Integrity Research Institute

helping renew the earth

FUTURE ENERGY ANNUAL 2013

Honoree Jim Dunn accepts the prestigious "Integrity in Research Award" from IRI President Valone during COFE6 in 2013

FUTURE ENERGY
Annual
2013

featuring

Best of *Future Energy eNews* from 2013

&

IRI Annual Report for 2013

Thomas Valone, Editor

CREDITS

Integrity Research Institute wishes to acknowledge the following sources for this IRI Member's Annual Report

Future Energy eNews

MIT Technology Review

New Scientist

Time

SEN News

IEEE Spectrum

Georgia Tech University

Yale Scientific

Energy Daily

Integrity Research Institute
5020 Sunnyside Avenue, Suite 209
Beltsville MD 20705
301-220-0440
A nonprofit 501(c)3 corporation

www.IntegrityResearchInstitute.org

TABLE OF CONTENTS

IRI OFFICERS AND DIRECTORS - 2013

Officers

Thomas Valone
President

Wendy Nicholas
Director

Jacqueline Panting
Secretary
Treasurer

BOARD OF DIRECTORS

Thomas Valone, PhD **Wendy Nicholas** **Jacqueline Panting, ND**

ADVISORS TO THE BOARD OF DIRECTORS

Elliot Maynard, Ph.D **Thorsten Ludwig PhD** **Jim Dunn**

John Powers, Ph.D **Beverly Rubik, Ph.D** **Jeff Norris, MBA**

Ivan Kruglak **James Newburn**

PRESIDENT's LETTER

As we look toward the future of IRI being perpetuated with increased membership, an endowment and/or royalties from licensed inventions in order to ensure its long-term service to humanity, we are pleased to present another valuable summary of our last year's activities. The highlights include our past **Conference on Future Energy** (COFE6 so far) and my presentations at other events. It was an honor to be a part of the **National Press Club Citizen Hearing** event and to summarize my autobiography in only ten minutes (it's on YouTube as well). I recommend it to all IRI Members so you are familiar with the unusual experiences that I'm following up so our future will perhaps be improved in the IRI three programs areas of energy, propulsion and bioenergtics.

The notable breakthrough in 2013 reveals a surprisingly new source of energy: a wet surface! I show the MIT narrated video in my "**Breakthrough Future Energy**" lecture online which demonstrates the intriguing polymer curling with wetness and then relaxing flat as it dries. The MIT guys were smart to attach a **piezoelectric transducer** so the repeated cycle generates electricity. I'm keeping a close eye on this development which may become more widespread since the hardware is inexpensive.

We have more bioelectromagnetic reports to share this year, including an electrical procedure that is giving hope to **paralyzed patients**, a discovery about using electric fields for wound healing, and implants for electric medicine.

Another big future energy development that is notable for 2013 is Japan's commitment to **Space Solar Power** as reprinted in this Annual Report. Also interesting is the number of **Energy Harvesting** discoveries, such as from ambient RF backscatter, that were made in 2013, which makes the future very promising for less batteries in most products.

We also emphasize our new project called, "**Power Africa Homes Light Project**" which is a simple solution to the sad situation of students using flashlights in Africa to study their books in the evening. There are only three parts needed which are inexpensive and we look forward to the collaboration with industrial donors for Africa distribution of the kits.

As Dr. Panting's first IRI patent is now going to allowance, we are also watching all of the low power portable electric generators that are suitable for clothing, such as the "**Self-Powering Cloth Electronics**" which uses an interesting new thread made from zinc oxide.

Sincerely,

Thomas Valone, PhD, PE
President

INTEGRITY RESEARCH INSTITUTE
HIGHLIGHTS 2013

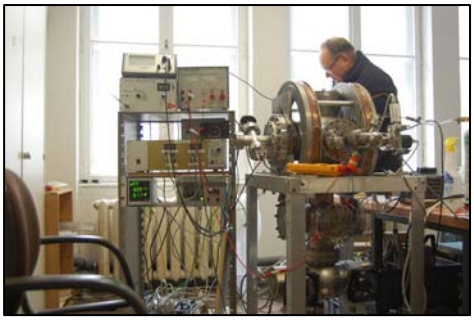
Conferences and Appearances. IRI continued to be very effective in 2013. In January, Dr Valone spoke at the **Tesla International Conference** in New York City, honoring the many inventions of Tesla and celebrating the acquisition of the Wardenclyffe tower property on Long Island by raising funds through crowdfunding.

Then on May 3, he was a witness in front of Congressmen and women for the **"Citizen's Hearing" at the National Press Club** (CitizenHearing.com) organized by the Paradigm Research Group, a think tank in Washington DC. Dr. Valone's slide presentation showed the Congressional Panel many inventions that have ET links. Our main event was the **Sixth International Conference on Future Energy, COFE6 at the University of Maryland** on July 10-12, with over 14 speakers discussing the latest advancements on Future Energy. We also presented the recipient of the "Integrity in Research Award" to Jim Dunn, IRI Advisor and former NASA Director for Tech Commercialization, for all his work in the advancement of emerging energy technologies for over 15 years. On July 24th, Dr Valone was a speaker at "**The Nexus Youth Summit**" in the United Nations in NY City to give an overview of the emerging energy technologies of today. Then in October, 2013, Dr. Valone presented at the **"GlobalBEM"** annual energy conference in Boulder, Colorado (video online at YouTube). While there he visited Dr. Garrett Moddel's laboratory, where much work on Zero Point Energy extraction experiments are being done under his direction at the University of Colorado. A productive year indeed!

Future Energy News Program:

FUTURE ENERGY eNEWS

Research of new emerging technologies; public appearances, free newsletters, brochures, and reports that include the latest news on energy developments, discoveries and research given to the public. ***"Future Energy eNews"*** is sent via email, monthly, to over 8000 recipients worldwide, free of charge through Constant Contact email service. Also we publish the Quarterly ***Future Energy Quarterly Magazine,*** and mail it to all members for free. This magazine contains all the latest papers and articles relating to emerging energy technologies. Also we continue to upgrade our IRI website including more information on emerging energy technologies, climate change, and video uploads and press releases.

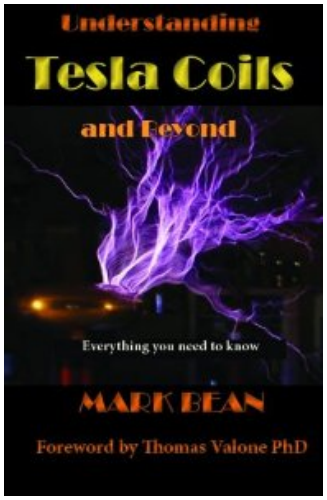


Single Electron Spin in a Magnetic Field Experiment Program. This is an exciting new program that we are doing together with Veden Academie, a charitable research institute like IRI, in Kränzlin, Germany. The experiment aims to study single quantum events with a single electron spin under different influences. The experiment is suitable to discover new human interactions with energy fields. In order to make experiments with a single electron spin, a Magnesium-Ion will be stored

in a linear Paul Trap. The experiment will be built up in cooperation with Veden Akademie, who has a donation for the labour cost for the scientist, adequate laboratory space, vacuum equipment and voltage sources. The Ion-Trap will be machined and set up in Kolberg, Germany. An ultra high vacuum chamber was purchased in December as well as a 280 nm Laser beam with a line with of 1-3 MHz will used to study the energy state of the electron spin via fluorescence. A UV-camera will take pictures of the stored ions in the energetic higher spin state. When external influences changes the spin state of the electron the ion will disappear on the picture and will be seen again when the state is flipped back to the higher state.

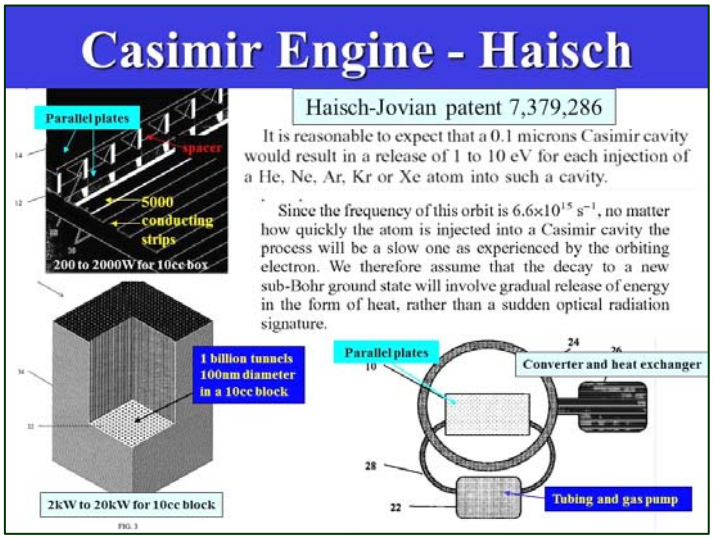
Bioenergetics Program. We are truly busy with this program that includes research on equipment, therapy machines and providers of electrotherapy. The completion of the new and improved ***EMPulser*** device inspired by Dr. Glen Gordon has now been completed and is available for purchase. Our line of **PREMIER Jr.** electrotherapy devices continue to be improved and are still our bestseller. The Microcurrent Electrotherapy clothes project is moving forward with the allowance announcement of Dr. Panting's patent from the US Patent and Trademark

Office. We also are working and researching Mark Bean's, "Carcinotron" High Voltage System and documenting its effects on the body.



IRI Publications: 1) We are very happy to report that we have now published "***Understanding Tesla Coils and Beyond"*** in 2013 authored by Mark Bean, who generously donated the unpublished manuscript to IRI. Sadly, Mark passed away this year shortly after the book's publication, but was able to see it and was very happy with the end result. Mark will be missed in the Tesla circles, as he was one of the most knowledgeable and gifted Tesla coil builder. **2)** ***"Future Energy Annual 2012"*** was also published and mailed free to our membership. Includes highlights of **Future Energy eNews** as well as the IRI Annual Report for 2012 and financials. **3)** ***Gravitoelectromagnetic Theories and their Applications to Advanced Science and Technology*** by Drs. Musha, Pinheiro, and Valone released by NovaPublishers.com in 2013 with two chapters on electrogravitics contributed by Dr. Valone.

Zero Point Energy Program. A new collaboration has begun with Dr. Bernard Haisch who was the coauthor of seminal Physical Review papers on gravity and inertia as zero point energy effects. He is also credited for a "space drive" in Arthur C. Clarke's last book, "***3001***". The tested Haisch-Moddel patented approach is described as a Casimir effect on noble gases as they are constricted in nanotubes, causing them to release energy. The effect has also been observed in the lab and reported at COFE5 by Dr. Moddel. This is different than the Valone approach to certain tunnel diodes as thermal electric noise rectifiers and non-thermal energy harvesters but both seek to tap zero-point energy which is ubiquitous. We are currently seeking more funding for this program through investors. Much research is still being done for the program slated for 2015.



Video and Document Download Program. A long-awaited service that has been requested by supporters of IRI is the electronic download of videos, books and documents. We have obtained software for its implementation and look forward to having a working electronic download service available on the IRI website sometime in 2014. In the meantime, Amazon.com offers a Kindle version of several IRI books which fills the gap.

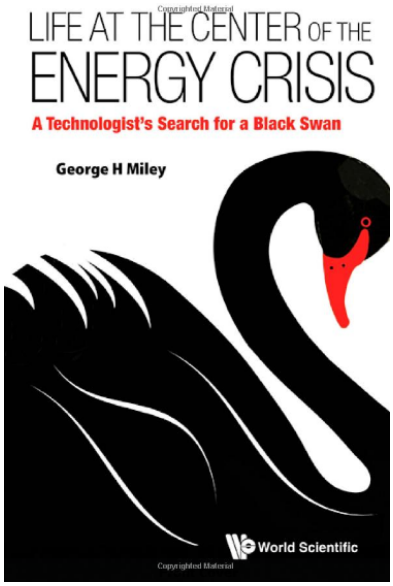
Renewable and Non-Conventional Energy Technology at COFE6 a Great Success

Sixth International Conference on Future Energy

July 14, 2013 - Washington DC. The Sixth Conference on Future Energy

(COFE6) www.futurenergy.org was a great success at the University of Maryland with a list of cutting edge energy developments that are unique to the IRI approach to public education.

Our plenary speaker, **Dr. Max Fomitchev-Zamilov** from Penn State University presented a talk on and demonstration of experimental cavitation fusion that can power the future with his cavitation reactor.



President Tom Valone encouraged Dr. George Miley to write this great book and then offered suggestions for illustrating it after reviewing the manuscript.

John Finnerty from Standard Solar spoke about the first Maryland Solar grid technology.

Jim Dunn who is a former CEO of NASA's Center for Technology Commercialization presented his latest assessment of energy developments. Jim was also this year's recipient of the "***Integrity in Research Award***" for his tireless efforts in researching and promoting new energy sources all over the US and the world.

Francis McCabe summarized his research into Gyro and Inertial Propulsion, which caused a shudder last year when an engineer from Boeing announced at COFE5 that many aerospace industries are using gyroscopic inertial propulsion on satellites.

Dr. Thorsten Ludwig from Germany gave two excellent presentations: His findings on the Coler magnetic current apparatus and the second regarding an experiment to measure subtle influences on a single electron spin. James Putnam presented on the Empirical Origins for Force and Acceleration.

Dr. George Miley presented his life story of the fusion research he performed everywhere in the world, which is also the subject of his autobiography just published by World

Scientific Imperial Press College and available through Amazon. The book's title is

"***Life at the Center of the Energy Crisis, A technologist's search for a black swan"*** We highly recommend it, especially to energy engineering students.

Matt Emery, who is an expert from www.Leedskalnin.com(Coral Castle), gave an excellent summary of Leedskalnin's work.

We also heard from **Sterling Allan**, Founder and CEO of Pure Energy Systems, via remote from Brazil, present his summary of five top emerging energy technologies nearing the market.

We were extremely pleased to have **Nick Simos** from Brookhaven National Labs present his amazing classical physics analysis of Nikola Tesla's wireless transmission of electrical power which gives it a high feasibility rating. His slide show is posted online

Also, **Dave Froning**'s prerecorded slide presentation on electromagnetic confinement for nuclear fusion was excellent.

The Closing talk was presented by IRI's President, Tom Valone on Zero Point Energy Harvesting as the most promising energy source for the new millennium.

We are happy to let you know that all the slide show presentations have been recorded and are available **FOR FREE** online at www.futurenergy.org . Just click on each speaker's link and follow the instructions. As we continue to strive to educate the public on all emerging energy technologies, we look forward to your continued support through your donations to our Non-Profit Institute and thank you for the generosity shown throughout the years.

All of us at IRI want to thank the attendees for supporting our conference and all the volunteers who made it possible! These conferences would not be possible WITHOUT YOUR SUPPORT. THANK YOU!

Free Energy: Polymer Generator Driven by Water

9:00 10 January 2013 by **Jacob Aron- New Scientist**
http://www.newscientist.com/article/dn23066-muscle-mimic-pulls-electricity-from-wet-surface.html

Electricity has been squeezed from a damp surface for the first time, thanks to a polymer film that curls up and moves - a bit like an artificial muscle - when exposed to moisture. The film could be used to run small, wearable devices on nothing but sweat, or in remote locations where conventional electricity sources aren't available.

Ed. Note: For the first time a new source of energy was discovered in 2013. A simple wet surface has now been proven to cause repeated twisting and flattening of a polymer, so MIT attached a piezoelectric generator to it for a free energy output. See video online. - TV

When a dry polymer absorbs water, its molecular structure changes. This can, in principle, be converted into larger-scale movement, and in turn electricity. But previous attempts at creating a material powered by **a moisture gradient** - the difference in chemical potential energy between a wet region and a dry region - failed to produce a useful level of force.

These unsuccessful tries used a polymer called polypyrrole. Now Robert Langer and colleagues at the **Massachusetts Institute of Technology** have turned to the material again, embedding chains of it within another material, polyol-borate. This more complex arrangement mimics structures found in muscles as well as in plant tissues that bend in response to changes in humidity.

Flipping film

The result looks like an ordinary piece of thin black plastic, but when placed on a wet surface, something extraordinary happens. As the material absorbs water, its end curls away from the surface and the film becomes unstable, so it flips over. The ends have now dried out, so they are ready to absorb more water, and the whole process repeats itself. This continuous flipping motion lets the film travel across a suitably moist surface unaided.

Langer found that a 0.03-millimetre-thick strip, weighing roughly 25 milligrams, could curl up and lift a load 380 times its mass to a height of 2 millimetres. It was also able to move sideways when carrying a load about 10 times its mass.

To extract energy from this effect, Langer's team added a layer of piezoelectric material - one which produces electricity when squeezed. When this enhanced film, weighing about 100 milligrams, flipped over, it generated an output of 5.6 nanowatts - enough to power a microchip in sleep mode.

Electricity from sweat

Though the output is small, it is proof that electricity can be extracted from a water gradient. "To the extent of our knowledge, we are the first to utilise a water gradient, without a pressure gradient, to generate electricity," says Langer.

Large-scale energy harvesting is unlikely as the size of the device needed would be

impractical, but it could be used to power small devices such as environmental monitoring systems in remote locations. "It will be interesting for applications where the amount of energy needed may be low but where access to energy may be difficult," says Peter Fratzl at the Max-Planck Institute of Colloids and Interfaces in Potsdam, Germany, who was not involved in the work.

Another application, Langer suggests, would be to place the film inside the clothing of joggers or athletes. The evaporation of sweat could generate enough electricity to power sensors monitoring blood pressure and heart rate.

Journal reference: *Science*, DOI 10.1126/science.1230262

Recycled Plastic Converted to Fuel

By Adam Williams *February 26, 2013 Gizmag*
http://www.gizmag.com/fuel-plastic-waste-sydney-london-flight/26391/

British pilot Jeremy Rowsell is set to fly solo from Sydney to London in a Cessna 182 aircraft powered solely by diesel derived from "end-of-life" plastic (ELP) waste. If all goes to plan, the endeavor will set a new record time for the journey in a single-engine piston plane, and represent a compelling argument for the viability of ELP as a fuel source.

The project, dubbed "On Wings of Waste," was conceived following longtime pilot Rowsell's growing concern about the role that the aviation industry plays in harming the environment, in addition to the larger problem of pollution in general. To bring attention to the practicability of recycled plastic as a fuel source, Rowsell teamed up with Cynar PLC, an Irish company that converts ELP into synthetic diesel.

Gizmag spoke with Cynar CEO Michael Murray via telephone, who explained that the company converts ELP typically destined for landfills into useful diesel. The conversion involves pyrolysis, which is the process of thermal degradation of a material in the absence of oxygen - so heating, but no burning, takes place.

ELP is broken down into gases by the pyrolysis process, then put through a specially-designed condenser system in order to produce a mixture equivalent to petroleum distillates. This is then further treated to produce liquid fuel, while leftover gases are diverted back into the furnaces which heat the plastics. Interestingly, the diesel produced by this method is actually claimed more efficient and lower in sulfur than generic diesel.

The only waste material left over from the ELP-to-diesel conversion process is roughly five percent char, which can also be put to use in the building industry for concrete and tile manufacturing.

Each Cynar plant can produce up to 19,000 liters (around 5,000 US gallons) of fuel from 20 tons of ELP per day. For the roughly 4,000 liters (1,000 US gallons) of fuel that Rowsell's flight will consume, approximately five tons of waste plastic will be recycled.

Cynar's tech is being incorporated into several worldwide waste recycling firms, enabling such companies to convert ELP into diesel themselves. In addition, Cynar has penned an agreement with the UK's Loughborough University to in a bid to further advance research on the subject.

While the diesel produced by Cynar's recycling process has been used many times in vehicles, Rowsell's flight will be the first time it has been used to power an airborne journey.

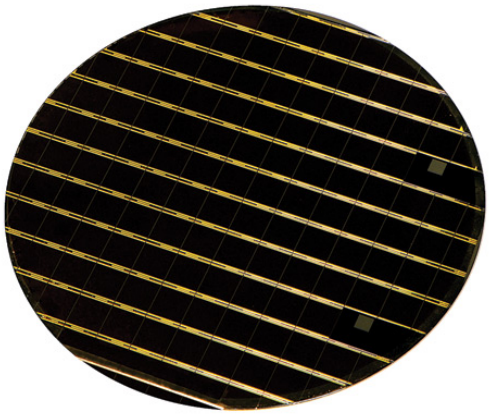
The pilot will follow in the footsteps of aviation pioneers such as Charles Kingsford-Smith and Bert Hinkler. He'll be flying for stretches of up to 13 hours at a time, usually at around 5,000 feet (1,500 meters), while crossing massive swathes of land and sea, for a total of around 12,000 nautical miles (22,000 km).

The ambitious voyage is scheduled to take place this coming July.

Sources: At Altitude, Cynar PLC via The Telegraph

Powerful PV's Approach 50% Efficiency

By RICHARD STEVENSON / DECEMBER 2012. IEEE - Reported in Future Energy eNews, Feb. 2013
http://spectrum.ieee.org/green-tech/solar/powerful-pvs-approach-50-percent-efficiency



Super Solar: Solar Junction's photovoltaic cell breaks efficiency records.

Silicon Valley start-up Solar Junction has raised the bar for solar efficiency to 44 percent, and even higher values are in the cards: The company has a road map for reaching 50 percent efficency and beyond.

To break the efficiency record, Solar Junction built a cell with three regions, known as junctions, that are stacked on top of one another; each absorbs a different spectral region of the sun's rays. The result is a device that delivers far more energy than conventional cells do. Ordinary photovoltaics have just a single junction. Each junction in the triple-junction cell operates at a different output voltage, and they are connected in series, so the total power produced gets a boost.

Manufacturing a triple junction is not a first, but the type of material that Solar Junction uses for the bottom cell, known as dilute nitride, is new. In this case, the material is made up of gallium indium arsenide antimonide with a splash in nitrogen.

Dilute nitrides have a checkered history. In the middle of the last decade, they were the key ingredient in a new generation of telecom-wavelength lasers that failed to win significant sales. "It wasn't for yield or lack of performance. It was because the telecom industry crashed, and that choked off any new products," explains Homan Yuen, Solar Junction's vice president of research and development.

In triple-junction cells, dilute nitrides are destined to make a big impact because they offer unprecedented versatility, says Yuen. This material's composition can be tuned to optimize the power that the cell harnesses from the sun's infrared energy. But what's really important is that engineers can make those tweaks while independently controlling the spacing of the atoms in the dilute nitride's crystal. Even tiny mismatches between this nitride's crystal lattice and that of the layers below and above can crush efficiency.

The 44 percent figure is remarkable on its own, but what's going to keep Solar Junction's new cell from just being another one for the record books is that the process can be extended to produce four-, five-, or even six-junction cells. This will increase the output voltage of photovoltaics and ultimately let them yield more power (the product of current and voltage)

The upshot of all this optimization is that the company will be able to boost efficiency past the coveted 50 percent mark, according to Solar Junction engineers, who've already mapped out a path to that goal. They will begin by inserting a bottom germanium junction to form a four-junction cell with better performance in the infrared. Further gains will then result from replacing the single dilute nitride layer with a pair of dilute nitride layers, before a sixth junction is added at the top of the structure, which will improve the cell's ultraviolet efficiency.

Multijunction cells are very expensive to produce because their structure is formed using painfully slow deposition techniques on small, costly substrates. So to make the photovoltaic systems that use them cost-competitive with those based on silicon, you need mirrors and lenses to focus sunlight, concentrating it by a factor of several hundred onto cells no bigger than a fingernail.

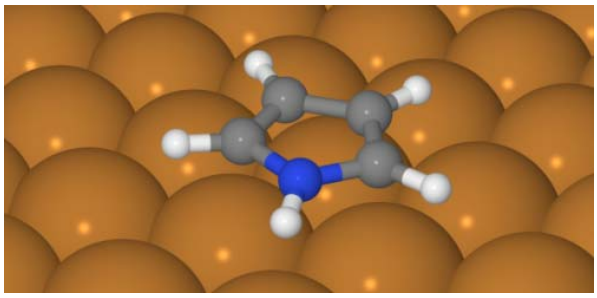
Concentrating solar not only trims costs, it also boosts cell efficiency, because it increases the output voltages at each junction. In Solar Junction's case, the record-breaking efficiency resulted from concentrating sunlight by a factor of 947 on a cell from a production run.

Installations of photovoltaic systems based on this technology must swivel and tilt from dawn to dusk to ensure that sunlight always hits an array of cells head-on. Despite that complexity, such PV systems are quickly becoming more popular in dry, sunny climes. According to IMS Research, in Wellingborough, England, 90 megawatts will be deployed in 2012, rising to 1.2 gigawatts by 2016. This rapid growth is spurred by the low cost of the energy that these systems generate over their lifetime. The multijunction PV systems can undercut silicon cells by 12 percent in some locations, and at the efficiencies Solar Junction is now seeing, this gap could widen.

"Cells are one of the main contributors to the total system costs," explains Jemma Davies of IMS. "By increasing efficiency and concentration, the output per cell is increased, and the cost per watt decreases.

Zero Point Energy? Molecule Runs Counter to Classical Physics

Future Energy eNews, April, 2013
(Phys.org) -New research shows that movement of the ring-like molecule pyrrole over a metal surface runs counter to the centuries-old laws of 'classical' physics that govern our everyday world.
Surprisingly, with pyrrole the predicted 'activation barriers' were way out, with calculations "less than a third of the measured value". **After much head scratching, puzzled scientists turned to a purely quantum phenomenon called 'zero-point energy'.**



Using uniquely sensitive experimental techniques, scientists have found that laws of quantum physics - believed primarily to influence at only sub-atomic levels - can actually impact on a molecular level.

Researchers at Cambridge's Chemistry Department and Cavendish Laboratory say they have evidence that, in the case of pyrrole, quantum laws affecting the internal motions of the molecule change the "very nature of the energy landscape" - making this 'quantum motion' essential to understanding the distribution of the whole molecule.
The study, a collaboration between scientists from Cambridge and Rutgers universities, appeared in the German chemistry journal *Angewandte Chemie* earlier this month.
A pyrrole molecule's centre consists of a "flat pentagram" of five atoms, four carbon and one nitrogen. Each of these atoms has an additional hydrogen atom attached, sticking out like spokes.

Following experiments performed by Barbara Lechner at the Cavendish Laboratory to determine the energy required for movement of pyrrole across a copper surface, the team discovered a discrepancy that led them down a 'quantum' road to an unusual discovery.
In previous work on simpler molecules, the scientists were able to accurately calculate the 'activation barrier' - the energy required to loosen a molecule's bond to a surface, allowing movement - using 'density functional theory', a method that treats the electrons which bind the atoms according to quantum mechanics but, crucially, deals with atomic nuclei using a 'classical' physics approach. Surprisingly, with pyrrole the predicted 'activation barriers' were way out, with calculations "less than a third of the measured value". A**fter much head scratching, puzzled scientists turned to a purely quantum phenomenon called 'zero-point energy'.**

In classical physics, an object losing energy can continue to do so until it can be thought of as sitting perfectly still. In the quantum world, this is never the case: everything always retains some form of residual - even undetectable - energy, known as 'zero-point energy'. While 'zero-point energy' is well known to be associated with motion of the atoms contained in molecules, it was previously believed that such tiny amounts of energy simply don't affect the molecule as a whole to any measurable extent, unless the molecule broke apart.

But now, the researchers have discovered that the "quantum nature" of the molecule's internal motion actually does affect the molecule as a whole as it moves across the surface, defying the 'classical' laws that it's simply too big to feel quantum effects.

'Zero-point energy' moving within a pyrrole molecule is unexpectedly sensitive to the exact site occupied by the molecule on the surface. In moving from one site to another, the 'activation energy' must include a sizeable contribution due to the change in the quantum 'zero-point energy'.

Scientists believe the effect is particularly noticeable in the case of pyrrole because the 'activation energy' needed for diffusion is particularly small, but that many other similar molecules ought to show the same kind of behavior.

"Understanding the nature of molecular diffusion on metal surfaces is of great current interest, due to efforts to manufacture two-dimensional networks of ring-like molecules for use in optical, electronic or spintronic devices," said Dr Stephen Jenkins, who heads up the Surface Science Group in Cambridge's Department of Chemistry.

"The balance between the activation energy and the energy barrier that sticks the molecules to the surface is critical in determining which networks are able to form under different conditions."

Related: Superconductivity-like electron pair formation in molecules discovered
More information: onlinelibrary.wiley.com/doi/10.1002/anie.201302289/abstract
Journal reference: Angewandte Chemie
Provided by University of Cambridge

Read more at: http://phys.org/news/2013-04-movement-pyrrole-molecules-defy-classical.html#jCp

Recyclable Wooden Solar Cells For Sustainable Power

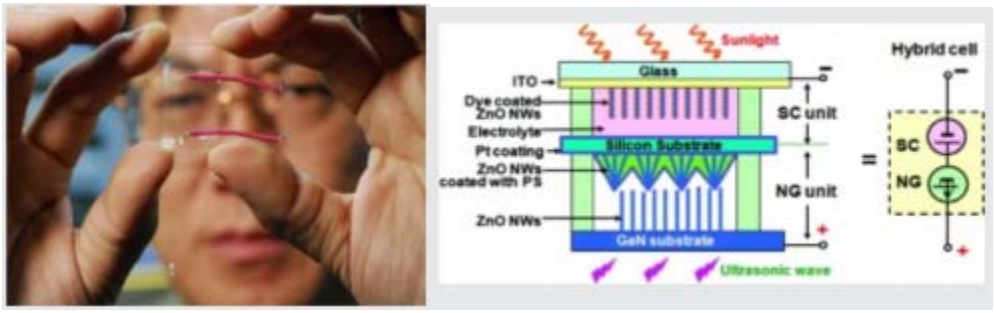
Georgia Tech Press Release, 4/26/13, http://video.techbriefs.com/video/Recyclable-Wooden-Solar-Cells-f;Power

Georgia Tech and Purdue University researchers, led by Georgia Tech engineering professor Bernard Kippelen, have developed efficient solar cells using natural substrates derived from plants such as trees. By fabricating them on cellulose nanocrystal (CNC) substrates, the solar cells can be quickly recycled in water at the end of their lifecycle. The CNC substrates are optically transparent, enabling light to pass through them before being absorbed by a very thin layer of an organic semiconductor. The new organic solar cells reach a power conversion efficiency of 2.7 percent - an unprecedented figure for cells on substrates derived from renewable raw materials.

Great two minute video http://video.techbriefs.com/video/Recyclable-Wooden-Solar-Cells-f;Power

Using Nanotechnology to Capture the Energy Around Us

Yale Scientific Magazine, May 11th, 2013
http://www.yalescientific.org/2013/05/electricity-from-thin-air-using-nanotechnology-to-capture-the-energy-around-us/



Energy exists all around us - in the motion of a heartbeat, the fluorescent light in an office building, and even the flow of blood cells through the body. These individual units of energy are relatively small, but they are numerous.

Dr. Zhong Lin Wang, Professor of Materials Science and Engineering at the Georgia Institute of Technology, has developed a way to harness this ambient energy. After months of work, Wang and his team have developed the very first hybrid cell, which is capable of harnessing both motion and sunlight. By tapping into multiple sources of readily available energy, the tiny cells have the potential to revolutionize the way we power our devices.

Since Wang's cell is small enough to work on the nanoscale, it can readily be incorporated into biomedical sensors, cellphones, and other small electronics. The cell's hybrid design is an advantage as well: Solar energy alone produces high voltages but is unsuitable for devices used in the dark, while energy from ambient motion is more consistent but is available on a smaller scale. By combining these sources, Wang's device can provide a highly reliable supply of electricity.

Wang developed the motion-harnessing component of the hybrid cell in 2006. These devices, called nanogenerators, can collect energy at the micro- and nanoscales of motion by relying on piezoelectricity, the production of a current from compression or strain. To construct a nanogenerator, Wang grew a vertical array of microscopic zinc oxide (ZnO) wires on a flat base. On top of this, he placed an electrode with multiple pointed peaks that give it a "zig-zag" appearance. When the ZnO nanowires are bent out of their ordered formation, they generate small electric charges due to piezoelectricity. They then touch the zig-zag edge of the electrode, which collects all the electricity to produce a current. Due to its sensitivity, a nanogenerator can capture even vibrations of very small magnitudes, which can then be harnessed to power an object such as a pacemaker. In fact, nearly a milliwatt of mechanical energy exists in each cubic centimeter of the ambient

environment.

Many devices, however, cannot be sustainably powered by nanogenerators alone; solar cells generate a larger voltage more practical for use in bright environments. To miniaturize solar power capture, Wang made use of an existing technology called a dye-sensitized solar cell (DSSC). These cells are made by combining an anode with an electrolyte solution to form a semiconductor. First, a dye is applied to the anode to make it sensitive to light. When light strikes the dye, it releases electrons that flow through the anode toward the electrolyte solution, generating a current. Wang's method employs the same principle on a miniaturized scale. Dye-coated ZnO nanowires serve as the anode, surrounded by the cell with a chamber of electrolytic fluid, forming a DSSC small enough to integrate with a nanogenerator.

After refining both technologies in collaboration with Dr. Xudong Wang of the University of Wisconsin-Madison, Wang has discovered a way to incorporate both nanogenerators and DSSCs into a device he terms a "hybrid cell." The upper layer of the cell harvests light energy, and the nanogenerator below collects ambient motion. A single layer of silicon is sandwiched between the two and functions as an electrode for both devices, combining their energy into a single output. The two sources can be connected in parallel for higher currents and in series for higher voltages.

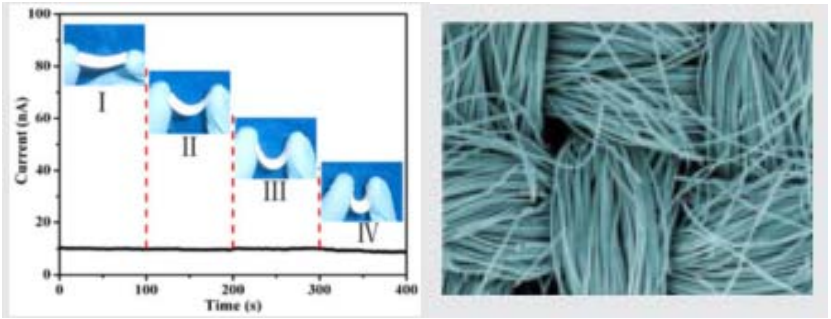
For balance of article, go to YaleScientific.org

Self-Powering Cloth Electronics

Chemistry World, July 2013, Emily Skinner
http://www.rsc.org/chemistryworld/2013/07/tin-oxide-cloth-bendy-electronics

Chinese scientists have made **compact, self-powering, bendable photodetectors from tin dioxide cloth**.

Flexible electronics are an exciting area of research with foldable displays and wearable electronics being potential uses. Self-contained power generation complements flexibility by removing the need for bulky external power supplies to make smaller devices more feasible.



Guozhen Shen from the Chinese Academy of Sciences, and co-workers at the Wuhan National

Laboratory for Optoelectronics, have made tin dioxide cloth by growing tin dioxide nanoparticles on a carbon cloth template to give hollow microtubes of tin dioxide in a woven pattern. Tin dioxide is a wide band gap semi-conductor that has high quantum efficiency in the UV region, making it a good material for both battery electrodes and light sensing. Shen's team integrated a tin dioxide cloth-based UV photodetector and a tin dioxide cloth-based lithium-ion battery into one device to form a flexible, self-powering photodetector that can be trimmed to match any shape. The detector's performance is comparable to conventional devices and, importantly, no change in performance occurs when the cloth is folded.

Shen says that fabricating large areas of cloth that retain a consistent woven structure was initially challenging, however, by growing a dense layer of nanoparticles on the template a well-defined structure could be reliably formed. He is pleased that the resulting device 'is a very simple system possessing advantages of adjustable size and portability.'

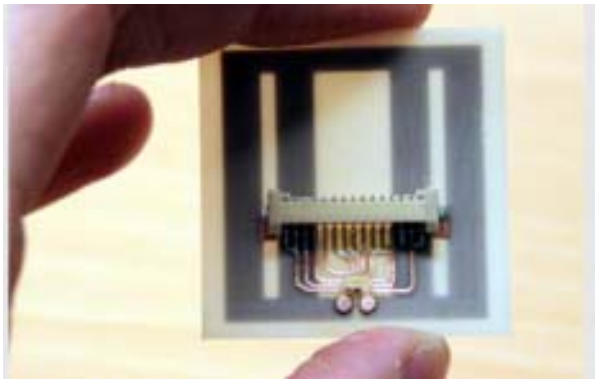
Jia Huang of Tongji University, China, an established researcher in the field of materials chemistry and electronics, is impressed by this low cost approach to fabricating flexible electronic devices which have 'unique applications in foldable, stretchable and wearable electronic systems.' However, he warns that optimising the mechanical durability of the cloth will be important when developing these devices in the future.

Shen and colleagues plan to develop even smaller and neater devices from this prototype to suit a wide range of applications.

Harvester Could Capture Energy from Ambient RF Signals

New Electronics, July 2013
http://www.newelectronics.co.uk/electronics-news/harvester-could-capture-energy-from-ambient-rf-signals/52390/#sthash.b0SsXk4R.dpuf

Imec and the Holst Centre, along with the Delft University of Technology and the Eindhoven University of Technology, have designed and fabricated a self calibrating RF energy harvester which may pave the way towards capturing energy from ambient WiFi or GSM signals.



According to the researchers, the device can harvest RF energy at lower input powers than current solutions. Measurements taken in an anechoic chamber in the 868MHz band show a -26.3dBm sensitivity for 1V output and 25m range for a 1.78W rf source in an office corridor. The maximum end to end power conversion efficiency is said to be 31.5%.

The key blocks are a five stage cross connected bridge rectifier, a high Q antenna and a 7bit capacitor bank. The capacitor bank and the rectifier are implemented in standard 90nm cmos and are esd protected.

The design is said to overcome several limitations of existing rf energy harvesters, including poor sensitivity, the need for calibration, the need for a special technology process and a large chip/antenna area.

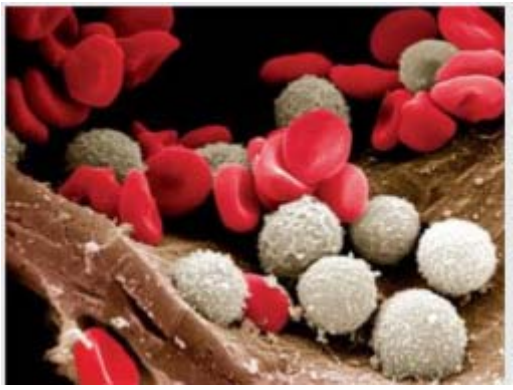
The device features a smaller antenna area and operates at lower frequencies and is believed to be suitable for powering small sensor systems in applications where other energy sources are not available.

- See more at: http://www.newelectronics.co.uk/electronics-news/harvester-could-capture-energy-from-ambient-rf-signals/52390/#sthash.b0SsXk4R.dpuf

ELECTRIC FIELDS ASSIST WOUND HEALING

New Scientist, September 2013
http://www.newscientist.com/article/mg19125624.400-to-heal-a-wound-turn-up-the-voltage.html

CELLS can't see or hear, but some of them have a sense we lack: they can detect the electric fields generated by a wound. Identifying how they do this could help efforts to boost wound healing. The flow of ions across a cell membrane creates tiny electric fields. Tissue damage changes that field, and cells involved in tissue repair seem to sense this change.



To work out what might cause these cells to respond to electric fields, Min Zhao and Alex Mogilner at Stanford University in California and their team looked at fish skin cells, which are often used to study cell motion. When placed in an electric field to mimic the field formed around a wound, whole cells moved towards the positive electrode, as if moving towards an injury. Curiously, though, smaller fragments of cellular material in the fish skin cell sample headed in the opposite direction.

The cells and fragments have one thing in common - both possess bundles of proteins that help them move. The team realised that these proteins act as tiny electromagnetic compasses: they propel cells towards a wound, but send cell fragments away (Current Biology, DOI: 10.1016/j.cub.2013.02.026).

Inducing electric currents at sites of injury could improve wound healing therapies, says Zhao.

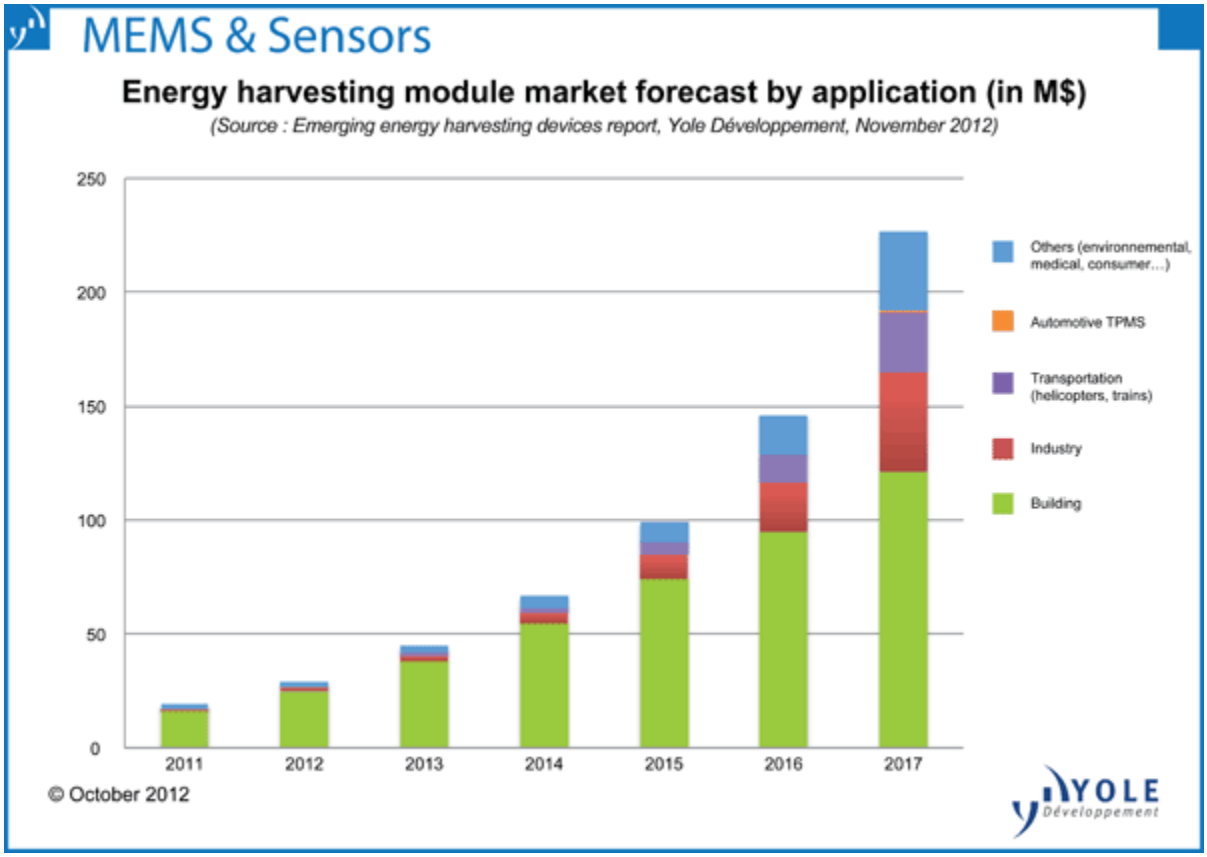
This article appeared in print under the headline "Internal compass points to injury"

ENERGY HARVESTERS REPORT

Hearst Electronics Magazine, Sept 2013

Energy harvesters challenge batteries in wireless sensors
Emerging Energy Harvesting Devices a report from Yole Développement

Lyon, France - Yole Développement announces its new analysis "Emerging Energy Harvesting Devices". In this report, Yole Développement analysts describe why and how emerging energy harvesting devices will be increasingly used in the dynamic wireless sensor business.



Building and industry will drive market growth to +51%/year
Until now, batteries were dominantly used to power those networks, but progress in low power electronics and communication protocols are enabling sensor networks to run of energy harvesters in conditions where it's not practical to replace batteries. Yole

Développement's report is an overview of the energy harvesting applications with a focus on building and industrial applications.

Building applications are by far the main use for energy harvesters with 1M units sold in 2011. They are used in commercial building where large networks of wireless switches (for lighting) and sensors (presence, humidity) are installed. The clear market drivers for energy harvesters are the huge installation cost reduction (no wiring), and their being maintenance free. Hence, production will be multiplied by a factor of more than 10 between 2012 and 2017.

"The industrial market will be the second key area for energy harvesters, again with applications in wireless sensors that are used to monitor machines and processes", announces Antoine Bonnabel, Technology & Market Analyst, MEMS Devices & Technologies at Yole Développement. Energy harvesters increase the autonomy of the battery and thus the measurement data rates which are today limited with batteries. Maintenance free is also a great argument for EH in those applications where accessibility is sometimes critical (oil & gas industry for instance). "Today, sales are limited because there is no real agreement on a low power radio protocol, as in buildings, but this will soon change and will allow significant price reduction and production ramp-up to several hundred thousand units in 2017", said Antoine Bonnabel.

Other emerging applications will also likely adopt energy harvesters to replace batteries in wireless sensors applications and will add additional volumes to the global energy harvester business: transportation (helicopters, trains), automotive TPMS, environmental, medical.... Yole Développement report provides a deep understanding of the market drivers and challenges for energy harvesters, and identifies the real businesses among hype applications.

"Overall, the global emerging energy harvesting business at the wireless module level will grow from $19 M in 2012 to $227 M in 2017, meaning an impressive growth of + 51 % /year", stated Yann de Charentenay, Senior Analyst at Yole Développement.

Mechanical and thermal harvesters are the most dynamic technologies
Wireless sensor modules require a power source from tens of microwatts up to tens of milliwatts, and energy harvesters have now enough power output in many applications to provide an infinite lifetime to those modules. The scope of technology candidates is very broad, with very variable technological maturity. In this report, Yole Développement's experts analyze and provide a detailed description of different energy harvesting technologies currently used and under development, along with their strengths and limitations. Those technologies have been segmented by mechanical, thermal and solar PV categories. Yole Développement's report provides market share of each technology per application, trend until 2017, and market forecast.

Mechanical and thermal are the most dynamic and innovative technologies and will experience a rapid adoption in several markets (building, industry, transportation) that will drive their sales to reach respectively 39% and 25% of the total energy harvesting sales in 2017. Price erosion will be very significant (12%/year) thanks to production ramp up.

"Energy harvesting devices produced by MEMS technologies will be mainly thermal thin-film technology whose production will start industrially in 2012", announces Yole Développement. Other mechanical vibration MEMS harvesters will take longer time to be adopted specially for TPMS due to cost challenge.
Analysis of energy harvesting industry dynamic

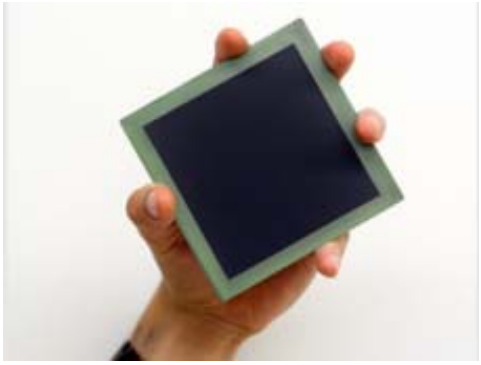
The report identifies and positions the key energy harvesting market players depending on technologies developed, level of maturity, business model and targeted markets. The dynamics of
the supply chain is analyzed, in order to understand:
- Who are the key market players, in each application field at both transducer and module level
- How the competitive landscape will evolve.

Catalogue price: Euros 3,990.00 (single user license) - Publication date: November 2012.
For special offers and the price in dollars, please contact David Jourdan (jourdan@yole.fr).

CHEAP FUEL CELL

Kevin Bullis, Technology Review, September 2013
http://www.technologyreview.com/news/518516/an-inexpensive-fuel-cell-generator/
http://www.redoxpowersystems.com/

People could soon get cleaner energy from a compact fuel-cell generator in their backyards, at costs cheaper than power from the grid. At least, that's the hope of Redox Power Systems, a startup based in Fulton, Maryland, which plans to offer a substantially cheaper fuel cell next year.



Redox is developing fuel cells that feed on natural gas, propane, or diesel. The cells, which generate electricity through electrochemical reactions rather than combustion, could allow businesses to continue operating through power outages like those caused by massive storms such as Hurricane Sandy, but they promise to be far cleaner and quieter than diesel generators. They can also provide continuous power, not just emergency backup power, so

utilities could use them as distributed power sources that ease congestion on the grid, preventing blackouts and lowering the overall cost of electricity.

Redox's claims sound a lot like those made in 2010 by Bloom Energy (see "Bloom Reveals New Fuel Cells"), a well-funded fuel-cell startup in Sunnyvale, California. But Bloom's fuel cells are based on relatively conventional technology, and so far they have proved far too expensive for homes. Redox claims to have developed fuel cells based on novel materials that could cut costs by nearly 90 percent. The first product will be a 25-kilowatt generator that Redox says produces enough electricity for a grocery store. The company eventually plans to sell smaller versions for homes.

Redox's fuel cells are based on highly conductive materials developed at the University of Maryland that help increase power output by a factor of 10 at lower temperatures (see "Gasoline Fuel Cell Would Boost Electric Car Range"). The company says its fuel cells will pay for themselves with electricity-bill savings in two years.

Redox, a self-funded company founded just two years ago, is basing its cost estimates on data derived from manufacturing key components of the fuel-cell systems. But it hasn't started making complete systems, which would include several stacks of the fuel cells and other equipment such as pipes and pumps for distributing fuel to them.

The type of fuel cell Redox makes is called a solid-oxide fuel cell. Like all fuel cells, it produces power through electrochemical reactions. Unlike those being developed for use in cars, it can run on a variety of fuels, not just hydrogen. Redox's cells will release carbon dioxide, but emissions per kilowatt-hour should be lower than those associated with power from the grid.

Though Bloom also uses solid-oxide fuel cells, Redox's are more advanced, says Mark Williams, a former technical director for fuel cells at the U.S. Department of Energy, who is not connected to Redox. He says they're among the most powerful solid-oxide fuel cells ever made, producing about two watts per square centimeter versus 0.2 watts for Bloom's cells.
Warren Citrin, the company's CEO, says the fuel-cell systems will cost about $1,000 per kilowatt, compared with $8,000 per kilowatt for Bloom.

However, the company's claim of a two-year payback is a rough estimate; it doesn't include the cost of financing, for example, and it factors in expected economies of scale from producing about 400 fuel-cell systems per year, although the company has yet to manufacture even one complete system so far.
Citrin says the company has made the individual ceramic plates that fit inside the fuel-cell system. It started with small, experimental "button" fuel cells from the University of Maryland and, working with contract manufacturers, demonstrated that it's possible to manufacture the larger, 10-centimeter-wide versions needed in a commercial system. It's also started testing stacks of these cells.

Citrin says the company plans to finish a 25-kilowatt prototype by the end of the year, in

time to start selling complete systems by the end of 2014.

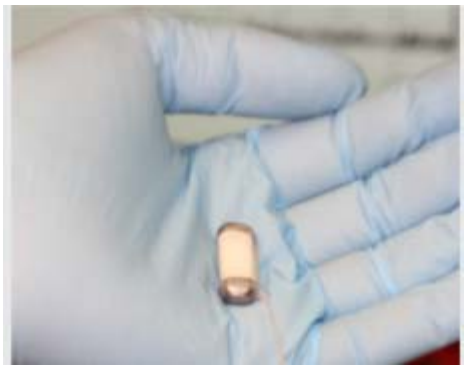
Because Redox hasn't yet manufactured complete systems, it remains to be seen how reliable they will be. Fuel cells are notorious for requiring expensive maintenance and not lasting more than a few years, which is one of the reasons they haven't taken off yet.

Eric Wachsman, director of the University of Maryland Energy Research Center, who developed the original technology, believes the system will perform well over time because it operates at lower temperatures than other versions, reducing damage to the fuel cells. He says data from individual cells suggest that the systems could last for 10 years-still far short of the lifetime of a power plant, but within the payback period.

ELECTRIC MEDICINE WITH IMPLANTS

Susan Young, Technology Review August 31, 2013 http://www.setpointmedical.com/

In early human tests, SetPoint Medical has found that an electronic implant helped reduce the symptoms of rheumatoid arthritis in six of eight patients. The company, which is based in Valencia, California, is one of many groups exploring the potential of electronic implants to treat diseases by delivering pulses to nerves that regulate organ or body functions.



Earlier this month, pharmaceutical giant GlaxoSmithKline, medical-device manufacturer Boston Scientific, and others invested $27 million in SetPoint. Although nerve-stimulating devices have been available for many years, GSK and academic researchers argue that the field of bioelectronic therapies is just beginning to ramp up and that in the future many conditions could be treated with electrical impulses.

The arthritis-regulating device is implanted in the patient's neck and wraps around the vagus nerve, a bundle of nerve fibers that communicates sensory information from internal organs and controls involuntary body functions such as heart rate and digestion. The device stimulates the nerve at regular intervals in a particular pattern that regulates the immune system, which is overactive in rheumatoid arthritis.

Brain implants have previously been used to treat movement disorders and some

psychiatric conditions (see "Brain Implants Can Rest Misfiring Circuits"). Devices are also used to stimulate nerves outside the brain. An electrical device that stimulates the vagus nerve is already used to treat some cases of drug-resistant epilepsy and depression, and another is undergoing testing as a treatment for congestive heart failure. But SetPoint is covering new ground by testing peripheral-nerve stimulation as a treatment for immune disease.

"The industry is expanding rapidly," says Kenneth Gustafson, a biomedical engineer at Case Western Reserve University in Cleveland, who is studying electrical nerve stimulation as a way to treat bladder dysfunction. The precedent set by pacemakers, deep brain implants, and other such devices enables researchers to "take that existing technology and repurpose it for all these new applications," he says.

Researchers say the main advantage of the electrical devices over drug treatments is that they may not cause as many side effects. "Electrostimulation can be much more selective," Gustafson says. "The targets are neural circuits that are not behaving as they should." Drugs, on the other hand, often affect many pathways in the body.

SetPoint has been running animal and human trials using devices developed by another company to treat epilepsy. In the future, trials will use a proprietary device that is smaller and specifically engineered for the infrequent stimulation needed to treat rheumatoid arthritis. The company will soon launch another small patient study to test stimulation in patients with Crohn's disease, an autoimmune condition that attacks the gastrointestinal system.

BLACKOUT: 1 BILLION LIVE WITHOUT ELECTRIC LIGHTS – POWER AFRICA INITIATIVE

By Bryan Walsh @bryanrwalsh, Time, Sept. 05, 2013
http://business.time.com/2013/09/05/blackout-1-billion-live-without-electric-light/#ixzz2ffnwLSUS

A summary of the expected impact for the President's Power Africa Initiative.
About 1.3 billion people around the world lack access to electricity.

What did you do when the sun went down? If you're reading this, chances are you switched on a

light. But for the 1.3 billion people around the world who lack access to electricity, darkness is a reality. There is no electric light for children to do their homework by, no power to run refrigerators that keep perishables or needed medicine cold, no power for cooking stoves or microwaves. What light they have mostly comes from the same sources that humans have relied on forever-firewood, charcoal or dung-and the resulting smoke turns into indoor pollution that contributes to more than 3.5 million deaths a year. "For us, life does not stop after dark," says Michael Elliott, president and CEO of the development nonprofit ONE. "For 550 million people in sub-Saharan Africa and many more than that around the rest of the world, it does."

That lack of electricity is called energy poverty, and it's a development challenge that hasn't gotten the attention it deserves. It's easy to see why. Extreme poverty, global hunger, HIV/AIDS and malaria are all immediate threats to human life. Not having somewhere to plug in a cell phone, by contrast, might seem like an inconvenience at worst. But energy poverty is connected to a host of deeper ills: 90% of the children in sub-Saharan Africa go to primary schools that lack electricity, which means no fans or air conditioners in the equatorial heat, no computers, no lights for evening classes. Economic growth is stunted as a result-60% of African businesses cite access to reliable power as a binding constraint on their operations. Energy poverty is even a political issue. In Pakistan, which has just half the electrical-generation capacity of the state of Virginia, frustration over an antiquated grid helped get President Asif Ali Zardari kicked out of office this year

The good news is that the issue is slowly receiving more notice. This summer, President Barack Obama announced his **Power Africa initiative**, which promises more than $7 billion over the next five years to bring electricity access to 20 million new households in countries like Ethiopia and Ghana. Development groups like ONE have begun making energy poverty a priority, weaving it into long-standing health and economic programs. "A light where currently there is darkness. The energy needed to lift people out of poverty," Obama told South African students in June. "That's what opportunity looks like."

The Price of Progress

But the challenge is enormous. While some 1.7 billion people have acquired access to electricity globally since 1990, the rate of electrification has been slower than the rate of population growth in the most energy-poor countries. Just to get all of sub-Saharan Africa-a region that generates about as much electricity as Spain-up to levels that comparatively well-off South Africa enjoys would require 330 gigawatts of new capacity. (Power Africa should account for about 10 gigawatts.) The World Bank estimates that it would take $1 trillion a year in global investment to eliminate energy poverty by the year 2030-more than twice what is being spent now. And even that level of investment would guarantee the poorest of the poor only enough electricity to run a floor fan, a mobile phone and two compact fluorescent lights for five hours a day.

The reality is that banishing energy poverty won't be easy or cheap, and it may come with an environmental cost. Much of Africa can and will be supplied with renewable energy sources-especially rural areas beyond the reach of any grid, where solar fits perfectly. But the fastest population growth is happening in the developing world's exploding urban areas, which will eventually need the same reliable, grid-delivered electricity that developed cities enjoy. Some of

that electricity will be generated by fossil fuels, including carbon-heavy coal. The result may well be an increase in greenhouse gases, but given that the average Ethiopian emits less than 1% of the carbon that the average American does, Africans should hardly feel climate guilt. For those who live in darkness, electricity by nearly any means will be worth the price.
Read more: http://business.time.com/2013/09/05/blackout-1-billion-live-without-electric-light/#ixzz2ffnwLSUS

Related Story: In 2013, IRI proposed a solution to the lack of solar electricity in the Obama Plan. We invite you to support our "Power Arica Homes Light Project" with seed funds to attract industrial donations for the three parts needed to light 10,000 homes at night for students. Distribution is available through several nonprofits that cater to Africa relief. The public is invited to help IRI accomplish this worthy goal in any way possible, through donations or networking to those who will help make it a reality.

Supply LED - Solar-NiCd modules for lighting homes
* Recruit African distribution nonprofit organization
* Aim for 10,000 homes per month supply
* Use donated money to accomplish project
* Goal: Jumpstart evening and nighttime studying and reading
http://www.one.org/us/2013/07/03/power-africa-but-only-with-your-support/

GlobalBEM Breakthrough Energy Conference a Breakthrough Indeed!

IRI Press Release, October 27, 2013 For more info contact: 301-220-0440

It's wonderful to find affinity groups around the world who support our future energy research. With over 30 speakers, 2 conference rooms and a 3 day program, the **Global Breakthrough Energy Movement conference** was held in Boulder CO on October 10-12, 2013. The event focused on the full scope of Breakthrough Energy Technologies. This is the second conference to be held by Global BEM. The first was in Hilversum, Holland last November. The speaker lineup (online at www.globalbem.com) for the conference represented some of the brightest minds in the field.

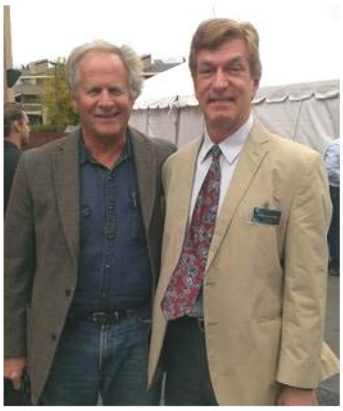
All presentations were live streamed and can be viewed online (link on IRI new page).
We want to congratulate all of the organizers and volunteers for their outstanding job in producing and hosting the conference and look forward to next year. We ask all to check out their website and see how you can contribute to the advancement of clean Breakthrough Future Energy! Below is Dr. Valone's title slide for the lecture, now on YouTube. Note: In the holiday mailing of 2014, all IRI Members will receive a FREE copy of this 45-minute lecture on DVD as a token of appreciation for their support!

The Slideshow of Dr. Valone's "Future Energy Breakthroughs" to a standing-room only crowd (14 MB, PDF). is available on the IRI website ‘News’ page.

A delightful surprise was meeting with Dr Garrett Moddel and his PhD candidate student from China, Weiming Peng. Weiming reported that he read Dr. Valone's Zero Point Energy-Fuel of the Future book, 7-8 years ago in mainland China and it sparked his interest in ZPE. He then obtained an Master’s Degree in physics from SUNY at Buffalo but noted that they still do not research zero-point energy there. He is now working with Prof. Moddel at the U of Colorado for a PhD program centered around the zero point energy investigations of Dr. Moddel. We are happy to see the worldwide influence the IRI books are having as they also influence the education of a new generation! Students are invited to email IRI to request a “Care Package” of related books at no cost to help with their career choices in future energy.

Enjoy the picture highlights below of the Conference. Foster (Proctor & Gamble heir) reviewed his “Thrive!” video; Russ Gries talked about his replication of the Papp engine with a single cell demonstration on display in the Exhibit Area shown below.

Dr. Valone and Foster Gamble



ZPE PhD student W. Peng

Conference Exhibit Area

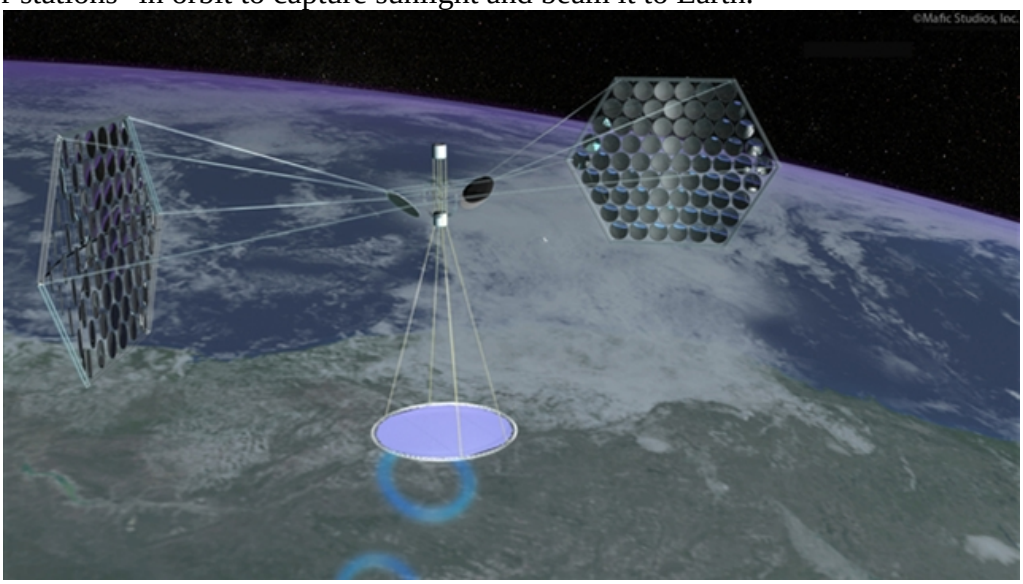
Vernon Roth, Moray King and others

Russ Gries with Papp Demo

Japan Aims to Beam Solar Energy Down from Orbit

By Paul Sutherland | SEN News, 28 September 2013
http://www.sen.com/news/japan-aims-to-beam-solar-energy-down-from-orbit

(Sen) - The Japanese space agency JAXA is developing a revolutionary concept to put "power stations" in orbit to capture sunlight and beam it to Earth.



The country has been looking for new power sources following the devastating earthquake and tsunami in March, 2011, that destroyed much of the north-east of the country and caused a meltdown at the Fukushima Daiichi Nuclear Power Plant.

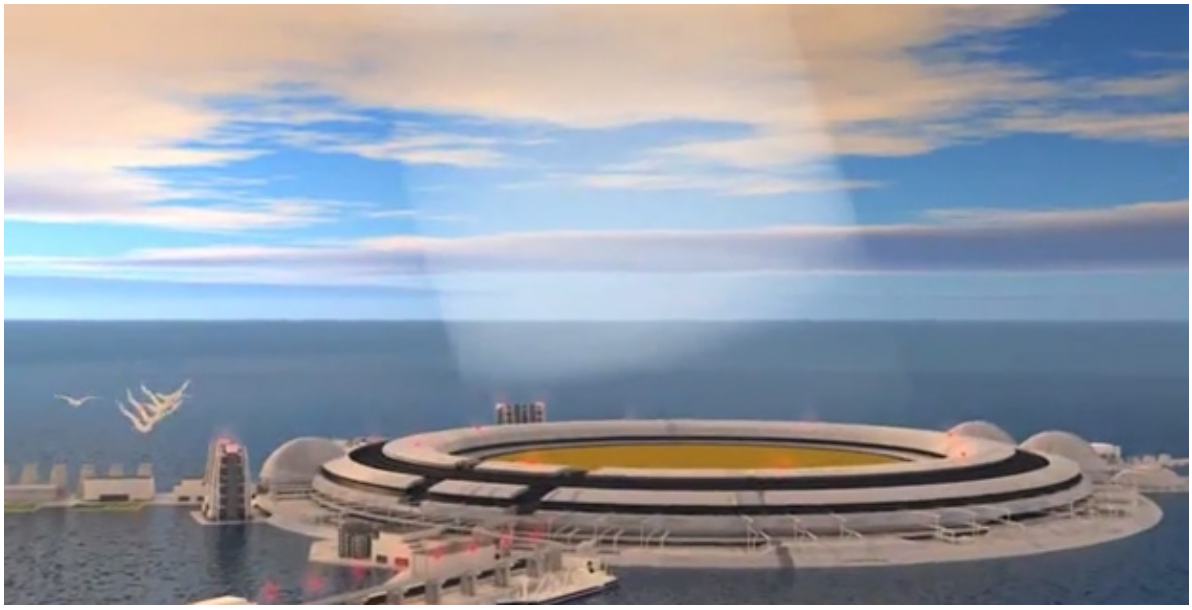
Many of the country's nuclear reactors were closed due to stricter safety regulations after the emergency. Now JAXA is aiming to set up a Space Solar Power System (SSPS) by 2030. An array of mirrors would sit in geostationary orbit to collect solar energy and then transmits it to a power plant on the ground via microwaves or laser beams. There it could be used to generate electricity and hydrogen.

Proponents of the technology say that it would provide continuous energy without any worry that resources would be depleted. It would be unaffected by the time of day or weather and would provide environmentally friendly, clean energy.

Interestingly, the idea is not a new one. An American, Dr Peter Glaser, designed a similar concept in 1968 to deploy large solar panels in space to generate power and convert it into microwaves to transmit to the ground. Following studies by NASA and the US Department of Energy, the project was deemed too costly and it was never developed.

Similar studies have been carried out in Europe. The idea is also reminiscent of a Russian plan in the 1990s to use mirrors to beam sunlight to the ground at night. This had astronomers and environmentalists up in arms because of the light pollution it would have

caused. The Japanese concept is different because there would be no stray light emitted from the beam.



Yasuyuki Fukumuro is leading research and planning for SSPS. He says: "We have not yet decided whether to use microwaves or laser beams with SSPS, or whether we will somehow combine them. We are currently conducting ground-based experiments to find the most efficient way to transmit energy.
"Regardless of which transmission technology we use, when we collect sunlight from outside the Earth's atmosphere, we can get a continuous supply of it, with almost no influence from the weather, the seasons, or time of day, allowing very efficient collection of solar energy.

"And since the energy source is the Sun, it's an endlessly renewable resource - it won't run out as long as the Sun is there. Also, because the power is generated in space and carbon dioxide is emitted only at the receiving site, emissions within the Earth's atmosphere can be greatly reduced, which makes this technology very friendly to the environment.'

Fukumuro suggests the technology will also be useful in disaster situations. In the event of a blackout, a collecting dish could be unfolded and deployed to receive microwaves from space for conversion into electrical energy.

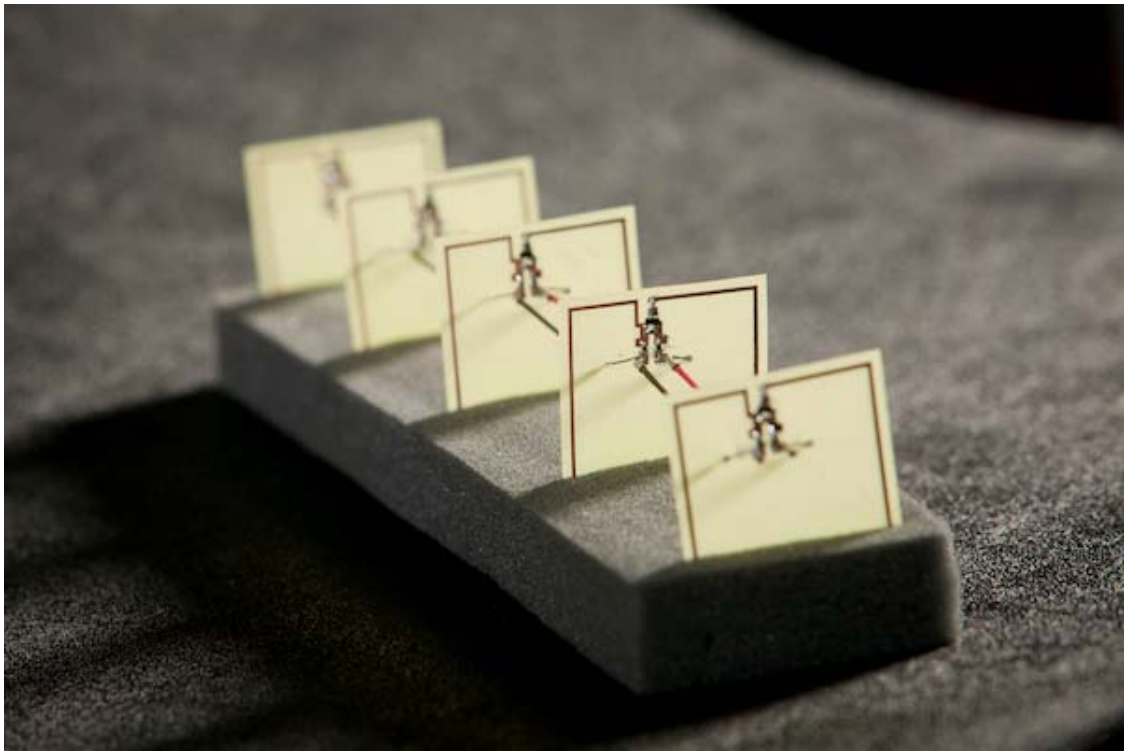
JAXA is working with a collective of machining and engineering companies called Kyoto Shisaku Net to develop the array of reflectors that would be lifted into orbit by reusable shuttle-like spacecraft and then assemble themselves.

JAXA Engineer and Senior Researcher Katsuto Kisara says: "The biggest problem we've encountered with the project is developing solar mirrors that are incredibly lightweight. I think that there is certainly a way to do it, but it has presented quite the challenge."

Wireless Device Converts "Lost" Energy into Electric Power

Energy Daily, Karen Heady. November 2013

http://www.pratt.duke.edu/news/wireless-device-converts-lost-energy-electric-power



Using inexpensive materials configured and tuned to capture microwave signals, researchers at Duke University's Pratt School of Engineering have designed a power-harvesting device with efficiency similar to that of modern solar panels.

The device wirelessly converts the microwave signal to direct current voltage capable of recharging a cell phone battery or other small electronic device, according to a report appearing in the journal *Applied Physics Letters* in December 2013. (It is now available online.)

It operates on a similar principle to solar panels, which convert light energy into electrical current. But this versatile energy harvester could be tuned to harvest the signal from other energy sources, including satellite signals, sound signals or Wi-Fi signals, the researchers say.

The key to the power harvester lies in its application of metamaterials, engineered structures that can capture various forms of wave energy and tune them for useful applications.

Undergraduate engineering student Allen Hawkes, working with graduate student Alexander Katko

and lead investigator Steven Cummer, professor of electrical and computer engineering, designed an electrical circuit capable of harvesting microwaves.

They used a series of five fiberglass and copper energy conductors wired together on a circuit board to convert microwaves into 7.3V of electricity. By comparison, Universal Serial Bus (USB) chargers for small electronic devices provide about 5V.

"We were aiming for the highest energy efficiency we could achieve," said Hawkes. "We had been getting energy efficiency around 6 to 10 percent, but with this design we were able to dramatically improve energy conversion to 37 percent, which is comparable to what is achieved in solar cells."

"It's possible to use this design for a lot of different frequencies and types of energy, including vibration and sound energy harvesting," Katko said. "Until now, a lot of work with metamaterials has been theoretical. We are showing that with a little work, these materials can be useful for consumer applications."

For instance, a metamaterial coating could be applied to the ceiling of a room to redirect and recover a Wi-Fi signal that would otherwise be lost, Katko said. Another application could be to improve the energy efficiency of appliances by wirelessly recovering power that is now lost during use.

"The properties of metamaterials allow for design flexibility not possible with ordinary devices like antennas," said Katko. "When traditional antennas are close to each other in space they talk to each other and interfere with each other's operation. The design process used to create our metamaterial array takes these effects into account, allowing the cells to work together."

With additional modifications, the researchers said the power-harvesting metamaterial could potentially be built into a cell phone, allowing the phone to recharge wirelessly while not in use. This feature could, in principle, allow people living in locations without ready access to a conventional power outlet to harvest energy from a nearby cell phone tower instead.

"Our work demonstrates a simple and inexpensive approach to electromagnetic power harvesting," said Cummer. "The beauty of the design is that the basic building blocks are self-contained and additive. One can simply assemble more blocks to increase the scavenged power."

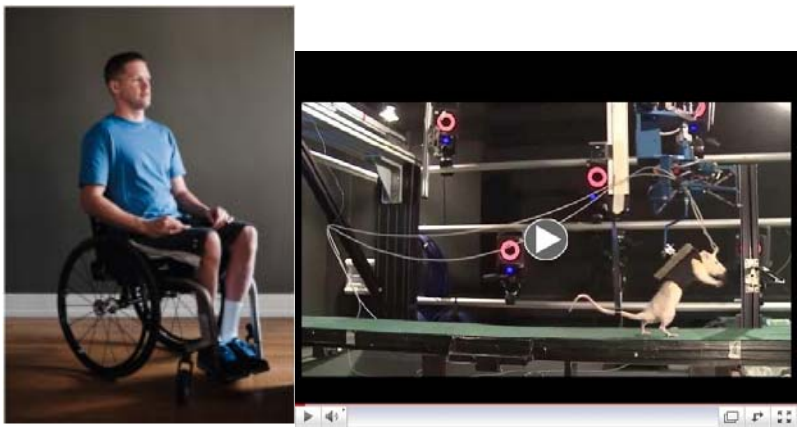
For example, a series of power-harvesting blocks could be assembled to capture the signal from a known set of satellites passing overhead, the researchers explained. The small amount of energy generated from these signals might power a sensor network in a remote location such as a mountaintop or desert, allowing data collection for a long-term study that takes infrequent measurements.

The research was supported by a Multidisciplinary University Research Initiative from the Army Research Office (Contract No. W911NF-09-1-0539). "A microwave metamaterial with integrated power harvesting functionality," Allen M. Hawkes, Alexander R. Katko, and Steven A. Cummer. Applied Physics Letters 103, 163901 (2013); doi: 10.1063/1.4824473

Fighting Paralysis with Electricity

Emily Waltz, IEEE Spectrum, *Future Energy eNews, November, 2013*
http://spectrum.ieee.org/biomedical/devices/spinal-stimulation-gets-paralyzed-patients-moving/?utm_source=techalert&utm_medium=email&utm_campaign=103113

Spinal stimulation: In both animal and human experiments, researchers are using electricity to restore function to paralyzed lower limbs.



Fighting Paralysis With Electricity

Article Excerpt (read it in its entirety on the IRI website under 'News')

A few months after being discharged from the hospital, in May 2011, Shillcox saw a news report announcing that researchers had for the first time enabled a paralyzed person to stand on his own. Neuroscientist Susan Harkema at the University of Louisville, in Kentucky, used electrical stimulation to "awaken" the man's lower spinal cord, and on the first day of the experiments he stood up, able to support all of his weight with just some minor assistance to stay balanced. The stimulation also enabled the subject, 23-year-old Rob Summers, to voluntarily move his legs in other ways. Later, he regained some control of his bladder, bowel, and sexual functions, even when the electrodes were turned off.

The breakthrough, published in The Lancet, shocked doctors who had previously tried electrically stimulating the spinal nerves of experimental animals and people with spinal-cord injuries. In decades of research, they had come nowhere near this level of success. "This had never been shown before-ever," says Grégoire Courtine, who heads a lab focused on spinal-cord repairat the Swiss Federal Institute of Technology in Lausanne and was not involved with the project. "Rob's is a pioneer recovery. And what was surprising to me was that his was better than what we've seen in rats. It was really exciting for me to see."

The report brought renewed hope for people living with paralysis. The prognosis is normally grim for someone like Shillcox, who has a"motor complete" spinal-cord injury. That level of damage usually results in a total loss of function below the injury site.

The U.S. Food and Drug Administration (FDA) had given Harkema the go-ahead to try the technique in four more paralyzed people. Shillcox put his name in the pool the night he saw the news report. He was selected, and in July 2012 he packed his wheelchair into his retrofitted Dodge Journey and drove himself from Green River to Louisville to begin 18 months of experiments.

Harkema, a former student of Edgerton's, ran with that concept. In her experiments with Summers, she

stimulated his spinal cord just enough to wake it up and then let the sensory input do its thing. "It's like putting a hearing aid on the spinal cord," says Edgerton. "We've changed the physiological properties of the neural network so that now it can 'hear' the sensory information much better and can learn what to do with it."

Harkema's group uses an off-the-shelf neurostimulation system-made by Minneapolis-based Medtronic-that's FDA approved for pain management. The system's array of 16 electrodes is surgically implanted in the epidural space next to the outermost protective layer of the spinal cord. The array is then connected to a pulse generator (which resembles a pacemaker) that's implanted nearby. Finally, the pulse generator receives a wireless signal from a programming device outside the body.

The array spans approximately six spinal-cord segments, the ones generally responsible for movement in the lower half of the body. By placing the electrodes over them, the researchers can generate a response in the corresponding muscle groups. Electrode 5, for example, is located near a segment of the spinal cord that controls hip muscles. Electrode 10 is located at the bottom of the array, over the segment that controls the lower leg.

Each of the array's 16 electrodes can be set to act as a cathode or an anode or be completely shut off. Stimulation intensities can range from 0 to 10.5 volts with pulses sent at frequencies ranging from 2 to 100 hertz, although the researchers usually don't go beyond 45 Hz. Picking the right combination of electrodes and stimulation parameters to generate a simple response in a single muscle is relatively straightforward. But generating a complex behavior like standing, which involves many muscle groups and a considerable amount of sensory feedback, is far more difficult. Choosing the right electrode configurations for standing requires both a tremendous amount of intuition and plenty of trial and error. "That's the challenge: to create the electrical field that's going to give you the desired behavior," says Harkema.

On a Wednesday in February of this year, Shillcox arrived at theFrazier Rehab Institute in downtown Louisville for one of his first stimulation sessions. The array and pulse generator had been implanted a few weeks before. He wore Nike sneakers and black gym shorts, revealing thin legs atrophied from lack of use.

Burdick's team is working with Edgerton's lab at UCLA to test the algorithm on paralyzed rats. The researchers are starting simply, using just a couple of electrodes and trying to maximize the response in a particular muscle. The first step is to make sure the algorithm is making reasonable decisions. The team has also begun a small human pilot study, Burdick says.

Shillcox-subject No. 4-remains hopeful, but he's trying to keep his expectations realistic. "I don't want to be too optimistic, and I'm trying to be prepared for no results at all," he says. "I hope that whatever they find from this research will at least benefit other people." Shillcox will likely complete his training by the end of the year, and Harkema says she cannot yet publicly reveal their preliminary results. Whatever the medical benefits ultimately prove to be, working with Harkema as a pioneer on an experimental treatment for spinal-cord injury has boosted Shillcox's confidence around others. "I have no problem asking for help now," he says.

This article originally appeared in print as "An Electrifying Awakening."

About the Author

Emily Waltz, a freelance journalist based in Nashville, frequently writes about biotechnology for IEEE Spectrum. Last year she strapped on an assortment of health-monitoring gadgets for an article about the "quantified self" movement

New Energy Harvester from STM Micro

IT News, December, 2013
http://www.itnews.it/news/2013/1210151502600/advanced-energy-harvesting-ic-from-stmicroelectronics-broadens-benefits-of-battery-free-technology.html

This new Energy Harvestor IC is a huge breakthrough that will allow a single PV cell to produce enough voltage to be converted up to typical USB device voltages of 5+ volts, at a cost of less than $1 !

The SPV1050 includes a buck-boost converter allowing the device to connect to either TEG or small solar-energy harvesting modules by providing a wide input-voltage range from 0.18V to 8V.

An operating efficiency of 90% allows fast battery charging even at low input power levels, while minimum MPPT accuracy of 90%maximizes energy extraction from solar or TEG sources.

See http://www.itnews.it/news/2013/1210151502600/advanced-energy-harvesting-ic-from-stmicroelectronics-broadens-benefits-of-battery-free-technology.html#sthash.bAwG0rl5.dpuf

This device will revolutionize the solar charging field as it means that one can soon charge their cell phones with only 1 large solar cell, vs. 10 or more small cells in series, typically needed today.

This could open up the third world market quickly, and also expand the use of LED lighting and Li-Ion batteries.

This could create a whole new market for low voltage power and solar devices, at a very low cost !

Thanks to IRI Advisor JIM DUNN for providing this story.

More Efficient and Faster Ways to Convert Carbon Dioxide into Fuel

Kevin Bullis, MIT Technology Review, December 5, 2013
http://www.technologyreview.com/news/522246/a-faster-and-more-efficient-way-to-convert-carbon-dioxide-into-fuel/?utm_campaign=newsletters&utm_source=newsletter-weekly-energy&utm_medium=

Making carbon dioxide by burning hydrocarbons is easy. A pair of novel catalysts recently made by researchers at the University of Illinois at Chicago could make it far more practical to do the reverse, converting carbon dioxide and water into fuel.

Because running this reaction normally requires large amounts of energy, it has been economical only in rare cases (see "Company Makes CO2 into Liquid Fuel, with Help from a Volcano"). But if the process could be done commercially, liquid fuels could be made from the exhaust gases of fossil-fuel power plants.

The new work, described this week in the journal Nature Communications, improves on a pair of catalysts discovered last year that more efficiently turn carbon dioxide into carbon monoxide, which can then be made into gasoline and other products. Those catalysts produce carbon monoxide slowly, however, and one is made of silver, so it's expensive. But the Illinois researchers have demonstrated that it's possible to replace the silver with relatively inexpensive carbon fibers while maintaining about the same efficiency. And the technique produces carbon monoxide about 10 times faster.

The work is still in early stages, says Amin Salehi-Khojin, a professor of mechanical engineering at the University of Illinois at Chicago, who led the work. Salehi-Khojin says it will be necessary to produce larger amounts of the catalysts and find a way to incorporate them into a membrane that helps keep them stable over long periods of time-development work that will require industrial partners.

Salehi-Khojin says it may be possible to incorporate the catalysts into an "artificial leaf." Right now, if the process were to run on sunlight, it would require at least two pieces of equipment: a solar panel to generate electricity, and then a reactor to form the carbon monoxide. A leaf-inspired system would absorb energy from the sun and use it to drive the chemical reactions directly, rather than making electricity first (see "A Greener 'Artificial Leaf,'" "Sun Catalytix Seeks Second Act with Flow Battery," and "Artificial Photosynthesis Effort Takes Root"). This approach would make the process more economical.

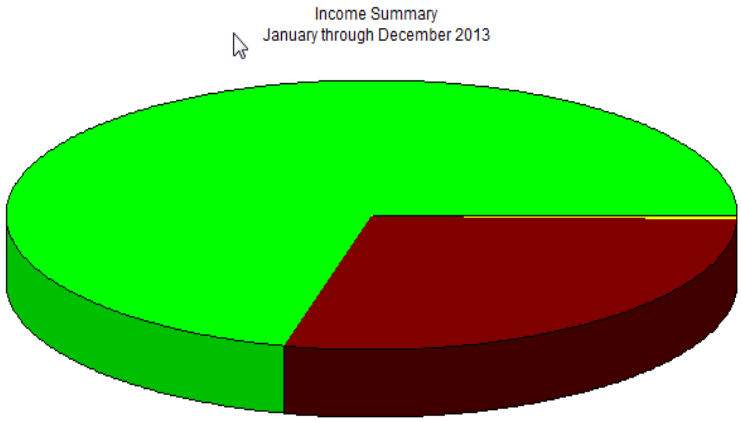
Related Story

A Faster and More Efficient Way to Convert Carbon Dioxide into Fuel: New catalysts turn carbon dioxide into fuels faster and more efficiently
http://www.technologyreview.com/news/522246/a-faster-and-more-efficient-way-to-convert-carbon-dioxide-into-fuel/

If We Can Bury Carbon Dioxide, Why Not Use It to Make Electricity? A startup is trying to demonstrate that carbon dioxide can be used to make clean geothermal power economical and far more widespread
http://www.technologyreview.com/news/521021/if-we-can-bury-carbon-dioxide-why-not-use-it-to-make-electricity/

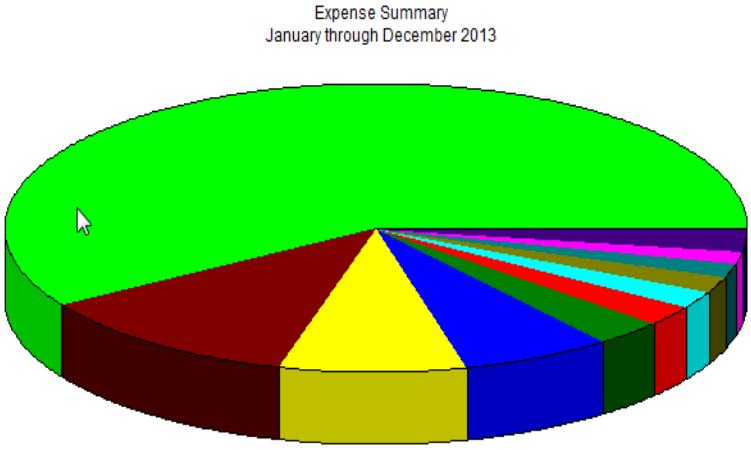
IRI FINANCIAL REPORT 2013

INCOME

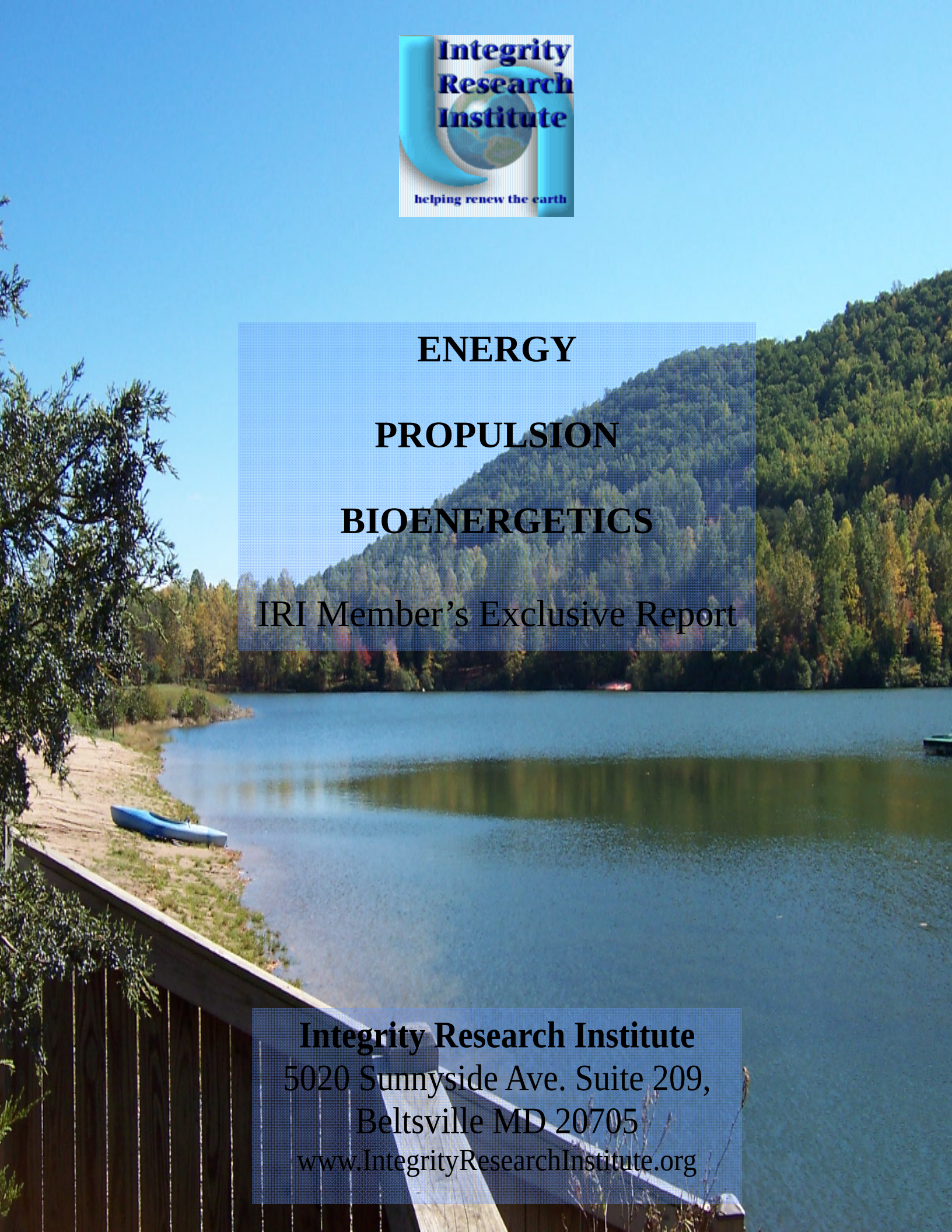


Direct Public Support	71.24%
Sales	28.62
Program Income	0.14
Total	$137,709.09

EXPENSES



Awards and Grants	59.05%
Facilities and Equipment	11.81
Operations	8.25
Parts for products	6.56
Shipping costs	3.10
Business Expenses	2.36
Equipment parts	2.18
Books printed	1.88
Contract Services	1.59
Other Types of Expenses	1.36
Other	1.84
Total	$115,231.72



ENERGY

PROPULSION

BIOENERGETICS

IRI Member's Exclusive Report

Integrity Research Institute
5020 Sunnyside Ave. Suite 209,
Beltsville MD 20705
www.IntegrityResearchInstitute.org