can absorb and convert into electricity.’

Qiao explained that visible sunlight contains only about 50% of the total solar energy. That means the sun is giving off just as much non-visible energy as visible energy. ‘We’re working on synthesizing novel polymers with variable band gaps, including high-, medium-, and low-band gap varieties, to absorb the full spectrum of sunlight. By this we can double the light harvesting or absorption,’ Qiao said. SDSU’s scientists plan to use the variable band gap polymers to build multi-junction polymer solar cells or PV. These devices use multiple layers of polymer/fullerene films that are tuned to absorb different spectral regions of solar energy. Ideally, photons that are not absorbed by the first film layer pass through to be absorbed by the following layers.

The devices can harvest photons from ultraviolet to infrared in order to efficiently convert the full spectrum of solar energy to electricity. SDSU scientists also work with OLEDs focusing on developing novel materials and devices for full color displays. ‘We are working to develop these new light-emitting and efficient, charge-transporting materials to improve the light-emitting efficiency of full color displays,’ Qiao said. Currently, LED technology is used mainly for signage displays. But in the future, as OLEDs become less expensive and more efficient, they may be used for residential lighting, for example.

The new technology will make it easy to insert lights into walls or ceilings. But instead of light bulbs, the lighting apparatus of the future may look more like a poster, Qiao said. Qiao and his colleagues are funded in part by SDSU’s electrical engineering PhD programme and by the National Science Foundation and South Dakota EPSCoR, the Experimental Program to Stimulate Competitive Research.

In addition, Qiao is one of about 40 faculty members from SDSU, the South Dakota School of Mines and Technology and the University of South Dakota who have come together to form PANS (Photo Active Nanoscale Systems). The primary purpose is developing PV, or devices that will directly convert light to electricity.
A new programme called ‘Roshni’ was inaugurated by the President of India, Smt. Pratibha Devisingh Patil on 25 July 2008 at the President Estate Auditorium. The aim of this programme was

- conserving power through renewables and improved energy-saving technologies,
- waste management,
- water management, and so on within the President’s estate, and
- increasing the green cover.

As a part of the programme, an exhibition was also organized at the President Estate.

‘Roshni’ is being implemented by the CPWD, BEE, Delhi Forest Department, Central Electronics Ltd, Central Groundwater Board, and others. MNRE (Ministry of New and Renewable Energy) was invited to demonstrate renewable-energy-based devices/products in the exhibition. Devices such as solar streetlights, solar water heater, solar lanterns, solar cookers, and solar inverters were displayed and demonstrated in the exhibition.
Introduction

Recent technological developments in biomass have made it possible to deploy various biomass-based systems for meeting total energy requirements of villages in an efficient, reliable, and cost-effective manner. Modern biomass technologies offer considerable efficiency gains over traditional biomass use. A concept to provide energy security in villages through renewable energy particularly through biomass has been developed. To begin with, a limited number of test projects on village energy security are being taken up in remote villages and hamlets that are not likely to be electrified through conventional means, with emphasis on forest fringe and tribal villages. The aim of the test projects on village energy security goes beyond electrification by addressing the total energy requirements for cooking, electricity, and motive power.

An outline plan was prepared with the objective of providing energy security in villages by meeting total energy needs for cooking, electricity and motive power through various forms of biomass material based on available biomass conversion technologies and other renewable energy technologies, where necessary. The benefits from such projects can be immense, including employment generation and enhanced incomes to rural households. This can be achieved in an environment friendly and sustainable manner through active and full participation of local communities.

Test projects on village energy security

Initially about 200 test projects on village energy security are being taken up with a view to demonstrate the techno-economic parameters of the village energy security plan, provide operational experience, mobilize local communities, etc.
and firm up the implementation and management strategy, institutional arrangements, and so on. The villages for the projects are selected with a view to provide broad-based feedback in the light of inter-regional variations with regard to resource availability, energy requirements, and social cohesion among local communities. Maximum demonstration effect would be derived through coverage in several states in different regions.

Identification of villages/hamlets

Identification of suitable villages/hamlets, which have a conducive environment for implementation of such test projects, is critical for their success. The village/hamlet identified could be a tribal or forest-fringe village/hamlet. The selected village/hamlet should have adequate availability of fallow, common or uncultivated non-grazing land for raising plantations. A cohesive and progressive social structure is also an important requirement.

The village/hamlet should have minimum of about 50 and maximum of 400 households and should be identified in consultation with forest, tribal and rural development departments/agencies. After selection of the village/hamlet, a preliminary proposal is prepared, got duly endorsed by the concerned State Nodal Agency and forwarded to the Ministry for consideration of ‘in principle’ approval. The format for preparation of preliminary proposal is given in the Box 1. An agree-to-do (ATD) Resolution from the Gram Sabha is an integral part of the preliminary proposal.

The test projects are undertaken in un-electrified villages and hamlets that are not likely to be electrified through conventional means. A certificate to this effect from a State Agency needs to be forwarded along with the preliminary proposal.

Preparation of a Village Energy Plan

A Village Energy Plan is prepared, with active and full participation of the village community. An assessment of the total energy demand needs is made, which may include requirements of energy for:-

- Household cooking,
- Household electricity for lighting, fans, and entertainment
- Community, commercial facilities such as shops, streetlights, health center, school, flourmill, information and communication technology
- Pumping water for drinking, irrigation
- Rural / cottage industry
- Any other specific demand

The minimum energy services to be provided for in any project should

<table>
<thead>
<tr>
<th>Box 1</th>
<th>FORMAT FOR PREPARATION OF PRELIMINARY PROPOSALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Name &amp; Full Address of the Implementing Agency (Forest Department / DRDA / NGO)</td>
</tr>
<tr>
<td>2.</td>
<td>Name &amp; Full Address of State Nodal Deptt./Agency</td>
</tr>
<tr>
<td>3.</td>
<td>Name of Gram Panchayat, Block &amp; District</td>
</tr>
<tr>
<td>4.</td>
<td>No. of Villages under Gram Panchayat</td>
</tr>
<tr>
<td>5.</td>
<td>Name of Village / hamlet selected for the Project</td>
</tr>
<tr>
<td>6.</td>
<td>Village census code</td>
</tr>
<tr>
<td>7.</td>
<td>Distance from nearest road-head</td>
</tr>
<tr>
<td>8.</td>
<td>Distance from the grid</td>
</tr>
<tr>
<td>9.</td>
<td>Length of transmission and distribution line required in the village.</td>
</tr>
<tr>
<td>10.</td>
<td>Total population of the village / hamlet</td>
</tr>
<tr>
<td>11.</td>
<td>Male / Female ratio</td>
</tr>
<tr>
<td>12.</td>
<td>Rate of literacy</td>
</tr>
<tr>
<td>13.</td>
<td>No. of households</td>
</tr>
<tr>
<td>14.</td>
<td>Number of Hamlets / Dalit Bastis in Village</td>
</tr>
<tr>
<td>15.</td>
<td>Type of Social Structure</td>
</tr>
<tr>
<td>16.</td>
<td>Community buildings – school, PHC, panchayat ghar, etc.</td>
</tr>
<tr>
<td>17.</td>
<td>Main occupation, indicating cash crops</td>
</tr>
<tr>
<td>18.</td>
<td>Biomass resource availability - type of biomass, local fuel wood / oil-seed bearing species, if any, cattle population and likely availability of dung for biogas plant.</td>
</tr>
<tr>
<td>19.</td>
<td>Availability of fallow land / waste land / uncultivated land etc. for energy plantations</td>
</tr>
<tr>
<td>20.</td>
<td>Availability of water with distance, depth etc.</td>
</tr>
<tr>
<td>21.</td>
<td>Indicative Estimate of Energy Demand</td>
</tr>
<tr>
<td>(a)</td>
<td>Household – cooking, lighting, other</td>
</tr>
<tr>
<td>(b)</td>
<td>Community services, including streetlights</td>
</tr>
<tr>
<td>(c)</td>
<td>Irrigation/Agriculture Operations</td>
</tr>
<tr>
<td>(d)</td>
<td>Commercial (Shops, Atta chakki, Oil expeller, etc.)</td>
</tr>
<tr>
<td>(e)</td>
<td>Industrial</td>
</tr>
<tr>
<td>22.</td>
<td>Proposed productive load development in the village.</td>
</tr>
<tr>
<td>23.</td>
<td>Existing pattern of energy / fuel use and average monthly expenditure per household</td>
</tr>
<tr>
<td>24.</td>
<td>Existing renewable energy devices in the village, if any</td>
</tr>
<tr>
<td>25.</td>
<td>Existing rural developmental schemes of Central/State Govt. in the village and proposed possible lineages with VESP.</td>
</tr>
<tr>
<td>26.</td>
<td>Biomass Technology package proposed to be deployed</td>
</tr>
<tr>
<td>27.</td>
<td>Indicative capacity of the energy systems</td>
</tr>
<tr>
<td>28.</td>
<td>Role of local community in planning, implementation and management, including revenue management</td>
</tr>
<tr>
<td>29.</td>
<td>Details of any local NGO already associated with the village / hamlet</td>
</tr>
<tr>
<td>30.</td>
<td>Agree-to-do (ATD) resolution to be attached to the preliminary proposal.</td>
</tr>
<tr>
<td>31.</td>
<td>Any other information</td>
</tr>
</tbody>
</table>
include cooking, lighting, street lights, pumping for drinking water supply, lights / fans in the school and primary health center etc.

An assessment of the biomass resources available locally is to be carried out. These may include dung, agro wastes, forestry residues, etc. Appropriate fast growing / oil seed bearing tree species are identified and a plan is prepared for raising the plantations for obtaining wood, vegetable oil and other raw materials. Until the plantations reach an age when annual increments of growth and other raw materials become available, biomass offset from use as cooking fuel and other locally available biomass can be utilized for energy production.

Based on the total energy requirements and the local resource availability, the energy production systems are configured. For an energy production system based on biomass, an appropriate technology mix can be selected from available biomass conversion technologies such as:-
- Single / Bi-phasic biogas production using tree based organic substrates, vegetable wastes / residues, vegetable wastes / kitchen wastes, animal dung etc.
- Biomass Gasifier coupled with 100% producer gas engines for electricity generation
- Stationary diesel engines run on straight vegetable oils or bio-diesel.
- The energy efficient Improved Chulha for each household
- Raising the plantations for obtaining wood, vegetable oil and other raw materials

Depending upon specific requirements, inclusion of solar photovoltaic devices such as solar lanterns or an appropriate battery backup arrangement could be considered in the system configuration.

Electricity distribution preferably to be carried out through a local mini grid. Emphasis should be on energy to be provided for productive activities with thrust on micro enterprise development, backed by micro credit facilities, with a view to facilitating job creation, income generation, increasing the purchasing capacity and reducing the migration from villages. The Guidelines for preparation of the Village Energy Plan are given in Box 2.

**Box 2 - PREPARATION OF VILLAGE ENERGY PLAN**

- **Demand** – Current and potential, special emphasis on loads related to income generation. Estimate of time taken to ramp up to full projected demand
- **Load management** – Load chart preparation taking into account seasonal variations in use of electricity, especially for irrigation
- **Plant sizing** – Sizing of the plant, capacity utilization factor for the plant as per the load chart
- **Technological options** – SVO or gasifier or biogas, taking into account load pattern, capacity utilization factor and type of biomass fuel available
- **Sources of biomass** – Current and potential, its stability
- **Financing plan** – Capital expenditure for power plant and other investments needed to reach projected demand. Sourcing working capital, sources of revenue, tariff setting, other non-tariff sources of revenue, operational sustainability, cash flow statement, plan to meet revenue gap if any, pay back period
- **Human resources** – Community empowerment, involving them in ownership and decision-making, training in operation and management of the power plant
- **MIS** – How information would be captured with respect to key elements and how it would be used by the management (Village Energy Committee) should be spelt out.
- **Risk management** – Identification of risk and how it would be managed
- **Project implementation plan** – Tasks and milestones with timelines and clear identification of responsibilities should be presented

In preparing and finalizing the VEP, Participatory Rural Appraisal (PRA) techniques should be used. This would among other things help:
- Introduce the VESP project, its structure, guidelines, etc. to the community.
- The community in making a choice of which energy needs is more important to them.
taken that the elected Panchayat member/s from that village are ex-officio members of the VEC.

**Creation of a Village Energy Fund**

A Village Energy Fund should be got created under the provisions of State Panchayati Raj Act, initially with beneficiary contributions for sustained operation and management of the project. Subsequent monthly / annual user charges should be deposited in this account. Grants from other Government Programmes such as rural development, forestry, tribal development, etc., if available, should be placed in this account, to be utilized towards operation and management of the project. The fund should be managed by the Village Energy Committee with two signatories nominated by the Committee. One of the signatories would be the Gram Panchayat member who is the ex-officio member on the Committee.

A separate capital account should also be got created, for receipts towards supply and installation of the energy production units. This Capital Account would also be operated by the VEC in accordance with the same procedure of joint signature and maintenance of accounts, which govern the Village Energy Fund. Both the VEF and the Capital Account of the VEC, being the accounts of the Gram Panchayat under the provisions of the law, would be subject to the processes of accounts maintenance and audit that apply to the Gram Panchayat.

Implementation of the test projects

The test projects are undertaken by the Panchayats/VECs duly facilitated by implementing Agencies such as DRDAs, forest departments, NGOs, entrepreneurs, franchises, other corporate entities, co-operatives and State Nodal Agencies. An implementing agency can forward the proposals for the test projects to the Ministry through the State Nodal Agency. The Detailed Project Report should, inter-alia, include the following information:

(i) Census code number of the village
(ii) Village Energy Plan
(iii) Confirmation about setting up of Village Energy Committee and creation of Village Energy Fund
(iv) Plan for training
(v) Implementation modalities
(vi) O&M arrangements
(vii) Commitment about balance 10% capital cost and funds for operation and management

The projects are owned by the village community with the responsibility for overall operation / management. However, the implementation agency helps them for about two years in this activity for which one-time Central assistance is provided. During this period, the implementing agency needs to train local youth in the operation and management of the project. After this period, the responsibility of operation / management should be undertaken by the Village Energy Committee. The Village Energy Committee may hire / lease out these services to an entrepreneur as a preferred option. The concerned State Nodal Agency closely monitors the implementation of the projects and provide monthly progress reports to the Ministry until commissioning.

**Project Costs**

Different packages based on the no. of households (50-250) in the village have
been prepared. For bigger villages upto 400 households, projects could be considered based on similar cost benchmarks. However, in specific cases the applicability of a package may not be dependent only on no. of households but will have to be considered on merit taking into account the resource availability, technology configuration, load profile, layout of the village etc. The cost of project depends upon the packages based on different technology configurations for electricity generation systems, biogas plants, improved chulhas, plantations etc. The estimated cost of a typical project for 100 households with biomass gasifiers electricity generating systems is given in Table 1.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Items</th>
<th>Qty./Nos.</th>
<th>Estimated cost (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Part A - Fixed Cost</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Biomass gasifier system with 100% producer gas engine/genset including all accessories with 5 years Annual Maintenance Contract including two year’s warrantee</td>
<td>1 × 10 kW</td>
<td>775000</td>
</tr>
<tr>
<td>2.</td>
<td>Civil foundation &amp; shed including storage shed for biomass and water tank.</td>
<td>LS</td>
<td>200000</td>
</tr>
<tr>
<td>3.</td>
<td>Gasifier room lights @ Rs.500/- per light</td>
<td>5</td>
<td>2500</td>
</tr>
<tr>
<td>4.</td>
<td>Atta Chakki / Rice Huller including connection and all equipments (Load development such as Dona Patta making machine etc.)</td>
<td>1</td>
<td>200000</td>
</tr>
<tr>
<td><strong>SUB TOTAL (fixed cost)</strong></td>
<td></td>
<td><strong>997500</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Variable Cost</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Plantation for fuel wood and oil-seed bearing trees @ Rs.30,000/- per ha</td>
<td>5 ha</td>
<td>150000</td>
</tr>
<tr>
<td>6.</td>
<td>Distribution line for 2 km @ Rs.1,50,000/km (as per SEB norms)</td>
<td>LS</td>
<td>300000</td>
</tr>
<tr>
<td>7.</td>
<td>Service line (@ Rs.1500/- per HH) with 2 light points and one 5 Amp. socket point per HH (as per SEB norms)</td>
<td>100</td>
<td>150000</td>
</tr>
<tr>
<td>8.</td>
<td>Battery back-up with Inverter to be charged by electricity generating unit.</td>
<td>1 × 5 kW</td>
<td>350000</td>
</tr>
<tr>
<td>9.</td>
<td>Street Lighting @ Rs.2,500/- per light</td>
<td>10 Nos.</td>
<td>25000</td>
</tr>
<tr>
<td>10.</td>
<td>Dung based biogas plants inclusive all accessories &amp; Civil Works for 25 HH @ 2 CuM per HH @ Rs.5000/- per CuM</td>
<td>50 M³</td>
<td>250000</td>
</tr>
<tr>
<td>11.</td>
<td>Improved Chulha fixed type / Portable or Turbo Portable Chulha (maximum Subsidy @ Rs.500/- per chulha)</td>
<td>100 Nos.</td>
<td>50000</td>
</tr>
<tr>
<td><strong>SUB TOTAL (variable cost)</strong></td>
<td></td>
<td><strong>1275000</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Optional Cost</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Oil Expeller with filter press and heater (35 kg/hour)</td>
<td>1</td>
<td>100000</td>
</tr>
<tr>
<td><strong>Sub Total [A]</strong></td>
<td></td>
<td><strong>2372500</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Part B - Capacity building</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>Capacity building, training, awareness and visits to project sites and manufacturer’s works.</td>
<td>LS</td>
<td>100000</td>
</tr>
<tr>
<td>14.</td>
<td>Social Engineering/Community mobilization</td>
<td>LS</td>
<td>100000</td>
</tr>
<tr>
<td><strong>Sub Total [B]</strong></td>
<td></td>
<td><strong>200000</strong></td>
<td></td>
</tr>
<tr>
<td><strong>GRAND TOTAL [A] + [B]</strong></td>
<td></td>
<td><strong>2572500</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Part C - Execution and Operational Cost</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>Professional Charges to the Implementing Agency (10% of the Part A)</td>
<td></td>
<td>237250</td>
</tr>
<tr>
<td>16.</td>
<td>Charges to State Nodal Agency for coordination and monitoring (5% of the Part A)</td>
<td></td>
<td>118625</td>
</tr>
<tr>
<td>17.</td>
<td>Operation and Maintenance Charges to the Implementing Agency for initial period of 2 years (10 % of the Part A)</td>
<td></td>
<td>237250</td>
</tr>
<tr>
<td><strong>Sub Total [C]</strong></td>
<td></td>
<td><strong>593125</strong></td>
<td></td>
</tr>
<tr>
<td><strong>GRAND TOTAL [A+B+C]</strong></td>
<td></td>
<td><strong>3165625</strong></td>
<td></td>
</tr>
</tbody>
</table>

1 – Depending on Village layout and number of households; 2 – Depending on resource availability and demand; * – Estimates for 100 households; + – Cost sharing on 90:10 basis between the Ministry and SNA/Implementing Agencies/beneficiary; 100% support from the Ministry.

Note: 20% higher project cost will be allowed in special category states, namely, North-Eastern States (including Sikkim); Himachal Pradesh; Uttarakhand; and, Jammu & Kashmir.
Financial assistance for the test projects

Central grant of 90% of the project cost approved by the Ministry is provided. The balance 10% towards the project cost needs to be mobilized by the community / implementing agency / State Nodal Agency. There is separate provision for providing funds for community mobilization, social engineering, operation & maintenance, capacity building, service charges and professional charges etc.

Project Ownership

The project is owned by the Village Community, executed by them with technical support from State Nodal Agency and is managed by the Village Energy Committee including regular operation and maintenance.

Present Status

A limited number of test projects on village energy security are being taken up and at present 65 projects are under implementation in nine States namely, Assam, Andhra Pradesh, Chhattisgarh, Gujarat, Jharkhand, Maharashtra, Orissa, Tamilnadu and West Bengal. Twenty nine of these have so far been commissioned. A total of 200 such projects will be taken up till 31st March, 2010. These projects are taken up in remote villages, and hence face challenges due to remoteness in operation & maintenance, post installation services, resource availability, lack of productive load, lack of revenue generation and lack of community participation. However, once the project is setup, the smiling faces of villagers from the remotest villages can be seen, one such village is Bhalupani in Mayurbhanj District of Orissa when the villagers are happy with the electricity and other energy systems in their life (see Box 3).

BHALUPANI TEST PROJECT IN MAYURBHANJ DISTRICT OF ORISSA

10kW biomass gasifier plant at village Bhalupani in Mayurbhanj district of Orissa. Left inset shows biomass feedstock and right inset shows the electricity distribution line.

Bhalupani test project in Simlipal Forest Range in Mayurbhanj District of Orissa was inaugurated and dedicated to the villagers on 7th November 2007. Bhalupani is a remote, tribal and forest fringe hamlet with 44 households of Suanspaul village and situated at a distance of about 390 km. from Bhubaneswar. This project was implemented by an NGO, namely, SAMBANDH, which is running several income generating activities at their Center, adjacent to the village. A 10 kW capacity biomass gasifier plant has been installed and the electricity generated is being used for running Honey Processing Unit of 8- kW capacity; Dona Patta (leaf cup) making machine of 2 kW capacity and a Rice Hauler 5 kW capacity. About 11 Self Help Groups (each group consisting of 20-25 members), including the Bhalupani villagers, are working in the center on different income generating activities. The smile on the faces of the villagers during the inauguration speaks volumes of their happiness. When asked about what was the most wonderful thing about electricity coming to the hamlet, a villager said, “Now my child can study at night also”.

Bhalupani Village Electrified through biomass gasification in Distt. Mayurbhanj, Orissa
The recently released Global Status Report on Renewables 2007 says that grid-connected SPV (solar photovoltaics) has been the fastest growing energy technology in the world with 50% annual growth in the cumulative installed capacity in 2006 as well as in 2007. The majority of the above capacity comes from about 1.5 million homes across Germany, Japan, Spain, and the US, which have installed small PV systems (a few kilowatts to tens of kilowatts) on their rooftops, feeding the electricity into the grid through two-way meters and enjoying the benefits of net-metered electricity bills at the end of the month. Technologies such as BIPV (building integrated PV), where PV panels double up as electricity generators as well as building facades, tiles, and walls by replacing the building material with aesthetically designed PV panels, have begun to get noticed by the architects and builders. This market is virtually non-existent in India which otherwise has a good track record of utilizing solar PV technology for off-grid applications ranging from power for off-shore oil and gas platforms to lighting up remote rural homes with solar home systems.

Of the total reported 25 lakh homes worldwide that use solar home systems today about 3.6 lakh are in India, second only to China which has 4 lakh solar home system users. In fact, India’s early commitment to promote solar PV arose from its concerns about energy access and energy security for all. The market for solar PV continues to be relevant in such decentralized off-grid applications even after huge resources were made available under the rural electrification programme.
schemes of the Ministry of Power and the Ministry of New and Renewable Energy. About 7.6 crore homes still use kerosene for lighting. Though lighting is not synonymous with electrification, and which by no means can be equated with energization (that includes energy for cooking, among others), it still is one of the primary amenities required by a household to step on to the socio-economic-cultural developmental ladder. This basic amenity is not provided to 56.5% of the 13.8-crore rural homes and 12.4% of roughly 5.37 crore urban homes in India, which continue to burn biomass, wax candles, and kerosene lamps, spending Rs 2 to 5 per day.

The solar lantern, a portable lighting device that uses CFL, has its own rechargeable battery inside that can be charged everyday using an 8- to 10-watt solar panel. This is an ideal device to light up homes that currently use biomass or kerosene for lighting. About 5.8 lakh solar lanterns have been distributed in India in the past 7 to 8 years under the programme of MNRE. The solar lantern with its solar panel currently costs about Rs 3200–3600 of which the user generally pays only 50%, as the remaining amount is supported through a central subsidy. It is also given free to some user categories.

However, an upfront payment of Rs 1800 often becomes a deterrent for the prospective user who can afford and probably is willing to pay smaller amounts on a daily or weekly basis. Such a scenario points to a potential microfinance market, provided the prospective user can be convinced about paying an instalment for a device that does not fetch him/her any direct income.

A solar lantern, though much cheaper compared to a solar home system, has not found much favour either with the lender or with the borrower except in a few pilots where the less expensive versions of white LED based solar lanterns are being sold to rural communities. While white LEDs and other advanced lighting technologies are going to revolutionize the lighting market, one should not forget that these technologies have to penetrate the urban market first, before they can be accepted by the rural masses.

When we shift the focus to the benefits rather than costs of switching to solar lanterns from the current options of kerosene lamp and candles (or nothing), the results are interesting. As per the National Sample Survey Organization’s survey on energy consumption patterns in 2005, and TERI’s rural energy projects data, a rural household consumes an average of 4 litres of kerosene per month for lighting. A total of 7.6 crore rural households would thus be consuming an average 3.6 billion litres of kerosene annually. At carbon emission intensity, or a release rate, of 2.4 kg CO2 per litre of burnt kerosene, the atmosphere gets polluted by 9 million tonnes of CO2 annually. This may well translate into a $90 million carbon market annually at a modest rate of $10 per tonne of CO2. Quite apart from direct carbon revenue benefits, each solar lantern offers a net annual saving of Rs 1200 by way of avoided kerosene subsidies estimated at approximately Rs 25 per litre. If the cumulative subsidy amount is instead targeted at solar lanterns, it would lessen the burden on a rural household to switch to a solar lantern.

The Kasturba Gandhi Balika Vidyalaya is a flagship scheme of the government that provides hostel facilities for schools for girl children of SC/ST and OBC categories. In the
Remote villages and hamlets in Arunachal Pradesh are the best examples of communities, which are most appropriate for electrification through renewable energy resources. They are small, far away from the roads, and the people there lead generally a subsistence level of life. The MNRE has been supporting the efforts of APEDA (Arunachal Pradesh Energy Development Agency) to provide some comfort to such households with the help of SPV (solar photovoltaic) home-lighting systems. About 200 remote villages have so far been covered under the RVEP (Remote Village Electrification Programme). APEDA has been implementing the projects with financial support from the ministry and has over the years, established a good network of service/maintenance technicians even in the remotest parts. The agency claims that SPV home-lighting systems have been widely welcomed by the householders and there is a vast unmet demand for such systems from other villages.

Let us now one again shift the focus, this time to the delivery and after sales service of solar systems. Who, where, how, and at what cost can deliver these services in remotest corners? Apart from the resources available through avoided kerosene subsidies, how will an initiative of lighting millions of homes using solar lanterns be financed and sustained? Let us first think from the user’s perspective. A household or a rural enterprise (shop, kiosk) would probably not have a constraint in spending Rs 2 to 5 per night for the use of solar lantern, even without actually owning the device. Some may even want to rent additional lanterns if charged lanterns are available on rent within a village. Also, it cannot be assumed that a village resident can easily purchase an item worth Rs 3200. Alternately, he/she may want to spend about half that amount (Rs 1600–1800) to purchase a lantern without the solar panel and pay a daily fee for charging, if such a facility is locally available.

We are talking about a delivery and service model familiar to most rural and peri-urban communities where households purchase new or recycled car batteries and charge them from the nearest battery-charging shop running either on diesel-generating set or grid electricity. This fee-for-service model is well established and thriving in most power-deficit areas. These one-stop entrepreneurial outlets offer repair, maintenance, and all other related services. If this model were to be adopted for solar lanterns, then we are talking about setting up solar-charging stations at village level, with not just solar-charging services for lanterns but also for mobile telephones, and other battery-operated devices.

A solar lantern is a powerful tool to take rural communities from darkness to light. It is also a commitment that would bind governments, corporations, the non-governmental sector, civil society, and individuals to light up a billion lives not only in India but across the globe as well.

**SPV home-lighting systems in Arunachal Pradesh**

Remote villages and hamlets in Arunachal Pradesh are the best examples of communities, which are most appropriate for electrification through renewable energy resources. They are small, far away from the roads, and the people there lead generally a subsistence level of life. The MNRE has been supporting the efforts of APEDA (Arunachal Pradesh Energy Development Agency) to provide some comfort to such households with the help of SPV (solar photovoltaic) home-lighting systems. About 200 remote villages have so far been covered under the RVEP (Remote Village Electrification Programme). APEDA has been implementing the projects with financial support from the ministry and has over the years, established a good network of service/maintenance technicians even in the remotest parts. The agency claims that SPV home-lighting systems have been widely welcomed by the householders and there is a vast unmet demand for such systems from other villages.
Handing power to the villages

NOMITA DRALL, Freelance Reporter, New Delhi

Well before dawn breaks in a remote Jharkhand village, the first thing a 13-year-old girl does is to hand-wind her lantern, and then gets down to homework. But, in many Indian villages, smoky kerosene lamps are all that keeps the darkness at bay. However, kerosene is a dangerous and increasingly expensive source of light for the many Indians who still do not have access to electricity.

But, now a new revolutionary, renewable and clean energy product is showing the light, quite literally in many rural homes. The Kisan Torches and Lanterns manufactured by the Freeplay Energy Group and distributed by IFFCO (Indian Farmers Fertiliser Cooperative Ltd) need no batteries, no kerosene, no electricity and come with a very long shelf life including one year warranty.

They’re ideal for emergencies and outdoor/indoor activities, and are also good for everyday use in their homes. After all, what’s more renewable than human power? Both the torch and the lantern give you about 15 to 20 minutes of shine per every minute of cranking, which is pretty good for a small hand-crank device. Also, the cranking does not need to be done at one go but can be done at convenient intervals.

With all of the emphasis on saving energy and eco-friendliness these days, hand-crank technology has seen increased use in devices ranging from torches and cell phone chargers to generators. The Freeplay Energy Group designs, manufactures and markets a range of portable products that make use of human energy. Freeplay Energy’s core technology revolves around the efficient conversion and storage of applied human energy and the delivery of this energy on demand as electricity to create self-powered electronic devices. Initial applications include torches/lanterns, radios (both consumer and humanitarian), mobile phone chargers and standalone foot chargers and the company has a new product development plan which anticipates broadening the application of its technology into numerous new product categories.

The 45% or so of people in India hooked up to a power grid suffer chronic, daily power cuts. Others trek long distances to buy a few expensive litres of polluting kerosene for lamps, often finding no supplies, much of it is sold in the black market to dilute petrol and diesel fuel. Batteries are one solution, but batteries are expensive and require frequent replacement. Further their disposal continues to provide environmental nightmares in the absence of an effective waste disposal policy. It is imperative that we move away from fossil fuels and look towards other alternatives sources of energy, which is efficient, clean, and inexpensive if we have to serve the needs of the rural population of the country.

Human kinetic energy is an important renewable source and can be transferred in a number of ways. Human energy is most commonly used to propel bicycles, but can also be used to generate electricity and power hand-crank tools. Some third world organizations are implementing human powered technologies to generate electricity to power computers and other appliances. In a time when many people are focusing on solar power or wind power as the main renewable resources, what is often overlooked is good old human power.

Everyone is convinced that ‘with the climate change a worrying issue and oil prices on fire, renewable energy is no longer an alternative option but the only way forward’. This is all the more relevant in the remote villages and the rural areas of the country that do not have access to conventional sources of power at all. Dependence on kerosene for lighting their homes costs dearly both in financial terms as well as affects their health. Renewable energy is the answer in this context and Freeplay Energy India (P) Ltd has made a modest but definite beginning in harnessing the human and animal energy for generation of quality light for the rural homes.

Akshay Urja
The promotion of renewable energy is in line with India’s objective of achieving energy security in the framework of sustainable development. Renewable energy uptake can contribute to India’s security of supply, and ensure long-term competitiveness since renewable energy options are low-cost in the mid and long term. In addition, they contribute substantially to reducing greenhouse gas emissions and mitigating climate change. An appropriate policy intervention is imperative to facilitate technology learning and cost reduction for promoting renewable energy technologies.

To increase the uptake of renewable energy technologies for power generation, various mechanisms have been devised. This article focuses on two such mechanisms: feed-in tariff laws, and the quota model, their comparative advantages and disadvantages, and the scope for the mechanisms in India.

India’s renewable energy potential
At present, India imports about 71% of its oil requirement, and its overall energy import dependence is likely to increase to over 90% by 2030 (TERI 2006). This situation clearly raises significant concerns for India’s competitiveness and the security of its energy supply. As India’s energy consumption grows, constraining the availability of fossil fuels, renewable energy sources can occupy an important place in India’s energy mix.

India has good potential in the areas of solar energy, wind energy, and biofuels. The country is located in the equatorial sun belt of the earth, thereby receiving abundant radiant energy from the sun. The country receives about 5000 trillion kWh/year equivalent energy through solar radiation. The annual global radiation varies from 1600 to 2200 kWh/m², which is much more than most of Europe. At the present, with conversion efficiencies of 11%, solar photovoltaic systems can produce 1 MWh of power per day on 0.118 ha (hectares) of land. Similarly, with a conversion efficiency of 13%, solar thermal power systems can produce 1 MWh of power a day on 0.140 ha of land area. Considering that 17.45% of the country’s land area is classified as wasteland, the vast scope for thermal power should be apparent. Further, given present yields of bio-diesel plantations, over 25% of the wastelands can displace 21% of current petroleum based transportation fuels. Surplus crop residues, estimated at 139 MT (million tonnes) per year, almost the same in coal-equivalent, form another significant renewable energy source at the village level.¹

Wind energy and hydropower are now commercially established. The country’s total wind potential is pegged at 45 000 MW (megawatt) in gross terms. Even while only 13 000 MW was considered feasible, these estimates have shown to be conservative. The country now has an installed wind power generation capacity of about 9500 MW. Other renewable sources include fuel wood plantations on wasteland and degraded forestland, and small hydro power.

Barriers to renewable energy
Several barriers have resulted in the slow uptake of renewable energy technologies vis-à-vis fossil fuel based technologies. These include costs, administration, and technical and legal concerns. Policies and government programmes are therefore required to support renewable energy technologies both in the short run as well as in the long run. The large subsidies supplied to the fossil fuel and nuclear industries even after several decades of support, form a barrier to up-take of renewables. Table 1 shows the barriers under the heads of costs, legal and regulatory issues, and market performance.

Renewable energy support schemes
Figure 1 depicts the existing support mechanisms that are available

¹The total yield of crop residues each year is 546 million tonnes, but a major proportion gets absorbed in the rural economy.
Table 1 Barriers to renewable energy

<table>
<thead>
<tr>
<th>Costs and Pricing</th>
<th>Legal and regulatory issues</th>
<th>Market performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsidies for competing fuels</td>
<td>Lack of legal framework</td>
<td>Lack of access to credit</td>
</tr>
<tr>
<td>High initial capital costs</td>
<td>Restriction on sites and construction</td>
<td>Perceived technology performance and risk</td>
</tr>
<tr>
<td>Difficulty of fuel price risk assessment</td>
<td>Transmission access</td>
<td>Lack technical and commercial skills and information</td>
</tr>
<tr>
<td>Unfavorable power pricing rules</td>
<td>Utility interconnection requirements</td>
<td></td>
</tr>
<tr>
<td>Transaction cost</td>
<td>Liability insurance and requirements</td>
<td></td>
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<tr>
<td>Environmental externalities</td>
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</table>

The following section provides details on two of the mechanisms—feed-in tariff laws and the quota model.

The feed-in tariffs model
The basic feed-in model can be considered a ‘pricing law’ under which producers of renewable energy are paid to set rates for their electricity, usually differentiated according to the technology used and size of the installation. The rate should be scientifically calculated to ensure profitable operation. The period for which the payment is made should also be set in law, and should cover a significant proportion of the working life of the installation. Grid operators are obliged to provide priority access to renewable energy installations.

The additional costs of these schemes are paid by suppliers in proportion to their sales volume, and are passed to the power consumers by way of a premium on the kilowatt-hour end-user price. In the best designs, the guarantee periods are long, thus providing investment certainty. A variant of the FIT (feed-in tariff) scheme is the fixed premium mechanism currently implemented in Denmark and partially in Spain. Under this system, the government sets a fixed premium or an environmental bonus, paid above the normal or spot price electricity to RE generators.

The quota model
The quota system is used extensively in the US, and
to a small extent in Europe primarily in the UK and Sweden. While feed-in laws set the price and let the market determine capacity and generation, quota systems work in the reverse. In general, governments mandate a minimum share of capacity or grid-connected generation of electricity to come from renewable sources. The share often increases over time, with a specific final target and end-date. The mandate can be placed on producers, distributors or consumers.

There are two main types of quota systems used today: obligation/certificate also known as the RPS (Renewable Energy Portfolio Standard), and tendering systems. Under RPS, a target is set for the minimum amount of capacity or generation that must come from renewables, which should increase over time. Investors and generators then determine how they will comply, in terms of the type of technology to be used except in the case where specific targets are established by technology types. They determine the developers to do business with, and the price and contract terms they will accept. At the end of the target period, depending upon the policy design, electricity generators and suppliers must demonstrate (through the ownership of credits that they earn through transactions) that their targets, in order to avoid paying a penalty. Producers receive credit in the form of green certifi-

<table>
<thead>
<tr>
<th>Support mechanism</th>
<th>Investor security</th>
<th>Simplicity</th>
<th>Proven success</th>
<th>Cost effectiveness</th>
<th>Guarantying a mix of different technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed-in tariff</td>
<td>Very high</td>
<td>Very high</td>
<td>Very high</td>
<td>Very high</td>
<td>Very high</td>
</tr>
<tr>
<td>Quota systems</td>
<td>Very low</td>
<td>Very low</td>
<td>Very low</td>
<td>Very low</td>
<td>Very low</td>
</tr>
<tr>
<td>Investment subsidies</td>
<td>Good</td>
<td>High</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Voluntary demand</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>Very high</td>
<td>Very low</td>
</tr>
</tbody>
</table>

Table 3 Feed-in tariff levels in select European countries as of 2006

<table>
<thead>
<tr>
<th>Country</th>
<th>Small hydro</th>
<th>Wind onshore</th>
<th>Wind offshore</th>
<th>Solid biomass</th>
<th>Biogas</th>
<th>Photovoltaic</th>
<th>Geothermal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>3.8–6.3</td>
<td>7.8</td>
<td>–</td>
<td>10.2–16.0</td>
<td>3.0–16.5</td>
<td>47.0–60.0</td>
<td>7.0</td>
</tr>
<tr>
<td></td>
<td>13 years</td>
<td>13 years</td>
<td>–</td>
<td>13 years</td>
<td>13 years</td>
<td>13 years</td>
<td></td>
</tr>
<tr>
<td>Cyprus</td>
<td>6.5</td>
<td>9.5</td>
<td>9.5</td>
<td>6.5</td>
<td>6.5</td>
<td>21.2–39.3</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>no limit</td>
<td>15 years</td>
<td>15 years</td>
<td>no limit</td>
<td>no limit</td>
<td>15 years</td>
<td></td>
</tr>
<tr>
<td>Denmark</td>
<td>–</td>
<td>7.2</td>
<td>–</td>
<td>8.0</td>
<td>8.0</td>
<td>8.0</td>
<td>6.9</td>
</tr>
<tr>
<td></td>
<td>20 years</td>
<td>–</td>
<td>–</td>
<td>20 years</td>
<td>20 years</td>
<td>20 years</td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>5.5–7.6</td>
<td>8.2</td>
<td>13.0</td>
<td>4.9–6.1</td>
<td>4.5–14.0</td>
<td>30.0–55.0</td>
<td>12.0–15.0</td>
</tr>
<tr>
<td></td>
<td>20 years</td>
<td>15 years</td>
<td>20 years</td>
<td>15 years</td>
<td>15 years</td>
<td>20 years</td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td>6.7–9.7</td>
<td>8.4</td>
<td>9.1</td>
<td>3.8–21.22</td>
<td>6.5–21.22</td>
<td>40.6–56.8</td>
<td>20 years</td>
</tr>
<tr>
<td></td>
<td>30 years</td>
<td>20 years</td>
<td>20 years</td>
<td>20 years</td>
<td>20 years</td>
<td>20 years</td>
<td></td>
</tr>
<tr>
<td>Spain</td>
<td>6.1–6.9</td>
<td>6.9</td>
<td>6.9</td>
<td>6.1–6.9</td>
<td>6.1–6.9</td>
<td>23.0–44.0</td>
<td>6.9</td>
</tr>
<tr>
<td>Fixed</td>
<td>no limit</td>
<td>no limit</td>
<td>no limit</td>
<td>no limit</td>
<td>no limit</td>
<td>no limit</td>
<td></td>
</tr>
<tr>
<td>Premium</td>
<td>8.6–9.4</td>
<td>9.4</td>
<td>9.4</td>
<td>8.6–9.4</td>
<td>9.4</td>
<td>25.5</td>
<td>9.4</td>
</tr>
</tbody>
</table>

The maximum value for Germany is only available if all premiums are cumulated. This combines the enhanced use of innovative technologies, CHP generation and sustainable biomass use.
technologies have concluded that FITs have produced the most quick and low-cost deployment of renewable energy technologies in countries that have implemented them well.

Table 3 shows the feed-in tariffs of select European countries. The most successful cases of implementation of FITs are in Germany and Spain. As of 2006, about 41 countries had adopted FITs. India has been the first developing economy to have adopted the mechanism in 2005.

The Indian experience
India, as stated, is the first developing country to adopt the feed-in tariffs system in 2005. The central regulatory authority has also announced the adoption of RPS by all states in India, such that at least 10% of power is generated from renewables by 2012. Early this year the Ministry of New and Renewable Energy announced two feed-in laws for (1) grid-connected solar-PV-based power generation and (2) grid-connected solar-thermal-based power generation. In both these cases, the time period is 10 years and the maximum capacity set is 10 MW. The central subsidy per kWh for PV and for solar thermal is Rs 10 and Rs 12 respectively. This will be in addition to the state subsidy. This policy makes renewable power generation an attractive option for renewable energy technology developers and investors. It will be seen in the coming years how these policies facilitate the up-take of renewable energy technologies.

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Fraunhofer Institute Systems and Innovation Research, and Energy Economics Group

Inviting articles for Akshay Urja
The need to have a sustainable supply necessitates the exploitation of available energy sources, and among these, renewable resources are at the forefront. It is now an established fact that RE (renewable energy) can be an integral part of sustainable development because of its inexhaustible nature and environment-friendly features. RE can play an important role in resolving the energy crisis in urban areas to a great extent. Today RE is an established sector with a variety of systems and devices available for meeting the energy demand of urban inhabitants, but there is a need to create mass awareness about their adoption. Akshay Urja is an attempt to fulfil this need. 20 000 copies are being disseminated in India and abroad.

Akshay Urja publishes news, articles, research papers, case studies, success stories, and write-ups on RE. Readers are invited to send material with original photographs and statistical data. The photographs should be provided on hard copy or as high resolution (minimum 300 DPI) files on a CD. Akshay Urja will pay suitable honorarium for each published article of about 1500 words and above to the authors. The publication material in two copies, along with a soft copy on CD/floppy/e-mail may be sent to

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www.mnre.gov.in
Tanzania has one of the lowest rates of electrification in the world. Only 10% of the population has access to the electricity grid, and in rural areas only 2% has access, leaving people dependent on increasingly expensive kerosene for lighting. The recently expanded mobile phone network is opening up new business opportunities for people and enabling them to stay in touch with family, provided that they can recharge their phones. Even small solar PV systems are able to provide people with enough power to light their homes, and larger models can run televisions. These services also bring great benefits in health care, education and social welfare. As well as eliminating kerosene lamps, the use of solar PV allows businesses such as mobile phone charging to be started, and cafes can bring in more business when they have good lighting and TV in the evening. Zara Solar and its sister company Mona-Mwanza Electrical & Electronics both based in Mwanza provide high-quality, affordable PV systems in Northern Tanzania. Zara Solar is a rapidly growing business that uses a network of self-employed technicians to reach out to the remote rural areas.

Recognizing that the customer base is poor and difficult to reach for servicing, Zara Solar insists on high-quality equipment that is less likely to break down, but buys it in bulk to get good prices. The next step is offering micro-credit facilities to make solar PV available to people who can afford monthly payments but do not have the money to pay up-front. To date over 3600 systems have been sold.

Background
Mwanza, with a population of around 717,000, is the largest city in the north of Tanzania, and the second largest city overall. The population of the whole Mwanza region is about 3.7 million. People are drawn to the town for employment in fishing, fish processing, manufacture and trading, and many live in informal settlements on the hills around the city, with no mains services. The rural population in the surrounding areas are involved in subsistence agriculture growing rice, maize, fruit and vegetables, and selling an surplus in the city. Only 10.5% of the population of Tanzania has access to grid electricity and this is mainly in the cities, in rural areas the access is only 2%. Even in Mwanza where there is grid supply, there is a large backlog of applications for grid connection, and it may take many years to get connected. Many people are therefore dependent
on expensive kerosene for lighting. There is considerable demand for the services of electricity in the region, for homes, health centres, schools and businesses.

The recent arrival of mobile phone and television networks has increased demand. The availability of mobile phones increases business opportunities, and enables people in rural areas to keep in touch with family members who have moved to paid employment in the towns and cities. Zara Solar and its sister company Mona-Mwanza Electrical & Electronics, both based in Mwanza provide high-quality, affordable PV systems in Northern Tanzania.

Technology and use
The technology used by Zara Solar is standard solar PV equipment. The most popular system for homes uses a 14 Wp amorphous silicon solar panel, a lead-acid battery of 25–50 Ah and two fluorescent lights, which can be used for about three hours each night. Although Zara Solar always recommends buying a charge controller it adds about 17% to the system price so many customers choose not to use one. Customers who choose not to buy one are given careful instructions about how to avoid over-discharging the battery. Flooded batteries tend to be used, supplied dry, and the acid is purchased separately. Zara Solar encourages customers to buy sealed lead-acid batteries if they can afford them, as they are designed for deep discharge and are safer. Most domestic users buy systems in the 14–60 Wp range, while systems of 100W and above are usually bought by institutions, and may include an inverter for powering mains devices such as televisions.

Amorphous silicon PV modules are used because for small power demand they are cheaper than crystalline modules. Amorphous silicon has a poor reputation in some parts of the world because in the past modules degraded rapidly in use, usually because poor sealing of the edges led to water absorption into the thin layer of silicon. Zara Solar will buy amorphous modules only from reputable manufacturers who offer a warranty on their products, and currently imports from Europe and the USA. The batteries, charge controllers, inverters and lights are also imported. Zara Solar buys in bulk to keep costs low.

Benefits
The 3600 systems sold by Zara Solar and Mona-Mwanza Electrical & Electronics bring electric light and power for small appliances to about 18,000 people. Most users report that the availability of adequate lighting, mobile phone charging and television are the key benefits of using solar PV. Mobile network coverage has recently reached this part...
of Tanzania, as has the availability of TV, so there is a growing demand for access to these services in rural areas, especially as fixed-line telephone communications are so poor. Quite a number of Zara Solar’s customers are in places which are covered by the grid and have applied for grid connection and had grid wiring installed in their homes. However, because of the long delays in getting a connection they have bought a PV system instead.

Because of the poor road access, the cost of kerosene for lighting – about 1000 Tsh/litre in Mwanza – is much higher in the rural areas, typically 2000 Tsh/litre. For a typical family using 6–9 litre/month (as found in a UNDP survey) this represents a monthly cost of 12,000 to 18,000 Tsh (£4.80 to £7.20), a substantial burden in a region where the minimum employed wage is only 50,000 Tsh (£20) a month. Thus the cost of a 14 Wp system could easily be paid off in less than two years from savings in kerosene alone, if suitable financing methods were available. Some other companies in Mwanza sell similar systems through hire purchase agreements, but they cost between two and four times as much as the Zara Solar systems depending on the repayment time. The use of PV provides significant social benefits for health, welfare and education.

In health centres, improved lighting and mobile phone charging are very useful: one centre found that more women came to give birth after kerosene lamps were replaced by PV lighting in the delivery room. Where solar PV is used in schools the students benefit from better lighting in the evening and the use of some electrical equipment. One of the many organizations caring for street children has used PV-powered TV as one way to make life more attractive off the streets.

According to the coordinator of Up-end Daima family home for street children, ‘Having electricity for lighting and TV gives a more enjoyable life for the children, it’s one of the things which encourages them not to go back to the streets.’

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**SPV home-lighting systems in Assam**

The ASEB (Assam State Electricity Board) has been identified as one of the three nodal agencies for implementation of the Remote Village Electrification Programme in Assam. The ASEB and the state forest department are the other two agencies involved in the programme. Out of 2139 villages identified for coverage under the programme, 1058 have been allocated to ASEB, which has so far taken up 360 villages in the districts of Barpeta, Darang, Goalpara, Karbi, and Anglong hills. Model-II home-lighting systems are being provided to the villagers under the programme. Apart from nominal upfront payments from the beneficiaries, a monthly contribution of up to Rs 40 is being planned. Awareness camps for the villagers and other stakeholders have helped in proper sensitization. Due to its organizational reach, ASEB is well equipped to service the beneficiaries in the long run. The experience of ASEB in this endeavour could become a model for other state electricity boards also.
Utta Pradesh is one of the poorer states in India. For centuries, people have been subsistence farmers, growing rice, wheat, lentils, and mustard seeds. Some cash crops like sugar cane, potato, and mentha are also now cultivated on a large scale. Buffalos are reared for milk and meat. Over the years, the farms have become smaller as the land is divided between children in a family. Many rural areas of the state have no grid electricity, and even where the grid is available there are frequent power cuts. Some shops provide a battery-charging service so that people can run DC lights and small appliances from car batteries. SPV (solar photovoltaic) home systems can be very effective in providing power for lighting and small appliances. However, in many parts of India, and other developing countries, the main obstacle for rural families who want to install an SHS (solar home system) is finance.

Late Ms Indira Gandhi, the former Prime Minister of India, launched the social banking system in India. This system aimed at providing banking facilities in rural areas, and at making small loans available to farmers and other rural people. The network of RRBs (regional rural [grameen] banks), established starting October 1975, is regulated by the RBI (Reserve Bank of India) and NABARD (National Bank for Agriculture and Rural Development). The RRBs were very effective in bringing services to rural customers and currently account for a quarter of bank branches in rural areas. However, their small size gradually became a barrier to efficient operation. In 2005, the Indian government gave RBI and NABARD the task of re-organizing the RRB set up. Groups of two or more RRBs were amalgamated, creating 45 larger grameen banks and another 43 standalone RRBs, which still operate in specific small geographical locations.

As part of this process, the Avadh Grameen Bank, Farrukhabad Grameen Bank, and Barabanki Grameen Bank were amalgamated into the AGB (Aryavart Grameen Bank) on 3 October 2006. The AGB operates in six districts of Uttar Pradesh around Lucknow, through 289 branches employing 1445 people. It provides loans for agricultural activities, including cattle, machinery, and inputs for cash crops. However, it is challenging to run a modern, computer-based bank in a place with unreliable mains power. In 2006, the AGB decided to install PV systems at five of its branches to provide back-up power during mains power cuts. The PV modules generate DC electricity in sunlight, which is stored in rechargeable lead-acid batteries. When the mains fail, the batteries are used to run an inverter, which converts the DC to AC at mains voltage and frequency to power essential loads like computers.

Technology and use
The AGB programme provides two sizes of SHS. The more common Venus I package has a 35-Wp (TBP 1235) PV module; a 12-V, 40 Ah tubular lead-acid battery; two 9-W CFLs, which includes reflectors to enhance the light output; a charge controller (MCR 1210 L); and a mounting assembly for the module. The larger Venus II package has a 70-Wp (TBP
1270) PV module; a 12-V 110 Ah battery; four 9W CFLs; and the charge controller (CI 10) and mounting assembly. The PV modules are made from polycrystalline silicon and manufactured in Bangalore by Tata BP Solar. The batteries, charge controllers, and CFLs are all produced in India by various manufacturers under contract to Tata BP Solar.

Both systems are specified to provide lighting for four hours per day with autonomy of three days (that is, continue to supply power for two dull days after one sunny day) although in practice up to eight hours of light is often possible. The systems can also support a mobile phone charger, a DC fan, and/or a black and white TV.

How users pay
The AGB negotiated a bulk supply deal with Tata BP Solar so that it could make available a Venus I system for Rs 13,520 (£171) and a Venus II for Rs 27,040 (£342) including 4% VAT which has been levied by the UP state government from January 2008. The bank will supply SHS only to its own KCC (Kisan [farmer] Credit Card) customers, who have already established a track record of reliable credit repayment. The KCC is a loan scheme for farmers offered by all the banks in India. The bank offers its KCC customers a finance package through which Venus I purchasers pay Rs 2520 (£32) upfront and are provided with a loan of Rs 11,000 (£139) at 12% interest per annum, which is repaid with monthly instalments of Rs 245 (£3.10) over five years. For the Venus II package the down payment is Rs 5040 (£64) and the instalments are Rs 490 (£6.20) per month.

To promote the idea of the SHS, the AGB branches hold ‘credit camps’ in villages. Speakers from the bank and solar industry demonstrate the SHS and explain how it works. They also explain the details of the finance package, and invite participants to sign the contract agreement for a SHS.

Training, support, and quality control
PV systems need checks and occasional maintenance even if they are manufactured and installed to high standards. The AGB has developed an innovative way of providing this continuing supervision, which also brings employment to rural areas. Branch managers identify and engage young people with reasonable education in each village to become part-time ‘business facilitators’. These facilitators are trained by the local Tata BP Solar dealer in system installation, maintenance, and repair, and the company provides them with a basic tool kit and a mobile phone. Each facilitator is allocated 100 SHS customers, and helps the Tata BP Solar engineer to install their systems. The facilitator then trains the customer in the use of the system, answers any questions, and is available to solve basic problems.

Direct benefits to families
The Venus SHS provide power for at least four hours and sometimes as much as eight hours per night with three days autonomy. Solar lighting enables school- and college-going children to study for longer and in brighter light without the fumes and fire risk associated with kerosene. With a kerosene lamp they would study for no longer than two hours in the evenings. With an SHS, pupils preparing for higher school examinations are now studying for up to four hours in the evening and two hours in the morning.

Environmental benefits
The replacement of kerosene reduces the emission of greenhouse gases. A typical household using eight litres/month of kerosene would have produced about 240 kg/year CO₂. The total saving for the 8007 systems installed up to the end of April 2008 is about 1900 tonnes/year CO₂. The target of 25,000 systems by October 2008 will save about 6000 tonnes/year CO₂.

Potential for growth and replication
In many parts of India, and other countries, the main obstacle for rural families who want to install an SHS is finance.
Electrification of hamlets in district Panchkula, Haryana using solar photovoltaic systems

Though all villages in the state of Haryana have been electrified, there are still few hamlets (Dhanies) in the hilly Shivalik Belt of district Panchkula that are yet to be electrified. These hamlets have very few households and are not accessible by road. People in these hamlets were using kerosene and so on to meet their lighting needs. Electrification of these hamlets with the conventional electricity grid is not economically feasible due to hilly terrain and few houses in each hamlet.

Realizing the needs of the people living in such unelectrified hamlets of Block Morni, District Panchkula, HAREDA has taken up the electrification of 45 such hamlets of Morni Hills using SPV technology. In 38 hamlets, SPV home-lighting systems consisting of two light points and one fact to each household along with SPV streetlights were provided. In the remaining seven hamlets electrification was achieved by installing SPV power plant of 5-kW capacity in each hamlet. This project provides electricity to 305 houses in the 45 hamlets with a population of 1564 at a total cost of Rs 250.19 lakh with the ministry providing central financial assistance of Rs 146.83 lakh.

Banks are cautious about providing personal loans to purchase SHS. In addition, solar dealers have to take out commercial loans to buy stock, and this restricts their rate of growth. Having a bank, which actively promotes solar is therefore an enormous benefit. The AGB is convinced of the benefits of SHS and is confident that loans will be repaid, because it has set the standards for systems quality and maintenance, and is lending to its own customers with an established credit history. By bulk-supplying stock and using existing dealers as installers, the bank has also saved the dealers from having to take out commercial loans.

The Ashden Awards
The AGB was one of the winners of the Ashden Awards in the international category for the year 2008. The £20 000 award was received by Mr N K Joshi, Chairman, AGB. The awards ceremony was presided over by Nobel Laureate, Dr Wangari Maathai.

Since then, it has helped more than 80 innovative projects develop their work. Today, the awards are an internationally recognized yardstick for excellence in the field of sustainable energy.
India’s quest for energy security and sustainable development rests a great deal on our ability to tap energy from renewable sources, and to use it extensively to meet our growing and diverse needs. With faster economic growth, the demand for energy will rise further, and we will need to supplement our energy requirements by harnessing renewable sources of energy. The threat of global warming and climate change due to excessive use of fossil fuels increases the urgency of finding environmentally benign ways of generating energy. India is blessed with an abundance of non-depleting and environment-friendly renewable energy resources such as solar, wind, biomass, and hydro. India is implementing a large programme for the deployment of renewable energy products and systems, and is the only country in the world to have a dedicated Ministry for New and Renewable Energy.

Intended as a platform for providing value to the domestic industry and showcasing opportunities in the Indian market for global players, the RE (Renewable Energy) India Expo 2008 was organized during 21–23 August 2008 at Pragati Maidan, New Delhi. Organized by the Exhibitions India Group, it was a forum to nurture business contacts, imbibe the latest technology trends, cultivate business relations, and prepare for the exponential growth of renewables in India. The exhibition was inaugurated by the Hon’ble Minister of State for New and Renewable Energy, Shri Vilas Muttemwar and the Secretary, MNRE, Shri Deepak Gupta who were the Chief Guest and Guest of Honour, respectively. Shri Muttemwar urged the gathering to not just consider renewables as an attractive business proposition but also as a duty and responsibility. Keen to promote new projects, the minister also promised to welcome practical suggestions from industry leaders.

The Hon’ble Secretary Mr Deepak Gupta added that wind energy is one of the most advanced options with a large installed capacity worldwide while biofuels like ethanol and bio-diesel also hold promise. He further pointed out that the challenge of new and changing technologies is never ending and he hoped that all participants would take advantage of the platform provided by this expo. Reinstating the government’s commitment towards streamlining the trading mechanism, Smt. Gauri Singh, Joint Secretary, MNRE, Government of India, said, ‘Our focus is to make technology cost effective. Once we do that, we need all sectors to grow as a basket of alternative technologies, so that we can harness energy depending upon the resource availability in various regions to their best capabilities.’

The exhibition saw participation by over 200 companies in the concurrent trade show, showcasing the potential of power generation through renewable sources. Some of these industry majors included Acme Telepower Ltd, Asys Group, Bergen Associates, Centrotherm Photovoltaic AG, DuPont, Ghodawat Industries, Hero Electric, Lapp Kabel, Mitsubishi Electric Asia Pte Ltd, Nano PV...

The three-day international conference, concurrent with the exhibition, also brought together eminent industry experts, key decision-makers, and government officials including Shri Deepak Gupta, Secretary, MNRE; Smt Gauri Singh, Joint Secretary, MNRE; Dr Anil Kane, World Wind Energy Association; Shri Deepak Puri, Moser Baer India Pvt. Ltd; Mr Gerhard Stryi-Hipp, German Solar Industry Association; Shri K Subramanya, (Tata BP Solar India Ltd; and Shri Rabindra Satpathy, Reliance Industries. The speakers deliberated upon the challenges and potential of achieving a capacity addition of 15 GW during the Eleventh Five-year Plan of India (2007–12). To achieve this vision, the Government of India has planned a subsidy support system of approximately $1 billion in government funds to complement $15 billion investment requirement for enhancing the present installed capacity.

The expo also had parallel events on wind, solar, hydro, and bioenergy that saw speakers addressing different aspects of renewable energy. An added attraction was the Renewable Energy Youth Summit 2008, which discussed policy issues and career opportunities in this field. The RE Expo also provided a platform to bring together the people involved in the development, trade, and policy aspects of renewable energy technologies, to enable them to supply these technologies at competitive costs. The expo hoped to bring about a dramatic increase in entrepreneurial activity and give the participants tremendous benefits.

Courtesy: Ambika Shankar, TERI
India is on the path of rapid economic growth along with speedy development. Simultaneously, it has to face the global threat of climate change. India has unique natural resources and its development path depends on harnessing them to a great extent. While developing infrastructure, meeting energy needs, eradicating poverty, and social development are the overriding priorities before India, these have to be achieved without compromising on the environment and maintaining ecological balance alongside.

The Government of India has recently announced the NAPCC (National Action Plan on Climate Change), which mainly focuses on mitigation of greenhouse gas emissions by adopting various means. NAPCC entails eight national missions representing multi-pronged, long-term, and integrated strategies for achieving key goals in the context of climate change. These missions are the National Solar Mission, National Mission for Enhanced Energy Efficiency, National Mission on Sustainable Habitat, National Water Mission, National Mission for Sustaining the Himalayan Ecosystem, National Mission for a ‘Green India’, National Mission for Sustainable Agriculture, and the National Mission on Strategic Knowledge for Climate Change. It may be seen that while the National Solar Mission is directly related to renewable energy, the other missions also have indirect dependence on renewable energy.

The National Solar Mission is being launched to significantly increase the share of solar energy in the total energy mix while recognizing the need to expand the scope of other renewable and non-fossil options such as nuclear energy, wind energy, and biomass. Solar energy has the advantage of permitting a decentralized distribution of energy, thereby empowering people at the grass-roots level. PV (photovoltaic) cells are becoming cheaper with new technology. There are newer, reflector-based technologies that could enable setting up of megawatt-scale solar power plants across the country. Another aspect of the Solar Mission would be to launch major R&D programmes, which could draw upon international cooperation as well, to enable the creation of more affordable, more convenient solar power systems, and to promote innovations that enable the storage of solar power for sustained, long-term use.

The National Solar Mission
The National Solar Mission would promote the use of solar energy for power generation and other applications. Where necessary for
In India, as a result of efforts made during the past two decades, a significant infrastructure has emerged for the manufacture of different solar energy systems. The cyclical (diurnal, annual) and episodic (cloud cover) variations of solar insolation, and the impossibility of regulating the solar flux means that in order to ensure steady power supply, meet peaking requirements, as well as to ensure optimal utilization of steam turbines and generators, it is either necessary to hybridize solar thermal systems with alternative means of raising steam, or provide for high-temperature thermal energy storage. The former may be accomplished by hybridization with conventional fuels, or by biomass combustion systems. The latter may be accomplished by insulated storage of molten salts; however, in their case the rate of heat loss may be significant, and storage for more than 10–12 hours is uneconomic.

The investment cost of standalone (that is, without hybridization) solar thermal power plants are in the range of Rs 20–22 crore/MW. It usually includes the cost of the solar concentrators, BOS (balance of system), receiver (turbine) with generator, control equipment, and so on. The estimated unit cost of generation is currently in the range of Rs 20–25/kWh. Proposed R&D activities in respect of STPG would cover design and development of concentrating solar thermal power systems, including parabolic troughs, central receiver systems, and dish/engine systems. The
R&D effort should be directed mainly at reducing costs of production and maintenance, and include both production design and fabrication/assembly techniques. In addition, R&D should cover balance of systems issues involved in hybridization with biomass combustion based systems and/or molten salts thermal storage.

Solar photovoltaic generation

In PV generation, solar energy is directly converted to electricity using a semiconductor, usually a silicon diode. However, while there are other semiconductors (for example, cadmium telluride) that may be used for power generation, most of them are at various stages of R&D. The investment costs of solar PV based power systems are in the range of Rs 30–35 crore/MW. This includes the cost of the solar panels and BOS. The unit cost of generation is still in the range of Rs 15–20/kWh, but may fall significantly for thin film based systems.

Proposed R&D activities in respect of SPV generation, for the near and medium term would include improvement in solar cell efficiency to 15% at commercial level; improvements in PV module technology with higher packing density and suitability for solar roofs; and development of lightweight modules for use in solar lanterns and similar applications.

R&D collaboration, technology transfer, and capacity building

In specific areas of both solar thermal and PV systems, it would be useful to enter into collaboration with institutions working elsewhere, with sharing of the resulting IPRs. Technology transfer in both solar thermal technologies and PV technologies will be required in respect of cost-effective and efficient technologies suitable for use in India. Support to commercial demonstration by entrepreneurs of solar thermal and PV, both standalone and distributed generation systems, in particular in remote locations, and using these as training facilities for local entrepreneurs and O&M personnel would also help develop this sector.

The National Solar Mission would be responsible for (a) the deployment of commercial and near-commercial solar technologies in the country; (b) establishing a solar research facility at an existing establishment to coordinate the various research, development, and demonstration activities being carried out in India, both in the public and private sector; (c) realizing integrated private sector manufacturing capacity for solar material, equipment, cells, and modules; (d) networking of Indian research efforts with international initiatives with a view to promoting collaborative research and acquiring technology where necessary, and adapting the technology acquired to Indian conditions; (e) providing funding support for the activities foreseen under points (a) and (d) through government grants duly leveraged by funding available under global climate mechanisms, and earnings from deployment of research sponsored by the Mission. Policy and regulatory measures for the promotion of solar technologies would also be enhanced as common to all renewables-based technologies.

Over the Eleventh and Twelfth plan periods (till 2017), the mission would aim to deliver at least 80% coverage for all low-temperature (<150 ºC) and at least 60% coverage for medium-temperature (150 ºC to 250 ºC) applications of solar energy in all urban areas, industries, and commercial establishments. Rural solar thermal applications would also be pursued under public–private partnerships where feasible. Commensurate local manufacturing capacity to meet this level of deployment, with necessary technology tie-ups, where desirable, would be established. Further, the mission would aim for local PV production from integrated facilities at a level of 1000/annum within this time frame.

In India, as a result of efforts made during the past two decades, a significant infrastructure has emerged for the manufacture of different solar energy systems.

The untapped energy potential of each of the three generic solar-based energy approaches (that is, SPV, solar thermal, and biomass) is well beyond current usage levels. In the long term, the mission would aim to network Indian research efforts in solar technology with global initiatives in these three areas, so as to enable delivery of solar solutions to India’s energy needs in tandem with developments worldwide.

In the long term, the mission would direct Indian solar research initiatives to deliver truly disruptive innovations that cut across more than one approach or technology. These include, (a) getting the same electrical, optical, chemical, and physical performance from cheap materials as that delivered by expensive materials; (b) developing new paradigms for solar cell design that surpass current efficiency limits; (c) finding catalysts that enable inexpensive, efficient conversion of solar energy into chemical fuel; (d) identify novel methods of self-assembly of molecular components into functionally integrated systems; and (e) developing new materials for solar energy conversion infrastructure, such as robust, and inexpensive, thermal management materials.

The ultimate objective of the mission would be to develop a solar industry in India that is capable of delivering solar energy competitively against fossil options from the kilowatt range of distributed solar thermal and PV to the gigawatt scale of base load priced and dispatchable CSP within the next 20–25 years.
Frequently the site of crisis or turmoil, individual cities can be fragile environments. For the first time in history, however, the future of the entire urban system is being thrown into doubt. Catastrophic climate changes threaten the life support of hundreds of millions, perhaps billions of urban dwellers around the world. Supplies of fossil fuels, especially oil and natural gas, are declining worldwide. Modern cities not only depend on petroleum products for their power, but also for their goods and services—including the making and packaging of virtually all food. As a historical phenomenon the use of oil, gas, and coal is extremely short lived—a mere blink of an eye at a little over 1% of a total history of urban living of under 10 000 years. Yet, today’s global urban civilization is almost entirely based on it. As a result, the fossil fuel economy is fragile: not only does our dependency on it pose a massive security risk and endanger our survival, but it also lies at the root of the vast majority of urban sustainability problems. The fossil disease is a complex global pandemic.

How might this precarious global condition be turned around? How can the energy infrastructure of cities, towns, and rural settlements be restructured to confront the environmental challenges of our time? Could a new, positive global vision emerge out of the impending, massive shift from unsustainable fuels to a renewable energy base? Opening with a definition of renewable power, the book concisely sets out the fundamental logic and philosophical framework of the urban energy revolution. It then progresses to look at how cities best attempt adaptation to accelerating, anthropogenic climate change: by mitigating it and fighting its root causes. Two central chapters map the spatial implications of the urban renewable energy transformation and the new technologies that might be involved in successfully creating the renewable city. The guide not only compares different approaches to creating renewable cities, but also examines various sustainable building assessment and design tools. The volume concludes with an easy-to-use best practice template for local governments and planners, applying lessons from advanced cities around the world.

The Renewable City is written about and for urban communities – cities, towns, villages, neighbourhoods, citizen groups, people – that pin their hopes for greater autonomy and prosperity on a broad, systematic, and targeted application of renewable energy and energy efficiency principles. It is devoted to cities that wish to rely increasingly on renewable energy. But this is not a call for institutional, cultural, and political change in the interest of technological substitution alone. Renewable Cities are also cities of ‘weather lovers’—they are designed to respond to and benefit from the local climate (air movement, sunshine, and precipitation)—they harvest local water and energy resources while wasting little of either. All forms of renewable energy are placed within a community context: good building design, and water, wave, wind, solar thermal, photovoltaic, biofuel, and heat-pumping power.

**Book Review**

Renewable City: a comprehensive guide to an urban revolution

Peter Droege

UK: Wiley-Academy • ISBN: 0-4700-1926-3 • Price: $42.95
Internet resources

**Photovoltaic systems**
This web site is devoted to promote photovoltaic applications and technologies. It was developed as non-commercial helpful information to serve teachers, students and others interested in photovoltaics. The website provides many interesting information on photovoltaic technologies, systems, applications, and so on. Further detailed information and answers on the most complex questions about solar electricity use are accessible through links leading to web sites of many different organizations and institutions.

www.pvresources.com

**Solar utilities network**
The SUN (solar utilities network) is a not-for-profit informational website sponsored by the Caspar Institute in support of global efforts to reform energy use. The web site provides practical information and strategies for saving energy and using renewable resources in the home. On this site are links to case studies describing the actual applications of sustainable energy technologies, do-it-yourself project ideas, and a schedule of 1996 training courses taught by experts from the SUN.

http://www.solarnet.org/

**Photovoltaic Power**
This website aims at the coordination and dissemination of information on global photovoltaic technologies, its applications, history, and resources. It also contains a searchable database of all the solar products including solar panels, solar heating systems, pumps, generators, and inverters.

http://www.pvpower.com/

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**Wind Energy Basics: a guide to small and micro wind systems**
Gipe P. 1999
This book gives an overview of the burgeoning use of wind energy around the globe, describing and analysing the most affordable small wind generators, including the new generation of highly practical micro turbines. The wind power industry has been transformed in the 1990s by steady progress in efficiency, economy, and adaptability. This book includes detailed information on planning, purchasing, siting, and installing a wind system, and on integrating wind power with solar photovoltaics for more cost effective and reliable off-the-grid applications.

ISBN: 1-890132-07-1 • Price: $25.00

**Photovoltaics for Professionals: solar electric systems marketing, design, and installation**
Antony F, Dürschchner C, and Remmers K H. 2007
This book describes the practicalities of marketing, design, and installing photovoltaic systems, both grid-tied and standalone. It has been written for electricians, technicians, builders, architects, and building engineers who want to get involved in this expanding industry. It answers all the beginner’s questions and serves as a textbook and work of reference, provides designers and installers with the practical specialist knowledge needed to design and install high-quality solar electric systems, and gives a comprehensive overview of major photovoltaic market sectors.

ISBN: 978-1-84407-461-7 • Price: £49.49

**The Biomass Assessment Handbook: bioenergy for a sustainable environment**
This handbook provides the reader with the skills to understand the biomass resource base, the tools to assess the resource, and explores the pros and cons of exploitation. Topics covered include assessment methods for woody and herbaceous biomass, biomass supply and consumption, remote sensing techniques as well as vital policy issues. International case studies, ranging from techniques for measuring tree volume to transporting biomass, help to illustrate step-by-step methods and are based on fieldwork experience. Technical appendices offer a glossary of terms, energy units, and other valuable resource data.

ISBN: 978-1-84407-526-3 • Price: £59.95
National events

India Energy Conference 2008
Oil, Gas, and Alternatives: building competitive markets
3–4 October 2008, New Delhi, India

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E-mail garimaj@teri.res.in
Web www.teriin.org

Green Energy Summit 2008
16–19 October 2008, Bangalore, India

Saltmarch Media
Tel. +91 99015 08099
E-mail info@greenenergysummit.com
Web www.greenenergysummit.com

ICORE 2008
16–17 October 2008, Chennai, India

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Tel. +91 11 6564 9864, 2695 9759
Fax +91 11 2695 9759
E-mail info@sesi.in
Web www.sesi.in

Solar Industry Conference 2008
23–24 October 2008, Madrid, Spain

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Fax 49 30 7262 9630–9
E-mail julia.krohn@solarpraxis.de
Web www.solarpraxis.de

International events

Third Renewable Energy Finance Forum
20–21 November 2008, Mumbai, India
E-mail webmaster@euromoneyenergy.com
sponsorihip@euromoneyenergy.com

Renewable Energy Asia 2008
11–13 December 2008, New Delhi, India
Tel. 91 11 2659 6351
Fax 91 11 2659 1121
E-mail rea2008@gmail.com
Web web.iitd.ac.in/~rea2008

18th International Photovoltaic Science & Engineering Conference & Exhibition
19–23 January 2009, Kolkata, India
Tel. 91 33 2473 6612
Fax 91 33 2473 2805
E-mail info_pvsec18@iacs.res.in
Web www.pvsec18.in

Biofuels in India: setting new paradigms
4–5 March 2009, New Delhi

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Web www.winrockindia.org

Third Renewable Energy India 2009 Expo
12–19 August 2009, New Delhi

New Delhi (Head Office)
Exhibitions India Pvt. Ltd
# 217 B, Second Floor
Okhla Industrial Estate, Phase III
New Delhi – 110 020, India
Tel. +91 11 4279 5054

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10th Renewable Energy Finance Forum
15–16 September 2008, London
E-mail www.euromoneyenergy.com

Bioenergy 2008
23–24 September 2008, Oxford, UK
E-mail www.r-p-a.org.uk

BiomassWorld 2008
23–24 September 2008, Beijing, China
E-mail www.cmtevents.com/eventschedule.aspx?id=499&event=080950

Photovoltaic 2008
20–23 November 2008, Athens, Greece
Tel. 30 210 6141164
Fax 30 210 8024267
E-mail info@leaderexpo.gr
Web www.leaderexpo.gr

PHOTON’s 7th Solar Silicon Conference
3 March 2009, Munich, Germany
Tel. 49 241 4003 102
Fax 49 241 4003 302
E-mail petra.boehne@photon.de
Web www.photon-expo.com

Solar 2009
8–14 May 2009, Buffalo, New York, USA
Tel. 1 303 443 3130
Fax 1 303 443 3212
E-mail ases@ases.org
Web www.ases.org
# Renewable energy at a glance in India

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Source/system</th>
<th>Estimated potential</th>
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<td></td>
<td><strong>Power from renewables</strong></td>
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<td>Biomass/cogeneration (non-bagasse)</td>
<td>—</td>
<td>95.00</td>
</tr>
<tr>
<td>8</td>
<td>Biomass gasifier</td>
<td>—</td>
<td>100.11</td>
</tr>
<tr>
<td>9</td>
<td>Energy recovery from waste</td>
<td>—</td>
<td>26.70</td>
</tr>
<tr>
<td></td>
<td>Sub total (B)</td>
<td>—</td>
<td>221.81</td>
</tr>
<tr>
<td></td>
<td>Total (A+B)</td>
<td>—</td>
<td>13 154.05</td>
</tr>
<tr>
<td></td>
<td><strong>Remote village electrification</strong></td>
<td></td>
<td>4 198 villages/hamlets</td>
</tr>
<tr>
<td>I</td>
<td><strong>Decentralized energy systems</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Family-type biogas plants</td>
<td>120 lakh</td>
<td>39.94 lakh</td>
</tr>
<tr>
<td>11</td>
<td>Solar photovoltaic systems</td>
<td>50 MW/km²</td>
<td>120 MWp</td>
</tr>
<tr>
<td></td>
<td>i. Solar street lighting system</td>
<td>—</td>
<td>70 474 nos</td>
</tr>
<tr>
<td></td>
<td>ii. Home lighting system</td>
<td>—</td>
<td>402 938 nos</td>
</tr>
<tr>
<td></td>
<td>iii. Solar lantern</td>
<td>—</td>
<td>670 059 nos</td>
</tr>
<tr>
<td></td>
<td>iv. Solar power plants</td>
<td>—</td>
<td>2.22 MW</td>
</tr>
<tr>
<td></td>
<td>v. Solar photovoltaic pumps</td>
<td>—</td>
<td>7148 nos</td>
</tr>
<tr>
<td>12</td>
<td>Solar thermal systems</td>
<td>140 million m²</td>
<td>2.30 million m² collector area</td>
</tr>
<tr>
<td></td>
<td>i. Solar water heating systems</td>
<td>collector area</td>
<td>6.20 lakh</td>
</tr>
<tr>
<td></td>
<td>ii. Solar cookers</td>
<td>—</td>
<td>1284 nos</td>
</tr>
<tr>
<td>13</td>
<td>Wind pumps</td>
<td>—</td>
<td>675.27 kW</td>
</tr>
<tr>
<td>14</td>
<td>Aero generator/hybrid systems</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Awareness programmes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Energy parks</td>
<td>—</td>
<td>504 nos</td>
</tr>
<tr>
<td>17</td>
<td>Akshay Urja shops</td>
<td>—</td>
<td>269 nos</td>
</tr>
<tr>
<td>21</td>
<td>Renewable energy clubs</td>
<td>—</td>
<td>521 nos</td>
</tr>
<tr>
<td>22</td>
<td>District Advisory Committees</td>
<td>—</td>
<td>560 nos</td>
</tr>
</tbody>
</table>

MW – megawatt; kW – kilowatt; MWp – megawatt peak; m² – square metre; km² – kilometre square
Visitors to our windfarm reap the bounties through the power of wind

Turnkey projects | “Green Power” sale
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Identifying opportunity, implementing and managing “Green Power” projects.

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..Use Solar Energy for water heating and light

Solar Lantern

Major Benefits:
- Near zero maintenance
- Each lantern, on an average, saves 100 liters of kerosene per year
- Freedom from power cut
- Pollution free and better light
- Ideal for students

Solar Domestic Lighting System

Major Benefits:
- Near zero maintenance
- Easy to use
- Lights up an area of about 100 square feet
- A single charge can operate the system for about 4-5 hours

Solar Water Heating System

Major Benefits:
- Return of investment in 3 years
- Uninterrupted supply of hot water
- No requirement of electricity
- Safe and simple to use
- Long life span (about 20 years)
- Near zero maintenance
- No requirement of gas
- Saves up to 1500 units of electricity in a year

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Now available with easy finance option at effective interest rate of
Domestic 2% Institutional 3% Commercial 5%
(Solar Water Heating Systems only)

There are more than 330 Sunny days in a year in India. India receives more than 5000 trillion kWh of solar radiation annually. This is more than our total annual requirement of energy.

For purchase and repair of Solar Lantern, Solar home lighting system and Solar water heating systems, please contact the State Renewable Energy Development Agencies/Akshay Urja Shops/Suppliers existing in the States. List of addresses and phone nos. are available at the website of the Ministry.

For more details, contact:
Indian Renewable Energy Development Agency Limited (IREDA), New Delhi
Phone: 011-24682214-21 Extn.-239

Ministry of New and Renewable Energy
Government of India
Block No.-14, O.G.O. Complex, Lodhi Road, New Delhi-110 003
Website: www.mnre.gov.in

Solar Energy – Forever Energy