Social entrepreneur Harish Hande has bagged the prestigious 2011 Ramon Magsaysay Award for his pioneering work in bringing light to 'dark' Indian villages.

Harish Hande co-founded Selco (Solar Energy Lighting Company) India to eradicate poverty by promoting sustainable technologies in rural India. He has many accolades to his credit. He won the Ashden Award for Sustainable Energy 2005 and Tech Museum Award 2005. He is also a recipient of the world's leading Green Energy Award from Prince Charles in 2005.

In 2007, his company Selco won the Outstanding Achievement Award in the Ashden Awards. The award was presented by Al Gore, former Vice President of the United States of America. Harish Hande was also named the Social Entrepreneur of the Year 2007 by the Schwab Foundation for Social Entrepreneurship and the Nand & Jeet Khemka Foundation. In 2008, he was chosen by *Business Today* as one of the 21 young leaders for India's 21st century. In mid-2008, *India Today* named him one of the 50 pioneers of change in India.

This year, Harish Hande was one among the two Indians to receive Asia's prestigious Magsaysay Award, also sometimes referred to as Asia's Nobel Prize. He dedicated the award to his team at Selco-India. Neelima Mishra of Maharashtra was the other recipient of the award.

Harish Hande co-founded Solar Energy Lighting Company, India to eradicate poverty by promoting sustainable technologies in rural India.


Courtesy: Ashden Awards

Selco-India is a social enterprise whose mission is to enhance the quality of life underserved households and livelihoods through sustainable energy and solutions. SELCO Solar Pvt. Ltd, a social enterprise established in 1995, provides sustainable energy solutions and services to under-served households and businesses. It was conceived in an effort to dispel three myths associated with sustainable technology and the rural sector as a target customer base:

1) Poor people cannot afford sustainable technologies;
2) Poor people cannot maintain sustainable technologies;
3) Social ventures cannot be run as commercial entities.

SELCO aims to empower its customer by providing a complete package of product, service and consumer financing through grameena banks, cooperative societies, commercial banks and micro-finance institutions.

SELCO's key features:

- Creating products based on end user needs: going beyond just being a technology supplier but customizing our products based on individual needs.
- Installation and after-sales service: dedicating regional energy service centers to ensure prompt maintenance and service.
- Standardized financing packages: creating channels for end users to afford systems based on their cash flow.
- SELCO currently employs about 170 employees in Karnataka and Gujarat spread across 25 energy service centres. Since 1995, we have sold, serviced and financed over 115,000 solar systems to our customers.

Source: http://www.selco-india.com/about_us.html

THE GROWTH OF SOLAR PV INDUSTRY IN INDIA

Dr Satyendra Kumar is presently the Chief Technology Officer (CTO) at Lanco Solar, a subsidiary of Lanco Infratech Ltd. He has over 25 years of experience in research and development on solar cells and flat panel displays. He completed his education from IIT Roorkee, IIT Delhi, Ecole Polytechnique France and Penn State University, USA.

Before joining Lanco Solar in 2008, Dr Kumar was a full-time Professor at IIT Kanpur and was also heading the Samtel Centre for Display Technology—a unique concept in industry–academia–university partnership in the country. He has consulted, collaborated and worked with several leading industries in India and abroad in the areas of solar cells, selective coatings and flat panel displays. He has published and presented more than 150 papers in International journals and conferences. He is also an active member of FICCI, CII, IEEE, MRS, SID and SESI.

In an interview with Dr Suneel Deambi, Dr Satyendra Kumar discusses the changing trends in the Solar PV industry in India.

Q1. The Jawaharlal Nehru National Solar Mission (JNNSM) has opened the floodgates for a large number of new solar companies. Where does Lanco Solar position itself in this fast changing scenario?

Lanco Solar is strongly positioned in this fast emerging scenario of growing solar company participation. We welcome such participation as it may ultimately lead to smoothening of technology, programme, market and finance related issues for the expected gain of the Indian solar energy programme as a whole. It will then be analogous to a consolidation phase witnessed in the conventional industry segments too. Solar technology mixes expertise cutting across both the conventional and non-conventional manufacturing strengths, whether it is power storage or associated distribution to the point of end-use.

Courtesy: Salt River Project

Q2. Could you update us on the current status of solar projects approved for your company under the Special Incentive Package of the Ministry of Communications and Information Technology? In the ultimate analysis, can a major cost reduction benefit be possible?

Lanco Solar is fully committed towards providing sustainable, innovative, and cost-effective solutions across the entire solar power value chain. It has an envious distinction of being the first Indian company to effectively integrate the entire solar value chain in the country with a marked presence ranging from production of poly silicon to that of wafers and modules. Our company proposal in this regard has been approved under the special incentive package of the concerned ministry. We are quite expectant of meeting the local silicon wafer requirement to a good extent and at a market competitive price too. Currently, efforts are underway to take this manufacturing initiative to an early phase of project implementation.

It will be a 1250 MT poly silicon plant and 80 MWp wafering facility based in Chattisgarh. This facility is spread over a sprawling area of 250 acres in order to accommodate the planned 250 MW of integrated value chain. The total annual installed capacity as on date is 50 MWp of solar modules.

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Q3. As far as the megawatt scale grid power generation is concerned, several categories of Engineering, Procurement and Construction (EPC) players are emerging in the Indian solar market. To what extent can this ensure long-term field performance reliability of megawatt scale solar power plants?

I strongly believe that it is just not the PV equipment manufacturing alone that matters in the scheme of things concerning the setting up of MW scale grid interactive power generation plant. The job of an EPC contractor is to adhere to the best component assembly, component engineering mixed with standardized installation, and commissioning procedures. Obviously enough is the fact that those beginning afresh in this field will have to go through the whole learning curve at a time consuming constraint. Contrast to this situation with Lanco, which has a huge experience via its major conglomerate, i.e., Lanco Infratech Limited in the planning and execution of large scale infrastructural projects. The company has one of the largest solar power projects in the pipeline. It has signed PPA's for 35 MW solar PV projects in Gujarat under the ambit of its solar policy, out of which 5 MW capacity has already been commissioned successfully. Our predominant focus is on ensuring that solar power plants operate at optimum capacity utilization and are monitored in terms of their field performance. The underlying rationale is to study the synergy between the design and performing parameters.

Q4. Lanco Solar is committed towards promoting large scale solar thermal power generation. Are there any major challenges in achieving this goal? Please elaborate.

Our company is now targeting the installation of a solar thermal power plant in the sun soaked state of Rajasthan. Surely solar thermal-based power generation is not the same as observing the silent operation of solar photovoltaic power. In this case, the process features are definitely more complex needing precision engineering and control mechanism skills. Water availability is also of an utmost importance for the wetting operations of this type of plant. The issues, challenges and prospects of solar thermal route, though seemingly simplistic to look at, would initially require a wholesome perspective from a variety of end-use considerations. It is not a teething problem though to think about the indigenous availability of the accompanying plant and machinery.

Q5. How far do you agree with the emerging view that lack of trained manpower is one of the major challenges faced by the EPC contractors today? Further, could you please enunciate the other key factors to accelerate the pace of solar project development in India?

Our country is flush with a huge scientific and engineering manpower resource. Even though they may not have the hands on experience in the solar energy area per se, it is not a problematic issue at all. I have always believed that actual learning skills develop while someone is really

Courtesy: NREL/DOE

I have a strong optimism in the fact that whatever is available anywhere in terms of technology availability/upgradation will become available for others too. This simply opens up the concept of technology adaptation akin to the one seen in the Indian mobile telephony sector.

at a shop floor for example or happens to be at a power plant installation site. Yes, capacity building initiatives that we see now are taking shape at various levels. It includes the training of trainers and the technicians for example under the nation-wide programme being implemented through MNRE–DGET and TERI. I do not foresee the manpower issue turning up as any major constraint but quick employability of the trained manpower may prove beneficial in more ways than one.

Q6. The JNNSM lays a lot of emphasis on the issue of indigenous manufacturing of solar equipment (for example, solar cells). Please share your views on this issue. Are you also of the opinion that indigenous manufacturing of solar equipment could have any resultant benefits? Please elaborate.

I have a strong optimism in the fact that whatever is available anywhere in terms of technology availability/upgradation will become available for others too. This simply opens up the concept of technology adaptation akin to the one seen in the Indian mobile telephony sector. It is a well-placed initiative on the part of MNRE to allow participation of any global company in the solar business through setting up of manufacturing facilities at a local level. That alone will reap rich dividends for every one including the end-user at large, for whom cheap availability of solar equipment matters the most. It will also help in forging strong alliances between the Indian and foreign companies thus unfolding plethora of rich and varied experience across several key areas of PV technology and programme implementation too.

Q7. As far as solar technology is concerned, affordability is a major issue. Do you envisage a day in the future when companies like Lanco Solar would be able to showcase a truly affordable solar technology and bring about a revolution akin to the mobile telephony revolution?

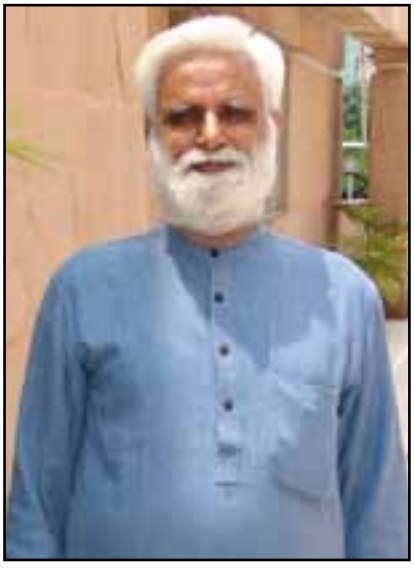
Yes, that would mark the true dawn of sun in India the day when a large number of households (both rural and urban) would have solar systems much like the Direct-to-Home (DTH) dishes on the rooftop. This does not seem to be a long drawn out dream considering the fact that 40% reduction has already occurred in the cost of solar modules in just a year or so. The balance of system cost too may also nosedive once the economies of scale are realized in full. Perhaps the greatest selling point of solar remains in its capability to meet power requirements in the milliwatt to megawatt power range. However, it is no less important for the solar companies including ours to produce the best quality equipment which ensures long-term field endurance too. Continuous innovations are needed to customize the power conditioning equipment especially to the intermittency of solar power and the resulting interface with the power grid. Time may soon witness switching of loyalties towards solar power especially when it comes to thinking about putting up a standby diesel power generator.

Q8. Is there any special message that you wish to put across to the young readers of *"The Solar Quarterly"* magazine.

I would like to pass on the message to one and all to keep abreast with the latest developments taking place in the solar area. The age old perception of solar being expensive needs to be dispensed with. Solar has reached this current phase of affordability after a lot of effort and optimism. The youngsters for instance need to bring in a discipline of saving energy as and when possible. Then solar would make a better sense to be incorporated in our day to day activities too. ■

EXPANDING THE FRONTIERS IN RE EDUCATION

Prof Rameshwar Lal Sawhney has recently joined TERI University, after teaching at DAVV, Indore; IIT, Delhi; Ilorin University, Nigeria; MLN College, Delhi; and DAV College, Dehra Dun for about 44 years. At DAVV, Indore, he was instrumental in establishing the School of Energy and Environmental Studies (for research and academic programmes) and the Centre of Energy Studies and Research (for implementing development projects and extension activities). He was Principal Investigator for the Regional Testing Center-cum Technical Backup Unit for Solar Thermal Devices, Regional Biogas Centre, Technical Backup Unit for Improved Chulha Programme and Technical Backup unit for Integrated Rural Energy Planning, all funded by the Ministry of New and Renewable Energy, Government of India. Besides nine books and seven review articles, he has published about 100 research papers in refereed journals. He is on the UNFCCC's roster of experts for assessment of DOEs and is a member of BIS Sectional Committee on Non-Conventional Energy Sources and Sub Committee on Solar Thermal Energy. He has been member of various committees of MNRE, BEE, UGC and IITs and has organized and participated in a large number of national and international conferences/workshops and seminars. He is an accredited lead assessor for ISO-14001:2004 and the ISO/IEC-17025:2005 testing procedures developed by the RTC, Indore for Thermosyphonic Solar Water Heating Systems which has been accepted by BIS as the National Standard.



In an interview with Dr Suneel Deambi, Prof Sawhney talks of the importance of renewable energy education in India and the need to improve the same.

Q1. You have a long drawn experience of teaching variety of solar energy courses at the Devi Ahilya University at Indore. In this specific backdrop could you kindly present your holistic outlook of solar energy technologies?

I have enjoyed teaching solar energy curriculum at multiple levels. The solar energy technologies have now moved quite ahead from the earlier times giving enough room for academic cum research pursuits. All this has led to design, development and market worthiness of a diverse range of solar products and systems. Even building designs too have improved, though only limited incorporation of passive solar architecture has taken place. Solar energy will continue to have an edge over rest of the technologies for one reason or the other.

Q2. You are now quite actively involved in teaching solar energy courses at the TERI university. Which specific course

The larger idea of running PG Diploma course on Renewable Energy Management course originated from the need of blending Indian experiences in RE area with those prevalent abroad. The Open University in the UK is a collaborating partner in this course and course elements have been customized for our specific needs.

are you teaching now and what is the resultant outcome of the same?

I have been teaching various courses like heat and mass transfer besides renewable energy resource characteristics and solar thermal power based generation. In essence, these are the foundation courses and are especially aimed at enriching the knowledge base in the fast emerging solar thermal area. After all, we need people with sound analysis and oriented skills, and with genuinely stimulated interest in solar energy area at large.

Q3. TERI University runs a special PG Diploma course on Renewable Energy management in a distance education mode. Has the course curriculum been developed in-house and what is the outreach of this course?

The larger idea of running this course originated from the need of blending Indian experiences in RE area with those prevalent abroad. The Open University in the UK is a collaborating partner in this course and course elements have been customized for our specific needs. Currently, there are 60 persons enrolled for this course possessing rich and varied professional experience. Contact programme for a week or so is organized at the end of each semester, mainly to offer solutions to any impending problems.

Q4. The Indian solar energy programme is now appearing on a larger canvass of being useful, reliable, safe, and more importantly environment friendly. Accordingly, several academic institutions and universities are formulating/ offering solar energy courses both at the undergraduate and diploma programme levels. How far do you agree to the need of having a nation-wide common course curriculum?

Surely there should be a common course curriculum supplemented by field driven orientation at technician, diploma and graduate levels across all such institutions. Among the courses at the post graduate level the content should depend on the available faculty's capability and research interest of that particular institute. That would also mean enhancing the credibility of such a course stimulated by an equally higher employability potential as well. The vast network of ITIs, diploma institutes and engineering colleges for instance can be drawn towards this streamlined process of thought and practice. It may also go a long way in forging alliances amongst a varied lot of stakeholders who are genuinely interested in wholesome development of the solar energy programme.

Q5. Solar thermal products like the box type cookers and water heating systems have been the most preferred in the southern region of our country. Contrast this with minimal numbers of these products finding favour in other parts of India. How do you view this north-south divide for example in terms of actual market penetration of such products?

Courtesy: NREL/DOE

I would like to pass on the message that the future belongs to solar energy. Thereby, people should gear themselves up to the fast changing dimensions of solar sector. The availability of green jobs in huge numbers is an added advantage in this arena.

It is amazing to witness a large number of households using solar water heating systems in south India. Predominant reason seems to be in terms of their extended period of use of hot water throughout the year for their bathing requirements in south India. The same is not true with households in a place like Delhi for instance mainly due to far reduced requirement of solar water heater only in the winter season..

The concept of quick payback period of 3–4 years for solar water heater also does not hold ground with an individual. Simply put, he/she continues to take a liking to the electrically operated geysers available at just one-third of the cost of a solar geyser. There is also an issue of easily available servicing facility for these products too, should anything go wrong with these products.

Q6. Do you foresee any entrepreneurship opportunities other than those at production/installation cum commissioning stages in the solar area? If so, kindly enunciate the same.

There are a plethora of opportunities available at the operation cum maintenance level. Sadly, there is a near total reluctance and diminished preparedness for undertaking repairs and maintenance in a well organized manner. Seemingly, there is not enough market volume/incentive which could catalyse the interest of at least a selective few organizations. Needless to say a well treated O&M structure would be a foolproof guarantee of enhancing the outreach of solar products. After all, a consumer is just interested in having an unfailing use of the product be it solar or any conventional product for that matter.

Q7. Do you have any special message to convey to the curious readers of The Solar Quarterly?

I would like to pass on the message that the future belongs to solar energy. Thereby, people should gear themselves up to the fast changing dimensions of solar sector. The availability of Green jobs in huge numbers is an added advantage in this arena.The solar interface mixes inter-disciplinary talent and capabilities hovering around science, engineering, economics, and management streams. Thus everyone can take pride in the fact of tiling nature's bounty in whatever way it becomes possible. The youngsters in particular are expected to play a pivotal role in this area.

Q8. Are there any innovative path breaking solar technologies in sight which could make the solar technologies truly affordable and acceptable across different sectors of our energy economy?

Technology upgradation in any manner is a continuous process which can take place in academic, research and industry environments. I foresee something of a dramatic nature happening in the area of PV balance of system. The cost of solar modules is dropping leaving enough scope for further cost reduction at the levels of batteries and power conditioning units, etc. ■

Courtesy: LaBL, TERI

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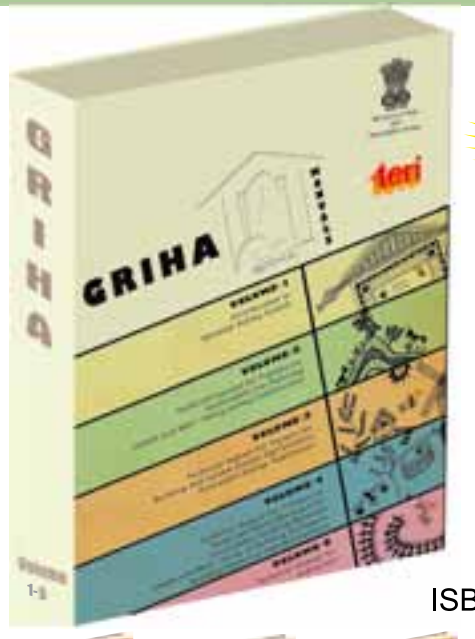

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SOLAR TECHNOLOGICAL UPDATE

Quantum dots manufactured in continuous flow process

Using a microreactor and control software, Quantum Materials Corporation (QMC) and the Access2Flow Consortium of the Netherlands achieved a continuous flow process to mass produce quantum dots. With mass production, Quantum Materials Tetrapod Quantum Dots will be available in material quantities needed for high-volume electronics products, such as solid-state lighting, quantum-dot light emitting diode (QLED) displays, nano-bio apps, and so on. This process will also be used for QMC's subsidiary, Solterra Renewable Technologies, for quantum dot solar cells, and solar panels.

The inherent design of the microreactor allows for commercial-scale parallel modules to achieve large production rates at low cost in a regulated, optimized system. Material choice for QD production is flexible, enabling work on heavy-metal (cadmium) free quantum dots, and other biologically inert materials.

While quantum dots offer performance improvements for products from LED displays to energy storage systems, lacking high-volume manufacturing methods have limited quantum dot integration into commercial products. The continuous flow manufacturing process is meant to eliminate the difficulty in manufacturing quantum dots, the lack of quality and uniformity of quantum dots, and the corresponding high cost (average $2500–$6000/gram).

Source: www.electroiq.com

Carbon nanotubes super capacitors enable harsh-environment energy storage

Rice University researchers created solid-state, nanotube-based super-capacitors for energy storage, combining aspects of high-energy batteries and fast-charging capacitors with harsh-environment ruggedness. The super-capacitor uses a solid nano-coating of oxide dielectric material rather than liquid or gel electrolytes. The solid material better withstands extreme heat and cold while performing discharge/recharge functions.

The researchers used 15–20 nm bundles of single-walled carbon nanotubes (SWCNT) up to 50 µm long. Carbon nanotubes were used to give the electrons high surface area, increasing capacitance. Each bundle of nanotubes is a self-contained super capacitor that is 500 times longer compared to its width. A chip could contain hundreds of thousands of bundles. The array was transferred to a copper electrode with thin layers of gold and titanium for adhesion and electrical stability. The nanotube bundles (the primary electrodes) were doped with sulphuric acid to enhance their conductive properties; then they were covered with thin coats of aluminum oxide (the dielectric layer) and aluminum-doped zinc oxide (the counter electrode) with the help of atomic layer deposition (ALD). A top electrode of silver paint completed the circuit. It creates a metal/insulator/metal structure. The university researchers assert that the project is the first-of-its-kind with such a high-aspect-ratio material and ALD fabrication.

Source: w ww.electroiq.com

Applied materials solar PV screen printer features modular design

Applied Materials (AMAT) installed the Pegaso screen printer—a nod to the mythical flying horse Pegasus—on its Baccini platform, fabricating electrical circuits on both sides of a solar cell.

The architecture features dual independent lanes (dual print heads) with closed-loop metrology for adjusting printing parameters on-the-fly from wafer-to-wafer. The system's specifications include <8 µm alignment accuracy, >2,900 wph throughput, a net throughput >2,700 wph, <0.15% wafer breakage, and handling for wafers as thin as 120 µm. Jim Cushing, senior director, product management, Applied Solar, and Andrea Moretto, The new platform, continues the Baccini legacy of "very soft wafer handling" with more sophisticated motion control algorithms, and the use of planar motors and Bernoulli "flippers" that are essential to the tool's performance. Furthermore, the short kinematic chain design concept directly enables the system's precision and accuracy. (Short kinematic chain refers to a reduction in the number of components necessary for achieving relative motion, as well as better machine tolerances, and reducing the derived stack uncertainty of the kinematic chain.) Also, the tool does not use bearings.

Applied believes that scaling of solar cell manufacturing is no longer enough to achieve the decrease in cost of module manufacture. With respect to wafer handling, Cushing described how wafer breakage negatively impacts a screen print production line (for example, cost and value of the wafer, downtime for cleaning and maintenance, and chips of wafers can tear the print screen). The economic impact of broken wafers can be as much as $500 k/yr with alternative screen printing systems, said Cushing.

Cushing noted that the system's modular design enables a "future-proof" upgrade path. End users are developing different cell designs, new printing capabilities, and new laser or metrology capabilities. Applied considers the new tool to be a kind of backbone that enables swapping out different modules/capabilities.

Source: www.electroiq.com

Applied Materials stops selling 'SunFab' thin-film lines: focus on c-Si solar and LED technology

In a significant change of direction, Applied Materials has revealed that it will stop selling its turnkey a-Si thin-film technology under the SunFab name to potential new customers, shifting emphasis away from thin-film altogether and focusing on crystalline silicon (c-Si) and LED manufacturing equipment and technology. Applied materials has not been as active in the growing LED market as other equipment suppliers, primarily from the semiconductor industry. Leading semiconductor foundry, Taiwan Semiconductor Manufacturing Company (TSMC) is entering the LED market. As for the equipment used in the SunFab line, Applied would continue to offer individual tools for sale to thin-film solar manufacturers. Efforts in the research and development area to improve thin-film efficiency levels and high-productivity deposition would continue for existing customers.

A number of customers have struggled to gain traction in the market due to the competitive strength of thin-film leader and CdTe technology user, First Solar, which has the lowest manufacturing cost-per-watt structure. The dramatic fall in polysilicon prices has also played its part in boosting the competitive position of c-Si technologies and recent resurgence in cell efficiency gains.

Source: www.pv-tech.org

Solar power plant switches to PV from thermal

Developers of the giant Blythe Solar Power Project in California have switched from solar thermal technology to photovoltaic (PV) solar panels. Recently, Solar Millennium said that the first 500-megawatt phase of the Blythe plant will use photovoltaic (PV) panels because the economics work better. Earlier this year, the company received a conditional loan guarantee from the Department of Energy to develop a concentrating solar thermal plant, where heat from mirrored troughs generates steam which passes through a turbine to generate electricity. But Germany-based Solar Millennium and its US subsidiary said it will use commercial financing and PV technology instead.

Seven other utility-scale solar projects in South West US have decided to scrap concentrating solar power (CSP) for PV. Total, 2,515 megawatts of solar capacity has been converted, according to GTM research analyst Brett Prior. The moves underscore how falling costs have improved the competitiveness of PV for large-scale projects. Solar PV prices have fallen by more than 50% over the last two years, making them more attractive to both the energy developer and institutions investing money to finance these projects.

Solar Millennium has not yet chosen which technology it will use for the second half of the 1,000 megawatt project, which is projected to be the largest solar plant in the world. But the company said it remains committed to CSP in other countries. Solar thermal plants also have the ability to add storage using molten salt.

Source: news.cnet.com

How to make efficient solar cells from impure materials

Most solar cells are made from crystalline silicon. These solar cells are easily available in the market. Crystalline silicon is expensive because it has to be very pure to make efficient solar cells from it. Unfortunately, nobody knows exactly how pure and that is why manufacturers play it safe. And in the process they may be manufacturing more expensive silicon than probably necessary.

For the first time, the effects of a whole range of (metal) impurities in the silicon starting material ('feedstock') on the efficiency of modern solar cells are described in detail. This way it becomes possible to purify the silicon in more targeted ways and to optimize the costs. Since 'good is good enough', unnecessary steps in the purification processes can be avoided.

The essence of the new findings described in this thesis is that the negative effects on solar cell performance of impurities in silicon feedstock can be strongly reduced during and by some of the process steps that follow feedstock fabrication, in particular, growing large crystal blocks or rods (which are subsequently cut into very thin wafers) and processing wafers into solar cells.

It can now indicate the percentage of impurity (per type) that is acceptable in the feedstock, if one is to manufacture efficient solar cells. This is a crucial step towards full specifications of 'solar grade' silicon.

The availability of silicon of (assumed) sufficient chemical purity has been an important limiting factor for rapid growth and price reduction during part of the last decade, and could be same even in the future. There is a strong need for low-cost and low-investment-cost technologies for the production of silicon for PV applications. However, such low-cost production technologies will most likely compromise the purity of the resultant silicon. The aim of the studies presented in this thesis is to understand the complex relation between the impurity content of the silicon starting material (the "feedstock") and the resulting solar cell device performance, taking into account the effects of processing and device architecture.

Source: www.solardaily.com

CO utility selects leading solar garden provider CEC for renewable project

The Clean Energy Collective has been selected by San Miguel Power Association, Inc (SMPA) to build and operate a community-owned solar array within the rural electric cooperative's service

territory. SMPA released a request for proposal seeking bids for the design, construction, and implementation of a community-owned renewable energy solution, and SMPA's Board of Directors selected the Clean Energy Collective. SMPA and the Clean Energy Collective are now working to identify the appropriate site for a 1 MW community-owned solar facility.

The community solar project will give all SMPA members the option to invest in solar generation without having to build a system on their home or business. In a programme that is the first-of-its-kind in the nation, the Clean Energy Collective model allows customers to adopt renewable energy by owning panels in a locally-sited array, and through the utility directly reap the benefits on their electric bills.

This model eliminates several barriers by opening to everyone the doorway to ownership with electric service.

This will be CEC's fourth solar facility in Colorado, along with a recently approved 1 MW site in El Jebel, an 858 kW facility operating in Rifle (currently the largest community-owned solar garden in the nation), and the 80 kW pilot facility in El Jebel.

Source: www.solardaily.com

Parabolic mirrors concentrate sunlight to power lasers

Legend tells of Greek engineer and inventor Archimedes using parabolic mirrors to create "heat rays" to burn the ships attacking Syracuse. Though the underpinnings of that claim are speculative, a modern-day team of researchers at the Scientific and Production Association in Uzbekistan has proposed a more scientific method of harnessing parabolic mirrors to drive solar-powered lasers. The small scale analogs of giant reflector telescopes would convert an impressive 35% of the Sun's energy into a laser light, providing a considerable increase in the maximum power produced by current-day solar pumped lasers, which typically achieve only a 1%–2% efficiency.

The new solar lasers would concentrate light with a small parabolic mirror of 1 m in diameter that has a focal spot approximately 2–3 cm in diameter. The concentrated light would then strike a two-layer ceramic disk known as a Neodymium and Chromium co-doped yttrium aluminium garnet (YAG) laser material. One side of the disk would have a highly reflective coating; the other side would be anti-reflecting. When sunlight penetrates through the ceramic material, it excites the electrons in the material, causing them to emit laser light of a specific wavelength (1.06 micrometres).

To control the searing heat produced by the concentrated sunlight, the ceramic disk would be mounted atop a heat sink through which water would be pumped.

The laser light would then travel to a prime focus and be reflected back to the ceramic surface before exiting the solar collector at an oblique angle. It is this "double pass" path that increases efficiency, thus enabling a greater fraction of sunlight to be converted into laser light. Potentially, parabolic reflector lasers could be harnessed for the large-scale synthesis of nanoparticles and nanostructures.

Source: www.solardaily.com

Advancements in solar technology will allow more people to power their own homes

A recent issue of the *Inorganic Chemistry* contains a report about the advancements being made in the field of solar energy production. The concept of "personalized solar energy", a model by which people power their own homes using the energy from the sun rather than rely on the power grid, is becoming more viable as scientists have discovered improved ways of storing large quantities of solar energy. The new method of energy storage is similar to plant photosynthesis. Scientists have designed a catalyst that splits water into oxygen and hydrogen that are then stored as fuel in fuel cells. The entire process from production to consumption is both clean and sustainable.

Although the initial cost of solar equipment is typically high, the unlimited availability of free energy from the sun is an invaluable asset. Researchers recognize the benefits of energy independence both for the well-being of people and the environment, and they hope that the concept will become more mainstream.

Source: www.naturalnews.com

3D solar cells capture more sunlight, boost solar panel efficiency

Scientists at the Georgia Tech Research Institute (GTRI) have developed a prototype of a three-dimensional solar panel that is able to capture sunlight from nearly every angle and transform it into electricity, according to a report in the journal *JOM*, which is published by the Minerals, Metals and Materials Society. According to researchers, the new cell should be vastly more efficient than current photovoltaic panels. Current photovoltaic cells are made in the shape of flat panels. This means that sunlight must strike the panels directly, and that light falling at the wrong angle is not collected. In addition, flat panels reflect a significant portion of the light that hits them, making it unavailable for electricity generation.

The new panels make use of nanotechnology, and are shaped much like a city skyscape—a collection of tower-like structures with small spaces between them. To the naked eye or even a regular microscope, the panels still appear flat; the "towers" are on the scale of microns, or millionths of a metre. This unique shape allows the towers to collect light from nearly any angle. The towers are squares about 40 microns on a side, 100 microns tall, and 10 microns apart. This unique shape increases the panels' efficiency for yet another reason. All solar panels have a coating that is designed to trap photons (light particles) rather than reflect them. The thicker the coating, the more photons trapped. However, thicker coatings also reduce the speed at which current-carrying electrons exit the panel, thus reducing its efficiency. Because the new panels capture more light, the coating can be made thinner, and thus a single panel can generate more current.

Source: www.naturalnews.com

CURRENT R&D SOLAR

Xu S M, Huang X D, Du R. 2011. **An investigation of the solar powered absorption refrigeration system with advanced energy storage technology**. *Solar Energy* **85**(9): 1794–1804

Abstract

The Variable Mass Energy Transformation and Storage (VMETS) technology is introduced into the solar powered absorption refrigeration field. It can effectively shift the loads between solar radiation and air conditioning. With the VMETS technology, more solar energy can be used in the systems for cooling, heating or dehumidifying. The characteristics of the Solar Powered Absorption Refrigeration system with the VMETS technology are obtained by numerical simulation. The study results are helpful for readers to understand the operation principle and feature of the system.

Shi Zhiyang, Zhang Xiong. 2011. **Analyzing the effect of the long wave emissivity and solar reflectance of building envelopes on energy-saving in buildings in various climates**. *Solar Energy* **8**(1): 28–37

Abstract

A dynamic computer simulation is carried out in 35 cities across the world. The variation of the annual air-conditioning energy loads due to changes in the longwave emissivity and the solar reflectance of the building envelopes is studied to find the most appropriate exterior building finishes in various climates (including a tropical climate, a subtropical climate, a mountain plateau climate, a frigid-temperate climate, and a temperate climate). Both the longwave emissivity and the solar reflectance are set from 0.1 to 0.9 with an interval of 0.1 in the simulation. The annual air-conditioning energy load trends of each city are listed in a chart. The results show that both the longwave emissivity and the solar reflectance of building envelopes play significant roles in energy-saving for buildings. In tropical climates, the optical parameters of the building exterior surface affect the building energy-saving most significantly. In the mountain plateau climates and the subarctic climates, the impacts on energy-saving in buildings due to changes in the longwave emissivity and the solar reflectance are still considerable, but in the temperate continental climates and the temperate maritime climates only limited effects are seen.

Nielsen Martin Vraa, Svendsen Svend, Jensen Lotte Bjerregaard. 2011. **Quantifying the potential of automated dynamic solar shading in office buildings through integrated simulations of energy and daylight**. *Solar Energy* **85**(5): 757–768

Abstract

The façade design is and should be considered a central issue in the design of energy-efficient buildings. That is why dynamic façade components are increasingly used to adapt to both internal and external impacts, and to cope with a reduction in energy consumption and an increase in occupant comfort. To gain a complete picture of any façade's performance and subsequently carry out a reasonable benchmarking of various façade alternatives, the total energy consumption and indoor environment need to be considered simultaneously. We quantified the potential of dynamic solar shading façade components by using integrated simulations that took the energy demand, the indoor air quality, the amount of daylight available, and visual comfort into consideration. Three types of façades were investigated (without solar shading, with fixed solar shading, and with dynamic solar shading), and we simulated them with various window heights and orientations. Their performance was evaluated on the basis of the building's total energy demand, its energy demand for heating, cooling and lighting, and also its daylight factors. Simulation results comparing the three façade alternatives show potential for significant energy reduction, but greater differences and conflicting tendencies were revealed when the energy needed for heating, cooling, and artificial lighting were considered separately. Moreover, the use of dynamic solar shading dramatically improved the amount of daylight available compared to fixed solar shading, which emphasizes the need for dynamic and integrated simulations early in the design process to facilitate informed design decisions about the façade.

Norton B, Eames P C., Mallick T K, Huang M J, McCormack S J, Mondol J D, Yohanis Y G. 2011. **Enhancing the performance of building integrated photovoltaics**. *Solar Energy* **85**(8): 1629–1664

Abstract

Recent research in Building Integrated Photovoltaics (BIPV) is reviewed with the emphases on a range of key systems whose improvement would be likely to lead to improved solar energy conversion efficiency and/or economic viability. These include invertors, concentrators, and thermal management systems. Technological advancements for specific aspects of systems design, installation, and operation are also discussed.

Branz H M, Teplin C W, Romero M J, Chen I T, Wang Q, Alberi K, Young D L, Stradins P. 2011. **Hot-wire chemical vapor deposition of epitaxial film crystal silicon for photovoltaics.** *Thin Solid Films* **519**(14): 4545–4550

Abstract

We have demonstrated that hot-wire chemical vapour deposition (HWCVD) is an excellent technique to produce high-quality epitaxial silicon at high rates, at substrate temperatures from 620 to 800 °C. Fast, scalable, inexpensive epitaxy of high-quality crystalline Si (c-Si) in this temperature range is a key element in creating cost-competitive film Si PV devices on crystalline seed layers on inexpensive substrates such as display glass and metal foil. We have improved both the quality and rate of our HWCVD Si epitaxy in this display-glass-compatible T range. We understand factors critical to high-quality epitaxial growth and obtain dislocation densities down to 6×10^4 cm^{-2} by techniques that reduce the surface oxygen contamination once growth is initiated. We have also developed and validated a model of the HWCVD silicon growth rate, based on fundamentals of reaction chemistry and ideal gas physics. This model enables us to predict growth rates and calculate the sticking coefficient of the Si radicals contributing to film formation between 300 and 800 °C. We obtain efficiencies up to 6.7% with a 2.5-micron absorber layer grown on heavily-doped 'dead' Si wafers, although these cells still lack hydrogenation and light trapping. Open-circuit voltages up to 0.57 V are obtained on 2-μm cells. Efficient film crystal silicon photovoltaics will require dislocation spacing more than 6 times the cell thickness, or else effective H passivation of the dislocations.

Fthenakis V M, Kim H C. 2011. **Photovoltaics: life cycle analyses.** 2011**.** *Solar Energy* **85**(8) 1609–1628

Abstract

Life-cycle analysis is an invaluable tool for investigating the environmental profile of a product or technology from cradle to grave. Such life cycle analyses of energy technologies are essential, especially as material and energy flows are often interwoven, and divergent emissions into the environment may occur at different life cycle stages. This approach is well exemplified by our description of material and energy flows in four commercial Photovoltaics (PV) technologies, that is, mono-crystalline silicon, multi-crystalline silicon, ribbon-silicon, and cadmium telluride. The same life cycle approach is applied to the balance of system that supports flat, fixed PV modules during operation. We also discuss the life cycle environmental metrics for a concentration PV system with a tracker and lenses to capture more sunlight per cell area than the flat, fixed system but require large auxiliary components. Few select life cycle risk indicators for PV, such as fatalities, injuries, and maximum consequences are evaluated in a comparative context with other electricity-generation pathways.

Urbanetz J, Zomer C D, Rüther R. 2011. **Compromises between form and function in grid-connected, building-integrated photovoltaics (BIPV) at low-latitude sites.** *Building and Environment* **46**(10): 2107–2113

Abstract

The integration of photovoltaic (PV) modules on building façades and rooftops is an ideal application of solar electricity generators in the urban environment. Maximum annual performance of grid-connected PV is usually obtained with modules tilted at an angle equal to the site latitude, facing the equator. The performance of PV systems not tilted and oriented ideally can drop considerably, depending on site latitude. With grid parity expected in many countries in the present decade, a more widespread application of PV on buildings is expected, and in this context the main goal of this paper is to demonstrate that good compromises between form and function are possible. In this work, we compare the annual energy generation of a curved BIPV system installed as a car port rooftop, with an ideally-oriented and tilted, flat BIPV system installed as a building's rooftop cover at a low-latitude site (27 °S). For the one-year period analysed, the curved-shape BIPV system annual yield was 12% lower than that of the reference BIPV system, and during the summer months (November to February), the curved BIPV installation presented a higher energy yield than the latitude-tilted generator. With these results, we show that a good compromise can be reached between form and function in BIPV systems.

Lloyd M T, Peters C H, Garcia A, Kauvar I V, Berry J J, Reese M O, McGehee M D, Ginley D S, Olson D C. 2011. **Influence of the hole-transport layer on the initial behavior and lifetime of inverted organic photovoltaics**. *Solar Energy Materials and Solar Cells* **95**(5): 1382–1388

Abstract

The inverted organic photovoltaic (OPV) device architecture represents an important advancement due to the relative environmental stability of the electron transport layer (ETL) and hole-collecting contact. We investigated the initial and long-term behaviour of inverted devices to identify changes taking place at the Ag hole-collecting contact. We show that efficient hole collection can be obtained after modifying the Ag contact by thermal annealing, long-term exposure to ambient atmosphere, or employing a high work function organic hole-transport layer (HTL). We find that whether or not the device employs an organic HTL, degradation of the photocurrent initially follows a simple exponential decay. After prolonged illumination (>500 h), devices with an organic HTL fail catastrophically due to a precipitous drop in photocurrent. Based on evidence for pinhole-induced degradation observed in photocurrent maps, we propose a nucleation and island growth mechanism and a model for the photocurrent behaviour employing a modified Johnson–Mehl–Avrami–Kolmogorov

(JMAK) equation. Devices that do not contain an HTL appear to degrade by a mechanism other than pinhole ingress resulting in a more uniform degradation of the photocurrent across the active area.

Galagan Y, Ike G. de Vries, Langen A P., Andriessen R, Verhees W J H, Veenstra S C, Kroon J M. 2011. **Technology development for roll-to-roll production of organic photovoltaics.** *Chemical Engineering and Processing: Process Intensification* **50**(5–6): 454–461

Abstract

In order to reach the objective of low-cost, large area organic photovoltaic systems, we build up a knowledge base concerning the influence of process conditions on the performance of polymer solar cells. A large area solar cell module, with roll-to-roll coated PEDOT:PSS and photoactive layers (based on P3HT:[C60]PCBM blend) on a flexible substrate, has been demonstrated. Both the PEDOT:PSS and photoactive layer were deposited by slot die coating. A non-chlorinated solvent was used for the deposition of the photoactive blend. The flexible solar cell module illustrated a power conversion efficiency of 0.7% under AM 1.5 conditions.

Ruderer M A, Hinterstocker M, Müller-Buschbaum P. 2011. **Structure in ternary blend systems for organic photovoltaics**. *Synthetic Metals* **161**(17–18): 2001–2005

Abstract

The incorporation of an organic dye in the active layer of a polymer-based solar cell and its structural and spectroscopic influence is investigated. The phthalocyanine derivative, 1,4,8,11,15,18,22,25-octabutoxy-29H,31H-phthalocyanine (OPc), is incorporated in the blend of poly(3-hexylthiophene) (P3HT) and 1-(3-methoxycarbonyl)-propyl-1-phenyl-(6,6) C_{61} (PCBM) forming a ternary blend, which expands the absorption range as compared with the binary P3HT:PCBM system. Absorption and structural characterizations of the single components and the ternary blend films reveal structural changes due to blending and annealing of the ternary system. The OPc is found to be homogenously distributed in the polymer-based film rather then aggregating. Photovoltaic performance measurements complement the investigation showing the absence of improvement by addition of OPc.

Cruz-Campa J L, Okandan M, Resnick P J, Clews P, Pluym T, Grubbs R K, Gupta V P, Zubia D, Nielson G N. 2011. **Microsystems enabled photovoltaics: 14.9% efficient 14 μm thick crystalline silicon solar cell**. *Solar Energy Materials and Solar Cells* **95**(2): 551–558

Abstract

Crystalline silicon solar cells 10–15 times thinner than traditional commercial c-Si cells with 14.9% efficiency are presented with modelling, fabrication, and testing details. These cells are 14 μm thick, 250 μm wide, and have achieved 14.9% solar conversion efficiency under AM 1.5 spectrum. First, modelling results illustrate the importance of high-quality passivation to achieve high efficiency in thin silicon, back contacted solar cells. Then, the methodology used to fabricate these ultra thin devices by means of established microsystems processing technologies is presented. Finally, the optimization procedure to achieve high efficiency as well as the results of the experiments carried out with alumina and nitride layers as passivation coatings are discussed.

Liu F, Jiang C-S, Guthrey H, Johnston S, Romero M J, Gorman B P, Al-Jassim M M. 2011. **Optical response of grain boundaries in upgraded metallurgical-grade silicon for photovoltaics**. *Solar Energy Materials and Solar Cells* **95**(8): 2497-2501

Abstract

Using upgraded metallurgical-grade silicon (UMG-Si) is a cost-effective and energy-efficient approach for the production of solar cells. Grain boundaries (GBs) play a major role in determining the device performance of multicrystalline Si (mc-Si) solar cells. In this study two UMG-Si wafers, one from the middle part of a brick and the other from the top part of the same brick, were investigated. An excellent correlation was found between the grain misorientation and the corresponding optical response of GBs as indicated by photoluminescence (PL) imaging, electron backscattered diffraction (EBSD), and cross-sectional transmission electron microscopy (TEM). In addition, the PL features at random GBs also depend on the impurity levels in the wafer. In particular, the PL emission was greatly enhanced in the narrow regions close to the random GB in the top wafer, which is an interesting phenomenon that may have potential application in high efficiency light-emission diodes (LEDs) based on Si.

Rüther R, Zilles R. 2011. **Making the case for grid-connected photovoltaics in Brazil**. *Energy Policy* **39**(3): 1027–1030

Abstract

In the developed world, grid-connected photovoltaics (PVs) are the fastest-growing segment of the energy market. From 1999 to 2009, this industry had a 42% compound annual growth rate. From 2009 to 2013, it is expected to grow to 45%, and in 2013 the achievement of grid parity is expected in many places worldwide. Grid-connected PV is usually perceived as an energy technology for developed countries. This rationale is based on the still high costs of PV when compared with conventional electricity. We make the case for grid-connected PV generation in Brazil, showing that with the declining costs of PV and the rising prices of conventional electricity, urban populations in Brazil will also enjoy grid parity in the present decade. We argue that governments in developing nations should act promptly and establish the mandates and necessary conditions for their energy industry to accumulate experience in grid-connected PV, and make the most of this benign technology in the near future.

INSTITUTE OF ENERGY AND SUSTAINABLE DEVELOPMENT DE MONTFORT UNIVERSITY

The Institute of Energy and Sustainable Development (IESD) of the De Montfort University in Leicester, has undertaken research and consultancy for over 30 years to create the underlying knowledge and technologies necessary to achieve more energy-efficient and sustainable lifestyles.

The Institute employs a multi-disciplinary team of Professors, Lecturers and Researchers–supported by higher degree students–who are respected internationally for the quality of their work. Their disciplines range from mathematics and physics, through engineering, to economics, sociology, and psychology. This enables them to lead multi-disciplinary projects that address environmental, economic, and social research problems.

The Institute provides a high quality environment for doctoral study and offers an established programme of flexible-taught masters' course.

Research Programmes

The Institute's research has developed over a 30-year period to create the underlying knowledge, techniques, and technology necessary to achieve more energy-efficient and sustainable lifestyles.

The current research is driven by the UK's commitments to reduce greenhouse gas emissions, increase the use of new and renewable energy technology, and provide a high-quality, comfortable, safe, and efficient built environment.

Applied research seeks practical solutions to contemporary problems, whilst more theoretical and/or blue sky explorations seek to understand our physical and social world, generating new knowledge which can have long term benefits in many fields of human endeavour.

An institute advisory panel, with representatives from academia, industries and other relevant stakeholder groups, helps determine the strategic direction of the Institute's research.

The current portfolio of research projects, worth in excess of £3m, is funded by the UK Research Councils, EU, and overseas funding agencies, energy utilities, industry, and local and national government. Research is further underpinned by science research infrastructure (SRIF) funding.

Courses on Renewable Energy and Sustainable Development include the following:

- ***Msc Climate Change and Sustainable Development***: A multi-disciplinary course equipping graduates to meet the diverse challenges of climate change and sustainable development.
- ***MSc Energy and Sustainable Building Design:*** A unique new course providing detailed understanding and practical experience of modern approaches to sustainable building design.
- ***MSc Energy and Industrial Sustainability:*** A new course equipping graduates for a role in the low-carbon sustainable industries of the future. Students will learn how to reduce the impact of industrial operations upon the environment

while exploring the opportunities and operational risks represented by climate change.

Sustainable buildings need not be technologically complex but a high level of sophistication in design procedures and performance analysis is required. The course has a multi-disciplinary approach to provide a broad insight into energy and sustainability issues.

Graduates will:

- understand how renewable energy can be harnessed in buildings
- be able to undertake the simulation and modelling tasks that are essential for credible building performance design and analysis
- be able to work creatively within a multi-disciplinary design team

Modules studied:

- Energy in Buildings
- Ventilation and Airflow Modelling
- Renewable Energy
- Climate and Daylight Analysis
- Energy and Thermal Performance
- Sustainable Development
- Energy Analysis Techniques
- Research Methods

Students also undertake a group design project, equivalent in scope to four modules. Working in teams from a realistic architectural proposal and design brief, students produce a design that satisfies specific environmental design criteria. The project develops modelling skills and applies computer analysis techniques in a design team context. Project outcomes are communicated through presentations and group and individual written reports.

People

Acting Director: Prof Paul Fleming
Head of Research: Prof Li Shao
Faculty Assessor for the IESD: Prof Mark Rylatt
Director of Policy: Dr Peter Mallaburn

All information has been gathered from the IESD, De Montfort University, website.
For any further details kindly access the following link given
http://www.iesd.dmu.ac.uk/research/index.html

VENUS
SOLAR HOME LIGHTING

The Venus Solar Home Lighting is a very compact, home-lighting system for rural areas. It is highly cost-effective and reliable lighting system for home use in rural areas. CFL is used in the system, which provides quality light. And the light produced is bright enough for both domestic and commercial applications.

- Various components in the system
- Luminaires – 9W CFL
- Solar module
- Flooded, thick plate, low maintenance battery
- Solar charge controller – MCC & Venus
- Array cable, battery cable

Features	Benefits
High efficiency compact fluorescent lamp	Emits bright light that fills the entire room and can be used for 3–4 hours daily.
Preheating provided to lamp	Ensures that the lamp operates effectively even in the cold and enhances the life of the lamp
Luminaire with three positions angular adjustment	This makes it wall mounting
Flooded, thick plate low maintenance battery	Lengthens battery life and Ensures top-up once a year
Battery terminal caps are provided	This helps avoid accidental short circuits and fire hazards
Battery Compliant to IS 1651	Compliant with performance standards

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TRACING THE SHADE FREE SOLAR PATH

Dr Suneel Deambi, Consultant, TERI <sdeambi@airtelmail.in>

Understanding the ground need

These days solar energy systems are being used for a variety of end-use applications such as lighting, water pumping, battery charging, and so on. As we all know, there is a specific mechanism behind its functioning, especially in the case of a solar module (power producing part) or a solar collector (heat producing part). Solar energy modules have to gather sunlight and convert it into a usable form of energy. The real success of a solar energy installation depends upon several factors. The solar site assessment is generally woven around the following few parameters.

Solar radiation

Solar radiation is the amount of sunshine available from the sun. The North and South Pole regions receive the least amount of sunlight. As against this, the equatorial region receives the maximum amount of sunshine. Thus, it is very important for solar panel to collect the maximum possible amount of sunshine.

Possible effect of shading

Shade from the trees planted around a building is an ideal solar passive measure. However, it is not an ideal condition for solar lighting or heating. The adjacent trees, buildings, weather conditions can block the site from direct sunlight, which results in less solar energy reaching the solar panel.

Analysing the site

The solar pathfinder shows the extent of shading for the site. The sun diagram shows data by year, month, and time of the day. These diagrams are available both for the northern and southern hemispheres. Thus, a solar pathfinder works out the amount of shade covering the solar panel. The immediate purpose is to ensure that the site under consideration from solar lighting/ heating system throughout the year. The site analysis tool reflects an image of the trees, building, or any other obstruction which prevents solar radiation from reaching the solar panel.

The design feature

The solar pathfinder uses a highly polished transparent plastic convex dome for providing a panoramic view of the complete site. The sun path diagram can be easily seen through the transparent dome. A unique feature of the sun path finder is that it works on a reflective principle rather than showing shadows. So, it can be used any time of the day and year, and under any weather condition.

Positioning a solar pathfinder

There are several design variants available in the market. However, a pathfinder, in general, consists of a clear plastic dome on a platform, which is mounted on a tripod base. The following few steps are needed to make use of this innovative device.

- Place the pathfinder where you intend to install the solar panels.
- Ensure that the built-in compass point towards north.
- Ensure that the bubble level is in the centre of the circle.
- Try to view the pathfinder from directly over the top of the unit.
- Make use of the available wax pencil to trace a line on the diagram around the shaded areas.

The function

It is quite important to get a precise feel of the amount of sunlight available much before the system is installed at any given site. A solar pathfinder has the following few operational features.

- Plots sun paths for latitude and longitude of the site.
- Determines annual, seasonal, monthly, and quarterly shading percentages, on hourly basis.
- Automatically adjusts data for magnetic declination for a specific site location.
- Stores above 100 site readings on the hand-held unit.
- Transfers data to a desktop for subsequent review.

The SOLAR QUARTERLY

FEEDBACK FORM

Your views about *The Solar Quarterly* are invaluable to us. Kindly take some time off to complete this feedback form and send it to the Editorial Team, *The Solar Quarterly*, TERI (The Energy and Resources Institute), Library Block, India Habitat Centre Complex, Lodhi Road, New Delhi—110003 or fax it to (011) 2468 2144/45 or e-mail it to roshnis@teri.res.in.

1. Why do you read *The Solar Quarterly*?
- ☐ To know more about solar energy related issues
- ☐ Acquire knowledge about issues in general
- ☐ Like to read the views of people working in this field
- ☐ The contents are exceptional
- ☐ Others (please specify)

2. How do you go about reading the magazine?
- ☐ Read all sections thoroughly
- ☐ Read certain sections
- ☐ Read only the main articles
- ☐ Glance at it generally
- ☐ Share with family, friends, and colleagues

3. Which section do you find the most interesting?
- ☐ Thematic articles
- ☐ Features
- ☐ Interviews
- ☐ Technical corner
- ☐ Current research and development
- ☐ University focus
- ☐ Learning Package
- ☐ Others (please specify)

5. What do you think about the new look and feel of *The Solar Quarterly*?
- ☐ Brilliant
- ☐ The previous look was better
- ☐ Needs more work
- ☐ Design is not a priority, content is
- ☐ Others (please specify)

6. How do you rate the magazine overall?
- ☐ Best in the business
- ☐ Informative and interesting
- ☐ Marginally useful
- ☐ Not useful at all
- ☐ Others (please specify)

7. Which other solar based/renewable energy based magazine do you read?
- ☐ _____
- ☐ _____
- ☐ _____
- ☐ None

8. What issues would you like *The Solar Quarterly* to cover?
- ☐ _____
- ☐ _____
- ☐ _____
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- ☐ _____

9. Any other suggestion?

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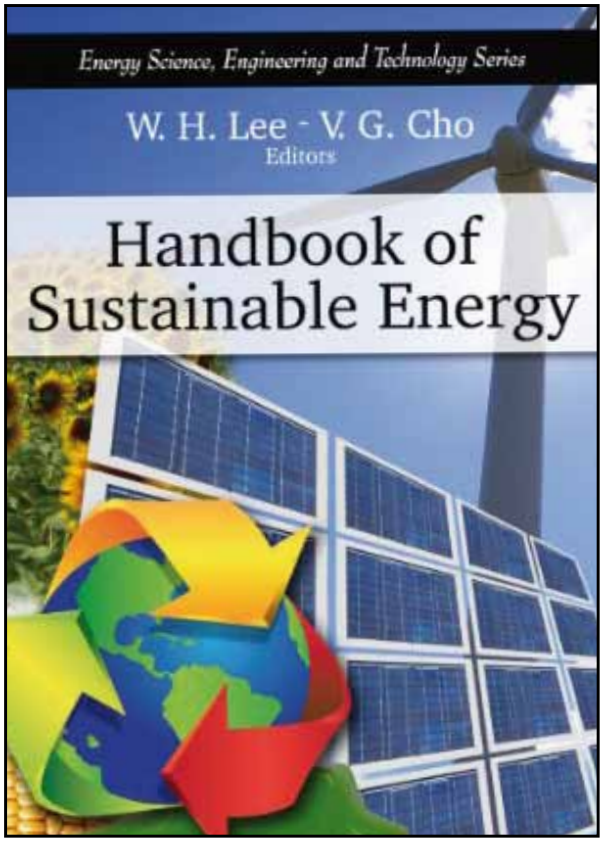
HANDBOOK OF SUSTAINABLE ENERGY

(Energy Science, Engineering and Technology Series)



Editors: Lee W H and Cho V G
Year: 2011
Pages: 803 pp.
Publisher: Nova Science Publishers, Inc.

Sustainable energy is all about meeting the present day needs without compromising on the future. A broader interpretation includes fossil fuels and nuclear fission as transitional sources of energy. A narrower interpretation includes only those sources of energy, which are not expected to be depleted within a time frame relevant to the human race. Sustainable energy sources mostly include all renewable sources, such as biofuels, solar power, wind power, wave power, geothermal power, and tidal power. It also includes technologies that improve energy efficiency. This new and important handbook gathers the latest research from around the globe in the study of sustainable energy and highlights topics such as monitoring sustainable energy development, methane, energy and territory, biodiesel production, electrochemical hydrogen storage, environmental policies in an electricity sector, and others.

Chapter 1 discusses how global warming is considered as one of the most critical problems facing mankind. The use of renewable energy sources for the production of electrical power can contribute significantly to the reduction of greenhouse emissions such as carbon dioxide and other harmful emissions.

Evaluating the sustainability factor of a source of energy, however, is a difficult task. The entire life cycle of a source of energy will have to be examined before it can be classified as sustainable. An approach to analyse the current energy technologies and how sustainable they are is the focus of Chapter 2. The primary focus of this assessment is wind power, biomass, and solar power.

The objective of Chapter 3 is to introduce the subject of ejector in refrigerating plants in view of energy savings. Chapter 4 analyses various tools for monitoring sustainable energy development in the country and to develop new tools seeking to enhance synergies between energy and environmental policies. In Chapter 5, the thermal decomposition of corn straw samples were studied using thermogravimetric analysis.

Chapter 6 reviews methane—its sources utilization. Chapter 7 investigates the relation between rapid economic growth and environmental degradation in Brazil, Russia, India, and China (BRIC) countries. Chapter 8 is all about examples of small-scale energy converters. In Chapter 9, a case study is presented involving the engineering design of a new product, an enhanced ceiling fan, which addresses energy and environmental concerns by increasing the efficiency of building energy utilization. Chapter 10 looks at the strategic planning that is the main interactive tool for change. Chapter 13 is an effort to evaluate feasibility of popular alternative fuels of non-edible oils of Honge, Rice bran, and Neem that are locally available and producer gas as a total replacement for fossil fuels. As explained in Chapter 14, Malaysia's energy needs have been dominated by fossil fuels because of the existing supply of resources such as petroleum, natural gas, and coal. Chapter 16 assesses whether European policies and various national efforts in promoting RES-E have led to a reduction in the large gaps across European countries for RES-E shares. With this aim in mind, the paper analyses cross-country difference for shares of renewable electricity in the EU-27 for the period 1996–2005.

Chapter 19 states that for risk free application of nanoparticles in life science, energy, and environment, it is essential to understand their biological fate and potential toxicity.

Chapter 21 presents a study of the determination of free Methanol Content (MC) of Biodiesel (BD) by electrical properties (permittivity and conductivity) measurements and Flash Point (FP) determinations. In Chapter 24, a new parameter is proposed to comparison of the flue gas enthalpy values of the some common fossil fuels and biomass.

The book is a comprehensive and holistic study of sustainable energy. It is good reference guide for anyone interested in sustainable energy.

NEW BOOK INFORMATION

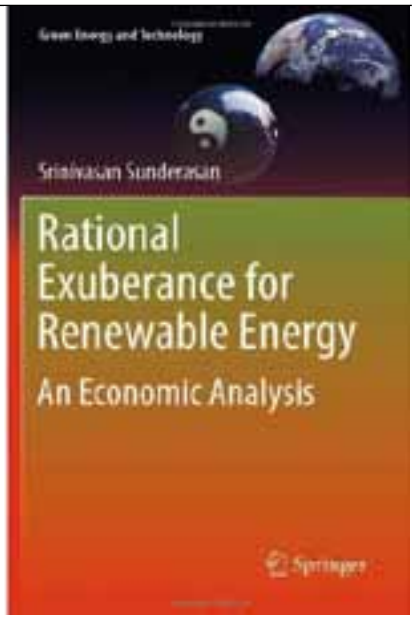
Solar technology: the Earthscan expert guide to using solar energy for heating, cooling, and electricity

Solar energy is free, abundant, and sustainable, with many methods existing to harness it. This guide is the essential introduction to the subject, explaining how the technologies work, how best they should be employed, and the costs and benefits of using them. It provides detailed yet accessible coverage of: passive solar building, solar water heating, solar space heating , other solar thermal applications (such as cooling and desalination), grid-connected photovoltaics, stand-alone photovoltaics. It also introduces the reader to larger scale applications such as concentrating solar power. Nicely illustrated, this is the perfect primer for anyone who wants to work with or simply learn more about solar technologies.

David Thorpe
Earthscan
238 pp. • Year: 2011

Rational exuberance for renewable energy: an economic analysis

This book is a beyond-the-hype account of the underlying issues that encourage or plague widespread dissemination of renewable energy (RE) technologies. The author argues that grants and subsidies could be provided to support research, development and technology improvement efforts, but should not be employed as an instrument of state policy to intervene in specific markets. It is important to recognize that although investors often demonstrate an appetite for market risk, they find technology risks and policy uncertainty much less appealing. *Rational Exuberance for Renewable Energy* blends classical economic theory with the everyday realities of the RE industry to identify incentive structures contributing to the success—or otherwise—of project implementation involving renewable sources and appropriate technologies. The book is a compilation of articles that analyse individual RE technologies, and offer multiple perspectives of the RE industry and markets. Rational Exuberance for Renewable Energy is intended for policy makers, advanced students of energy economics and sustainable development, and for potential mainstream investors.



Series: Green Energy and Technology; Springer
Srinivasan Sunderasan
1st Edition • 113 pp • Year: 2011

Solar Energy Technologies Programme

The Solar Energy Technologies Programme focuses on developing cost-effective solar energy technologies that have the greatest potential to benefit the nation and the world. The website provides all necessary details in this regard. The website has separate sections on research and development, market transformation, financial opportunities, information resources, lasts news in the area of solar technologies, and upcoming events.

http://www1.eere.energy.gov/solar/

Sun works solar

Sun works is a leading installer of customized solar systems. They specialize in solar electricity and solar thermal. They help customers lower electric bills, increase energy efficiency, reduce carbon emissions, and fulfill their renewable energy goals. And the website gives a comprehensive analysis to understand of how to meet these goals. The website has two main sections—commercial and residential. The commercial section provides solutions for business and government and the residential section provides information to the homeowners on how to save energy.

http://www.sunworkssolar.com/

Energy Savers

Visit this website if you want to know all about energy saving and various ways to save energy in your office, home, public spaces, and so on. The website talks about the US Energy of Department's various programmes and policies to conserve energy in homes, vehicles, buildings, and so on.

http://www.energysavers.gov/tips/

Solar Energy International: renewable energy education for a sustainable future

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http://www.solarenergy.org/

ANNOUNCEMENT

The Product Update section

The Solar Quarterly magazine invites updates and information on all new products in the solar energy sector. The update and information provided will be featured in the 'Product Update' section of the magazine.

Send in your write ups to

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NATIONAL AND INTERNATIONAL EVENTS

National

EMPOWER India 2011
20–22 October 2011
New Delhi, India
Tel +91 22 2388 9076/77
E-mail urf@urja.org.in
Website www.urja.org.in

ICORE 2011 (International Congress on Renewable Energy) Trade Show
2–4 November 2011
Tezpur University, Assam
Tel +91 11 65649864
Fax +91 11 26959759
E-mail dg_sesi@yahoo.co.in
Website www.sesi.in

Conference and Exhibition: Solarcon India 2011
9–11 November 2011
Hyderabad, India
Tel 91 80 400371–03
Fax -13
E-mail solarconindia@semi.org
Website www.solarconindia.org

Conference and Exibition: Energy-Tech and Enviro-Tech 2011
14–27 November 2011
New Delhi, India
Tel 91/11/2337-1725
Fax -8464
E-mail info@itpo-online.com
Website www.indiatradefair.com

India's International Exhibition and Conference for the Solar Industry
14–16 December 2011
Mumbai, India
Bombay Exhibition Centre
Mumbai
Website www.intersolar.in

International

World Renewable Energy Asia Regional Congress and Exhibition (WREN Asia)
28–31 October 2011
Chongqing, China
Tel +44/1273/625-643
Fax -768
E-mail SuDBE2011@Vip.163.com
Website www.sudbe2011.org

Conference and Exhibition: PV Asia Pacific Expo
1–4 November 2011
Singapore
Tel +65/6392-4121
E-mail office@apvia.org
Website www.pvap.sg

3rd China (Wuxi) International Renewable Energy Conference and Exhibition
3–5 November 2011
Wuxi, China
Tel +86/510/827647
Fax -38
Website www.crecexpo.com.cn

Conference: Solar Energy Business Forum 2011
9–10 November 2011
London, UK
Tel +44/20/7845759-5
Fax -9
E-mail events@newenergyworldnetwork.com
Website solarforum.newenergyworldnetwork.com

Conference & Exhibition: 3rd IPVSEE 2011
9–11 November 2011
Beijing, China
Tel +86/10/8719441-8
Fax -6
E-mail info@solarpromotion.org
Website www.solarpromotion.org

3rd Conference for Sustainable Energy (CSE 2011)
10–12 November 2011
Brasov, Romania
Tel +40/268/475597
E-mail cse@unitbv.ro
Website www.unitbv.ro/cse

Conference: Solar Summit Freiburg 2011
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Conference and Exhibition: 2011 Shanghai International PV Expo & Industry
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Trade fair: PVTech
16–19 November 2011
Milan, Italy
Tel +390/2/6630-6866
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E-mail artenergy@zeroemission.eu
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Conference: Global Green Techies (GTECHs Bahrain 2011)
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RENEWABLE ENERGY AT A GLANCE

S.No.	Source/system	Estimated potential	Achievement as on 31 August 2011
I	**Power from renewables**		
A	**Grid-interactive renewable power**	(MW)	(MW)
1	Wind power	45,195	14,989.10
2	Bio power (agro residues and plantations)	16,881	1,083.60
3	Bagasse cogeneration	5,000	1,779.03
4	Small hydro power (up to 25 MW)	15,000	3,153.93
5	Energy recovery from waste (MW)	2,700	73.46
6	Solar photovoltaic power	—	46.16
	Sub total (A)	**84,776**	**21,125.38**
B	**Captive/combined heat and power/distributed renewable power**		(MW)
7	Biomass/cogeneration (non-bagasse)	—	327.95
8	Biomass gasifier	—	141.43
9	Energy recovery from waste	—	75.80
10	Aero generator/hybrid systems		1.24
11	Water mills/micro hydel	—	1818 nos.
12	Solar PV power plants and street lights (>1 kW)	—	72.50
	Sub total (B)	**—**	**618.92**
	Total (A+B)	**—**	**21744.30**
II	**Remote village electrification**	—	8,846 villages/hamlets
III	**Decentralized energy systems**		
13	Family-type biogas plants	1.20 million	4.31 million
14	Solar photovoltaic systems		
	i. Solar street lighting system	—	1,22,697 nos
	ii. Home lighting system	—	6,56,707 nos
	iii. Solar lantern	—	8,17,369 nos
	iv. Solar power plants	—	2.92 MW_p
	v. Solar photovoltaic pumps		7,495 nos
15	Solar thermal systems		
	i. Solar water heating systems	140 million m^2 collector area	4.67 million m^2 collector area
	ii. Solar cookers		.66 million
16	Wind pumps		1,352 nos
IV	**Awareness programmes**		
17	Energy parks	—	511 nos
18	Aditya solar shops	—	302 nos
19	Renewable energy clubs	—	521 nos
20	District advisory committees	—	560 nos

MW – megawatt; kW – kilowatt; MW_p – megawatt peak; m^2 – square metre; km^2 – kilometre square
Source www.mnre.gov.in

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- Matte paper
- Number of pages: 96

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