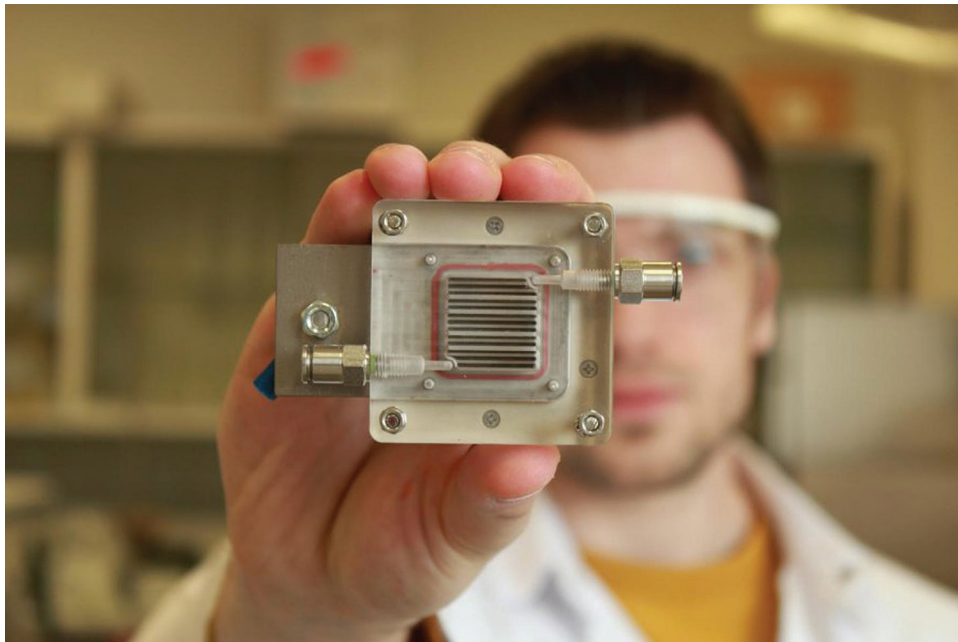


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## Highlights

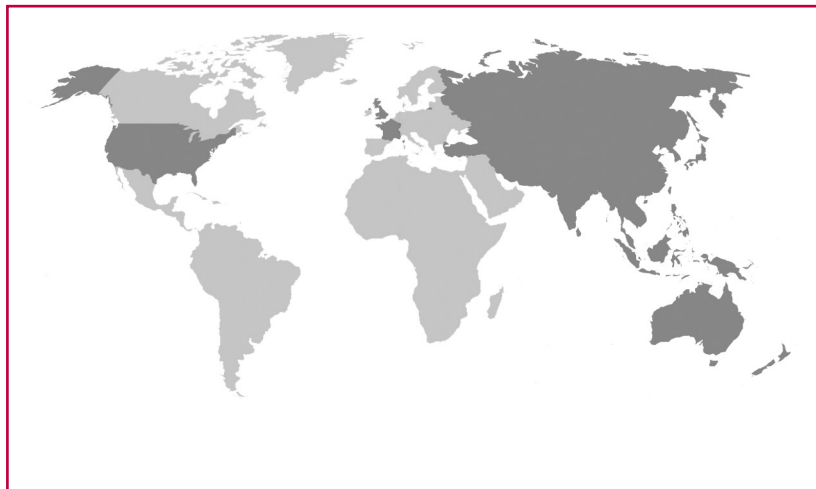
- Solar panel cleaning robot
- Bio-inspired wind turbines
- Wave energy convertor prototype
- Solar microbial fuel cell
- Researchers develop solar paint
- Biofuel for conventional diesel engines



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**

Researchers from the University of Antwerp and University of Leuven (KU Leuven), Belgium, have developed a device that purifies air and generates power

*(Credit: University of Antwerp and KU Leuven, Belgium)*

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## VATIS\* Update

### New and Renewable Energy

is published 4 times a year to keep the readers up to date of most of the relevant and latest technological developments and events in the field of New and Renewable Energy. The Update is tailored to policy-makers, industries and technology transfer intermediaries.

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This publication has been issued without formal editing

\* Value Added Technology  
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### National mission on cleaner coal in India

At the 2<sup>nd</sup> Mission Innovation Ministerial and 8th Clean Energy Ministerial held in China: India has announced mounting a National Mission on advanced ultra super-critical technologies for cleaner coal utilisation at a total cost of US \$ 238 million and setting up of two Centres of Excellence on Clean Coal Technologies at US \$5 million each. In its quest for cleaner fuels, a National Mission on methanol and di-methyl ether is being mounted. A new centre on solar photovoltaic, thermal storage and solar fuels research has been approved ~ US \$ 5 million.

Funding opportunities have been announced in the area of energy storage, clean coal, wastewater treatment amounting to US \$ 10 million. India also announced two MI-centric Funding Opportunities in Smart Grid and Off grid Access at US \$ 5 million each. Joint virtual Clean Energy Centre with UK and Indian Government funding of UK £ 5 million each has been initiated. Under the Indo-US Joint Clean Energy Research (PACE-R) the new collaborative public private programme (PPP) on Smart Grids & Energy Storage has been approved.

*Source: <http://www.dst.gov.in>*

### Marine energy services in Asia

Orcades Marine Management Consultants Ltd. (OMMC), the United Kingdom, Aquatera Ltd., the United Kingdom, and Ocean-Pixel (OP), Singapore, have formed Orcades Marine Asia Pte Ltd. to provide marine energy services in Asia. According to OMMC, Orcades Marine Asia will provide operational management of marine renewable energy installa-

tions, including tidal, wave, floating solar and offshore wind.

The firm will also engage in research and development projects aimed at developing innovative and cost-efficient deployment solutions for the Asian marine renewables sector. The collaborating team of Orcades Marine Asia has successfully installed operating tidal turbines in West Papua, Indonesia and Sentosa. "We've worked on projects in Asia now for a number of years and have an excellent relationship with OceanPixel and other key specialists in the region," said David Thomson, at OMMC.

Aquatera is developing marine energy business ties in Asia and OP is a 2-year-old company seeking to further its energy-related services. In April 2016, Aquatera entered into a partnership with the Nagasaki Marine Industry Cluster Promotion Association in an effort to help Japan bolster its marine energy sector through international collaboration. OP is a Singapore start-up spun off at Nanyang Technological University, incorporated in September 2014.

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

### Waste-to-energy project in China

Everbright Greentech, China, has announced that its construction is complete on the Lingbi integrated biomass and waste-to-energy project, with the site commencing commercial operation. The Lingbi urban-rural integration project is the first of its kind in China to have had its biomass treatment and waste-to-energy facilities constructed all at once. A total of RMB 250 million (€32 million) has been invested on the waste-to-energy component of the project.

The plant has a designed total household waste processing ca-

capacity of 400 tonnes, while its gas emissions fully comply with the Euro 2010 Standard. The total investment on the biomass component of the project will amount to RMB 320 million (€41 million), achieving a combined annual agricultural waste and straw processing capacity of 300,000 tonnes. It is equipped with a 130 tonnes/hour (t/h) furnace and 30mw turbine power generator. The project is expected to generate approximately 210 million kwh of electricity annually

*Source: <http://www.bioenergy-news.com>*

### India's renewable energy capacity increased

According to a latest data provided by the Ministry of New and Renewable Energy (MNRE), government of India, and analyzed by Mercom Capital Group, the United States, show a steady growth in renewable energy installations in India, which as of April 2017 account for 17.5% of the total energy source. Namely, the country's overall installed capacity has reached 329.4 GW, with renewables accounting for 57.472 GW.

This constitutes a significant increase on the data released by the MNRE in February, when the figure stood at around 50 GW. In India's renewables mix, solar took the share of 21.8% with 12.5 GW as the second largest after dominant wind power, which accounted for 56.2% with as much as 32.3 GW. However, solar is unparalleled in terms of the pace of installation growth. In April 2017, it reached 3.8% of total installed capacity up from 2.23% in April 2016.

The surge in installment comes on the wings of the rapidly falling solar tariffs, including the current record low of INR 2.44 (\$ 0.037)/kWh

accepted in the 500 MW Bhadla Phase-III Solar Park auction, successfully putting thermal behind solar on costs. Although the country's state utility National Thermal Power Corporation has showed itself to be the principle supporter of the government's green energy agenda.

Source: <https://www.pv-magazine.com>

## Renewable energy project in Sri Lanka

Sri Lanka's Cabinet of Ministers has given a go ahead to the development of a hybrid renewable energy project in Punarin, which includes 240 megawatts (MW) of wind and 800 MW of solar. The move is in line with the Sri Lankan government's plans to significantly expand renewable energy sources' share of the nation's power mix. The Sri Lanka Sustainable Energy Authority (SLSEA) has identified the northern regions of the country as a suitable location to construct wind and solar power plants.

Under the proposal, the construction of the hybrid energy park will be built in 3-phases spanning two years. The government recently unveiled its policy to add a considerable amount of electricity to the national grid through renewable energy sources. Ceylon Electricity Board has set a target to increase electricity produced by renewables from the 10% generated today, to 17% by the end of 2019. In March, the Cabinet announced the nation will issue an international tender to set up a 100 MW floating solar plant on the Maduru Oya Reservoir.

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

## Solar electricity in Afghanistan

The Afghanistan High Economic Council meeting has approved a plan to invest in producing electric-

ity from solar energy in the southern province. The project is part of a package of 100 megawatts (MW) electricity from renewable energy, which the government announced in 2016, asking private sector to invest in. They include 65 MW from solar, 14 MW from wind, 13.5 MW from biomass, 7.5 MW from hydropower.

The government announced that seven companies have expressed interest to invest in the projects which totally number 30 in 20 provinces, of which two companies were deemed eligible.

Power supply in Afghanistan is largely reliant on imports and only a third of Afghanistan's population is connected to power. However, the government is seeking to produce power domestically.

Source: <http://www.1tvnews.af>

## FIT and net metering scheme in Viet Nam

Viet Nam's government has released the Decision No. 11/2017/QĐ-TTg on supporting the development of solar power. The new regulation, which introduced a Feed-in Tariff (FIT) scheme for solar plants and a net metering mechanism for residential PV, came into force on Jun. 1, 2017 and expired on Jun. 30, 2019.

Under the new scheme, owners of grid-connected PV power plants were granted a 20-year FIT of 2,086 (\$0.091)/kWh excluding VAT. This rate, however, was subject to change based on the VND/\$ exchange rate. The power generated by all grid-connected PV installations will be sold to local power utility Electricity Viet Nam (EVN).

Furthermore, solar power producers were also exempted from paying taxes on importing goods for their fixed assets. However for net metering, Viet Nam's Ministry of

Trade and Industry will be in-charge of annually issuing the related buying and selling prices for rooftop grid-connected PV systems based on the VND/\$ exchange rate.

Source: <https://www.pv-magazine.com>

## Renewable energy in Kazakhstan

The European Bank for Reconstruction and Development (EBRD) Board of Directors has approved a financing framework of up to €200 million which will be used to finance primarily private renewable energy projects in Kazakhstan with a total generating capacity of 300 MW within the next five years.

Such projects can be in wind or solar power, small hydro plants or biogas. The construction of generating capacity will be allocated €160 million, while €40 million will be allotted to electricity grid modernisation, which is necessary in order to integrate these renewable projects into the national transmission system.

Significant co-financing for the same projects will be considered by the Clean Technology Fund, the Green Climate Fund and other international financial institutions and commercial financiers. Once all the projects come on-stream, annual CO<sub>2</sub> emissions are expected to reduce by about 600,000 tonnes, which would help the country to achieve its commitments to cut emissions under the Paris climate agreement.

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

## Cambodia's solar power development

The Asian Development Bank (ADB) has agreed to lend €9.2 to Sunseap Group, Singapore, for the building of a 10 MW solar facility in



Cambodia. The financing package, which was provided by ADB's Private Sector Operations Department (PSOD), includes co-financing from a private sector financial institution through ADB's B Loan program and a concessional loan from the Canadian Climate Fund for the Private Sector in Asia (CFPS).

The project, which will be Cambodia's first large-scale PV power plant, will be located in a special economic zone in the Svay Rieng province, near the Viet Nam border. Sunseap's local unit Sunseap (Asset) Cambodia Co. Ltd., has already secured a 20-year PPA for the project from local state-owned utility Electricité Du Cambodge (EDC). A consortium led by the Singapore-based company was selected to build the plant last year through a tender.

According to ADB, the project is expected to come online in August 2017. Cambodia has seen a very limited development of solar energy to date. The United Nations Development Programme (UNDP) in Cambodia is currently seeking consultants for De-risking Renewable Energy Investment (DREI) analysis and report for Solar PV in the country. According to UNDP, several issues remain barriers in up-scaling solar technologies in the country.

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

## ADB rolls out renewables package

The Asian Development Bank (ADB) has announced a \$200 million finance package for the support and deployment of renewable energy projects in the 11 smallest island nations of the Pacific. The Pacific Renewable Energy Investment Facility will steer funds to the Cook Islands, Micronesia, Kiribati, Nauru, Palau, the Republic of Marshall Islands, Samoa, the

Solomon Islands, Tonga, Tuvalu and Vanuatu.

Each of these small Pacific states faces its own set of energy generation, climate change and economic problems, and thus the ADB believes that the potential \$200 million package is money well spent. This is the first such facility devised by the ADB in the Pacific, and will target the transformation of shifting some nations' energy source from primarily diesel-based systems to renewable sources, such as solar and wind.

On top of the cumulative \$200 million the ADB will provide, the bank is also looking to source additional co-financing partners for support. With investors on board, ADB will be able to free up valuable resources that can more quickly process and approve small-value projects, helping to deliver lower transaction costs. The first three projects will be deployed in the Cook Islands, Tonga and Vanuatu, and will cover solar power, wind, hydro and grid rehabilitation.

Source: <https://www.pv-magazine.com>

## Iran offers tax incentives to renewables

International and domestic private companies in the renewable energy industry will be eligible for tax holidays for 5-13 years as part of incentives to prop up investment in the nascent renewable sector, a deputy economy minister said. Mohammad Khazai, who also is head of the Organization for Investment, Economic and Technical Assistance, told ILNA that the 20-year guaranteed power output purchase by the government from the private companies is a major incentive to boost investments in renewables. Depending on the region that investors choose to set up renewable plants, they will be

granted between five and 13 years of tax exemption, he said. "Equipment imported to be used in the renewable sector are also duty-free if their quality and efficiency comply with the standards of the Ministry of Industry," Khazai noted.

Energy Minister Hamid Chitchian recently said that investors in renewable projects who incorporate domestically-made equipment will be allowed to sell their electricity at rates that are 30% higher than normal tariffs. Khazai recalled that one of the administration's main policies is to reduce dependence on fossil fuels and move toward clean and environmentally-friendly fuels as well as renewable energy. A delegation visited Germany last week to discuss prospects for renewable collaboration.

Khazai underlined that over the past four years, 48 renewable projects, worth \$3.6 billion, have been ratified by the government. Some projects have gone on stream and the rest are in the development phase. Data show that power production from renewables has experienced a three-fold rise since mid-2013. "According to the sixth five year economic development plan (2017-22), 1% of the annual national budget must be allocated for incentives to encourage renewable investments," he said. Representatives of 195 countries including Iran negotiated a historic agreement in Paris last December to curb global emissions of greenhouse gases and limit the planet's warming to under 2°C, preferably 1.5°C, by 2100.

Iran has pledged to increase the share of renewables in its power mix to 7,500 MW by 2030. According to government data, installed power production capacity of renewables, including solar and wind, is approximately 240 MW, which accounts for just 0.3% of the country's total electricity generation capacity.

Source: <https://financialtribune.com>

## Solar panel cleaning robot

In a joint project between research organization SINTEF, Norway, and ProDSP Technology, Hungary, a robot performs cleaning without the use of chemicals or any unwanted discharges for the environment. In order to determine how much the contamination occludes sunlight, the scientists are now focused on studying different types of dirt, as not much earlier research was carried out into the matter.

“The degree to which dust particles and contamination affect solar cells is very location-dependent. We’ve seen that some dust particles absorb light while others reflect it, and small particles reflect more light than larger ones, whereas some scale contamination is biological and acts as a kind of ‘sun factor’”, explained Birgit Rynning, solar cell researcher. However, all types of dirt need to be removed for the solar cell to be able to work at its best.

Therefore, the researchers have developed a cleaning system that deals with all known types of contamination in a fast, sensitive and environmentally friendly way. “Cleaning is part of standard operational procedures at our solar energy farms, where equipment is cleaned at least once or twice a year on order to avoid soiling. This involves the removal of everything from sand to bird droppings”, said Caroline Sissener, at Scatec Solar, Norway.

Source: <https://www.pv-magazine.com>

## High efficiency solar cell design

Researchers at Kobe University, Japan, have designed a solar cell

that is a hundred times more effective at preventing energy loss than previous methods. Researchers designed a solar cell design that can raise the energy conversion efficiency to over 50 percent by absorbing the spectral components of longer wavelengths that are usually lost during transmission through the cell. Solar cells convert the sun’s energy into electricity by converting photons into electrons.

In theory, 30 percent energy-conversion efficiency is the upper limit for traditional single-junction solar cells, as most of the solar energy that strikes the cell passes through without being absorbed, or becomes heat energy instead. Experiments have been taking place around the world to create various solar cell designs that can lift these limitations on conversion efficiency and reduce the loss of energy.

The current world record is at 46 percent for a four-junction solar cell. If the energy-conversion efficiency of solar cells surpasses 50 percent, it would have a big impact on the cost of producing electricity. In order to reduce these large energy losses and raise efficiency, researchers developed a new solar cell structure for generating photocurrents. They used two small photons from the energy transmitted through a single-junction solar cell containing a hetero-interface formed from semiconductors with different bandgaps.

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

## Low-cost solar cells

Researchers at the Indian Institute of Technology (IIT), Roorkee, have found that a pigment found in jamun (*Syzygium cumini*) absorbs

large amounts of sunlight. In brief, researchers used naturally occurring pigment as an inexpensive photosensitizer. In their paper, the authors Nipun Sawhney, Anubhav Raghav and Soumitra Satapathii wrote, “Dye sensitized solar cells (DSSCs) were fabricated with four naturally occurring anthocyanin dyes extracted from naturally found fruits/juices.”

The team turned to jamun, plum, black currant, and berries as sensitizers. Anthocyanins are naturally occurring biodegradable and non-toxic molecules that are extracted using techniques that involve negligible low cost to the environment and therefore can provide eco-friendly alternatives to synthetic dyes for DSSC production. Acidified ethanol was used for the extraction of anthocyanin. The highest power conversion efficiencies were achieved for the DSSCs fabricated using anthocyanin extracts of blackcurrant and mixed berry juice.

According to the research, “Uncertainty over the pace at which new large dams or nuclear plants can be built means strong reliance on solar power – an area where India has high potential and equally high ambition – to deliver on the country’s pledge to build up a 40 per cent share of non-fossil fuel capacity in the power sector by 2030.” In brief, solar power is viewed as an important alternative in a goal to reduce dependence on fossil fuels.

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

## Next generation of solar cells

Researchers at University of Michigan (U-M), the United States, have developed a new semiconductor alloy that can capture the

near-infrared light located on the leading edge of the visible light spectrum. Easier to manufacture and at least 25 percent less costly than previous formulations, it's believed to be the world's most cost-effective material that can capture near-infrared light – and is compatible with the gallium arsenide semiconductors often used in concentrator photovoltaics.

This could be a major step forward for a new generation of solar cells called “concentrator photovoltaics”. Concentrator photovoltaics gather and focus sunlight onto small, high-efficiency solar cells made of gallium arsenide or germanium semiconductors. They're on track to achieve efficiency rates of over 50 percent, while conventional flat-panel silicon solar cells top out in the mid-20s. Researchers devised a novel approach for keeping tabs on the many variables in the process.

They combined on-the-ground measurement methods including X-ray diffraction done at U-M and ion beam analysis done at Los Alamos National Laboratory with custom-built computer modeling. Using this method, they discovered that a slightly different type of arsenic molecule would pair more effectively with the bismuth. They were able to tweak the amount of nitrogen and bismuth in the mix, enabling them to eliminate an additional manufacturing step that previous formulas required.

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

### Sand-resistant solar glass

Nutrition and material sciences company DSM, the Netherlands, has developed a new sand-resistant coating for glass for solar

panels. The company, which was already active in the production of anti-reflective coating for solar modules, claims its new sand-resistant coating material has a combination of anti-soiling and anti-reflective properties that makes it particularly indicated for solar panels installed in dry, desert-like regions.

The new technology is currently being tested at a solar facility located near Dunhuang, in the Gobi desert in northwest China. Middle East and North Africa are considered by the company as the main potential markets for its new technology. “Our new Solar Technology Lab in the Netherlands is where these innovations take place and where we constantly look for solutions to increase the efficiency of solar modules,” said Jan Grimberg, at DSM.

DSM operates an anti-reflective coating production plant in Sittard-Geleen, the Netherlands. The company's new manufacturing facility at the site began production in April 2013. In November 2014, the company opened an international research center for innovative materials at the same facility. The completion of the center was part of a €100 million investment in knowledge and innovation in the Netherlands that DSM announced in May 2012.

Source: <https://www.pv-magazine.com>

### Floating solar plant

Sungrow, China, a supplier of PV inverter systems, has built a floating solar power plant in China. The 40MW plant is now afloat in water four to 10 meters deep, and successfully linked to Huainan, China's grid. The placement was chosen in large

part because the area was previously the location of coal mining operations; and, as a result, the water there is now mineralized and mostly useless.

The lake itself was only formed after years of mining operations, the surrounding land collapsed and created a cavity that was filled with rainwater. Floating solar plants are advantageous because they put otherwise useless water and land to good use, and the water naturally cools the system and the ambient temperatures, improving generation and limiting long-term damage from heat.

They also avoid taking up space in densely populated regions, which is especially an issue in China; the country is currently home to more than 100 cities with populations of at least one million people each. Finally, the floating PV arrays, customized to work efficiently despite higher levels of humidity, prevent the evaporation of fresh water.

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

### Renewable Energy Statistics 2017

The *Renewable Energy Statistics 2017* yearbook of International Renewable Energy Agency (IRENA) shows data sets on renewable power-generation capacity for 2007-2016, renewable power generation for 2007-2015 and renewable energy balances for about 100 countries and areas for 2014 and 2015. Further, it features statistics on investments in renewable energy from 18 major multi-lateral, bilateral and national development financial institutions, presented for the period 2009-2015.

For more information, access: <http://www.irena.org>



## Bio-inspired wind turbines

Scientists at Sorbonne University, France, and École Nationale Supérieure des Arts et Métiers-ParisTech, France, have developed flexible wind turbine blades much like insect wings. The researchers constructed prototypes with regular hard turbine blades, slightly flexible turbine blades, and very flexible turbine blades. The last design turned out to be too floppy, but the slightly flexible blades outperformed the rigid ones, offering as much as 35 percent more power.

They also continued to work in lower wind conditions and weren't as susceptible to damage in high winds. But the scientists' work isn't yet done, they now need to search for the right material that's "flexible, but not too flexible," according to lead author Vincent Cognet. "The fluid mechanics and the physics make absolute sense. There's no reason why we cannot make morphing blades that will adapt to wind conditions," said Asfaw Beyene, at San Diego State University, the United States.

Source: <http://inhabitat.com>

## Offshore wind turbine

MHI Vestas, Denmark, specializes in making offshore wind turbines has installed a new wind turbine capable of producing 9.5 megawatts (MW) of electricity on its own – enough to power more than 8,000 homes in the United Kingdom. Its V164-9.5 is an upgrade to the V164, which can produce 8 MW of electricity. The only changes needed were to install a redesigned gearbox and a new cooling system.

The V164's three blades are each about 80 meters long, which is about the length of a soccer field. Each blade weighs about 35,000

kilograms. When they rotate, they cover an area that's more than 10 baseball fields. Typically, such large turbines are only used offshore, where it's easier to install them without a backlash from nearby residents, who have been known to complain about noise and ungainly views.

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

## Giant kites for generating wind energy

Kite Power Systems, the United Kingdom, have developed a smart technology for obtaining power from the wind with the aid of custom-built giant kites that fly in pairs, hundreds of feet up in the sky, with their movements powering a generator on the ground. "The KPS system has two hybrid kites that are flown as high as 1,500 feet," said David Ainsworth, at Kite Power Systems. The big advantage over traditional wind turbines is the lower cost in terms of the Levelized Cost of Energy (LCoE).

According to Ainsworth, Kite Power Systems' technology can reduce the capex of conventional offshore turbines by as much as 50 percent, due to the fact that the system doesn't require large quantities of steel or specialist installation vessels. Thus far, the technology has been successfully trialed and tested in the United Kingdom. A 40kW system is currently being tested at an airfield in Scotland, while a larger 500kW system is also in the works.

The company aims to achieve commercialization within the next 3-5 years. "Before we consider venturing into overseas markets, we first intend to develop a kite farm in Scotland – but rest assured we have our eye on the U.S. market and indeed other countries around

the world. Given that our system can be deployed in onshore and offshore locations, we see fantastic opportunities in the U.S. for kite power," said Ainsworth.

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

## Vortex generator produces more power

Edgewind, the United States, a company with roots in aerospace has formulated a material and shaped it to provide vortex generation and leading edge protection in one package. Edgewind's tough proprietary material, just 0.014-in. thick, sports a serrated edge for the vortex generator. Recent tests by the U.S. National Renewable Energy Laboratory (NREL) revealed that when coupled with an elastomeric tab on the blade's trailing edge, the turbine's performance improved 22%.

Most vortex generators (VGs) appear as small tabs fastened perpendicular to a blade surface. Reports are that these "conventional" VGs improve production at best 2.5%, which is a significant figure. "The conformal vortex generator, or CVG, and tab offers the potential for operators to significantly increase their wind farm production and ROI without adding additional turbines or capital investment," said Peter Ireland, at Edgewind. The work needs minimal surface prep, a visual alignment, and no special tools.

Also, an easy removal facilitates section repairs or replacement. The CART2 blades, a zero twist, high-speed design, do not represent a current commercial turbine blade design. However, its general power curve does have a shape similar to commercial MW-scale turbines. Tests collected five-minute average power and wind-speed data, which was filtered to remove noise from unstable wind.

Data for the baseline was limited at wind speeds over 15 m/s. An increased area under the curve indicates increased power production.

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

### Wind turbine variants

Vestas, Denmark, have introduced the fourth generation of the platform since its launch in 2010 and takes the platform's turbine portfolio to eight turbines, including the three new variants: V117-4.0/4.2 MW, V136-4.0/4.2 MW, and V150-4.0/4.2 MW. With its introduction, the V150-4.0/4.2 MW offers the largest rotor in its class and becomes the highest yielding onshore turbine in low wind.

The upgraded platform and its versatility is the result of Vestas' industry-leading investments in research and development and unparalleled scale and global reach, enabling Vestas to develop turbines for wind sites all across the globe. By offering customization beyond classic wind regime classification, the 4-MW platform sets new standards for onshore wind performance within regimes ranging from very strong wind and typhoon conditions to low wind.

Combining the industry's tallest tower of 166 meters with the evolutionary development of a thoroughly understood platform, the V150-4.0/4.2 MW offers 20+ percent more AEP in low wind, while lowering the maximum sound level down to 104.9 dBA. The V136-4.0/4.2 MW raises the bar in medium wind conditions through increased AEP, while achieving leading sound power levels in its class with 103.9 dBA.

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

### Self-healing wind turbine blades

Mechanical engineers from the University of Wisconsin-Milwaukee (UWM), the United States, have developed a new self-healing blade system that mimics the human circulatory system. The self-healing system, developed by UWM mechanical engineering professor Ryoichi Amano and his colleagues, has passed proof-of-concept tests, but still needs improvements before it can hit the market.

"The idea was to mold flat material samples, test them by bending, and see if the material could heal itself," said Arun Kumar Koralagundi Matt, a UWM graduate student. Engineers first made samples with several layers of plain-weave fiberglass like that used in many wind-turbine blades. They mixed Grubbs' catalyst, commonly used in synthetic organic chemistry, with an epoxy resin, and evenly dispersed it throughout the fiberglass.

The researchers then filled ultrathin borosilicate glass capillary tubes as long as a fingernail with a liquid "healing agent" that causes the epoxy to harden when the two come into contact in the presence of Grubb's catalyst. They then laid the tubes lengthwise in different layers and sections of the fiberglass, depending on the test. The researchers then used a universal flexing machine and standard tensile tests to gauge the strain, stress, and other properties of the material.

Source: <https://www.asme.org>

### Nature inspired wind turbine

The Aeroleaf is a micro wind turbine developed by NewWind, France, to capture urban winds, accumulate watts and produce kilowatts. The choice of a vertical

axis generator brings the benefits of silence and a compact design shaped like a leaf. The Aeroleaf is sensitive to all types of wind, turbulent or laminar, which allows a self-starting process at very low wind speed. The advantage of the Aeroleaf is its ability to reach significant power from small winds.

In addition, for each wind speed there is a corresponding optimum Aeroleaf rotation speed that provides the maximum power generation. To leverage on each available Watt, NewWind developed an electronic card with a micro-processor that keeps each Aeroleaf autonomous and drives the Aeroleaf rotation to its optimum speed for its own wind exposure.

Finally, a centrifugal brake helps to protect the components from excessive wear and tear at high wind speed, thus allowing a life span of 15 years. Jérôme Michaud-Larivière has been working towards an innovative solution inspired by nature with a goal to generate electricity to be directly used by the nearby connected infrastructures or services. On-site production and consumption, combined with an esthetical and natural design will allow for the development of better cities.

Energy harvesting in the urban environment is crucial as most of the worldwide population is living in cities. Focusing on the wind energy that poetically moves leaves in the parks, Jérôme Michaud-Larivière is interested in understanding the turbulences and potential of urban winds. A difficult and unstable energy that is both abundant and readily accessible to all. By its peaceful and elegant tree-shape, the WindTree revolutionises the concept of the wind turbine by hiding all the technology within the leaves and tree structure.

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

## Wave energy device

Ocean Power Technologies (OPT), the United States, has announced that its PB3 commercial PowerBuoy is meeting all of its performance requirements after eight weeks of deployment off Japan. The PB3 wave device was deployed in April 2017 off Kozu-Island for a six month period as part of previously agreed lease with Mitsui Engineering and Shipbuilding (MES).

OPT has also informed that the commercial PB3 Power Take-Off (PTO) accelerated life testing, which is conducted at the OPT's headquarters in New Jersey, reached over 67 million strokes that simulates over 4 years of ocean operation. OPT's PB3 PowerBuoy harvests the energy of the waves, and can act as both power and communication platform for remote offshore applications.

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

## Wave energy convertor prototype

Conventional hydropower product and service provider Wartsila, Finland, has announced that it will support the development of the latest WaveRoller marine hydrokinetic (MHK) wave energy convertor prototype with a series of sub-assemblies. Wartsila-supplied components will include metallic bearing housings, composite bearings, lip seals and hydraulic couplings. Wartsila will also provide the necessary installation services for the sub-assemblies.

AW-Energy, Finland, has developed the patented WaveRoller technology and has been operating three 100-kW test units off the coast near Peniche, Portugal, since 2012. In July 2016, the European Investment Bank announced

it would invest up to €10 million (US\$11.2 million) in AW-Energy to develop a 350-kW WaveRoller unit. As MHK development continues throughout the world, established conventional hydropower product and service providers have opportunity to use or adapt for use their existing technology.

According to AW-Energy, WaveRollers use an oscillating plate bolted to the sea floor. The fiber-glass/steel plate moves back and forth as waves roll in. Hydraulic piston pumps transfer fluid inside a closed circuit into a hydraulic motor that drives an electricity generator, creating an energy output between 500 and 1,000 kW per panel, depending on the intensity of the waves. The energy output is then transmitted via cable to an onshore power grid connection.

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

## Tidal turbine installed

Tidtec, Norway, has completed installation of its tidal turbine in the test rig at the Technical University of Munich, Germany. The turbine will be now tested to show performance data. The performance data from the lab tests will verify the overall efficiency for these types of turbines. In addition to increase in efficiency, the Tidtec solution is 35% lighter and has a reduced number of moving parts. The cost saving on this system compared to the Kaplan bulb are expected to be in the range of 6-9%.

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

## Wave and tidal measurement buoys

Researchers at the National Wind Technology Center at the National Renewable Energy Laboratory

(NREL), the United States, recently deployed two sets of buoys off the shores of Oregon and Maine, each equipped with a variety of high-accuracy sensors that can detect wave and tidal movement. Data from these devices will be used to improve marine and hydrokinetic (MHK) devices.

"We're characterizing the resource at a level of detail that has not been done at these sites," said Project Manager Levi Kilcher. Both buoys are designed to take similar measurements useful for developing future, energy-producing MHK devices – but with different applications. The Maine buoys are designed to assess tidal resources, whereas the Oregon buoys will obtain wave energy measurements in shallow water.

Data from these buoys will be used to quantify the accuracy of various wave and tidal models, and in turn, reduce risks for developers. These buoys allow researchers to "better understand the limitations and errors in existing global wave models," said Kilcher. The data produced in Oregon and Maine assist in prioritizing wave energy efforts, creating a cohesive development process, and reducing risks in tidal and ocean energy development.

Source: <https://www.nrel.gov>

### ADB Clean Energy Program

The Clean Energy Program of Asian Development Bank (ADB) seeks to increase energy efficiency and the adoption of low carbon technologies, and to improve access to energy for the poor and remote households in the Asia-Pacific.

For more information, access: <https://aric.adb.org>



## Solar microbial fuel cell

The U.S. Naval Research Laboratory (NRL), Center for Biomolecular Science and Engineering (CBSE), has received a U.S. patent for a self-assembling, self-repairing, and self-contained microbial photo-electrochemical solar cell driven entirely by sunlight and microorganisms. A solar microbial fuel cell (SMFC) is a non-semiconductor-based system, which employs microorganisms to generate electric power by photosynthetically replenishing reactants of a sealed microbial fuel cell using sunlight.

The SMFC reactants (glucose and oxygen) are internally regenerated by a group of photosynthetic microbes whose reactants, carbon dioxide (CO<sub>2</sub>) and water (H<sub>2</sub>O), are the products of the microbial fuel cell. This interdependency results in many thousands of hours of long-term electricity generation from sunlight without replenishment of the microbial fuel cell reactants. "Natural photosynthetic systems, such as trees and algae blooms, self-repair, a property that makes them highly durable," said Dr. Lenny Tender, at CBSE.

The BMFC generates electrical power by oxidizing organic matter (fuel) residing in sediment pore water with oxygen (oxidant) in overlying water, and consists of an anode imbedded in the marine sediment connected by an external electrical circuit to a cathode positioned in overlying water. Unlike the open marine-based BMFC generator, the SMFC apparatus does not require an endless flux of reactants from sediment and seawater to persistently generate power, but instead, recycles the organic matter sealed within the unit to regenerate the reactants.

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

## Multifunctional catalyst for hydrogen fuel cells

A collaboration led by Kyushu University, Japan, has recently developed a catalyst that can oxidize both hydrogen and carbon monoxide depending on the pH of the reaction system. The catalyst mimics the behavior of two enzymes: hydrogenase in acidic media (pH 4-7) and carbon monoxide dehydrogenase in basic media (pH 7-10). The catalyst is a water-soluble complex containing nickel and iridium metal atoms with a unique "butterfly" structure.

The researchers investigated the ability of their catalyst to oxidize hydrogen and carbon monoxide in a 1:1 mixture. Importantly, they were able to isolate various intermediates in the oxidation processes to confirm the mechanisms of hydrogen and carbon monoxide oxidation by the catalyst. "We found that the catalyst reacted with hydrogen to form a hydride complex under acidic conditions," said Professor Seiji, at Kyushu University.

The team then investigated the resistance of their catalyst to poisoning by carbon monoxide in a prototype fuel cell using feed gases of hydrogen, carbon monoxide, and a 1:1 mixture of the two. The power density of the fuel cell containing the catalyst depended on the system pH and feed gas composition. Oxidation of hydrogen by the catalyst was facilitated at low pH (acidic conditions) and oxidation of carbon monoxide was faster at high pH (basic conditions); these trends correspond well with the behavior observed for the related enzymes.

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

## Solar light based fuel cell

Researchers Takehiko Kitamori and Yuriy Pihosh and their col-

leagues at The University of Tokyo, Japan, have designed a photocatalytic microgenerator of hydrogen fuel, combined with a micro fuel cell, all set up on a microfluidic chip. This microfluidic power generator is based on sunlight and can provide continuously power supply to other miniaturized devices at room temperature and at atmospheric pressure.

The scientists describe their microfluidics power device as a modular system set on a glass platform with the two modules, the photocatalytic micro fuel generator and the micro fuel cell, being connected by a set of micro- and nanochannels. Both microfluidic modules contain a set of "extended nanochannels" for proton exchange – the authors argue that these ENC's provide an excellent proton conductance and allow much faster proton travel than the conventional Nafion proton exchange membranes.

The photoanode, namely, the photocatalyst for water splitting, is also innovative: it consists of especially designed metal-oxide nanorods that photocatalyze the production of hydrogen with "record efficiency," as the authors have demonstrated. Both gases, oxygen and hydrogen produced by water splitting, are then separately transported through the microchannels to the micro fuel cell, where oxygen, electrons, and protons electrochemically combine to water, providing the energy.

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

## Flexible fuel cell

Researchers at the Korea Institute of Science and Technology (KIST) have demonstrated the super-lightweight and flexible fuel cell stacks. According to KIST, the fuel cell is gaining attention as the next-generation environment-friendly energy



source, as it uses hydrogen and air to create electricity without making pollutant by-products. The technologies are expected to be widely used in the wearable device industry.

Flexibility is the catchphrase in the IT industry, as the market for wearable devices – such as smart watches or bands – is growing rapidly across the world. Tech titans including Samsung and Apple are also launching state-of-the-art wearable devices in a bid to build their own internet of things (IoT) ecosystem. The new development is raising expectations that fuel cells can replace lithium-ion batteries, which are most commonly used in wearable devices.

Scientists have tried to make flexible lithium-ion batteries, but have failed. For this reason, there have been growing calls for a new energy source that can be flexible, according to KIST. “The fuel cell comes with a lot of advantages compared with other energy sources in such areas as eco-friendliness and energy storage efficiency,” said Yoo Seong-jong, at KIST. In particular, the scientist expects the drone industry to benefit from the new technologies.

Source: <http://www.koreatimes.co.kr>

### New catalyst for hydrogen fuel cells

Researchers from the University of New South Wales (UNSW), Australia, have developed a new way to make hydrogen fuel cells more affordable. The researchers have developed a method of creating fuel cell catalysts, comprised of iron, nickel, and copper. These catalysts are free of the expensive materials they are usually made of. The researchers believe that the new catalysts could lead to more efficient hydrogen fuel production and help make fuel cell systems more attractive.

According to researchers, the new catalyst is not only less expensive than its predecessors, but it is also capable of generating hydrogen fuel more efficiently. They believe that their new catalyst could help resolve some of the infrastructure challenges that face fuel cells currently. Because the catalyst uses no rare earth materials, it can be adopted by a wide range of industries, especially those that are beginning to use fuel cells to generate electrical power. The auto industry is such a sector.

Most of the world’s leading automakers are developing vehicles equipped with fuel cells and these vehicles need infrastructure support in order to be successful. The new catalyst could help establish an affordable hydrogen fuel infrastructure. More research must be carried out before the catalyst can be considered ready for commercialization. Researchers plan to continue carrying out tests of their catalyst in order to determine if it can be made more efficient and if costs can be reduced even further.

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

### Microbial fuel cell

An international team of researchers has taken the first step in converting methane directly to electricity using bacteria, in a way that could be done near the drilling sites. “Currently, we have to ship methane via pipelines,” said Thomas K. Wood, holder of the biotechnology endowed chair and professor of chemical engineering, Penn State. “When you ship methane, you release a greenhouse gas. We can’t eliminate all the leakage, but we could cut it in half if we didn’t ship it via pipe long distances.”

The researchers’ goal is to use microbial fuel cells to convert methane

into electricity near the wellheads, eliminating long-distance transport. That goal is still far in the future, but they now have created a bacteria-powered fuel cell that can convert the methane into small amounts of electricity.

The researchers created a consortium of bacteria that produces electricity because each bacterium does its portion of the job. Using synthetic biological approaches, including DNA cloning, the researchers created a bacterium like those in the depths of the Black Sea, but one they can grow in the laboratory. This bacterium uses methane and produces acetate, electrons and the energy enzyme that grabs electrons. The researchers also added a mixture of bacteria found in sludge from an anaerobic digester — the last step in waste treatment. This sludge contains bacteria that produce compounds that can transport electrons to an electrode, but these bacteria needed to be acclimated to methane to survive in the fuel cell. They report the results of their work today (May 17) in *Nature Communications*.

Once electrons reach an electrode, the flow of electrons produces electricity. To increase the amount of electricity produced, the researchers used a naturally occurring bacterial genus — *Geobacter*, which consumes the acetate created by the synthetic bacteria that captures methane to produce electrons.

To show that an electron shuttle was necessary, the researchers ran the fuel cell with only the synthetic bacteria and *Geobacter*. The fuel cell produced no electricity. They added humic acids — a non-living electron shuttle — and the fuel cells worked. Bacteria from the sludge are better shuttles than humic acids because they are self-sustaining. The researchers have filed provisional patents on this process.

Source: <http://news.psu.edu>

## Researchers develop solar paint

Researchers from RMIT University, Australia, have developed a solar paint that can absorb water vapour and split it to generate hydrogen – the cleanest source of energy. The paint contains a newly developed compound that acts like silica gel, which is used in sachets to absorb moisture and keep food, medicines and electronics fresh and dry. But unlike silica gel, the new material, synthetic molybdenum-sulphide, also acts as a semiconductor and catalyses the splitting of water atoms into hydrogen and oxygen.

“We found that mixing the compound with titanium oxide particles leads to a sunlight-absorbing paint that produces hydrogen fuel from solar energy and moist air. Titanium oxide is the white pigment that is already commonly used in wall paint, meaning that the simple addition of the new material can convert a brick wall into energy harvesting and fuel production real estate,” said Lead researcher Dr. Torben Daeneke.

“Our new development has a big range of advantages. There’s no need for clean or filtered water to feed the system. Any place that has water vapour in the air, even remote areas far from water, can produce fuel,” added Dr. Daeneke. This system can also be used in very dry but hot climates near oceans. The sea water is evaporated by the hot sunlight and the vapour can then be absorbed to produce fuel.

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

## Solar material for producing hydrogen fuel

Researchers from Osaka University, Japan, have created new

material based on gold and black phosphorus to produce clean hydrogen fuel using the full spectrum of sunlight. The three-part composites of this material maximize both absorbing light and its efficiency for water splitting. The core is a traditional semiconductor, lanthanum titanium oxide (LTO). The LTO surface is partly coated with tiny specks of gold, known as nanoparticles.

Finally, the gold-covered LTO is mixed with ultrathin sheets of the element black phosphorus (BP), which acts as a light absorber. “BP is a wonderful material for solar applications, because we can tune the frequency of light just by varying its thickness, from ultrathin to bulk. This allows our new material to absorb visible and even near infrared light, which we could never achieve with LTO alone,” said the team leader Tetsuro Majima.

By absorbing this broad sweep of energy, BP is stimulated to release electrons, which are then conducted to the gold nanoparticles coating the LTO. Gold nanoparticles also absorb visible light, causing some of its own electrons to be jolted out. The free electrons in both BP and gold nanoparticles are then transferred into the LTO semiconductor, where they act as an electric current for water splitting.

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

## Researchers develop new photocatalyst

A group of researchers led by Takashi Tachikawa from Kobe University, Japan, and Tetsuro Majima from Osaka University, Japan, has developed a photocatalyst that can make hydrogen production ten times more efficient. In their study, researchers described a photocatalyst that increases the production of hydrogen tenfold. When light is

applied to photocatalysts, electrons and holes are produced on the surface of the catalyst, and hydrogen is obtained when these electrons reduce the hydrogen ions in water.

However, in traditional photocatalysts the holes that are produced at the same time as the electrons mostly recombine on the surface of the catalyst and disappear, making it difficult to increase conversion efficiency. Instead, Tachikawa’s research group developed a photocatalyst made of mesocrystal, a type of crystal that lacks the uniformity of regular crystals. This new photocatalyst is able to spatially separate the electrons and electron holes to prevent them recombining.

As a result, it has a far more efficient conversion rate for producing hydrogen than conventional nanoparticulate photocatalysts. By first using titanium oxide ( $\text{TiO}_2$ ), they were able to synthesize mesocrystal strontium titanate ( $\text{SrTiO}_3$ ) using a simple one-step hydrothermal reaction. By lengthening the reaction time, they could also grow larger particles near the surface while preserving their crystalline structure. When they attached a co-catalyst to the synthesized mesocrystal and applied ultraviolet light in water, the reaction occurred with approximately 7% light energy conversion efficiency.

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

## New catalyst for carbon neutral fuel

Scientists from University of Adelaide, Australia, in collaboration with CSIRO, Australia, have paved the way for carbon neutral fuel with the development of a new efficient catalyst that converts carbon dioxide ( $\text{CO}_2$ ) from the air into

synthetic natural gas in a 'clean' process using solar energy. The research could make viable a process that has enormous potential to replace fossil fuels and continue to use existing carbon-based fuel technologies without increasing atmospheric CO<sub>2</sub>.

The catalyst the researchers have developed effectively drives the process of combining CO<sub>2</sub> with hydrogen to produce methane (the main component of the fossil fuel natural gas) and water. Currently, natural gas is one of the main fuels used for industrial activities. "Capturing carbon from the air and utilising it for industrial processes is one strategy for controlling CO<sub>2</sub> emissions and reducing the need for fossil fuels," said PhD candidate Renata Lippi, at University of Adelaide.

Research has shown that the hydrogen can be produced efficiently with solar energy. But combining the hydrogen with CO<sub>2</sub> to produce methane is a safer option than using hydrogen directly as an energy source and allows the use of existing natural gas infrastructure. The main sticking point, however, is the catalyst – a compound needed to drive the reaction because CO<sub>2</sub> is usually a very inert or unreactive chemical. The catalyst was synthesised using porous crystals called metal-organic frameworks which allow precise spatial control of the chemical elements.

Source: <https://www.adelaide.edu.au>

### Efficient steam electrolysis module

Sunfire GmbH, Germany, has delivered the world's most efficient steam electrolysis module (SOEC) in the context of the Horizon 2020 project 'Green Industrial Hydrogen via reversible high-temperature

electrolysis' (GrInHy) at Salzgitter Flachstahl GmbH, Germany. With an input power of 150 kWel, the module produces 40 Nm<sup>3</sup> per hour of hydrogen. It can also be reversed into fuel cell mode with an output power of 30 kWel.

A particular feature of Sunfire technology is the high electrical efficiency of more than 80 percent with reference to the lower calorific value of hydrogen as it is not liquid water but gaseous water – i.e. steam – which undergoes the splitting process. The steam required is provided in the form of waste heat from the processes of the smelting plant at Salzgitter Flachstahl GmbH and supplied to the steam electrolysis unit.

This is housed in a 20-foot container on the production site. After purification, the crude hydrogen is fed directly into the local H<sub>2</sub> pipeline and recycled. In fuel cell mode, the module can be operated with both hydrogen and natural gas. In demo operation, one of the points being investigated is the extent to which the plant can contribute to the provision of grid services (energy balancing, load management).

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

### Method to split water, create hydrogen fuel

In the United States, a Florida State University (FSU) researcher played a major role in a new discovery in how to produce pure hydrogen, a green energy fuel, by splitting water. Jose Mendoza-Cortes, partnering with a research team at Penn State University (PSU), the United States, has investigated new ways to create clean energy, particularly hydrogen fuel. In particular, researchers found that by tinkering with a

transition metal alloy, they could effectively and efficiently split water molecules and produce pure hydrogen.

Mauricio Terrones, at PSU, had been interested in exploring how the compound molybdenum disulfide could be used to split water. However, he and his team realized that the compound's protons did not overlap well with that of hydrogen. The scientists had also been experimenting with adding tungsten and graphene to the molybdenum disulfide, so Mendoza-Cortes began running simulations on how much of these elements could be added and how it would affect the ultimate chemical reaction.

Mendoza-Cortes and Terrones ultimately determined that the best way to split the hydrogen was to create an alloy with the molybdenum disulfide. They created a thin film with alternating graphene and tungsten-molybdenum layers. That created a much more efficient process and lowered the electrical voltage required to split the water from 200 millivolts with pure molybdenum disulfide to 96 millivolts with the tungsten-molybdenum alloy.

Source: <http://news.fsu.edu>

#### SEforALL Asia-Pacific Hub

The SEforALL Asia-Pacific Hub aims to accelerate and facilitate achievement of SEforALL's goals by harnessing its three development partners' convening power, country presence and networks to mobilize partnerships to catalyze concrete actions at the country level.

For more information, access: <http://www.se4all.org/hubs/regional/apac>



## **Biofuel for conventional diesel engines**

Researchers from Kaiserslautern, Bochum, and Rostock, Germany, have developed a method for producing a petroleum diesel-like fuel from conventional biodiesel at low temperatures. The new biofuel fulfils the current EU and US requirements. It can be used undiluted in modern diesel engines or mixed in any ratio with petroleum diesel. The findings have been published in the journal *Science Advances*.

In collaboration with chemists Kai Pfister and Sabrina Baader from the collaborative research centre 3-MET at the University of Kaiserslautern, Dr. Lukas Gooßen has developed an innovative technique for treating biodiesel. "With virtually no energy input, we convert a mixture of plant-derived fatty esters and bio-ethylene, another chemical compound, into fuel. This can be combusted undiluted in modern diesel engines," said Dr. Gooßen.

The particular advantage of this new technique is that the researchers are able to precisely adjust the chemical properties of the mixture. This process changes the ignition and combustion properties of the biodiesel. Combustion starts at lower temperatures. Moreover, the process is environmentally friendly: it neither requires solvents, nor produces waste. The two methods were synchronised with each other using mathematical simulations by Mathias Baader from the University of Kaiserslautern.

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

## **Biomass converted into fuel and chemicals**

Researchers led by James Dumesic, from University of Wisconsin–Madison, the United States, have developed a new process for obtaining not one, but three high-value products from biomass. Their new process tripled the fraction of biomass converted to high-value products to nearly 80 percent, also tripling the expected rate of return for an investment in the technology from roughly 10 percent (for one end product) to 30 percent. The researchers have published their results in the journal *Science Advances*.

"When a technology is new and risky, proving its economic feasibility and profit potential is critical for attracting investors. That's why we are very excited about its 30-percent internal rate of return," said David Martin Alonso, at UW–Madison. The magic key for turning all three components – cellulose, hemicellulose and lignin – of lignocellulosic (non-edible) biomass into distinct high-value products is gamma valerolactone (GVL), a solvent that is derived from plant material and has several highly appealing properties.

"GVL is very effective at fractionating the biomass. But it is also much more stable than other solvents, allowing us to reuse 99 percent of it in a closed-loop process. Until now, solvent loss had been a major bottleneck for making a renewable and carbon-efficient bio-refinery economically feasible," said Alonso. It also explains why the new technology is so "green." It starts with renewable biomass, has a very high solvent-recycling rate, needs miniscule amounts of acid, and uses all three fractions of biomass, minimizing waste.

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

## **High quality charcoal from bamboo**

The Department of Science and Technology-Forest Products Research and Development Institute (DOST-FPRDI), the Philippines, has developed a charcoaling kiln to produce high quality charcoal from bamboo for industrial use. Under the "High Quality Charcoal from Bamboo for Industrial Uses" project funded by the DOST-Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD), a team of FPRDI researchers led by Belen Bisana innovated on an existing bamboo charcoaling kiln.

The bamboo charcoaling kiln can also produce pyroligneous liquor (PL) or wood vinegar recovered from the destructive distillation of bamboo when it is converted into charcoal. The technology for making high quality charcoal and PL is deployed at the CS First Green Agri-Industrial Development Inc. When bamboo is used as a raw material, the resulting charcoal can perform like activated carbon. The improved kiln can yield 34.56-44.50 percent of charcoal, compared to traditionally used pit, drum, and brick kilns, which can only yield 25-31 percent.

To monitor and evaluate the project, the Forestry and Environment Research Division of PCAARRD conducted a two-day site visit in Bayambang, Pangasinan. Classified under PCAARRD's strategic research and development banner program, the developed technology is envisioned to alleviate poverty by creating employment in rural areas. The next phase of the project is the development of products out of bamboo charcoal and bamboo vinegar.

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



## New technology to manufacture biofuel

Researchers at Indian Institute of Technology (IIT) Kharagpur, India, have developed a new technology which will change the way biofuel is manufactured by making the process cheaper, quicker and pollution-free. The new 'soil-to-soil' manufacturing technology is in the process of being patented. "2gm bioethanol can be produced from various naturally available ligno-cellulosic components. But to do so it needs to be treated chemically. Because of chemical treatment the process contributes to polluting the environment," said Dr. Rintu Banerjee, at IIT-KGP.

Lignocellulose refers to plant dry matter (biomass). "We have replaced this chemical treatment with enzymes which degrade the lignin specifically there by making the manufacturing process pollution free," said Banerjee. Lignin is a complex organic polymer deposited in the cell walls of many plants, making them woody. Explaining how the technology would work, Banerjee said, "Unlike the chemical treatment here the waste product is pollution-free and hence utilising the residual biomass to organic fertilizer is possible."

"It is soil-to-soil technology, an integrated process where we are using natural resources to extract gaseous and liquid biofuel and then converting the wastes into bio fertilizer. It is an unique integrated approach which we have developed in our lab. The technique that we are suggesting will ensure relatively quicker production of biofuel and that the process is completely green thereby not creating any secondary pollution. This, we feel can change the future of biofuel manufacturing in India and make it more cost effective," Dr. Banerjee claimed.

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

## Turning coffee waste into biofuels

Researchers at Lancaster University, the United Kingdom, have found a way to significantly improve the efficiency of the process – vastly increasing biofuel from coffee's commercial competitiveness. The researchers consolidated the existing multi-stage process into one step (known as in-situ transesterification), which combines extraction of the oils from the spent coffee grounds and the conversion of it into coffee biodiesel. In the traditional process, manufacturers mix spent coffee grounds with hexane and cook the mixture at 60°C for between 1-2 hours.

The hexane is then evaporated to leave behind the oils. Methanol and a catalyst is then added to make biodiesel, and a glycerol by-product – which also needs separating. Researchers found they are able to combine the processes by using just methanol and a catalyst – removing the need for hexane altogether and saving on chemical waste. In addition, they also discovered that the optimal time for the process was 10 minutes to gain the same yield of oils from the spent coffee grounds – a significant reduction in time needed and associated energy costs.

"Our method vastly reduces the time and cost needed to extract the oils for biofuel making spent coffee grounds a much more commercially competitive source of fuel. "A huge amount of spent coffee grounds, which are currently just being dumped in landfill, could now be used to bring significant environmental benefits over diesel from fossil fuel sources," said Dr Najdanovic-Visak, at Lancaster University. The pro-

cess has the potential to enable 720,000 tonnes of biodiesel to be produced each year from spent coffee grounds.

Source: <http://www.lancaster.ac.uk>

## Straw based biofuel production

Scientists from the University of Hong Kong (HKU), China, have developed a new strategy to enhance the efficiency of rice straw for biofuel production. Significantly, the authors of the study detailing the breakthrough claim the strategy can also be used to boost efficiency of biofuel production from other cereals like maize, wheat, and barley. The collaborative effort between the HKU and Kyoto University, Japan, has unveiled a new strategy to allow cellulose in rice straw to release its fermentable sugar more efficiently.

The team discovered that when flavone synthase II (FNSII), a key enzyme involved in triclin synthesis, is knocked out, not only is triclin not produced, but the lignin content in rice straw was also reduced by approximately one-third. In addition, the yield of glucose from cellulose degradation was increased by 37% without any chemical treatment.

Importantly, there are no negative impacts on rice growth and productivity. As plants in the grass family all contain triclin-bound lignin, this strategy can be applied to other cereals like maize, wheat, and barley as well as grass species (e.g. sorghum and switchgrass) cultivated around the world exclusively for ethanol production, so that they can be utilized more efficiently as raw materials for biofuel," said Clive Lo.

Source: <http://www.biofuels-news.com>

### Global trends in renewable energy 2017

The report finds that wind, solar, biomass and waste-to-energy, geothermal, small hydro and marine sources added 138.5 gigawatts to global power capacity in 2016, up 9 per cent from the 127.5 gigawatts added the year before. The added generating capacity roughly equals that of the world's 16 largest existing power producing facilities combined.

Contact: Frankfurt School – UNEP Collaborating Centre Frankfurt School of Finance & Management Sonnemannstrasse 9-11, 60314 Frankfurt am Main, Germany. E-mail: fs\_unep@fs.de; Tel: +49-69-154-008-647; Fax: +49-69-154-008-4647

### Asia Pacific Renewable Energy Policy Handbook 2017 – Current and Future Plans

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

Contact: Wise Guy Consultants Pvt. Ltd. India. Tel: +91-841-198-5042

### Accelerating the Energy Transition through Innovation

This working paper from the International Renewable Energy Agency (IRENA) examines the basic conditions required to nurture innovation and produce new technologies for a low-carbon future. By assessing current status and future needs for such technologies, it seeks to identify the elements of a flexible policy framework for innovation, broadly suitable to enable decarbonisation of the energy sector between now and 2050.

Contact: International Renewable Energy Agency (IRENA), Masdar City, PO Box 236, Abu Dhabi, UAE. Tel: +971-2-417-9000

### Renewables 2017 Global Status report

This report reveals a global energy transition well under way, with record new additions of installed renewable energy capacity, rapidly falling costs, particularly for solar PV and wind power, and the decoupling of economic growth and energy-related carbon dioxide (CO<sub>2</sub>) emissions for the third year running.

Contact: REN21 Secretariat C/o UNEP DTIE, Building VII 1 rue Miollis, 750015, Paris Cedex, France. Tel: +33-1-4437-5091; Fax: +33-1-4437-5095; E-mail: secretariat@ren21.net

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E-mail: marketing@solarmedia.co.uk  
Web: <http://www.moduletech.solarenergyevents.com>

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#### Solar & Off-Grid Renewables Southeast Asia

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Web: <http://www.seasia.solarenergyevents.com>

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107-17-01, Bistari Condominium,  
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Tel: +601-8934-8746  
E-mail: contact@warponline.org  
Web: <http://www.sciconference.net>

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Fax: +60-3-2692-2788  
E-mail: support@ambtarsus.com

**5-6 Dec**  
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#### Renewable Energy for Indonesia 2017

Contact: Suite 1707, 17th Floor,  
Plaza Permata, 6,  
Jalan Kampar off Jalan Tun Razak,  
50400 Kuala Lumpur,  
Malaysia  
Tel: +603-2771-1668  
Fax: +603-2771-1669  
E-mail: conference@confexhub.com  
Web: <http://www.there4i.org>

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India

#### INTERSOLAR INDIA

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Chakala, Andheri (E)  
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