From a disaster, the seeds of a new dawn

Following an innovative throwing down of the gauntlet by the Japanese government in July 2012, Japan is likely to earn the second place spot in the world's biggest markets for solar power. Japan's Industry Minister, Yukio Edano, had announced in July 2012 that the government's new feed-in tariff policy that would, according to a forecast by Bloomberg New Energy Finance, encourage at least $9.6 billion in new solar installations with a total capacity of 3.2 GW, an amount that is the combined capacity of three nuclear power plants. This was well-received by the renewable energy market, there was a rally among solar company stocks and the world waited with bated breath, aware of what can happen when the Japanese take to a technology. They had made cars, electronics, and video games smaller, faster, cheaper, and more efficient; surely they can work their magic again on renewable energy technology. Japan's newfound indulgence in renewable energy comes from a severe backlash against nuclear power by the public and analysts alike, especially after the 2011 Fukushima Daiichi nuclear disaster, where the Tohuku earthquake and tsunami led to a failure of the nuclear power plant's cooling system and caused three reactors to undergo a full meltdown. This disaster showcased that despite the plant possessing all necessary precautions and backups for all imagined scenarios, 100 per cent perfect safety is an impossible guarantee in the nuclear energy industry. And despite Fukushima being prepared for earthquakes and tsunamis, the scale of the Tohuku tsunami was a surprise, causing the backup generator room to flood and deactivate, resulting in the failure of the main and backup mechanisms to cool the reactors. It is a testament to Japanese efficiency and preparation that the second-biggest nuclear disaster in human history saw no loss of life and a relatively minor total of 37 injuries (at Chernobyl, the only nuclear disaster comparable to Fukushima, 56 people were killed directly and over 4,000 were killed through cancers caused by leaked radiation). In the aftermath of Fukushima, the then Japanese Prime Minister Yoshihiko Noda launched a wave of initiatives to cut his nation's dependence on nuclear energy, which is the source of nearly 30 per cent of all of Japan's electrical power.

Axis of solar power

On 1 July 2012, the Japanese government introduced a new feed-in tariff system that see utilities pay energy suppliers three times as

much for electricity generated from renewable sources of energy as they would for electricity generated from conventional energy sources. This model of introducing incentives in the feed-in tariff rate follows the examples set by Germany, Italy, and Spain, all of whom have—since the introduction of their competitive feed-in tariffs in 2000, 2007, and 2008 respectively—overtaken Japan in global rankings for their installed solar capacity. The lessons that most Japanese investors and energy companies took from Europe showed that those that got into the game early, reaped the maximum benefits of the tariffs, before the inevitable cutting of the rates. According to analysts at the reputed independent brokerage and financial services group CLSA Asia-Pacific Markets, of all the renewable energy options available in Japan today, the quickest to set up on a utility scale is solar.

Germany's feed-in tariff scheme saw them emerge as the world's biggest market for solar installations. Japan, in a bid to catch up on lost time, has apparently raised the stakes. The Japanese electricity market is divided into ten government-controlled utility companies, who will pay now 42 Yen ($0.53) per KWh for 20 years to solar power producers.This is close to double the rate in Germany, which in 2012 had a tariff rate of around $0.30 per KWh of solar power produced. Buoyed by the subsidies, real-estate developers and energy companies have accelerated plans for the construction of solar power parks. In 2011, Japan was ranked sixth in the world for new installations in solar power, adding 1.3 GW to bring its installed capacity to 5 GW. According to forecasts by Bloomberg New Energy Finance, by 2013, builders will have established three times that amount. They predict an addition of another 3.2 to 4.7 GW of solar generating capacity, which should be enough to power 800,000 to 1.1 million Japanese homes. This announcement saw massive investment in Japan's solar energy industry, with global banking behemoth Goldman Sachs Group Inc. and Japan's second-richest man, billionaire Masayoshi Son, leading the charge of investors interested in exploiting Japan's new solar power subsidies. However, we should remember that Goldman Sachs has been wrong before, and Masayoshi Son holds the world record, according to the New York Times, of losing the most money in history where his investments in the dot com bubble in the early new millennium saw him lose close to $70 billion, or nearly 9 times his current net worth.

Winds of change in other avenues

Wary of the emergence of what it has described as a "solar bubble", the Sumitomo Corporation, a Tokyo-based sogo shosha (a unique Japanese entity, a sort of holding company and trading corporation, which has diversified investment and business

interests), is looking at wind as an alternative. Sumitomo is Japan's second-largest investor in power generation outside utilities, and aims to exploit the new feed-in tariff rates for renewables through wind and biomass power plants. The president of the Summit Energy Corporation, an associated company of the Sumitomo Corporation, was quoted as expecting profits from wind power to be three times that of solar power over the next few years. Sumitomo's hesitance to blow the solar horn is understandable, seeing that the new feed-in tariff rates announced by the government has led to a sort of gold-rush mentality among investors. As people rush to buy, start, or invest in solar projects, real estate developers are reaping the benefits in real time, raising land prices that will definitely affect the final price of electricity generated by the solar plant. Salaries of people in the solar sector are increasing as more and more energy companies search for expertise in the sector, and everyone from asset managers with investment banks to owners of Mah-jong and Pachinko parlours are trying to get a slice of the action. Sumitomo's dire warnings of a bubble are further strengthened by Japanese government data, which shows that the price of constructing and operating wind farms in Japan is far cheaper and offers higher returns than constructing and operating a solar power plant generating equivalent electricity. Yet, over 99 per cent of applications by companies trying to exploit the new tariffs are for electricity generated from sunlight. Perhaps Sumitomo has a point when it says that Japan's ambitions in renewable energy look more manageable in the arena of wind energy.

However, be it solar or wind, what is undeniable is Japan's thirst for renewable energy. Japanese Prime Minister Yoshihiko Noda's new energy policy that was announced on 14 September 2012 stated its aim to phase-out nuclear energy over the next three decades while simultaneously trying to ensure that power generated from renewable sources is tripled. Japan's ruling political party, the Democratic Party of Japan, has recommended that renewable energy should contribute around 40 per cent of Japan's total energy mix by the early 2030s, which is a substantial increase from the current 8 per cent of renewable energy in Japan's energy mix, most of which comes from hydroelectric power.

Measures for their time

Currently, Japan is in the midst of a power crisis. Among all comparable developed nations, the cost of electricity in Japan is very expensive, and with the mass shutdowns of numerous nuclear power plants, it is bound to only get more expensive in

the immediate future. Japan's lack of natural conventional energy resources was seen as a stumbling block for their immediate energy security. Japan is the world's biggest importer of coal and is responsible for 17.5 per cent of all global coal imports (according to estimates in 2010) and has been consistently the largest coal importer in the world for the last few years, with China coming reasonably close in the last couple of years. Japan is also the world's second-largest importer of natural gas, and the third biggest importer of crude oil in the world according to the CIA World Factbook. This crippling dependence on fossil fuels for the energy future, along with Japan's aging population and economic competition in the electronics and manufacturing industry from China, meant that Japan's quest for a renewable alternative for their energy requirements was mostly a matter of time. The best immediate form of response in the renewable energy spectrum is solar, as they can be constructed and made operational in a matter of months. Wind farms take much longer and require much more bureaucratic interference. Developing a wind farm would require numerous assessments of the farm's environmental impacts on nearby wildlife, any potential climatic impacts, levels of noise pollution from turbines, the profit feasibility, and electricity generating potential. This can take many months, even years. Scaling up geothermal power plants can take even longer, and despite Japan's abundant locations for generating geothermal power, the time factor is what stops the Japanese from trying to benefit from the location on a precarious tectonic plate boundary, something that they usually have to pay for in the form of earthquakes and tsunamis.

Is it time to say *Konichiwa* to Japanese RE?

What primarily attracted so many people to the RE sector in Japan was the sheer price difference in the tariffs paid by industrial users and utilities to electricity supplied from conventional energy sources (around $0.19), and the rates announced for electricity supplied from renewable sources (around $0.53). In mid-September the Japanese city of Setouchi, in the Okayama Prefecture, approved a $840-million bid from a group of seven investors that includes such giants as the IBM Corporation and Goldman Sachs, to build Japan's largest ever solar power plant, which is slated to have an installed capacity of 250 MW. This follows Goldman Sachs investing in purchasing 5.1 per cent of Eliiy Power Company, a Japanese manufacturer of Lithium-ion batteries, the current leading source of energy storage in renewable energy plants. However, the doubts raised by the likes of Sumitomo are valid and need to be looked into. With land as a scarce commodity in Japan, building large-scale solar farms could see a sharp increase in real estate prices, a price increase that would eventually migrate to the final price of electricity generated at those farms. While wind and geothermal would be better options, large gestation periods and high capital investment can scare investors off. And there lie realistic and well-grounded fears that the solar boom may turn out to be a solar bubble, which in turn may further cauterize the renewable energy arena from receiving future investments.

While the future of renewable energy in Japan is still uncertain, what the feed-in tariff rates are indicative of is a renewed resolve to re-align Japan's energy future on the more dependable and reliable track of renewable energy. As one of the biggest importers of fossil fuel sources in the world with little or no fossil fuel exports (save for coal), Japan needs to ensure its energy security is placed on a far more stable pedestal, and renewable energy seems the best way to move forward. The extremely positive feedback from investors, both in Japan and internationally, to the change in feed-in tariff rates may herald a resurgence of Japan in the global economic arena as a leading supplier of renewable energy technology. Whether the "Land of the Rising Sun" will live up to that particular moniker in the renewables arena is something that one can look forward to with interest.■

With inputs from Harish Alagappa, TERI.

“WE’RE TRYING TO BRING IN OUR ENGINEERING EXPERTISE, SO THAT INDIA CAN LEARN FROM OUR LESSONS”

Based out of the picturesque city of Stirling in Scotland, Oldbaum Services Limited was founded in 2005 and has since grown to become one of the world’s leading consultancy firms for onshore and offshore wind energy. In the last decade, Oldbaum pioneered the use of technology that involves laser-based remote sensing (LIDAR), as well as sound wave remote sensing (SODAR) instruments to obtain precise and accurate information. Oldbaum prides itself on providing bankable data to the numerous wind energy companies that seek its services, which range from providing technical expertise, financial services, and data acquisition and management.

Andy Oldroyd is a Managing Director at Oldbaum Services, and has been with the company since its inception. With a Master’s in Environmental Sustainability from the University of Edinburgh, *Andy Oldroyd* has been involved in the wind energy sector in various roles in the academia and professionally for over 17 years. He is seen as one of the world’s leading experts on renewable energy, especially wind energy, and was recently a featured speaker at the 6th Renewable Energy India Expo 2012, delivering a talk entitled, “Embarking upon Indian offshores: taking the first steps”, where he highlighted the potential and perils of offshore wind energy for India. *Harish Alagappa* caught up with Andy Oldroyd to discuss the possible role of offshore wind energy in India’s energy future.

Why should India look at offshore wind power as an option for our energy future?

Well, there are two main aspects of offshore wind that make it a good, viable option for India. The first is that offshore, you get a higher and more consistent wind speed as compared to wind farms on land. The second aspect is that, from an Indian perspective, we can start to locate some of that generation near large population centres that would require that kind of energy. So, an offshore wind power plant near Mumbai, for instance, would be a very good example. It would be possible for a substantial amount of Mumbai's energy needs to be met by an offshore wind plant, which would allow the rest of the region to achieve greater energy security from traditional centres of energy generation. These elements would help to reduce the cost of energy generation and help supply that energy generated to where it is required, which is more energy efficient.

What do you look for in a location when you want to construct an offshore wind power project?

There are two important factors we have to take into account, the first is the resource, which in this case is wind. The consistency of the resource is critical; we need to ensure that there is a consistent amount of wind blowing in that region at speeds that would be optimal for turbines. The second factor is water depth, the deeper the water, the more expensive the cost of constructing the turbine. These are the main aspects that help define the cost of energy generation and hence, the potential of the site. Once we have that information, we can then start to look at what would be the appropriate technology in terms of turbines to use at the site, what kind of turbine would give us the highest return of energy per year.

One of the biggest concerns that people around the world have about offshore wind is the cost, which can be quite prohibitive. This is a serious consideration for a developing nation and emerging economy, such as India. How do you think India can overcome this particular obstacle?

In European terms, the cost of energy for offshore development is between 3 to 5 times more expensive per installed Megawatt (MW). But that is a skewed figure, because of the cost; 70 per cent is infrastructure cost, and 30 per cent is turbine cost. We cannot do a lot with turbine cost, but we can do a lot with infrastructure cost. By bringing to offshore wind projects Indian expertise in terms of local knowledge, local infrastructure knowledge, local engineering capabilities, local craftsmanship, local manufacturing facilities will help to greatly reduce the infrastructure cost, and as a consequence the cost of energy, making it more affordable and better available.

The UK is currently at the forefront of the offshore wind power industry (statistics from 2010 indicate that the UK has more than 50 per cent of the world's capacity of offshore wind farms). They have recently been working with Japan and South Korea, to help these nations develop their offshore wind power potential. Do you see the UK as a mentor in the global offshore wind industry?

I think that the UK has a lot of engineering expertise as well as offshore wind expertise to offer. In the UK, both my company and I come from Scotland, which also has a long history of engineering expertise and there are currently a number of centres and large companies based in and around Scotland, in places like Aberdeen, in the energy and offshore industry. What we are trying to do now, I think, is that since we understand the challenge of developing offshore projects—as I said in my talk earlier, we have learnt a lot of painful lessons—we have an opportunity to help marry our engineering knowledge and expertise and our offshore expertise with local manufacturing capabilities. Marrying those two together is the best way to introduce a new market to a new technology; it will also help keep the cost of energy down.

In the last decade, India has made substantial investments in onshore wind power, not all of which have really paid off. Recently, the Government of India, in a trend that is being seen around the world, is trying to reduce the subsidies

that these companies have been weaned on so far. In this economic environment, how would you pitch the idea of an offshore wind project to the government or to private investors, to get either subsidies or the required investment to develop India's offshore capabilities?

The anticipated revenue in the UK per annum from offshore wind is somewhere in the region of 19 billion ($30.8 billion, ₹1.7 lakh-crore), which is a huge amount of revenue, which requires a huge amount of investment, a huge amount of skills, and can give rise to a huge amount of growth and potential, to the point where offshore wind is looking to be contributing to the order of 2 per cent of the GDP of the United Kingdom. It's a large potential and can offer a large amount of economic benefit to the people of India to be involved in and proactive in this industry. What my company, Oldbaum, is interested in doing is building and bringing engineering expertise. The not-insubstantial manufacturing cost and installation costs, all of those will be Indian-centred cost that would help stimulate the local economy, which is what we are trying to do. It is about socio-economic impact, where do we put maintenance centres? How will that affect the local economy? How can we generate more jobs? How can we do all this safely? We want to ensure that no-one is hurt in any of the work that is being done. We are trying to bring forth the safety culture, which sometimes brings expense in its wake, but that is important for India and a necessary expense. We're trying to bring in engineering expertise, and I'm not trying to say that India does not have engineering expertise. I'm saying that the lessons we have learnt, in offshore wind specifically, in developing what we have developed in the UK and Europe, we can introduce those to India. Environmental impacts, health, and safety are very serious issues, and something we do not in the slightest take for granted. In the UK and Europe, it is a crucial part of our consenting process, in order to get a license to develop the offshore wind potential of a region we have to show that there is a safety culture in the project. In addition, in order to get a physical permit to build at a site, we have to show that we have taken into account any environmental concerns and present mitigation, if mitigation is required. This process is something that is and should be easily transferable to offshore projects in India.

There are a lot of concerns about the environmental impacts of offshore wind projects. Do you think these doubts are warranted?

There are some concerns for environmental impacts in terms of avian impacts or impacts on local birds. Although there are not many studies that show any clear physical impact, nevertheless we must not take anything for granted. There is some impact on fishing and local life, but some studies, again, have showed that having exclusion zones has helped populations of certain kinds of fish, and hence the local fishing communities, recover. One of the main issues is really to do with noise; installation is a noisy process, you have piling noise and those sorts of things and these noises have quite a large radius, which can affect sea mammals. It is an important concern and mitigation for this is an extremely important consideration. This is something that we have looked at and there are universities in the UK, St. Andrews' University in Scotland is looking specifically at noise mitigation methods for piling mechanisms.

Something we would have to take into account clearly before we can move forward with offshore in India is natural disasters. The Indian east coast, for example, is prone to cyclones and it is important to see how offshore wind power plants would cope in such situations.

You have to remember, we have been putting things in Indian waters in the oil and gas industry for many years now. So, we have data and understanding of what is happening there. We just have to take that data and translate it to a wind energy context, so that we can help secure the infrastructure against natural disasters and similar occurrences.

In conclusion, what message would you like to give to the readers of our magazine and to people who want to see a change in India's energy future?

I think offshore wind power has great potential for delivering consistent energy. It can be cost effective and India has one of the better chances of making it a real factor in your country's energy mix overall. ■

SOLAR TODAY

CONFERENCE 2013

15th March, New Delhi

Theme: Mainstreaming solar: Towards pricing parity and improved technology

Focus Areas

- Finance
- Policy
- Technology
- Research & Development
- The investment, incentives & tariff matrix

Key Sessions

- Market development and effects on project costs
- Research and development in solar
- What should be in store for phase two of National Solar Mission

Speakers

Industry leaders and Experts who will share their knowledge and experience through keynote addresses, presentations, panel discussions and case studies.

Who will attend

- Domestic & International Solar Industry
- Policymakers & stakeholders
- Engineers
- Manufacturers & Project Development Companies
- Solar Equipment & Construction Companies
- Solar Technology Companies & R & D Chiefs
- Consultants & Solutions Providers
- Banking Sector, Investors & Capital Markets

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BUILDING AN ENERGY FUTURE, BRIC BY BRIC

At the turn of the millennium the world was entering a new epoch. Perhaps, the most significant political and economic trend in world history at the end of the 20th century was the emergence of new economies that seemed to challenge the United States and Europe's centuries-long global hegemony. Former European colonies and the remnant of an erstwhile superpower were carving a name for themselves, exhibiting extraordinary economic growth that took the world by surprise. In 2006, the leaders of these nations met at New York to forge a unique association of emerging economic power. The BRIC—so named for its members nations: Brazil, Russia, India, and China—have since tried to overcome internal conflict and strife to present a united front that represents the aspirations of developing nations and acts as an alternative to the established world economic order. Russia's presence in the BRICS is seen by some as an anachronism. The BRICS are usually perceived as emerging global superpowers, while Russia is not an emerging superpower, rather in its form as the Soviet Union, it was the United States' chief rival for global domination throughout most of the second half of the 20th century.

The BRIC consists of four of the seven largest nations on earth by area, and three of the five most populated countries in the world. Combined, they cover a total land area of over 37 million square miles, 25 per cent of all the land on earth; and house 2.9 billion people, over 40 per cent of the world's population. Their combined GDP—adjusted for PPP (Purchasing Power Parity)—rings in at $20.4 trillion, more than the United States or the European Union, and over 25 per cent of the world's total GDP (PPP). Clearly, the BRIC is the powerhouse of the future. However, the best-laid plans of mice and emerging economic superpowers often go awry. If the BRIC nations wish to be able to make the leap from developing powers to full-fledged developed nations, they will need to answer one last, crucial question—the question of energy.

BRAZIL

Blessed with an abundance of natural resources, Brazil generates most of its electricity from hydroelectric power stations that dot the numerous rivers and Amazon tributaries that flow through the country. A remarkable

86.54 per cent of Brazil's electricity consumption in 2011 was provided by renewables, and 80 per cent of Brazil's energy needs are met by hydroelectricity. A large amount of this electricity is provided by the mammoth Itaipu Dam, second only to China's Three Gorges Dam in terms of installed capacity. The dam single-handedly provides 25 per cent of Brazil's electricity needs. Nevertheless, the Brazilian government is taking few chances.The oil embargo and shortages of the late 1970s that crippled the West were a learning experience for Brazil. Throughout the 1980s, Brazil invested heavily in researching alternate fuels. Due to its vast quantities of arable land and favourable tropical climate, Brazil soon settled on producing bioethanol from sugarcane as a viable alternative to crude oil and natural gas for vehicles. Today, vehicles in Brazil are, by government mandates, flexi-fuel, designed to run on gasoline and bioethanol.

RUSSIA

Russia is the largest nation on earth with a population that is the ninth largest in the world, which allows for an extraordinary resources per capita ratio. The frozen expanse of Siberia is Russia's source of energy security. Vast coal, oil, and natural gas reserves have made Russia an energy behemoth; it is the largest producer and exporter of crude oil and natural gas in the world. Renewable energy in Russia currently constitutes largely of hydroelectric power generating around 16 per cent of the electricity produced in the country. Other renewables include geothermal power and biomass power, together contributing only 0.33 per cent towards the nation's electricity production. Today, Russia is exploring wind and tidal energy. Penzhin Bay, on Russia's eastern frontier, witnesses some of the strongest tides on Earth, and proposals are underway to build

the largest tidal power station in the world at Penzhin, with a proposed capacity of 87 GW.

INDIA

The future economic success of India is dependent on how its myriad energy issues, ranging from a shortage of fossil fuel resources to an out-dated and inefficient electricity grid are dealt with.The Indian government is making substantial investments in renewable energy technology. The Ministry for New and Renewable Energy launched the Jawaharlal Nehru National Solar Mission (JNNSM) in 2009, with a target of making India a global leader in solar energy. The mission aims to develop 1,000 MW of solar power capacity in India by 2014. Currently, 16 per cent of India's electricity produced is generated by renewables, while 80 per cent of this energy comes from hydroelectric power projects. India also has the fifth-highest installed capacity for wind power in the world. Wind power constitutes 16 per cent of India's renewable energy mix, and generates 2.6 per cent of India's electricity produced.

By 2030, India will be the most populated country on Earth but without sufficient conventional energy resources and rising import prices for fossil fuels, the economic resurgence of this ancient global power might see a sudden halt.

CHINA

China is a world leader in producing and consuming electricity; it consumes around 4,300 billion units of electricity every year, of which 18 per cent is from renewable sources. China is also the world's largest producer of coal. China has immense potential for generating electricity from renewable energy, and has some of the largest hydroelectric power projects in the world, including the Three Gorges Dam. China currently has an installed capacity of nearly 200 GW from hydroelectricity. Over the second half of the last decade, China had extended significant efforts in building its wind energy infrastructure and studies show that by 2030 China can meet all of its energy needs from wind energy alone. Since 2010 China is the world's largest manufacturer of wind turbines, and installed capacity from wind energy in China has increased from 1.2 GW in 2005, to 62 GW in 2011. The government aims that China's installed capacity from wind power should reach 100 GW by 2015, generating 190 billion units of electricity per year, which will be enough to provide energy access for nearly 50 million people. ■

CURRENT R&D SOLAR

Sustainable thermal energy storage technologies for buildings: a review
Parameshwaran R, Kalaiselvam S, Harikrishnan S, Elayaperumal A. 2012.
Renewable and Sustainable Energy Reviews 16(5):2394–2433

Energy management in buildings is indispensable, which would control the energy use as well as the cost involved while maintaining comfort conditions and requirements in indoor environments. Energy management is intensely coupled with energy efficiency and increasing of which would provide a cost-effective pathway for reducing greenhouse gas emissions. In recent years, the magnitude of energy consumption in buildings seems to crest from the normal demand and that has to be carefully addressed through implementing energy conservation and energy management techniques. In the class of having several energy-efficient schemes, thermal energy storage (TES) technologies for buildings are increasingly attractive among architects and engineers. In the scenario of growing energy demand worldwide, the possibility of improving the energy efficiency of TES systems can be achieved from breakthrough research efforts. The prime intention of this paper is to review the potential research studies pertaining to a variety of latent heat energy storage (LHES) and cool thermal energy storage (CTES) systems solely dedicated for building heating, cooling, and air conditioning (A/C) applications. Technical revelations regarding the integration and performance evaluation of heat storage materials in building fabric elements as well as using separate heat storage facility to satisfy the space thermal load demand have been gleaned from numerous research contributions and presented. Emphasis is also given on advanced heat storage materials produced using micro and nanoparticles to realize their improved heat transfer characteristics, which would eventually enhance the overall performance of these TES systems. Furthermore, the sustainable aspects of these TES systems to gain the Leadership in Energy and Environmental Design (LEED) credentials for low carbon/high performance buildings are signified.

Energy models for demand forecasting: a review
Suganthi L and Samuel A A. 2012.
Renewable and Sustainable Energy Reviews 16(2):1223–1240

Energy is vital for sustainable development of any nation—be it social, economic or environmental. In the past decade, energy consumption has increased exponentially globally. Energy management is crucial for the future economic prosperity and environmental security. Energy is linked to industrial production, agricultural output, health, access to water, population, education, quality of life, etc. Energy demand management is required for proper allocation of the available resources. During the last decade, several new techniques are being used for energy demand management to accurately predict the future energy needs. In this paper,

an attempt is made to review the various energy demand forecasting models. Traditional methods, such as time series, regression, econometric, ARIMA as well as soft computing techniques, such as fuzzy logic, genetic algorithm, and neural networks are being extensively used for demand side management. Support vector regression, ant colony, and particle swarm optimization are new techniques being adopted for energy demand forecasting. Bottom-up models, such as MARKAL and LEAP are also being used at the national and regional level for energy demand management.

A review of energy storage technologies for wind power applications
Díaz-González F, Sumper A, Gomis-Bellmunt O, Villafáfila-Robles R. 2012.
Renewable and Sustainable Energy Reviews 16(4):2154–2171

Due to the stochastic nature of wind, electric power generated by wind turbines is highly erratic and may affect both the power quality and the planning of power systems. Energy Storage Systems (ESSs) may play an important role in wind power applications by controlling wind power plant output and providing ancillary services to the power system, and therefore, enabling an increased penetration of wind power in the system. This article deals with the reviews of several energy storage technologies for wind power applications. The main objectives of the article are the introduction of the operating principles, as well as the presentation of the main characteristics of energy storage technologies suitable for stationary applications, and the definition and discussion of potential ESS applications in wind power, based on an extensive literature review.

Thailand's energy security indicators
Jutamanee Martchamadol and Kumar S. 2012.
Renewable and Sustainable Energy Reviews 16(8):6103–6122

This study presents an assessment of the energy security of Thailand using 19 indicators. The assessment period is for a 45-year period (1986–2030), and used published data for 1986–2009, and applying three energy scenarios for the period 2010–2030. The three scenarios considered were "high economic growth and least cost option (HEG&LC)", "low carbon society (LCS)", and "current policy (CP)". The results find that LCS scenario shows higher energy security or lower vulnerability to energy risk on a long term. However, to achieve this, the additional target of energy saving by 2030 should be changed from 25 per cent reduction of energy intensity of final energy consumption to 60 per cent energy intensity reduction of primary energy compared to 2009 level. One benefit would be an increase in the non-carbon incentive fuel portfolio by 33 per cent of total primary energy supply in 2030. A reduction in crude oil and natural gas domestic production will be offset by an increase in their imports. CO_2 emission reduction of 123 $MtCO_2$ and improvements in domestic energy reserves will also result.

A review on energy scenario and sustainable energy in Indonesia
Hasan M H, Mahlia T M I, Nur Hadi. 2012.
Renewable and Sustainable Energy Reviews 16(4):2316–2328

The global energy consumption is likely to grow faster than the population growth. The fuel consumption was growing from 6,630 million tonnes of oil equivalents (Mtoe) in 1980 to 11,163 Mtoe in 2009. This projected consumption will increase by 1.5 per cent per year until 2030 and reach 16,900 Mtoe and the main drivers of this growth are mostly developing countries in Asia. Indonesia is one of the developing countries and energy supply is an important factor for all-around development. The country's energy consumption still depends on non-renewable energy, such as crude oil, coal, and natural gas as sources of energy. Utilization of fossil fuel continuously contributes to huge amount of greenhouse gas emission that leads to climate change. Facing such an unfavourable situation, the government of Indonesia prioritizes on energy supply securities by diversification of energy resources. The energy mixes in Indonesia are based on five main resources; these are crude oil, natural gas, coal, hydropower, and renewable energy. Although the country encourages utilizing renewable energy, the contribution is only around 3 per cent. Considering natural conditions and geography, this country is blessed with great potential of renewable energy, such as solar energy, wind energy, micro hydro, and biomass energy. Noting the potential of renewable and sustainable energy resources in the country, the government must pay more attention on how to utilize it. Many efforts have been made to promote renewable energy, such as to create energy policies and regulations, without satisfactory results. Government, non-government agencies, and the public should take more proactive steps to promote and use renewable energy in order to achieve the secure environmentally sustainable energy resources.

Energy behaviours as promoters of energy efficiency: a 21st century review
Lopes M A R, Antunes C H, and Martins N. 2012.
Renewable and Sustainable Energy Reviews 16(6):4095–4104

This paper presents a review of recent literature on energy behaviours in order to recognize recent trends, quantify energy behaviours and potential savings, characterize

energy behaviour modelling strategies, and identify potential research gaps. Energy behaviour research is vast and has been essentially focused on the residential sector, striving to establish behaviour determinants and the best strategies and instruments to promote more efficient energy behaviours. Potential savings of energy behaviours are expected to reach 20 per cent, but values differ up to 100 per cent between experiences and additional studies to quantify behavioural savings are needed, in particular by using standard quantification techniques.

Different modelling techniques have been used to model energy behaviours: qualitative approaches from the social sciences trying to interpret behaviour, here named energy behaviour frameworks; quantitative approaches from the engineering and economics that quantify energy consumption, here designated by energy models; and hybrid approaches that are considered the most relevant since they integrate multiple dimensions of energy behaviours, here referred as energy behaviour modelling.

Energy behaviours have a crucial role in promoting energy efficiency, but energy behaviours characteristics and complexity create several research challenges that must be overcome so energy behaviours may be properly valourized and integrated in the energy policy context.

Quantitative energy performance assessment methods for existing buildings

Shengwei Wang, Chengchu Yan, Fu Xiao. 2012.
Energy and Buildings 55: 873–888

Building energy performance assessment is crucial to ascertain the efficiency of energy use in buildings and is the basis to make any decision for enhancing energy efficiency. In order to assess the energy performance of existing buildings quantitatively, the energy use of the assessed buildings should be quantified first. The quantified energy use will be then used to compare with the assessment criteria to determine the energy performance quantitatively. This paper presents an overall review on the state of the art of the research and applications of quantitative energy performance assessment. A framework is proposed for categorizing the energy quantification methods and performance benchmarking methods for energy performance assessment for existing buildings. Energy quantification methods are classified into three categories, i.e., the calculation-based, measurement-based, and hybrid methods, according to the energy data acquisition approaches. Energy performance assessment methods are classified according to the assessment scope and depth of assessment, i.e., whole-building benchmarking method at building level and multi-level assessment method.

Projections of energy services demand for residential buildings: insights from a bottom-up methodology

Gouveia J P, Fortes P, and Seixas J. 2012.
Energy 47(1): 430–442

Projections of energy demand are important for energy security supply and low-carbon futures, and usually rely on final energy consumption trends methods, limiting the opportunity for future options. Methods supported by energy services are much preferred to estimate future energy demand, since they are better suited to accomplish end-user needs. Final energy can then be assessed through complementary tools, as technological models, resulting in deeper knowledge on the relation between energy services and technology options.

This paper presents a bottom-up methodology to project detailed energy end-use demand in the Portuguese residential buildings until 2050, aiming to identify the parameters governing energy services demand uncertainty, through a sensitivity analysis. The partial equilibrium TIMES (The Integrated MARKAL-EFOM System) model was used to assess technology options and final energy needs for the range of parameters variations for each end use, allowing to conclude on the impact of uncertainty of energy services demand in final energy.

Main results show that technology can overweigh behavioural practices and lifestyle changes for some end uses as in space heating and lighting. Nevertheless, important focus should be given to uncertain parameters related with consumer behaviour, especially those on heating and other electric end uses, as thermal comfort and equipment's use.

An assessment of Taiwan's energy policy using multi-dimensional energy security indicators

Chih Chuang M and Wen Ma H. 2013.
Renewable and Sustainable Energy Reviews 17: 301–311

Facing the challenges of global warming, energy scarcity, and energy price fluctuations, many countries consider energy security to be a major part of their energy policy and have started to develop relevant strategies. This study applies multi-dimensional energy security indicators to review the performance of Taiwan's energy security related measures and to analyse the impacts of the current energy policy on Taiwan's energy security. The results show that Taiwan's current energy policy is effective in improving the security of energy supply. Taiwan's dependence on imported energy is rather high, however, which makes Taiwan vulnerable to international energy price fluctuations and liable to suffer from increased energy costs. ■

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Solar charger specifications

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Charge times: Battery will be fully charged from 7 hours of direct sun, 5.5 hours from USB port on laptop or optional DC or AC.
Capacity: 3,000mAh, 11 Watt hour capacity
Output: M 5.5V, 600mA via USB port
Input: 4.8–12V, 650 mA
Connect to devices via the USB Port or 9 standard adapters

Manufacturer's warranty

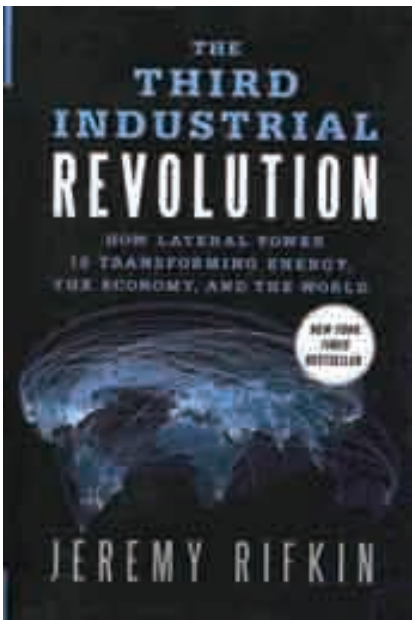
2-year warranty on bag or case and panels, 1-year warranty on battery, 30-day refund for products returned in new condition.

Bag specifications

Volume: 970 cubic inches (16 litres), enough room for a laptop and gear for a day trip.
Dimensions: 18" high x 12" wide x 6" deep (46 cm high x 31 cm wide x 15 cm deep)
Weight: 2.7 lbs (1,220 grams), including battery and solar panels
Fully padded, dedicated laptop sleeve: Fits up to a 17" laptop
Storage: One main compartment with 4 interior pockets, iPod or sunglass pocket, laptop sleeve and front pocket for charging and small electronics.
Wire channels: placed throughout the bag for headphones, water bladder tubes, etc.
Built for comfort: High-density padding in the shoulder straps and back. Mesh backing material for better air flow
Fabric: 600D shell made from recycled PET (soda bottles), which is waterproof, lightweight, and UV resistant.
Compatibility: The product will recharge all these handheld electronic devices and thousands more. Connect any USB charger direct to the battery's USB port or select from 5 included adapters. Below is a short list of some of the more popular phones and handheld devices.
Apple: iPhone 1G, 2G, 3G, 3GS, 4G, iPod Touch, Classic, Nano, Shuffle, iPad (limited, read iPad charger post)
BlackBerry: Bold 9700, Curve 8900, Pearl 8130, Storm 9530, Torch, Tour 9630
Flip: SlideHD, MinoHD, UltraHD
HTC: Eris, Evo, HD2, HD7 Hero, Incredible, myTouch 3G
Garmin: Oregon, Dakota, and zumo Series, eTrex with nuvi with Garmin's power cable
Iridium: 9555 Satellite Phone via Iridium car charger and panel output set to 12V
LG: Chocolate (requires optional adapter), Incite, Rumor
Kodak: zi6, zi8
Motorola: Backflip, Droid, Droid X, Pro and 2
Nintendo: DS with a USB charging cable
Nokia: N72, N900, N97 Mini, X3, X6
Samsung: Epic, Galaxy S, Instinct, Mythic, Rogue
Palm: Pre, Pre Plus
Sony: PSP (requires optional 4.0x1.7mm phone adapter)
TomTom: XL, XXL and GO Series
DSLR Cameras: In addition, you can adjust the voltage output of the solar panels from 6V to 12V. The 12V setting is suitable for charging larger 7.4V digital camera batteries. You will need an optional camera battery cradle that supports the specific battery in your camera. Read more about our digital camera charger solution. ■

THE THIRD INDUSTRIAL REVOLUTION

HOW LATERAL POWER IS TRANSFORMING ENERGY, THE ECONOMY, AND THE WORLD



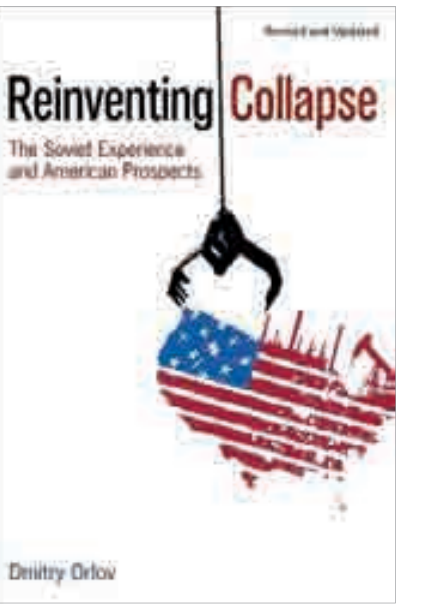
Author: Jeremy Rifkin
Year: 2011
Pages: 303
Publishers: Palgrave Macmillan

In his numerous vocations as author, policy advisor, economist, and social thinker, Jeremy Rifkin's work has possessed an enduring theme of unification as the best route to the continued survival and prosperity of the human species. At the core of *The Third Industrial Revolution: how lateral power is transforming energy, the economy, and the world* is a thought process Jeremy Rifkin first set in motion over 17 years ago in 1995 with *The end of work: the decline of the global labour force and the dawn of the post-market era*, a concept which was further ingrained in the popular consciousness through books, such as 2002's *The Hydrogen Economy: the creation of the worldwide energy web and the redistribution of power on earth* and *The Empathic Civilization: the race to global consciousness in a world in crisis* in 2010. These books appear to have preparations, if not observations from different vantage points, for a main thesis, which is finally presented in *The Third Industrial Revolution*.

In the book, Rifkin describes global civilization as being at the cusp of what he describes as the Third Industrial Revolution (where the first had occurred in Britain in the late 18th century, and the second had occurred in the United States in the late 19th and early 20th century), which he expects to culminate in the emergence of a new paradigm at whose core will lie the collaboration between modern communications technologies and renewable energy. Jeremy Rifkin's argument has its fair share of admirers in high places. In June 2007, the European Parliament formally endorsed Rifkin's concept. In May 2012, the European Union held a conference at Brussels, in Belgium, entitled, "Mission Growth: Europe at the lead of the new industrial revolution", where Jeremy Rifkin spoke about how major industrial revolutions have come at the junction of the emergence of new communications technologies and new energy systems. Clearly, then, this book is no mere popular attempt at trying to explain ideas in the energy sphere to a lay audience. Rifkin makes a cohesive and convincing argument. He draws from history while simultaneously making bold predictions based on current and future trends. The note of unerring optimism may strike some as naïve, as if the author is not fully aware of the perils being faced by modern economies, but Rifkin appears to be playing the long game. He views things like the recession as minor blips, the shocks of an economic transition process. The crux of Rifkin's treatise are what he describes as the Five Pillars of The Third Industrial Revolution; viz., renewable energy, small-scale energy generation, hydrogen and storage, Internet and smart grids, and electric transport.

Jeremy Rifkin believes that the convergence of renewable energy and modern communications technology can create a new energy paradigm that allows for greater synergy between localized energy generators and users. His book is highly thought-provoking and is a reflection of the truly fascinating times we are fortunate to be living in. He describes a new economic and social order that to some may appear to be an almost utopian vision. But this is backed up with excellent research and well-presented arguments that make it compelling. A highly recommended book for anyone interested in what the future of humanity could possibly look like. ■

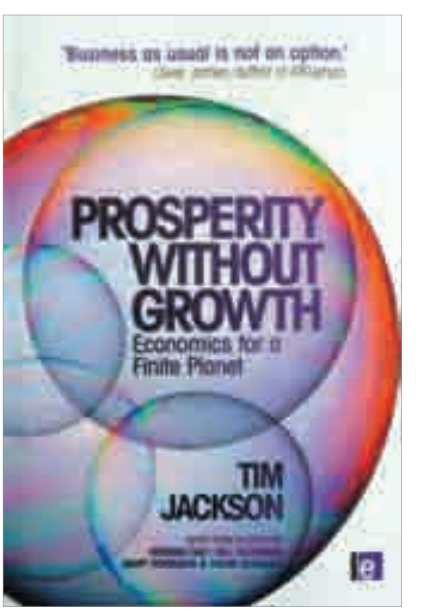
Reinventing Collapse: The Soviet Experience and American Prospects



Dmitry Orlov was born and raised in Leningrad (now, St. Petersburg) in the erstwhile USSR. In the mid-1970s, he emigrated to the United States of America after conditions in his native home become increasingly difficult and hostile. In a series of visits in the next two decades, Dmitry Orlov bore witness to the sudden collapse of the Soviet Union, one of the world's two superpowers. An engineer by profession, he has worked in the United States in a variety of fields, ranging from High-Energy Physics to Internet Security. With the emergence of China as the world's leading economic power, the severe recession, and the social and political instability prevalent in the United States, Dmitry Orlov is witnessing many signs and symptoms that bear a striking resemblance to the Soviet Russia he saw in the 1980s. He has written extensively about how such a large nation can undergo a sudden economic and political collapse, and believes the United States is on its way there. He does, however, see the differences; both economic and cultural. In this book, Dmitry Orlov draws from his experience of the collapse of the Soviet Union and applies it to the United States of America, bearing both a warning and a guide. He believes that the United States is en route to a collapse, but the scale and the consequences can be mitigated by preparing and avoiding the mistakes of the Soviet Union. ■

Author: Dmitry Orlov
Pages: 208
Year: 2011
Publisher: New Society Publishers

Prosperity without Growth: Economics for a Finite Planet



Tim Jackson has held numerous positions in the UK's energy and sustainable development sector. Apart from being the Professor of Sustainable Development at the University of Surrey, he is also the Economics Commissioner on the UK Sustainable Development Commission, and Director of the UK's Economic and Social Research Council's Research Group on Lifestyles, Values, and Environment. In this book, he combines his knowledge of economics and sustainability to provide a blueprint of the way forward for a world at the brink. In a controversial argument, he believes that economic growth should no longer be a priority for developed nations in the first world. Stating that while developing nations need to grow, continued economic growth in the developed world merely constitutes to greater consumption, which is not only harmful for the planet's environment and the energy security of those nations, but is also unlikely to improve the standard and quality of life of the people. Further consumption, argues Jackson, could even impede people in these nations from living fulfilled, happy lives. With a forward from His Royal Highness, the Prince of Wales, the book may appear facetious to some and has been described as economic heresy. Yet, others, such as Dame Ellen MacArthur have described it as "a thought-provoking gateway to redesigning our future". It is a counter-intuitive argument, and one many are likely to disagree with, but it is also likely that future generations will look back and wonder why this obvious course of action was not taken. ■

Author: Tim Jackson
Pages: 288
Year: 2011
Publishers: Routledge

RENEWABLE ENERGY TECHNOLOGY DEVELOPMENT

Greener storage for green energy

Storing energy from these intermittent sources has aroused interest, yet practical economics and basic chemistry have limited the wider use of green energy. Storage, to be viable, cannot add much to the price of renewable electricity without making it unacceptably expensive. Fossil fuels remain the world's chief energy source due to their relatively low cost.

To give renewables a fighting chance, a team led by engineers and chemists at Harvard University will use a one-year, $600,000 innovation grant from the US Department of Energy's Advanced Research Projects Agency-Energy (ARPA-E) programme to develop a new type of storage battery. The grant may be subject to renewal beyond a year, depending on performance. The award is part of a $130-million funding effort by ARPA-E through its "OPEN 2012" programme, designed to support innovative energy technologies.

Called a flow battery, the technology offers the prospect of cost-effective, grid-scale electrical energy storage based on eco-friendly small organic molecules. Because practical implementation is a core driver for the programme, the researchers are collaborating with Sustainable Innovations, LLC, a commercial electrochemical system developer.

"Storage of very large amounts of energy is required if we are to generate a major portion of our electricity from intermittent renewable sources, such as wind turbines and photovoltaics," says lead investigator Michael Aziz, Gene and Tracy Sykes Professor of Materials and Energy Technologies at the Harvard School of Engineering and Applied Sciences (SEAS). "Currently, no cost-effective solution exists to this large-scale storage problem. Flow batteries may make stationary storage viable in the marketplace, and that will enable wind and solar to displace a lot more fossil fuel."

A type of highly rechargable fuel cell, flow batteries, are suitable for storing large amounts of electrical energy in the form of liquid chemicals, which are flowed past the electrochemical conversion hardware and stored externally in inexpensive tanks that can be arbitrarily large. This permits the designer to independently size the electrochemical conversion hardware (which sets the peak power capacity) and the chemical storage tanks (which set the energy capacity). By contrast, in solid-electrode batteries, such as those commonly found in cars and mobile devices, the power conversion hardware and energy capacity are packaged together in one unit, and cannot be decoupled. Consequently, they can maintain peak discharge power for less than an hour before being drained. Studies indicate that 1 to 2 days (the cycle of day/night) are required for rendering renewables like wind and solar dispatchable through the current electrical grid.

To store 50 hours of energy from a 1-megawatt wind turbine (50 megawatt-hours), for example, a possible solution would be to buy solid-electrode batteries with 50 megawatt-hours of energy storage. The effective result, paying for 50 megawatts of power capacity when only 1 megawatt is necessary, however, makes little economic sense."Not only are existing solid-state batteries impractical for storing intermittent wind and solar energy, but flow batteries currently under development have their own set of limitations," says Aziz. "The chemicals used for storage in flow batteries can be expensive or difficult to maintain."

For example, vanadium redox flow batteries—the type of chemistry receiving the most attention—have limited commercial head room because the high price of vanadium sets a floor on the cost per kilowatt-hour of storage. Sodium-sulphur batteries operate with their components in a molten state, requiring the tanks to be kept at very high temperatures in hot houses. Both cost and complexity limit their use. Aziz believes that using a particular class of small organic molecules may be the key. These molecules, which his team has already been working on, are found in plants and can be synthesized artificially at a very low cost. They are also non-toxic and can be stored at room temperature. Furthermore, they cycle very efficiently between the chemical states needed for energy storage.

As an expert in materials science and a developer of high-performance flow cells, Aziz will focus his efforts on molecular and electrode electrochemistry and flow cell development.

Joining him will be Roy Gordon, Thomas Dudley Cabot, Professor of Chemistry and Professor of Materials Science, who will be responsible for the chemical screening and synthesis of molecules and of practical electrocatalytic and protective coatings. Alán Aspuru-Guzik, an Associate Professor in the Department of Chemistry and Chemical Biology, will use his pioneering high-throughput molecular screening methods to identify optimal molecules. Trent M Molter, President and CEO of Sustainable Innovations, LLC, will provide expertise on implementing these innovations into commercial electrochemical systems.

"We think our particular approach could have advantages over other flow batteries, such as higher power density, high efficiency, inexpensive chemicals, and a safer type of energy storage," says Aziz. "The success of this programme would render intermittent renewables like wind and photovoltaics dispatchable at will, and thereby permit them to supply a large fraction of our electricity needs."

Aziz foresees using next-generation flow batteries for local energy storage, such as in the basement of a house or office outfitted with rooftop solar panels or, at a larger scale, directly integrated into wind and solar farms. The technology could even out-compete lead-acid batteries for solar energy storage in remote areas without access to a grid.

"While not eliminating fossil fuels, flow battery storage potentially eliminates a barrier to doing so within the existing energy system and market," says Aziz. "The best engineering and chemistry alone are not enough to solve our energy challenges. Compatibility with current infrastructure is almost always essential, and economic viability is always essential. Flow batteries may play a huge role in our transition off of fossil fuels and I am very excited that Harvard has the opportunity to develop a potential game-changer."

http://www.sciencedaily.com/releases/2012/11/121129103414.htm

Synchrotron gives insight into green energy enzymes

One option for powering clean, environment-friendly vehicles is to run them on hydrogen fuel rather than carbon-based fuels. Cheap catalysts to prepare hydrogen gas (H2) are key to this future "hydrogen economy".

Current human-made catalysts are based on the rare and precious metal platinum. But, living cells contain enzymes called hydrogenases, based on the abundant metals such as nickel and iron, which can do the same job. Chemists are very interested in figuring out how these natural catalysts work and are trying to mimic them. Saeed Kamali, a postdoctoral researcher at UC Davis and Stephen Cramer, Professor of Chemistry have just published a study revealing new details of the iron-nickel complex at the heart of the natural hydrogenase. In collaboration with researchers at the Max Planck Institute in Germany and in the US, they used a technique called Nuclear Resonance Vibrational Spectroscopy (NRVS) and the SPring-8 synchrotron at the Japan Synchrotron Radiation Research Institute to probe the crystals and discovered new information about how the atoms in the complex can move.

The work was funded by grants from the National Institutes of Health, the US Department of Energy, and the Max Planck Society.

http://www.sciencedaily.com/releases/2012/12/121204145908.htm

India's largest solar plant up and running

India's biggest solar power plant, capable of generating 40 MW, has started operating in a Rajasthan, *The Times of India* reported.

The plant, based in the sunshine-trapped Indian district of Jaisalmer, Rajasthan, is owned by Reliance Energy and was built at an estimated cost of ₹400 crore on 140 ha of land. At the opening of the plant, Minister of New and Renewable Energy, Dr Farooq Abdullah said India would soon become a global leader in solar energy and the government is making all efforts towards achieving this goal. Building India's solar energy capacity could strengthen the Indian economy, said Abdullah. Rajasthan "is ideal" for solar energy and "would provide electricity to the entire country by setting up a large number of solar plants," he added. India has set a target to produce 20,000 MW of solar energy by 2022, confirmed Abdullah. He said he hoped Rajasthan alone would cross this target. India ranks fifth in wind energy production in the world and the way work is progressing "we could further move ahead", said Abdullah. Currently, 90 per cent of India's power generation fund is spent on coal, petrol, diesel, and other natural gases, according to the minister. But, if solar and wind energy is used then in every village this percentage could drastically change, he said. Chief Minister of Rajasthan, Ashok Gehlot said there is huge scope to expand the sector. For example, efforts are being made to set up a new solar energy park in western Rajasthan and to develop the state as a solar hub, he said. Some ₹10,000 crore has been invested in developing solar energy in Rajasthan; a further ₹6,000 crore could be invested further.

Reliance CMD, Anil Ambani said the new solar plant was a "historic moment for Rajasthan". "That we will be getting 40 MW power every single day is a record in itself," he said. ■

http://www.renewable-energy-technology.net/solar/india%E2%80%99s-largest-solar-plant-and-running

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NATIONAL AND INTERNATIONAL EVENTS

2013 International Conference on Electrical Energy and Networks (ICEEN 2013)
Conference
19th to 20th January 2013
Singapore
Website: http://www.iceen.org/

2013 2nd International Conference on Clean and Green Energy (ICCGE 2013)
Conference
19th to 20th January 2013
Dubai, United Arab Emirates
Website: http://www.iccge.org/

IEEE International Conference on Power, Energy and Control (ICPEC'13)
Conference
6th to 8th February 2013
Dindigul, Tamil Nadu, India
Website: http://www.psnacet.edu.in/icpec

International Conference on Energy Resources and Technologies for Sustainable Development (ICERTSD 2013)
Conference
7th to 9th February 2013
Howrah (near Kolkata), West Bengal, India
Website: http://www.icertsd.org/

2nd International Conference on Energy Systems and Technologies (ICEST 2013)
Conference
18th to 21st February 2013
Cairo, Egypt
Website: http://www.afaqscientific.com/icest2013/

Deeper Water Offshore Wind
Conference
6th to 7th March 2013
London, United Kingdom
Website: http://www.offshorewindconference.com

The 9th International Energy conference Tehran-Iran 20-21 Feb 2013
Conference
20th to 21st February 2013
Tehran, Iran
Website: http://www.irannec.com

2nd Annual International Conference on Sustainable Energy and Environmental Sciences
Conference
25th to 26th February 2013
Singapore
Website: http://www.env-energy.org/

INTERNATIONAL CONFERENCE ON NATURAL RESOURCE MANAGEMENT IN A CHANGING WORLD
Conference
24th to 27th February 2013
AL-AIN, ABU-DHABI, United Arab Emirates
Website: http://www.fos.uaeu.ac.ae/conference/nrm/

Ninth International Conference on Environmental, Cultural, Economic and Social Sustainability
Conference
23rd to 25th January 2013
Hiroshima, Japan
Website: http://onsustainability.com/conference-2013/

SMi Group's 6th annual Unconventional Gas Conference
Conference
6th to 7th March 2013
London, England, United Kingdom
Website: http://www.smi-online.co.uk/2013unconventional-gas6.asp

2013 NELA National Conference "Delivering a Low Carbon Future"
Conference
7th to 9th March 2013
Melbourne, VIC, Australia
Website: http://www.nelaconference.com.au

3rd International Conference on Electrical, Electronics and Civil Engineering (ICEECE'2013)
Conference
4th to 5th January 2013
Bali, Indonesia
Website: http://psrcentre.org/listing.php?subcid=184&mode=detail

Middle East and North Africa Energy
Conference
28th to 29th January 2013
London, United Kingdom
Website: http://www.chathamhouse.org/mena-energy2013?campaign=confalerts

FLNG 2013
Conference
13th to 14th February 2013
London, United Kingdom
Website: http://www.smi-online.co.uk/flng20.asp

ICWRE 2013- International Conference of Water Resources and Environment
Conference
12th to 14th February 2013
Marrakesh, Morocco, United States of America
Website: http://www.icwre.com

Solar POWER-GEN Conference & Exhibition
February 13, 2013 to February 15, 2013
San Diego, CA US
Website: http://www.solar-powergen.com/index.html

RENEWABLE ENERGY AT A GLANCE

New & Renewable Energy Cumulative deployment of various Renewable Energy Systems/ Devices in the country as on 30 November 2012				
Renewable Energy Programme/ Systems	**Target for 2012–13**	**Deployment during November, 2012**	**Total Deployment in 2012–13**	**Cumulative achievement up to 30.11.2012**
I. POWER FROM RENEWABLES				
A. GRID-INTERACTIVE POWER (CAPACITIES IN MW)				
Wind Power	2,500	46.30	968.45	18,321.10
Small Hydro Power	350	13.10	69.28	3,464.59
Biomass Power	105	16.00	92.50	1,242.60
Bagasse Cogeneration	350	24.00	214.00	2,199.23
Waste to Power -Urban	20	-	4.00	93.68
-Industrial		-	-	-
Solar Power (SPV)	800	2.00	105.88	1,047.16
Total	4,125.00	101.40	1,454.11	26,368.36
B. OFF-GRID/ CAPTIVE POWER (CAPACITIES IN MWEQ)				
Waste to Energy -Urban	20.00	0.36	9.36	111.10
-Industrial				
Biomass(non-bagasse) Cogeneration	60.00	7.00	41.44	423.94
Biomass Gasifiers -Rural	1.50	0.384	0.512	16.632
- Industrial	10.00	0.60	4.57	138.65
Aero-Generators/Hybrid systems	0.50	-	0.10	1.74
SPV Systems (>1kW)	30.00	-	13.60	103.81
Water mills/micro hydel	2.00(500 Nos.)	-	(68 nos)	2,121 Nos.
Total	126.00	8.344	69.582	795.872
II. REMOTE VILLAGE ELECTRIFICATION				
No. of Remote Village/ Hamlets provided with RE Systems	-	-	-	-
III. OTHER RENEWABLE ENERGY SYSTEMS				
Family Biogas Plants (No. in lakhs)	1.25	-	-	45.45
Solar Water Heating - Coll. Areas (Million m^2)	0.60	0.12	0.61	6.07

Source: www.mnre.gov.in

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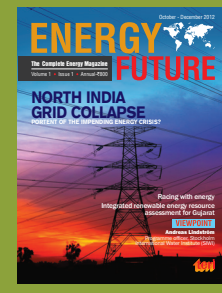

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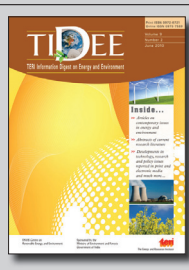

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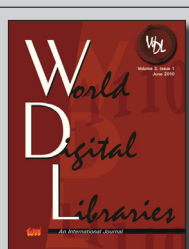

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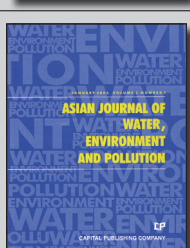

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