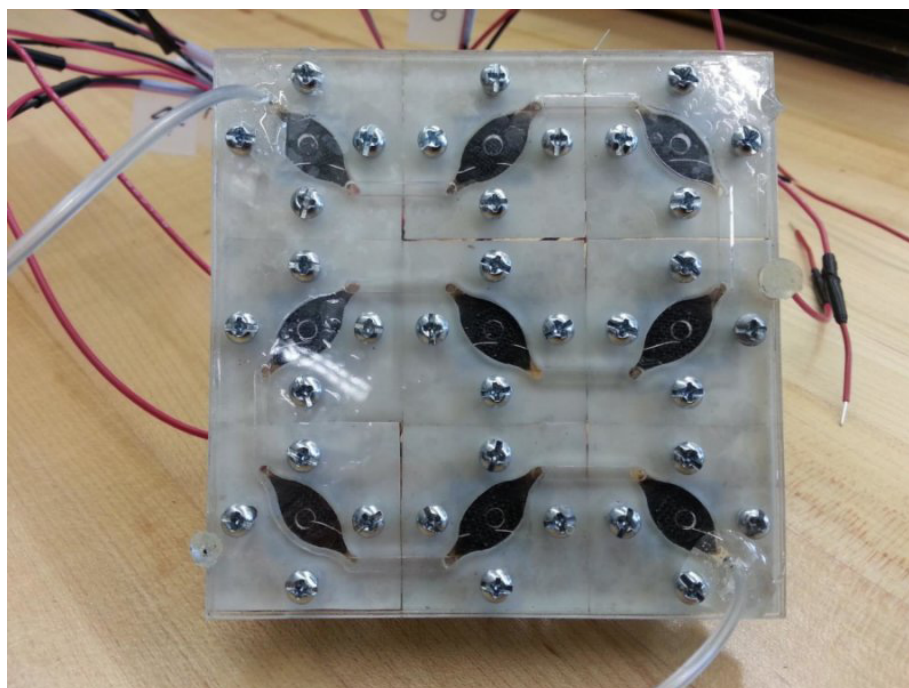




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Highlights

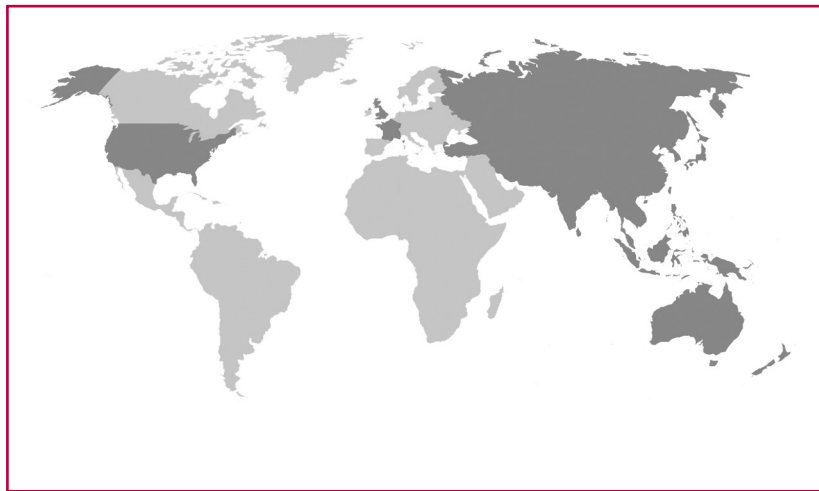
- Thin-film solar cells
- Bladeless wind energy convertor
- Device to harvest wave energy
- Carbon capture through fuel cells
- Production of ultra-pure hydrogen
- Biodiesel fuel from algae



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:

- 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

Biological-solar (bio-solar) cells connected into a bio-solar panel have been developed by researchers from Binghamton University, the United States

(Credit: Seokheun "Sean" Choi; <https://www.sciencedaily.com>)

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Feed-in tariffs to incentivize renewable energy

According to research and consulting firm GlobalData, the United Kingdom, the use of Feed-in Tariffs (FiTs) continues to be a popular form of incentive utilized to promote renewable power installations in Asia-Pacific (APAC) countries. The report states that apart from Malaysia, New Zealand, Republic of Korea and Singapore, all other countries covered in the region have FiTs for one or more renewable technologies. At the same time, net-metering, which is a recent and more advanced incentive, is popular in Japan and is gaining ground in India with a few states having introduced the same for rooftop solar installations.

“An FiT works by offering eligible energy companies contracts declaring that they will receive a fixed return on the renewable energy they provide proportional to how much it costs to produce, which encourages investment in the industry. In most APAC countries, the introduction of dedicated agencies to coordinate installations and the roll out of FiTs has led to a significant and prompt growth in the corresponding technologies,” said Harshavardhan Reddy Nagatham, at GlobalData.

India, for example, had fewer than 50 MW solar capacity in 2010, which increased to more than 1,000 MW in 2011, partly because of the introduction of FiTs. China has seen similarly impressive results through the use of FiTs, achieving the largest installed capacity of renewable energy across the APAC region and adding 10,950 MW of solar power in 2013, up from 3,500 MW in 2012.

In 2015, China added around 15,000 MW of solar PV capacity.

Source: <http://www.windpowerengineering.com>

Upgraded global atlas for renewable energy

The International Renewable Energy Agency (IRENA), UAE, has launched a new version of the Global Atlas for Renewable Energy, the online renewable energy mapping platform, which now allows users to download resource data for offline analysis, and to print and export map images. The enhancements include an online GIS interface, datasets for five renewable energy technologies that cover every country in the world, online analysis tools, and the ability to export data and maps in several different formats.

The Global Atlas provides access to more than 2,000 datasets for free, but previously users could only view this data graphically on a map, or get a numerical value for a single point. Now users can also download the raw data in selected datasets for further analysis and use. The data download feature is available in geographical blocks of 4 MB, and provides a GeoTIFF file which users can upload to their own GIS systems to conduct further analysis.

Source: <http://www.offshorewind.biz>

Micro-hydroelectric projects in Pakistan

According to a statement by Pakistan's Tehreek-e-Insaf Chairman Imran Khan, the government of Khyber Pakhtunkhwa, a province located in northwest Pakistan, has completed work on 37 micro hydroelectric projects under the country's power en-

hancement initiative. The initiative, as it relates to hydropower, seeks to construct a total of 350 micro-hydropower plants that will have a total installed capacity of 35 MW. The hydropower projects are being constructed in Abbotabad, Mansehra, Batagram, Tor Ghar, Kohistan, Malakand, Buner, Swat, Shangla, Dir (Upper/Lower) and Chitral.

The province is home to a number of large hydropower projects, including the 243-MW Warsak and 3,480-MW Tarbela plants. But, the micro-projects are planned to reduce load shedding and provide uninterrupted power supply in the province. So far, the completed projects have a totaled installed combined capacity of 2 MW. The provincial government decided to construct the community-based micro hydro stations through non-governmental organizations and the program's total estimated cost is US\$82.3 million, being funded through Pakistan's Hydel Development Funds.

Source: <http://www.hydroworld.com>

Asia projected in world energy use

According to *International Energy Outlook 2016* (IEO2016), released by the U.S. Energy Information Administration (EIA), world energy consumption is projected to increase by 48% over the next three decades, led by strong increases in the developing world – especially in Asia. Rising incomes in China, India, and other emerging Asia economies are a key driver of the global energy outlook. “Developing Asia accounts for more than half of the projected increase in global energy use through 2040,” said Adam Sieminski, at EIA. Clean energy technologies play an important role in the outlook,

with renewables expected to be the fastest-growing energy source.

IEO2016 presents updated projections for world energy markets through 2040. Outside of the United States, projections are based on current laws, regulations, and announced policies, where such indicators have historically been reliable guides. For the United States, the projections are generally based on existing laws and regulations but do not include the effects of the recently finalized Clean Power Plan (CPP) regulations. Published EIA analysis of the proposed version of the CPP shows potential significant reductions in U.S. coal consumption and increases in U.S. renewable consumption.

Source: <http://www.windpowerengineering.com>

Off grid solar lighting market

According to a new market report released by Transparency Market Research, India, the off-grid solar lighting market revenue stood at US\$908.65 Mn in 2015 and is projected to reach US\$4,542.26 Mn by 2024 at a CAGR of 17.56% from 2016 to 2024. The off-grid solar lighting market has been analyzed in terms of volume (million units) and revenue (US\$ Mn). Additionally, the market has been segmented on the basis of type (solar lantern system (SLS), solar home system (SHS), and large solar home system (LSHS)) and geography.

Decreasing cost of solar off-grid lighting products, increasing price of traditionally used kerosene oil, and rising mobile penetration in Asia Pacific and Africa are some of the major drivers of the off-grid solar lighting market. Asia Pacific

was the largest market for Off Grid Solar Lighting globally, accounting for 55.2% share in 2015. India was the leader in terms of revenue realization from Off Grid Solar Lighting, followed by Bangladesh, in 2015. Africa was the second-largest market for Off Grid Solar Lighting in 2015.

Kenya, Tanzania, Ghana, and Nigeria spearhead the Off Grid Solar Lighting market in Africa with the need for clean and reliable source of off-grid electricity. Latin America was the third-largest market for Off Grid Solar Lighting, in terms of market share, in 2015. Peru and Brazil were the leading countries with highest revenue realization from off grid solar lighting in 2015. The market in Africa is expected to witness significant growth in the near future and would surpass the growth rate of Asia Pacific market by 2019.

Source: <http://www.yourrenewablenews.com>

Off-grid solar programme in India

India's Ministry of new and Renewable Energy (MNRE) is moving forward with its off-grid solar programme, as part of the National Solar Mission (NSM), after a year of the utility-scale sector stealing the limelight. MNRE is now implementing the "Off-Grid and Decentralized Solar Applications" scheme to promote the use of solar home lights, solar street lights, power plants, solar pumps and mini and micro grids in rural areas of the country, where significant number of the population remain without access to electricity. The programme also contains an emphasis on Concentrating Solar Thermal (CST) technology.

MNRE is providing a Central financial assistance (CFA) subsidy of

30% of the system cost to promote the use of solar in these remote locations. The ministry is bringing in a "Small Wind Energy and Hybrid system (SWES)" scheme to promote the use of hybrid systems in similar locations. These would involve solar PV, aero generators and/or small wind turbines. A CFA subsidy of INR100,000/kW (US\$1,500) will be provided for community users. The ministry will also introduce biogas, and manure management programmes in rural areas.

Utility-scale solar continues to dominate the Indian solar market, with a slower than expected start to the rooftop segment and few announcements regarding off-grid applications. India's popular Rural Electrification Programme, which seeks to bring power to India's thousands of disconnected villages, has been dominated by coal-powered connections thus far. Similarly, the Solar Energy Corporation of India (SECI) is tendering for 500MW of rooftop across India, but consultancy firm Bridge to India has said this is highly ambitious because it would require an eight-fold increase in the market over just one year.

Source: <http://www.pv-tech.org>

Wind power generation to triple in China

According to research and consulting firm GlobalData, the United Kingdom, wind power installed capacity in China will increase from approximately 149 GW in 2015 to over 495 GW by 2030, representing a Compound Annual Growth Rate (CAGR) of 9%. The report states that China has the highest wind power globally by far, accounting for a third of cumulative

wind power capacity worldwide in 2015, followed by the US with 17% of the global share.

GlobalData states that the Chinese government's policies promoting wind power include the Law on Renewable Energy (2005, revised in 2009), Wind Power Technology Special Planning (2012) and the Notice on Integrating and Accommodating Wind Power (2013). Despite China's wind development achievements to date, the sector faces the key problem of its increasing inability to accommodate the rapid surge in the number of wind turbines in remote areas due to its underdeveloped electrical grid.

The Chinese government announced that it will put new wind power projects approvals on hold in 2016 in its northern provinces such as Inner Mongolia, Jilin, Heilongjiang, Gansu, Ningxia and Xinjiang, as the country is faced with grid constraints such as wind power output, system load, power source structure, regulation capability, power transmission scale and operation methods.

Source: <http://www.renewableenergyfocus.com>

Alternative fuels for commercial vehicles

BCC Research, the United States, in its new report has revealed that the region's aggressive pursuit of reducing air pollution is spurring big market growth. The global market for alternative fuels for commercial vehicles, estimated at \$52.6 billion in 2014, declined in value terms to \$39.3 billion in 2015 due to the major drop in energy prices. Based on a \$40/bbl case scenario, the market would reach \$54.3 billion in 2020. In a \$80/bbl case scenario, the market

would reach \$80 billion in 2020. In a \$120/bbl case scenario, the market would reach \$107.8 billion.

By 2020, the end year of the five-year forecast, LPG (autogas) as a fuel type segment should remain the global market leader in all three oil price scenarios. It holds a 36% alternative fuel market share in 2015 and would retain a share of 29% to 34% by 2020 despite the significant growth of the other alternative fuels. This results in an increase in the value of alternative fuels in 2020 vs. 2015 of \$1.3 billion even at \$40/bbl oil, and \$22 billion in the \$120/bbl scenario.

Compressed natural gas (CNG) as a segment fuel type, which currently holds the second-highest share at 23%, would retain its standing by 2020 in all three oil price scenarios. It is expected to hold appx. 27% share by 2020. The 27% share would occur if oil prices remain low because CNG is the most competitive fuel against diesel fuel. The 24% share would occur if oil rises to \$120/bbl because at that diesel/oil price, many of the other alternative fuels that are non-competitive at \$40/bbl become competitive with CNG.

Source: <http://www.bccresearch.com>

MoU on wind energy cooperation in Viet Nam

GE, the United States, has signed a Memorandum of Understanding (MOU) with the Ministry of Industry and Trade on developing 1,000MW of Wind energy in Viet Nam. The MOU calls for collaboration in accelerating the development of renewable energy in Viet Nam. Accordingly, the ultimate purpose of both parties is to develop a minimum of 1,000MW of new wind farms by 2025. This

represents enough energy to power the equivalent of approximately 1.8 million Vietnamese homes.

Under the agreement GE, with more than 20 years of experience operating in Viet Nam, will utilize its global wind development expertise and work with local developers to identify potential projects. Furthermore, GE will support the implementation of Viet Nam's National Target Program through local manufacturing of wind turbine equipment and components at GE's Hai Phong facility, plus collaboration with other local suppliers.

Source: <http://www.english.vietnamnet.vn>

Green energy blooms on 'solar tree'

Scientists at Central Mechanical Engineering Research Institute (CMERI), India, have developed a 'solar tree' made out of photovoltaic panels at a cost of Rs 3 lakh each. The 'tree', which will require less than 4 sq.ft. space, can power about five households. "Initiatives like this will promote usage of green and clean energy and will help the nation combat the threat of pollution," said Union science and technology minister Dr. Harshvardhan.

"It takes about 400 sqft to set up a solar panel, but we have developed it in less than 4 sq.ft. These 'solar trees', when planted on both side of the highways, hold the capacity to produce 1 lakh MW of renewable energy. Each 'tree' can power about five households," said Dr. Sibnath Maity, at CSIR-CMERI.

Source: <http://www.timesofindia.indiatimes.com>

REN21 Network

<http://www.ren21.net>

Thin-film solar cells

A team of German, Israeli, and British researchers has investigated the deposition of thin chalcopyrite layers. They were able to observe specific defects as these formed during deposition and under what conditions they self-healed using the BESSY II X-ray source at the Helmholtz Zentrum Berlin. The team conducted detailed studies of how different fabrication techniques influence the microstructure. They were able to observe the defects as these formed during deposition and under what conditions they self-healed by using in-situ X-ray diffraction and fluorescence analysis capabilities at the BESSY II X-ray source.

Vapour deposition of thin CIGSe films is a complex process. Indium, gallium, and selenium are first deposited on the substrate. The deposition of the copper and selenium atoms takes place in a second step. These atoms migrate into the In-Ga-Se layer. Tiny CIGSe crystals of chalcopyrite form there. The concentration of copper only reaches the correct value over the course of this second step. The prior copper-poor phase is characterised by numerous defects within the crystal. The defects increasingly disappear with the addition of copper and selenium.

If more copper and selenium atoms are added after reaching the "right" ratio, then these two elements no longer fit into the existing crystal matrix and deposit themselves as copper and selenium grains in and on the polycrystalline CIGSe layer. This is actually problematic, since the grains must be removed afterwards. Nevertheless, they apparently have an important function in reducing the defects to near zero, as the current work shows. The

results have been published in *Energy & Environmental Science*.

Source: <http://www.helmholtz-berlin.de>

Silicon/perovskite tandem solar cell

A team led by Henry Snaith at the University of Oxford, the United Kingdom, along with contributions by Bernd Rech and Lars Korte of the Helmholtz-Zentrum Berlin (HZB), Germany, has now shown, that an ultimate efficiency of 30% should be attainable with such tandem cells. They discovered a structurally stable perovskite composition with its band gap tuned to an optimum value of 1.75 eV. Tandem solar cells based on silicon and perovskites have raised high hopes for future high efficiency solar modules.

A tandem solar cell works by absorbing the high energy photons (visible light) in a top cell which generates a high voltage, and the lower energy photons (Infra red) in a rear cell, which generates a lower voltage. This increases the theoretical maximum efficiency by about 50% in comparison to a standalone silicon cell. To maximise efficiency, the amount of light absorbed in top cell has to precisely match the light absorbed in the rear cell. However, the band gap of ~1.6eV of the standard perovskite material is too small to fully exploit the efficiency potential of this technology.

They conceived together a tandem cell, in a configuration where the perovskite and the silicon cell are mechanically stacked and contacted separately. The HZB team contributed the silicon cell. The Oxford group did vary systematically the chemical composition of the perovskite layer, and with a precise cocktail of ions discovered a structurally stable perovskite with

its band gap tuned to an optimum value of 1.75 electron volts, maintaining a high electronic quality of the layer. At the same time, they increased the chemical and thermal stability of the material significantly.

Source: <http://www.helmholtz-berlin.de>

New method to generate electricity

Scientists from Osaka University, Japan, have used sunlight to efficiently turn seawater into hydrogen peroxide, which can then be used in fuel cells to generate electricity. According to the researchers, it is the first photocatalytic method of hydrogen peroxide (H_2O_2) production that achieves a high enough efficiency so that the H_2O_2 can be used in a fuel cell. "The most earth-abundant resource, seawater, is utilised to produce a solar fuel that is H_2O_2 ," said Shunichi Fukuzumi, from Osaka University.

The researchers developed a new photoelectrochemical cell, which is basically a solar cell that produces H_2O_2 . When sunlight illuminates the photocatalyst, it absorbs photons and uses the energy to initiate chemical reactions - seawater oxidation and the reduction of O_2 - in a way that ultimately produces H_2O_2 . After illuminating the cell for 24 hours, the concentration of H_2O_2 in the seawater reached about 48 Millimolar (mM), which greatly exceeds previous reported values of about 2 mM in pure water.

Researchers found that the negatively charged chlorine in seawater is mainly responsible for enhancing the photocatalytic activity and yielding the higher concentration. Overall, the system has a total solar-to-electricity efficiency of 0.28 per cent. Although the total efficiency compares favourably to that of some

other solar-to-electricity sources, such as switchgrass (0.2 per cent), it is still much lower than the efficiency of conventional solar cells.

Source: <http://www.indiatoday.intoday.in>

Solar efficiency record for unfocused sunlight

Researchers Martin Green and Mark Keevers at the University of New South Wales (UNSW), Australia, have utilised the light-trapping effects of a simple prism to dramatically boost the efficiency of solar cells. The device has set a world record for sunlight-to-electricity efficiency using “unfocused light” – the sort of sun that hits our roofs. The UNSW team said its mini-module converts 34.5% of received solar energy into electricity. The result, confirmed by the US National Renewable Energy Laboratory (NREL), has eclipsed the 24% efficiency achieved by an 800-square-centimetre commercial module made by Alta Devices, the United States.

Typical efficiency for commercially available solar panels is 14% to 22%. Other solar cells have obtained higher efficiencies from unfocused sunlight, but these results were achieved before being placed into prototypes or modules that could be scaled up for commercial use. “The intention is for our device to be suitable for rooftop photovoltaics, but this is a longer-term proposition. What we’ve done is a very early-stage [expensive] prototype. “Our next step is to see if we can use [the prism and] the associated spectrum-splitting to make cheaper modules that could go on the roof of your house,” said Dr. Keevers. The UNSW solar cell is designed to maximise energy squeezed out of light hitting the receiver.

Source: <http://www.smh.com.au>

Laser-based manufacturing of solar cell

A laser-based manufacturing process from the Fraunhofer Institute for Solar Energy Systems ISE (Fraunhofer ISE), Germany, is revolutionizing the photovoltaics market. For the first time point-contacted solar cells can be manufactured in series. Several million cells with significantly higher efficiency levels are already on the market. Dr. -Ing. Ralf Preu and his colleague Dr. Jan Nekarda, at the Fraunhofer ISE, have already made an important contribution to climate protection with the development of Laser-Fired Contact (LFC) technology, enabling the manufacture of more efficient solar cells at lower cost.

The LFC process developed by the Fraunhofer researchers has enabled the first industrial mass production of PERC solar cells. A very thin non-conductive layer is deposited on the underside of a PERC solar cell between the contact layer and the wafer. Acting as a mirror, this layer reflects the share of sunlight not absorbed when penetrating the wafer back into the silicon wafer. Since the front side also reflects this light back into the wafer, it is also captured in the silicon wafer and the efficiency level of the solar cell increases.

Drawing the electricity from the wafer requires many small apertures in the non-conductive layer in order to establish contact between the electrode metal and the silicon wafer. The LFC procedure creates each of these approximately 100,000 contacts per wafer with a single laser pulse. “The challenge was to coordinate the pulses in such a way that contact is completely established, while damage to the silicon is kept to

minimal levels. Here it’s crucial that the laser light effect is limited to between 50 and 2,000 nanoseconds,” explained Dr. Jan Nekarda, at the Fraunhofer ISE.

Source: <http://www.phys.org>

New solar cell

A team of researchers at Massachusetts Institute of Technology (MIT), the United States, has for the first time demonstrated a device based on a method that enables solar cells to break through a theoretically predicted ceiling on how much sunlight they can convert into electricity. The findings are reported in the journal *Nature Energy*, by doctoral student David Bierman, professors Evelyn Wang and Marin Soljačić, and four others.

Instead of dissipating unusable solar energy as heat in the solar cell, all of the energy and heat is first absorbed by an intermediate component, to temperatures that would allow that component to emit thermal radiation. By tuning the materials and configuration of these added layers, it’s possible to emit that radiation in the form of just the right wavelengths of light for the solar cell to capture.

The key is using high-tech materials called nanophotonic crystals, which can be made to emit precisely determined wavelengths of light when heated. In this test, the nanophotonic crystals are integrated into a system with vertically aligned carbon nanotubes, and operate at a high temperature of 1,000 degrees Celsius. Once heated, the nanophotonic crystals continue to emit a narrow band of wavelengths of light that precisely matches the band that an adjacent photovoltaic cell can capture and convert to an electric current.

Source: <http://www.news.mit.edu>

Bladeless wind energy convertor

Start-up company Saphon Energy, Tunisia, has taken inspiration from the sailing boats of Ancient Carthage to develop a bladeless, non-rotating wind energy convertor that is more efficient than traditional turbines as well as safer and quieter. According to the developers, the aerodynamic bowl-shaped sail on its turbine is capable of capturing twice as much wind energy over the same swept area as a conventional turbine. The designers, led by Anis Aouini, looked to the old technology of sailing boats, as well as the movements of birds and fish for their design.

The bladeless design uses a non-rotational sail-shaped body combined with a wind converter that follows a figure of eight pattern in the air. All wind turbines are subject to the Betz limit of capturing 59 percent of the energy from wind, but its developers says the Saphonian is quite capable of surpassing this limit because it is bladeless, making it far more efficient than traditional turbines. Saphon Energy says the Saphonian will be able to convert wind to energy at around 80 percent. Its lower cost could make it an attractive source of off-grid energy in developing countries.

Source: <http://www.huffingtonpost.com>

Lidar system installed on 6MW prototype

Goldwind Global, China, has installed a lidar system on its 6MW prototype offshore wind turbine at a test site in China to help certification. Developed by ZephIR Lidar, the United Kingdom, the ZephIR DM Lidar has been installed on the prototype in Jiangsu province, eastern China. It will be used to help DNV GL verify the turbine before being used in a programme

to aid lidar-assisted control. The lidar will measure the wind before it hits the turbine, allowing it to react, ensuring the turbine is at the optimum pitch and angle as early as possible.

According to ZephIR, the lidar will help Goldwind optimise the prototype turbine before it enters mass production. It measures power curves and helps to understand the effects of wind flow propagation on the turbine's performance. Goldwind's direct-drive turbine has a rotor diameter of 150 metres and is an upgrade from its 5MW turbine. The prototype has been installed for just over two years.

Source: <http://www.windpoweroffshore.com>

Wind turbine for cell towers

With the aim of helping make electricity more available in rural parts of India, a team of students at the University of Wisconsin (UW), the United States, has designed a wind turbine that could provide power to cellular phone towers. The team developed and tested a model of a cylindrical wind turbine using vertical axis helical blades, with a total "real-life" size that's about 6 feet tall and 3 feet in diameter. The blades feature a spiral shape so the impression is that of a model of a DNA molecule.

This style of machine was chosen because it's efficient in capturing the wind and because it has fewer mechanical and moving parts, meaning it should be easier to maintain than a typical wind turbine, said team leader Benjamin Kufahl. The machine is efficient in capturing the wind and converting it into electricity. But it's difficult to manufacture, so the group turned to a local prototyping facility, Midwest Prototyping in Blue

Mounds. Midwest used 3-D printing technology to print the blade.

Source: <http://www.jsonline.com>

Solar and wind energy from single device

Scientists at the Beijing Institute of Nanoenergy and Nanosystems (BINN), China, and the Georgia Institute of Technology, the United States, have developed a flat device that can harvest energy from both the sun and wind at the same time. Instead of relying on wind to spin a rotor, the device instead makes use of the triboelectric effect, the same effect behind everyday static electricity. When two different materials repeatedly touch and then separate, the surface of one material can steal electrons from the surface of the other, building up charge.

The researchers coupled a triboelectric nanogenerator with silicon-based solar cells. The triboelectric nanogenerator consists of thin sheets of plastic and Teflon separated by air. When wind blows on the hybrid device, the plastic film vibrates toward and away from the Teflon, generating triboelectricity. The device the researchers created is about 120 millimeters long and 22 mm wide, making it about as long and wide as a candy bar. However, at 4 mm deep, it is only about as thick as a windowpane. "The device could be extensively installed on the roofs of city buildings," said Ya Yang at the BINN.

In experiments, the generator could deliver up to about 8 milliwatts of solar power and up to 26 mw of power from the wind. It could charge a lithium-ion battery from 0.2 to 2.1 volts in 10 minutes, and could also power the kind of temperature and humidity sensors one might find in a smart house, the researchers say. Future research will seek to get a



Triboelectric generator that can harvest wind energy.

constant voltage of about 5 volts from the device, Yang says. The scientists have detailed their findings in the journal *ACS Nano*.

Source: <http://www.spectrum.ieee.org>

Unique turbine to generate power

Two students from the Indian Institute of Technology Kanpur (IITK), India, have developed an unconventional wind turbine to generate power for residential purposes. The aesthetically designed lightweight wind turbine model for residential buildings can be installed on the front or side walls of the building. Designed by Ashwin Gandhi and Saurabh Anand also won the first prize in the energy category at Hackathon, India. "The turbine looks like glass façade in series, waving as the wind blows. All units are connected with the Internet and can communicate with each other, which helps them prepare to accept the wind current," explained Ashwin.

The duo specifically designed the turbine for urban areas in such a way that it can tap energy to generate power even if the wind speed is less. The turbine can generate one unit of power at a wind speed of 8km per hour. A first-of-its-kind, the turbine can tap energy with the highest efficiency and also help reduce global warming. "When the wind blows through the gaps between buildings, the speed gets accelerated. This accelerated speed can then be used to tap energy by setting up the wind

turbines on the side walls of these buildings," said Ashwin.

Source: <http://www.hindustantimes.com>

Improved vertical axis wind turbine

According to a study done by Svetlana Marmutova, at University of Vaasa, Finland, a vertical axis 'Savonius' wind turbine can be further improved. Due to the mechanical modification of the rotor the power coefficient was shown to be increased by around 8 percent (2% units). The power coefficient is the ratio of the power extracted by the rotor to the available kinetic power in the air flow. The variation of the power coefficient under gusty wind conditions depends on the level of gustiness: the higher the gustiness the more stable is power coefficient.

Savonius wind rotor was invented by Finnish marine engineer Sigurd Savonius in early twenties of the last century. Initially it was proposed by Savonius to use the rotor for sailing, water pumping, ventilation and power generation using air and water as well. Nowadays Savonius wind turbine has many modifications. Among the advantages of a vertical axis Savonius wind turbine are low noise level, the ability to operate with low wind speeds and relative independence on the wind direction and simplicity of maintenance and manufacture of the turbine.

Basically the simple rotor can be obtained by cutting any cylindrically shaped object and moving the parts sideways along the cutting plane.

The proposed modification adds a plane in the center of a rotor, which decreases the pressure behind the advancing blade thus increasing the lift force. Thus, a Savonius rotor is drag and lift device.

Source: <https://www.sciencedaily.com>

A software "detective" for wind power generation

Advanced detection of wind anomalies could help prolong the lifespan of wind turbine components and reduce the cost of wind energy generation. In this context, European researchers have developed smart control software. The researchers from University of Strathclyde in Scotland developed a new anomaly detection scheme that can be a useful aid in the early detection of anomalous conditions, such as wind shear and extreme gusts. The scheme also includes the early detection of structural anomalies, such as yaw misalignments, mass or aerodynamic imbalances. Its algorithms are based on advanced mathematics. But we apply them on real data. The algorithms developed find the best possible balance between energy production and machine life. When anomalies are detected, the wind turbine controller must take appropriate diagnostic action to cope with such conditions.

The detection uses an extended Kalman filter (EKF), a statistical tool for regression analysis. The EKF filters the needed information, out of the plenitude of registered data from 39 variables. It is based on a 3D-wind model and on a turbine with three blades. Using the detected and statistically processed information, the researchers created a three-dimensional map of the wind field at the rotor field.

Source: <http://cordis.europa.eu>

Riverine energy technology

HeliosAltas Corp. (Helios), and DA Green Power Consulting (DAGPC), the United States, have announced their partnership to deploy Helios PowerWheel™ riverine energy technology in the Republic of the Philippines. Helios said the agreement during the first four years is for a minimum of US\$16.2 million. The announcement did not include specific sites at which the in-stream energy device will deploy.

According to the company, Helios PowerWheel units range in power output from 5 kW to 40 kW. The drive assembly is composed of aluminum and stainless steel in an aluminum shell, and the suspended generator wheel rises and falls with changing water levels. The device is modular technology and all of its generation components are contained within its shell. "This unique renewable technology can provide consistent baseload power at a significant cost savings to our customers," said Archimedes Flores, at DAGPC.

Units can be installed to produce power in series or parallel. "We have been working with [DAGPC] under a memorandum of understanding for over a year to analyze and understand the Philippine market," said Michael Carroll, at Helios CEO. Helios said this technology will afford some of the remote islands in the country, which have few or no reliable renewable energy power sources, the option to develop stable in-stream generated power.

Source: <http://www.hydroworld.com>

Device to harvest wave energy

Oscilla Power, the United States, has developed a new technology which directs all kinetic energy to-

wards a solid piece of metal instead of rotating the blades of an impeller. This, in turn, creates an alternating magnetic polarity in the metal which is subsequently converted into electrical current. Oscilla's technology, predominantly a solid-state implementation, may eventually prove far more durable than any previous effort. Once implemented, it is supposed to produce power from oceans cleanly and endlessly.

This specific mechanism is called Triton which remains on the ocean surface and generates power from the ever moving source of waves. The basic implementation is a giant, floating, metal plate which is connected to tethers. Tethers generate electricity when they're pushed around by waves. Each Triton implementation is expected to generate about 600kW of power which is adequate to supply energy to 500 average homes every month. It is expected that, in its full blown form, this program should cater to 1/3 of the United States' power requirement and about 15% of global need.

Source: <http://www.technologyvista.in>

Wave energy converter

SINN Power, Germany, has developed wave energy converter that can be used in coastal areas all over the world to supply people with affordable and reliable renewable electricity created from ocean waves. SINN Power founders position their product as an ecological and economical alternative to traditional diesel generators that are often much more expensive and contribute to the increase of greenhouse gas emissions. SINN Power wave energy converter gives much greater flexibility since, depending on the wave power in the location and the electricity needs of the customer, the number and the size

of wave energy converter's modules can be individually adjusted.

The SINN Power wave energy converter is built from mass-produced standard components – this not only makes wave energy converter easy to transport, install and maintain, but also allows to generate electricity at a much lower cost in remote islands and countries with less developed infrastructure. In December 2015, to test functionality and corrosion resistance of components, SINN Power successfully installed wave energy converter module in original size at the port of Heraklion in Crete (Greece). The module will be operating on the port wall by the end of 2016 since the team expects to derive further insights for the development of the floating SINN Power wave energy converter.

Source: <http://www.magazine-mn.com>

Ocean waves into electricity and fresh water

Carnegie Wave Energy (CWE), Australia, is on the brink of revolutionizing the green power movement with the latest version of its wave energy technology that harnesses electricity from the movement of the ocean. This innovative system developed by CWE is named 'CETO', after a Greek sea goddess. The latest version – CETO 6 – incorporates submerged buoys anchored to the sea floor that move up and down with the ocean swell.

This movement powers an on-board hydraulic pump, turning kinetic energy into electrical energy, which is then transferred to a facility onshore via undersea cables. In addition to electricity, the CETO system also supplies freshwater, as the energy generated can be used to both pump sea water on shore and operate a reverse osmosis desalination plant.

An earlier iteration of this technology – CETO 5 – was first successfully implemented on an island off the coast of Perth in 2014. Three buoys, each producing 250 kW, successfully operated for 13,000 cumulative hours at a depth of 5.8 m in waves over 3 m. CETO 6 sees the buoys upgraded to providing 1 MW each, as well as being capable of operating at greater depths and higher sea states.

Source: <https://www.buzzworthy.com>

Harnessing the kinetic energy of waves

According to ExxonMobil Energy Outlook, the United States, the global energy demand is expected to increase about 25% in the 2014-2040 time-frame. This is largely because of factors like population and economic growth, and rapidly depleting non-renewable resources (e.g. petroleum) aren't going to last forever. So the only way is to shift focus towards renewable energy resources. Kinetic energy holds a lot of promise, and the Wavestar offers a revolutionary way of harnessing the kinetic energy of waves and convert it into electricity.

Located in Denmark, Wavestar is a sort of hybridized machine and production facility. It's equipped with kinetic-energy harvesters called 'floats' that resemble the oars used to propel boats. The floats move up and down with the kinetic energy of the waves, and their motion is transferred via hydraulics to rotate power generators. The technology enables continuous energy production with a smooth output. It's also safe, as the floats can be lifted to a safe position in the event of a storm. The facility can be even upgraded to utilize wind and solar power, and the power stations are planned to hit the market next year.

The full-scale machine will have 20 floats with a diameter of 10 m each, thus making each power station capable of producing 6 megawatts of energy. This means that a single machine could be used to provide energy for close to 4,000 households. Our oceans are a vast source of clean energy. If we could capture just 0.1% of the oceans' tidal kinetic energy, it would be enough to satisfy the current global energy demand over five times. Innovative technologies like the Wavestar are the need of the hour, and could one day offer definitive solution to the world's energy problems.

Source: <http://www.timesofindia.indiatimes.com>

Tidal power breakthrough

A power company in Shetland has claimed a breakthrough in the race to develop viable offshore tidal stations after successfully feeding electricity to local homes. Nova Innovation said it had deployed the world's first fully operational array of tidal power turbines in the Bluemull Sound between the islands of Unst and Yell in the north of Shetland, where the North Sea meets the Atlantic. It switched on the second of five 100kW turbines due to be installed in the sound this month, sending electricity on a commercial basis into Shetland's local grid.

The islands, which are not connected yet to the UK grid, get most of their electricity from a diesel-fuelled power station which is supplied by tankers, despite having some of the world's strongest and most reliable wind, wave and tidal resources.

Nova Innovation said the two turbines installed so far were operating at 40% of their installed capacity. The company hopes its turbines, which were cofunded by the Belgian

renewables company ELSA, will be sold worldwide now they have been commercially proven. "We are absolutely delighted to be the first company in the world to deploy a fully operational tidal array," said Simon Forrest, the firm's managing director.

Source: <https://www.theguardian.com>

Turbine for tidal farm unveiled

A 200-tonne turbine for the MeyGen tidal stream project, the world's first large-scale tidal energy farm, has been unveiled in Scotland before its dispatch to the Pentland Firth. The 15m tall and 16m in diameter 1.5 MW turbine is the first of the four originally proposed for the project developed by Edinburgh-based Atlantis Resources. The developer thinks up to 269 turbines could eventually be installed in the Pentland Firth between Caithness and Orkney, which would deliver 398 MW of power – enough to supply 175,000 homes with clean electricity.

"MeyGen is set to invigorate the marine renewables industry in Scotland and provide vital jobs for a skilled workforce, retaining valuable offshore expertise here in Scotland that would otherwise be lost overseas," said Nicola Sturgeon, the First Minister of Scotland, during the unveiling ceremony at the Nigg Energy Park outside Inverness in the Scottish Highlands. "There is no doubt that the eyes of the world are on this project which is why the Scottish government's investment is so crucially important. Yet it is absolutely vital that the UK government honours its earlier commitment to provide a ring-fenced allocation for marine energy in its renewables support scheme." Atlantis Resources has received £23m in Scottish government funding towards the project.

Source: <http://eandt.theiet.org>

Carbon capture through fuel cells

FuelCell Energy (FCE), the United States, one of the largest suppliers of fuel cells worldwide, and ExxonMobil, the United States, has entered in a partnership on May 5 to explore the possibilities for using fuel cells for carbon capture. Normally in FCE's carbonate fuel cells, methane is reformed in the cell anode to create carbon dioxide (CO₂) and hydrogen (H₂), which is then used to generate electricity by combining with oxygen from ambient air to create an electric current and exhaust streams of water vapor and CO₂.

The carbon-capture fuel cell will still be powered by methane, but by using flue gas instead of ambient air, the chemical reactions in the cell can concentrate up to 90% of the incoming CO₂, which flows with the CO₂ generated in the reforming process into the normal exhaust stream, where it can easily be separated from the water vapor. A critical difference – and bonus – in this process is that rather than being a parasitic drain on the plant, it actually generates additional power. According to FCE, the power output is larger than the parasitic drain from conventional carbon-capture technologies.

Source: <http://www.powermag.com>

Efficient and eco-friendly batteries

According to researchers from Indian Institute of Technology- Kanpur (IIT-K), a common mineral often mistaken for gold ore, has found new worth as raw material for a new type of eco-friendly and efficient storage battery. The mineral, also called iron pyrite, crystallizes from iron and sulphur deposits. The researchers say that batteries

made from iron pyrite nanocrystals are lightweight and portable, allowing it to be used in rural settings as well as for strategic applications. "In its present laboratory prototype, the battery powers solid-state electronic devices and electric motors," said Mainak Das, at IIT-Kanpur.

To assemble the prototype battery, the IIT-K team, supported by the Solid State Physics Laboratory, Indian Institute of Engineering Science and Technology (IIST), West Bengal, used graphite sheets as current collectors, nano iron pyrite coated with poly aniline as the electrode, and a non-corrosive, bio-compatible electrolyte gel.

Source: <http://www.scidev.net>

Technique to improve efficacy of fuel cells

Researchers from the Harvard John A. Paulson School of Engineering and Applied Sciences (SEAS), the United States, have found a way to harness the quantum behavior of these fuel cells to make them even more efficient and robust. In doing so, they've observed a new type of phase transition in an oxide material. Shriram Ramathan, at SEAS, and his graduate student You Zhou discovered that by designing the electrolyte on the quantum level, they could create a material that becomes more robust when exposed to fuel.

Ramanathan and his team used a perovskite-structured nickelate as their electrolyte. On its own, the nickelate conducts both electrons and ions, like protons, making it a pretty lousy electrolyte. But the team coated the surface of the nickelate with a catalyst and then injected or "doped" it with electrons. These electrons joined the electron shell of the nickel ion and transitioned the material from

an electron conductor to an ion conductor.

Source: <https://www.seas.harvard.edu>

New fuel cell technology

According to a research done through collaboration between the CSIRO, Australia, and Hanyang University, Republic of Korea, a newly-developed fuel cell technology looks to the cactus to solve a problem involving this promising but complex form of clean energy, which generates power without emitting planet-warming greenhouse gases. The technology, which is a thin plastic membrane, could help improve the performance of fuel cells to make them more useful for everything from electric cars to desalination plants.

"The new membrane aims to help keep fuel cells cool, solving a significant problem for the development of green technology. The problem the membrane is aimed at solving concerns a particular type of fuel cell, known as proton-exchange membrane fuel cells. Such fuel cells generate energy by mixing gases like hydrogen and oxygen," said Aaron Thornton, at CSIRO.

But this adds weight and more complexity to the fuel cell. The new plastic membrane can solve this problem by holding water and acting in a similar way to a cactus. The new membrane performs in much the same way, using two plastic, or polymer, skins. The internal skin, which actively draws in and holds water, is coated by a layer that repels water but also has tiny nano-cracks. It then closes back up in low-humidity environments to retain the water. This feature allows the performance of the fuel cell to be increased up to fourfold.

Source: <http://www.mashable.com>

Breakthrough for hydrogen fuel

Scientists at the nanoscience institute CRANN, Ireland, have discovered a new cheap way to make hydrogen which could revolutionise how we fuel the cars of the future. Researchers say the discovery could herald a new era in the adoption of hydrogen as a fuel in energy-efficient transportation. The CRANN team has developed a material which enhances the splitting of water at a very low energy cost using earth abundant raw materials. Prof Mike Lyons, principal investigator at CRANN, said hydrogen is a credible and clean alternative to petrol.

"Hydrogen can be generated at the forecourt, it can be pumped just like petrol and, between fills, you can perhaps go 400 to 500 miles. So it really is a credible alternative to petrol," said Lyons. According to Prof. Lyons, this new method of extracting hydrogen from water was a "significant breakthrough" in the move towards clean energy. This means that the cost of producing hydrogen via water electrolysis will be significantly reduced, which will result in a more rapid uptake of hydrogen as an automotive fuel. The research has been published in the journal *ACS Catalysis*.

Source: <http://www.irishexaminer.com>

Production of ultra-pure hydrogen

According to Dr. Hyungwoong Ahn, at Edinburgh University, the United Kingdom, a new method for increasing the yield of ultra-pure hydrogen from cheaper feedstocks such as coal and biomass could help to bring costs down. Reactors that use coal or biomass to produce hydrogen have previously been unable to match the high yields possible with natural gas. But the new

method, developed alongside researchers at Yonsei University, Republic of Korea, can improve their yield, while also capturing carbon emissions. The researchers found that the tail-gas can be split into three streams and used to improve the hydrogen yield from the reactor.

One stream can be used as a supplementary fuel for a carbon capture unit, to remove carbon dioxide from the synthetic gas stream. A second stream of the gas can then be recycled to the reactors to improve the hydrogen yield by converting more carbon to hydrogen. Finally, the third stream can be used as a fuel for drying the coal or biomass, rather than using clean synthetic gas. The researchers have found that the process could improve the hydrogen yield of solid reactors by 2 per cent, above that expected from simply adding a carbon capture unit.

Source: <https://www.theengineer.co.uk>

Harvesting hydrogen with iridium oxide

A recent study conducted by a team of researchers at the U.S. Department of Energy's (DOE's) Argonne National Laboratory, has described a new empirical inter-atomic potential that models the IrO₂ properties important to catalytic activity at scales relevant to technology development. Also known as a force field, the interatomic potential is a set of values describing the relationship between structure and energy in a system based on its configuration in space. The team developed their new force field based on the MS-Q force field.

Until now, researchers have relied on the quantum mechanical modeling method based on density functional theory (DFT) to investigate the electronic structure of IrO₂ on the atomic scale. However, DFT is a

computationally intensive method, and while it enables some calculations of electronic behavior, DFT simulations are only capable of handling a small number of atoms. DFT models cannot scale to sizes relevant to nanotechnology components, typically 1 to 5 nanometers, at which structural and long-range behavior can influence performance.

To create a computational framework that can help engineer IrO₂ structures for powerful and efficient material technologies, researchers first needed to simulate a system of realistic size. In the past, computational and materials scientists have turned to the empirical force field over DFT for larger structures. By modeling with a typical empirical force field, researchers can readily calculate a larger system but without the electronic properties modeled in DFT.

Source: <http://www.anl.gov>

New generator can halve cost of hydrogen

Start-up company H₂ Energy Renaissance, the United States, has built a hydrogen generator that's inexpensive to manufacture and produces on-demand affordable hydrogen. According to the company, this technology shall reduce the costs of electricity and fuel transport at least by 50%. The company claims its H₂ Energy Renaissance hydrogen generator can produce the gas for 50 cents to \$1 per kilogram.

The generator uses tap water, aluminum and a small amount of electricity – from 50 to 150 watts. The electricity can come from a small solar panel, a mini wind turbine, a wall socket or a self-charging battery similar to those used in cars. The aluminum and chemical catalyst can be changed every

few days to every few months, depending on the generator's size, the company said. Large amounts of hydrogen are produced by using hydroelectric shock applied to plates of aluminum placed in water.

The hydroelectric reaction burns at a temperature hotter than the sun and creates a pressure of more than 100,000 atmospheres at a micro level. The hydroelectric shock, or electrohydraulic reaction, eats away at the aluminum plates destroying the oxide film on them, which decomposes water molecules releasing the hydrogen. The hydrogen gas is then cooled and has a purity of 97%. The generator runs at 150 degrees Fahrenheit.

Source: <http://www.computerworld.com>

Bike that runs on hydrogen

Students of Automobile Engineering Department of RVS School of Engineering and Technology, India, have designed a bike that runs on hydrogen. For one litre hydrogen, the bike runs 148 km. A team of students consisting R. Balaji, Gowthem Raj, Jerry George and Kalid Ibrahim, has designed a bike that addressed global warming and high-level air pollution. "Today, the world needs eco-friendly alternative fuel to operate vehicles. We have analysed the scope of hydrogen as supplementary fuel in a four-stroke bike," said the team members. The total cost of the vehicle is just Rs. 7,000. No modification in engine is needed to convert it into an eco-friendly one.

Their project guide P. Lakshmanan was instrumental in converting their thought into action. With a simple technology, all existing vehicles can be modified to run on hydrogen. The cost of hydrogen as fuel is very cheap when compare to other

fuels. Hydrogen gas costs just Rs. 30 per litre. The life of the engine is increased manifold as this dry gas does not leave behind any residue during combustion. Above all, it restricts tuning of the engine when compared to other fuel engines. This project has opened an avenue for further research in developing a new technique required to run the vehicle continuously without maintenance.

Source: <http://www.thehindu.com>

Clean and cheap hydrogen fuel cells

In 2008 researchers from Monash University, Australia, using only manganese, sunlight, and 1.2 volts were able to split water into hydrogen and oxygen. Up until then, most of the hydrogen collected for fuel cells came from oil and coal, the irony being that burned hydrogen produces no carbon dioxide (CO₂). Hydrogen can be produced via means of wind-mills and electrolysis, but these methods are incredibly expensive, tempting no one to trade in their vehicles anytime soon.

The method of hydrogen production at Monash University consisted of a Nafion-coated anode to form a polymer membrane. This membrane is incredibly thin and hosts clusters of manganese. The 1.2 volts transforms (oxidizes) manganese-II to manganese-IV. Manganese-IV is often found in nature in the form of "birnessite." The sunlight is then used to convert the manganese-IV back to manganese-II. This switching from back and forth produces protons, electrons, and oxygen gas. The gas is released, causing the remaining protons and electrons to form hydrogen gas.

Source: <http://www.rollresearch.com>

More efficient method of producing hydrogen

Inspired by the way plants convert sunlight into energy, scientists at the Ulsan National Institute of Science and Technology in the Republic of Korea have developed a new type of photoelectrode that boosts the ability of solar water-splitting to produce hydrogen, an essential process in the development of hydrogen as a fuel source. The special photoelectrode is capable of absorbing a high percentage of visible light from the sun and then using it to split water molecules into hydrogen and oxygen. The multilayered photoelectrode has a two-dimensional hybrid metal-dielectric structure that consists of three layers: gold film, ultrathin TiO₂ (titanium dioxide), and gold nanoparticles. According to the team's study published last month in *Nano Energy*, this structure shows high light absorption, which in turn significantly enhances its photocatalytic applications.

In contrast to preexisting designs, according to Professor Jeong Min Baik, one of the project's leaders, "this is the first time to use the metal-dielectric hybrid-structured film with TiO₂ for oxygen production." This particular structure incorporates plasmonic metal nanoparticles (i.e. the gold nanoparticles) to enhance photoactivity in almost the entire visible region of the solar spectrum (95% according to their report, which is in turn about 40% of full sunlight). Plasmonic nanoparticles are particles whose electron density can couple with electromagnetic radiation of wavelengths that are far larger than the particle, unlike a pure metal where there is a maximum limit on what size wavelength can be effectively coupled.

Source: <https://energyvulture.com>

Microbes for bio-fuel production

A new research done at the University of California in Los Angeles (UCLA), the United States, has led to a new discovery of getting the microbes to produce fuel from the proteins instead of utilizing the protein for its own growth. The focus of the experiment was to induce the microbes under the study to produce a specific kind of proteins rather than what they otherwise might be inclined to produce. This special protein can be refined in to biofuel. The findings have published in the journal *Nature Biotechnology*.

The task is to make the microbes produce only this kind of protein rather than utilizing it for their own growth and growth related activities as they otherwise do. This kind of biofuel production is different from the traditional behavior of microbes where they use the protein only for growth. This is like tricking the microbes to deviate from that and produce fats or material that can be converted to biofuel. "We have to completely redirect the protein utilization system, which is one of the most highly-regulated systems in the cell," said lead researcher, Yi-xin Huo, at UCLA.

By this process, they are letting the cells to retain the nitrogen and take out just the ammonia. Once done with the biofuel production, the residue is a better kind of fertilizer thanks to the low nitrogen levels. This in turn will lessen any greenhouse emissions that happen during the fertilizer production. The new process will reprocess the nitrogen back and will help in maintaining a nitrogen neutral state and less harmful emissions during fertilizer production.

Source: <http://www.alternative-energy-news.info>

Biodiesel fuel from algae

A recent study done by Ben Wen, lead researcher of United Environment and Energy LLC, the United States, throws interesting light on the first economical, eco-friendly process to transform algae oil into biodiesel fuel. "This is the first economical way to produce biodiesel from algae oil. It costs much less than conventional processes because you would need a much smaller factory, there are no water disposal costs, and the process is considerably faster," said Wen.

Processing cost is a great hurdle for manufacturing biodiesel from algae. But researchers claim that their pioneer method is at least forty percent cheaper than the current manufacturing processes. We already have necessary infrastructure for supply of biodiesel fuel. Amount of algae is also not a problem. We have abundance of algae growing in the major water bodies of the world, be it ocean, lakes or rivers. The research team calls this method "continuously flowing fixed-bed."

According to the team members, this process will not produce wastewater which causes pollution. Wen also explained that algae has an "oil-per-acre production rate 100-300 times the amount of soybeans, and offers the highest yield feedstock for biodiesel and the most promising source for mass biodiesel production to replace transportation fuel in the United States."

Source: <http://www.alternative-energy-news.info>

Fuel from chicken feathers

Scientists in University of Nevada, the United States, have created a new and environmentally friendly

process for developing biodiesel fuel from 'chicken feather meal'. Professor Manoranjan 'Mano' Misra and his team members at the University of Nevada discovered that chicken feather meal consists of processed chicken feathers, blood, and innards. Chicken feather meal is processed at high temperatures with steam. This feather meal is used as animal feed and also as fertilizer.

Chicken feather meal has high percentage of protein and nitrogen. The researchers have paid attention to the 12% fat content of the chicken feather meal. They have arrived at the conclusion that feather meal has potential as an alternative, non-food feedstock for the production of biofuel. They have extracted fat from chicken feather meal using boiling water and processing it into biodiesel. Another advantage of extracting fat from feather meal is it provides both a higher-grade animal feed and a better nitrogen source for fertilizer applications.

Source: <http://www.alternative-energy-news.info>

Biofuel from agricultural waste

Scientists at Agricultural Research Service (ARS), the United States, have advanced a process to produce crude liquid fuel called "bio-oil" from agricultural waste. The bio-oil is produced by a process called "pyrolysis," which involves chemical decomposition of plant and other organic matter at very high heat without oxygen. This new technology for producing renewable fuels is called "tail-gas reactive pyrolysis" or TGRP. The TGRP method might be considered a new generation of pyrolysis because it holds promise for processing and improving bio-oil as an intermediate product toward finished biofuel.

Formed from organic compounds subjected to intense heat and pressure over time, natural petroleum is removed from beneath sedimentary rock. Crude petroleum is treated in established refineries to produce gasoline and other products. The TGRP method provides use of new refining techniques that are similar to those currently being used at these petroleum refineries. TGRP is an important step toward the ultimate goal of producing cleaner bio-oils that can be distilled at petroleum refineries versus building new, specialized refineries.

Raw material called “biomass” is the basis for producing biofuel. The raw biomass material includes non-food-grade plant matter procured from agricultural or even household waste residue, including wood, switchgrass, and animal manure. A new high-output mobile processing unit can produce bio-oils from these materials at an accelerated rate. This is significant, because instead of shipping large amounts of agricultural waste to a refinery at high cost, the mobile unit converts the biomass into energy-dense bio-oil right on the farm.

Source: <http://www.blogs.usda.gov>

Advanced biofuels

Researchers at the U.S. Department of Energy’s Lawrence Berkeley National Laboratory (Berkeley Lab) have engineered a strain of bacteria that enables a “one-pot” method for producing advanced biofuels from a slurry of pre-treated plant material. The *Escherichia coli* (*E. coli*) is able to tolerate the liquid salt used to break apart plant biomass into sugary polymers. Because the salt solvent, known as ionic liquids, interferes with later stages in biofuels production, it needs to be removed before proceeding, a process that takes time and money.

The basic steps of biofuel production start with deconstructing, or taking apart, the cellulose, hemicellulose and lignin that are bound together in the complex plant structure. Enzymes are then added to release the sugars from that gooey mixture of cellulose and hemicellulose, a step called saccharification. Bacteria can then take that sugar and churn out the desired biofuel. The multiple steps are all done in separate pots.

Researchers at Joint BioEnergy Institute (JBEI), the United States, pioneered the use of ionic liquids, salts that are liquid at room temperature, to tackle the deconstruction of plant material because of the efficiency with which the solvent works. But what makes ionic liquids great for deconstruction also makes it harmful for the downstream enzymes and bacteria used in biofuel production.

Source: <http://www.newscenter.lbl.gov>

New technique to make biodiesel production

Scientists from National University of Mexico (UNAM), Mexico, have developed a new process which makes biodiesel production cheaper and much more efficient. UNAM researchers conducted the experiment together with researchers from the University of Newcastle, the United Kingdom. The new technique uses microalgae developed in wastewater to create biodiesel. Microalgae retain large amounts of carbohydrates, lipids and proteins that are suitable for energy production without a biomass limit or transformation.

The researchers made use of a sample of mixed microalgae namely *Chlorella*, *Scenedesmus* and *Demosdesmus* – all native

to the Lake of Texcoco. “We want to avoid changing the natural environment of microalgae and not introduce genetically modified species. Depending on the biofuel will be the fraction of the microalgae nutrient we use. In our case we use fats, we extract them and transform them into biodiesel, meaning we improve the properties of lipids, its viscosity to use as a liquid fuel,” said Dr. Sharon Velazquez, from University of Newcastle.

The researchers emphasized the use of microalgae which grows in less than 24 hours in comparison to corn or palm oil that take several weeks to grow. Microalgae are also easy to transform into biofuel – the researchers demonstrated the transformation procedure in just about three hours. This will enable daily harvesting of microalgae and daily production of biodiesel.

Source: <https://www.worldindustrialreporter.com>

Global Energy Efficiency and Renewable Energy Fund

GEEREF is an innovative Fund-of-Funds catalyzing private sector capital into clean energy projects in developing countries and economies in transition. GEEREF invests public and private sector risk capital in specialist renewable energy and energy efficiency private equity funds developing small and medium-sized projects in emerging markets. GEEREF’s funds invest in emerging markets with appropriate regulatory frameworks for clean energy, where high quality renewable energy resources and steadily reducing technology costs create compelling investment opportunities.

For more information, access: <http://geeref.com>

Asia Pacific Renewable Energy Policy Handbook 2016

This handbook offers comprehensive information on major policies governing renewable energy markets in the region. The report covers fifteen key countries in the region, providing the current and future renewable energy targets and plans along with the present policy framework, giving a fair idea of overall growth potential of the renewable energy industry in each of the countries.

The report also provides major technology specific policies and incentives provided in the each country.

Contact: Research and Markets. Tel: +1-917-300-0470; Fax: +353-1-481-1716; E-mail: press@researchandmarkets.com

Capacity Needs Assessment for Renewable Energy Statistics

This publication presents a structured methodology that countries can use to assess their capacity to produce renewable energy statistics. It describes seven main requirements for effective data collection, highlighting some of the challenges often faced by countries in each area and suggesting improvements that can be made.

It also presents three simple tools that can be used by countries to identify current data flows and assess their capacities in each of these areas.

Boosting Biofuels: Sustainable Paths to Greater Energy Security

This report examines sustainable paths for biofuel development. These include: Boosting yields of food crops and residues; Freeing up farmland through yield improvements; Reducing losses and waste in the food chain; and Freeing up pastureland through better livestock management.

For the above two publications, contact: IRENA Headquarters, Masdar City, PO Box 236, Abu Dhabi, U.A.E. Tel: +971-2-417-9000; E-mail: statistics@irena.org

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Intersolar India

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19-21 Oct
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Int'l Exhibition on Power Generation and Transmission, Energy and Renewable Energy

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Tel: +1-646-416-7902, Fax: +1-646-365-8625
E-mail: contact@powerbangladesh.com
Web: <http://www.powerbangladesh.com>

31 Oct-02 Nov
Tokyo, Japan

15th World Wind Energy Conference and Exhibition (WWEC)

Contact: Arakawa Lab., Faculty of Engineering, The University of Tokyo, Hongo 7-3-1, Bunkyo-ku Tokyo 113-8656, Japan
E-mail: contact@wwec2016tokyo.com
Web: <http://www.wwindea.org>

2017

7-9 Jul
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Contact: Tomorrow People Organization
Dusana Vukasovica 73, 11000 Belgrade, Serbia
Tel/Fax: +381-6268-0683
E-mail: contact@tomorrowpeople.org
Web: <http://www.tomorrowpeople.org>

26-27 Jul
Kuala Lumpur, Malaysia

Renewable Energy Project Financing Forum

Contact: Anastasia Tupikova
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