international association for hydrogen energy
Clean and Abundant Energy for Sustainability

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Clean Energy Soared in the U.S. in 2017 Due to Economics, Policy and Technology

As President Donald Trump moved to roll back environmental protections and foster a boom in fossil fuel energy production, his administration effectively abandoned the race for global leadership in slowing global warming.

But in many ways, the transformation of the energy economy in a new, green direction continued apace in the United States, just as abroad.

Some pre-Trump policies, like U.S. tax breaks for renewables, survived. The social and market forces that have been shouldering coal aside persisted. And the mantle of leadership passed not only to Europe, China and developing nations, but to American cities and states.

The cost of renewable energy keeps going down, comparing favorably with coal. Battery technology also continues to improve and get cheaper. And digital technology is making electric markets cleaner and more efficient, as well.

Here are how these trends are emerging, both in the United States and abroad.

Coal: It's Closing Time

Trump famously promised to bring back coal, and he's been trying. At the U.N. climate conference in Bonn in November, the only official U.S. event promoted "clean" fossil fuels as a solution to climate change. Trump's proposed rollback of the Clean Power Plan would retract stringent limits on emissions from coal plants. Energy secretary Rick Perry told the Federal Energy Regulatory Commission to "fix" grid resiliency by requiring some power plants to maintain larger on-site reserves of coal and nuclear fuel—a strategy widely derided.

Signs of coal's demise are everywhere. More than half of the coal plants in the United States have closed since 2010, and coal's market share continues to decline rapidly, according to a new report from UK-based Carbon Tracker, an independent financial think tank. It concludes that "new coal capacity is not remotely competitive" and, in the next few years, building new power plants that use natural gas and renewables will often be cheaper than continuing to operate existing coal plants.

The economics are just as unfavorable for coal in Europe. Another recent report from Carbon Tracker found more than half of coal plants there are losing money. By 2030, almost all will be, thanks to tougher air pollution protections and higher carbon prices. Soon it will be cheaper to build new solar and wind generation than to continue running existing coal plants, the report found. The United Kingdom has slashed its coal usage from 40 percent of the nation's electricity to 2 percent in the last five years. Australia and China are also among the countries that shut down coal plants or canceled plans for new ones.

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IAHE Objective

The objective of the IAHE is to advance the day when hydrogen energy will become the principal means by which the world will achieve its long-sought goal of abundant clean energy for mankind. Toward this end, the IAHE stimulates the exchange of information in the hydrogen energy field through its publications and sponsorship of international workshops, short courses, symposia, and conferences. In addition, the IAHE endeavors to inform the general public of the important role of hydrogen energy in the planning of an inexhaustible and clean energy system.

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More and more places around the world, including China and India, are deciding that air pollution impacts on human health must be controlled, requiring costly scrubbers and filters that increase the cost of coal generation. At the same time, prices for other energy sources have stayed low—including natural gas due to copious fracking in the United States, and wind and solar, which are continuing their steep decline due to economies of scale and technological improvements.

Even the International Energy Agency (IEA), known for its myopic view of fossil fuels and routine underestimates of renewable energy growth, discerns this trend. "[Renewable energy's] explosive growth in the power sector marks the end of the boom years for coal," says its latest World Energy Outlook, predicting that renewables will capture two-thirds of global investment and generate 40 percent of total power in 2040 "as they become, for many countries, the least-cost source of new generation."

Renewables Are Competing on Price

In fact, renewables are already the cheaper option in many places. The IEA's 2017 Energy Outlook notes that, since 2010, costs of new solar PV have come down by 70 percent and wind by 25 percent. And China's energy agency announced last January that it intends to spend at least $360 billion on renewable energy by 2020. It's that kind of investment that is helping to bring prices down worldwide.

Just 18 months ago, Zambia made headlines when a World Bank-led solar power auction saw a winning bid of 6.02 cents per kilowatt-hour. In October this year, Saudi Arabia saw a solar price of 1.79 cents per kilowatt-hour, and in November, Mexico saw 1.77 cents per kilowatt-hour for wind. Even in surprising corners such as Alberta, home to Canada's oil sands and coal mines, the province's first wind auction saw a winning price of 3.7 cents per kilowatt hour, half the cost of new natural gas generation there.

These prices are turning heads. In 2016, renewable energy accounted for almost two-thirds of new power capacity globally, and this was another record year. The IEA expects that domination to continue, at least through 2022. That's true in the United States as well. Renewables have been the majority of added capacity since 2014, despite this year's solar dramas such as lobbying for tariffs on cheaper Chinese panels and industry shakeups.

U.S. wind and solar also emerged only lightly scratched by the Republican tax cut, after tax credits were in the crosshairs. Republicans buckled under pressure from red states like Texas, where a new wind facility that opened in December pushed the state's wind capacity past coal.

Aside from what happens at the federal level, states continued with their strong commitments. For example, California's Public Utilities Commission reported that it is well ahead of its target to get 33 percent of its power from renewables by 2020 and appears on track to meet the 2030 target of 50 percent by 2020. Gov. Jerry Brown, seizing on that momentum, is now advocating that the state hit 100 percent by 2040.

Batteries: Cheaper and Better

Renewables' strong growth demands more energy storage to avoid dumping wind and solar power that can't be used immediately, and regulators are increasingly aware of storage's value in supporting the modern grid. It helps that adding storage is now more feasible because battery prices have come down by 40 percent since 2010, according to the IEA's 2017 Energy Outlook. Water storage via pumped hydro and regulated dam use are also supporting wind and solar, along with "virtual storage" such as demand response.

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lithium-ion batteries used for grid storage, vehicles and home storage have been getting incrementally better and cheaper, both from economies of scale and technological advances. Meanwhile, innovation continues in other battery technologies. The progress led to a flurry of new electric vehicles and manufacturer and country commitments to phasing out internal combustion engines. Even trucking is beginning to go electric.

A report from Bloomberg New Energy Finance predicted in November that the energy storage market will double six times between 2016 and 2030. This boom will mirror solar's rise from 2000 to 2015, the report said, in which the share of solar as a percentage of energy generation doubled seven times. In the U.S., states are following California's lead, which first set a storage target in 2013. Now 21 states have storage targets or are planning projects.

Lithium-ion batteries are even beginning to compete on price with natural gas peaker plants, the older, dirtier power plants that currently supply electricity when demand spikes. This month the California Public Utilities Commission is set to vote on a plan to replace three natural gas-fired power plants with energy storage. Experts say this could be the beginning of the end for peaker plants.

Digitalization of electricity

As solar, wind, storage, and other new energy resources such as electric vehicles and smart appliances come onto the grid, supply is more variable and transactions—moving and paying for energy—are going in both directions. These changes make grid management and the delivery of reliable electricity challenging.

Increasingly, grid managers are using vast reams of data; powerful analytics, including machine learning; and widespread connectivity, including machine-to-machine communication to make energy systems more flexible, efficient, and reliable, a trend the IEA covered in a special report on digitalization and energy.

These systems can optimize myriad variables in real time. For example, they can store solar power generated in the afternoon for later use when people get home from work, or they can send wind power from the desert to the city, or they can shave tiny amounts of electricity delivery from multiple customers via their smart appliances, aggregating enough to not turn on a peaker plant. The IEA report found that, by 2040, demand response could provide 185 gigawatts of system flexibility, roughly equivalent to the supply capacity of Australia and Italy combined, saving $270 billion in new electricity infrastructure.

Electric vehicles' batteries can be used as storage for the grid, and energy digitalization can shift cars' charging to times when electricity demand is low and supply is high. Doing so could save $100 billion to $280 billion in avoided investment in new electricity infrastructure between 2016 and 2040, according to the IEA report. Improving analytics and AI can also create more accurate forecasts for wind and solar, allow grid managers to better capture that energy and reduce fossil fuel use.

This is the future of energy, and it's coming much faster than conventional wisdom predicted. Deals between data and artificial intelligence startups and energy companies increased 10-fold in 2017, according to accountancy firm BDO. Altogether, these policies, technologies, and markets are overcoming hurdles to new types of greener energy—solar, wind, storage, efficiency—decreasing greenhouse gas emissions from electricity.

It may prove impossible for those who favor fossil fuels to turn back the gears of progress.

Source: https://insideclimatenews.org/news/03012018/clean-power-renewable-energy-jobs-technology-grids-policy-2017

Kenworth shows hydrogen fuel cell T680 at CES

Kenworth showed a zero-emissions T680 day cab equipped with a hydrogen fuel cell as part of its Paccar Innovations booth at the Consumer Electronics Show in Las Vegas.

This is the first time Paccar and Kenworth have exhibited at CES, an electronics industry trade show with an eye on future technologies and innovations that draws in close to 200,000 visitors. Kenworth's zero-emissions project was announced in May 2017 and is part of the Zero Emission Cargo Transport demonstration project managed through Southern California's South Coast Air Quality Management District.

The Kenworth T680 day cab's fuel cell combines compressed hydrogen gas and air to produce electricity with only water vapor emitted at the tailpipe. This electricity can power the dual-rotor electric motor to move the truck, or it can recharge the lithium-ion batteries for use later. The hybrid drive system manages the power from the fuel cell to and from the batteries, as well as the traction motors and other components, such as the electrified power steering and brake air compressor.

"Kenworth's hydrogen fuel-cell T680 is a reality," said Stephan Olsen, Kenworth director of product planning. "The T680 has been running trials in the Seattle area and performing very well. The next step is real-world testing with Total Transportation Services Inc. at the ports of Los Angeles and Long Beach in Southern California."

The truck will initially have a range of 150 miles and is designed for short haul and port operations. The truck's electric motor can output 565 horsepower and is capable of carrying Class 8 loads.

"Our testing shows that this truck performs equally as well, if not better than, current diesel trucks on the market," said Olsen. "There is a lot of promise, and we see the day where Kenworth's zero and near-zero emission trucks could be a common sight in regional operations. Kenworth is heavily focused on the evaluation and development of both zero and near-zero emission solutions for the trucking industry."

To develop the hydrogen-based T680, Kenworth used $2.8 million in funding under a larger grant from the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy, with Southern California's South Coast Air Quality Management District being the prime applicant. Project oversight was provided by the Center for Transportation and the Environment. Kenworth is also working on a second project under the larger program for DOE and SCAQMD to develop a near-zero emission-capable T680 day cab using a near-zero natural gas engine and generator to extend the battery range.

Source: http://www.truckinginfo.com/channel/fuel-smarts/news/story/2018/01/kenworth-shows-hydrogen-fuel-cell-t680-at-ces.aspx

Hyundai previews, announces name of longer-range hydrogen fuel cell SUV

Hyundai Motor recently previewed a sleek, next-generation, fuel-cell-powered small SUV with increased driving range. The latest fuel-cell electric vehicle (FCEV), which it has named Nexo, replaces Hyundai's Tucson ix35 FCEV that debuted in 2013 and has been seen on roads in Southern California. Launch in South Korea is expected in early 2018, followed by North America. The latest FCEV in

Hydrogen Vehicle News

Hyundai's lineup heralds the automaker's accelerated rollout of "green" vehicles as part of its new eco-vehicle program, according to a company statement.

The Nexo's power is based on Hyundai's fourth-generation hydrogen fuel-cell technology that emphasizes fuel-cell system efficiency, performance (output), durability, and improved tank storage. Efficiency is enhanced by 9% by reducing hydrogen consumption. Hyundai states that the new emission-free FCEV has a target driving range of 360 miles (580 km) on a single charge, based on Korean test standards. Performance output is boosted by 20% to 160 horsepower (163PS). Another plus is that the new FCEV will now cold-start even in sub-freezing temperatures, Hyundai says.

Aerodynamic design enhancements in the architecture, such as a tunnel inside the D-pillar and special low-drag wheels, also boost efficiency. The new FCEV bears striking styling cues to Hyundai's FE Concept shown at the 2017 Geneva International Motor Show that emphasize organic, flowing lines.

The interior of the new Nexo is "minimalist" design with a wide dashboard that incorporates a large infotainment screen. The cabin's seat design features eco-friendly woven fabric and suede accents in muted colors from nature.

Hyundai says it has reduced production costs for the new Nexo FCEV with new components such as the MEA (membrane electrode assembly) and bipolar plates. Hydrogen storage has been improved with a tank that is configured with three storage tanks of the same size. Advanced driver-assistance technologies featured in the new production FCEV will be revealed at the 2018 CES.

Currently, Hyundai's alternative-fuel lineup includes the Ioniq, with a choice of three electrified powertrains. It will add an electric Kona small SUV late next year as well as new EVs in the premium Genesis brand line in 2021.

Source: http://www.jdpower.com/cars/articles/car-news/hyundai-previews-announces-name-longer-range-hydrogen-fuel-cell-suv

French company debuts hydrogen-powered bikes

Pragma Industries just became the first company to launch a hydrogen powered bicycle for commercial and municipal purposes. Based in Biarritz, France, the company has already secured 60 orders for the hydrogen bikes from French municipalities such as Saint Lo, Cherbourg, Chambery and Bayonne. While the bikes are currently too expensive for the commercial market, costs are expected to eventually drop from 7,500 euros to 5,000 euros.

While Pragma is not the only company interested in hydrogen-powered bicycles, they have taken production of such vehicles the farthest—so far. "Many others have made hydrogen bike prototypes, but we are the first to move to series production," Pragma founder and chief executive Pierre Forte told Reuters. Pragma's Alpha bike is able to travel a distance of 100 kilometers (62 miles) on a two-liter (0.5 gallon) tank of hydrogen. Although the range is similar to that of a typical electric bike, the recharge time is significantly reduced from hours for a traditional e-bike to merely minutes for the Alpha hydrogen-powered bike.

Pragma offers two types of recharging stations: one that uses hydrolysis of water to generate hydrogen fuel on-site, and another, more affordable station that relies on tanks of already prepared hydrogen fuel. Due to the high cost, Pragma is currently marketing its bikes to larger commercial and municipal operations such as bike-rental operators, delivery companies, and municipal or corporate bicycle fleets. After producing 100 such bikes last year, Pragma hopes to sell 150 this year to organizations in places such as Norway, the United States, Spain, Italy and Germany. In addition to developing a bike that is capable of turning water into fuel without the need of a charging station, the company plans to massively expand into the retail market within the next few years.

Source: https://inhabitat.com/french-company-debuts-hydrogen-powered-bikes/

Ford brushes off doubts about electric vehicles with $11 billion pledge

A recent survey by KPMG indicates that the auto industry is still committed to electric vehicles, despite a fairly large population of doubters among executives and consumers alike. Well, it looks like The Ford Motor Company does not have any of those skeptics in its ranks. At this week's North American International Auto Show in Detroit, the company pledged an $11 billion investment in EVs by 2022.

Ford doubles down on electric vehicles

The new $11 billion pledge more than doubles a $4.5 billion electrification plan that Ford launched in 2015.

Highlights of the 2015 plan included the addition of 13 new electric vehicles to the Ford line by 2020.

The company also pledged that globally, more than 40 percent of its nameplates would include electric vehicles by 2020.

Ford's new EV plan is even more ambitious. As reported in *The Detroit Free Press*, the company plans to introduce 16 all-electric vehicles by 2022, and 22 more electric vehicles that are plug-ins or hybrids.

That's a huge leap forward from the current roster, which includes just one all-electric vehicle.

What about fuel cell EVs?

All of the vehicles included in Ford's plan run on batteries. That may disappoint hydrogen fans, who are waiting for the company to join the emerging hydrogen fuel cell EV market.

That may take a while. Last year *Business Insider* took a long look at Ford's fuel cell EV dilemma. Back in 2013 Ford paired with Mercedes-Benz and Nissan on hydrogen fuel cell development, but the usual obstacles—price and fuel station availability— are still holding the company back.

On the positive side, Ford CTO Raj Nair sees some indication that fuel cells will gain traction in the heavy-duty vehicle market, where fuel cells offer lighter weight and quicker fueling times than battery packs.

That's in accord with recent moves by GM, which is working with the U.S. Army on hydrogen fuel cell vehicles. The startup Nikola is also moving forward with plans to market a long-haul fuel cell truck, in tandem with fueling stations that can produce renewable hydrogen on site.

Another approach is illustrated by UPS, which has customized a delivery van to run on electricity generated by a hydrogen fuel cell.

Ford is firming up its marketing plans for a hybrid version of the F-150 pickup, and those plans include pitching the battery pack as a source of portable power. If the electric version sells well, that could provide Ford with a window for accelerating its fuel cell activity.

Electric vehicles winning hearts and minds

Ford has its marketing work cut out for it. At the Detroit auto show, Executive Chairman Bill Ford Jr. emphasized that the company is committed to electric vehicles, even if consumers still have some doubts:

"We're going to electrify even our most iconic vehicles," he said at Cobo Center. "The only question is, will the customer be there with us?"

That's a good question, considering the results of the KPMG auto industry survey. Although overseas auto buyers are coming over to the electric side, the U.S. auto buyers in the survey are still more inclined to make their next new car purchase on the internal combustion side.

Ford's plans for winning hearts and minds include electrifying iconic models like the F-150, which are already deeply embedded in American culture.

The company is also taking advantage of the relatively strong interest in electric vehicles overseas. As described by the *Free Press*, the company is working on plans to expand in China's "rapidly growing" EV market.

Ford has put considerable muscle behind the electrification effort. Here's a snippet from the company's website:

> *The expanded engineering capabilities enabled by the Ford Engineering Laboratory will allow the team to control a network of world class facilities in China,*

England, Germany, and the U.S. Through this network, the EPE team will take advantage of globally connected technologies to develop light, durable EV batteries.

Evidently Ford sees the EV market evolving rapidly, with a speed beyond the capabilities of conventional product development.

The plans include new virtual battery testing technology that will help the company accelerate its R&D while cutting down costs related to fabricating prototypes.

Source: https://www.triplepundit.com/2018/01/ford-brushes-off-doubts-electric-vehicles-11-billion-pledge/

Infrastructure needs put a drag on fuel cell vehicle popularity

The debut of Toyota Motor Corp.'s fuel cell vehicle, about three years ago, captured the limelight and raised anticipation that FCVs would blossom. But they appear to be losing momentum as the world turns its attention toward electric vehicles.

With various nations working toward a future ban on conventional gasoline-powered vehicles, many automakers have announced plans to boost EV production in the coming years. But promotion of hydrogen-powered FCVs has been barely visible.

What are the latest developments in FCVs? Will they really take off? Which will become mainstream—EVs or FCVs? Here are some questions and answers about FCVs.

Why do automakers seem to be favoring EVs over FCVs?

EVs are easier to manufacture than FCVs, so promoting EVs lets automakers quickly show the world they are taking on climate change, said Koichi Oyama, senior manager of Deloitte Tohmatsu Consulting Co. and a consultant to the auto industry.

The world has been under intense pressure to reduce carbon dioxide emission since the Paris accord at the COP21 in 2015.

Under the agreement, 196 countries aimed to hold the increase in global average temperatures to less than 2 degrees above pre-Industrial Revolution levels and pursue efforts to limit the increase to 1.5 degrees.

This has pushed automakers to speed up the transition from gasoline- and diesel-powered cars to EVs, FCVs or plug-in hybrid cars.

More specialized parts are used for FCVs than EVs, which means their production requires more coordination between parts manufacturers and automakers.

EV production is straightforward, and can be achieved by just assembling simpler parts. Even nonautomakers, such as Dyson Ltd. and Apple Inc., are reportedly looking to produce EVs on their own.

"Although having cost-competitiveness and securing a supply chain is a different matter, EVs are technologically easy to make and many automakers already have plans for mass production," said Oyama.

How are FCVs selling?

According to Toyota, as of October it has sold 4,500 units of the Mirai sedan globally since its debut in December 2014.

Hisashi Nakai, director of the technologies communication groups at Toyota, said the automaker aims to boost sales to 30,000 units annually in 2020.

Honda Motor Co. is the only other Japanese automaker selling an FCV model; its Clarity Fuel Cell, which debuted in March 2016.

The Tokyo-based firm said it had sold 181 units in Japan and 455 in the U.S. as of November.

"The figures are a little smaller than our initial estimation," said Oyama.

In overseas markets, Mercedes-Benz recently announced that it plans to launch a plug-in fuel cell vehicle in 2019.

What else is hampering the spread of FCVs?

Unlike electricity networks that have already been spread thoroughly in many countries, FCVs need a whole new charging station infrastructure to supply hydrogen.

Japan had 91 hydrogen filling stations in operation as of October, and the government aims to increase that number to 320 by fiscal 2025.

But Japan already has more than 20,000 power charging spots.

Building a hydrogen station is costly, too, at about ¥400 million to ¥500 million compared with the ¥100 million required for a conventional gas station.

Do we need FCVs? Aren't EVs enough?

Some experts say FCVs and EVs both have advantages and disadvantages, so FCVs can complement the weaknesses of EVs' and vice versa.

One strength of FCVs is that they can travel farther. While the cruising distance for EVs is around 400 km, Toyota's Mirai can go about 750 km.

Also, FCVs can be charged faster, taking some 3 minutes to fill up with hydrogen. EVs require 30 minutes even with a rapid charging spot.

In addition, if automakers only produce EVs there would likely be power supply crunches.

For instance, analysts expect that power demand could jump 15 percent in the U.K. by 2040 when the government there plans to ban the sales of gasoline vehicles, according to a survey by Reuters.

For this reason, Oyama said there is "no doubt" hydrogen-powered FCVs will be needed.

"But compared to EVs, it will take longer for fuel cell vehicles to become widespread," he said.

Oyama said more automakers will probably start mass-producing FCVs after 2025, whereas EV's will already be becoming popular by around 2025.

"Eventually, we think the ratio (of EVs to FCVs, among all vehicles) will be 70 percent to 30 percent," said Oyama.

Source: https://www.japantimes.co.jp/news/2017/12/22/business/infrastructure-needs-put-drag-fuel-cell-vehicle-popularity/#.WI-g41SnGM8

Lexus unveils new crossover concept supporting all-electric powertrain as it prepares to launch its first EV

As a brand, Lexus has been suffering on the electric vehicle front due to being part of Toyota, which has until recently been too focused on hydrogen fuel cell to make electric vehicles.

But Toyota has now greenlit Lexus EVs and it unveiled a new crossover concept supporting an all-electric powertrain at the Detroit Auto Show this week.

Toyota says that "by around 2025, every model in the Toyota and Lexus line-up around the world will be available either as a dedicated electrified model or have an electrified option."

Those new electric vehicles will start hitting the market in 2020, according to the Japanese automaker.

It means that the automaker's future vehicles will need to support different powertrains and the LF-1 Limitless concept is an example of that.

Lexus says that the "LF-1 concept could be powered by fuel cell, hybrid, plug-in hybrid, gasoline, or even all-electric."

Kevin Hunter, president of CALTY Design Research, commented:

"This is our vision for a new kind of flagship vehicle that embraces crossover capability without giving up the performance and luxury delivered by today's top sedans. The LF-1 Limitless concept incorporates imaginative technology while creating a strong emotional connection by improving the human experience for the driver and passengers."

Electrek's Take

It's one of the rare 'potentially all-electric' vehicles unveiled at the Detroit Auto Show this year. The show revolved mostly around gas-powered pickup trucks and

large SUVs.

But Toyota has been tentatively moving toward battery-electric vehicles lately with its announcement that it will launch 10 new BEVs worldwide by "the early 2020s" and it wants to have electric options throughout its entire lineup of cars by 2025.

It would make sense for them to focus on an all-electric Lexus to try to compete with Tesla.

We have heard about competing EV programs from virtually every other luxury brand but Lexus.

Now this new vehicle is very much a concept and I wouldn't exactly expect this to hit production anytime soon, but I wouldn't be surprised if one of those "early 2020s" all-electric vehicles end up being a Lexus crossover.

Source: https://electrek.co/2018/01/16/lexus-unveils-new-crossover-concept-all-electric-powertrain/

GM plans to profit from its electric vehicles by 2021

Automaker sees significant promise in electric vehicles

General Motors is placing a great deal of faith in electric vehicles. The company sees great promise for these vehicles in the future, so much so that it believes it will begin generating profit from all of its clean cars by 2021. Many automakers have been slow to embrace clean technology due to potential losses. As technology has improved, however, the potential to generate revenue from the use of batteries and fuel cells has increased.

GM's new clean vehicle has found modest success

GM recently launched its new Chevrolet Bolt EV. CEO Mary Barra suggests that the vehicle has already received a warm welcome among consumers. In the United States, the sales of this vehicle have increased month over month, becoming one of the top five bestselling electric vehicles currently available on the market. GM intends to release new electric vehicles at a faster pace, hoping to establish a significant lead in the rapidly growing clean transportation market.

Cost of battery technology will determine the future of clean cars

The future profitability of electric vehicles will be determined by the cost of battery technology. Over the past several years, the price of batteries has fallen considerably. This has made electric vehicles significantly more affordable to consumers interested in clean transportation. If costs continue to fall, GM believes that the adoption of clean cars will accelerate, creating new opportunities for automakers throughout the world.

Automakers are showing favor for hydrogen fuel cells

Automakers have been somewhat torn on the use of batteries or hydrogen fuel cells. Many companies are investing in fuel cells due to their high performance capabilities and efficiency. GM is also investing heavily in fuel cell technology, believing that these energy systems could play a major role in the future of clean transportation. These automakers believe that batteries could serve as a sort of bridge, making it easier for consumers to enter into the clean transportation space.

Source: http://www.hydrogenfuelnews.com/gm-plans-to-profit-from-its-electric-vehicles-by-2021/8533888/

Toyota boosting efforts to develop fuel cell buses

Automaker plans to have more than 100 units operating for 2020 Tokyo Olympics

Toyota Motor is accelerating its efforts to develop buses and commercial trucks that run on fuel cells, in a push for popularizing the environment-friendly technology despite a global shift toward electricity.

Toyota plans to launch such carbon dioxide-free—at least on the road—vehicles mainly in Tokyo next year.

Fuel cell vehicles are still better placed than electric vehicles in terms of charging time and longer driving range.

At the Tokyo Motor Show in October, Toyota showcased its Sora fuel cell concept bus. The bus uses the Toyota Fuel Cell System, originally developed for the Toyota Mirai fuel cell sedan, to improve its eco-friendliness.

Source: https://asia.nikkei.com/Business/Trends/Toyota-boosting-efforts-to-develop-fuel-cell-buses

Ballard's updated hydrogen fuel cell system for drones

At the end of 2017, Ballard Power Systems released its next generation high performance fuel cell propulsion system to power unmanned aerial vehicles (UAVs) or drones.

Ballard has also received a follow-on contract from Insitu, a Boeing subsidiary, for extended durability testing of the next-generation 1.3 kilowatt (kW) fuel cell propulsion system to power test flights of its ScanEagle UAV platform.

Ballard and Insitu have partnered over the past two years to integrate Ballard's prior generation fuel cell propulsion system—a complete hydrogen (H_2) power system for small unmanned fixed wing and vertical take-off and landing (VTOL) platforms—into the ScanEagle platform. Successful flight testing was announced in mid-2017.

The next generation fuel cell propulsion system delivers a number of important advances: increased power density, resulting from a new membrane electrode assembly (MEA) design; reduced cost, resulting from a combination of new MEA and one-step fuel cell stack sealing process; and extended lifetime. The increase in rated power, without any appreciable increase in size or weight, is a particularly significant development for UAV applications.

Phil Robinson, Vice-President of Unmanned Systems at Protonex, a Ballard subsidiary, said, "The Ballard and Insitu teams have collaborated closely over the past several years to integrate our proven fuel cell technology into the industry-leading ScanEagle platform. This new fuel cell has the potential to deliver a range of benefits compared to the use of an internal combustion engine, or ICE, to power the ScanEagle. These benefits are likely to include an increase in reliability and available electrical power along with a simultaneous reduction in audible noise, thereby enabling lower altitude missions."

In addition to military use, the commercial market for drones is expected to grow significantly over the next few years, from 0.25 million working drones in 2017 to more than 2.5 million working drones by 2021. Applications are anticipated in such areas as agriculture, construction, environmental management, urban & rural surveying, mining, emergency response and law enforcement.

Source: https://www.gasworld.com/ballards-updated-fuel-cell-system-for-drones/2014050.article

Dubai to launch Toyota Mirai fuel cell taxi service

The Dubai Taxi Company, a subsidiary of Dubai's Roads and Transport Authority, has added a Toyota Mirai hydrogen fuel cell car to its fleet. The Mirai has a range of about 300 miles on a single tank of compressed hydrogen. Refueling takes only a matter of minutes, which is an advantage over most electric cars in use today, which can require up to several hours to recharge.

"RTA attaches paramount importance to protecting the environment and saving power consumption, and environmental sustainability is a strategic goal of RTA. This experiment is part of Dubai's low carbon strategy aimed at making Dubai a role model in efficient power consumption and low carbon emission," Mattar Al Tayer, director general of RTA's board, tells Gulf News. "RTA will start a trial run of the vehicle as part of its limousine service in the Dubai International Airport to assess the economic feasibility and environmental benefits of its operation besides verifying the efficiency of the engine, maintenance cost and other parameters," he says.

Dubai Taxi Company began switching to low emissions cars in 2008, starting with Toyota Prius hybrids. Today, there are about 800 hybrid taxis in and around the

city. "Results of our trials with hybrid vehicles have proved the economic and environmental feasibility of the experiment by saving fuel consumption by 30 per cent and reducing carbon emission by 30 per cent as well," said Al Tayer. The goal is for half the local taxi fleet—about 4750 cars—to be low- or zero-emissions vehicles by 2021.

The new Toyota Mirai will be refueled at a hydrogen station installed by Air Liquide at Al Futtaim Motors in Dubai Festival City recently. "The opening of the station will facilitate the use of hydrogen fuel cell vehicles at a larger scale," says Saud Abbasi, managing director of Toyota sales at Al Futtaim Motors. The hydrogen powered Toyota Mirai will be part of a trial run, as the RTA continues to look for alternate fuel options as part of its sustainable transport strategy. Dubai Taxi Company is the first taxi service to offer rides in a fuel cell powered car in the region.

Source: https://cleantechnica.com/2017/12/27/dubai-launch-toyota-mirai-fuel-cell-taxi-service/

CitySprint begins testing new fuel cell vehicles

Company is examining how fuel cells can be used to power vehicles

CitySprint, a leading same-day delivery company in the United Kingdom, has begun testing a new hydrogen-powered van. The new van is meant to help the company reduce its emissions output. During the test period, CitySprint will be assessing its performance to determine whether or not fuel cells would be adequate to power a fleet of delivery vehicles. Relatively few fuel cell vehicles are in use in the United Kingdom, but these cars are becoming more popular among delivery companies and those responsible for corporate fleets.

Van will be able to travel 200 miles on a single tank of hydrogen fuel

The hydrogen-powered van has been manufactured by Renault. The van is equipped with a fuel cell system as well as a battery. The fuel cell generates the electricity that is used to charge the battery and the van is capable of traveling some 200 miles on a single tank of hydrogen fuel. The van will be joining CitySprint's green fleet, which was initially launched in August of last year. Since the launch of this fleet, the company has managed to reduce its carbon emissions by as much as 10 tons.

Fuel cell vehicles continue to gain momentum

Fuel cell vehicles have been gaining popularity for some time, but they are still quite rare in the UK. While these cars are highly efficient and boast of high performance capabilities, they lack comprehensive infrastructure support. Without an ample number of hydrogen fuel stations, these vehicles are relatively unattractive to consumers. Companies like CitySprint still have significant interest in fuel cell vehicles, however, especially as more hydrogen fuel stations take form throughout the country.

UK government is showing support for clean vehicles

Clean transportation has become a major priority for the UK government. Clean vehicles are receiving subsidies from the government that are meant to encourage consumer adoption. These subsidies have helped make fuel cell vehicles more affordable. Several automakers are bringing new clean vehicles to the UK as well, hoping to take advantage of the growing clean transportation market.

Source: http://www.hydrogenfuelnews.com/citysprint-begins-testing-new-fuel-cell-vehicles/8533823/

Honda files patent for new motorcycle that uses fuel cells

New patent could show Honda's next move with fuel cells

A new patent from Honda may have unveiled more about the automaker's future plans with fuel cells. The company has filed for a patent concerning a hydrogen-powered motorcycle. Honda has yet to show off the new prototype vehicle, but the patent shows that it will, indeed, be equipped with a fuel cell system. The automaker has been working to aggressively promote hydrogen fuel in recent years. The automaker has showcased its forthcoming hydrogen-powered sedan, which will likely hit markets at some point in 2020.

Motorcycle will have a standard configuration but will be powered by hydrogen

According to the patent, Honda's new prototype motorcycle will feature a standard sport bike configuration. A hydrogen fuel cell system will be located underneath the seat. The new motorcycle will likely make use of advanced fuel cell technology that Honda has been developing. The automaker has been working to make fuel cell systems smaller and more efficient, thereby making them more affordable. This will not be the first motorcycle equipped with a fuel cell system, but it may be the first to use Honda's more advanced technology.

Honda is working to promote fuel cell technology

Honda has been supporting fuel cells for many years. The automaker was the first to bring a production fuel cell vehicle to the market in 2008 and has since been working on improving fuel cells. Recently, Honda joined a coalition seeking to promote fuel cell vehicles and build new hydrogen fuel stations in its native Japan. This group seeks to build 80 new hydrogen stations throughout the country within the next four years.

Automakers are looking to make fuel cells less expensive

Fuel cells have become quite popular in the clean transportation field. These energy systems have won the support of many automakers but still face significant challenges. One of the greatest challenges these energy systems face is their high cost. Compared to other solutions, fuel cells are relatively more expensive, making them somewhat unattractive to consumers. This is a problem that automakers throughout the world are currently working to solve.

Source: www.hydrogenfuelnews.com/honda-files-patent-for-new-motorcycle-that-uses-fuel-cells/8533666/

Toyota plans to build 100% renewable power and hydrogen plant

Toyota has released plans for a 100% renewable power and hydrogen plant. We consider the possibility that this is a move to produce fuel cell vehicles in the future.

TOYOTA

Scientists around the world have been hard at work solving the mystery of commercialized renewable energy. I often wonder, though, when we'll actually see such technology become widespread.

Well, that time may be coming soon. As I write this article, Toyota is hard at work on a project that will bring renewable energy to California.

The most interesting part, to me at least, is that the source of their renewable energy is cow manure. From manure, they plan to generate water, electricity, and hydrogen for homes on a massive scale.

And while powering homes is so very, very important, it's that bit about hydrogen that has me really excited. Ramping up the production of hydrogen could mean that we're

closer to fuel cell powered vehicles and that alone could take a huge bite out of our greenhouse gas emissions.

This news pairs well with the kinds of things we posted about last year, such as PEMFCs and new fuel cell catalysts.

But let's not get ahead of ourselves. It's important to get some perspective on Toyota's plans, first.

Toyota is Going all in with Renewable Energy

At the Los Angeles auto show, Toyota announced the Tri-Gen Project.

The Tri-Gen Project will be the world's first commercial-scale renewable energy power and hydrogen generation plant. That's right, folks. We're finally getting a commercial-scale, 100% emission-free power plant.

Oddly enough, we have cows to thank for this development. The plant will capture methane gas from dairy cattle manure.

We recently published an article talking about how avoiding factory farm meat and other products can improve your personal health as well as the health of the planet. However, it's unlikely that a move away from cow dairy and protein will happen anytime soon. To that end, Toyota's project could be a useful and efficient compromise.

The project could be a huge step toward reducing emissions, according to Doug Murtha over at Toyota North America. He says, "Tri-Gen is a major step forward for sustainable mobility and a key accomplishment of our 2050 environmental challenge to achieve net zero CO_2 emissions from our operations."

The plant should be able to produce approximately 2.35 megawatts of electricity a day, which is enough to power over 2000 homes. As for hydrogen production, how does 1.2 tons a day sound?

Moving forward, the plant may serve as a source for Toyota fuel cell vehicles, but more importantly, it will start to create the kind of infrastructure that we'll need to convert over to fuel cell cars.

To support this idea, Toyota added into their announcement that they have built one of the largest hydrogen fueling stations in the world.

So far, there are thirty-one retail hydrogen stations open in California. With this move, Toyota has made it clear that they intend to raise that number. Of course, they'll need the help of different companies. That's no problem, though. It's easy to find partners when you're an automobile giant like Toyota.

Bring On the Fuel Cell Automobiles

Many solutions have been offered, but most of them aren't sustainable.

For example, not everyone can ride a bike or walk to work. Also, it is unfeasible so far to wean ourselves off of fossil fuels. Renewable energy sources just aren't cost-effective enough to become widespread. That's why a commercial venture like this is so important; it shows us that progress is being made.

Now, I say that, but there are examples of countries like Costa Rica, who went with 100% renewable energy for an entire year. There's progress out there, folks. You just have to look for it.

Source: https://edgylabs.com/toyota-plans-to-build-100-renewable-power-and-hydrogen-plant

Pressure is mounting—Automakers need to deliver

The current standard in all things transportation is China. It makes policy with which even automakers in Germany need to comply if they want to keep their foot in the door. Air pollution in many large Chinese cities is so high that politicians have been forced to take drastic measures. It is the reason why the government is providing massive amounts of subsidies to promote electric transportation, which has led to half of all electric vehicles worldwide being manufactured in China—and driven there as well. But that's not all: The People's Republic could soon implement a production quota, earlier than most had hoped.

One country where the announcement of a quota has caused great unease is Germany, as the design of the related policy could have serious consequences for the domestic automotive industry. It came as no surprise then

that there had been several rumors making the rounds and many attempts to intervene on the industry's behalf.

Initially, the plan was to set the share of electric – or at least, hybrid – vehicles sold by each manufacturer to 8 percent from January 2018. It was to rise by 2 percent each year thereafter and non-compliance would result in a penalty.

When Sigmar Gabriel went on his first visit to China in his new capacity as Germany's foreign minister in May, German associations injected themselves into the debate and even Chancellor Angela Merkel felt the need to mention the quota when meeting China's Premier Li Keqiang. In response, Beijing seemed willing to consider other options and the German automotive industry had new hope that they would get more time and fewer restrictions. One car expert, Ferdinand Dudenhöffer, subsequently explained: "The carmakers are gaining valuable time that they should use to the best of their abilities."

In June, however, it was said that the rules were not going to be introduced later than planned, nor would they be watered down. This prompted several carmakers to jointly write a letter to the Chinese government, discussing openly the possibility of a trade war. It seemed as if China was very much intent on following through with its policy proposals, but news outlets reported in late September that their implementation might be postponed by one year.

What about Europe?

Meanwhile, there are more and more voices within the EU calling for the establishment of a quota. As the Energate magazine reported this June, some of the staff from the office of EU Commissioner Maroš Šefčovič had floated the idea of targeting a mandatory electric vehicle share in new car sales. A spokesperson for the commission did deny the report in September, but two other German magazines – Handelsblatt and Climate Home – said shortly thereafter that the idea was not off the table. It was "increasingly clear" that there would be a decision in fall to establish an up to 15 percent minimum for sales in the EU from 2025.

Even in Germany, there have already been discussions about some type of mandatory share. In mid-August, during the election campaign, the Social Democratic candidate for chancellor, Martin Schulz, spoke in favor of it as part of a five-item agenda and announced on the Spiegel online website: "We will put mounting pressure on the industry." In contrast, the Stern magazine had reported earlier that lobbyists from the automotive industry had spoken out against a quota and a much more ambitious electric vehicle program, on which the ministries had agreed in September 2015.

The amount of economic incentive, which was originally supposed to be financed through a bonus-malus system and not by using tax money to cover half of it, had been planned to go up to EUR 5,000. One expert working in the environment ministry, however, had warned that even this amount could be too low considering the difference in price between electric and fossil fuel vehicles.

Driving bans in sight?

Both the French and British government confirmed that they intend to ban sales of new fossil fuel-powered cars by 2040. Likewise, the Austrian transportation minister announced a 2030 target of only zero-emission vehicles in new registrations. Additionally, metropolitan areas such as Athens, Madrid, Mexico City and Paris are planning to prevent diesel cars from driving into their inner cities from 2025.

In Germany, the Green Party and former environment minister Barbara Hendricks from the Social Democrats have called for a ban on selling any more cars powered by gasoline and diesel from 2030. Hendricks said at this year's eMobility Summit in Berlin that the exit from fossil fuels was doable and that by 2030, German engineers would "easily be able to design zero-emission vehicles."

Source: https://www.h2-international.com/2017/11/02/pressure-is-mounting-automakers-need-to-deliver/

California aims to have 5 million electric cars on the road and 250k charging stations by 2030

In January, California Gov. Jerry Brown announced a series of new executive orders to push the state to have 5 million electric cars on the road by 2030.

It's the most ambitious zero-emission goal in the US, but is it enough?

It's an update to the state's goal to have 1.5 million zero-emission vehicles by 2025.

With the goal, the Administration is also proposing a new "eight-year initiative to continue the state's clean vehicle rebates and spur more infrastructure investments". The rebate already includes payment of up to $2,500 at the purchase of new electric vehicles and infrastructure investments would represent a $2.5 billion initiative to bring 250,000 vehicle charging stations and 200 hydrogen fueling stations to California by 2025.

The state already leads the country for both electric vehicle adoption and the number of total charging stations.

They claim to have 350,000 "zero-emission vehicles" today and new sales account for approximately 5 percent of all new car sales in California.

Electrek's Take

I think the last statistic is the most important. California is seeing 2 million new car sales per year and now only 5 percent are electric (and they are counting PHEVs).

Five million EVs by 2030 would mean roughly 30 percent of the state's total car fleet would be electrified, but it's not a great metric. You can't do much about existing vehicles on the road, which is why you want to focus on the adoption rate.

Five percent is not bad in the US, but if California really wants to be the EV leader it once was, it really needs to think bigger—like Norway, which is now at over 50%.

Now don't get me wrong, this is a great initiative and certainly better than what we are seeing from the federal level, but I think it could be even more ambitious.

They are considering combining the strategy with a goal to reach 100% of new car sales to be electric by 2040. I think they should make that by about 15 years sooner.

If they aim to be at 100% electric in 2025, then they will easily reach their goal of 5 million EVs on the road by 2030.

Anyway, I don't see how someone in their right mind would want to buy a car that is not electric by 2025.

Source: https://electrek.co/2018/01/29/california-electric-cars-charging-stations/

Hydrogen-fueled truck maker announces $1 billion Arizona plant

Nikola Motor Company unveiled plans on January 30, for a $1 billion manufacturing hub for its hydrogen-fueled semi-trucks, as the company seeks to expand in the nascent market for alternative-fuel freight trucking.

The 500-acre (202.34 hectare) Phoenix-area facility would be one of the largest stand-alone manufacturing facilities for next-generation semis, Nikola said, and is the latest sign of investor confidence that alternative-fuel trucks can gain a toehold in the freight market alongside relatively low-cost, time-tested diesel trucks.

The announcement for the plant comes more than two months after Tesla Inc unveiled plans for an all-electric semi-truck that would be in production in 2019, though it has not said where the truck will be built.

It also comes as companies like Navistar International Corp and Volkswagen AG VOWG-P.DE are working to launch electric medium-duty trucks by late 2019, and Daimler AG has delivered the first of a smaller range of electric trucks to customers in New York.

Nikola, currently based in Salt Lake City, Utah, manufactures hydrogen-electric vehicles and hydrogen fueling stations, and has received pre-orders for more than 8,000 of its semi trucks, it said.

Nikola said it expects construction in 2019 with the first trucks rolling off an assembly line in 2021.

The company declined to provide details of an incentive package it received from Arizona, but said the costs for developing the $1 billion facility would be shared between Nikola and the state.

Source: https://www.reuters.com/article/nikola-plant/hydrogen-fueled-truck-maker-announces-1-billion-arizona-plant-idUSL2N1PP1T5

Secrets of ancient Egypt may spark better fuel cells for tomorrow's cars

To make modern-day fuel cells less expensive and more powerful, a team led by John Hopkins chemical engineers has drawn inspiration from the ancient Egyptian tradition of gilding.

Egyptians artists at the time of King Tutankhamun often covered cheaper metals (copper, for instance) with a thin layer of a gleaming precious metal such as gold to create extravagant masks and jewelry. In a modern-day twist, the Johns Hopkins-led researchers have applied a tiny coating of costly platinum just one nanometer thick—about 1/100,000th the diameter of a human hair—to a core of much cheaper cobalt. This microscopic marriage could become a crucial catalyst in new fuel cells that generate electric current for powering cars and other machines.

The new fuel cell design would save money because it would require far less platinum, a very rare and expensive metal that is commonly used as a catalyst in present-day fuel-cell electric cars. The researchers, who published their work earlier this year in *Nano Letters*, say that by making electric cars more affordable, this innovation could curb the emission of carbon dioxide and other pollutants from gasoline- or diesel-powered vehicles.

"This technique could accelerate our launch out of the fossil fuel era," said Chao Wang, a Johns Hopkins assistant professor of chemical and biomolecular engineering and senior author of the study. "It will not only reduce the cost of fuel cells. It will also improve the energy efficiency and power performance of clean electric vehicles powered by hydrogen."

In their article, the authors tipped their hats to the ancient Egyptian artisans who used a similar plating technique to give copper masks and other metallic works of art a lustrous final coat of silver or gold. "The idea," Wang said, "is to put a little bit of the precious treasure on top of the cheap stuff."

He pointed out that platinum, frequently used in jewelry, also is a critical material in modern industry. It catalyzes essential reactions in activities ranging from petroleum processing and petrochemical synthesis to emission control in combustion vehicles, as well as being used in fuel cells. But, he said, platinum's high cost and limited availability have made its use in clean energy technologies largely impractical—until now.

"There's a lot more cobalt out there than platinum," said lead author and Johns Hopkins post-doctoral fellow Lei Wang (not related to Chao Wang). "We've been able to significantly stretch the benefits of platinum by coating it over cobalt, and we even managed to enhance the activity of platinum at the same time."

Earlier attempts to plate precious metals on non-precious materials were largely stymied by galvanic replacement reactions—oxidation of the non-precious metal. In this study, the team successfully suppressed such reactions by introducing carbon monoxide, a gas molecule that strongly binds to cobalt, protecting it from oxidation.

Not only did the cobalt-platinum nanoparticles reduce the usage of platinum; they performed almost 10 times better than platinum alone. The researchers said this enhanced catalytic activity resulted from both the maximized exposure of platinum atoms on the surface and from interactions between the two metals. "The intimate contact between cobalt and platinum gives rise to compressive strain," Lei Wang said. "It shortens the distance between platinum atoms and makes the chemical reactions more feasible on the surface."

Because platinum and other rare metals play key roles in many industrial applications, the implications of this work extend beyond fuel cells. Currently, the team is working on adapting their technique to other precious metals and non-precious substrates. New developments will target further applications of such materials in chemical conversions of hydrocarbons.

"Many reactions that depend on precious metal catalysts could be rendered cheaper and more effective by taking advantage of our technology," Chao Wang said. "At a time when we are becoming painfully aware of the limits of our non-renewable sources of energy and materials, this technique points us in a very welcome new direction."

Source: https://www.sciencedaily.com/releases/2017/12/171219220817.htm

China is new world leader in renewable energy

Made in China

China continues to be an unstoppable force in the realm of renewable energy. A new report released by the Institute for Energy Economics and Financial Analysis (IEEFA) delves deep into the country's efforts to lead the world in laying an international foundation for renewable energy generation. The report states that in 2017, China's total investment in clean-energy projects represented more than $44 billion in investment—a significant growth from 2016's $32 billion.

According to the report's lead author, Tim Buckley, IEEFA's Director of Energy Finance Studies, the United States' decision to withdraw from the Paris climate agreement was an important catalyst for China's growing renewable energy dominance. "Although China isn't necessarily intending to fill the climate leadership void left by the U.S. withdrawal from Paris, it will certainly be very comfortable providing technology leadership and financial capacity so as to dominate fast-growing sectors such as solar energy, electric vehicles, and batteries."

Pushing coal out

While the commitment to renewables is impressive, China has not completely divested from its ties to fossil fuels. The country still relies on coal to meet part of its massive energy needs. Still, the nation's energy portfolio is rapidly expanding beyond fossil fuels as the nation embraces a variety of renewable resources, such as hydro, wind, solar, bioenergy, and other renewables.

China has experienced some serious growth in the past few decades, making it an industrial powerhouse—but with that has come a reputation for dangerous levels of pollution. In recent years, the Chinese government has made significant strides in changing that tide, even going so far as to shut down 40 percent of its factories for not abiding by emissions regulations.

Experts from the International Energy Agency (IEA) are projecting that China's reliance on coal will continue to decline and its investment in renewable energy projects around the world will continue to grow. With many nations around the world stepping up to more fully embrace renewable energy, the U.S. will have a lot of catching up to do if it hopes to be a force in the renewable energy revolution.

Source: https://futurism.com/china-new-world-leader-renewable-energy/

Inventors search for 'missing link' in renewable energy

What may become one of the most disruptive renewable energy experiments in recent history is taking shape behind a building here in an assemblage of girders, pipes and tanks. It's called a bioreactor, but has the look of an unfinished project built with pieces from a giant erector set.

It's the apparatus of an ambitious goal: to make a renewable form of natural gas, which chemists also call methane. Instead of being produced from underground fossil fuel deposits, the methane from this machine will come from a two-step process. First, supplies of cheap solar and wind-powered electricity will be used to split hydrogen from water. Then the hydrogen will be combined with carbon dioxide, the otherwise troublesome greenhouse gas.

The bioreactor will subject this gaseous mix to pressure, plus the metabolisms of an unusual and very obliging community of tiny microbes called archaea. These bugs catalyze a reaction that turns the hydrogen and CO2 into a renewable form of methane that could be stored in great quantities in the globe's existing natural gas pipeline systems. That kind of storage could provide a cleaner fuel almost anywhere it is needed.

Within a century or two, the world's natural gas supplies might be depleted, predicts Kevin Harrison, an engineer who is overseeing this "Power to Gas" (P2G) experiment here at the National Renewable Energy Laboratory (NREL).

"It would be nice to leave some of that underground," Harrison said, referring to naturally occurring methane, which also becomes a powerful global warmer when it leaks into the atmosphere.

P2G could be disruptive because it upends the current system. Instead of burning natural gas to make electricity or heat, it would use renewable electricity and carbon dioxide—that would otherwise be emitted into the atmos-

phere—to make natural gas. The Department of Energy, which has used NREL to spur cheaper supplies of wind and solar power over recent years, sees the resulting gas as one way to avoid expensive renewable energy storage systems that use hydrogen, electric batteries and molten salt. If it works, the storage system for this methane is already built and paid for.

Like many stories in the scientific saga to remove problems posed by climate change, this one features improbable beginnings and blind alleys. The archaea were discovered by a group of Swiss engineers lounging at a hot springs resort in Iceland in the 1970s. They found what appeared to be bacteria that were producing the springs' 150-degree-Fahrenheit temperatures. They isolated one strain and deposited it in a collection of curious microorganisms in Germany.

The developer of the archaea catalyst chosen for P2G is Laurens Mets, a molecular biologist at the University of Chicago. He wants to see it demonstrated here at NREL because he was forced to develop the process in Europe. To some Americans, his project has a fairy tale aspect to it, an aura that he wants to dispel. "People who don't believe it can go in and watch it in action," he said in an interview.

He started his research in the 1990s, when many scientists thought that the next breakthrough in clean energy would involve just the first step: to store renewable energy as hydrogen and distribute it in that form. Some scientists still refer to the expanded idea as the future "hydrogen economy." At the time, Mets was struggling with a process that used light beams to coax algae to produce hydrogen, but he began having doubts about whether hydrogen, a tiny, flammable atom that can work its way into most metals, could be stored safely and cost-effectively.

He decided to refocus his efforts on archaea, microbes that resemble bacteria, but are smaller and genetically quite different. Their metabolism produces heat and methane, which Mets knew could be stored. Methane contains 3 ½ times more energy than hydrogen. But Mets heard reports that the bugs he found couldn't be trusted to scale up their methane production because they would use more of it to grow, and that the process could be poisoned by nearby oxygen.

But after testing them in his Chicago laboratory, Mets concluded that these reports were "urban myths." His archaea didn't divert much methane into their bodies and were very tidy, scrupulously removing oxygen from their surroundings. As he put it: "We brought in a whole bunch of these strains to compare and settled on this one group that seemed to be extremely efficient. They need almost nothing. We feed them hydrogen and carbon dioxide."

With help from the University of Chicago's Polsky Center for Entrepreneurship and Innovation, which commercializes promising technologies developed by its researchers, Mets obtained a patent on the selected strain and formed a company called Electrochaea in 2010. The business set up offices in St. Louis.

But then he found himself in what seemed to be another blind alley. The process of hydraulic fracturing, a relatively new method of drilling for natural gas, was producing so much fuel that by 2010, the U.S. price of natural gas began to drop by as much as 60 percent. Not many Americans were interested in a sketchy idea that promised a more expensive form of natural gas.

"The economics really went in the tank," Mets recalled.

But Mich Hein, an "entrepreneur-in-residence" working at the Polsky Center, became CEO of Electrochaea and discovered a much different situation evolving in Europe. In Denmark, which had begun to produce a considerable amount of wind-powered electricity, natural gas prices were climbing. The country relied on supplies from wells in the North Sea, which were being depleted, posing the possibility that it might have to depend on buying future natural gas supplies from Russia. Sweden and Germany were worried about the same problem.

Hein, who had previously organized some small biotechnology companies, worked up a pitch to sell archaea. Most biotech processes, he explained, don't scale up. "We tend to take microbes that can do X and try to get them to do Y. And they can do that if you beat them with a stick, but as soon as you stop doing that, they'll stop doing Y and go back to making X," he said. "But these guys [archaea] want to do Y for a living."

Energinet, Denmark's state-owned operator of its electricity and natural gas systems, was intrigued. It had excess wind power, and it helped finance an experiment with Electrochaea at a Danish university. When that worked,

Energinet found partners to help finance a larger experiment just outside Copenhagen that fed the bugs CO_2 from a local sewage plant. They devoured it.

Hein found venture capital partners in Munich, where he helped set up a European headquarters. Then he found a utility in Hungary, Magyar Villamos Muvek, that agreed to build a 10-megawatt pilot facility, the first commercial-sized plant that produces renewable natural gas.

Another selling point, Hein discovered, was that Europe is seriously considering carbon taxes to help reduce greenhouse gas emissions. That brought in Audi AG, the German carmaker, as an investor. According to Hein, it had worked out the math and found that lowered carbon emissions would give it a tax break to sell its Audi A3 Sportback, which, like many cars, can run on gasoline or, with some adjustments, on natural gas.

Finally, in 2017, the heroic feats of Mets' bugs began to raise eyebrows in the United States. Southern California Gas Co., or SoCalGas, has over 21 million customers. It is the largest natural gas distributor in the United States and is located in a state that encourages low-carbon fuels and where many electric utilities have more available solar and wind power than they can sell.

SoCalGas is partnering with NREL to build the bioreactor that is taking shape here. "We're helping with the study of this technology because it may offer the potential to use a natural gas distribution system as a utility-scale storage for excess wind and solar electricity generation," SoCalGas said in a statement to E&E News.

"It holds the potential to be a tool to support the expansion of our wind and solar energy resources to meet California's electricity needs around the clock. Additionally, it could drive economic growth in the Western U.S. by helping to optimize the region's electric and gas grid operations," SoCalGas added.

But even that may not be the end of this renewable energy fairy tale. According to Harrison, the engineer at NREL, an animal feed company that he would not name wants to use NREL's bioreactor when SoCalGas, which owns it, is finished with it. The feed company's goal is to see if the bugs would make a basic and more expensive cattle and chicken feed ingredient: amino acids.

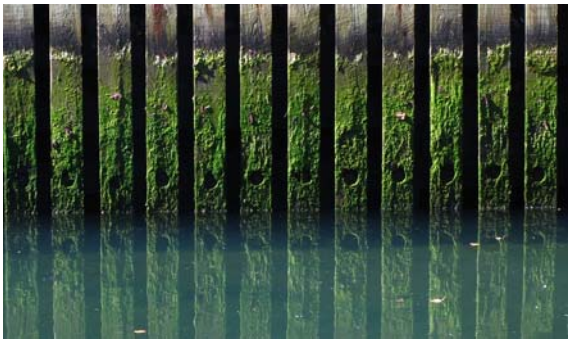
Mets, the inventor, says he has no interest in amino acids but intends to focus more research on getting his bugs to make precursors for jet fuel and gasoline. Finally, Hein, who directs Electrochaea, says he has been having "extended discussions" with owners of wind farms and promising wind farm sites in Canada, West Texas and Iowa that have no nearby connection to the electric power grid.

But they might become commercial if they turned their electricity into methane, which can be piped or trucked.

"What we're looking at here," he said, "is the missing link in the renewable energy portfolio."

Source: https://www.eenews.net/stories/1060071143

Researchers develop new algae-powered fuel cell system



New system is five times more efficient than other plant-based solutions

Researchers from Cambridge University have developed a new fuel cell that is powered by algae. According to the research team, the fuel cell is five times more efficient than similar plant-based systems that are currently in use. This particular fuel cell does not use hydrogen to generate electrical power, but it does leverage the energy provided by the sun. Algae-powered fuel cells are quickly becoming popular due to their efficiency and use of renewable energy.

New system uses algae to efficiently generate electrical power

The new fuel cell is designed to be biophotovoltaic. The fuel cell is equipped with a solar cell that takes advantage of biological mechanisms in order to collect sunlight and generate electrical power. The algae within the fuel cell

system convert sunlight into electrons that are then funneled through the fuel cell. The system is separated into charging and power delivery components. This has allowed researchers to make the system more efficient by improving each component.

System is still less powerful than conventional solar cells

The research team was able to improve the system by first engineering more efficient algae. The algae being used by the fuel cell system dissipate less energy during the photosynthesis process. This has allowed the fuel cell to be five times more efficient than its counterparts, but the system is actually less powerful than actual solar cells. Compared to solar cells, however, the new system is somewhat less expensive. The technology could eventually be used in rural areas that are in need of electrical power.

Algae-based fuel cells are gaining popularity in the renewable energy field

Fuel cells typically make use of hydrogen to generate electricity, but newer forms of these energy systems are becoming more common. Algae-based fuel cells have shown some promise due to their focus on using photosynthesis to generate power. These types of fuel cells are typically more affordable because they do not require the expensive materials needed to develop conventional hydrogen-powered systems.

Source: http://www.hydrogenfuelnews.com/researchers-develop-new-algae-powered-fuel-cell-system/8533850/

Saudi Arabia plans up to $7 billion of renewable energy projects this year

Saudi Arabia expects to start up to $7 billion of renewable energy projects this year, with solar plants leading the way.

Tenders will be issued this year for eight projects totaling 4.125 gigawatts of capacity, Turki Mohammed Al Shehri, head of the kingdom's Renewable Energy Project Development Office, said Tuesday in an interview in Abu Dhabi. The cost will be $5 billion to $7 billion, he said.

Saudi Arabia and other Middle Eastern oil producers are looking to renewables to feed growing domestic consumption that's soaking up crude they'd rather export to generate income. The kingdom wants to have 9.5 gigawatts of solar and wind capacity installed by 2023. Developers have been cutting their bids for solar power to record lows in recent years.

"We do hope to continue breaking records," Al Shehri said.

The Saudi projects this year will include 3.3 gigawatts of solar photovoltaic power and 800 megawatts of wind, Al Shehri said. Winning bidders will cover financing costs while the government guarantees to buy power produced from the projects over 25 years, he said.

The kingdom plans to have 3.45 gigawatts of renewable power online by 2020, according to Al Shehri. That includes 700 megawatts of solar and wind power already tendered, he said. Saudi Arabia expects final bids to build a 400-megawatt wind plant at Dumat Al Jandal in the country's northwest on March 20, according to an email from Al Shehri's office.

Source: https://www.bloomberg.com/technology

Nike takes steps toward 100% renewable energy in North America

Nike announced today that it has signed its second major wind contract with Avangrid Renewables—this time for 86 megawatts of Texas wind power.

"This agreement enables us to source 100 percent renewable energy across our owned or operated facilities in North America," says Hannah Jones, Chief Sustainability Officer and VP of the Innovation Accelerator for Nike. "Investing in renewable energy is good for athletes, the planet and for business."

This virtual power purchase agreement (PPA) will come to life through the Karankawa Wind Farm near Corpus Christi, Texas, that's scheduled for completion in mid-2019. Nike's power purchase commitment of 86 megawatts over the life of the agreement is equivalent to powering more than 400,000 average American households with carbon-free energy or to the emissions reduction of taking nearly 800,000 vehicles off the road for one year.

Source: https://news.nike.com/news/nike-renewable-energy-wind-farm

Could giant "Solar Rigs" floating on the ocean convert seawater to hydrogen fuel?

Scientists at Columbia University have designed a device that could make the process economically viable

Usually, when we think about energy production at sea, we imagine giant oil rigs, or perhaps rows of towering wind turbines. Recently, though, floating solar panels have been added to the mix, including a solar farm the size of 160 football fields that went into operation in China last year.

Now, a team of researchers at Columbia University wants to go a step farther. They say it's possible to use solar panels on the ocean surface to power devices that can produce hydrogen fuel from seawater.

Hydrogen is a clean form of energy, but it's most commonly produced from natural gas in a process that also releases carbon dioxide, a key driver of climate change. The Columbia scientists say their device, called a floating photovoltaic electrolyzer, eliminates that consequence by instead utilizing electrolysis to separate oxygen and hydrogen in water molecules, and then storing the latter for use as fuel.

Team leader Daniel Esposito, an assistant professor of chemical engineering, points out that using existing commercial electrolyzers to generate hydrogen is pretty costly. "If you take off-the-shelf solar panels and commercially available electrolyzers, and you use sunlight to split water into hydrogen and oxygen, it's going to be three to six times more expensive than if you were to produce hydrogen from natural gas," he says.

He also notes that those electrolyzers require membranes to keep the oxygen and hydrogen molecules separated once they're split apart. That not only adds to the cost, but those parts would tend to degrade quickly when exposed to the contaminants and microbes in saltwater.

"Being able to safely demonstrate a device that can perform electrolysis without a membrane brings us another step closer to making seawater electrolysis possible," Jack Davis, a researcher and lead author of the proof-of-concept study, said in a statement. "These solar fuel generators are essentially artificial photosynthesis systems, doing the same thing that plants do with photosynthesis, so our device may open up all kinds of opportunities to generate clean, renewable energy."

Bubbling up

So, what makes their electrolyzer distinctive?

The device is built around electrodes of titanium mesh suspended in water and separated by a small distance. When an electrical current is applied, the oxygen and hydrogen molecules split apart, with the former developing gas bubbles on the electrode that's positively charged, and the latter doing the same on the one with a negative charge.

It's critical to keep these different gas bubbles separated, and the Columbia electrolyzer does this through the application of a catalyst to only one side of each mesh component—the surface farthest away from the other electrode. When the bubbles get larger and detach from the mesh, they float up along the outside edges of each electrode instead of mixing together in the space between them.

Not only have the scientists avoided using expensive membranes, but they also didn't have to incorporate the mechanical pumps that some models use to move liquids. Instead, their device relies on buoyancy to float the hydrogen bubbles up into a storage chamber. In the lab, the process was able to produce hydrogen gas with a 99 percent purity.

Alexander Orlov, an associate professor of materials science and chemical engineering at Stony Brook University in New York, agrees that the elimination of membranes is a "substantial" development. "The membranes are weak points in the technology," he says. "There are some more sophisticated solutions, but Esposito's approach is extremely simple and quite practical. It has been published and peer-reviewed in very high-impact publications, so despite its simplicity, the science and novelty are solid."

Thinking big

Esposito and Davis readily acknowledge that it's a big leap from the small model tested in their lab to the massive kind of structure that could make the concept economically viable. It might need to comprise hundreds of thou-

sands of connected electrolyzer units to generate a sufficient amount of hydrogen fuel from the sea.

In fact, says Esposito, it might be necessary to make some design changes as the project scales up and becomes more modular, so many pieces can fit together to cover a large area. Also, they face the challenge of finding materials that can survive for a long time in saltwater.

That said, both believe their approach has potential to affect the country's energy supply in a meaningful way. Hydrogen already is heavily used in the chemical industry, for instance, to make ammonia and methanol. And, demand is expected to keep rising as more auto manufacturers commit to cars that run on hydrogen fuel cells.

Their long-term vision is of giant "solar fuel rigs" floating in the ocean, and Esposito has gone so far as to estimate how much cumulative area they would need to cover to generate enough hydrogen fuel to replace all the oil used on the planet. His calculation: 63,000 square miles, or an area slightly less than the state of Florida. That sounds like a lot of ocean, but he points out that the total area would cover about .045 percent of the Earth's water surface.

It's a bit of a pie-in-the-sky projection, but Esposito has also thought about the real-world challenges that would face a floating energy production operation not tethered to the sea bed. For starters, there are big waves.

"Certainly, we'd need to design the infrastructure for this rig so that it can withstand stormy seas," he says. "It's something you would take into account when you're thinking where a rig is located."

And maybe, he adds, these rigs could be able to move out of harm's way.

"There's the possibility of a rig like this being mobile. Something that could perhaps expand, and then contract. It probably wouldn't be able to move fast, but it could move out of the way of a storm.

"That would be really valuable," he says.
Source:
https://www.smithsonianmag.com/innovation/could-giant-solar-rigs-floating-on-ocean-convert-seawater-to-hydrogen-fuel-180967750/

How hydrogen could help clean up the global shipping industry

With their greenhouse gas emissions rising and regulations looming, shipping companies that transport nearly all of the world's goods are looking at renewable fuel sources to power container ships.

The shipping industry is responsible for about 3 percent of global greenhouse gas emissions, according to the International Maritime Organization (IMO), and the European Commission estimates that its spew could grow between 50 percent and 250 percent by 2050. Yet the international climate accord hashed out in Paris in 2015 gave the industry a free pass, placing no requirements on the IMO, the body that regulates shipping, to reduce carbon emissions.

Nevertheless, the organization is working on a strategy to cut emissions, which it plans to unveil this year. If the IMO fails to come up with an acceptable plan by 2021, however, the European Union's emissions reduction scheme will include shipping by 2023. IMO regulations go into effect in 2020 that will limit vessels' sulfur emissions, a deadly byproduct of fossil fuels that's found in particularly high concentrations in the cheap, lightly refined petroleum product known as bunker fuel favored by shippers.

These developments have the industry scrambling to adopt alternative fuels. Low-sulfur diesel and biofuels will probably make up the bulk of the substitution in the near term, but eventually, say shipping industry executives and energy experts, the fuel of the future for cruise liners, ferries and container ships will likely be hydrogen. Electricity generated from a hydrogen fuel cell to drive a motor produces no emissions, and when coupled with batteries and a device called an electrolyzer, the system can produce hydrogen from a resource that all vessels have easy access to: seawater.

Already, Compagnie Maritime Belge, based in Antwerp, has built a small passenger shuttle boat that runs on hydrogen called the Hydroville. While fuel cells, which convert hydrogen into electricity through a chemical reaction, will likely be the generator of choice in the future, the company's research and development manager, Roy Campe, converted a diesel engine to run on compressed

hydrogen. "We know how to maintain a [combustion] engine onboard and if something breaks we can fix it," he told Oceans Deeply. "But with fuel cells it's a different story."

Campe and Alexandre Closset, chief executive of Swiss Hydrogen, which designs and builds hydrogen fuel cells for stationary and mobile applications and is currently working to install them on two research vessels, emphasized the challenging marine environment as one obstacle that will need to be figured out before fuel cells see widespread adoption on ships. "We have more work to do on air filters due to the salinity of the air," Closset said. Campe noted that fuel cells' high cost and lack of a backup fuel option (for systems that don't include a costly electrolyzer) are other factors now limiting their use at sea.

But Scott Samuelsen, director of the National Fuel Cell Research Center at the University of California, Irvine, sees electricity produced from hydrogen as the inevitable choice of the shipping industry for three reasons.

Environmental regulation is one: Already, ports including the United States' largest, in Long Beach, California, are placing stringent pollution limits—not just on ships docking there but also on the trucks that offload containers from the vessels.

The second is that hydrogen can be generated locally, either onboard or from wind and solar farms onshore deploying an electrolyzer, obviating the complex and fraught geopolitics around fossil fuel production. That method has an ancillary benefit of putting renewable energy power plants to use when the weather is favorable but utilities' electricity demand is low.

The third is that in the long term, hydrogen fuel will mean lower operating costs for shippers as fuel cells drop in price due to economies of scale and petroleum becomes more expensive due to environmental regulations. "It will be an evolution and a changeover in the population of ships over many decades," Samuelsen said.

As was the case with cars a decade ago, the first electrically powered vessels will be hybrids because of the current high cost of fuel cells and the immense amount of power required to propel a cruise liner or container ship. One such system would couple an array of fuel cells with a turbine engine running on liquefied natural gas. South Korea's LG is expected to offer the first such hybrid fuel-cell gas turbine propulsion system in the next four years, Samuelsen said. The liquefied natural gas component of the system can later be converted to run on hydrogen.

Fuel cells can also power a ship's ancillary electrical systems while the vessel is propelled by an electric motor hooked to a diesel generator and a battery. When the ship approaches port, it can run on the battery to reduce emissions. As fuel cells fall in price, Closset said, "You just replace the diesel generator with fuel cells, as the boat is already equipped with an electric motor."

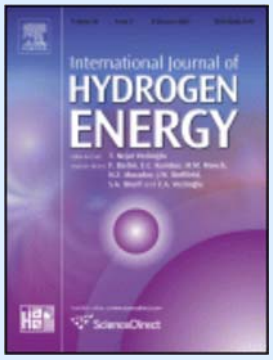
Full fuel-cell propulsion is probably still decades away, though. Swiss Hydrogen is part of a consortium that is working on a system for the Finnish research vessel Aranda. Scientists aboard Aranda collect air samples that must not be contaminated by engine fumes, and vibration from the engines can interfere with other observations scientists make onboard the ship. The hydrogen-powered system will enable maneuvering onsite, solving both problems at once. To propel the vessel, however, "we'd probably need 10 times more power," Closset said.

Ferry operators and cruise lines have approached the company about developing a fuel-cell stack on such a scale. "They can promote to customers, 'We're using clean fuel, the ship doesn't smell,' and so forth," Closset said.

But the container ships that produce the bulk of that 3 percent share of global emissions and transport 90 percent of the world's products are another matter. The industry fiercely lobbied to be left out of the Paris agreement, according to a report last year from the United Kingdom-based organization Influence Map, which researches corporate influence on climate policy and other issues. And Closset said that low-emission systems need to be low-cost, "so it will be very difficult for them to introduce new technology."

Source: https://www.newsdeeply.com/oceans/articles/2018/01/10/how-hydrogen-could-help-clean-up-the-global-shipping-industry

International Journal of Hydrogen Energy Highlights



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   Ge L, Han C, Xiao X, Guo L. Int J Hydrogen Energy 2013;38(17):6960-6969
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   Durbin D, Malardier-Jugroot C. Int J Hydrogen Energy 2013;38(34):14595-14617
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   Abbas S, Dupont V, Mahmud T. Int J Hydrogen Energy 2017;42(5):2889-2903
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7. **Metal hydride materials for solid hydrogen storage: A review**
   Sakintuna B, Lamari-Darkrim F, Hirscher M. Int J Hydrogen Energy 2007;32(9):1121-1140

The investment costs of electrolysis—A comparison of cost studies from the past 30 years

S. M. Saba, M. Müller, M. Robinius, D. Stolten. Int J Hydrogen Energy 2018: 43(3):1209-1223

With the goal of increasing the amount of renewable energy on electrical grids worldwide comes the challenge of determining how to store grid-level amounts of energy on account of the intermittent nature of renewables. On a global scale, the total installed renewable capacity in 2015 was 785 GW (up from 665 in 2015) without hydro, and 1849 GW including it. Having renewables online presents new challenges in the form of distributed generation management as well as storage and utilization of surplus energy. Hydrogen produced by water electrolysis from excess renewable energy is a solution to the aforementioned challenges and is the key technology that has been investigated for energy storage on this scale. This article takes a look at state of the art cost estimates from across the past 30 years and compares them in the value of the Euro in 2017 per kW ($€_{2017}$/kW) adjusted for inflation. Several different types of electrolyzers have been considered over the years including polymer electrolyte membrane (PEM) electrolyzers, alkaline electrolyzers and solid oxide electrolyzers (SOE) thus the estimates over the years take into account which type of system, the approximate efficiency, the output flowrate and the cost. While there is a high degree of variability due to the sampling of over 25 different studies, of which multiple cost approximations are posited, the cost estimation currently is for today is between 397 and 955 $€_{2017}$/kW, where it was in the range of 306 to 4748 $€_{2017}$/kW. Higher automation, mass production, larger cell areas, market penetration and technology development are all expected to have further impacts on the investment costs.

https://www.sciencedirect.com/science/article/pii/S0360319917344956

-By Cyrus Daugherty

Floating membraneless PV-electrolyzer based on buoyancy-driven product separation

J. T. Davis, J. Qi, X. Fan, J. C. Bui, D. V. Esposito (December 2017). Int J Hydrogen Energy 2018: 43(3): 1224-1238.

Polymer electrolyte membrane (PEM) electrolyzers and alkaline electrolyzers are two technologies dominating the commercial market for the electrolyzers. These technologies usually utilize a diaphragm or a membrane in their architecture to separate the hydrogen (H_2) and oxygen (O_2) evolving electrodes. However, membranes can be costly, prone to degradation and failure, and susceptible to cross-over issues. Therefore, an alternative design for an electrolyzer with similar energy efficiency but with no membrane is highly desirable.

This work describes the design and performance of a scalable, stand-alone photovoltaic (PV) electrolysis device used for hydrogen (H_2) production by solar-driven water electrolysis. The electrolyzer component of this device is a membraneless design that enables efficient operation with high product purity and without active pumping of the electrolyte. A novel electrode configuration comprised of mesh flow-through electrodes that are coated with catalyst on only one side has been used within the electrolzer design. These asymmetric electrodes promote the evolution of gaseous H_2 and O_2 products on the outer surfaces of the electrodes, followed by buoyancy-driven separation of the detached bubbles into separate overhead collection chambers.

The successful demonstration of this concept was further verified with high-speed video and analysis of product gas composition with gas chromatography. While the device based on asymmetric electrodes achieved product cross-over rates as low as 1%, a control device based on mesh electrodes that were coated on both sides with catalyst had cross-over rates typically exceeding 7%. The asymmetric electrode configuration was then incorporated into a standalone, floating PV-electrolyzer and shown to achieve a solar-to-hydrogen efficiency of 5.3% for 1 sun illumination intensity. The simplicity of this membraneless prototype, as characterized by the lack of a membrane, scaffolding, or actively pumped electrolyte, makes it attractive for low-cost production of hydrogen.

https://www.sciencedirect.com/science/article/pii/S036031991734466X

-By Yasser Ashraf Gandomi

From the Bookshelf

Hydrogen in Crystals

Z.A. Matysina, S.Yu. Zaginaychenko, D.V. Shchur, A. Veziroglu, T.N. Veziroglu, M.T. Gabdullin, N.F. Javadov, Al. Zolotarenko, An. Zolotarenko

The work is devoted to a theoretical study of phase transformations in metal hydrides having a differing crystal structures as well as to an experimental study of their hydrogen capacity.

The atomic ordering in alloys is investigated from a theoretical perspective. The ordering features due to the presence of hydrogen are shown and explained. A formula is derived that determines the dependence of the solubility of hydrogen on the composition of the alloy, temperature and the degree of long-range atomic order in the lattice of the crystal.

The solubilities of interstitial elements, which can be hydrogen, nitrogen, boron and carbon in alloys, are calculated. Isotherms, isobars, isoplets, isosters of the solubility of the interstitial elements, as well as the mutual influence on the solubility of various interstitial elements have been studied. Comparison of the results of calculations with experimental data showed their qualitative agreement.

https://www.journals.elsevier.com/international-journal-of-hydrogen-energy/news/hydrogen-in-crystals

Have suggestions for a future book feature? If so, send the book title to Kathy Williams at williamk@utk.edu.

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Hydrogen and Fuel Cell Research at National Renewable Energy Laboratory (NREL)

NATIONAL RENEWABLE ENERGY LABORATORY

Overview:

The hydrogen and fuel cell research and development (R&D) center at national renewable energy laboratory (NREL) focuses on developing, integrating, and demonstrating hydrogen production and delivery, hydrogen storage, and fuel cell technologies for transportation, stationary, and portable applications.

A wider range of projects from fundamental research to overcome technical barriers, manufacturing process improvement to enable high-volume fuel cell production, systems analysis to identify the most promising commercialization pathways, and market transformation to support early market deployments is underway at NREL's hydrogen and fuel cell R&D section.

Major research areas at this center includes:

1. Fuel Cells

NREL's fuel cell research is performed on a variety of fuel cell types including polymer electrolyte membrane (PEMFC), alkaline membrane (AMFC), and direct methanol fuel cells (DMFC). The major objective is to lower the cost and improve the performance and durability of various fuel cells focusing on the following aspects:

- Catalysts
- Polymer Electrolytes
- Electrode Design/High-Current-Density Operation
- Contaminants

2. Hydrogen Production and Delivery

Researchers at NREL are developing advanced processes to produce hydrogen economically from sustainable resources. The major areas of research include:

- Biological Water Splitting
- Fermentation
- Conversion of Biomass and Wastes
- Photoelectrochemical Water Splitting
- Solar Thermal Water Splitting
- Renewable Electrolysis

3. Hydrogen Storage

NREL develops comprehensive storage solutions, with a focus on hydrogen storage material properties, storage system configurations, interface requirements, and life cycle analysis. This work is majorly supported by the U.S. Department of Energy (DOE).

4. Manufacturing

NREL's fuel cell manufacturing R&D focuses on improving quality-inspection practices for high-volume manufacturing processes to enable higher production volumes, increased reliability, and lower costs.

5. Market Transformation

NREL's market transformation activities address technical and non-technical barriers to the commercialization of hydrogen and fuel cell technologies to ensure that laboratory advances can be realized in the marketplace.

6. Safety, Codes, and Standards

NREL's hydrogen safety, codes, and standards projects focus on ensuring safe operation, handling, and use of hydrogen and hydrogen systems through safety sensors and codes and standards for buildings and equipment.

7. Systems Analysis

NREL's hydrogen systems analysis activities provide direction, insight, and support for the development, demonstration, and deployment of a broad range of hydrogen technologies.

Analysis focuses on hydrogen production, storage, and delivery systems for fuel cell electric vehicles (FCEVs) as well as stationary fuel cells and emerging-market applications such as material handling and backup power.

8. Technology Validation

The NREL technology validation team works on validating hydrogen fuel cell electric vehicles; hydrogen fueling infrastructure; hydrogen system components; and fuel cell use in early market applications such as material handling, backup power, and prime-power applications. The team also analyzes the current status of state-of-the-art laboratory fuel cell technologies, with a focus on performance and durability.

More information is available on their website https://www.nrel.gov/hydrogen/staff.html.

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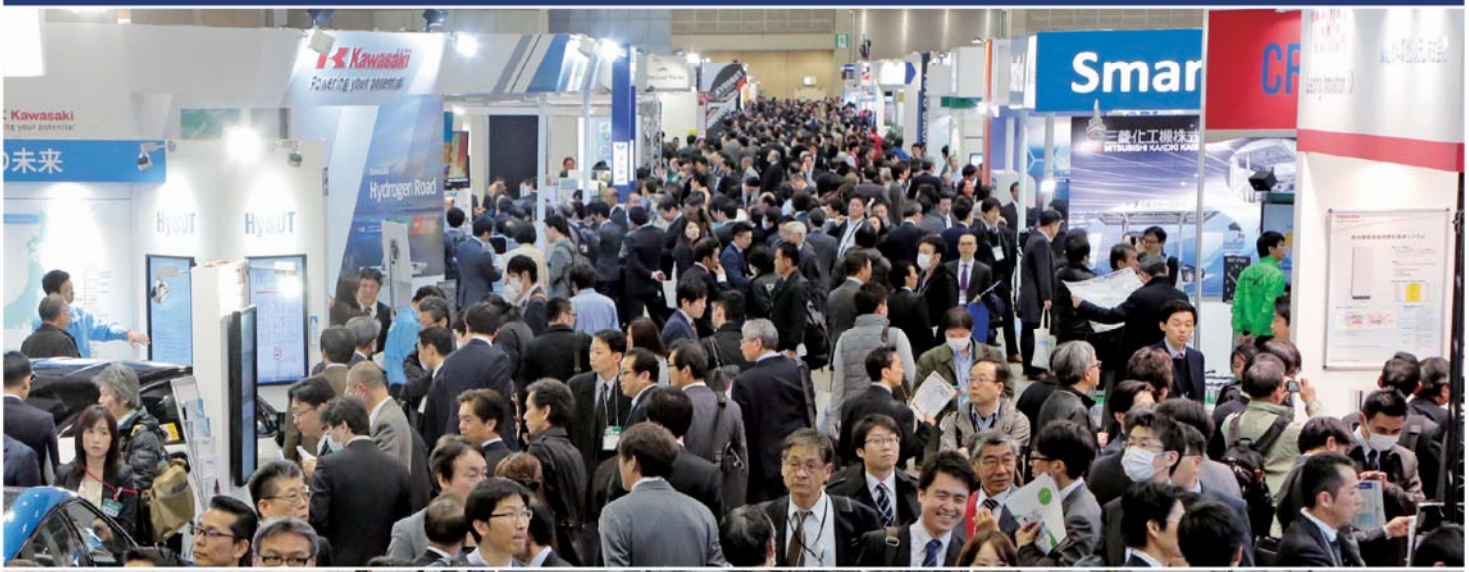

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Special issues of selected papers will be published in top journals

PSVHE	MGIO	WSE	ORER	CPCA	ARE-CA	CRER
«Production, Storage and Valorisation of Hhydrogen Energy»	«Micro-Grids Implementation And Optimization»	«Wind as a Source of Energy»	«Optimization of Renewable Energy Resources»	«Chars Production, Characterization and Applications»	«Advances in Renewable Energy: Conversion And Application »	«Challenges in Renewable Energy Research»
SCI Thomson (IF=3.41)	ESCI Thomson	ESCI Thomson	ESCI Thomson	ESCI Thomson	ESCI Thomson	ESCI Thomson

Contact : info@irec-conference.com Website : irec-conference.com

Important Dates

Full paper submission
November 25th, 2017
Acceptance notification
December 30th, 2017
Camera ready
February 20th, 2018
Registration
February 25th, 2018

Université de Sfax

ENET'COM

Universidad de Valladolid

ALL PRESENTED PAPERS THAT FULFILL IEEE CONDITIONS WILL APPEAR IN IEEEXPLORE

16th International Conference on Clean Energy (ICCE-2018)

Famagusta, North Cyprus
May 9-11, 2018

icce2018.emu.edu.tr

CALL FOR ABSTRACTS

We would like to invite you to submit your research on clean and sustainable energy to ICCE-2018. Please follow the web site of the conference for the deadlines. The conference is organized under the auspices of University of Miami, Eastern Mediterranean University and Fredonia State University of New York. More information is available at the conference web site.

Selected papers will be published in world renowned Journals

Conference Topics

- Fuel cells
- Smart grids
- Nuclear energy
- Waste-to-energy
- Energy economics
- Hydrogen economy
- Biomass and biofuels
- Multi-generation systems
- Hydrogen energy storage
- Wind energy technologies
- Photovoltaic
- Energy and Law
- Energy efficiency
- Solar desalination
- Solar thermal energy
- Energy and buildings
- Solar energy materials
- Passive solar buildings
- Energy and environment
- Financing energy projects
- Hydrogen energy production
- Intelligent or smart buildings
- Sustainable building solutions
- Energy management and policy
- Investment appraisal of energy projects
- Exergetic and exergoeconomic analyses
- Renewable energy storage technologies
- Control systems for energy management
- Renewable energy technologies and systems
- Economic viability of renewable energy systems

Energy Research Center (ERC)
of Eastern Mediterranean University

Clean Energy Research Institute (CERI)
of University of Miami

Grand Renewable Energy 2018
International Conference and Exhibition

ISES International Solar Energy Society

Advanced Technology Paths to Global Sustainability

www.grand-re2018.org

Conference: June 17 (Sun) - 22 (Fri), Exhibition: June 20 (Wed) - 22 (Fri)

Venue: Pacifico Yokohama, Yokohama, Japan

How to accelerate Renewable Energy Integration

Chairperson's Message

The Paris Agreement in COP21 is the agreement applicable to all participants of parties for the first time in history and serves as a turning point with an eye toward a decarbonized society. Under the Agreement, the greenhouse gas emissions are to be reduced dramatically to almost zero by the end of this century. With this long-term goal in the Paris Agreement, it is important for us to accelerate strategic efforts and initiatives carbon emission reduction in energy demand and supply.

The practical challenge to achieve is low- carbonization of energy supply, energy conversion, and energy conservation including smart integration of renewable energy in maximum both in supply and demand sides. Financial strategy, policy initiatives and advanced technology development must be associated with them. Intelligence and cutting- edge technologies are indispensable in the fields of electricity, electronics, mechanics, physics, chemicals, biology, architecture, civil, mathematics, meteorology, sociology, systems, finance, and integrated management.

We have great expectation and feel glad to have discussion about these crucial issues through more than 900 papers' presentation covering 12 areas of renewable energies. Plenary session by the invited speakers, more than 15 experts, from all over the world are also programmed. International exhibition is held in parallel.

We, Organizing Committee, welcome all those participating in Grand Renewable Energy 2018 Conference, and look forward to seeing in Yokohama.

General Chair, **Prof. Kazuhiko Ogimoto** (the University of Tokyo), Deputy Chair **Dr. Yoshiro Owadano** (AIST), Oversea Rep, **Dr. Dave Renné** (ISES)

ABSTRACT submission *on going!! through Web*

- Jan. 31, 2018: Due date of Abstract submission
- Apr. 30.2018: Early Bird end of Registration
- Jun. 17-22: Full Paper submission at onsite venue
- Sep. end 2018: Almost all Full Papers in DVD,

Features of Conference

- **Main CASTER:** all those presenting the paper, totaling 1000.
- **Keynotes:** Directors from NREL and Flaunhofer
- **Invited Speakers:** 15 Experts from 12 Logo Areas
- **Special Sessions and Workshop** will be programmed.
- **Exhibition:** about 40,000 visitors for 300 exhibitors

Conference

1. Policy & Integrated Concept
- Policy Instruments, e.g.FIT
- Scenario
- RE and Climate Change, toward CO2 Zero
- RE in the Context of Sustainable Development
- Mitigation Potential and Costs
- Financing and Implementation
- R&D Policy
- Energy Technology Loadmap
- International Cooperation and Collaboration

2. Photovoltaics
- Novel Materials and Concepts
- Silicon Solar Cells
- Compound Semiconductor Thin Film Solar Cells
- III-V Solar Cells, Concentrator and Space Applications
- Perovskite Solar Cells
- Organic Thin Film and Dye-sensitized Solar Cells
- Multijunction Solar Cells
- Module Reliability
- Performance Characterization Method
- PV Systems, BOS Components and Grid Integration
- Operation and Maintenance
- Forecast and Solar Resources

3. Solar Thermal Application
- Solar thermal collector
- Solar based heat pump technology
- Solar Cooling
- Solar-fired power generation
- Solar Binary Power Generation
- Thermal Energy Storage
- Solar-thermally driven chemical processes
- Solar thermal utilization for hydrogen or fuel production
- Solar desalination
- Solar cooker
- Solar thermal detoxification

4. Innovative Bioclimatic Architecture
- Vernacular Architecture / Passive Design
- Zero Energy House/ Zero Energy Building
- Zero Net Carbon
- Affordable Green Housing
- Building Stock Activation / Refinement
- Smart City / ICT
- Comfort and Indoor Climate
- Energy Management System /Commissioning
- Elements and Materials
- Building Evaluation Index/Tool

5. Wind Power
- Offshore Wind Energy
- Advanced Wind Turbine Technology
- Grid Connection and Electrical Systems
- Site Assessments and Forecasting
- Plant Design and Management
- Operation and Maintenance
- Tower and Foundation
- Measurement and Monitoring Techniques
- Acoustics and Noise Issues
- Small/Distributed Wind Power
- COE of Wind Power
- Social and Environmental Issues

6. Biomass
- Biofuels (Bioethanol, BDF including BTL)
- Biomaterials
- Gasification and combustion
- Biomass Refinery
- Marine Biomass including freshwater biomass
- Pyrolysis and carbonization including torretaction
- Anaerobic Digestion
- Carbon Neutrality
- Forestry
- Hydrothermal Technology
- Sustainability

7. Hydrogen & Fuel Cell
- Hydrogen Energy Systems
- Hydrogen Production
- Hydrogen Transportation and Storage
- Hydrogen End-Use Technology
- Technology and Fabrication
- Fuel Cell for Transportation
- Fuel Cell Power Plants
- Fuel Cell for Co-generation

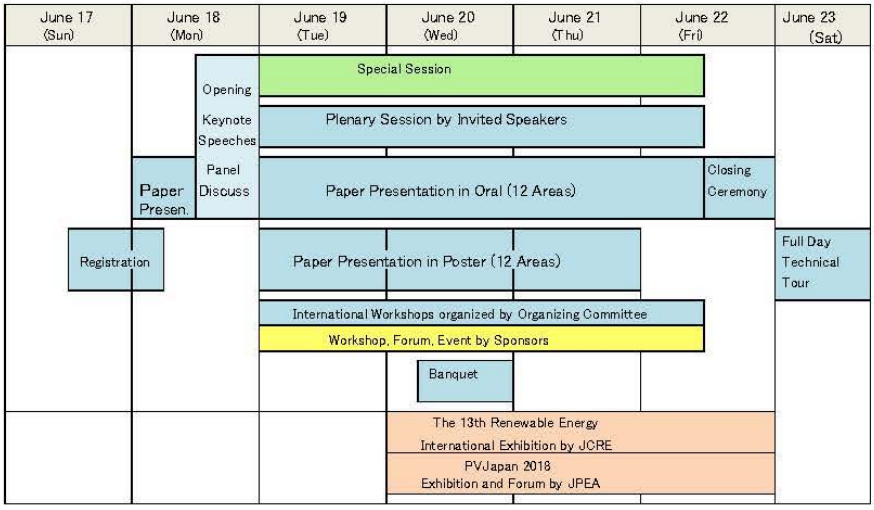
8. Ocean Energy
- Wave Energy
- Tidal Current Energy
- Ocean Current Energy
- OTEC
- Offshore Wind Energy
- Utilization wirh Aquaculture
- Resource Assessment and Monitoring
- Economic Assessment
- Ocean Resources for Energy
- Ocean Marine Biomass
- Deep Sea Water Application

9. Geothermal Energy & Ground-Source Heat Pump System
- Exploration
- Geothermal Field
- Reservoir Engineering
- EGS
- Power Generation
- Public Acceptance
- Geochemistry
- Environmental Aspects
- Geo-Heat
- Ground-Source Heat Pump
- Direct Use
- Geothermal Frontier

10. Energy Network
- Smart Grid
- Micro-grid
- Energy Network
- Distributed Energy Resources
- Power Storage and System
- Vehicle to Grid
- Demand Response
- Power Electronics
- Superconductor and System
- Advanced Electric Car

11. Energy Conservation & Heat Pump
- Air-conditioning/Heat Pump
- Area Energy and Environmental Management
- Combined Heat and Power Utilization
- Energy Conservation and Assessment
- Global Warming/Heat Island and Other Environmental Issues
- Net Zero Energy Building/House
- Refrigeration and Refrigerants
- Renewable Energy Utilization
- Thermal Energy Technology and Storage
- Thermodynamics and Energy Management

12. Small Hydro & Non-Conventional Energy
- Hydropower Development and Utilization
- Practical Examples and Field (Model) Tests
- Micro & Pico System
- Undeveloped Energy for Human Life
- Unused Energy Recovery



Manuscript Procedures

① Abstract Submission
| 2 Pages, Due Jan.31

②Abstract peer review
| February

③Acceptance Notice
| march

④Detail Presen. Notice
| May (When, Where)

⑤Full Paper submission
| June 17–22 at Onsite

⑥Presentation at Venue
| June 17–22 at Onsite

⑦J-Stage Option
| June 17–22 at Onsite

⑧Full Papers Compiling
| Complete by Sep 31

⑨DVD to all participants

Dear colleagues,

The **Economy, Sustainable Development and Energy International Conference (ESDEIC)**, will be held at the Queen Margaret University (Edinburgh, Scotland, UK), from the 25th to the 27th June 2018.

Main dates and details are:

- 15th of April 2018: Submission of abstracts
- 30th April 2018: Notification of acceptance of abstracts
- 30th of May 2018: Submission of full papers
- Early bird registration: 30th of May 2018

For information about the different types of registration fees, please click HERE.

In this edition of ESDEIC:

- One award for the best communication (refund of the registration fee and certificate of best communication)
- One award for the best communication by a PhD. student (refund of the registration fee and certificate of best communication)
- Registration fee includes coffee-breaks, lunches, conference dinner, merchandising of the conference, publication of all works in the e-books of abstracts and full papers, certificates of attendance and presentation, and a walking tour to Edinburgh.
- Papers must be written and presented in English.
- Selected papers will be published in the journals associated to the conference
- Selected papers and/or papers not accepted by the journals, will be published in a selected papers e-book edited by the conference

For full details related to the conference, please visit: www.esdeic.com

If you wish to submit your abstract, please click HERE.

For further information, please contact Monica Martins by email: info@esedeic.com

Please, do not hesitate to share this information with your colleagues and contacts.

Best regards:

Dr. Ramon Sanguino Galvan

Co-Chairman of ESDEIC

GIG

10th International Exergy, Energy and Environment Symposium

July 1-4, 2018
Katowice, Poland

IEEES - 10

Contact:

e-mail: ieees-10@gig.eu

tel. +48 32 259 27 00, +48 32 259 25 54

fax +48 32 259 65 33

address:
Central Mining Institut (Główny Instytut Górnictwa)
Poland, 40-166 Katowice, Plac Gwarków 1

www.ieees-10.gig.eu

IEEES-10 Symposium

The 10th International Exergy, Energy and Environment Symposium (IEEES-10) facilitates close cooperation and intellectual exchange with a large number of experts from the academia, leading R&D institutions, government agencies and the industry. It provides a platform for researchers, scientists, engineers, technologists and practitioners to discuss the current challenges, opportunities and future directions in the development of sustainable energy systems.

IEEES-10 covers a wide range of topics, including clean coal technologies, renewable energy technologies, smart energy systems, alternative fuels, hydrogen and fuel cell technologies, nuclear energy, desalination technologies and environmental technologies. A special symposium session will be devoted to hydrogen economy with a particular focus on hydrogen as a new and environmentally friendly energy carrier.

The previous successful editions of the symposium were organized in Izmir, Turkey (2003); Kos, Greece (2005); Evora, Portugal (2007); Sharjah, United Arab Emirates (2009); Luxor, Egypt (2011); Eurasia, Turkey (2013); Valenciennes, France (2015); Antalya, Turkey (2016) and Split, Croatia (2017).

Venue
Central Mining Institute, Katowice, Poland

Founding Chair
I. Dincer, UOIT, Canada

Honorary Chair
T.N. Veziroglu, IAHE, USA

Symposium Chair
A. Smoliński, Central Mining Institute, Poland

- clean coal technologies
- synthetic and alternative fuels
- renewable energy systems
- hydrogen production and utilization technologies
- biowaste utilization
- fossil fuels
- nuclear energy
- exergy analysis and modeling
- energy systems and applications
- environmental impact assessment
- environmental engineering technologies
- life cycle assessment
- refrigeration and heat pump systems
- combustion, pyrolysis, and gasification technologies
- thermal systems and applications
- smart grids
- desalination technologies
- green buildings
- thermodynamic optimization
- heat and mass transfer
- sectoral energy management
- green transportation vehicles
- sustainable communities
- electrochemical devices (fuel cells, capacitors, batteries, etc.)
- new materials for energy applications

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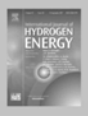

WSSET World Society of Sustainable Energy Technologies

UNIVERSITY OF ONTARIO INSTITUTE OF TECHNOLOGY

2018 International Symposium on Hydrogen Fire, Explosion and safety Standard (ISHESS2018)

July 6-8, 2018- Hefei, China

First Announcement and Call for Papers

The 2018 International Symposium on Hydrogen Fire, Explosion and Safety Standard (ISHFESS2018) will be held in Hefei, China on July 6-8, 2018 under the support of Code and Standard Division of International Association for Hydrogen Energy, National Technical Committee on Hydrogen Energy of Standardization Administration of China, Hefei University of Technology and Zhejiang University.

In view of global commercialization of hydrogen fuel cell electric vehicles and other hydrogen applications, ISHFESS hopes to provide an open platform for the presentation and discussion on hydrogen safety theory, technology and standard etc. Especially ISHFESS seeks contributions in fields such as hydrogen leakage, combustion theory, fire, explosion, material safety, risk analysis, safety management, hydrogen standard and code etc.

All contributions to ISHFESS2018 will be evaluated exclusively in the light of their scientific content and relevance to hydrogen safety and standard. High impact papers will be selected for publication in the **International Journal of Hydrogen Energy**.

The topics include but not limited to:

1. Hydrogen combustion theory and basic physics.
2. Liquid/gas hydrogen leakage, dispersion and diffusion
3. Hydrogen fire and its protection technology
4. Hydrogen explosion and its protection technology
5. Hydrogen standards and codes
6. Hydrogen risk analysis and management
7. Hydrogen energy and Hydrogen Economy.
8. Hydrogen material.
9. Hydrogen safety in manufacture, storage and transportation etc.
10. Other hydrogen related theory, technology and applications.

Symposium language

The ISHFESS2018official language will be English.

Important Dates:

Full Paper Submission (Deadline): 30April, 2018
Notification of Paper Acceptance: 30May, 2018
Submission of Paper Final Versions: 15 June, 2018
ISHFESS Date: 6-8 July, 2018
Work-In Progress Poster Submission: 30May, 2018
Work-In Progress Poster Notification: 15 June,2018
Early Registration Open: 10May, 2018

Local Organizing Committee:

Changjian Wang(Chair), JingyangZheng (Co-Chair), Jennifer Wen (Co-Chair), Geng Wang, Deqing Mei,Linxin Chen, ZhiheShen,Jin Guo, Wulin Han, Shenlin Yang, Manhou Li, Lin Zhang

Scientific Committee:

Jennifer Wen, Jingyang Zheng, Changjian Wang, Weixin Ren, Ibrahim Dincer,TrygveSkjold, Marco Carcassi, Bai An,Shouxiang Lu, Regis Bauwens, Gaby Ciccarelli, Simon Jallais, Xuanya Liu, Jin Guo

Contact Information:

Changjian Wang: +86 13856917064, chjwang@hfut.edu.cn
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Manhou Li: +86 13739249256, mhli@hfut.edu.cn
Website: ISHFESS.hfut.edu.cn
Address: ISHFESS2018 Secretariat,
School of Civil Engineering, Hefei University of Technology
No.193,Tunxi Road, Hefei, Anhui,China.

Sponsor:




ICRIC-2018

16-19 July 2018 / Zagreb, Croatia

2nd International Conference on Research, Innovation and Commercialization

Research-Innovation-Commercialisation (RIC) Concept for Technological Success

CALL FOR PAPERS

GOALS – The ICRIC-18 is a multi–disciplinary international conference on research, innovation and commercialization and will provide a forum for the exchange of latest technical information, the dissemination of the high-quality results on these issues, the presentation of the new developments and methodologies in these areas, and the debate and shaping of future directions and priorities for better industrial, environmental, energetic, and economic sustainability as well as sustainable development for global security. The primary themes of the conference are research, innovation and commercialization, not only in engineering and science but also in all other disciplines (e.g. ecology, education, social sciences, economics, management, medical sciences, political sciences, and information technology). Therefore, papers on related topics are solicited from all relevant disciplinary areas, ranging from current problems, projections, new concepts, new technologies, new methodologies, modeling, experiments, innovation, commercialization, and measurements, to simulations.

FORMAT - The format of the ICRIC-18 will be arranged with the following major elements as general papers presented in oral sessions, keynote papers by invited speakers, and panel discussion and specialized sessions on special topics. There will also be exhibitions, social events and pre- and post-symposium tours. High quality papers of archival value will be considered in extended form for publication in various reputable international journals.

ABSTRACT SUBMISSION - Initial screening will be based on the abstracts, and authors should submit 400-500-word abstracts through website only. Each abstract should contain the title of paper, name of authors and affiliations and complete addresses (along with the phone and fax numbers and e-mail addresses), and summarize the content of the work, objectives and main findings.

Supporting journal:

International Journal of Research, Innovation and Commercialisation

Founding chair: Ibrahim Dincer, University of Ontario Institute of Technology, Canada
Conference chair: Sandro Nižetić, University of Split, Croatia

International Advisory Committee

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Web master

Željka Milanović Croatia

Technical chair: Petar Šolić, University of Split, Croatia

Conference Topics - The topical areas of interest include, but are not limited to:

- Benchmarking and best practices in innovation activities
- Building relationships for technological Innovation
- Business and technological innovation
- Business development and commercialization practices
- Commercialisation strategies and policies
- Company development strategies
- Diffusion of innovation
- Economics of innovation
- Empirical analysis and case studies in business innovation and research
- Energy innovation
- Energy R&D strategies and policies
- Entrepreneurship and innovations
- Environmental issues in technology management
- Family business development in technology-intensive environments
- Gaming policy
- Geography of Innovation
- Industry perspectives on high-tech new ventures creation and development
- Innovation incubation and incubators
- Innovation issues, management approaches, policies and strategies
- Inter-organisational relations and open innovation models
- Knowledge-intensive business services and regional innovation systems
- Managing creativity and innovation culture and its eco-world
- New product and process innovation
- Performance measures and metrics in business innovation and research
- Profits from innovation
- R&D collaboration
- R&D management/policy/strategy
- Research policy
- Research management/policy/strategy, partnerships and innovative approaches
- Spin-off company development
- Strategic innovation
- Strategic planning, business development and commercialisation practices
- Technological entrepreneurship
- Technology alliances and collaboration
- Technology management/policy/strategy.
- Technology transfer and licensing
- Technology transfer offices
- University technology transfers

Important dates

ONE-PAGE ABSTRACT DUE:	ABSTRACT ACCEPTANCE NOTICE:	FULL MANUSCRIPT DUE:	FINAL NOTICE OF ACCEPTANCE:
FEBRUARY 01, 2018	FEBRUARY 20 2018	APRIL 01, 2018	JUNE 01, 2018

REGISTRATION FEES	Early registration (Until June 15, 2018)	Late registration (After June 15, 2018)
Student delegate	370 EUR	450 EUR
Full delegate	470 EUR	550 EUR
Accompanying person	200 EUR	250 EUR

Registration fee includes:
- Entrance for all oral and poster sessions,
- Conference materials (Congress bag, abstract book, proceedings, etc).
- Three day lunch and all coffee breaks
- Welcome Banquet & Gala dinner

Venue
The conference will be held at Hotel International (4*)
www.internationalhotelzagreb.com
A special rate for the accommodation units will be ensured for ICH2P-2018 conference participants.

http://www.icric2018.fesb.unist.hr

ICH2P-2018

16-19 July 2018 / Zagreb, Croatia

9th INTERNATIONAL CONFERENCE ON HYDROGEN PRODUCTION

Hydrogen economy for a sustainable future

CALL FOR PAPERS

Goals - The International Conference on Hydrogen Production (ICH2P-17) is a multi–disciplinary international conference on the production of hydrogen through various thermal, chemical, biological and other methods, as well as its use in various systems, including fuel cells. It will provide a forum for the exchange of latest advances and technical information, dissemination of new research developments in the areas of hydrogen production and usage, and debate involving the future directions and priorities in the hydrogen economy for a sustainable future. The conference will have particular value and interest to researchers, scientists, engineers and practitioners who are working in the field of hydrogen production technologies, ranging from policy making and technical development to management and marketing.

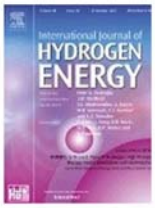
The format of ICH2P-17 will be arranged with the following major elements as general papers presented in oral sessions, keynote papers by invited speakers, and panel discussions and specialized sessions on selected topics. There will also be, social events and symposium tours. High quality papers of archival value will be considered in extended form for publication in various reputable international journals.

Authors are invited to submit their abstract(s), of approximately half a page length (about 250 words). The full paper(s) should be submitted in electronic format. Instructions for abstact and full paper preparations are available at symposium webpages.

The papers accepted and presented at the ICH2P-2018 will be published in a book of abstracts and USB, with ISBN. High quality papers of archival value will be considered in extended form for publication in various reputable international journals:

International Journal of Energy Research (IF 2.59)

Interational Journal of Hydrogen Energy (IF 3.582)



IF: 3.582

IF: 2.59

Conference chair: S. Nižetić, FESB, Croatia
Founding Chair: I. Dincer, UOIT, Canada
Honorary Chair: T. N. Veziroğlu, president of IAHE, USA

International Advisory Committee:

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F. Le Naour, France
G.F. Naterer, Canada
S. Nižetić, Croatia
T. Ohta, Japan
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T.B. Reed, USA
N. Ren, China
M.A. Rosen, Canada
T. Sato, Japan
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S.A. Sherif, USA
L. Sjunnesson , Sweden
R. Solmaz, Turkey
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T.N. Veziroglu, USA
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Ž. Penga Croatia
P. Šolić Croatia
I. Tolj Croatia

Web master

Željka Milanović Croatia

Technical chair: Petar Šolić, University of Split, Croatia

Conference Topics - The themes of the conference will cover topics ranging from the conversion of fossil fuels to the use of renewable energy sources and nuclear power for hydrogen production. Fossil fuel conversion includes processes for the gasification of coal and biomass, thermochemical systems such as steam-methane reforming, and photochemical systems. The electricity produced from renewable energy sources, or nuclear power, could be used to generate hydrogen by the electrolysis of water, and the development of these technologies will be included.

The conference will cover broad areas that extend beyond technical areas, to policy making, hydrogen infrastructure development, environmental concerns, regulatory actions, standards development, safety, storage, commercialization, education, training, and so forth. Therefore, papers on related topics are solicited from all relevant disciplinary areas, including new concepts, modeling, experiments, and simulations. The topics of the conference include, but are not limited to:

- Codes and standards
- Education and training for hydrogen
- Electrolysis
- Energy security related to hydrogen
- Environmental impact
- Fuel cells
- Global warming
- Government policies on hydrogen
- Greenhouse gas mitigation by hydrogen
- Hydrogen economy
- Hydrogen infrastructure
- Hydrogen production methods
- Hydrogen safety
- Hydrogen storage
- Hydrogen technologies
- Hydrogen vehicles
- Innovation and commercialization practices
- International perspectives on hydrogen
- Life cycle assessment
- Life cycle costing
- Materials for hydrogen systems
- Modeling and simulation
- Nuclear-based hydrogen production
- Renewables and their use for hydrogen
- Sustainable development
- Thermochemical and hybrid cycles

Important dates

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A special rate for the accommodation units will be ensured for ICH2P-2018 conference participants.

http:/ich2p-2018.unist.fesb.hr

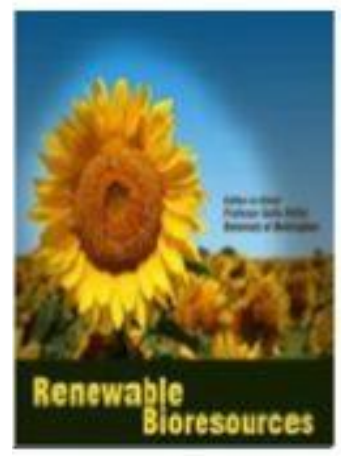
17th International Conference on Sustainable Energy Technologies

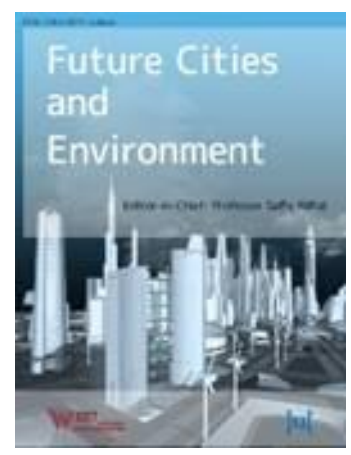
Sustainable Energy Technologies for Eco Cities and Environment

21st-23rd of August 2018 Wuhan, China

CALL FOR PAPERS

Contributions are invited on the topics within the conference scope of sustainable energy technologies. All contributions should be of high quality, original and not published elsewhere or submitted for publication during the review period.
All accepted papers will be presented orally or by poster, and included in the conference proceedings.
Selected papers will be published in our partner journals.





Energy Technologies & Renewables | Energy Storage & Conversion | Policies & Management | Sustainable Cities & Environment

SET 2018 is a multi–disciplinary, peer-reviewed international conference on sustainable energy sources and technologies that provides a forum for the exchange of latest technical information, the dissemination of the high-quality research results, the presentation of the new developments in the area, and the debate and shaping of future directions and priorities for sustainable development and energy security.

SET 2018 will be hosted by the Hubei University of Technology, a Chinese tier-one university. It primarily focuses on teaching and research in the domain of green technology as well as the greening of traditional technologies, and has always been playing an active role in international academic exchange.

Chair: Professor Saffa Riffat, University of Nottingham
Chair: Professor Liu Defu, Hubei University of Technology
Co-Chair: Ms. Amy Long, Hubei University of Technology

Confirmed keynote speakers include:
Professor T. S. Zhao, HKUST Energy Institute
Professor Ibrahim Dincer, University of Ontario Institute of Technology
Professor Chris Twinn, Twinn Sustainability Innovation
Professor Peter D. Lund, Aalto University, Finland
Professor Shengqiang Shen, Dalian University of Technology
Professor Steffen Lehmann, University of Portsmouth

WSSET members benefit from 20% discount on conference registration fees.

KEY DATES

Deadline Date	Action
5th March 2018	One Page Abstract Submission
4th June 2018	Full Manuscript Submission
16th June 2018	Notification of Manuscript Acceptance
9th June 2018	Submission of Final Manuscript

Supported by the International Association for Hydrogen Energy (IAHE) and the International Journal of Hydrogen Energy ((IJHE)

www.set2018.org

2nd International Conference on Energy Materials and Fuel Cell Research.

Conference Dates: August 27-28, 2018 **Boston, Massachusetts, USA**

About Conference:

The EMFC 2018: 2nd International Conference on **Energy Materials and Fuel Cell Research** is going to be held on **August 27-28**, **2018** in **Boston, Massachusetts, USA** which aims to bring together leading academic scientists, researchers and research scholars to exchange and share their experiences and research results on all aspects of Advanced Energy Materials, Hydrogen Energy and Fuel Cell Technology with the Theme: *Generation of Energy Evolution for Sustainable Future*. EMFC Conference 2018 has become a premier event to connect professionals, scientists, academics, and students in the energy industry and provides a premier interdisciplinary platform to present and discuss the most recent innovations, trends, and concerns as well as practical challenges encountered and solutions adopted in the fields of Energy Materials and Fuel Cell Technology.

The 2-days conference at Boston will become a must-attend event for the Energy and Fuel Cell Industry to hear about future infrastructure projects plans, government strategies and market-leading innovation. We invite you to contribute and help to shape the Energy Materials and Fuel Cell Research Congress through submission of your research abstracts, papers and e-posters.

More changes have occurred recently in the global energy sector since 100 years prior. In its 2nd edition, the EMFC Conference 2018 will be exploring enabling technologies for the future of clean energy, energy digitization, and existing energy infrastructure.

We will bring together leaders and visionaries from industry, government, the scientific community, and the private sector that are looking at the entire value chain in a holistic way and can speak about and debate the development of these complex changes, which are redefining the future of energy worldwide.

Why to attend?

»» Certificate Accreditation from the International Organizing Committee (IOCM)
»» Access to All Sessions
»» Ask the Expert Forum (One to One Pre-Scheduled meeting on interest & availability) ·
»» Each registrant will get 50% abatement on manuscript publication fees
»» 10% abatement on the registration fees for the next annual conference -Abstracts will be published in the conference souvenir and respected international journals.

Conference Highlights:

1. Advanced Materials for Energy
2. Fuel Cell Technology
3. Advanced Nanomaterials
4. Hydrogen Economy and Alternative Fuels
5. Advances in Materials Science and Engineering
6. Advanced Solar Energy Materials
7. Electric, Hybrid, and Fuel-Cell Vehicles
8. Green Energy Materials

9. Batteries and Energy Storage
10. Graphene and 2D Energy Materials
11. Biomaterials and Surface Science Engineering
12. Electrical, Optical and Magnetic Materials

Benefits:
Student Delegate for 300$
E Poster for 99$

Best Poster Awards:
Student Poster competition is organized at Energy Materials 2017 Conference, to encourage students and recent Graduates to present their original research which will be later published in Respective International Journal with D.O.I number by Cross Ref.

Young Researchers Forum:
The young research offers young researchers the possibility to meet and discuss research topics and methodologies, share and develop ideas learn from each other and gain knowledge from senior research researchers. They can present their research in the form of an Oral presentation. Best Y.R.F competition is organized at Energy Materials 2018.

Group Registration Discount: Avail our Group registration discount
For 5 or more members in a group flat 20% Discount on Registration.
For 8 or more members in a group flat 25% Discount on Registration.

Special Women Offer: Offering 20% discount to Women Participants as a special appreciation to Women in Science & Technology
Visit the Link below: https://energymaterials.conferenceseries.com/women-offers.php

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Mail id: energymaterials@materialsconferences.org; energymaterialsconferences@gmail.com

For online registration, please visit conference Website:
https://energymaterials.conferenceseries.com/registration.php
Take advantage use of group bookings, discounted prices and special features etc.

NURER 2018

CALL FOR PAPERS

6th International Conference
Nuclear and Renewable Energy Resources
September 30~October 3, 2018
Jeju, Korea

The 6th International Conference on Nuclear and Renewable Energy Resources (NURER2018) is recognized as one of the major international conference for the exchange of information on scientific, engineering, and other technical aspects of innovative nuclear and renewable energy science and technology. The conference is intended to provide an excellent opportunity to report on recent technical progress, discuss key issues and fostering international collaboration for the promotion of innovative nuclear and renewable energy system development and their synergic collaborations. Papers related to science, engineering, facilities, experiments, modeling, analysis, design and safety are welcome.

Technical Topics

- **Fission Energy**
- **Fusion Energy**
- **Renewable Energy**
- **Hydrogen and Solar Energy**
- **Energy Management and Environmental Issues**
- **Renewable-Nuclear Synergy, International Cooperation and Innovation**
- **Other relevant topics**

The working language of the conference and the proceedings is English. Technical papers will be peer reviewed and accepted papers will be published in a symposium proceedings. The authors are encouraged to send full extended papers to The International Journal of Hydrogen Energy, The International Journal of Energy Research, Fusion Science and Engineering and The International Journal of Renewable Energy after the conference.

Authors are invited to submit a one-page 400 word abstract (text only) to the NURER-2018.
Website: http://nurer2018.org

Due Dates

March 31	**2018**	**Abstract Submission Deadline**
May 31	**2018**	**Abstract Acceptance Notification**
July 31	**2018**	**Early Registration Deadline**
August 31	**2018**	**Manuscripts Submission Deadline**
September 30~October 3	**2018**	**Conference Convened**

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16th International Symposium on Metal-Hydrogen Systems

Oct.28th-Nov. 2nd 2018, Guangzhou China

www.MH2018.cn

Crowne Plaza
No. 28 Ningcai Road
Central District, Science City,
Guangzhou, China

IMPORTANT DATE

Tuesday May. 1, 2018
Open for abstract submission

Saturday Jun. 30, 2018
Deadline for abstract submission

Friday Aug. 31, 2018
Deadline for early bird registration

Sunday Oct. 28. 2018
Registration and conference opening

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Key Laboratory of Advanced Energy Storage Materials of Guangdong Province

Upcoming Meetings & Activities

February 2018

FC Expo 2018-14th Int'l Hydrogen & Fuel Cell Expo
February 29-March 2, 2018
Tokyo, Japan
http://www.fcexpo.jp/en/home/

March 2018

European Hydrogen Energy Conference 2018
March 14-16, 2018
Costa del Sol, Spain
http://www.ehec.info/

3rd International Hydrogen Technologies Congress
March 15-18, 2018
Alanya, Turkey
http://www.ihtec2018.org/

April 2018

SAE World Congress Experience
April 10-12, 2018
Detroit, Michigan
http://wcx18.org/

May 2018

16th International Conference on Clean Energy
May 9-11, 2018
Famagusta, North Cyprus
http://icce2018.emu.edu.tr/en

233 ECS Meeting
May 13-17, 2018
Seattle, WA
http://www.electrochem.org/233-planning-deadlines

June 2018

CIMTCE 2018
June 4-12, 2018
Perugia, Italy
http://2018.cimtec-congress.org/

22nd WHEC
June 17-22, 2018
Rio de Janeiro, Brazil
http://www.whec2018.com/

Grand Renewable Energy 2018 International Conference and Exhibition
June 17-22, 2018
Pacifico Yokohama, Japan
http://www.grand-re2018.org/english/index.html

Economy, Sustainable Development and Energy International Conference (ESDEIC)
June 25-27, 2018
Edinburgh, Scotland
http://www.esdeic.com/

July 2018

10th International Exergy, Energy and Environmental Symposium (IEEES)
July 1-4, 2018
Katowice, Poland
http://www.ieees-10.gig.eu/

2018 International Symposium on Hydrogen Fire, Explosion and Safety Standard (ISHESS2018)
July 6-8, 2018
Hefei, China
http://ishfess.hfut.edu.cn/

HYPOTHESIS XIII
July 24-27, 2018
Singapore
http://www.hypothesis.ws/

August 2018

17th International Conference on Sustainable Energy Technologies
August 21-23, 2018
Wuhan, China
http://set2018.org/

2nd International Conference on Energy Materials and Fuel Cell Research
August 27-28, 2018
Boston, MA
https://energymaterials.conferenceseries.com/

Get Connected—Internet Groups of Interest

LinkedIn Connections

Hydrogen Group

Hydrogen Group is a global specialist recruitment business, placing exceptional, hard to find candidates in over 70 countries.

Global Hydrogen Ambassadors Network

Their goal is to exchange opinions on a topic, which may look easy at first glance, but is rather complex. All questions are allowed. A wealth of answers can be expected.

World EcoEnergy Forum: Driving Innovation in the Energy Storage and Smart Grid Industry

The aim of this group is to bring together executives responsible for R&D to discuss about new product development and sustainable development in the energy storage and smart-grid industry.

Hydrogen Pathway

This is a very active group-page within LinkedIn that includes discussions and latest news regarding hydrogen energy.

Renewable Energy Solutions

I.R.E.S. platform to create bridges between international based investors, manufactures and wholesale companies in the Renewable Business Industry. Solar power, wind energy, tidal power, geothermal power, air power, hydrogen, waste management.

Global Renewable Energy Network

Global Renewable Energy Network (GReEN) is the premier business network for professionals and companies involved in the development, commercialization, and utilization of renewable energies (e.g. bioenergy, geothermal, hydro, hydrogen, ocean, solar, and wind), worldwide.

Fuel Cell & Hydrogen Network

Bringing together professionals and enthusiasts alike, the Fuel Cell & Hydrogen Network serves to connect those advocating fuel cell and hydrogen technologies. The group welcomes people who are interested in all types of fuel cell technologies as well as the wide variety of hydrogen technologies, and is not exclusive of hydrogen fuel cells.

Fuel Cells

Welcomes those who are interested in clean energy fuel cell applications and technologies. Encourages members to start discussions that are relevant to fuel cells, to post promotions and jobs, and to use this group to develop their professional network.

Fuel Cell Energy

The Fuel Cell Energy Group advocates the use of Fuel Cell Energy & the promotion of its Technology and for those interested in learning more about Fuel Cell Technology. Fuel Cell Professionals, Renewable Energy, Clean Technology, and Environmental Advocates are welcome. Solar, Wind, Biomass, Biofuel, Tidal Power & Wave Professionals also welcome to learn about this emerging technology.

Facebook Connections

Horizon Fuel Cell Technologies

Horizon Fuel Cell Technologies was founded in Singapore in 2003 and currently owns 5 international subsidiaries, including a new subsidiary in the United States. Having started commercialization with small and simple products while preparing for larger and more complex applications, Horizon already emerged as the world's largest volume producer of commercial micro-fuel cell products, serving customers in over 65 countries.

International Association for Hydrogen Energy

Facebook community for sharing the information regarding advances in hydrogen energy.

Blogs

Fuel Cell Nation

Fact-Based Analysis and Discussion of Clean Energy
http://blog.fuelcellnation.com/

H2-International

Offers a blog and newsletter that contains articles which are published in the German magazine HZwei. Offers detailed information on hydrogen and fuel cells, and is a respectful attempt at continuing the work of Peter Hoffman, the author of *Hydrogen & Fuel Cell Letter*.
http://www.h2-international.com/

Contacts and Information

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International Journal of Hydrogen Energy (IJHE)
The Official Journal of the IAHE
http://www.elsevier.com/locate/he