VATIS UPDATE

New and Renewable Energy

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Apprise yourself with the latest technological innovations

Highlights

- Solar cell design
- New small-wind turbine
- Tidal turbine trial
- Fuel cell CHP plant
- Hydrogen production method
- Cellulosic biofuel

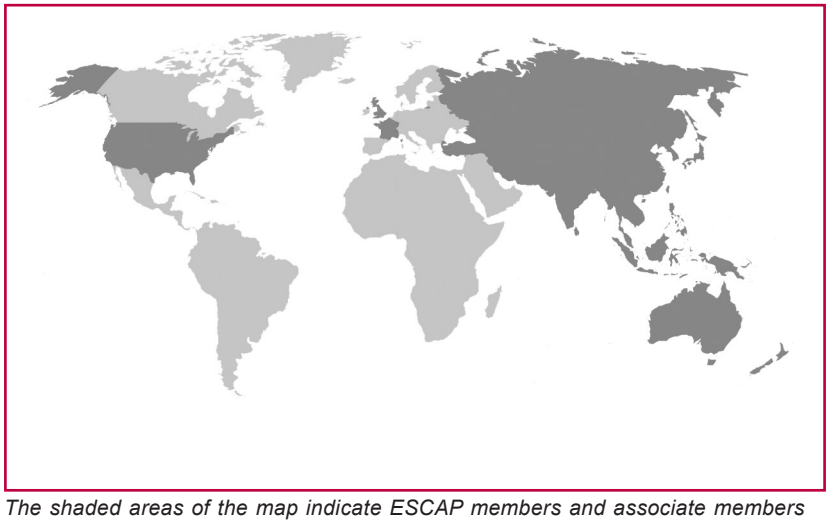
APCTT
Asian and Pacific Centre for Transfer of Technology

UNITED NATIONS
ESCAP
Economic and Social Commission for Asia and the Pacific

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

A new wave energy device tested at the Australian Maritime College
(Credit: Australian Maritime College)

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VATIS* Update
New and Renewable Energy

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Renewable capacity addition in India

According to data analysed by leading consultancy and knowledge services provider Bridge to India, the country's total renewable capacity including solar, wind, bio-mass and small hydro grew by around 11.2 GW in FY 2016-17, at par with thermal capacity addition, which registered a decline of 50% in the year. As per the data published by the government, India added 5,526 MW of new solar capacity (up 83% over FY 2015-16) and 5,400 MW of new wind capacity (up 63%) in the year.

While these numbers are impressive, it is worth noting that the solar capacity addition including rooftop solar is almost 50% below the annual target of 12,000 MW. In contrast, wind capacity addition was +35% over the 4,000 MW target. India added 5.8 GW of renewable capacity in a single month as implementing agencies pushed for commissioning of projects before the close of the financial year. There has been a downward trend in new renewable allocations in FY 2016-17 and the 2017-18 target of 20,450 MW will be impossible to meet.

As renewables continue to grow, prospects for thermal capacity addition seem limited and we expect renewables to decisively beat thermal capacity addition in the coming years. The figures released by Ministry of New and Renewable Energy (MNRE), Government of India, suggest that March was a blockbuster month with addition of 5.8 GW renewable capacity in a single month – more than the combined figure for previous eleven months.

Source: http//www.economictimes.indiatimes.com

Renewables purchase obligations in India

The Central Electricity Regulatory Commission (CERC) has proposed to decrease the floor prices of renewable energy certificates (RECs), making it easier for the state discoms to meet their renewable energy purchase obligations (RPOs). For solar, the proposed floor price is Rs. 1,000 per REC, substantially lower than the current rate of Rs. 3,500. For non-solar RECs, the proposed floor price has been suggested to be Rs. 1,000, down from the current Rs. 1,500.

The proposed reduction in REC floor prices are in line with the fall in renewable energy costs. REC mechanism is a market-based instrument to promote renewable energy and facilitate compliance of RPOs. It aims to address the mismatch between availability of renewable energy resources in the states and the requirement of the obligated entities to meet their RPOs. One REC is treated as equivalent to 1 MWh of green electricity.

RPO mandates that all electricity distribution licensees should purchase or produce a minimum specified quantity of their requirements from renewable energy sources. The state electricity regulatory commissions fix the minimum RPO for the states. The forbearance prices of RECs, or the upper price limit at which the RECs can be traded, have also been proposed to be cut. Forbearance prices for solar RECs may be slashed by more than half to Rs. 2,500 from Rs. 5,800.

Source: http//www.financialexpress.com

Floating solar plant in Sri Lanka

Sri Lanka has decided to go ahead with an international tender to set up a 100MW floating solar plant on the Maduru Oya Reservoir in the eastern part on the island. The Cabinet of Ministers has approved the program for solar to cover around 4% of the reservoir, the equivalent of 202 hectares. This is the first step in a previously approved wider plan to set up floating PV plants on various dams and reservoirs, across Sri Lanka.

The proposal has been put forward jointly by president Maithripala Sirisena, as well as Susil Premajayantha, minister of science, technology and research, and Ranjith Siyambalapitiya, minister of power and renewable energy. As part of goals to generate 20% of the island's electricity via renewables by 2020, the Cabinet had approved the implementation of a training programme for prototype manufacturing of solar panels last April.

The Cabinet has now also approved an extra LKR80 million (US$530,000) allocation to obtain the necessary equipment, chemicals and consumer goods for the training program. PV progress has been muted in Sri Lanka, although PV Tech understands there is strong interest at a high level to carry out large-scale solar auctions – not just on reservoirs – with discussions ongoing.

Source: https://www.pv-tech.org

World Bank solar maps for Pakistan

The World Bank (WB), in partnership with the Alternative Energy Development Board (AEDB), has launched a series of new solar maps for Pakistan in support of the efforts to increase the deployment of renewable energy in Pakistan. This will help in expanding access to sustainable and affordable sources of indigenous energy in the country. With these

efforts, Pakistan will become the first country to benefit from validated solar maps.

The global initiative on renewable energy resource mapping is led by the Energy Sector Management Assistance Programme (ESMAP), a multi-donor trust fund administered by the WB. Pakistan joins a small group of mainly developed countries, having access to duly validated and high quality solar energy maps available for planning and prospecting purposes. This initiative will facilitate investors in making more informed project decisions.

The WB project on solar mapping in Pakistan included field data, which is being generated by nine solar measurement stations installed two years ago throughout the country. The project supports AEDB's efforts to harness renewable energy in all the provinces by improving access to bankable data. The solar maps used the latest solar resource modelling techniques, based on 18 years of satellite and global atmospheric data from 1999-2016.

Source: https://www.dawn.com

Afghanistan to deploy 65 MW of solar

Afghanistan's High Economic Council has approved a plan to deploy 100 MW of renewable energy generation capacity across the country. The plan includes 65 MW of solar, 14 MW from wind power projects, 13.5 MW from biomass and 7.5 MW from hydropower plants. The government said that seven companies have expressed interest in developing the 30 projects of the plan, and that two unnamed developers were deemed eligible.

According to the United Nations Economic Commission for Europe (UNECE), the solar projects selected in the government tender range in size from 1 MW to 30 MW. The largest project is a 30 MW solar diesel hybrid system located in Kandahar, which is especially plagued by electricity shortages. President Mohammad Ashraf Ghani said that the energy issues of the region would be also be solved by, among other things, solar energy's transmission from the Ghazni province.

The second and third biggest projects are a 10 MW solar hydro hybrid plant and a 5 MW rooftop PV system, which will both be located in Kabul. Another 5 MW solar project will be developed in the province of Ghor, while a 3 MW installation will be built in Helmand province. The remaining projects have a capacity between 1.5 MW and 1 MW and are located in other provinces. Overall, these solar projects are expected to require an aggregate investment of $221.5 million.

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

Solar power investment in Bangladesh

Four joint venture companies are going to invest more than $600 million in different parts of the Bangladesh to generate 258 megawatts (MW) of electricity from solar energy. The government will purchase electricity at Tk 10.40 to Tk 11.20 per kilowatt-hour unit. Funds for the power plants will be raised from international banks and financial institutions. The division has selected the companies based on their financial strength and capacity to raise credit.

The figure on the actual investment to be made by the companies will be available after implementation of the projects, which have to be completed within 18 months of signing the agreements. A consortium of Zhejiang DunAn New Energy Co, China National Machinery Import and Export Corporation, Solar Tech Power and Amity Solar will set up a 100 MW plant in the Teesta barrage area under Nilphamari and Lalmonirhat districts.

Bangladesh now produces 190 MW of electricity from solar energy, according to the Sustainable and Renewable Energy Development Authority. This represents 44 percent of the renewable energy produced in the country. The government is diversifying its energy sources amid depletion of natural gas reserves, which account for more than half of 8,000 MW to 9,000 MW of actual electricity generation in the country.

Source: http//www.thedailystar.net

Philippines clears RE projects

According to the latest data released from the Philippines Department of Energy (DOE), seven renewable energy projects were cleared to proceed undertaking grid impact studies as of March. These projects are seen to generate 562 megawatts (MW) of power to the grid. The geographic information system (GIS) is necessary in determining if the electricity to be generated by the power project can be absorbed by the grid.

Three of the projects will harness wind resource and will be developed by Currimao Solar Energy Corp, Philippines. These are the 150 MW Talisay Wind Power Project in Camarines Norte, the 140 MW Talim Wind Power Project in RIzal and the 80 MW Calatagan Wind Power Project in Batangas. The DOE also gave the go ahead to conduct studies on three solar projects.

Sindicatum C-Solar Power Inc. is working on the Capas Solar Power Plant located in Tarlac. It is estimated to have a capacity of 22 MW. Two solar farms are located in Pangasinan. Pilipinas Newton Energy Corp. and Pilipinas Einstein Energy Corp. will each work on 70 MW solar project. Meanwhile, Silay Global Energy Solutions is working on a 30 MW battery energy storage in Negros Occidental. Year-to-date, 22 projects have been cleared for the conduct of GIS.

Source: http//www.philstar.com

Malaysian PV investment

The Malaysian Investment Development Authority (MIDA) has approved 2.42 billion ringgit ($544 million) of solar investments in the 12 months to the end of December. Roughly 1.77 billion ringgit was invested in seven PV production facilities last year, with investments in 83 undisclosed renewable energy projects rising to 650 million ringgit.

About 11.1 billion ringgit of unspecified solar products were exported from Malaysia in 2016, while 1.42 billion ringgit of equipment was sourced in the country, MIDA said, citing data collected from an undisclosed number of companies. MIDA pointed to Chinese monocrystalline silicon producer Longi's recent $240 million investment in a new wafer, cell and module plant in the state of Sarawak as the biggest solar investment in the country last year.

"We are building up local capabilities to develop further in areas such as system integration and balance of system components, which are important parts of the PV system value chain," said Dato' Azman Mahmud, at MIDA. About 95% of investments in solar production in Malaysia comes from outside of the country. The Malaysian government is targeting 2.08 GW of installed renewables capacity by 2020.

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

Cambodia makes solar power play

Solar firm Sunseap, Singapore, is building a US$9.2 million solar power plant in Cambodia which will provide a quarter of the energy needs of the city of Bavet, and will cut the country's emissions by 5,500 tonnes of carbon dioxide (CO_2) a year. The US$9.2 million solar farm, slated to be operational by August 2017, will be Cambodia's first sun-powered electricity source to be connected to the national grid.

The farm will provide Southeast Asia's second poorest country with 10 megawatts (MW) of power. This is enough to meet a quarter of the energy demands of Bavet, a frontier city of 37,000 people, where the park is located. The 21-hectare installation is a flagship project for a country that relies heavily on hydropower and fossil fuels, as well as energy imports from neighboring Viet Nam, to meet its growing energy demands.

The solar farm is expected to reduce Cambodia's green house gas (GHG) emissions by 5,500 tonnes of CO_2 equivalent a year. The World Bank estimates that in 2013, Cambodia's annual emissions were about 5,574,000 tonnes. The project is being funded partly by loans from Asian Development Bank, the Canadian Climate Fund for the Private Sector in Asia, and also a private investor.

Source: http//www.eco-business.com

Bangladesh leads in solar home systems

Bangladesh has topped a global list of countries that have installed the highest number of Solar Home Systems (SHS). With four million of the systems set up so far, the country is also at the forefront of nations using clean stoves and biogas plants, and promoting the cause of renewable energy that constitutes a fifth of the world's final power consumption. This growth in renewable energy use also helped increase employment in Bangladesh.

"As of 2016, more than 6 million SHS and kits were in operation worldwide, with 25 million people benefiting from them. Bangladesh, the largest SHS market worldwide, now has more than 4 million units installed," said the just released "Renewables 2017 Global Status Report". Paris-based energy think-tank, REN21, brought out the report with financing from the German Federal Ministry for Economic Cooperation and Development (BMZ), the German Federal Ministry for Economic Affairs and Energy (BMWi), UN Environment Programme (UNEP) and the Inter-American Development Bank (IDB).

The report also credited microcredit schemes for helping Bangladesh achieve the feat of becoming the largest SHS market in the world. "Markets for both mini-grids and stand-alone systems are evolving rapidly. Bangladesh, with 4 million units installed, has the largest solar home system market using mainly microcredit schemes," said the report.

Source: http://www.thedailystar.net

Mono-crystalline silicon solar cell

Trina Solar, China, has announced that its State Key Laboratory (SKL) of PV Science and Technology (PVST) has set a new record of 24.13 per cent total-area efficiency for a large-area (156 x 156 mm^2) n-type mono-crystalline silicon (c-Si) Interdigitated Back Contact (IBC) solar cell. The cell was fabricated on a large-sized phosphorus-doped Cz Silicon substrate with a low-cost industrial IBC process, featuring conventional tube doping technologies and fully screen-printed metallization.

The 156 x 156 mm^2 solar cell reached a total-area efficiency of 24.13 per cent as independently measured by the Japan Electrical Safety & Environment Technology Laboratories (JET). The IBC solar cell has a total measured area of 243.3 cm^2 and was measured without any aperture. The champion cell presents the following characteristics: an open-circuit voltage V_{oc} of 702.7 mV, a short-circuit current density J_{sc} of 42.1 mA/cm^2 and a fill factor FF of 81.47 per cent.

In February 2014, Trina Solar and the Australian National University (ANU) jointly announced a world record aperture efficiency of 24.37 per cent for a laboratory-scale 4 cm2 IBC solar cell, fabricated on a Float Zone (FZ) n-type substrate and using photolithography patterning. In December 2014, Trina Solar announced a 22.94 per cent total-area efficiency for an industrial version, large size (156 x 156 mm^2 substrate), IBC solar cell.

Source: https://www.pacetoday.com.au

Solar cell design

According to a new research carried out by a team led by Kita Takashi and Asahi Shigeo at the Kobe University Graduate School of Engineering, Japan, a new solar cell design could raise the energy conversion efficiency to over 50% by absorbing the spectral components of longer wavelengths that are usually lost during transmission through the cell. The findings have been published in *Nature Communications*.

In theory, 30% 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 4-junction solar cell.

If the energy-conversion efficiency of solar cells surpasses 50%, it would have a big impact on the cost of producing electricity. In order to reduce these large energy losses and raise efficiency, the research team used two small photons from the energy transmitted through a single-junction solar cell containing a hetero-interface formed from semiconductors with different bandgaps. Using the photons, they developed a new solar cell structure for generating photocurrents.

Source: https://www.phys.org

Researchers study perovskite solar cell

In a study researchers from the Ulsan National Institute of Science and Technology (UNIST), Republic of Korea, described a cost-efficient way to produce inorganic-organic hybrid perovskite solar cells (PSCs) that can reach record-breaking efficiencies. PSCs are made of a mixture of organic molecules and inorganic elements within a single crystalline structure, that together capture light and convert it into electricity.

As PSCs can reach a photovoltaic efficiency comparable to silicon solar cells but can be fabricated cheaply and easily, they have attached much attention as next-generation solar cells. Using methaylammonium lead iodide as the perovskite material and lanthanum-doped barium stannate as the electrode, they were able to produce the PSCs under mild conditions of less than 200 °C, much lower than the conventional temperature of over 900 °C.

Furthermore, the new material retains 93 percent of its initial performance after 1,000 hours of exposure to sunlight, showing excellent photostability.

Source: https://www.asianscientist.com

Bifacial n-type PERT solar cell

Belgian micro and nanoelectronics research center (IMEC) has announced that it has developed a bifacial n-PERT solar cell with front-side conversion efficiency of 22.8%. The cell has an average conversion efficiency of 22.4%, with the best cell topping 22.8%. The result was internally measured based on a calibrated reference cell used by the photovoltaic calibration laboratory at the Fraunhofer ISE (CalLab), Germany, without specifying whether it was confirmed by an independent entity.

The cell has thin and narrow (< 20 µm) nickel-silver (Ni/Ag)

plated fingers on both of its p+ and n+ sides, and that the cell contacts were manufactured in a patented process of simultaneous plating both cell sides. "This cell plating is performed on cassette level (simultaneous plating on a full cassette of wafers in a chemical bath) without the need for an electrical contact to be made to the substrates," said IMEC.

IMEC claims that this new cell technology has the potential for a low cost-of-ownership at module level, less than $0.30/W. In particular, IMEC cites the very limited use of silver, along with the potential for multi-wire interconnection schemes, as the main factors that could lead to a low cost production process. IMEC announced a 22.02% efficiency for its n-type PERT cell in January 2015.

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

Bifacial solar module

The Solar Energy Research Institute of Singapore (SERIS) at the National University of Singapore (NUS) has developed the world's first full-size Interdigitated Back Contact (IBC) bifacial solar module using ZEBRA solar cells from the International Solar Energy Research Center (ISC) Konstanz. With high-efficiency IBC silicon solar cells of 6 inches in width, the 60-cell bifacial module is capable of producing up to 400 Watts of electric power, a much higher power compared to conventional modules with power output in the range of 270 to 290 Watts.

The module technology's first prototype was produced using bifacial ZEBRA IBC solar cells from ISC Konstanz with efficiencies as high as 22%. The cells were fabricated using industrially proven process equipment and standard industrial 6-inch n-type Cz monocrystalline silicon wafers. The module's structural reliability is ensured by using a double-glass insulation technique perfected by SERIS since 2009. Encapsulated using the double-glass structure, IBC bifacial solar modules could offer a longer warranty period of 30 years or more.

Furthermore, by utilising the bifacial nature of the solar cells, as much as 30% extra power is generated by the double-glass module due to reflection of sunlight from the ground ('albedo') towards the module's rear surface.

Source: https://www.photonicsonline.com

High efficiency solar cell

Researchers with chemical manufacturer Kaneka Corporation, Japan, have built a solar cell with a photo conversion rate of 26.3 percent, breaking the previous record of 25.6 percent. Although it's just a 2.7 percent increase in efficiency, improvements in commercially viable solar cell technology are increasingly hard-won. Not only that, but the researchers noted that they were able to further optimize their solar cell to achieve 26.6 percent efficiency. That result has been recognized by the National Renewable Energy Lab (NREL), the United States.

The researchers build a 180.4 cm^2 cell using high-quality thin-film heterojunction (HJ) – that is, layering silicon within the cell to minimize band gaps where electron states can't exist. Controlling heterojunctions is a known technique among solar cell builders – Panasonic uses it and will likely incorporate it into cells built for Tesla at the Solar City plant in Buffalo, and Kaneka has its own proprietary heterojunction techniques.

Source: https://www.arstechnica.com

Low-cost solar cells

Scientists at IIT Roorkee, India, have used the juicy, delectable Indian summer fruit Jamun to create inexpensive and more efficient solar cells. Researchers used naturally occurring pigment found in jamun as an inexpensive photosensitiser for Dye Sensitised Solar Cells (DSSCs) or Gratzel cells. Gratzel cells are thin film solar cells composed of a porous layer of titanium dioxide (TiO_2) coated photoanode, a layer of dye molecules that absorbs sunlight, an electrolyte for regenerating the dye, and a cathode.

These components form a sandwich-like structure with the dye molecule or photosensitizer playing a pivotal role through its ability to absorb visible light. "The dark colour of jamun and abundance of jamun trees in IIT campus clicked the idea that it might be useful as a dye in the typical Dye Sensitised Solar Cells (DSSC)," said lead researcher Soumitra Satapathi, at IIT Roorkee.

Researchers extracted dyes from jamun using ethanol. They also used fresh plums and black currant, along with mixed berry juices which contain pigments that give characteristic colour to jamun. The mixture was then centrifuged and decanted. The extracted coloured pigment called anthocyanin was used as a sensitiser. The research has been published in the *Journal of Photovoltaics*.

Source: http://www.indianexpress.com

Wind turbine monitoring and fault diagnosis

Researchers from Technical University of Denmark (DTU) have developed a new method for wind turbine monitoring and fault diagnosis. Lead researcher Henrik Niemann and his research team have developed a new method to monitor the wind turbine and find the location of any wear or fault and nature of the fault. The monitoring will be carried out using the symmetry created by the wind turbine when the blades rotate.

The new method will offer measurements that include the information about the fault of wind turbine, as well as location and nature of the fault. According to DTU, the new method will be generous in terms of both wind turbine monitoring, as it helps to know in advance where errors and wear and tear are about to occur. Researchers have perfectly tested the new method in the laboratory, and are now planning to test in the field.

They are dealing with various wind turbine manufacturers to conduct the test. "We use data from sensors positioned at the point where the wind turbine blade is attached to the axis. There are two torque sensors on each blade. These are sensors which are already found on newer wind turbines in order to monitor the blade load. A wind turbine has three blades, so this provides three sets of measurements in total," said Niemann.

Source: http//www.wind.energy-business-review.com

New small-wind turbine

Bergey Windpower, the United States, recently announced a new product, the Excel 15 wind turbine. This innovative turbine is anticipated to be 40% more efficient than Bergey's 10-kW turbine, produce 85% more energy, and be sold at a similar price point. These factors lead to a significant reduction in levelized cost of energy (LCOE), the benchmark of competitiveness for energy generation technologies.

Over a three-year period, the advanced technology was developed with support from the US Department of Energy (DOE), under the Wind Energy Technologies Office's Distributed Wind Competitiveness Improvement Project (CIP). The CIP is a periodic solicitation funded by DOE and administered by its National Renewable Energy Laboratory (NREL).

Manufacturers of small and medium-sized wind turbines are awarded cost-shared contracts via a competitive process to optimize their designs for increased energy production, develop advanced manufacturing processes for reduced hardware costs, and perform turbine testing for certification to national performance and safety standards.

Source: http//www.windpowerengineering.com

Greater turbine power production

Aquanis Inc, the United States, has developed a new device which requires minimal modifications to a new blade. The design features a blade-mounted plasma flow actuator, a software controlled, solid-state electrical device that is simple and inexpensive. When a blade-embedded sensor detects deflection, software would signal the device to generate plasma that modulates the aerodynamic lift and drag forces, similar to the effect of trailing edge flaps in airplane wings. Each device weighs only a few ounces and would be placed on the outer 20 to 30% of the blade length near the tip. An electronic driver weighing a pound or two would mount inside the blade and provide 8 to 12 kV signals to the plasma generators. The device is based on patented technology developed at the University of Notre Dame, the United States. Aquanis has an exclusive license to the patent portfolio for the wind energy field of use.

All remedies tried to date use moving parts and are costly and complex to implement. "The simplicity of our plasma actuator technology provides the basis for an inexpensive, no-moving-parts control system that will let wind turbines react instantly to changes in the wind," said Neal Fine, at Aquanis. *Contact: Aquanis, Inc., 224 Wickham Road, North Kingstown, RI 02852, USA. Tel: +1-401-595-7379; E-mail: info@aquanisinc.com.*

Source: http//www.windpowerengineering.com

Wind turbines inspired by insect wings

Scientists at Paris-Sorbonne University, France, have found a way to make wind turbine blades 35% more efficient at producing energy by drawing inspiration from the flexible wings of insects. If commercialized, the advance could make this green technology a more viable alternative to fossil fuels in the coming years. "The optimal amount of power comes from intermediate rates of rotation," said Vincent Cognet, at the Paris-Sorbonne University.

In order for them to produce power most efficiently, the wind must strike their blades at just the right "pitch angle" to apply just the right amount of torque to a generator. Insect wings don't have this prob-

lem. Because they're flexible, the wings of bees and dragonflies are able to direct the aerodynamic load in the direction of their flight, increasing the power. And because they naturally bend in the wind, they can minimize drag to avoid damage.

To see whether such flexibility would improve the efficiency of wind turbines, Cognet and his team built small-scale turbine prototypes with three different rotor styles. One was completely rigid, one was somewhat flexible, and one was very flexible. All three turbines had three rotors, but the flexible ones were made with a pliable material called polyethylene terephthalate, whereas the rigid version was made with a stiff synthetic resin.

Source: http//www.sciencemag.org

Wind turbine model

Nordex Group, Germany, has launched an upgraded version of its N131 wind turbine model raising capacity to 3.9MW. The N131/3900 is an enhanced version of the N131/3600 and raises the nominal output by 8% to achieve yield gains of between 1% and 4%. The new turbine will be offered with hub heights of up to 134 metres. It will be available in North America as well as large parts of Europe from January 2018.

According to Nordex, acoustic emissions could be kept to 106.2 decibels by using serrations at the rear edges of the blade, despite the increased output. Noise-optimised operation modes are also available, meaning that the turbine can also be used in sound-sensitive locations. Nordex will also now offer the N131/3600 for medium wind speed locations, as well as for light wind conditions.

The turbine will be available at hub heights of between 84 and 134 metres and will have noise levels of 104.9 decibels because of blade serrations. The company said the rotor sweep in this wind class is 25% greater than that of the medium-wind turbine N117/3600, improving turbine yields by up to 15%. The first turbine of this type has been installed in January close to Husum in northern Germany.

Source: http//www.renews.biz

Researchers study vertical axis wind turbines

Anna Craig, a mechanical engineering doctoral candidate at Stanford University, the United States, and her research team recently studied modeling VAWT array arrangements. While a single VAWT is not as energy-producing as an individual HAWT, the wind flow synergies created in a closely-spaced array of VAWTs can potentially generate up to 10 times more power per unit of land area than an array of widely-spaced HAWTs.

"For the vertical axis wind turbines, what you get, especially as you place them in close transverse proximity to each other, is that they can actually interact positively," said Craig. Researchers agree that there is more research to be done on VAWTs before they can be deployed at an energy sector scale. However, they provided significant insights into one central VAWT challenge on how to research, test and develop insights for effective array arrangements.

They did this in a lab experiment because field testing is currently very expensive, and computer simulations are not yet refined enough or are too computationally expensive.

Researchers believe that this lab experiment and similar follow-ups offer important possibilities both for in-field arrangements and refining numerical simulations. They conducted the experiment in the large water flume with the system's water flow effectively representing the wind flow.

Source: https://www.publishing.aip.org

Bladeless wind turbines

A Spanish company, Vortex Bladeless, has developed an electric wind generator characterized by its lack of blades. The system, also known as Vortex Bladeless, leverages aerodynamic instabilities to capture energy. Vortex engineers created prototypes of this innovative wind turbine a couple of years ago. To reduce development time and cost, they turned to finite-elementanalysis (FEA) and computational fluiddynamics (CFD) solutions to hone their designs and product development process.

The wind generator has a cylindrical shape that oscillates in the wind, and electricity is generated through a lineal alternator system. The device is configured with a fixed mast, a power generator and a hollow, lightweight and semi-rigid fiberglass cylinder on top.

The outer conical cylinder is designed to be substantially rigid and has the ability to vibrate, remaining anchored to the bottom rod. The top of the cylinder is unconstrained and oscillates in the wind. An inner cylindrical rod, which may penetrate into themast for up to 20% of its length, is anchored to it at its top and secured to the ground atits bottom part.

Source: http://www.altair.de

Tidal turbine performance

Scotrenewables Tidal Power Ltd (STRP), the United Kingdom, has announced its 2-MW SR2000 tidal turbine's performance level matched established offshore wind turbines after it generated more than 18 MWh within a continuous 24-hour testing period at the European Marine Energy Centre (EMEC) in Orkney, Scotland. The SR2000 weighs 550 tonnes (606 U.S. tons) and was deployed from Harland & Wolff Heavy Industries Ltd., Northern Ireland.

In May 2016, the turbine began preliminary trials in Belfast Lough before being towed to its grid connection at EMEC's Fall of Warness tidal test site. In February, Scotrenewables secured a European Commission (EU) Horizon 2020 grant of €10 million (US$10.63 million) for its Floating Tidal Energy Commercialization (FloTEC) project. The project will build on the information gleaned from testing the SR2000 to develop a mark two prototype of the SR2000 technology.

There will be a significant focus on reducing the levelized cost of energy at every stage of the design, build and demonstration of the SR2000-m2. "The SR2000 is providing invaluable experience and validation of our engineering – both of which are informing the optimization exercise, which we are undertaking within our flagship Horizon 2020 project," said Jonathan Meason, at Scotrenewables.

Source: http//www.hydroworld.com

Tidal turbine trial

Norwegian Ocean Power, Norway, has successfully completed the initial trials on its Pulsus horizontal-axis spiral-design tidal turbine. These trials were primarily aimed at testing the bearings of the turbine which are a critical part of the unit. The work was carried out at Drammensfjorden in Norway where the dynamic test on the composite structure and bearings was performed.

The engineering, design, and the bearing itself was supplied by Vesconite Bearings, South Africa, while Norwegian Ocean Power looked at the deflection and the bearing's ability to absorb structural vibration resulting from the turbulence that can be associated with tidal turbine operation. The 0.5metre diameter Vesconite bearings which were installed on each end of the horizontal unit, also performed well in their ability to absorb vibration.

They were chosen after the testing of various competing products that were less flexible and exhibited dry-run problems. Norwegian Ocean Power has developed a tidal current turbine based on the Darrieus turbine design with one moving part that drives a variable speed direct drive generator, which in turns produces electricity. The company is focused on the development of its first commercial unit, planned to have the capacity of 350kW.

Source: http//www.maritimejournal.com

Tidal kit

European Marine Energy Centre (EMEC), the United Kingdom, has redeployed its bespoke integrated monitoring pod for measuring the impact of turbulence on tidal energy devices. The upgraded kit is fitted with an innovative system to enable tidal developers to optimise device design so that technologies can withstand the effects of strong tides and currents.

The sensor system combines standard flow measurement technology (acoustic and electro-magnetic) with novel non-acoustic measurement technology (shear probes). The pod also features Valeport current sensors installed alongside a recovery system developed by Leask Marine, the United Kingdom, which negates the need for divers operating in a tidal situation.

Source: http//www.renews.biz

Harvesting power from ocean waves

Wave Swell Energy (WSE), Australia, has taken a novel approach to harvest power from ocean waves using an artificial blowhole. WSE's artificial blowhole is a concrete column resting in the sea; waves rushing in and out of a central chamber cause air to have a positive or negative pressure. The pressure changes allow the air to pass by a turbine, generating clean power. All the moving parts are above the water line for ease of maintenance.

According to the company, they've based their technology on the idea of an oscillating water column. But the difference between their technology and that of other organizations is their turbine is only hit by air flowing from one direction. This means the turbine design is simpler, more reliable, and more durable. The design also yields higher energy conversion efficiency, the company said.

Their blowhole can produce up to one megawatt (MW) of power; as wave conditions and weather change, the average output is around 470 kilowatts. Its capacity factor – or ratio of average to peak power – is around 47 percent, much greater than the 30 percent achieved by other wave power systems. That means WSE could offer their electricity for around seven cents per kil-

owatt-hour (kWh), which is roughly competitive with coal.

Source: http//www.inhabitat.com

Catching waves for clean energy

A team of engineers called CalWave, working closely with UC Berkeley's Theoretical and Applied Fluid Dynamics Laboratory, the United States, has developed a "wave carpet" invented by professor Reza Alam. It looks like an underwater boardwalk that undulates inside a wave tank.

The carpet sits atop a series of double-acting piston pumps. CalWave project lead Marcus Lehmann explained that when "the waves run over the carpet, the carpet adopts the wave motion," which in turn runs the pumps. They generate hydraulic pressure that gets sent into a discharge pipe, which brings the pressure onshore to convert it into electricity.

Source: https://www.alumni.berkeley.edu

Wave energy device

Researchers at Australian Maritime College (AMC) and engineers at Wave Swell Energy, Australia, have tested a new wave energy device and now heading for commercial application in Australia's Bass Strait. The device was at least 120% more efficient than a conventional device. Wave Swell have now announced to build a commercial-sized plant to provide power to King Island, halfway between Tasmania and Victoria.

Wave Swell's design is a concrete gravity structure that sits on the seabed in 10m of water. It is based on the oscillating water column concept, which acts like an artificial blowhole with water rising and falling inside a chamber. Wave Swell have introduced novel vents that allow the air to escape from the chamber as a wave enters. The vents then close and as the wave passes, it draws air through the turbine.

This has two significant advantages: the venting of the chamber as the wave enters greatly reduces damping, meaning more water enters the chamber – resulting in an increase in efficiency. More significantly, it means that a simpler, more robust and efficient unidirectional turbine can be used, rather than a bi-directional turbine used by conventional wave energy converters of this type.

Source: http//www.amc.edu.au

Electricity from wave energy

The Dresser-Rand business, the United States, has developed a significantly more efficient turbine, called HydroAir™, for extracting power from wave energy. It promises substantial improvements to power plants operating on the oscillating wave column (OWC) principle, by which waves inside a chamber generate an airflow that drives the turbine.

The HydroAir turbine significantly improves the financial feasibility of wave energy power plants. The turbine is one of the few, if not the only, turbine of its type that operates at up to 75 percent efficiency with a power rating of one megawatt. Earlier similar solutions achieved efficiency levels of around 38 percent.

The engineers developed a housing that extends "funnel-like" from the two sides of the turbine. Inside, guide vanes direct the air toward the turbine's rotor. The guide vanes on the two sides are oppositely oriented so that the inlet and outlet air always drives the rotor in the same rotational direction.

Source: https://www.siemens.com

Tidal energy for off-grid sites

Canada's Water Wall Turbine (WWT) tidal vessel demonstration project has resulted in the development of 3 major sub-systems which combined could prove a viable solution for powering many remote communities around the world. WWT installed its 1MW turbine driving a 500kW power plant, coupled with the proprietary micro-grid management system and the energy storage system, at Dent Island Lodge, located in Canadian province of British Columbia last year.

The project has developed a commercially viable tidal energy system suitable for narrow, shallow channels and river streams, and micro-grid management system with advanced energy storage for remote and distributed generation.

The floating tidal turbine consists of an anchored 550-tonne catamaran-like barge that houses a large 72-tonne paddle wheel turbine. It rotates at less than 12 revolutions per minute, and is designed using WWT's patented technology that extracts not just the kinetic energy, but also the latent potential energy of fast moving currents by operating on the surface where currents are strongest, according to Natural Resources Canada (NRCan).

A remote 'islanded' micro-grid system was designed and developed to enable Dent Island to manage tidal generation, 500kWh energy storage and emergency back-up diesel.

Source: http://tidalenergytoday.com

Fuel cell CHP plant

Posco Energy, Republic of Korea, has recently constructed a 20 MW fuel cell combined heat and power (CHP) plant has been inaugurated in Seoul. The Noeul Green Energy Co plant features technology from US-based FuelCell Energy. The plant is owned by Republic of Korea's largest utility, Korea Hydro & Nuclear Power (KHNP).

It supplies power to Korea Power Exchange (KPX) and heat to a district heating network operated by Korea District Heating Co, the nation's largest heat supplier. The park has been constructed in 10 months. "The project occupies less than two acres of land and benefits Seoul by generating enough power for approximately 43,000 Korean households and heat for approximately 9000 households," said Chip Bottone, at FuelCell Energy.

Source: http//www.decentralized-energy.com

Catalytic material for fuel cell

Scientists at Ames Laboratory, the United States, have discovered a method for making smaller, more efficient intermetallic nanoparticles for fuel cell applications, and which also use less of the expensive precious metal platinum. The researchers succeeded by overcoming some of the technical challenges presented in the fabrication of the platinum-zinc nanoparticles with an ordered lattice structure, which function best at the small sizes in which the chemically reactive surface area is highest in proportion to the particle volume.

"That surface-to-volume ratio is important in getting the most out of an intermetallic nanoparticle. The smaller the particle, the more surface there is, and more surface area increases the catalytic activity," said Wenyu Huang, at Ames Laboratory. But the high temperature of the annealing process necessary to form intermetallic nanoparticles often defeats the goal of achieving a small size. High-temperature annealing can cause the particles to aggregate or clump, and produces larger sizes of particles that have less available surface and aren't as reactive.

Source: https://www.phys.org

Self-healing membrane for fuel cells

Researchers at the University of Delaware (UD), the United States, are working on extending the life of membranes in hydrogen fuel cells by equipping them with similar self-healing powers. To keep the fuel cells running smoother for longer, the UD team developed a membrane that would be able to make those spot repairs on its own.

It works on the same principle as other self-healing polymers, concrete and paints that contain microcapsules designed to break open under stress to plug holes as they form. In this case, those tiny bubbles are full of Nafion. The research has been published in the *Journal of the Electrochemical Society.*

After more than 220 hours of durability testing, the researchers found that adding the microcapsules greatly improved the lifespan of the membrane. That should help bring down some of the barriers facing these fuel cells, including not only the service life but the overall cost of these devices.

Source: http//www.newatlas.com

Bacteria-fueled power cell

Researchers at Binghamton University – State University of New York (SUNY), the United States, have developed the next step in microbial fuel cells (MFCs) with the first micro-scale self-sustaining cell, which generated power for 13 straight days through symbiotic interactions of two types of bacteria.

"The evolution of this technology will require additional exploration, but we, for the first time, realized this conceptual idea in a micro-scale device," said said Seokheun Choi, at SUNY. In a cell chamber about one-fifth the size of a teaspoon (90 microliters), researchers placed a mixed culture of phototrophic and heterotrophic bacteria.

Source: http//www.energyharvestingjournal.com

Polluted air into hydrogen fuel

Scientists from the University of Antwerp and KU Leuven (University of Leuven), Belgium, are developing a device that cleans up the air and generates power at the same time. It relies on a process called 'heterogeneous photocatalysis,' which uses light and a special catalyst (typically a semiconductor) to trigger a chemical reaction.

Heterogeneous photocatalysis has been used before to siphon hydrogen from water and nullify gas-based pollutants. Rarely are the two used in combination, however. The research team has solved this with a "photoelectrochemical cell," which uses a solar cell to produce hydrogen in a similar manner to electrolysis water-splitting.

Source: https://www.engadget.com

Hydrogen Production Method

Researchers from Technion-Israel Institute of Technology have developed a new method for the production of hydrogen from water that uses solar energy in a centralized way at the point of sale, such as a gasoline station for electric cars fueled by the gas. This eliminates the need for "solar farms" whose hydrogen has to be trucked a long distance, making the process cost effective, safe and efficient.

Led by Avigail Landman, and Dr. Hen Dotan, the new process allows for geographic separation between the solar farm, which consists of millions of PEC cells that exclusively produce oxygen, and the site where hydrogen is produced. To achieve this, the team used a pair of auxiliary electrodes made of nickel hydroxide, an inexpensive material used in rechargeable batteries, and a metal wire to connect them.

Source: http//www.jpost.com

Enabling hydrogen fuel cell supplies

Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia, is developing a technology to export Australia's supply of gas and renewable energy in a form that can power next generation hydrogen fuel cell transport. "CSIRO's new membrane technology can enable a new, and potentially carbon-free, export industry for Australia that could match the scale of the current LNG (liquefied natural gas) industry," said Chair of Renewable Hydrogen, Brett Cooper.

"With this technology, we can now deliver our renewable energy to Japan, Republic of Korea and across the Asia-Pacific region in liquid form, as renewable ammonia, and efficiently convert it back to pure hydrogen for cars, buses, power generation and industrial processes. This market didn't exist 10 years ago – now Australia is positioned to be the number one renewable fuel provider in the world's fastest growing region," said Mr. Cooper.

CSIRO's approach is to transport the hydrogen as ammonia (NH3) to bowsers, where it can be converted back to high-purity hydrogen for use in fuel cell vehicles. The project has received $1.7 million from the Science and Industry Endowment Fund (SIEF), which will be matched by CSIRO. Multinational gas supplier BOC, Renewable Hydrogen Pty Ltd and car makers Hyundai and Toyota have welcomed the move.

Source: http//www.theaustralian.com.au

Catalyst fuels hydrogen car

Researchers in Peking University, China, have developed a catalyst that they think will enable more practical hydrogen fuel cell vehicles, which could overthrow today's convenient but polluting combustion engines. Ding Ma and co-workers has made hydrogen and carbon dioxide (CO_2) from methanol and water, which happens in traditional approaches at 200-350˚C.

Ma's team's platinum-molybdenum carbide catalyst lowers that to 150-190˚C. According to the researchers, producing enough hydrogen from methanol to power a fuel cell car travelling at 100km/h would take 6-8g of platinum. For comparison, typically catalytic converters contain 2-8g of noble metals like platinum.

Fuel cells rip electrons from hydrogen molecules at one electrode, forcing the electrons to power a circuit, and leaving protons behind. The electrons return to recombine with protons and oxygen and form water at the other electrode. Toyota's Mirai already powers its engine with such fuel cells, emitting only water, using hydrogen compressed to 690 times atmospheric pressure in a 120 litre tank.

Source: https://www.chemistryworld.com

Innovative hydrogen fuel production system

Scientists from the University of Cambridge, the United Kingdom, have developed an innovative new method of producing hydrogen fuel. The method involves combining ambient sunlight and biomass, such as paper, wood, and leaves, in order to generate hydrogen. Converting biomass into hydrogen has long been an interest for the renewable energy community, but relatively few endeavors have managed to find success. The new method mainly focuses on biomass waste.

The new system leverages a photocatalyst in an alkaline water solution. The photocatalyst is comprised of various nanoparticles. When exposed to sunlight, either natural or synthetic, the photocatalyst triggers any biomass particles present in its alkaline solution to produce gaseous hydrogen. Notably, the hydrogen produced using this method is free from fuel cell inhibitors, such as carbon monoxide.

This means that the hydrogen can be used by a fuel cell to generate electricity in an efficient and sustainable manner. The research team intends to bring their new hydrogen fuel production system to the commercial market at some point in the future. The research team predicts

that the new system could be effective for small-scale hydrogen fuel production, but it could be scaled up for industrial use in the future.

Source: http//www.hydrogenfuelnews.com

Hydrogen technology to power trains

Fuel Cell Systems, the United Kingdom, has demonstrated the feasibility of using hydrogen cells to power trains in a study conducted for the UK rail industry. Performed in collaboration with the University of Birmingham and Hitachi Rail Europe, the six-month study indicated that hydrogen fuel cell technology can be retrofitted to increase the life of current rolling stock.

The study also showed that fuel cells are a clean alternative for the self-powered regional trains in the country. Funded by Rail Safety and Standards Board (RSSB) and Network Rail, the project established that using the technology could cut journey times, reduce emissions at the point of use and improve passenger comfort.

To examine the real-life applications, the study included mathematical modelling on known rail routes such as the Norwich to Sheringham. It is expected that the hydrogen fuel cell powered trains would complement the future electrification of the railway network, eliminate the interruption in services caused by installation of overhead wires, or modifications to bridges and tunnels during full electrification.

Source: http//www.railway-technology.com

Fuel-efficient renewable energy

Chemists at the USC Loker Hydrocarbon Research Institute, the United States, have devised a way to produce and store hydrogen from methanol, without concurrent production of either carbon monoxide (CO) or carbon dioxide (CO_2), by trapping it in organic derivatives of ammonia called amines. The research has been published in the *Journal of the American Chemical Society.*

Senior author G. K. Surya Prakash, 1994 Nobel Prize in Chemistry winner George Andrew Olah, and their team at the USC Dornsife College of Letters, Arts and Sciences, the United States, have outlined a carbon-neutral method for doing just that, with a little help from the simplest alcohol known to man: methanol.

The well-known steam reforming process usually used to extract hydrogen from methanol, called the methanol reformer, traditionally produces CO and CO_2 as part of this extraction process. CO_2 is a greenhouse gas (GHG) that causes global warming and ocean acidification. The research demonstrated that just one more way carbon has been freed from the cycle of creating and storing fuels via methanol.

Source: https://www.phys.org

Solar material for producing clean hydrogen fuel

Materials like titanium oxide, known as semiconductors with the wide band-gap, are traditionally used to convert sunlight to chemical energy for the photocatalytic reaction. However, these materials are inefficient because only the ultraviolet (UV) part of light is absorbed—the rest spectrum of sunlight is wasted. Now, researchers from Osaka University, Japan, have created a 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," the team leader Tetsuro Majima says. "This allows our new material to absorb visible and even near infrared light, which we could never achieve with LTO alone."

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.

Hydrogen production using this material is enhanced not only by the broader spectrum of light absorption, but by the more efficient electron conduction, caused by the unique interface between two dimensional materials of BP and LTO. As a result, the material is 60 times more active than pure LTO. "By efficiently harvesting solar energy to generate clean fuel, this material could help to clean up the environment," Majima says.

Source: https://phys.org/news/2017-06-solar-material-hydrogen-fuel.html

Grass into biofuel

Researchers at Ghent University (UGent), Belgium, have developed a process that turns grass into biofuel. To improve its biodegradability, the grass is first pretreated, and then bacteria are introduced. The bacteria convert the sugars in the grass into lactic acid and its derivatives. This lactic acid can serve as an intermediate chemical to produce other compounds such as biodegradable plastics (PLA) or fuels. The lactic acid then was converted into caproic acid, which was further converted into decane, which can be used in aviation fuel.

Although it might sound revolutionary, there's still a lot to do before this becomes practical. Right now, the amount of biofuel that can be made from grass is still limited to a few drops. The current process is very expensive, and engines would have to be adapted for this new kind of fuel. "If we can keep working on optimizing this process in cooperation with the business world, we can bring down the price. And maybe in a few years, we can all fly on grass," said Way Cern Khor, at UGent.

Source: https://www.phys.org

Bio-based fuels

Researchers at the Department of Energy's Oak Ridge National Laboratory (ORNL), the United States, have a new process developed that recycles wastewater from biofuel production to generate hydrogen. The hydrogen can then be used to convert bio-oil into higher grade liquid fuels such as gasoline or diesel. "We are solving multiple problems at the same time," said Abhijeet Borole, at ORNL. The team's lab-scale demonstration can produce 11.7 liters of hydrogen per day at rates that are required for industrial applications.

Borole noted that although more work is required to bring the technology to the commercial scale, their progress demonstrates the potential of microbial electrolysis to make bio-refineries more efficient and economically viable. Much like a conventional petroleum refinery, the bio-refinery concept is focused on the conversion of plant materials into higher value products, including hydrocarbon fuels and chemicals. Microbial electrolysis is powered by electrogens – bacteria that digest organic compounds and generate an electric current.

Borole put these bacteria to work in breaking down organic acids in liquid bio-oil that is produced from plant feedstocks such as switchgrass. Normally, about a quarter of the liquid bio-oil is contaminated water that contains corrosive acids. The hydrogen generated from the microbes could displace the need for natural gas, which is used later in the production process to upgrade bio-oil into more desirable drop-in liquid fuels. "You can recycle the water, produce clean hydrogen and eliminate the natural gas," said Borole.

Source: http//www.rdmag.com

Cellulosic biofuel

A team of scientists at the University of Wisconsin-Madison, the United States, has found a way to produce from biomass a valuable compound used in plastic production that they estimate could lower the cost of ethanol produced from plant material by more than two dollars per gallon. The development is the latest in an ongoing effort at UW-Madison to create commodity chemicals currently derived from petroleum out of biomass.

These bio-derived chemicals could serve as high value co-products of the biofuels manufacturing process, improving the economics of cellulosic bio-refineries. "This breakthrough shows how biomass-derived commodity chemicals can economically be used to replace petroleum-derived products. It also shows how we might improve the rural economies in which biomass grows," said George Huber, at UW-Madison.

Huber and team reported a new chemical pathway used to produce 1,5-pentanediol, a plastic precursor primarily used to make polyurethanes and polyester plastics. The group's highly efficient approach is six times cheaper than a previously reported method, and represents the first economically viable way of producing 1,5-pentanediol from biomass. Plant biomass is typically about 40 percent oxygen by weight, while petroleum oil is less than 0.1 percent oxygen.

Source: https://www.engr.wisc.edu

Biofuel from used coffee

Researchers at Lancaster University, the United Kingdom, have discovered a technique to considerably increase the efficiency of the process, thus hugely increasing biofuel from coffee's commercial competitiveness. The researchers combined the existing multi-stage process into a single step (transesterification), which incorporates extraction of the oils from the used coffee grounds and the transformation of it into coffee biodiesel.

In the traditional process, manufacturers blend used coffee grounds with hexane and cook the mixture at 60 °C for about 1 to 2 hours. Once the hexane evaporates, only the oils are left behind. Methanol and a catalyst are then added to create biodiesel and a glycerol by-product - which also

requires separating. The team realized that they could combine the processes by using only methanol and a catalyst.

Thus, eliminating the need for hexane totally, and therefore saving on chemical waste. Furthermore, they also discovered that the optimum time for the process was 10 minutes to obtain the same yield of oils from the used coffee grounds – a substantial reduction in time and associated energy costs. The process looks promising and could enable 720,000 tonnes of biodiesel to be produced annually from used coffee grounds.

Source: http//www.azocleantech.com

Biofuel from microalgae

Researchers from Kumamoto University, Japan, have used a nanosecond pulsed electric field to extract hydrocarbons from microalgae. By using the shorter duration pulse, they were able to extract a large amount of hydrocarbons from the microalgae in a shorter amount of time, using less energy, and in a more efficient manner than current methods. Researchers used a nanosecond PEF (nsPEF) to focus on the microalgae matrix instead of the cells.

The researchers performed several tests with the nsPEF on the microalgae *Botryococcus braunii* (Bb) to determine the optimal electric field, energy, and pulse repetition frequency for hydrocarbon extraction. Interestingly, it was found that doubling the energy only resulted in a 10% increase in hydrocarbon extraction. At 10 Hz, the optimal field and energy conditions were determined to be approximately 50 kV/cm and 55.6 J/ml respectively per volume of algae.

Further, the researchers found that pulse frequency had little to no effect on extraction percentage, meaning that a large amount of hydrocarbons may be extracted quickly for large/industrial systems. "Other microalgae do not secrete a matrix so the cell membranes must be damaged or destroyed to get at the hydrocarbons, which both takes more energy and is less efficient than our method," said Hamid Hosseini, at Kumamoto University.

Source: https://www.sciencedaily.com

Algae's biofuel potential

A group of researchers at Kobe University Graduate School of Science, Technology and Innovation, Japan, has developed a new method to synthesize oil within microalgae cells, which could lead to more efficient biofuel development. The research, led by Professor Hasunuma Tomohisa and Kato Yuichi, found that Chlaamydomonas sp. JSC4, a new species of green algae harvested from brackish water, combines a high growth rate with high levels of lipids.

The researchers developed a new analysis method called dynamic metabolic profiling, which they used to analyze JSC4 and observe how the algae produces oil within its cells. The researchers incubated JSC4 with carbon dioxide as the sole carbon source, and four days after the start of incubation, over 55 percent of cell weight consisted of a carbohydrate – mainly starch.

The researchers saw a decrease in carbohydrates and an increase in oil when the saltwater was comprised of 1-to-2 percent of the incubation liquid. Seven days after the start of incubation over 45 percent of cell weight had become oil. By using this method, the researchers revealed that the sugar biosynthesis pathway, which is activated when starch is produced, slows down and the pathway is activated for synthesizing triacylglycerol, a constituent element of oil.

Source: http//www.rdmag.com

Biofuel production

A recent discovery by researchers at Sandia National Laboratories (SNL), the United States, may unlock the potential of biofuel waste, and ultimately make biofuels competitive with petroleum. The researchers have decoded the structure and behavior of LigM, an enzyme that breaks down molecules derived from lignin. The enzyme has little in common with other, better understood proteins, which previously made it impossible for scientists to guess how it functions.

This is the first time anyone has solved the structure of LigM, opening a path toward new molecules and new, marketable products. Researchers knew enzymes could metabolize lignin and its derivatives because there are decades-old records of bacteria using enzymes for this purpose. Sphingomonas bacterium was discovered living in the waste water of a pulp mill more than 30 years ago.

Once researchers realized the bacterium's unique enzymatic pathways enabled it to live on lignin, their challenge then was to understand the enzymes in these pathways so they could mimic what nature had already done, and use that understanding productively. The team focused on LigM, an enzyme used by Sphingomonas, because it performs a key step in the conversion of lignin derivatives and it is the simplest of the known enzyme systems that perform this function.

Source: http//www.biomassmagazine.com

Nanotechnology for Bioenergy and Biofuel Production

A unique feature of this book is its focus on nanotechnological solutions for the production of bioenergy and biofuels. Coverage includes topics such as nanobiotechnology, microalgae, biofuel cells, biomass pretreatment, and biomass conversion. An international team of experts also addresses the need to precisely characterize nanoparticles and the role of catalysts.

Clean Energy from Waste

This book explores the use of recent advanced multiple stage conversion technologies. These applications combine conventional fluidised bed systems with new plasma technologies to efficiently generate different energy outputs from waste materials with minimum cleaning effort. The author has provided fundamental insights into how the key operating variables of the two-stage process may impact the final quality of syngas.

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