

VATIS UPDATE

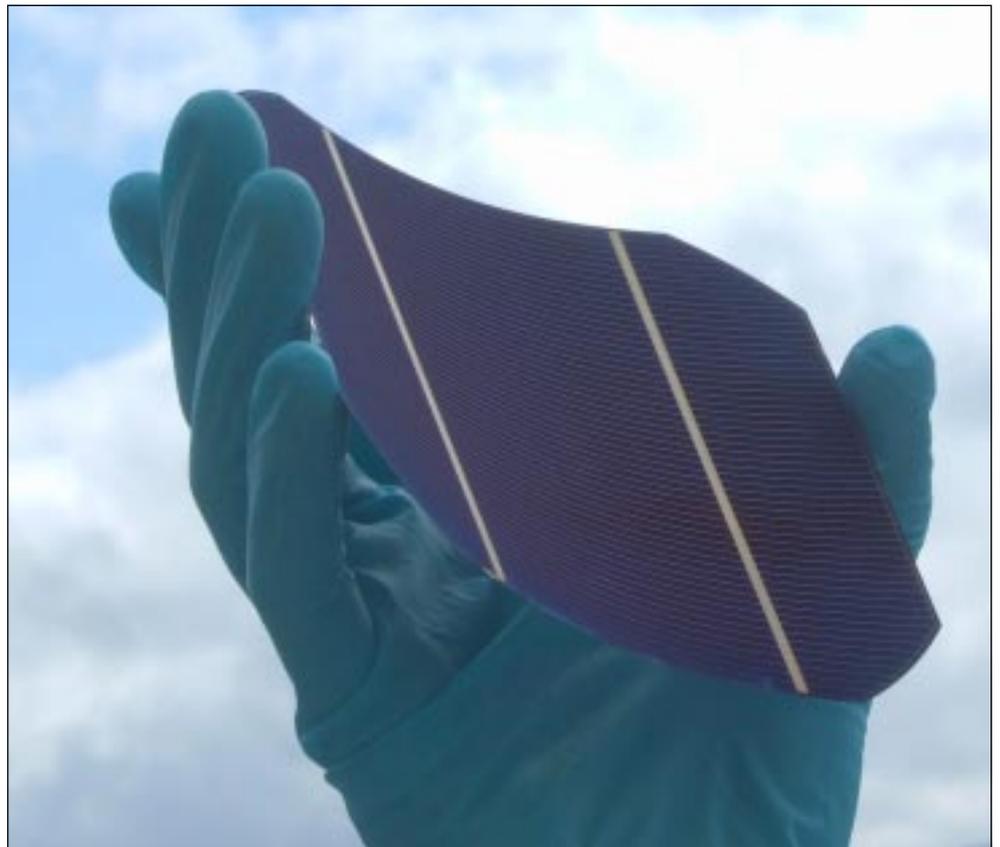
# Non-conventional Energy

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## Highlights

- Hybrid solar thermal power plant ●
- Flaps reduce wind turbine blade loads ●
- Electricity from slow-moving waves ●
- Miniature tubular SOFC system ●
- Hydrogen engine matches turbo diesel ●
- Biodiesel from trap grease ●



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ASIAN AND PACIFIC CENTRE FOR TRANSFER OF TECHNOLOGY

The **Asian and Pacific Centre for Transfer of Technology (APCTT)**, a subsidiary body of ESCAP, was established on 16 July 1977 with the objectives: to assist the members and associate members of ESCAP through strengthening their capabilities to develop and manage national innovation systems; develop, transfer, adapt and apply technology; improve the terms of transfer of technology; and identify and promote the development and transfer of technologies relevant to the region.

The Centre will achieve the above objectives by undertaking such functions as:

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- Advisory services;
- Dissemination of information and good practices;
- Networking and partnership with international organizations and key stakeholders; and
- Training of national personnel, particularly national scientists and policy analysts.



*The shaded areas of the map indicate ESCAP members and associate members*

#### **Cover Photo**

130  $\mu\text{m}$  thin solar cell, slightly flexible, and with an efficiency of 18 per cent

*(Credit: Fraunhofer ISE, Germany)*

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Vol. 2 No. 96

May - Jun 2009

**VATIS\* Update  
Non-conventional Energy**  
is published 6 times a year to keep the readers up to date of most of the relevant and latest technological developments and events in the field of Non-conventional Energy. The Update is tailored to policy-makers, industries and technology transfer intermediaries.

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## Editorial Board

Dr. Krishnamurthy Ramanathan  
Mr. Nanjundappa Srinivasan  
Dr. Satyabrata Sahu

## ASIAN AND PACIFIC CENTRE FOR TRANSFER OF TECHNOLOGY

Adjoining Technology Bhawan  
Qutab Institutional Area  
Post Box No. 4575  
New Delhi 110 016, India  
Tel: (91) (11) 2696 6509  
Fax: (91) (11) 2685 6274  
E-mail: [postmaster@apctt.org](mailto:postmaster@apctt.org)  
Website: <http://www.apctt.org>

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*This publication has been issued without formal editing*

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### Big push for China's renewable energy

China will construct two hydropower stations and two wind farms with a total capacity of 2,001 MW in a bid to increase the share of renewable energy in the national energy matrix. The National Development and Reform Commission (NDRC) reports that it has approved for construction the Luding hydropower station (4 x 230 MW) in Sichuan province and the Dongjing Hydropower plant (4 x 220 MW) in Guizhou province. The two wind farms, the Rudong wind farm in Jiangsu province and the Guyuan wind power station in Hebei province, are of the same capacity – 100.5 MW.

Prime Minister Mr. Wen Jiabao had stated that China would persist with energy conservation efforts, reduction in emission and environmental protection even as it tries to limit the economic slowdown. Further, China would accelerate the development of clean energy. The latest stimulus package includes an investment in energy conservation and ecological engineering. Part of the funds distributed from November 2008 to March 2009 went to local wind turbine manufacturing and household biogas in rural areas.

*Source: www.chinadaily.com.cn*

### India harnesses 27 billion units of electricity from wind

India generated 26.95 billion units of electricity from wind power projects in the last three years (2005-2008). With an installed capacity of 9,645 MW, India occupied the fifth position in the world at the end of 2008, after the United States, Germany, Spain and China with installed capacity of 25,170 MW, 23,900 MW, 16,754 MW and 12,210 MW,

respectively. The capacity addition in wind power depends on various factors, such as wind potential quality, incentives mechanism, feed in tariff, higher percentages of commitments for renewable energy and manufacturing cost.

The steps taken by the Indian government to promote commercial wind power projects through private sector investments include fiscal incentives such as concessional import duty on certain components of wind electric generator, excise duty exemption, 10 years' tax holiday on income generated from wind power projects, benefit of accelerated depreciation and loan from the Indian Renewable Energy Development Agency (IREDA). Technical support, including detailed wind resource assessment to identify further potential sites, is provided by the Centre for Wind Energy Technology, Chennai. This apart, preferential tariff is being provided for wind power by potential states.

*Source: www.pib.nic.in*

### Project utilizes pig wastes for biogas

In the Philippines, wastewater from piggeries is being used in the 1.1 MW biogas waste-to-energy project at Robina 12 farm in San Miguel. Led by Hacienda Bio-Energy Corp. and Philippine Bio-Sciences Co. Inc. (PhilBIO), the project uses biogas recovered from advanced anaerobic digestion. The project is expected to capture gases equivalent to about 42,000 t/y of carbon dioxide, which would otherwise be released to the atmosphere, further hastening global warming. According to PhilBIO, the Robina 12 farm project employs the next-generation covered in-ground anaerobic reactor (CIGAR) technology to ensure both higher quantity and quality of biogas. "The CIGAR is coupled with an

on-site electric power generation plant utilizing the captured biogas (tested at 70 per cent methane gas by volume) as fuel to generate electricity," states PhilBIO.

*Source: www.blogs.inquirer.net*

### Indonesia, Republic of Korea to develop seaweed power

An agreement has been reached between Indonesia and the Republic of Korea to invest in alternative energy research for converting seaweed into biofuel. According to the memorandum of understanding signed recently, Indonesia will cultivate seaweed and the Republic of Korea will provide the know-how. The latter already has technology needed to produce biofuel from seaweed but has not commercialized it so far.

Research on seaweed energy gained momentum in recent years as alternatives were sought for palm oil, which is criticized by conservationists because crop plantations often replace old forests that store huge quantities of carbon dioxide. Seaweed is considered more environment-friendly because it absorbs greenhouse gases blamed for climate change and can be cultivated at sea.

*Source: www.thejakartapost.com*

### Pakistan to get US\$630 million from ADB

Pakistan is to receive about US\$ 630 million from the Asian Development Bank (ADB) for developing the country's energy sector over the next three years. This financial aid is earmarked for use in power generation through renewable and hydropower resources and for power transmission stations. ADB will also provide

technical assistance in clean energy development initiatives. Pakistan is facing shortage of power due to lack of power development and increasing energy requirement.

Source: [www.news.xinhuanet.com](http://www.news.xinhuanet.com)

## Thailand to produce power from garbage

Waste-to-energy plants will form part of Thailand's new Very Small Power Producer programme, which is aimed at encouraging renewable energy projects. Thailand produces 39,000 t/d of waste, or 14.2 million tonnes per year, and only 80 per cent of this is collected. The government hopes to have at least 10 waste-to-energy plants operating by 2011, each generating 10 MW of power.

Source: [www.upi.com](http://www.upi.com)

## CIIE encourages innovation in renewable energy

In India, the Centre for Innovation, Incubation and Entrepreneurship (CIIE) at the Indian Institute of Management in Ahmedabad has joined hands with the Ministry of New and Renewable Energy to encourage research and innovation in renewable energy. Through a programme called the Renewable Energy Search, CIIE and the Ministry propose to identify, encourage and incubate entrepreneurial ideas aimed at solving the energy crisis through the creation of viable business models around existing clean energy related technologies.

The programme aims at commercializing scaleable existing technologies developed by researchers, individual inventors, start-ups and large corporations across the world through the creation of viable business around it. The programme shall provide support recognition, licen-

ing, seed-funding and mentoring to the start-ups, entrepreneurs in residence and innovators.

Source: [www.timesofindia.indiatimes.com](http://www.timesofindia.indiatimes.com)

## Test run of China's large-scale crop stalk biogas project

The Chinese Ministry of Agriculture reports that a large-scale, patented crop stalk biomass gasification project has had a successful trial run. The Ministry has initiated evaluations on crop stalk resources. Based on this, a national database for crop stalk resources will be established. The project aims to use anaerobic fermentation to convert crop stalks into biogas. The raw materials can be mixed together in a flexible way – stalks from rice, wheat, corn and other crops, as well as rural household garbage and organic waste from fruits and vegetables can be used.

China's annual output of crop stalks is nearly 700 million tonnes. Utilization of the stalks can help save resources, prevent environmental pollution, promote structural readjustment and increase farmers' income. It can also provide raw materials for gasification to farming families that do not raise pigs. Experimental projects using crop stalk gasification technology have been established in 12 provinces nationwide in recent years. The project has selected and used several major technologies. A Shandong-based experimental project, for example, adopted fermentation technology developed by the Beijing University of Chemical Technology, and it can now produce approximately 400 m<sup>3</sup>/day of methane to serve about 375 households.

Source: [www.english.people.com.cn](http://www.english.people.com.cn)

## The Philippines considers hike in biodiesel blend

The Department of Energy (DOE) of the Philippines is considering an increase in the biodiesel blend to 3 per cent (B3), from the current 2 per cent, at the end of the year to further promote the use of alternative fuel in the country. According to DOE, this measure will also allow the Philippines to catch up with its neighbours in terms of their use of biofuels. For instance, in Thailand PTT Public Co. has been selling a 5 per cent blend of biodiesel (B5). The state-run oil firm is said to be considering an increase of the said blend to 10 per cent and 20 per cent in the near future.

Mr. Mario Marasigan, Director of DOE's Energy Utilization and Management Bureau, has expressed optimism that the Philippines will be able to surpass Thailand's efforts with DOE's recent promulgation of Republic Act 9637 or the Biofuels Act of 2006. The order will promote development of the biofuel industry in the country and encourage private sector participation, as well as to institute mechanisms that will fast-track investments in the biofuel industry. "The joint administrative order published provides clearer and faster accreditation process for biofuel producers, distributors and oil companies," Mr. Marasigan said.

Source: [www.abs-cbnnews.com](http://www.abs-cbnnews.com)

## Fiji keeps biofuel dreams alive

Fiji's energy experts are advising against shelving the nation's proposed ethanol projects in spite of questions over their viability due to decreasing international fuel prices. Mr. Vilimone Vosarogo, a biofuel engineer with Fiji's Department of

Energy, states that ethanol is the only sustainable solution to Fiji's fuel crisis, echoing the determination of the local administration to get the ethanol industry off the ground. Mr. Vosarogo expects the global fuel price to soar again, given the evidence of depleting oil reserves all over the world.

Some local companies, such as Fiji Sugar Corp. and South Pacific Distilleries, have been producing biofuel, albeit on a small scale. "We have vast amounts of land and human resources, small population and easy access to technology and funding transfer from countries such as China and, to a lesser extent, Australia and New Zealand," Mr. Vosarogo added. A team from China is expected to help establish mills for production of biofuel from cassava.

Source: [www.fijilive.com](http://www.fijilive.com)

## Republic of Korea to construct more wind generators

The Republic of Korea government will place orders to build ten new locally made wind power generators to help reduce reliance on imports in the renewable energy sector. According to the Ministry of Knowledge Economy, the 2-3 MW generators, which are expected to compete commercially with market-dominating foreign products, will be built on land owned by three state-run thermal power plants by 2010. A consortium that includes Doosan Heavy Industry and Construction and Hyundai Heavy Industries will be responsible for designing and building the 100 per cent locally developed power plants.

Of the 146 wind power generators currently operating in the country, only one medium-sized 750 kW unit was made by a local company. At present, the country can manufac-

ture 80-90 per cent of all parts that go into such generators, but due to uncertain demand, there has been little incentive to make indigenous machines. Owing to its inherent inconsistency, wind power, like solar and other eco-friendly sources, continues to face barriers to wide-scale application.

Source: [www.joonggangdaily.joins.com](http://www.joonggangdaily.joins.com)

## Viet Nam approves plan to use biofuels

Viet Nam, which has a technology-sharing pact with leading ethanol producer Brazil, has approved the production and use of biofuels as it looks to diversify its energy sources. Viet Nam's Deputy Prime Minister Mr. Hoang Trung Hai stated in a directive that biofuel output, including ethanol, would reach 250,000 tonnes by 2015 and 1.8 million tonnes by 2025, meeting about 5 per cent of the energy-hungry Southeast Asian country's total fuel demand. According to the directive, the government would create favourable conditions to promote the transfer of biofuel technology and investment, including tax incentives and low-interest loans.

The economy of underdeveloped Viet Nam is growing at more than 8 per cent a year. The country's economy has expanded between 8.5 per cent and 9 per cent in 2008, boosted by in-frastructure and energy projects. Fears about climate change have fuelled a boom in biofuels which has diverted some food crops into fuel production, pushing up the prices of cereals. But some environmentalists and food experts say any major use of biofuels, especially wood, as an alternative to burning fossil fuels could lead to further deforestation and hunger.

Source: [www.bioenergy.checkbiotech.org](http://www.bioenergy.checkbiotech.org)

## Malaysia to switch palm oil usage for biodiesel

Malaysia has decided to change the usage of palm oil for biodiesel when the price reduces. According to the Head of Malaysian Palm Oil Board, Mr. Sabri Ahmad, the alteration was needed as one way to manage stocks of the palm oil industry. Mr. Ahmad stated that the world's needs for biodiesel cannot be fulfilled by the supply only from Indonesia and Malaysia. So, this is a large opportunity for both countries to produce palm oil as biodiesel.

Source: [www.temppointeractive.com](http://www.temppointeractive.com)

## Solar panels demonstrated in the Philippines

In the Philippines, two Hong Kong-based companies recently demonstrated solar devices that promise to deliver power to those areas that are not connected to the power grid. One product is a portable panel that can light up a light-emitting diode (LED) for reading, charge cellular phones and power a flashlight or radio or any other 12 volt devices. Solar panels for use in street lamps are also available.

Solar energy is viewed as the most promising technology for the world's future requirements of renewable and sustainable energy. One area being looked into is to educate the people about the wide applications of solar panels, since there is a difference between a solar panel that provides light and one that supplies heat. A local distributor, Sol (Araw) Power Now Inc., is accepting applications for exclusive dealership in Luzon, Visayas and Mindanao.

Source: [www.businessmirror.com.ph](http://www.businessmirror.com.ph)

## Silicon solar cell

In the United Kingdom, Swansea University's School of Engineering has teamed up with Pure Wafer to develop a low-cost solar cell. A key feature is that the silicon used for fabricating the low-cost solar cell is recovered as a waste product from Pure Wafer's main semiconductor wafer reclamation business.

Researchers at the university hope that the use of the recovered silicon will lead to significantly cheaper photovoltaic (PV) modules for the development of solar panels and renewable energy plants. The cells developed by Pure Wafer and the Swansea team have been incorporated into modules made up of around 90 connecting cells that can generate a larger amount of electricity. Researchers report that the first prototype cell achieved an efficiency of 14 per cent, but they are hoping to get closer to 20 per cent with their next attempt – 5 per cent better than current commercial cells. Pure Wafer and Swansea's School of Engineering hope to increase the scope of their research and are currently in the process of applying for funding from the Welsh government.

Source: [www.theengineer.co.uk](http://www.theengineer.co.uk)

## Nanotechnology boosts conversion efficiency

Researchers at the University of Arkansas at Little Rock (UALR), the United States, report they have developed a process involving nanostructures that show great promise in boosting the efficiency of titania photoanodes employed to convert solar energy into hydrogen in fuel cells. The UALR team, working with researchers from the University of Nevada and supported by the United States' Department of Energy and the Arkansas Science and Technol-

ogy Authority (ASTA), has reported an 80 per cent increase in efficiency with a new process.

Electrochemical methods were used to synthesize titania photoanodes with nanotubular structures. The photoanode surfaces were then subjected to low-pressure nitrogen plasma to modify their surface properties. The plasma treatment increased the light absorption by the photoanode surface. It also removed surface impurities that are detrimental for photoelectrochemical hydrogen production. "The plasma treatment significantly enhanced the photoelectrochemical activity of the samples," stated Dr. Rajesh Sharma, an assistant research professor at Applied Science in UALR's Donaghey College of Engineering and Information Technology (EIT). The photocurrent density of plasma-treated material was approximately 80 per cent higher than that of the control electrodes.

Source: [www.sciencedaily.com](http://www.sciencedaily.com)

## Thin-film silicon solar cell demonstrates 8.7 per cent efficiency



New thin films cells being readied for testing at Sencera

Sencera, the United States-based manufacturer of thin-film silicon-based photovoltaic modules, has developed single-junction silicon

solar cells with an initial 8.7 per cent sunlight-to-electricity conversion efficiency under standard test conditions. Sencera's solar device efficiency was achieved with process and hardware enhancements to its deposition technology platform.

Viper™ is a proprietary, fully automated, plasma-enhanced chemical vapour deposition manufacturing platform. Recent innovations on the Viper have improved cell absorption of both blue and red light sections of the solar spectrum resulting in the conversion of more light to electricity. "We intend to expand our present 1 MW research capacity to 35 MW annual capacity over the next two quarters," said Dr. Rusty Jewett, Sencera's CEO. *Contact: Sencera, 3101, Stafford Drive, Charlotte, NC 28208, United States of America. Tel: +1 (704) 3931 951; Fax: +1 (704) 3931 941; Website: [www.sencera.com](http://www.sencera.com).*

Source: [www.sev.prnewswire.com](http://www.sev.prnewswire.com)

## Sanyo introduces N series solar panels

In the United States, Sanyo Energy Corp., has introduced HIT Power® N series of solar panels featuring Sanyo Electric's proprietary technology. The new series features the latest technological improvements, including higher module output, lower voltage, space savings and lower installation costs that make the HIT Power N series the most efficient and competitive cost per kilowatt-hour panels in the solar market today, claims Sanyo.

HIT Power N series solar panels allow maximum power generation per square foot, reducing the number of panels needed. The improved technology also features a higher output range (205-215 W) and lower voltage – which means up to 60 per cent more capacity per string and

fewer parallel connections, cutting total installation costs. Each HIT Power N module contains 72 cells that are 5 × 5 inch (125 mm<sup>2</sup>) compared with HIT Power B modules that contain 96 cells measuring 4 × 4 inch (104 mm<sup>2</sup>). Further, HIT Power N series solar panels have silent operation and no moving parts, making them among the lightest per watt device in the industry. The packing density of the solar panels helps reduce transportation, fuel as well as storage costs per installed watt. *Contact: Ms. Anna Lickova, Sanyo Energy Corp., 2600, Network Blvd., Suite 600, Frisco, Texas TX 75034, United States of America. Tel: +1 (469) 3625 600; Fax: +1 (469) 3625 699.*

*Source: [www.renewableenergyworld.com](http://www.renewableenergyworld.com)*

### Polymer solar cells

Researchers at Monash University, Australia, have developed a solar cell that is thin, flexible and can be mass produced using the same technology used to print polymer banknotes. The first of the trial polymer solar cells has rolled off the presses at the Melbourne-based plant of Securrency International – the company responsible for printing Australian polymer banknotes and the currencies for 26 countries around the world.

According to the team, the film-like solar cells are fabricated on a polymer substrate and are almost as thin as a sheet of paper. The printable cells offer a number of advantages over traditional solar panel technology. They are lightweight and easily transportable, making them attractive to a domestic market and also flexible like a banknote. Being partially transparent, they can be installed almost anywhere, including roofs of homes and cars, glass panels and windows. The cells also float, allowing them to cover pools

or dams, reducing evaporation while generating energy.

*Source: [www.theengineer.co.uk](http://www.theengineer.co.uk)*

### Better solar panel efficiency achieved

Researchers at Boston College, the United States, are reported to have developed a titanium nanostructure that provides an expanded surface area and greater efficiency in the transport of electrons. This achievement will help in the development of solar panels thick enough to absorb sunlight, yet thin enough to collect and transport electrons with minimal energy loss.

The scientists found that incorporating two titanium-based semiconductors into a nanoscale structure improved the efficiency of power-collecting efforts by approximately 33 per cent. Under ultraviolet light, the research team achieved a peak conversion efficiency of 16.7 per cent compared with an efficiency of 12 per cent from a structure composed only of titanium dioxide. The efficiency gains within the novel material can serve water splitting, wherein semiconductor catalysts have been shown to separate and store hydrogen and oxygen gases.

*Source: [www.upi.com](http://www.upi.com)*

### Ultra-lightweight solar cell module

Fuji Electric Systems (FES), Japan, has developed a solar cell module that is only 1 mm thick and weighs 8 kg/m<sup>2</sup>, which is just half that of conventional crystal silicon-based solar cell modules. The amorphous “F Wave” will be commercialized for use in large areas such as rooftops. While the module that uses a 0.8 mm steel plate as a basis is very flexible, its power generation efficiency is only 8 per cent (compara-

ble silicon-based cells boast up to 16 per cent). The long-term aim of FES is to improve the efficiency to 12 per cent.

*Source: [www.crunchgear.com](http://www.crunchgear.com)*

### Hybrid solar thermal power plant

Aora Solar, part of E.D.I.G. Group in Israel, has developed a small-scale hybrid solar thermal power plant. Both photovoltaic and regular solar thermal power require vast tracts of land to accommodate all the mirrors or heliostats they need. Aora’s new model requires just half an acre of land to produce 100 kW, enough to power 50 homes. While that is not a great deal of electricity, there are several advantages to the new system, says Mr. Yuval Susskind, COO of Aora. “It is modular, it is hybrid, it can run on alternative fuels and it offers all of those options in one base package.”

What is the secret behind the new technology? Pairing a proprietary solar concentrator with a micro-gas turbine instead of a steam turbine. Conventional solar thermal power relies on heated water turning into steam, which is then used to power a turbine. However, steam turbines are only efficient when producing many megawatts, which also needs a great deal of land. Aora uses a micro-gas turbine that is effective at less than 1 MW and requires far fewer heliostats (30) to produce 100 kW. In addition to modularity, the gas turbine also allows for energy production round the clock. The breakthrough technology was developed jointly with the Weizmann Institute and Rotem Industries. The company hopes to have its first commercial base unit producing electricity sometime soon at Kibbutz Samar outside Eilat.

*Source: [www.jpost.com](http://www.jpost.com)*

## Electromagnetic brake for wind turbines



*Electromagnetic brake designed for wind turbines*

Warner Electric, the United States, has modified its ERS series of electrically released, spring-engaged brakes to serve as pitch brakes for wind turbine applications that need both “static” holding power and the ability to withstand high-inertia dynamic stops in emergency situations. Each electromagnetic brake is mounted outboard of inductive encoder, which is mounted to back of motor to position blades to proper pitch. In normal use, the brake functions as a static brake to hold the blades from rotating in a power-off situation, such as during routine maintenance. ERS68, the largest model, has a capacity of more than 20,000 fully loaded dynamic stops. The emergency braking requirements of large wind turbines under maximum wind conditions can be compared with that of a 40 t mining truck driving down a 25 per cent gradient at 140 km/h with a cliff 400 m ahead. The ERS68 brake offers 13.8 kg.m of static torque with a maximum of 2,000 rpm and a brake release time of 0.2 s.

The new blade pitch brakes also offer the advantage of being a one-piece design, fully enclosed and painted to withstand extreme environmental conditions (such as salt

spray, condensation and water). Before the new design, pitch brake models have used two-piece designs that require an adapter plate, extra fasteners and an external boot-type seal in the gap between the brake and the adapter plate to prevent contamination. Warner Electric has also developed a series of static holding brakes that meet the strict design criteria for controlling yaw when the wind turbine nacelle faces into the wind. For this technically simpler application, the yaw brakes are also mounted on the back end of a motor. The nacelle of each wind turbine would typically have three pitch brakes and 4-5 yaw brakes for motion control. *Contact: Mr. Tim Heikkinen, OEM Sales Manager, Warner Electric, 449 Gardner Street, South Beloit, Illinois 61080, United States of America. Tel: +1 (262) 3922 071; Website: www.warnerelectric.com.*

*Source: news.thomasnet.com*

## Simulation technology for wind prospecting

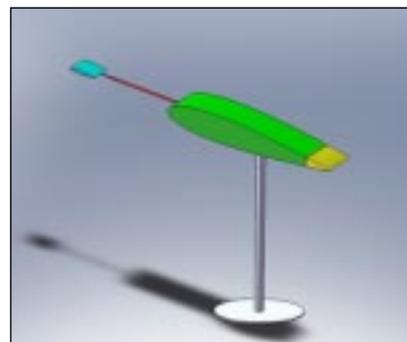
CD-adapco, a leading independent computational fluid dynamics (CFD) software firm based in the United States, has unveiled a new simulation technology for the prospecting of wind parks and wind turbine installations. The simulation technology, which is already being used by a leading turbine manufacturer, addresses the prediction of wind power density across complex terrain and the identification of local flow features likely to negatively influence asset durability – two of the biggest challenges in prospecting.

CD-adapco’s unique automated process helps evaluate large areas of terrain with little or no manual input from the operator. The process is based around STAR-CCM+, CD-adapco’s flagship simulation tool, which automates every part of the

wind park simulation – from importing the terrain geometry to producing a final report that identifies the suitability of a particular area of land for wind turbine installation. Apart from evaluating the wind power density, the report also identifies local three-dimensional flow features such as wind shear, wind weir and local gustiness that are likely to have a negative impact on the durability of the wind turbine gearbox.

*Source: www.prweb.com*

## Flaps reduce wind turbine blade loads



*A design for a blade with a robust controllable trailing edge*

Researchers at Technical University, Denmark, have developed trailing edge flaps for wind turbine blades, with the idea of reducing dynamic blade loads. However, unlike those on aircraft, the flaps being developed by the team are elastomeric and are made as integral parts of the blades. “By providing the blade with a movable trailing edge it is possible to control the load on the blade and extend the life time of the wind turbine components. This is similar to the technique used on aircrafts, where flaps regulate the lift during the most critical times such as at take-off and landing,” explained Mr. Helge Aagaard Madsen, a researcher working on the project. The trailing edge is either controlled in response to measurements of inflow to a Pitot tube attached to the front edge of the blade

section or from the load on a small profile section mounted in front of the main blade.

The trailing edge itself is made of rubber with fibre-reinforced cavities. The cavities and directional fibre reinforcement provide the desired movement when the cavities are put under pressure by air or water. "In this project a number of different prototypes have been manufactured with a chord length of 15 cm and a length of 30 cm. The best version shows very promising results in terms of deflection and in terms of the speed of the deflection," Mr. Madsen said. The prototype suits a blade airfoil section with a 1 m chord and a section is now being produced and is to be tested inside a wind tunnel. Mr. Madsen adds, "If the results confirm our estimated performance, we will test the rubber trailing edge on a full-scale wind turbine within a few years." *Contact: Mr. Helge Aagaard Madsen, Technical University, Frederiksborgvej 399, PO Box 49, DK-4000 Roskilde, Denmark. Fax: +45 4677 5688; E-mail: hama@risoe.dtu.dk.*

*Source: www.eurekamagazine.co.uk*

### Rotor control

GE Energy, the multinational energy giant based in the United States, has unveiled a system that is reported to improve the performance and integration of wind farms on the national grid. The service, known as WindINERTIA, is part of GE's range of grid integration products. The technology is intended to provide wind turbines with the same reliability standards as thermal generators by adjusting their performance during network disturbances.

The technology works by allowing wind turbines to provide an inertial response for large, short-duration frequency disturbances through a

control system. The mechanical inertia turbine rotor allows it to increase its power output by 5 per cent to 10 per cent over a duration of a few seconds, giving the grid time to increase power production from other sources.

GE has also launched a service – WindLAYOUT – aimed at improving the efficiency of wind farms by using data from the components, alongside data from wind performance. The offering provides clients with a report detailing locations and estimates of wind energy production for wind farms using GE turbines.

*Source: www.theengineer.co.uk*

### Whales spur radical wind turbine blade design

Researchers in the United States are developing a wind turbine blade based on the design of flippers on humpback whales. Dr. Frank Fish, a biology professor at West Chester University in Pennsylvania, has been collaborating with Dr. Paul Jacobs and Mr. Thomas McDonald, both from the Technology Development Associates (TDA) of Rhode Island, to design a radical wind turbine blade that has proven, in actual performance tests, to increase electrical power generation by up to 25 per cent over existing blade designs.

Preliminary laboratory tests comparing conventional blades with bumpy leading edge – or tubercle technology – blades showed promising results. The tubercle technology blades showed a reduction in drag, higher efficiency, less noise and less blade vibration. The design demonstrated the potential to significantly improve both the performance and economic viability, in dollars per kilowatt-hour, of wind-generated electrical power. The next step was an *in situ* test, which was

conducted by the Wind Energy Institute of Canada on full-size tubercle technology blades fabricated by Whalepower Corp. of Toronto. The tests were conducted on an actual tubercle technology wind turbine, running alongside conventional wind turbines, on a bluff overlooking the Atlantic Ocean on Prince Edward Island. The results were obtained from a year of testing, with winds ranging from dead calm to gale warning. Newly released results show that the radical leading-edge turbine blade alone increases electrical energy output by a staggering amount of 22-24 per cent. This increase comes *without* taller towers, bigger turbines or any change whatsoever in existing moving parts. It is achieved just by using the radical new blades or retrofitting existing blades with a tubercle leading edge.

*Source: www.capecodtoday.com*

### Computerized hybrid system for VAWTs

WePower LLC, the United States, has introduced a hybrid power system combining wind energy, solar power and batteries. The computer-controlled hybrid power system will generate uninterrupted clean power using renewable sources as well as energy from the grid. The hybrid power system, developed in collaboration with Aura Systems, combines the sophisticated Aura Generators with a computer-controlled power management system that delivers uninterrupted power from a combination of vertical axis wind turbines (VAWTs), solar panels, battery systems and the grid. The system combines and stores power from multiple clean sources, and from the grid at off-peak hours, from which users can draw electricity, regardless of the current availability of wind or sunlight.

*Source: news.thomasnet.com*

### Hydrokinetic energy from water currents

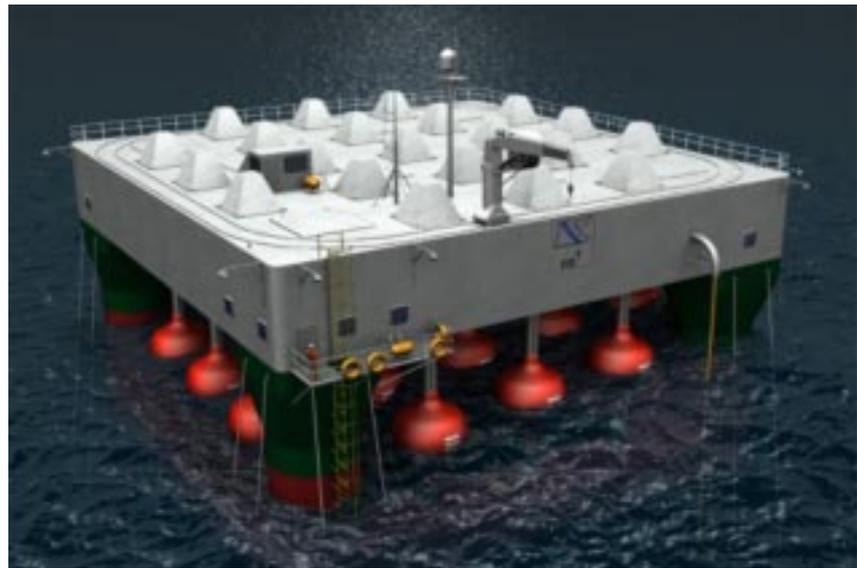
Researchers at the National Aeronautics and Space Administration (NASA), the United States, have proposed a hydrokinetic energy transfer system in which the flow of water current causes turbine blades to rotate. The rotor's rotational speed is increased through a gearbox, which drives a high-pressure fluid pump. The high-pressure fluid will be transported through flexible tubes to a larger pipe and then to an efficient, onshore hydroelectric power plant.

The technology is a spin-off of a new way to power robotic underwater vehicles. This technology helps convert ocean energy into electrical energy on a much larger scale. The team hopes that clean, renewable energy produced from the motion of the ocean and rivers could potentially meet an important part of the world's demand for electricity. The underwater hydrokinetic energy system uses water motion to generate a high-pressure liquid rather than electricity. That liquid is then transported to shore and used to produce electricity on land. Furthermore, the pressurized hydraulic energy can be stored in an elevated onshore reservoir and can be used to generate electricity when it is needed to respond to energy demand. Most environment-friendly energy systems produce power intermittently. Caltech holds the patent on this technology.

Source: [www.physorg.com](http://www.physorg.com)

### Wave power converter relies on composites

The FO<sup>3</sup> wave energy converter is a floating platform with oscillating point absorbers and is designed to



Artist's impression of the wave energy converter (Credit: Fred Olsen Ltd.)

be installed near the shore. Energy is absorbed from the waves as they move the floating absorbers hanging beneath the platform up and down. This motion is used to drive a generator to produce electricity. Both the platform and absorbers could employ composite construction. The FO<sup>3</sup> development team includes:

- Fred Olsen Ltd., Norway, the developer, owner and operator of the wave energy converter;
- Ghent University, Belgium, which is responsible for the mechanical design and testing of the materials and structures, including the floating point absorbers;
- Spiromatic NV, Belgium, which manufactures the components; and
- 3B, Belgium, a supplier of glass fibre reinforcements for composite applications.

The FO<sup>3</sup> wave energy converter is being assisted by the European Union-funded Sustainable Economically Efficient Wave Energy Converter (SEEWEC) project. It is also participating in the United Kingdom's Wave Hub project, one of the first large-scale commercial wave farms and planned for launch

in early 2010. Fred Olsen is one of several wave energy companies working with the Wave Hub project to evaluate new technologies.

Source: [www.reinforcedplastics.com](http://www.reinforcedplastics.com)

### Innovation in ocean energy

In the United Kingdom, Aquamarine Power has signed a development agreement with Airtricity to develop sites capable of hosting 1,000 MW of various types of marine energy by 2020. The two companies have agreed to enter into a 50:50 joint venture to develop wave and tidal energy sites in the United Kingdom and the Republic of Ireland. Work on the first two sites has already started, with plans to roll out further sites over the coming three years. Airtricity is the renewable energy development division of Scottish and Southern Energy (SSE).

The agreement focuses on at least two of the technologies Aquamarine is currently developing – a wave power generator called Oyster<sup>®</sup> and an underwater tidal stream device named Neptune<sup>®</sup>. Oyster is a hydro-



The wave power converter Oyster (full-scale) in open position

electric wave power converter designed to capture the energy found in amplified surge forces in near-shore waves. The system consists of a simple steel oscillating wave surge converter, or pump, fitted with double-acting water pistons, placed near-shore in depths around 10-12 m. Each passing wave activates the pump, which delivers high-pressure water via a sub-sea pipeline to the shore. Onshore, high-pressure water is converted to electrical power by means of conventional hydroelectric generators. Each unit generates a peak power between 300-600 kW, depending on configuration and location. When deployed in multi-megawatt arrays, several pumps will feed a single onshore hydroelectric generator linked to a single manifold pipeline. The company envisions power plants of at least 21 MW to achieve economies of scale to keep the cost of power relatively low.

Neptune, a little further away from a prototype, is a propeller-type tidal stream device that is expected to be rated at 2.4 MW per unit. The device, in its first version for demonstration, will be mounted on a single monopile planted on the seabed. Neptune sports bi-directional (flood and ebb) generation, with its design heavily influenced by the use of proven components from the wind turbine industry. Aquamarine has also invested in Ocean Flow Energy, which is developing and now testing a 1/10th scale Evopod™. That technology includes a moored

semi-submersible structure that is designed to generate electricity in exposed, deep water sites.

Source: [www.green-energy-news.com](http://www.green-energy-news.com)

## Electricity from slow-moving waves

For about three years, a wave power plant has stood on the bottom of the ocean a couple of kilometres off the west coast of Sweden, near Lysekil. "Instead of trying to adapt conventional energy technology to the special challenges of wave energy, we developed a technology that is adapted to the ocean from the start," states Mr. Rafael Waters at Sweden's Uppsala University Division of Electricity. The generator in the wave power plant is very special. It is a "linear generator", which generates electricity apace with the slow wave movements. An ordinary generator transforms rotation energy to electricity, and it needs to turn at about 1,500 rpm to be efficient. It is thus necessary to somehow convert the slow wave movement into a rapid rotating movement.

Next year the wave power facility will be complemented by two more plants and connected to one of the world's first wave energy parks, which will be capable of supplying household electricity to about 60 homes. Eventually, the park will have some 10 plants. In the long term, wave energy should be able to supply Sweden with 10 TWh/y of electricity, comparable to 12 nuclear power plants.

Source: [www.recyclingportal.eu](http://www.recyclingportal.eu)

## Prototype wave energy converter

In Australia, Oceanlinx has completed the construction of a 250 kW wave energy conversion unit – a full-



The full-scale prototype of wave energy conversion unit of Oceanlinx

scale prototype designed to extract energy from ocean waves and convert it to electricity or to convert ocean water to clean water – with the assistance of ABB. The prototype was completed at the ABB Performance Service Centre. The full-scale prototype has a unique commercially efficient system for extracting energy from waves. ABB was involved in fabrication modifications and installation of the wave energy conversion unit hood and steel work – including stiffening sections of the structure and fabricating two watertight doors.

Oceanlinx Ltd. is an international company working in wave energy conversion. It developed the proprietary technology for extraction of energy from ocean waves, and its conversion into electricity or its utilization to desalinate sea water to provide industrial-grade or potable water. Oceanlinx's core patented technology is an oscillating water column (OWC) device based on the established science of wave energy, but one which, when compared with other OWC technologies, offers major improvements in the design of the system, turbine and in construction technique. The technology has been successfully constructed and tested with the first full-scale Oceanlinx wave plant at Port Kembla. The unit reportedly produced zero carbon dioxide and sulphur dioxide pollution.

Source: [www.pacetoday.com.au](http://www.pacetoday.com.au)

## Bacteria generate cleaner power and water

Microbial fuel cells can store away carbon dioxide as well as produce electricity, according to an international team of scientists. Microbial fuel cells offer a clean and efficient way of producing energy because the microbes that power them can feed off almost any organic waste. Mr. Xia Huang and colleagues at the Tsinghua University, China, and the Ghent University, Belgium, have demonstrated that sunlight helps microbes use dissolved carbon dioxide (CO<sub>2</sub> as bicarbonate) in wastewater to produce electricity. The team showed that when a cathode is inoculated with a mixture of anaerobic and aerobic bacteria and a light is shone on it, the biocathode reduces bicarbonate, generating electricity and increasing bacterial growth (biomass). However, in the dark, power generation decreased rapidly, indicating that light is required to supply energy to the fuel cell.

"The process it uses to generate power is different from a typical microbial fuel cell, which uses precious metal catalysts to chemically reduce oxygen at the cathode," explains co-worker Mr. Xiaoxin Cao. "Using oxygen reduction to provide power is not ideal because it requires the water to be aerated – a very energy-intensive process." Typical wastewater has a high CO<sub>2</sub> concentration.

Source: [bioenergy.checkbiotech.org](http://bioenergy.checkbiotech.org)

## Miniature tubular SOFC system

In Japan, a team of researchers from the Functional Assembly Technology Group of the Advanced Manufac-



External appearance of a micro SOFC module (fuel stack at the centre)

turing Research Institute, and the National Institute of Advanced Industrial Science and Technology (AIST), has developed a very small fuel cell module with tubular solid oxide fuel cells (SOFCs), in collaboration with NGK Spark Plug Co. Ltd. (NGK). The micro fuel cell module has a size of 1 cm<sup>3</sup> with small-size tubular SOFCs of diameters ranging from millimetre to sub-millimetre, and achieves a power density of larger than 2 W/cm<sup>3</sup> at 550°C.

Compared with other types of fuel cells, SOFCs offer several advantages such as the highest energy conversion efficiency among all fuel cells, high reliability because they are made solely from solid materials, easy handling, and direct use of hydrocarbon fuel. AIST has been developing cubic micro SOFCs in collaboration with NGK. To meet the demand for very compact fuel cells, this collaboration has developed the micro fuel cell module by optimizing the module design and ceramic electrode microstructure. As a result, the module needs a negligible amount of power for feeding air into the porous solid and allows air supply by natural diffusion. Thus, a fuel cell system of much higher efficiency and small size will be achieved by using the newly developed module. This technology is likely to find wide application in powering small portable electronic devices.

Source: [www.fuelcelltoday.com](http://www.fuelcelltoday.com)

## Sony improves on glucose-powered fuel cell

In August 2007, Sony had unveiled a new fuel cell concept that was powered by glucose. A prototype of this technology could achieve 50 mW output. Now, the latest version can produce 70 mW and all it requires to do that is 28 cm<sup>3</sup> of sugar-filled cola. The battery was originally developed in conjunction with the Agricultural Department, Kyoto University, Japan, and employs enzymes to break down the energy from a glucose solution. The only by-product of this process is water.

Source: [www.geek.com](http://www.geek.com)

## Cheap power from wastewater fuel cells

The idea of generating energy using microbes and waste biodegradable material is now a step closer to reality, thanks to an unassuming stainless-steel brush developed at Pennsylvania State University, the United States. The steel brush can be used to replace the expensive platinum normally employed in the cathode of a microbial electrolysis cell (MEC), slashing costs by more than 80 per cent.

MECs harness the electrons produced by certain bacteria, as they feed on biodegradable material. The bacteria sit on the anode, as they metabolize organic matter in an oxygen-devoid chamber. Unable to react with oxygen, the electrons travel from the anode to the cathode, where they combine with protons to form hydrogen. Compared with platinum, which acts as an effective catalyst when applied in a thin layer to a flat piece of carbon cloth, a simple piece of stainless steel is two-thirds less effective. However, when the surface area of the stainless-

steel cathode was increased by arranging the material in the form of a high-density bristle brush, hydrogen production rates increased to values that matched or exceeded those of the platinum cathode. The stainless-steel brush costs only US \$0.03, while the platinum cathode is about US\$0.15. The researchers hope that further modifying the chemistry of the brush will improve the results even more.

Source:  
[www.waterandwastewater.com](http://www.waterandwastewater.com)

### New catalyst makes efficient fuel cells feasible

A team of researchers at the Brookhaven National Laboratory (BNL) of the United States Department of Energy has developed, in collaboration with researchers from the University of Delaware and Yeshiva University, a new catalyst that could enable efficient production of fuel cells powered by ethanol. The new catalyst succeeds in achieving two previously unreachable steps needed to oxidize ethanol and produce clean energy in fuel cell reactions.

The new electrocatalyst – made of platinum and rhodium atoms on carbon-supported tin dioxide nanoparticles – has been proven to be capable of breaking carbon bonds at room temperature and efficiently oxidizing ethanol into carbon dioxide (CO<sub>2</sub>). This as opposed to common catalysts that produce acetaldehyde and acetic acid as their main reaction products and are thus unsuitable for power generation purposes. The ability to split the carbon-to-carbon bond and generate CO<sub>2</sub> at room temperature is a new feature that no other catalyst has achieved at practical potentials.

Brookhaven researchers report that the ternary catalyst's structural and



Brookhaven Lab researchers who developed the new catalyst

electronic properties, which were determined using X-ray absorption techniques combined with data from transmission electron microscopy analyses at the Centre for Functional Nanomaterials at BNL, show it to be applicable to a variety of other alternative energy solutions. These findings can open new research possibilities not only for fuel cells and electrocatalysts but also for many other catalytic processes. The catalyst developed is currently undergoing extensive testing, as scientists are assessing its performance in a real fuel cell.

Source: [www.thefutureofthings.com](http://www.thefutureofthings.com)

### Nanowire electrodes for fuel cells

Woven nanowire electrodes could provide hydrogen fuel cells the boost needed to make them commercially viable, report researchers at the University of Rochester, the United States. Nanowires have aspect ratios in the millions, enabling them to expose thousands of times more surface area than traditional platinum electrodes, thereby potentially boosting efficiency, reducing cost and increasing the longevity of

hydrogen fuel cells. The electrodes will be woven from nanowires that are very, very long compared with their width. Their small size exposes more catalyst, making the fuel cells using them more efficient while reducing their expense since less platinum is required.

The new technique of manufacturing the nanowires has been shown to be capable of achieving nanometre diameters for wires several centimetres long. The method works by mixing liquid platinum salt with a polymer which is then spun into long, narrow wires. During the process, the platinum metal migrates to the centre of the wire. Individual polymer-coated wires are then woven into a braided electrode. Finally, heat is used to burn off the polymer and salts, leaving behind a pure woven platinum surface with vastly more surface area than flat electrodes. So far, the researchers have shown they can use the spinning process to create platinum nanowires with very high aspect ratios. Next, they plan to further reduce wire diameter – 10 nm compared with 2 nm for available nanoparticle coatings.

Source: [www.eetimes.com](http://www.eetimes.com)

## Hydrogen engine matches turbo diesel

Germany's BMW Group Forschung und Technik has joined forces with researchers from Austria and Vienna to develop a hydrogen combustion engine that has an efficiency level of up to 42 per cent – placing it on par with the best turbo-diesel engines. With the need for high economic and energy efficiencies, a hydrogen engine comes into its own due to its excellent ability for turbo-charging, especially compared with spark-ignited engines as combustion anomalies such as backfiring and knocking can be ruled out. This increases the compression ratio. With no particulate emission limit, the hydrogen engine can produce effective pressure.

According to the researchers, the main challenge for combustion of hydrogen with self-ignition is the high auto-ignition temperature with other challenges, including pressure increases, ignition pressures and the impact of high Exhaust Gas Recirculation (EGR) rates and nitrogen oxide formation rates. However, the newly developed system includes a new cylinder head for hydrogen operation. It combines the strengths of diesel concept with spark ignition, while utilizing the combustion properties of hydrogen to achieve high efficiency values. Test runs have shown that this combination followed by a diffusion style of combustion is ideal for engine efficiency.

Source:  
[www.thegreencarwebsite.co.uk](http://www.thegreencarwebsite.co.uk)

## Catalysts for hydrogen storage materials

A team of scientists report to have identified that carbon nanostructures can be used as catalysts to store and release hydrogen, a finding that may point researchers to-

wards developing the right material for hydrogen storage for use in cars. The team comprised researchers from Virginia Commonwealth University (VCU), the United States, the University of Uppsala in Sweden, and the Savannah River National Laboratory of the United States Department of Energy.

"Our work paves the way to design and synthesize new and improved catalysts for the dehydrogenation of complex hydrides, taking us one step closer to finding the right material for hydrogen storage," said Prof. Puru Jena from the VCU Department of Physics. Complex hydrides are a class of materials that have shown promise for the storage of hydrogen. Because they are not reversible and removing hydrogen from them is difficult at temperatures less than 100°C, catalysts are needed to improve the reaction rates. However, previous studies indicate that the addition of catalysts causes defects in the hydrides. The research team developed a solvent technique that allowed the introduction of carbon fullerenes and nanotubes without introducing any defects and also functioned as catalysts. Prof. Jena and the team at the University of Uppsala, led by Rajeev Ahuja, performed theoretical calculations to illustrate the mechanism of how these catalysts work.

Source: [www.news.xinhuanet.com](http://www.news.xinhuanet.com)

## Fuelling hydrogen powered vehicles

A ground-breaking technology from Linde North America in the United States provides a fast, efficient and safe way to fuel hydrogen vehicles. The Ionic Compressor is a compression system that has been used extensively in Europe for cars and buses and is now being introduced to North America for fork lift trucks. It employs an ionic liquid in direct

contact with hydrogen instead of a piston in the pressurizing process. "It is a high-efficiency, high-throughput, low maintenance and low-noise compression solution," claimed Mr. Michael McGowan, Head of Hydrogen Solutions for Linde. Together with Linde's proprietary fuelling protocol and advanced station design, the Ionic Compressor is part of a complete and compact compression storage and indoor dispensing solution for the hydrogen fuel cell fork lift truck market.

Source: [www.azom.com](http://www.azom.com)

## Hydrogen storage steps up a gear

Researchers in the United Kingdom report a material that stores more hydrogen, while scientists in China have found a way to release the gas more quickly. Mr. Martin Schroder and colleagues at the University of Nottingham in the United Kingdom have made a porous solid for hydrogen storage with significantly higher hydrogen capacity. Mr. Ping Wang's team at the Chinese Academy of Sciences has found that mechanical milling with magnesium hydride speeds up hydrogen release from ammonia borane, a material with high hydrogen storage capability.

Mr. Schroder's solid is a copper(II)-based metal-organic polymer made up of three polyhedral cages that fit together to give a hollow framework. The polymer can take up 10 wt per cent hydrogen at 77 bar and 77°K. This is among the highest uptake to date for this class of porous material, claims Mr. Schroder. Mr. Wang's milling technique speeds up hydrogen release. More than 8 wt per cent hydrogen can be released within 4 h at 100°C, the lowest temperature obtained in any hydride system tested so far.

Source: [www.fuelcelltoday.com](http://www.fuelcelltoday.com)

## Biodiesel from trap grease



*BlackGold Biofuel's biodiesel plant*

BlackGold Biofuels, based in Philadelphia, the United States, has agreed to license its technology that converts trap grease into biodiesel and sell a processing unit for US\$1 million to the San Francisco Public Utilities Commission (PUC). The San Francisco PUC expects to be producing biodiesel from trap grease at the plant at the rate of 378,540 litres per year. It intends to make its Oceanside plant a model for how to use BlackGold's technology.

*Source:*  
[philadelphia.bizjournals.com](http://philadelphia.bizjournals.com)

## Electricity from straw

At the Fraunhofer Institute for Ceramic Technologies & Systems (IKTS) in Germany, scientists have developed a biogas plant that runs purely on waste materials, transforming waste into a valuable material. The new plant, developed in collaboration with several small and medium enterprises, generates 30 per cent more biogas than its predecessors.

"In our pilot plant, we exclusively use agricultural waste such as maize stalks, that is, the maize plants without the cobs. This allows us to generate 30 per cent more biogas than in conventional facilities," says Dr. Michael Stelter, IKTS Head of the Department, Modules and Systems. Until now, biogas plants have

only been able to process a certain proportion of waste materials, as these are more difficult to convert into biogas than pure cereal crops or maize, for instance. The pilot plant has an electricity output of 1.5 kW, enough to cover the needs of a household.

The researchers have also optimized the conversion of biogas into electricity. They divert the gas into a high-temperature fuel cell with an electrical efficiency of 40-55 per cent. By comparison, the gas engine normally used for this purpose has an average efficiency of about 38 per cent. Another improvement is that the fuel cell operates at 850°C. The heat can be used directly for heating or fed into a district heating network. If the electrical and thermal efficiency are added up, the fuel cell has an overall efficiency of up to 85 per cent.

*Source:*  
[www.engineeringnews.co.za](http://www.engineeringnews.co.za)

## Biodiesel could make millions for pulp mills

A patented chemical process invented in Canada could turn pulp mill waste into fuel for cars, or even to run the mills themselves. Mr. Mark Logan, a chemist who used to work for Canfor's Intercon pulp mill, has patented the technology, which uses "soap-derived refinery feedstock" (SDRF) to make biodiesel. SDRF, which is called soap in the industry, is common and plentiful at any pulp mill and so is the need to burn diesel for a number of functions at a pulp mill. Mr. Logan calculated that a small mill using his method could increase revenue by around US\$3 million, whereas a medium-sized mill's revenue would increase by US\$5 million and a large mill could reap nearly US\$7 million a year.

*Source:*  
[www.princegeorgecitizen.com](http://www.princegeorgecitizen.com)

## Power from bio CHP

In Japan, a local power plant is using biomass updraft gasification technology to deliver 2 MW of combined heat and power (CHP) to residents. Located 400 km north of Tokyo, the plant uses technology licensed from Denmark-based Babcock & Wilcox Volund A/S to turn 60 t/d of wood chips into wood gas. The plant was designed by Japan's JFE Environmental Solutions Corp.

In the updraft gasification process, moist biomass fuel is fed at the top and descends through hot gases rising through the reactor. The fuel is dried in the gasifier's upper zone while pyrolysis occurs below. The biomass then passes through a reduction zone (gasification). Updraft technology allows for a wide fuel mix and a range of moisture content. It is also scaleable for units up to 20 MW of fuel input.

*Source:*  
[www.renewableenergyworld.com](http://www.renewableenergyworld.com)

## Two-step chemical process turns raw biomass into biofuel

Researchers at the University of Wisconsin-Madison (UWM) in the United States have developed a two-step method to convert cellulose in raw biomass into a promising biofuel. A main feature of this process is its use of untreated and inedible biomass as the starting material. The key to the new process is the first step, in which cellulose is converted into the "platform" chemical 5-hydroxymethylfurfural (HMF), from which a variety of valuable commodity chemicals can be made.

Dr. Ronald Raines, a professor at the Department of Biochemistry and the Department of Chemistry, and graduate student Mr. Joseph Binder developed a unique solvent system

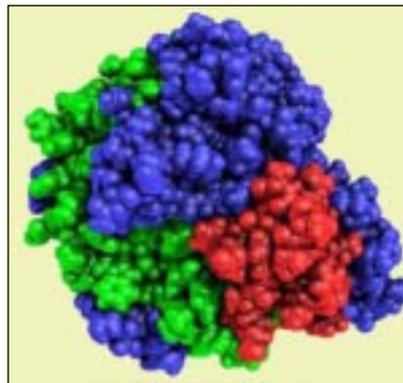
that makes this conversion possible. The special mix of solvents and additives has an extraordinary capacity to dissolve cellulose. As cellulose is one of the most abundant organic matter on the planet, it is widely seen as a promising alternative to fossil fuels. This approach simultaneously bypasses another vexing problem – lignin, the glue that holds plant cell walls together. Often described as intractable, lignin molecules act like a protecting cage for the cellulose. The research team used chemicals small enough to slip between the lignin molecules, where they work to dissolve the cellulose, cleave it into its component pieces and then convert those pieces into HMF. In the second step, the team converted HMF into 2,5-dimethylfuran (DMF), a promising biofuel. Taken together, the overall yield for this two-step biomass-to-biofuel process is 9 per cent. Besides corn stover, the team tested the method using pine sawdust.

Source: [www.news.wisc.edu](http://www.news.wisc.edu)

## New enzymes for biofuel production

In the United States, researchers at the California Institute of Technology (Caltech) and world-leading gene-synthesis company DNA2.0 have taken a notable step towards the development of a cost-efficient process to extract sugars from cellulose – the world's most abundant organic material and cheapest form of solar energy storage.

Researchers report 15 new highly stable fungal enzyme catalysts that efficiently break down cellulose into sugars at high temperatures. Previously, fewer than 10 such fungal cellobiohydrolase II enzymes were known. In addition to their remarkable stabilities, the new enzymes degrade cellulose in a wide range of conditions. Biofuels are made



Thermostable cellulase recombined from three natural fungal cellulases

by converting renewable materials – for example, corn kernels, wood chips left over from pulp and paper production, prairie grasses and even garbage – into fuels and chemicals. Cellulose is much tougher to break down than starch. Another issue is that while the fermentation reaction that breaks down corn starch needs just one enzyme, the degradation of cellulose requires a whole suite of enzymes, or cellulases, working in concert. The current industrial cellulases, which were isolated from various species of plant-decaying filamentous fungi, are slow and unstable and, as a result, the process remains prohibitively expensive.

The 15 new enzymes were created using a process called structure-guided recombination. Using a computer program to design where the genes recombine, the Caltech researchers “mated” the sequences of three known fungal cellulases to make more than 6,000 progeny sequences that were different from any of the parents, yet encoded proteins with the same structure and cellulose-degradation ability. By analysing the enzymes encoded by a small subset of those sequences, the researchers from Caltech and DNA2.0 were able to predict which of the more than 6,000 possible new enzymes would be the most thermostable. Thermostability is essential for efficient cellulases because at

higher temperatures – say, 70°C or 80°C – chemical reactions are more rapid. Further, cellulose swells at higher temperatures, which makes it easier to break it down. Unfortunately, the known cellulases from nature typically will not function at temperatures higher than around 50°C, and hence, the need for new thermostable enzymes. *Contact: Ms. Kathy Svitil, California Institute of Technology, United States of America. Tel: +1 (626) 3958 022; E-mail: [ksvitil@caltech.edu](mailto:ksvitil@caltech.edu).*

Source: [www.eurekalert.org](http://www.eurekalert.org)

## Permaflo biodiesel tested in the Arctic

In Alaska, the United States, the Indiana Soybean Alliance (ISA) and others have tested a new cold climate Permaflo biodiesel, which was developed at the Purdue University. Researchers from the University of Alaska-Fairbanks, the Alaska Agricultural and Forestry Experiment Station, ISA farmer-directors and Purdue agricultural and biological engineering professor Dr. Bernard Tao drove two vehicles running on B100 biodiesel over a distance of 580 km. One of the vehicles continued on a 320 km trip to the Arctic Circle, where the group camped overnight using a generator powered by Permaflo biodiesel.

Purdue researchers developed Permaflo biodiesel using a process to create biodiesel with a cloud point as low as -55°C. The process involves using urea to separate saturated and unsaturated oil molecules. The saturated molecules bond with the urea and drop out of the solution, with the remaining molecules used to make the Permaflo biodiesel. The cold-flow fractionation process alters the chemical composition to improve the cold weather properties.

Source: [www.biodieselmagazine.com](http://www.biodieselmagazine.com)

## Handbook of Energy Efficiency and Renewable Energy

This book provides a thorough grounding in the analytic techniques and technological developments that underpin renewable energy use and environmental protection. The handbook emphasizes the engineering aspects of energy conservation and renewable energy. Practical in approach, the book covers technologies currently available or those expected to be ready for implementation in the near future. It sets the stage with a survey of current and future worldwide energy issues, then explores energy policies and incentives for conservation and renewable energy, covers economic assessment methods for conservation and generation technologies, and discusses the environmental costs of energy generation technologies. The book goes on to examine distributed generation and demand-side management procedures and gives a perspective on the efficiencies, economics and environmental costs of fossil and nuclear technologies.

Contact: CRC Press, 6000 Broken Sound Parkway, NW, Suite 300, Boca Raton, Florida, FL 33487, United States of America. Tel: +1 (561) 9940 555; Fax: +1 (561) 9899 732; E-mail: [international.orders@taylorandfrancis.com](mailto:international.orders@taylorandfrancis.com).

## The Analysis of Tidal Stream Power

This book integrates a wide range of research and tidal resource theory and data to present a detailed analysis of the physics and oceanography of tidal stream power devices together with a worldwide resource analysis. Clearly structured throughout, the book is divided into two distinct parts. Key features include:

- Reviews the tidal resources around the world;
- Provides a complete analysis of tidal stream power systems;
- Includes historical information on tidal science and biographical information on major figures;
- Concentrates on engineering physical geography rather than engineering specifics; and
- Includes a website with a wide range of computer models, data and simulations.

Contact: Customer Service Department, John Wiley and Sons (Asia) Pte. Ltd., 2, Clementi Loop #02-01 LogisHub@Clementi, Singapore 129809. Tel: +65 6463 2400; Fax: +65 6463 4604; E-mail: [csd\\_ord@wiley.com.sg](mailto:csd_ord@wiley.com.sg).

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### ICEE 2009 International Conference on Energy and Environment

Contact: World Academy of Science, Engineering and Technology. Website: [www.waset.org/conferences/2009/singapore/icee/index.php](http://www.waset.org/conferences/2009/singapore/icee/index.php)

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### 2009 Asia-Pacific Clean Energy Summit & Expo

Contact: Mr. Tommilyn Soares, Honolulu, Hawaii 96804, United States of America. E-mail: [tsoares@dbedt.hawaii.gov](mailto:tsoares@dbedt.hawaii.gov); Website: [www.asiapacificcleanenergy.com](http://www.asiapacificcleanenergy.com).

**16-18 Sep**  
Manila  
Philippines

### POWERTRENDS 2009

Contact: Leverage International (Consultants) Inc., Suite 84, Legaspi Suites, 178 Salcedo Street, Legaspi Village, Makati City, 1229 The Philippines. Tel: +63 (2) 818 6828; Fax: +63 (2) 810 1594; E-mail: [leverage@leverageinternational.com](mailto:leverage@leverageinternational.com) Website: [powertrends.leverageinternational.com](http://powertrends.leverageinternational.com)

**09-11 Oct**  
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India

### Energy Expo India 2009

Contact: Confederation of Indian Industry – CII, Ahmedabad, 203-204, Sears Tower Gulbai Tekra, Nr. Panchvati, Ahmedabad, India 380 006. Tel: +91 (79) 6521 5956; Fax: +91 (79) 2646 2878; E-mail: [manoj.shethia@ciionline.org](mailto:manoj.shethia@ciionline.org).

**14-17 Oct**  
Jakarta  
Indonesia

### Renewable Energy Indonesia 2009

Contact: PT. Pamerindo Buana Abadi, Deutsche Bank Building, 13th Floor, Jl. Imam Bonjol No. 80, Jakarta, 10310 Indonesia. Tel: +62 (21) 316 2001; Fax: +62 (21) 316 1981; E-mail: [info@pamerindo.com](mailto:info@pamerindo.com).

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### PERIODICALS

(Free access at [www.techmonitor.net](http://www.techmonitor.net))

- Asia Pacific Tech Monitor (6 issues/year) (e-version)
- VATIS Update (6 issues/year)
  - Biotechnology (e-version)
  - Non-conventional Energy (e-version)
  - Food Processing (e-version)
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