



Non-conventional Energy

Apprise yourself with the latest technological innovations

Highlights

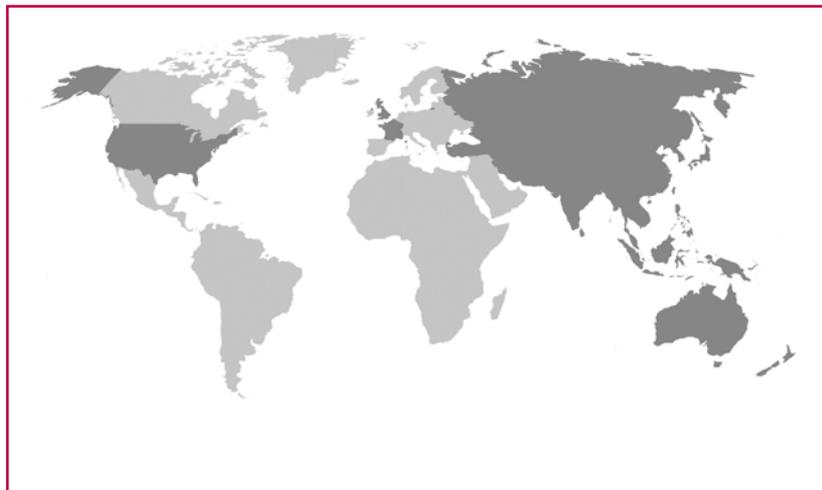
- Nanomaterials for enhanced solar cell efficiency
- Supercharged wind turbines
- Lightweight, robust tidal generator
- Novel fuel cell system with cheaper catalyst
- Solar reactor produces hydrogen
- Sustainable process for wastewater algae-to-biocrude



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

- Research and analysis of trends, conditions and opportunities;
- 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

A model of MODEC's SKWID hybrid wind and ocean power generation system (details on page 9).

(Credit: MODEC Inc., Japan)

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Solar-powered water supply in Pakistan

The solar power company Phaesun GmbH from Germany has installed 200 solar water pumping systems in 12 districts in Pakistan. The latest systems were put into operation by Phaesun and its Pakistani partner Izhaz Energy in December 2012 in Sukkur district. The United Nations Development Programme (UNDP) initiated and financed the project to counteract the destructive effects of the tidal flood in Pakistan in the summer of 2010. Thousands of families will benefit from the project that secures water supply for drinking, irrigation and livestock farming. The flood in 2010 severely affected the water supply, with people in many places having to travel long distances to collect potable water. Organized water supply for agriculture and livestock farming was often not existent in many places. The UNDP-project aims at a sustainable water supply for local communities by means of renewable energies.

Local communities where water supply was almost completely disrupted were identified in 12 districts. The 200 solar water pumping systems were individually sized according to the needs on site, such as water quantity and pumping head, before their installation. The systems use pumps manufactured by Grundfos, Denmark, and are operated using solar modules of 400 W to 700 W. The project is expected to have a sustainable effect on the development of the affected regions.

Source: www.pv-magazine.com

ADB funding for Philippine renewable energy sector

The Asian Development Bank (ADB) has provided US\$102 million to the

Philippines to boost the country's renewable energy sector, specifically for solar and hydropower projects. According to a statement by Mr. Sohail Hasnie, Principal Energy specialist at ADB, US\$100 million in loans is available for solar rooftop projects, while US\$2 million is to jump-start micro-hydropower plants in Mindanao. Of the US\$100 million loan facility, US\$20 million would come from the Clean Technology Fund and US\$80 million would be provided by ADB. While the facility was made available last year, it remained untapped, Mr. Hasnie said.

In June 2012, ADB completed a rooftop solar power project on its main building. The 2,040 photovoltaic (PV) panels that occupy 6,640 m² on the building's roof, produce 613 MWh/year of power to run part of ADB's air-conditioning, lighting and computer systems, and reduce ADB's carbon emissions. Using the fund, ADB, together with the state-run National Electrification Administration and other stakeholders, has identified 25 potential sites in the Caraga region where power plants will be set up. The goal is to build at least two small hydropower facilities with a combined capacity of 500 kW. According to a report by First Metro Investment Corp., the Philippines had an existing capacity of 5,500 MW of renewable energy power in 2010, of which 61 per cent came from hydropower.

Source: www.ecoseed.org

Thailand boosts its solar power capacity

Conergy, Germany, has strengthened its market position in Thailand with a 31.5 MW order that brings the company's total capacity signed with Siam Solar Energy (SSE), a subsidiary firm of Thai Solar Energy Company Ltd. (TSE), to 52.5 MW since autumn 2012. At present, the



A Conergy solar panel installation in Thailand

country is targeting 25 per cent of its energy generation from renewables by 2022. In 2012, Conergy started construction of two plants, with a total capacity of 21 MW, for SSE with a view to connection in the first quarter of 2013. Three additional solar parks with an installed capacity of 10.5 MW are scheduled to follow.

The three new plants are located in Suphanburi and Kanchanaburi provinces. The plants will cover around 790,000 m² in total and Conergy is collaborating on the construction work with Annex Power and Ensys. Conergy is the general contractor with responsibility for planning, engineering and design as well as for the supply of components and installation. With nine power plants and a total capacity of 70 MW, Conergy is hoping to become one of the market leaders in Thailand. The company is hoping to reach grid parity in the country because of its high irradiation levels and falling PV prices.

Source: www.renewableenergymagazine.com

India moves to green the telecom sector

The Government of India has approved recommendations made by the Telecom Regulatory Authority of India (TRAI) on green energy applications. The following directives have been issued to the licensees/

all international long distance (ILD) service providers to adopt measures to green the telecom sector, setting broad directions and goals:

- At least 50 per cent of all rural towers and 20 per cent of the urban towers are to be powered by hybrid power (renewable energy technologies and grid power) by 2015, and 75 per cent of rural towers and 33 per cent of urban towers need to be powered by hybrid power by 2020.
- Service providers are required to evolve a carbon credit policy in line with the carbon credit norms with an ultimate objective of achieving a maximum of 50 per cent over the carbon footprint levels of the base year in rural areas and 66 per cent over the carbon footprint levels of the base year in urban areas by the year 2020. For calculating existing carbon footprints, the base year is to be 2011, with an implementation period of one year and the first year of carbon reduction would be 2012.
- Service providers must declare the carbon footprints of their network twice in a year. Further, based on the details of footprints declared by all service providers, service providers should target carbon emission reduction targets for the mobile network at 5 per cent by 2012-2013, 8 per cent by 2014-2015, 12 per cent by 2016-2017 and 17 per cent by 2018-2019.

Source: *pib.nic.in*

Hydropower in Sri Lanka recovers generation levels

Sri Lanka's hydropower generation doubled in November 2012 on improving rains, allowing the utility to cut thermal generation by a quarter; however, demand remained flat according to official data. Sri Lanka generated 959 GWh in November 2012, on par with 958 GWh a year

earlier. Hydropower generation in the month rose 114 per cent to 396 GWh from a year earlier, but thermal generation fell 25.2 per cent to 184 GWh. But in December 2012, Sri Lanka also raised furnace oil prices by about 25 per cent, which was being sold below cost to the power utility.

Power purchases from private producers fell 27 per cent to 387 GWh. Non-conventional renewable energy purchases – mostly made up of private mini-hydros – surged to 10 GWh from 2 GWh. In the 11 months up to November 2012, total power generation was up 2.6 per cent to 10.8 GWh, with hydro falling 43 per cent to 2,203 GWh and thermal rising 52 per cent to 3,346 GWh. The Ceylon Electricity Board's hydro storage rose to over 80 per cent of capacity by the end of the North-east monsoon rains and started to ease with the onset of the dry season in February 2013.

Source: *www.power-eng.com*

Wind energy hits new milestone in China

China has been making significant progress towards meeting its sustainability goals through the adoption of renewable energy. China has become a leader in the global solar energy industry, with its presence helping drive down the cost of solar panels in numerous markets around the world. Though the wind energy sector in China receives only moderate attention, it has achieved a major milestone according to GTM Research, a leading market analysis firm based in the United States. GTM Research reports that China's wind energy capacity reached over 50 GW in 2012. This is largely due to the numerous wind energy projects that have taken form all over the country and the strong support these projects have received from

the central government. The growth in China's wind energy sector has made the country a very attractive market, leading many companies specializing in wind power to flock to the country to take advantage of the many opportunities.

China has ambitious plans to further increase its wind energy capacity by another 40 per cent by the end of 2013. An addition of 18 GW installed wind capacity will help it make more progress in its ongoing effort to reduce carbon emissions and establish independence from fossil fuels. Further progress in this endeavour will also single China out as a leader in the adoption of renewable energy, with more than 140 GW of installed capacity predicted for 2015.

Source:

www.hydrogenfuelnews.com

Test bed projects gain traction in Republic of Korea

In the Republic of Korea, renewable energy test bed projects – which support the commercialization of technologies and products developed by Korean renewable energy companies – have been given the much-needed impetus. On the solar power front, 29.9 billion won (US\$ 26.8 million) will be invested in Gumi Electronics & Information Technology Research Institute's solar power test bed project in Daegu and North Gyeongsang. The solar power test bed projects in Chungcheong-do will try to build key infrastructure designed to test technologies and products developed by solar power firms.

As for wind power, by 2014, 16.2 billion won (US\$14.5 million) will be invested in wind power system test bed projects in South Jeolla province to build infrastructure that will enable the testing, evaluation

and certification of wind power generator systems. Also, a total of 18.7 billion (US\$16.8 million) will be provided for the fuel cell test bed project in Daegu and North Gyeongsang, organized by Pohang University of Science and Technology.

Source: www.koreaitimes.com

Indonesia to set FiT to promote solar energy

In an attempt to attract more private investors in the development of solar energy, the Government of Indonesia will set a feed-in tariff (FiT) for electricity generated by solar power plants. "The tariff will be as high as 25 cents per kWh," stated Finance Minister Mr. Agus Martowardojo after a meeting with several other ministers. FiT is the rate that the state utility firm Perusahaan Listrik Negara (PLN) will pay for electricity generated from privately owned power plants. The development of solar power facilities would still be conducted through a competitive bidding process and the electricity generated will be purchased by PLN. "Should the investors decide to use more locally made components, then the price would be higher," Mr. Agus added.

The tariff is expected to encourage private investors to develop solar power plants in remote areas of the country. Indonesia's remote areas are concentrated in the less developed eastern part, including Flores island in East Nusa Tenggara and some parts of Papua. "The electricity solution for remote areas is independent power plants and it can't be [powered] by diesel fuel," Mr. Agus stated. The government, with the assistance of PLN, had identified several regions where the feed-in tariff would be applied. According to Mr. Rida Mulyana, Director General of renewable energy at the Ministry of Energy and Mineral Resources,

the tariff was in line with the Ministry's proposal. As development is still being handled through competitive bidding, the price level could be lower than the US\$0.25 per kWh quoted by Mr. Agus. Mr. Rida added that the FiT would then be reduced in stages after 20 years of operation. The average lifespan of a solar power plant is about 20 years.

Source: www.thejakartaglobe.com

New degression rates proposed for solar PV technology

The Energy, Green Technology and Water Ministry, Malaysia, has said that the degression rate for solar photovoltaic (PV) with installed capacity of up to 24 kW will remain at 8 per cent. Deputy Secretary-General (Energy) Mr. Badaruddin Mahyudin said the degression rate for solar PV with an installed capacity of more than 24 kW would be increased from 8 per cent to 20 per cent. There will be no degression rates for bonus criteria of locally manufactured PV modules and inverter as the rate will be reduced from 8 per cent to zero per cent. Mr. Badaruddin stated that the new degression rates would be applicable to solar PV quota released in 2012. The degression rates for solar PV technology are under the feed-in tariff (FiT) mechanism administered by the Sustainable Energy Development Authority Malaysia (Seda Malaysia). Meanwhile, Seda Malaysia has announced changes to the rules and regulations and administrative guidelines for renewable energy installations:

- All companies registered in the e-FiT, the on-line FiT system, will be required to key in information of all their ultimate beneficiary shareholders when the e-FiT opens on 5 March 2013;

- All companies are required to provide documents related to ownership or shareholding, as well as its structure (in percentages) disclosing all the ultimate beneficial shareholders;

- Companies need to update their profiles in which they are required to have minimum paid-up capitals of M\$20,000 (US\$6,140) for Feed-in Approval (FiA) application of up to 72 kW or M\$50,000 (US\$15,350) for FiA application of more than 72 kW; and

- FiA applicants must provide the latest memorandum of association and articles of association under the Companies Regulations (1966), showing power generation from renewable energy to be part of their lines of business. Companies are also not allowed to make any alterations to the immediate shareholders declared at the previous FiA submission.

Source: biz.thestar.com.my

Viet Nam expands rural electricity

Ninety-six per cent of all homes in Viet Nam now have electricity, said government officials noting that the country is turning away from coal to renewable energy. According to the Ministry of Industry and Trade, Viet Nam has installed 29 hydroelectric plants since 2002, and a commitment by France to invest millions of euros to modernize the nation's electric grid has helped Viet Nam turn to renewable energy rather than burning coal to create power. France has committed 75 million euros for a 270 mile high-voltage power line to connect hydro-electric power stations in the central portion of the country to southern Viet Nam, where demand for electricity is increasing.

Source: www.upiasia.com

Nanomaterials for enhanced solar cell efficiency



NanoPhoSolar test equipment

The multi-partner European project NanoPhoSolar is aiming to develop nanophosphor down-converting material that will be incorporated into coatings and polymer films for integration into new solar modules and retrofitting of existing solar modules. Down-converter materials significantly increase the solar cell efficiency and lifetime of conventional technologies [for example, silicon-based, copper indium gallium selenide (CIGS) and cadmium telluride (CdTe)] and emerging technologies such as dye-sensitized solar cells. The NanoPhoSolar project will overcome the limitations relating to efficiency and performance range of solar cells through nanophosphor down-converting materials capable of absorbing ultraviolet (UV) and short wavelength visible light, and re-emitting them in the more useful longer wavelength visible spectrum. In effect, the solar cell will be able to harvest more energy from sunlight and thus raise cell efficiency.

In addition, the solar module will experience less of the damaging sections of light (high-energy UV rays), through the down conversion to visible light, thus increasing module lifetime. By doing this, the photovoltaic (PV) system created will offer greatly improved PV performance due to the capture of a larger proportion of the incident visible

spectrum. This will lead to significant economic and societal benefits to consumers and manufacturers. Ten European and two Israeli companies are participating in the project, which began in January 2013 and will run till December 2015.

Source: www.nanowerk.com

New world record for CdTe solar cell efficiency

First Solar Inc., the United States, has announced that it has set a new world record for cadmium telluride (CdTe) photovoltaic (PV) solar cell conversion efficiency. Constructed utilizing processes and materials – including the glass substrate – that are designed for commercial-scale manufacturing, the record-setting cell achieved 18.7 per cent cell efficiency in tests confirmed by the United States Department of Energy’s National Renewable Energy Laboratory (NREL). “Our advanced thin-film technology yields superior energy output in desert regions while also having the twin benefits of being more economical and more efficient sources of alternative energy,” claimed Mr. Raffi Garabedian, First Solar’s Chief Technology Officer.

First Solar had increased its average production module efficiency to 12.9 per cent in the fourth quarter of 2012, up 0.7 percentage points from 12.2 per cent in the last quarter of 2011. The company’s lead line was producing modules with 13.1 per cent efficiency during the fourth quarter, up from 12.6 per cent in the same period in 2011. First Solar utilizes a continuous manufacturing process that transforms a sheet of glass into a complete solar module in less than 2.5 hours, contributing to the industry-leading energy pay-back time and low-carbon footprint.

Source: www.ameinfo.com

Plasmonic solar cell grown from a forest of gold nanorods

Researchers at the University of California–Santa Barbara (UCSB), the United States, are excited over a new solar cell that they have been working on. The research team has developed a free-floating plasmonic device that produces hydrogen from water using only clean, renewable solar energy. Zero-emission hydrogen fuel cells run on hydrogen, and splitting water into hydrogen and oxygen is an expensive, energy-intensive process. One way to get around that is to use solar energy to power the process. Plasmonic devices offer another more durable, and potentially more efficient, way. As sunlight strikes a conventional solar cell made of semiconductor material, electrons shift positions to leave positively charged “holes”, thereby creating an electric current. Plasmonic solar devices also create a shift in electron position using solar energy, but they are made of metal nanostructures instead of semiconductors.

The researchers created a cell in the form of a “forest” of gold nanorods, topped with titanium dioxide (TiO₂) crystals and platinum (Pt) nanoparticles. When placed in water with a catalyst and exposed to visible light, electrons in the nanorods oscillate together, creating “plasmonic waves”. As the ‘hot’ electrons in these plasmonic waves are excited by light particles, some travel up the nanorod, through a filter layer of crystalline TiO₂, and are captured by Pt particles. This causes the reaction that splits hydrogen ions from the bond that forms water. Meanwhile, the holes left behind by the excited electrons head towards the cobalt-based catalyst on the lower part of the rod to form oxygen. The plasmonic cell is still many

years away from commercial development. However, one promising aspect of the work so far is the ruggedness of the nanorods – which could lead to a device that has a far longer lifespan than the present conventional solar cells, in addition to increased efficiency.

Source: [cleantechnica.com](#)

Spray-on photovoltaic cells

In a bid to reduce solar panel costs, researchers in the United Kingdom have devised a spray-coating technique for photovoltaic (PV) cells. The researchers from University of Sheffield and University of Cambridge replicated methods used to spray-paint cars to make PV cells. Prof. David Lidzey from University of Sheffield says, “We found that the performance of our spray-coated solar cells is the same as cells made with more traditional research methods, but which are impossible to scale in manufacturing.” Most solar cells are manufactured using special, energy-intensive materials that themselves contain large amounts of embodied energy. Comparatively, plastic requires much less energy to make than silicon. By spray-coating a plastic layer in air, the scientists hope the overall energy required to make a solar cell can be reduced significantly.

A downside to using plastics as a solar cell material – needed for the spray technique – is that they are not currently as efficient at generating electricity as cells made from silicon. Most solar panels are made from silicon and are expected to last over 25 years. The scientists believe it is unlikely that plastic cells will ever be this stable. However, if the energy cost of plastic cells can be lowered enough, they will become more cost-effective than silicon over their life cycle. Prof. Lidzey adds,

“Increasing the energy conversion efficiency and lifetime of plastic cells are significant issues that many groups are working on. It should also be noted that the cost of silicon solar panels have reduced significantly over the last few years; so plastic solar cells will have to catch up with these improvements.” The scientists believe that the new technology could one day be used on glass in buildings or car roofs.

Source: [www.solarpowerportal.co.uk](#)

Improved solar cell technology

In the United States, Yale University researchers have developed cost-effective technology that increases the efficiency of solar cells. The new technology entails hybrid solar cells – made of carbon nanotubes and silicon – which convert sunlight to electrical energy more efficiently than traditional solar cells. The cells are physically robust, flexible and “optically thin”, and suitable for a wider range of applications. Lead author Mr. Xiaokai Li from the Department of Chemical and Environmental Engineering said that their research bridges the cost effectiveness of traditional organic solar cells with the efficiency of silicon.

In order to create their hybrid solar cell, the researchers developed a low-cost method that can be performed at room temperature. The researchers applied thin, smooth carbon nanotube films to silicon and then used an acid wash to dissolve the carbon, allowing the nanotubes to collapse together to form a highly conductive network. Applications of the new technology are not limited to solar panels and solar-powered devices – the cells may be used in photodetectors, sensors and displays as well. These cells could also be used on various

surfaces, not just those that are flat and square.

Source: [yaledailynews.com](#)

Organic solar cell's record efficiency for third-generation PV

In Germany, Heliatek GmbH in cooperation with University of Ulm and Technical University (TU) Dresden has established a world record in organic photovoltaics (OPVs). The important milestone was reached in January 2013 with a new global record of 12.0 per cent cell efficiency, which was measured and confirmed by the accredited testing facility SGS. The superior low-light and high-temperature performance of OPVs when compared with traditional solar technologies – another advantage of the third-generation photovoltaic technology – were also confirmed by SGS.

The record-setting cell is a standard 1.1 cm² module combining two patented absorber materials that convert light of different wavelengths. The use of two different absorber materials leads to stronger absorption of photons and improves energy utilization through a higher photovoltage. OPV's unique behaviour at high temperature and low light conditions makes this 12 per cent efficiency comparable to about 14-15 per cent efficiency for traditional solar technologies like crystalline silicon and thin-film cells. Whereas those technologies significantly lose cell efficiency with rising temperatures and decreasing solar radiation, organic cells increase their efficiency in these conditions. The new world record efficiency topples an earlier record of 10.7 per cent, set just nine months ago by the same company.

Source: [www.scienceworldreport.com](#)

Wind and tidal hybrid power generation system

MODEC Inc., Japan, has come out with a renewable energy generating system that harnesses both wind energy and tidal energy to provide clean electricity. The floating wind and current hybrid power generation system dubbed SKWID is capable of converting two inexhaustible ocean energy sources into abundant power. SKWID's pioneering technology provides cost-effective power generation with minimum environmental impact. The first-of-its-kind system is made by combining a Darrieus windmill with erect blades and a Savonius waterwheel that rotates in the same direction regardless of the tidal current's direction.

The amount of energy generated by the Darrieus windmill is twice the power generated by a conventional propeller windmill, as the Darrieus windmill has a larger swept area. Moreover, because of its low centre of gravity, it is a lot more stable on water. The waterwheel used in the design is made up of vertically split cylinders to allow the wheel to utilize slow tidal currents. Moreover, both the systems are connected to a generator installed in the centre of the floating system to allow more power to be generated.

Source: www.ecochunk.com

New generation of wind turbines

Turbine manufacturer Nordex SE, Germany, is launching a new generation of wind turbines for medium and strong wind conditions: N117-3000 and N100-3300 for IEC 2 and IEC 1 wind classes, respectively. According to Technical Director Mr. Jorg Scholle, Nordex engineers have altered not only the control system

of the turbines but the drive train and its support frame as well. The main objective of Generation Delta is a turbine suited for the wind farms in Northern Europe with cold climates and a lot of full-load hours. Nordex says that the new N117s are calculated to be able to generate power at full performance in medium wind conditions of 8 m/s for up to 3,500 hours annually.

The support frame and drive train of Generation Delta will have a clearly stronger design and be bigger than in the current Generation Gamma N90-2500, N100-2500 and N117-2400, to generate more power from the wind. The tower head may be heavier and the gearbox somewhat wider and longer. To accommodate the heavier loads, both a gearbox with protracted gear stages and a significantly longer main shaft are provided. The main shaft was lengthened to absorb the bumps and curves on the rotor from the wind and pass them on via the four mounting points and to the tower. The nacelle would be more spacious than in previous Nordex models. Each new strong wind turbine will produce at least 21 per cent and 30 per cent more energy than the current strong wind models with a hub height from 75 m to 120 m, respectively. Higher rated output and a larger rotor diameter are the main reasons for this increase. Nordex has added two plates adjacent to one another on the rear end of the turbine roof, so that the generators will once again be passively cooled. In June 2013, Nordex will start building the first three prototypes of the turbines.

Source: www.renewablesinternational.net

New turbines for low-wind conditions

Acciona Windpower, Spain, is adding a rotor for low winds to its 3 MW

platform for low-wind sites. Before the end of the year, the company wants to build a prototype of AW 125/3000. Compared with AW 116/3000, the current largest model with its 125 m rotor diameter, the new model enlarges the swept area by around 16 per cent, to 12,271 m² for the average wind speeds of low-wind sites. All over Europe, sites with an average wind speed of 7.5 m² through the year will be standardized to IEC III class. At these speeds, the energy content of the wind is 258 W/m² (at an air density of 1,225 kg/m³).

The company says that the fourth evolution of the 3 MW platform will produce a turbine that will deliver maximum energy production at a low cost for almost any wind site. A 3 MW generator is calculated to sufficiently reach full power at 244 W/m² rotor area owing to the long blades. In practice, however, only a maximum of 52 per cent of the wind energy can be used. In order to increase the yield in sites with less wind, the new turbine will be constructed on concrete towers as tall as 120 m. Acciona has adapted turbine construction of the 3 MW platform so that the turbine will now be available with rotor diameters of 110 m, 109 m, 116 m and 125 m. The platform strategy allows the turbines to be optimized for a variety of sites with as few changes to the basic concept as possible. In early 2014, after AW 125/300 is certified, the commercial delivery of versions with 50 Hz and 60 Hz is expected to start.

Source: www.renewablesinternational.net

Siemens' new direct-drive turbine

Siemens Wind Power, Germany, will be setting up two prototypes of its new 6 MW direct-drive turbine at

Gunfleet Sands, an offshore wind farm in the United Kingdom. The first SWT-6.0 with 120 m rotor diameter has been running onshore since May 2011 in Hovsore, Denmark. Siemens has been testing a new 75 m long rotor blade in a further prototype in Osterild since October 2012. The framework agreement with Dong Energy, Denmark, from mid-2012 includes the installation of 300 large turbines off the British coast.

Siemens has been using its experience from recent years from the gear turbine SWT-3.6. In December 2012, an offshore prototype with an output of 4 MW was installed in Osterild. The machine is a further development of Siemens' SWT-3.6 that was installed some 500 times off the coast in recent years. Like its predecessor, the prototype has a rotor diameter of 120 m. At the beginning of 2013, the technology group wants to upgrade the rotor diameter to 130 m. The higher efficiency and bigger rotor ensure that the SWT-4.0-130 will achieve up to 15 per cent more output than the SWT-3.6-120 in typical offshore locations, with wind speeds of 9-10 m/s.

Source:
www.renewablesinternational.net

Supercharged wind turbines

Wind turbines wound with a superconducting wire instead of regular copper could turn 2-3 MW generators into 10 MW powerhouses, say research teams in Europe and the United States that are on a race to produce such machines. Basically, a wind turbine is simple – a series of wire coils attached to the rotor blade spin in the presence of strong magnetic fields, provided by stationary magnets. This generates a current, but the resistance in copper wire limits the current that can

flow through the coils. Making the coils from a resistance-free superconductor will not only boost power generation but also cut down on weight. However, using superconductors will not be easy, partly due to the ultra-low temperatures they require. Developing a coil that can be cooled while simultaneously rotating with the turbine blades is a big challenge. A research project dubbed Suprapower, funded by the European Union, was kicked off to address this problem.

Mr. Holger Neumann at Karlsruhe Institute of Technology, Germany, and other members of the Suprapower consortium are betting on a new high-temperature superconductor – magnesium diboride – that works at 20°K. "It is light, easily made into wires and is really cheap compared with the old niobium-titanium superconductors, which needed cooling way down to 4°K," Mr. Neumann explained. That temperature difference might not sound much but it means, crucially, that just one-seventh of the power is required to cool the magnesium diboride superconductor. The team will also have to fabricate a casing, called a cryostat, in which the superconducting coil will be kept chilled by gaseous helium. This is tricky as its supporting structure will act as a "heat bridge" to the warmer world outside. According to Mr. Neumann, they have cracked the problem with a novel arrangement of an outer vacuum vessel and insulating inner layers of plastic and titanium.

Another hurdle is the unusual property of superconductors – when the wires sweep through a magnetic field, their ability to generate current is reduced. That means more coil turns would be needed to make up for the current loss, which would negate some of the weight savings and make the turbines more expensive to construct. "Magnetic flux lines

interfere with the wires' ability to transport electricity, lowering its performance," states Mr. Venkat Selvamamickam from the University of Houston, Texas, where the United States' government is funding work via its Advanced Research Projects Agency – Energy. Mr. Selvamamickam's team reports to have found a way to solve this problem – adding 5 nm wide particles of barium zirconate to the wire. This "pins" the magnetic flux lines in place as the wires sweep through the field, preventing the formation of swirling magnetic vortices that reduce current flow. So far the team has eliminated 65 per cent of this current limiting problem. The team in the United States claims to be within a few years of building their own 10 MW wind turbine and reports that their techniques could make superconducting wires suitable for electricity generation and distribution.

Source: www.newscientist.com

China's first 2 MW low wind turbine

CSR Zhuzhou Electric Co. Ltd. in China has successfully developed the nation's first 2 MW low-wind speed turbine that works in wind speeds of less than 7 m/s. This wind power generation equipment will harness resources in China's central and southeast regions. The first wind turbine will be set up in Hunan, and mass production will immediately follow. The development of the 2 MW low-wind speed wind turbine can help fully utilize the low-speed winds in developed, populous areas with large power needs, such as central, southern and eastern China that account for more than 68 per cent of the "low wind speed areas". Contact: CSR Zhuzhou Electric Co. Ltd. Website: www.csrelectric.com.

Source: www.jeccomposites.com

Systems for improved fluid flows through a turbine

Hydro Green Energy LLC. in the United States is patenting systems for improved fluid flows through a turbine. A system for installing and extracting a flowing water turbine below the surface of the water includes a flow inducer assembly for improving the conversion of the kinetic energy of a waterway to mechanical energy. The flow inducer assembly includes a nozzle that may be shaped as a cowling and an outlet diffuser. The system may be useful in a number of settings, including, but not limited to, dams, streams, rivers, ocean currents or tidal areas that have continuous or semi-continuous water flow rates and windy environments.

Source: patft.uspto.gov

Tidal blades with embedded insert technology



Nautricity with 1-shot RTM tidal blades

Airborne Marine, the Netherlands, has successfully manufactured 1-shot Resin Transfer Moulded (RTM) tidal blades with embedded insert technology. The two blades made form part of a series of seven 4 m blades for the Nautricity 250 kW test turbine, shortly to be deployed at the European Marine Energy Centre (EMEC) test site in Scotland. In the summer of 2013, this series will be followed by blades of approximately

8 m for Nautricity's Mull of Kintyre project. Airborne's concept of a 1-shot RTM tidal blade, in combination with embedded insert technology, is unique and the first of its kind. The production method incorporates the philosophy of de-risking, manufacturing optimization and performance enhancement.

The 1-shot RTM tidal blades do not have any adhesive bonds present and have a root-hub connection. As such, this concept does not require bolting and/or adhesives on the composite blade. In this way, de-risking and reliability, the two major factors in the emerging tidal energy market, are addressed optimally. Meeting these requirements is crucial, as the blades have to function in the harsh environment of tidal currents.

Source: www.offshorewind.biz

Lightweight, robust tidal generator

SCHOTTEL, Germany, has come out with its first tidal generator, STG 50, which presents a new approach on the market, focusing especially on high efficiency at relatively low investment and maintenance costs. The lightweight and robust STG 50 is based on the concept that reducing turbine size leads to a better ratio of power and material use. High overall power can be reached with a higher number of turbines. STG 50 is a horizontal free flow turbine with a rotor diameter of 4.0-4.5 m and a rated power of 45-50 kW. It can easily be composed in arrays of various types and sizes, depending on the available space and the output expectations. The turbine is fitted with an asynchronous generator to convert the variable rotation into electric power. Each of the turbines is connected to a frequency converter that feeds into a common DC bus installed on the tidal platform. Finally, a common frequency

converter and a large transformer are used together to produce grid-ready electricity. Thanks to the modular approach, STG 50 can be installed in rivers, sea straits and offshore in jetty or floating platforms. The latter are developed by TidalStream Ltd. in which SCHOTTEL holds shares.

The STG turbine was designed with a focus on high efficiency with respect to both hydrodynamics and electrical components. The turbine design has been supported by various model tests and RANS-CFD simulations. Different sets of rotor blades as well as the entire power generation chain have successfully been tested.

Source: subseaworldnews.com

Harnessing tidal energy using vertical axis tidal turbine

In China, researchers at the College of Shipbuilding Engineering, Harbin Engineering University, are investigating the use of vertical-axis tidal turbine (VATT) for harnessing tidal energy. The team has delineated the background to the development of unique and novel techniques for power generation using the kinetic energy of tidal streams and other marine currents. The study focuses only on VATTs, with the purpose of gathering up to date data on VATT. The leader of the study is also working on straight bladed variable pitch VATT for a PhD at Harbin Engineering University, China.

From the study it can be concluded that VATT has a simple structure with straight blades, so that it has no directionality issue when tidal flow change its direction diurnally. The design and hydrodynamic forecasting of VATT need complex engineering and expertise in the field of fluid structure interaction. For low head and shallow depth, VATT is a

better option. VATT is more sensitive to cavitation because its working principle is based on lift type design. So, incorporating proper blade airfoil theory and computational fluid dynamics (CFD) techniques plays an important role to mitigate cavitation and thereby erosion and noise effects. *Contact: College of Ship-building Engineering, Harbin Engineering University, Harbin 150001, China.*

Source: maxwellsci.com

A kite-like tidal energy harvesting device

A tidal energy device developed by Minesto, Sweden, converts energy from tidal stream flows into electricity by way of a novel principle – somewhat similar to the posture of a wind kite. The tidal turbine assembly consists of a wing and turbine attached by a tether to a fixed point on the ocean bed. As water flows over the hydrodynamic wing, a lift force is generated that allows the device to move smoothly through the water and for the turbine to rotate, generating electricity. The new technology, named Deep Green, utilizes low-velocity tidal currents as opposed to other technologies that compete for tidal hotspot locations: an area where velocities are in excess of 2.5 m/s. Conventional stationary tidal energy devices cannot operate in the low-velocity locations, as the flow of water is not sufficient to generate a useful flow of electricity. However, the hydrodynamic principle on which Deep Green is based allows the kite-like device to move at speeds of up to 10 times that of the flow of water it is operating in, thus unlocking many more potential tidal farm sites than its competitors.

The main parts characterizing the Deep Green technology is the wing, tether and swivel – which form the “motor” of the device, ensuring that

the driving forces are large enough to overcome the drag forces and attain a speed that is sufficient to ensure high flow velocities into the turbine for efficient power production. The wing is designed to create high loads, requiring a stiff structure but lightweight with sufficient fatigue and material properties, and includes watertight compartments. The wing accommodates systems for buoyancy, batteries and pressure sensors. The tether is mainly a force-bearing element designed to take the high loads created by the wing but will also accommodate power cables from the generator and signal cable to the control system.

For the best possible performance, the tether is designed considering hydrodynamic forces to minimize the overall drag of the device. The swivel mounted on the foundation is the anchoring point for the tether, assuring that the tether can move smoothly in all directions depending on the current velocity direction and the kite motions. The kite consists of a wing that carries a nacelle and turbine, which is direct coupled to a generator inside the nacelle. The wing is attached to the seabed by struts and a tether. The tether accommodates power cables and cables for communication. The kite is steered in a pre-designated trajectory by means of a rudder and servo system in the rear cone of the nacelle and a control system.

Besides the competitive advantages already mentioned, Deep Green is claimed to be economical in operation and maintenance. Being at 20 m or more below the water surface, it offers minimal visual and environmental impact. The device is low in weight (less than 7 tonnes for a 50 kW unit) and compact. *Contact: Mr. Anders Jansson, CEO, Minesto AB, Vita gavelns vag 6, 426 71 Vastra Froolunda, Sverige, Sweden. Tel: +46 (31) 760 2102; +46 (707) 57*

5762; E-mail: anders.jansson@minesto.com.

Source: www.minesto.com

Tidal current turbines

Andritz Hydro Hammerfest, Austria, is part of the Andritz Hydro Group, a global supplier of electromechanical equipment and services for the hydropower business. In December 2011, Andritz Hydro Hammerfest successfully deployed its 1 MW pre-commercial tidal turbine HS-1000 to validate the technology for the world's first tidal power array at the European Marine Energy Centre (EMEC) in Orkney, Scotland. The technology already had a five-year track record as the first-ever tidal current turbine with permanent connection to a public electricity grid. This smaller prototype has delivered over 1.5 GWh to the grid and shown up to 98 per cent availability during prolonged test runs.

The seabed-mounted HS-1000 that builds on the prototype is a tried-and-tested design with horizontal axis rotor, pitched blades and yaw feeding a variable-speed conventional generator via a gearbox. Automatic control software governing a sensor-driven monitoring system adjusts the leading edge to capture optimum output from a given tidal environment. It is designed for the most taxing marine currents, to handle flows from 1 m/s to more than 4 m/s, in water depths down to 100 m. A new installation method will reduce installation time significantly and enable efficient future maintenance. Performance and operational capabilities have been fully validated according to expectations during test runs, including continuous, autonomous running over a prolonged period. *Contact: Andritz Hydro GmbH, Austria. Tel: +43 508 05 52694.*

Source: www.andritz.com

Novel fuel cell system with cheaper catalyst

ACAL Energy, the United Kingdom, has developed a new fuel cell technology that cuts costs and boosts the durability of hydrogen fuel cells by replacing the fixed platinum catalysts on the cathode of traditional proton exchange membrane (PEM) fuel cells with a liquid regenerating catalyst system. PEM fuel cells degrade by approximately 28 mV per 1,000 hours – a key barrier to their widespread adoption. ACAL's FlowCath system avoids the issues that cause degradation, while ensuring a 25 per cent savings in cost due to the reduced need for platinum. A test model has now passed the equivalent of 250,000 road miles with zero degradation.

A conventional PEM fuel cell strips hydrogen atoms of their electrons at the anode, ionizing them and releasing negatively charged electrons to provide electrical current. Oxygen in the form of air enters the fuel cell at the cathode, combining with electrons returning from the electrical circuit and hydrogen ions that have travelled through the membrane, separating the anode and cathode to create water. However, in FlowCath system, while hydrogen is catalysed on the anode, the proton and electron are absorbed into a solution containing redox catalyst systems, which flow continuously from the stack to an external regeneration vessel. In the regenerator, the solution comes into contact with air, and the electron, proton and oxygen react to create water, which exits as vapour, while the solution flows back to the cell. By using a liquid system and carrying out the oxygen side of the reaction outside of the fuel cell stack, the system has managed to address durability problems caused by unwanted oxidation reactions occur-

ring in the cell, degradation of the membrane through repeated drying and degradation of the catalyst. The system is also far simpler than most PEM fuel cells, requiring no air compressor or humidity control; further, the liquid catalyst is able to act as a coolant reducing volume and cost.

Source: eandt.theiet.org

Tri-generation fuel cell for landfill site

FuelCell Energy Inc., the United States, has received a contract to demonstrate a tri-generation stationary fuel cell power plant near Vancouver, Canada, using landfill gas as the fuel source. The landfill gas clean-up will be performed by the prime contractor, Quadrogen Power Systems Inc., Canada, and the cleaned landfill gas will be used by the fuel cell power plant to generate multiple revenue streams, including ultra-clean electricity, usable high-quality heat and renewable hydrogen. The heat in the form of hot water will be supplied to Village Farms International Inc., a leading hydroponic greenhouse operator in Canada. Renewable hydrogen will be exported for vehicle fuelling or industrial applications.

The project will include FuelCell Energy's solid-state electrochemical hydrogen separation and compression (EHSC) technology, which efficiently and cost-effectively purifies and compresses hydrogen for industrial uses or vehicle fuelling. The landfill for the City of Vancouver has an advanced gas collection system. Some of the gas is flared, wasting a potential fuel and generating pollutants such as smog-producing nitrogen oxides (NOx). Using the landfill gas to generate ultra-clean power converts a waste disposal problem into an environment-friendly source of revenue.

Power production is expected to commence in early 2014. *Contact: Quadrogen Power Systems Inc., 4250 Wesbrook Mall, Vancouver, BC V6T 1W5, Canada. Tel: +1 (604) 221 7170; Website: www.quadrogen.com.*

Source: www.fuelcelltoday.com

Fuel cell stacks built for industrial vehicles

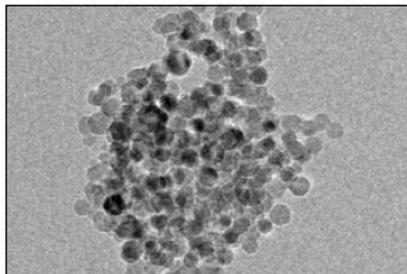
In the United States, Nuvera Fuel Cells has introduced its new Orion[®] fuel cell stack designed for easy integration by manufacturers of forklift and other industrial vehicles in to their product portfolio. When used to power material handling equipment, Orion delivers higher productivity, lower cost of ownership and reduced emissions. Nuvera's Orion provides the performance, serviceability, versatility and ruggedness required for heavy-duty industrial operations. Orion incorporates a unique fuel cell stack architecture that provides industry-leading current density, offering reduced capital cost for a given quantity of power produced, higher efficiency leading to lower operating cost and a high-durability design. Orion delivers unsurpassed performance in a range of 8 kW to 300 kW. It is supplied with SmartStack[™], Nuvera's innovative stack control logic that enables rapid and reliable integration of Orion by original equipment manufacturers (OEMs) into products. SmartStack can be supplied as a software download into the control unit, or optionally with a Nuvera electronic control unit. *Contact: Ms. Lauren Armstrong, Marketing Communications Specialist, Nuvera Fuel Cells, 129 Concord Road, Building #1, Billerica, MA 01821, United States of America. Tel: +1 (617) 245 7571; Fax: +1 (617) 245 7511; E-mail: larmstrong@nuvera.com.*

Source: www.nuvera.com

Silicon particles used to produce hydrogen on demand

Super-small particles of silicon react with water to produce hydrogen almost instantaneously, according to researchers at University at Buffalo, the United States. In a series of experiments, the scientists created spherical silicon particles about 10 nm in diameter. When combined with water, these particles reacted to form silicic acid (a nontoxic by-product) and hydrogen – a potential source of energy for fuel cells. The reaction did not require any light, heat or electricity and, furthermore, created hydrogen about 150 times faster than similar reactions using silicon particles 100 nm wide and 1,000 times faster than bulk silicon.

The scientists were able to verify that the hydrogen they made was relatively pure by testing it successfully in a small fuel cell that powered a fan. “With further development, this technology could form the basis of a ‘just add water’ approach to generating hydrogen on demand,” stated researcher Mr. Paras Prasad. Portable energy sources would be the most practical application. The speed at which the 10 nm particles reacted with water surprised the researchers. In under a minute, these particles yielded more hydrogen than the 100 nm particles yielded in about 45 minutes. The maximum reaction rate for the 10 nm particles was about 150 times as fast. The discrepancy is due to geometry. As they react, the larger particles form non-spherical structures whose surfaces react with water less readily and less uniformly than the surfaces of the smaller, spherical particles. Though it takes significant energy and resources to produce super-small silicon balls, the particles could help power portable devices in situations where water is avail-



Spherical silicon nanoparticles about 10 nm in diameter

able and portability is more important than low cost. Military operations and camping trips are two examples of such scenarios.

Source: www.sciencedaily.com

Hydrogen technology for renewable energy storage

McPhy from France and Ecowill Engineering Group from Spain have entered into a strategic alliance to develop a renewable hydrogen solution for the Colombian market. The first “green hydrogen” plant will be installed near Bogota. Hydrogen produced by electrolysis of water using either wind or solar power will be absorbed in discs of magnesium for storage in solid form in containers. The two elements combine to form magnesium hydride, allowing storage of large amounts of hydrogen in a stable and relatively dense form at low pressure (10 bar), which facilitates its transport. “To meet the needs of the Colombian market, we will have six containers of 2.5 m wide, which will store up to 2 MW each. Where it is possible to install an external heat exchanger, we can store nearly 23 MW in the same volume,” explained Mr. Guillaume d’Arche who represents McPhy in Spain, Portugal and South America.

Easy to fill and empty, the containers can be transported safely and used for many applications. The energy contained in them can be

used to produce electricity through a combustion engine, a fuel cell or a gas turbine. Hydrogen can also be used as vehicle fuel. For McPhy and Ecowill, the goal is to provide quick access to electricity at sites awaiting a viable energy solution. In areas where grid connection is not possible, the hydrogen storage effectively complements existing systems. For example, in isolated communities, where solar and wind are the only sources of electricity, hydrogen would be generated during production hours and converted into electricity at night or when there is no wind. The concept has been already demonstrated successfully in France, Italy, Germany and the United Kingdom.

Source: www.fuelcelltoday.com

Solar reactor produces hydrogen

In the United States, University of Delaware doctoral candidate Mr. Erik Koepf and research associate Mr. Michael Giuliano worked two months in Switzerland testing a new solar reactor that Mr. Koepf had developed to produce hydrogen from sunlight. Eight weeks of sophisticated testing at temperatures up to 1,200°C revealed that the reactor’s mechanical, electrical and thermal systems worked as predicted. Small amounts of fuel could be collected in a vial, despite operating below critical reaction temperatures, to validate the system components in a high-temperature environment.

The new reactor is designed to accomplish the first stage in a two-stage process that splits water to generate hydrogen renewably from sunlight. The reactor, which is closed to the atmosphere, uses gravity to feed zinc oxide powder (the reactant) into the system through hoppers that dispense the powder onto a ceramic surface. There it under-

goes a thermochemical reaction on being exposed to highly concentrated sunlight within the reaction cavity, producing solar fuel. Mr. Koepf and Mr. Giuliano have designed and built a mirror that provides concentrated sunlight to achieve the very high temperature range (1,750°C-1,950°C) needed to produce solar fuel. The mirror is a perfectly flat, water-cooled aluminium plate with a 98 per cent reflective foil surface. It is about 2.5 cm thick, measures 114 cm by 114 cm and contains 13 holes bored through the plate along one of the mirror's axes, enabling water to continuously pass through the channels and cool the mirror's surface while in use. To allow for precise adjustments in real time, the mirror is suspended above the reactor by threaded rods connected to a motor and control assembly and is controlled using a joystick. Placed on a 45° angle, it will enable a perfectly reflected, concentrated light cone that is free of distortion to enter the reactor. The mirror assembly and reactor, which weigh nearly 1,360 kg, are undergoing tests at present in Switzerland.

Source: www.udel.edu

Iron-based catalyst developed for hydrogen fuel cell

At the Pacific Northwest National Laboratory, the United States, scientists have developed the first iron-based catalyst to convert hydrogen directly into electricity for more affordable fuel cells. In most fuel cells, the catalyst used to trigger the reaction is either platinum or platinum-based. This is a drawback as the metal is "a thousand times more expensive than iron," says chemist Mr. R. Morris Bullock, who led the research. Mr. Bullock's team at the Centre for Molecular Electrocatalysis has been developing catalysts

that use cheaper metals such as nickel and iron. Mr. Bullock and his colleagues developed a catalyst based on the molecule hydrogenase that uses iron to split hydrogen.

To achieve the desired results, the catalyst has to be able to split the hydrogen atom into all of its parts. One hydrogen molecule is made up of two protons and two electrons and the catalyst would need to separate the protons, sending it away to be caught by a proton acceptor molecule (oxygen molecule, in a fuel cell). Sans the protons, the electrons will move on to the fuel cell's electrodes, creating an electric current. The scientists determined the shape and size of the catalyst and also tested different proton acceptors. With iron in the middle, arms hanging like pendants around the edges, draw out the protons.

With the design done, the scientists measured the speed at which the catalyst could split molecular hydrogen. Their best time was about two molecules per second – thousands of times faster than the nearest, non-electricity producing iron-based competitor. The catalyst can also efficiently produce energy at around 160-220 mV, similar in efficiency to most commercially available catalysts. The catalyst would be tested further, to figure out how to make the reactions faster and to determine the optimum conditions under which it performs.

Source: www.ecoseed.org

Low-eco impact technology for hydrogen production

The doctoral thesis by Mr. Aingeru Remiro-Eguskiza, a chemical engineer at University of the Basque Country, Spain, investigates a process to produce hydrogen from bio-oil, a process that has less impact

on the environment than currently used processes. At present, hydrogen is obtained through methods that require separating hydrogen from other chemical elements like carbon (in fossil fuels) and oxygen (from water). The methods used for this purpose are not desirable from an environmental or economic perspective for large-scale production of hydrogen. Mr. Remiro-Eguskiza's thesis aims to contribute towards the laboratory-scale development of a process for producing hydrogen from bio-oil by means of catalytic reforming using water vapour. Bio-oil is a heterogeneous mixture of wood-based oxygenated products, the catalytic transformation of which routinely entails problems of operability and deactivation of the catalyst. This is because, on heating, a fraction of the compounds that make up the bio-oil form a solid residue (pyrolytic lignin) and collects on the inlet pipes of the reactor and in the reactor itself.

To address these problems, the research used a specially designed reaction unit comprising two stages (thermal and catalytic). In the thermal stage (heating of the bio-oil), the controlled deposition of pyrolytic lignin that takes place minimizes operational problems and achieves deactivation of the catalyst. That way, the compounds obtained in the thermal stage are more susceptible to transformation. In addition, a third stage has been incorporated into the process – carbon dioxide (CO₂) capture intended to intensify the production of hydrogen also increases its purity and cuts the associated contaminating emissions. The process involves using an adsorber in the reaction bed and is designed to capture CO₂. *Contact: Aitziber Lasa, Elhuyar Fundazioa, Spain. Tel: +34 (943) 363 040; E-mail: a.lasa@elhuyar.com.*

Source: www.eurekalert.org

Pyrolysis of biomass into liquid fuel

Malaysia's ambition to produce and use more second-generation biofuel is fast picking up as process engineers begin converting biomass to liquid fuel through fast pyrolysis. Second-generation biofuel, like bio-oil, is more environment-friendly than biodiesel or bio-ethanol because it is derived from inedible biomass instead of food crops. It is a realistic alternative to the costlier fossil fuels because it can be used to heat up water to produce steam to operate turbines that generate electricity. This is a valuable means of replacing depleting fossil fuels like coal, petroleum and natural gas.

A wide range of biomass – for example, agricultural waste like oil palm waste – can be converted into stable, concentrated bio-crude. This is then refined into bio-oil to replace fuel oil burnt in boilers. Bio-oil plants adopt the fast pyrolysis process, where biomass is heated rapidly to temperatures between 300°C and 550°C at high pressure in the absence of oxygen. Gases released by the burnt biomass enter a quench tower, where they are quickly cooled and recycled back as fuel to the reactor. Currently, Lipochem's demo plant in Klang is able to process 5 t/d of dry biomass. The plant can be scaled up 20 times to a commercial size of 100 t/d, at the cost of around M\$30 million (US\$9.2 million), stated Mr. Koh Pak Meng, Managing Director of Lipochem.

Source: www.malaysia-chronicle.com

Sustainable process for wastewater algae-to-biocrude

A team at University of Kansas, the United States, has demonstrated the



Demonstration of integrated wastewater algae-to-biocrude process

feasibility of a sustainable, integrated wastewater algae-to-biocrude process using hydrothermal liquefaction (HTL) for biofuel production. According to the team, the municipal wastewater matrix and resultant mixed-culture biomass significantly influenced liquefaction product distribution, yielding a higher proportion of biochar, a potentially valuable co-product. Traditional conversion technologies of algal biomass to biofuels have mainly included lipid extraction or pyrolysis for biodiesel, hydrotreated renewable diesel or bio-oil production. These processes have significant drawbacks when using algal feedstocks. Lipid extraction, for example, requires extensive dewatering and organic solvents, diminishing the economics of fuel production and increasing environmental concerns. Whole cell conversion pathways like pyrolysis alleviate environmental concerns from solvent extraction but still require extensive dewatering.

A wet whole cell conversion pathway, HTL, uses subcritical water as the chemical driving force to convert biomass to a carbon-rich biocrude. Using microalgal feedstock, biocrude yields from HTL processing are 5-30 per cent greater than the initial algae lipid content, as cellular components other than lipids too are converted to biocrude. Economic analyses of producing fuel oil, synthetic petroleum and diesel from wood chips with 50 wt per

cent moisture have shown that atmospheric flash pyrolysis costs less than high-pressure liquefaction. For high water content biomass such as algae, however, the energy costs of dewatering may offset the energy demand of liquefaction processes. Also, HTL of algae gives a biocrude with a composition and energy density that more closely resembles petroleum crude than bio-oil from pyrolysis.

The new process developed by the researchers used pilot-scale algal cultivation ponds that were fed with municipal wastewater as the nutrient source. The open ponds were self-inoculated from the wastewater source, resulting in a mixed-culture microalgal community with distinct differences compared with monocultures maintained and fertilized in a laboratory. GC/MS analysis of the biocrude showed a significant number of straight-chain and branched hydrocarbons and mono- and polyaromatics in addition to fatty acids. The co-products could greatly enhance sustainability and the value chain for algal biofuels, adding markets in carbon sequestration, soil amendments, absorbents and fertilizers. The demonstration, while promising, requires further work upon optimizing the energy balance of the conversion method in conjunction with the cultivation strategy and determining the efficacy of the identified co-product markets.

Source: www.fis.com

Efficient biodiesel production from waste vegetable oils

In the United States, Greenleaf Biofuels has begun producing biodiesel fuel at its New Haven, Connecticut plant. When fully operational, the facility is slated to produce up to 38 million litres of biodiesel fuel per

year. In its cost-effective, moderate-sized biofuel plant, Greenleaf plans to use as feedstock waste vegetable oils collected from restaurants and food manufacturers along the Boston to New York City corridor.

Greenleaf Biofuels evaluated various methods and chose a continuous-feed biodiesel production technology developed by JatroDiesel. The JatroDiesel process begins by drying the feedstock, followed by acid esterification using methanol and sulphuric acid to convert free fatty acids into methyl ester. The methyl ester is passed through a two-stage transesterification process, which converts triglycerides into biodiesel and glycerin. Glycerin and excess methanol are removed from the biodiesel, purified and cycled back for reuse in the process. The biodiesel is polished using compounds based on magnesium silicate to eliminate any trace amounts of glycerin and then passed through a final filter on its way to finished product storage. *Contact: Ms. Cheryl Verdone, Administrator, Greenleaf Biofuels LLC, 100 Waterfront Street, New Haven, CT 06512, United States of America. Tel: +1 (203) 6729 028; E-mail: cheryl@greenleafbiofuels.com.*

Source: www.sustainableplant.com

Ceramic membrane reactor technology for biofuel production

BioDiesel Reactor Technologies Inc. (BDR), a Canadian clean energy technology company, has received a United States patent for its "Apparatus and Method for Biofuel Production", covering the commercial application of BDR's ceramic membrane reactor technology for the production of biodiesel and fatty acid acyl esters (FAAE). The patent that includes 22 claims was also granted a 1,081-day patent term extension. The patented technology

is compatible with existing conventional plant technologies and can be used for new plants or to retrofit existing plants to make them compliant with new quality standards and to improve profitability. The technology can be used for converting into biodiesel: virgin oils; feedstock high in free fatty acid content, such as used cooking oils, yellow grease, waste corn oil and jatropha; and next-generation feedstocks (algae oils). BDR's technology also has application in the Omega-3 supplements industry.

Source: www.biodieselmagazine.com

New process speeds up conversion of biomass to fuels

Scientists in the United States have reported an important step forward in transforming biomass-derived molecules into fuels. The team led by Los Alamos National Laboratory researchers elucidated the chemical mechanism of the critical steps that can be performed under relatively mild energy-efficient conditions. According to Mr. John Gordon, one of the senior Los Alamos scientists working on the project, while efficient conversion of non-food biomass into fuels and chemical feedstocks could reduce use of fossil fuels and production of greenhouse gases, current technologies that convert

biomass into fuels require very high temperatures and high pressures – conditions that make the conversion process prohibitively expensive.

The study provides important insight into a critical step in the synthesis of biomass fuels and it may enable the design of better, non-precious-metal catalysts and processes for large-scale transformation of biomass into fuels and commodity chemicals. For this breakthrough, the researchers aimed for simplicity, opening up a component of the molecule to make it easier to transform. They perfected a method for the "direct-ring opening" of the furan rings (made of four carbon atoms and one oxygen atom), which are ubiquitous in biomass-derived fuel precursors. "Opening these rings into linear chains is a necessary step in the production of energy-dense fuels," stated Mr. Gordon "because these linear chains can then be reduced and deoxygenated into alkanes used in petroleum and diesel fuel. The reaction requires relatively mild conditions using the common reagent hydrochloric acid as a catalyst." The research team tested the process on several biomass-derived molecules and performed calculations to determine the selectivity and mechanism of reaction. This information is key to designing better catalysts and processes for biomass conversion.

Source: phys.org

India Solar Generation Guarantee Facility

The India Solar Generation Guarantee Facility helps India scale up its use of solar power as a major renewable energy source. It mobilizes long-term funding for solar energy development and support India's push to diversify its energy mix away from a heavy reliance on fossil fuels to lower-carbon, renewable sources. For more information, contact:

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Website: <http://www.adb.org>

Energy from the Desert: Very Large Scale PV Power-State of the Art and into the Future

This fourth volume in the established *Energy from the Desert* series examines and evaluates the potential and feasibility of very large-scale photovoltaic (VLS-PV) power generation systems, with capacities that range from several megawatts to gigawatts, and the development of practical project proposals towards implementing the VLS-PV systems in the future. It comprehensively analyses all major issues involved in such large-scale applications, based on the latest scientific and technological developments by means of close international co-operation with experts from different countries. From the perspective of the global energy situation, global warming and other environmental issues, it is apparent that VLS-PV systems could soon become economically and technologically feasible to contribute substantially to global energy needs; global environmental protection; and global socioeconomic development.

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Optical Modelling and Simulation of Thin-Film Photovoltaic Devices

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