Integrity Research Institute Annual 2024

featuring

IRI Annual Report for 2024

Thomas Valone, PhD, Editor

CREDITS

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

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PRESIDENT's LETTER

We are happy to communicate with you regularly on a quarterly basis when you renew your IRI Membership to rejoin our wonderful adventure pioneering new vistas in energy, propulsion, and bioenergy.

Our Annual Report this time consists mostly of the summary of our accomplishments, including samples of the many journal articles and book chapters that we released during the year, as well as samples of the best Future Energy eNews from 2024.

IRI Annual Report 2024 also has the best Highlights of the year's activities, all of which is posted on our IRI website. Many other nonprofit organizations are also transitioning to doing this as well with an electronic annual report.

Some of you may have previously received **The KEY, a 16 GB flash drive** with the best portions of our twelve Conferences on Future Energy (COFE1-12). If there are some that have not received a copy of The KEY when you renew (or if already renewed or Lifetime), just indicate that you would like a copy of The KEY on the IRI Membership Renewal sheet, even if you pick another FREE gift too! The reason is that we have some extra ones still left and this year, I have secured a deal with Flashbay to give us a bunch of **64 GB flash drives** with lots more videos, documents, and proceedings from our conferences on them. We may want to choose another style or shape for the drive and it should be available later this year in 2025.

Lastly, we have several new books in the works thanks to the Amazon KDP publishing service. However, the climate topic is so important that I am also seeking a contract with a literary agent for an expanded, color version of the book this year. Thanks for joining and sustaining our efforts for the world.

Sincerely,

Thomas Valone
Thomas Valone, PhD, PE
President

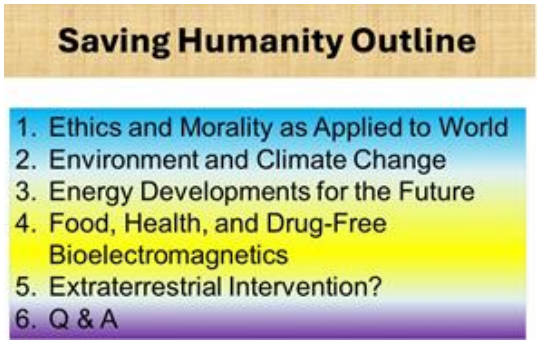
Integrity Research Institute ANNUAL HIGHLIGHTS 2024

We were pretty busy in 2024! Every month included several presentations, social media appearances, or online presentations. Our YouTube channel has grown significantly with over 1300 subscribers and many of our videos have had over 1000 views. We are proud of our new podcasts with many outstanding futurists and blogs are posted all the time on our website. Our *Facebook page, Instagram channel* have also grown. All our programs are easily accessible, filled with videos of our lab, interviews of our President Dr. Valone, videos of our products and historical information such as conferences. Our online IRI Electronic Catalog hosted by Shopify, has continued to thrive and we have customers from all over the globe. We also highlight all our programs, IRI publications, products, and bioenergy devices on the site. This year, we proudly supported students at "Agnes J. Johnson Charter School" In California, giving them a small grant of science kits for their annual Science Fair. We cherish the lovely Certificate of Appreciation we received.

Conferences, & Social Media Appearances. This year we proudly started our new Podcast channel! We were honored to have Ms. Brit Elders, the internationally published author, filmmaker and the CEO of ShirleyMacLaine.com. Her book ***"UFO… Contact from the Pleiades"*** on Billy Meier's the Swiss farmer unique contact case, where her team compiled many layers of evidence, photos, videos, audios that were originally published in a two volume in the 1980s. It now has a new one-volume book called the 45th anniversary edition. We highly recommend this new book. The podcast with the author Brit Elders is available on our YouTube channel (https://tinyurl.com/IRIChannel) and is a delightful and informative interview.

Dr. Valone, also had many in-person and online presentations this year, including: Las Vegas, Aug 19-20, **"Environmental Sustainability and Climate Change, 7th International Conference"** (see link to slideshow on page 4), where he presented on "*Reversing Global Heat Accumulation by Researching Recent Paleoclimatology*; On October 21st, **The Conference on Earth Science and Climate Change** "*Trend Analysis of the Hansen Three Variable climate graph as a predictive roadmap based on paleoclimatology*"; then on November 24-26th, **Climate Conclave 2024**, "Reversing Global Heat" and finally **"The Natural Living Expo"** at the University of Maryland, Marriot Conference Centers, an excellent venue for showcasing our bioenergy products and future energy books, he presented the popular

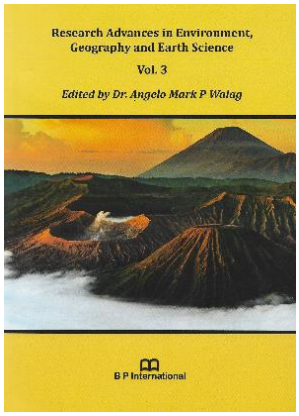
workshop entitled: "*Modern Meditation at the Workplace*". We also had several online podcasts interviews this year, including ***"Fade To Black" "Ubiquity University's Saving Humanity Show", "The James McConnell Show", "Love Covered Life Show", "The Dick Russell Show"*** and ***"Steve's Place".*** In all of them, he discussed the best energy research results, his latest book publications, some of the latest electrotherapy studies published in *NASA Tech Briefs, Nature*, etc. Also prominent was his discussions on our global situation addressing the climate and energy crises, with a view toward what the future may be like, such as his Open Access journal articles, "**Breakthrough Energy Technologies Toward a Solution for Climatic Change"** www.tinyurl.com/EJASValone, and the 52-page "**Linear Global Temp Correlation to CO2, Sea Level and Solutions to a Projected 6C Warming**" which has received over 15,000 views through 2024 and 5,000 downloads: https://tinyurl.com/ValoneClimate1. Also Dr. Valone was invited again to present on APEC (energy – propulsion online conference site) about the University Level *Ufology and Astrosociology Textbook* he's writing, which will be published in 2025. He also did several podcasts on the YouTube channel throughout the year, including one for www.altpropulsion.com.



The Bioenergetics Program: The *EM Pulser Model 78* has been a bestseller since its inception. We are currently working on a new model, the *EM MiniPulser*, a palm-sized device for a marketing firm. We hope to have it available in 2026. Our line of PREMIER electrotherapy devices, is unique as we are the only purveyors in the world. It includes the PREMIER 4000, which has been redesigned to run several minutes safely while the previous model had a maximum of 10 minutes on time. Known as the **Energy Chair** (see Jackie lighting up a fluorescent bulb by sitting on the Chair), it has many therapeutic benefits and the favorite of health practitioners, chiropractors and integrative medicine physicians. Our line of OsteoPads and MaxiMat models continue to be very popular and effective for bone and cartilage regeneration. We have improved their design that increases wear tolerance and durability.

Future Energy News Program: 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 5000 recipients worldwide, free of charge through Constant Contact email service. This year marks 25 years of providing this free electronic newsletter that showcases all the latest emerging eco-friendly technologies that are being developed worldwide and published in Journals, Magazines and Newspapers. Also we published the Quarterly "Future Energy Quarterly" and mailed it to all members for free. This magazine contains all the latest papers and articles relating to emerging energy technologies. Also, we continue to

upload to our IRI website the latest information on emerging energy technologies, climate change, and video uploads and press releases.



IRI Publications and Books: We had several journal papers and articles published this year and many were presented at conferences which are included in the First Section of this summary. A high impact article was: "*Gigatonne Carbon Dioxide Removal Reversing Global Heating Trends*"

Research Advances in Environment, Geography and Earth Science Vol. 3

(https://stm.bookpi.org/RAEGES-V3/index)

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published in Chapter 6 of the above-mentioned book by B P International in 2024 (see Abstract).

Also we were asked to contribute "*How Energy Medicine Will Save Health Care",* a 7-page article published in the **American Journal of Biomedical Science and Research** in 2024 (see below).

American Journal of Biomedical Science & Research

www.biomedgrid.com

ISSN: 2642-1747

Review Article

How Energy Medicine Will Save Health Care

Thomas F Valone*

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Introduction

Therapeutic use of electromagnetism has ancient roots, and was first introduced into the US by Hahnemann just prior to 1800. In 1890 and subsequently, the American Electro-Therapeutic Association conducted annual conferences on the therapeutic use of electricity and electrical devices by physicians on ailing patients. Some involved current flow through the patient, while others were electrically powered devices. At first, only Direct Current (DC) devices were utilized in the medical doctor's office for relieving pain and vibrating female patients who were routinely diagnosed with "hysteria."

In 1865, Maxwell's equations established electromagnetism as paper that he read at the eighth annual meeting of the American Electro-Therapeutic Association in Buffalo, NY entitled, "High Frequency Oscillators for Electro-Therapeutic and Other Purposes" [2]. Tesla concluded correctly that bodily "tissues are condensers", which today is the basic ingredient for an equivalent circuit only recently developed for the human body [3]. In fact, the relative "permittivity" for tissue at any frequency exceeds most commercially available dielectrics on the market [4]. This unique property of the human body indicates an inherent adaptation and perhaps innate compatibility toward the presence of high voltage electric fields. This can be traced to the high "transmembrane potential" (the electrical voltage across every cell membrane) already present

Propulsion Program: The CMG Project or Control Moment Gyro Project had a milestone this year, with a successful proof of principal model that moved with powered by the scissoring gyros. We continue with more data and measurements being done. Dr Valone is the principal director along with Mike Gamble a retired aerospace engineer. For years, Inertial Propulsion has been advocated by IRI and now we have replicated a table-top model. The purpose of this experiment is to show that levitation and thrust is possible by scissoring gyros.

Regarding our Spiral Magnetic Motor (SMM) project, we have had much advancement. Yes, a magnetic gradient has been implemented into a permanent magnet motoring cycle. Now we have built a proper choice of a magnetic switch with a piezoelectric cube squeezing a magnetostrictive unit to pulse a magnetic field on and off quickly. This Spiral Magnetic Motor is designed to provide mechanical drive for electrical power. Peer-reviewed, online -> https://tinyurl.com/SMMslides or https://tinyurl.com/SMMpaper. Lastly, Our Annual *"Future Energy Annual 2023"* was mailed free to our membership and is available online. That was the last postal mailing of our Annual reports which will be posted online from now on.

Gigatonne Carbon Dioxide Removal: Reversing Global Heating Trends

Thomas F. Valone

Research Advances in Environment, Geography and Earth Science Vol. 3, 19 May 2024, Page 123-145
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Abstract

The present study highlights about implementation of gigatonne carbon dioxide removal technologies. The inextricably tight connection between global CO_2 values and global temperature, delineated and publicized by James Hansen and others, will finally create an urgency in the minds and hearts of all people so that global atmospheric carbon capture by the gigaton can begin in earnest and in parallel with carbon-free fuels, zero carbon emissions, renewable energy, and even negative carbon emissions, implemented worldwide. It is a surprising realization to many that a changing temperature *tightly* correlates with the carbon dioxide (CO_2) levels worldwide in a linear, lockstep manner with a reversible but very short temporal feedback loop of only a few decades. A mapping of the past 400,000 years of earth's climate history by Hansen, based on the Vostok ice core sampling, offers a glimpse into this remarkably tight relationship between CO_2 and global temperature levels but also the average sea level over four ice ages that are clearly delineated in his historic depiction of all three quantities. As his Table accompanying the graph is analyzed, an equation linking the three variables has now been generated, yielding a fresh view into how past decades of hundreds of gigatons of atmospheric increase will continue to affect a worldwide temperature rise, also called "global warming." Such an examination inevitably leads to the conclusion that the true cause of the global "heat-trapping effect" in physics is the current stored CO_2 level, which exceeds that of 1950 by a factor of over 40%. (Note:

View: Dr. Valone's presentation slideshow (PDF) for the 7th Int. Conf. on Env. Sus. and Climate Chg. "Reversing Global Heat with Paleoclimatology" held in Las Vegas NV in August, 2024 (https://integrityresearchinstitute.org/Valone-ReversingHeat2024.pdf)

Next: Reprints from the best of our **IRI Future Energy eNews** monthly (subscribe today from our homepage for free!)

ETH Zurich Process Uses Sunlight To Remove Carbon Dioxide From The Atmosphere

CleanTechnica, January 2024 – reprinted in Future Energy eNews, Jan. 2024

Carbon capture sounds simple. Capture a couple billion tons of carbon dioxide from the atmosphere. Stick it somewhere out of the way for a couple of centuries. Presto! Average global temperatures start declining and we all can go back to our unlimited growth economic scenario without feeling guilty. It's brilliant!

There's only one problem. The carbon capture technologies we have available at the moment can only remove a thimbleful of carbon dioxide at a time and costs upward of $300 a ton to do that. If that's the best humans can do, it will be a long, long time before any significant decline in the concentration of carbon dioxide occurs and everyone on Earth will go bankrupt before temperatures start dropping.

The technology we have today is really no solution at all. It is an expensive boondoggle that gives fossil fuel political cover to keep on doing what they have always done — extract and burn fossil fuels. Not only that, it consumes a lot of energy. Advocates say, "Pish, tosh. We have lots of excess renewable energy that needs to be used or it will go to waste. We can just use some of it." Except there is no excess of renewables and won't be for several decades, if then.

A Novel Carbon Dioxide Removal Process

An ETH Zurich research team led by Maria Lukatskaya, a professor of electrochemical energy systems, has found a way to take advantage of the fact that carbon dioxide when present in acidic aqueous liquids stays in the form of carbon dioxide, but in alkaline aqueous liquids it reacts to form salts of carbonic acid, known as carbonates. This chemical reaction is reversible. Acidity determines whether the liquid contains carbon dioxide or a carbonate.

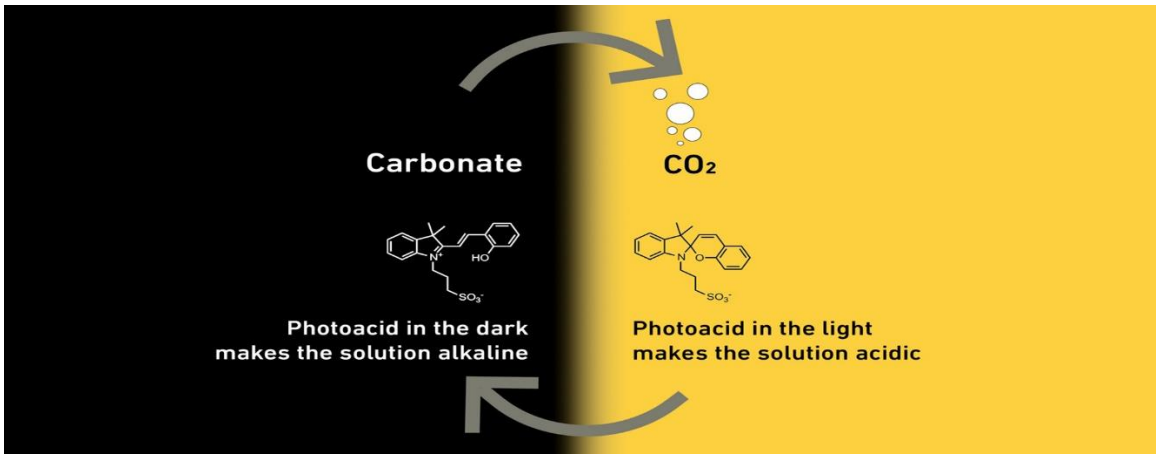
To influence the acidity of a liquid, the researchers added photoacid molecules that react to light. When exposed to light, those molecules make the liquid acidic. However, in the dark they return to their original state, making the liquid alkaline. The beauty of the process is that sunlight can be used to create the chemical change, which eliminates the need to use heat to drive the process. Here's the abstract to a research paper published by the research team in the Journal of the American Chemical Society on December 20, 2023.

Photoacids are organic molecules that release protons under illumination, providing spatio-temporal control of the pH. Such light-driven pH switches offer the ability to cyclically alter the pH of the medium and are highly attractive for a wide variety of applications, including CO2 capture. Although photoacids such as protonated merocyanine can enable fully reversible pH cycling in water, they have a limited chemical stability against hydrolysis (<24 h). Moreover, these photoacids have low solubility, which limits the pH-switching ability in a buffered solution such as dissolved CO2.

In this work, we introduce a simple pathway to dramatically increase stability and solubility of photoacids by tuning their solvation environment in binary solvent mixtures. We show

that a preferential solvation of merocyanine by aprotic solvent molecules results in a 60% increase in pH modulation magnitude when compared to the behavior in pure water and can withstand stable cycling for >350 h. Our results suggest that a very high stability of merocyanine photoacids can be achieved in the right solvent mixtures, offering a way to bypass complex structural modifications of photoacid molecules and serving as the key milestone toward their application in a photodriven CO2 capture process.

Capturing Carbon Dioxide



Credit: ETH Zurich

In this new process, air is channeled through a liquid to capture carbon dioxide, the ETH Zurich researchers say. If the liquid is irradiated with light, the greenhouse gas is released again and can be collected. They have developed a special mixture of different solvents to ensure that the light-reactive molecules remain stable over a long period of time. Conventional carbon capture technologies are driven by temperature or pressure differences and require a lot of energy. This is no longer necessary with the new light-based process.

To slow the pace of global warming, we need to drastically reduce greenhouse gas emissions. Among other things, we need to do without fossil fuels and use more energy efficient technologies, the researchers say. However, reducing emissions alone won't do enough to meet the climate targets. Large quantities of carbon dioxide must be captured from the atmosphere and either stored permanently underground or used as a carbon neutral feed stock in industry.

The researchers begin by passing the air through a liquid containing photoacids in the dark. Since this liquid is alkaline, the carbon dioxide in the air reacts with the photoacids to form carbonates. As soon as the salts in the liquid have accumulated to a significant degree, the researchers irradiate the liquid with light, which makes it acidic. When that happens, the carbonates transform back to carbon dioxide which bubbles out of the liquid just like it does in a bottle containing carbonated water and can be collected in tanks. When there is hardly any CO2 left in the liquid, the researchers switch off the light and the cycle starts all over with the liquid ready to capture carbon dioxide again.

Problem Solving

That's the theory but in reality, photoacids are unstable in water. "In the course of our earliest experiments, we realized that the molecules would decompose after one day," says Anna de Vries, a doctoral student in ETH Zurich research group and lead author of the study. So she, Lukatskaya, and their colleagues analysed the decay of the molecule. They solved the problem by running their reaction not in water but in a mixture of water and an organic solvent. The scientists were able to determine the optimum ratio of the two liquids by laboratory experiments and explain their findings thanks to model calculations carried out by researchers from the Sorbonne University in Paris.

This mixture enabled them to keep the photoacid molecules stable in the solution for nearly a month. It also ensured that light could be used to switch the solution back and forth as required between acidic and alkaline. If the researchers were to use the organic solvent without water, the reaction would be irreversible.

Other carbon capture processes are cyclical as well. One established method works with filters that collect the CO2 molecules at ambient temperature. To subsequently remove the CO2 from the filters, these have to be heated to around 100ºC. However, heating and cooling are energy intensive and account for most of the energy required by the filter method. "In contrast, our process doesn't need any heating or cooling, so it requires much less energy," Lukatskaya says. In addition, the new method of carbon dioxide removal potentially works with sunlight alone.

"Another interesting aspect of our system is that we can go from alkaline to acidic within seconds and back to alkaline within minutes. That lets us switch between carbon capture and release much more quickly than in a temperature driven system," de Vries explains. With this study, the researchers have shown that photoacids can be used in the laboratory to capture carbon dioxide. Their next step on the way to market maturity will be to further increase the stability of the photoacid molecules. They also need to investigate the parameters of the entire process to optimize it further.

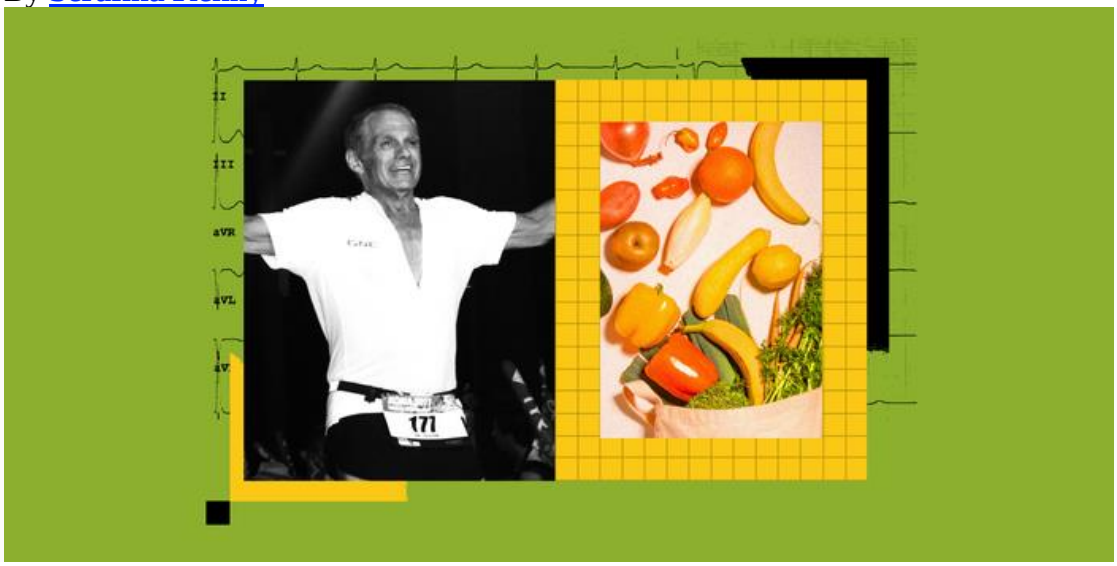
The Takeaway

This research is years away from commercial applications but the researchers must feel like the early photovoltaic panel pioneers who proved it was possible to generate electricity from sunlight. It took decades to make PV panels commercially viable and it will take a similar amount of time to use sunlight to extract carbon dioxide from the air using sunlight. Yet the implications of this research are enormous. If this system can be scaled up to the point where it can remove statistically significant amounts of carbon dioxide, **humanity may be on a path that will keep us from turning our home planet into a boiling cauldron**.

There is something so utterly appropriate about using sunlight to help solve the climate change mess caused by burning fossil fuels. Of course, decreasing or eliminating the use of fossil fuels is the number one priority but finding a way to remove carbon dioxide effectively and economically could be vitally important as well. The race is on to see if human brains can devise a way to slow or reverse global overheating caused by humans in the first place. What a delicious irony that sunlight may be the catalyst that saves us from our own foolishness.

An 83-year-old doctor and triathlete transformed his health in his 40s. He shares his 4 key diet principles.

By **Serafina Kenny**



Dr. Joseph Maroon/ Uproar PR, Crystal Cox/BI, Tyler Le/BI

Feb 10, 2024, 5:01 AM ET **Business Insider** – reprinted in FE eNews, Feb. 2024

- Joseph Maroon is an 83-year-old practicing neurosurgeon who competes in triathlons.
- Maroon says he uses four key diet principles to boost his health and longevity.
- These include following a Mediterranean-style diet and eating less sugar.

An 83-year-old doctor and triathlete who transformed his health in his 40s shared the diet principles he believes have helped him live a long, healthy liJoseph Maroon, a neurosurgeon at the University of Pittsburgh Medical Center who's part of Aviv Clinics' Global Aging Consortium, told Business Insider he struggled to climb a flight of stairs at age 40. "I was out of shape, living on fast food and not exercising," he wrote on his website.

By 53, Maroon had signed up for his first Ironman Triathlon and has since completed eight in total. Maroon came in second in his age category for the 2022 National Senior Games triathlon. Maroon previously shared with BI how he was staying fit, and his diet principles are explained below.

Follow a Mediterranean-style diet

Maroon says he follows the Mediterranean diet, which ***US News & World Report*** has said for seven years in a row is the best way to eat. It's not a "diet" in the way you may think, but more a way of eating that centers on healthy choices rather than restriction.

It's mostly plant-based and focuses on whole foods, including fruits, vegetables, whole grains, beans, legumes, and healthy fats such as olive oil. It includes some fatty fish and red meat on occasion. The diet has been linked to a multitude of health benefits, including a lower risk of heart disease, cancer, and Alzheimer's disease.

Avoid ultra-processed food

Ultra-processed foods, or UPFs, are made using techniques that are difficult to recreate at home and may include additives such as salts, sugars, and saturated fats, according to the Nova scale, which categorizes foods by how processed they are. An easy way to tell whether something is ultra-processed is if it doesn't look like its ingredients — such as protein bars or hot dogs. UPFs have been linked to an increased risk of illnesses, including cancer, dementia, and cardiovascular disease.

Avoid trans fatty acids

Trans fats can increase levels of "bad" low-density-lipoprotein cholesterol in the blood while decreasing levels of "good" high-density-lipoprotein cholesterol, which can increase the risk of heart disease and stroke, as Dana Ellis Hunnes, a senior dietitian at UCLA Medical Center, previously told BI. Artificial trans fats are made by hydrogenating vegetable oil. They were commonly found in packaged UPFs until the FDA declared trans fats unsafe to eat in 2015. The FDA gave food manufacturers three years to remove trans fats from their products, so most foods no longer contain them.

But foods can still legally contain under 0.5 grams of trans fats, as Kristin Gillespie, a registered dietitian, previously told BI, so it can be worth watching out for them. They typically appear in ingredient lists as "partially hydrogenated" oil in foods such as margarine, premade pie crust, non-dairy coffee creamer, and packaged baked goods.

Eat less sugar

The healthiest diet involves "avoiding a whole lot of things that people like to eat," Maroon says, including sugar.

Heidi Tissenbaum, a professor in molecular, cell, and cancer biology at the University of Massachusetts Chan Medical School, previously told BI that in her research, removing added sugar from the diet of roundworms, which are used to model the human health span, was linked to increased longevity. It's theorized that this is because when the body metabolizes sugar, it produces by-products associated with an increased risk of diabetes, cardiovascular disease, chronic kidney disease, and Alzheimer's disease.

She said it was also important to keep blood-sugar levels stable to prevent wearing out the mechanism the pancreas uses to regulate spikes, which could increase the risk of developing type 2 diabetes.

Avoiding UPFs, which tend to be high in added sugar, can help with this because eating more fiber-filled whole foods helps regulate blood-sugar levels.

Iron Fuel Shows Its Mettle

The plentiful metal could be a carbon-free fuel and store energy long term

PRACHI PATEL 22 JUN 2023, **IEEE SPECTRUM,** REPRINTED IN F E ENEWS, MARCH 2024

RIFT's iron furnace installation provides heat to 500 households in the city of Helmond in the Netherlands. KROLS MEDIA

By the end of June [2023], a large 1-megawatt plant that burns iron fuel will fire up, producing the heat needed to brew beer at the Swinkels brewery near Eindhoven, Netherlands, in a test lasting for several months. Startup IRON+ is a joint venture between three companies and built on technology first demonstrated as a 100-kilowatt system in 2020 by the Metal Power Consortium, which includes the Eindhoven University of Technology and innovation center Metalot, which was spun out of the university. The high melting points of metals make them useful components for machinery, electronics, and furnaces. But even metals can burn if you grind them into fine powders. What's more, metals can burn without emitting toxic or planet-warming emissions, making them a potentially attractive fuel for producing clean power—one that can be easily stored and transported.

RIFT (Renewable Iron Fuel Technology), another spinoff out of Eindhoven, recently demonstrated that it could heat 500 homes using its iron fuel technology. In Canada, meanwhile, startup Altiro Energy, launched by McGill University researchers, has run a prototype 10-kW iron fuel plant that they now plan to scale up.

Demonstration plants like this one are showing the possibility of iron as a fuel. EUROPEAN SPACE AGENCY

Iron powder is an ideal alternative to carbon fuels, says Jeff Bergthorson, a mechanical engineering professor at McGill and the chief scientific advisor for Altiro. Bergthorson and colleagues at the European Space Agency and the Canadian Space Agency developed the metal fuel concept and published their report in the journal *Applied Energy* in 2015.

Iron is one of the most abundant metals on Earth, and the most produced. It has an energy density of about 11.3 kilowatt-hours per liter—better than gasoline. Burning iron powder produces heat that can be used directly or converted into electricity by a steam turbine, leaving behind iron oxide, or rust. This can later be reduced—that is, the oxygen can be stripped away—back into iron powder. "You can think of iron fuel as a clean, recyclable coal," says Bergthorson.

Iron oxide can also be reduced to iron using hydrogen. Hydrogen is already a carbon-free green fuel if produced by splitting water using renewable electricity. But it is also an ultralight, voluminous gas, so it must be converted using high pressures and extreme cold into liquid, which then has to be stored and transported in special containers. Iron, by contrast, is already moved in dry containers for a lower cost. So while both hydrogen and metals are essentially a way to store energy, using metals makes more sense, Bergthorson says. Technical assessments by Metalot and the Technical University of Darmstadt suggest that "it's more efficient to produce iron from hydrogen gas than to produce liquid hydrogen. So iron powder as fuel is more expensive than gaseous hydrogen but cheaper to produce and move across the oceans than liquid hydrogen."

That's not to say iron fuel doesn't come with its own challenges. It does not ignite as easily as hydrocarbon fuels, and the flame speed is slower, which makes it unstable and more prone to extinguishing. Altiro gets around this problem by adding a little natural gas to ignite the iron powder when the boiler first starts up. They have also come up with a technology to stabilize the flame so that it burns for long periods of time without extinguishing, Bergthorson says. Collecting the resulting iron oxide is also tricky. Altiro's technology ensures the formation of iron oxide particles that are large enough to easily capture "using cyclones and other methods without needing high-tech or costly equipment," Bergthorson says.

Some of the iron powder inevitably evaporates to form iron-oxide nanoparticles that cannot be collected and turned back to iron. Both Altira and IRON+ have worked out ways to minimize this nanoparticle formation to reduce metal loss. "We improved the boiler by increasing the efficiency of heat transfer," says Philip de Goey, a mechanical engineering professor at Eindhoven and cofounder of Metalot. "The evaporation of iron powder leading to nanoparticle emissions has been decreased by a factor of 10, so it is smaller than 0.3 percent. The nanoparticles are not emitted in the atmosphere but captured in a HEPA filter." The next step for iron fuel is further increasing the conversion efficiency of iron to iron oxide since some of the iron does not get completely converted, de Goey says. Then there are market hurdles to jump, such as increasing iron powder production and lowering the cost of producing green hydrogen.

If these problems can be overcome, you could use renewable electricity to produce iron, store it as long as necessary, transport it there and then burn it for power when needed, says Bergthorson. "Places that have excess energy could make iron, and others can buy it. This way, you could commodify renewable energy so it can be globally distributed without the need for transmission lines. Metals can solve a big problem in the renewable energy transition: long-duration energy storage."

Editor's note on corrections to this article: In the second sentence, "The plant, IRON+" was changed to "Startup IRON+" and "startup Metalot" was changed to "innovation center Metalot." The first sentence of the third paragraph was corrected to state that Metalot could heat 500 homes using its iron fuel technology.

Chinese scientists create ‘water battery’ that can hold much more energy than lithium cells: study

May 11, 2024, Batteries News, 3 min read, reprinted in Future Energy eNews, May, 2024

Chinese scientists create ‘water battery’ that can hold much more energy than lithium cells: study. Researchers in China have developed a water-based battery, which is claimed to be much safer and energy-efficient than “highly flammable” non-aqueous lithium batteries.

Interestingly, the researchers say that these new batteries will be twice as energy-dense as traditional lithium-ion options. This holds the potential to revolutionize the electric vehicle industry.

Moreover, aqueous batteries use water as the solvent for electrolytes, enhancing their safety. Traditional non-aqueous lithium-ion batteries have a high energy density, but their safety is compromised due to the flammable organic electrolytes, a component that allows the battery to charge and discharge, they utilize.

Lower energy density

However, aqueous batteries generally have a lower energy density due to the limited solubility of the electrolyte and low battery voltage. Now, researchers in China have developed a high-energy-density aqueous battery based on halogen multi-electron transfer. A research group led by Prof. LI Xianfeng from the Dalian Institute of Chemical Physics (DICP) of the Chinese Academy of Sciences (CAS), in collaboration with Prof. FU Qiang’s group also from DICP, developed a multi-electron transfer cathode based on

bromine and iodine. This cathode achieved a specific capacity of more than 840 Ah/L and an energy density of up to 1200 Wh/L based on catholyte in full battery testing, according to a new study published in Nature Energy.

Researchers used a mixed halogen solution

To improve the energy density of aqueous batteries, researchers used a mixed halogen solution of iodide ions (I-) and bromide ions (Br-) as the electrolyte. They developed a multi-electron transfer reaction, transferring I- to iodine element (I2) and then to iodate (IO3-). Researchers said that during the charging process, I- were oxidized to IO3- on the positive side, and the generated H+ were conducted to the negative side in the form of a supporting electrolyte. During the discharge process, H+ were conducted from the positive side, and IO3- were reduced to I-.

The process

The developed multi-electron transfer cathode had a specific capacity of 840 Ah/L. Combining the cathode with metallic Cd to form a full battery, researchers achieved an energy density of up to 1200 Wh/L based on the developed catholyte.

According to the researchers, Br- added to the electrolyte could generate polar iodine bromide (IBr) during the charging process, which facilitated the reaction with H2O to form IO3-. During the discharge, IO3- could oxidize Br- to Br2 and participated in the electrochemical reaction to realize reversible and rapid discharge of IO3-. Therefore, the bromide intermediate formed during the charge and discharge process optimized the reaction process, effectively improving the kinetic and reversibility of the electrochemical reaction.

Batteries' life cycle could be extended to 1,000 cycles

According to SCMP, when the researchers tested their electrolyte with a vanadium anode, they found the batteries' life cycle could be extended to 1,000 cycles, "demonstrating significant stability." Scientists also mentioned that their batteries' energy density even "exceeded that of some solid electrode materials" and could be comparable in cost to traditional lithium batteries.

They claimed that their work showcases that aqueous batteries with high energy density can be developed, and it offers a development option for grid-scale energy storage and even electric vehicles.

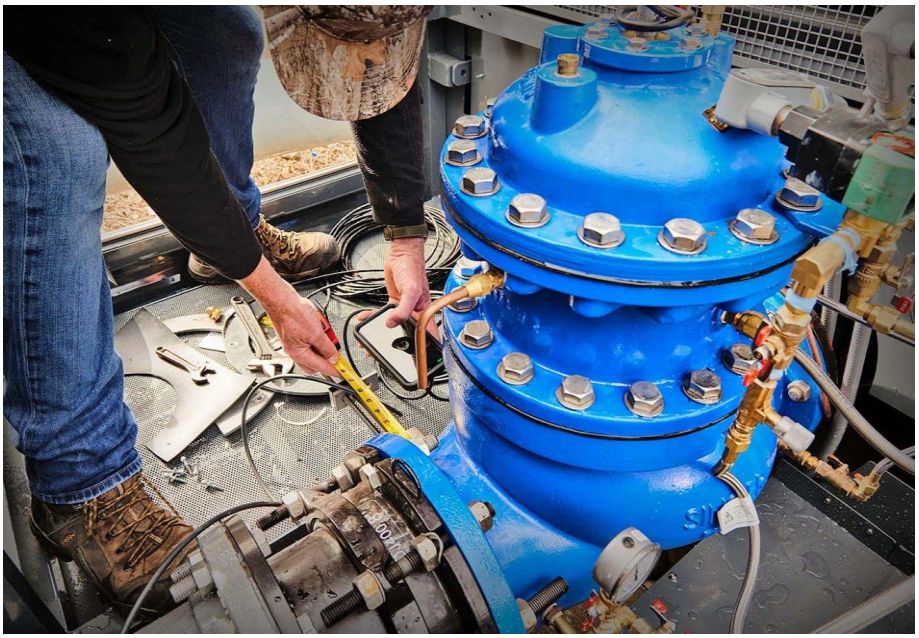
Prof. LI, said:

"This study provides a new idea for the design of high-energy-density aqueous batteries and may expand the aqueous batteries application in power batteries field."

Microturbines can generate electricity from drinking water pipes

Water pipes offer a largely untapped source of renewable electricity that could provide 1.4 gigawatts of power in the US alone

By James Dinneen, *New Scientist*, 10 January 2024, Reprinted in Future Energy eNews, June, 2024



A miniature hydroelectric turbine that can generate electricity from water pipes

The excess pressure in water pipes can be used to spin miniature hydroelectric turbines, providing an underutilised source of clean energy. Some envision a distributed network of small turbines serving as a form of reliable storage to back up wind and solar power.

"I think it is a very under-tapped resource," says Shannon Ames at the Low Impact Hydropower Institute, an environmental non-profit based in Massachusetts. "The infrastructure is there; adding a turbine into the infrastructure makes a lot of sense."

This type of "in-conduit" hydropower already supplies around 530 megawatts of generation capacity in the US, according to a 2022 study by researchers at Oak Ridge National Laboratory in Tennessee. If such systems were installed at all potential sites in the country, the study estimated this could provide at least 1.41 gigawatts of additional capacity – equivalent to around 450 onshore wind turbines – without requiring any large new infrastructure to be built.

"Billions of miles of pressurised pipelines exist in the world," says Gregg Semler at InPipe Energy, an Oregon-based company that has installed three such systems, including one that powers floodlights in a baseball stadium outside of Portland. The company's latest

installation to a pipe carrying drinking water to people in the East Bay Municipal Utilities District (EBMUD) in California started generating power in November.

The EBMUD system is expected to generate 130,000 kilowatt-hours of electricity per year, which will be used to power nearby water pumps. Any excess power will be sent to the grid, helping the utility move towards its target of carbon neutrality by 2030, says Christopher Tritto at EBMUD. The project is predicted to reduce the utility's carbon dioxide emissions by about 6 tonnes each year.

Semler says a similar system will be installed in Aurora, Colorado, in April, and that InPipe is in discussions with the New York City government about ways to generate electricity from the nearly 4 billion litres of water that flow into the metropolis every day. Eventually, he envisions water utilities with networks of small systems working in concert as a form of hydropower storage backing up intermittent renewables.

"If there was no sun, or there was no wind, water utilities could put more water through the pipes to produce more energy," he says.

InPipe's system serves the same function as a regular pressure valve, which dissipates the excess water pressure generated by gravity and pumps. Instead of simply releasing this pressure, however, InPipe's technology uses it to generate electricity. In parallel to an existing valve, the system diverts piped water through a bypass, where it spins a hydroelectric turbine before returning it to the pipe. "We don't change the flow of the water, but we take out pressure," says Semler.

This is different from the approach taken by Semler's previous company, Lucid Energy, which aimed to generate power by placing turbines directly within existing pipes. The company – which has since shuttered – installed one such system in Portland that is still generating power. But Semler says convincing water utilities to cut open their pipes and abandon existing pressure valves to generate electricity proved difficult.

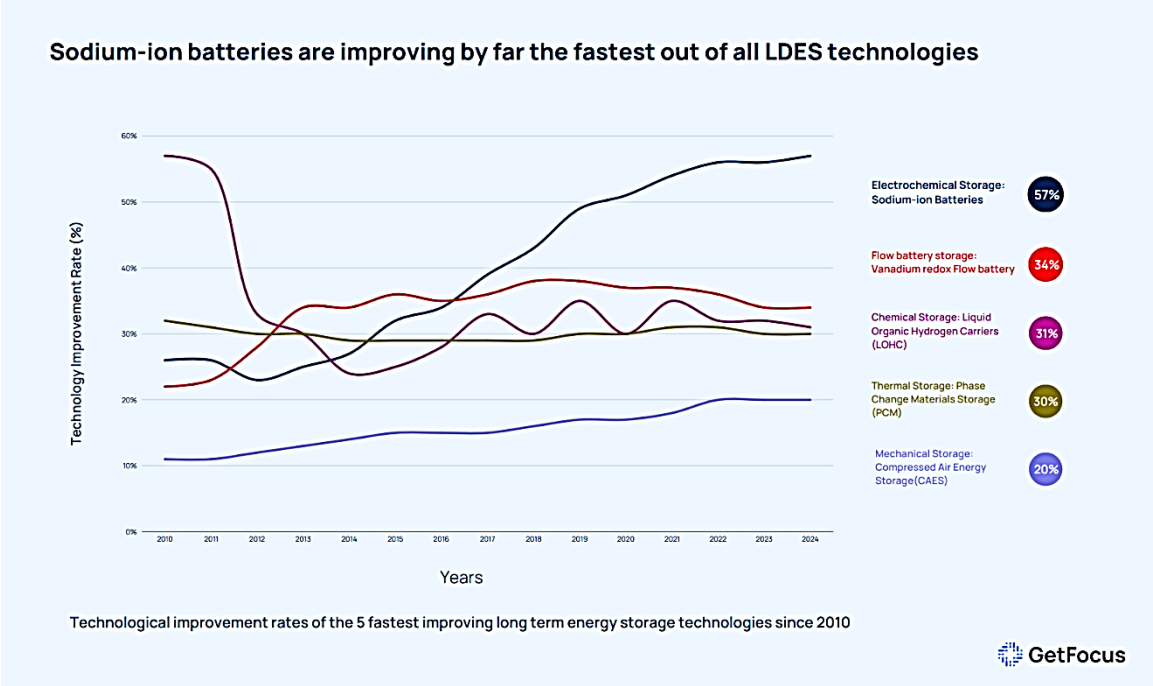
Other hydropower companies, such as NLine Energy and Canyon Hydro, have developed similar in-conduit hydropower systems, and the idea has been around for at least two decades. But only a hundred or so have been installed, says Frank Zammataro at Rentricity, a New York City-based company that has installed more than 30 systems across the US.

However, Zammataro thinks such systems could soon be adopted more widely. He says the industry is at an "inflection point" thanks to a new emphasis on cutting emissions, support for upgrading infrastructure and growing track record of in-conduit systems. "We're not going to break your pipes," he says.

Exclusive: sodium batteries to disrupt energy storage market

With costs fast declining, sodium-ion batteries look set to dominate the future of long-duration energy storage, finds AI-based analysis that predicts technological breakthroughs based on global patent data.

Oliver Gordon July 1, 2024, Power-Technology.com, Reprinted in Future Energy eNews



A versatile option across the energy grid

Sodium battery technology is experiencing similar improvements in areas such as energy density as lithium-ion (Li-ion) batteries did two decades ago. The associated cost reductions will mean the emergent technology is set to become a competitive solution for LDES by 2028 at the latest, finds the research.

Analysing 30 LDES technologies, the research found sodium-ion batteries to hold the most promise due to their fast improvement rate – around 57% in 2024. They offer more efficiency in round-trip energy use, greater operational flexibility and lose less energy during storage and supply. Their rapid improvement rate will likely lead to better energy density and reduce the cost per unit of stored energy, positioning them as a versatile option across the energy grid, even in large-scale operations, states the report.

The average cost for sodium-ion cells in 2024 is $87 per kilowatt-hour (kWh), marginally cheaper than lithium-ion cells at $89/kWh. Assuming a similar capex cost to Li-ion-based battery energy storage systems (BESS) at $300/kWh, sodium-ion batteries' 57% improvement rate will see them increasingly more affordable than Li-ion cells, reaching around $10/kWh by 2028.

According to GetFocus, achieving a cost of around $50/kWh is essential for BESS to be economically viable for grid-scale LDES in renewable energy applications. "That is the point when energy storage matches the cost of using dispatchable power sources like gas-fired power plants," explains Gorski.

Indeed, in comparison with other forms of LDES, batteries are the best way to store energy, according to Gorski. "You can develop a new generation of batteries incredibly quickly in comparison to something like compressed air energy storage (CAES) – with all that infrastructure," he says. "You can tweak the chemistry pretty quickly, and you can do it on a small scale and be fairly confident that you will be able to ramp it up to whatever storage requirement you need.

"But it is a bit 'horses for courses' with LDES," he caveats. "There might be some other solutions like the phase change or CAES that are more attractive in certain locations."

Sumitomo Electric Industries, Hitachi and Yuasa Battery are leading the development of sodium-ion battery technologies, states the report. Although the companies are yet to commercialise their technologies, Chinese battery company Great Power last year announced a 50MW/100 megawatt-hour LDES project to power a data centre, demonstrating that sodium-ion batteries are already under consideration for LDES.

"China will probably lead the way for sodium-ion battery production," adds Gorski. "Europe and the US don't have the appetite for the dangers of battery production." Just last week, a fire at a lithium battery plant in South Korea killed 22 people and injured eight.

Power to the people

However, the supremacy of sodium-ion technology is still far from guaranteed. Manufacturers still have work to do to improve its energy density and round-trip efficiency, with ongoing developments also aimed at increasing the batteries' longevity and life cycle performance.

"There are also unknowns around the production," adds Gorski. "We are assuming you can turn a lithium-ion battery production facility into a sodium-ion battery production facility without too many issues."

However, much of the technology's fate lies in the hands of policymakers, with many eyes on China and the US as to how they incentivise the production. Gorski predicts LDES will be boosted if President Biden wins a second term in the upcoming US election, with speeding up the energy transition a key priority for the administration.

“If we are going to take this transition seriously, we will need an awful lot of megawatts to be stored reliably. In Europe, we need to store this energy for nine months. The cost drop we are forecasting for sodium-ion would make it very attractive for that purpose,” says Gorski.

Overall, sodium-ion batteries’ compact footprint and cost-effective integration with renewable sources will position them as the dominant LDES technology for a variety of applications. Their versatility, applicability for both front-of-the-meter such as near wind or solar farms and behind-the-meter, has them poised to revolutionise the LDES market in the coming years, found the researchers.

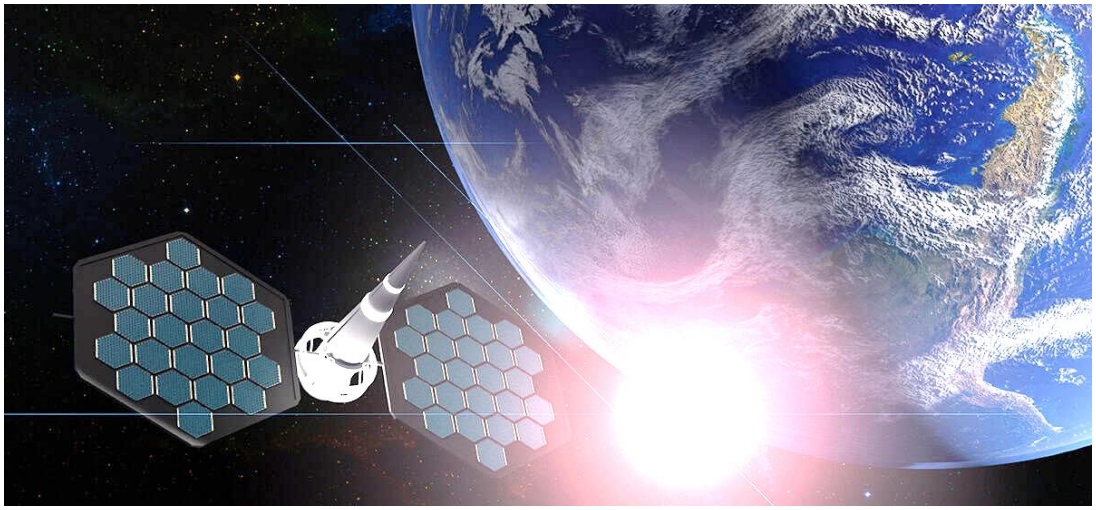
However, the technology may have another superpower up its sleeve. Gorski believes it holds the potential to truly democratise power in the future. Eventually, households will be able to link the solar panels on their roofs with sodium-ion batteries in their garages or gardens to become truly energy self-sufficient.

“If we are able to package it up in a way that makes sense for the average consumer, suddenly they can be less reliant on the geopolitical or energy-price swings. The future is very bright – that could happen in less than a decade.”

Why NASA thinks you should forget about space-based solar power

05 Aug 2024 James McKenzie, PhysicsWorld.com, Reprinted in Future Energy eNews

Space-based solar power sounds a cool idea but with a new NASA report suggesting it will never make economic sense, **James McKenzie** thinks we should just crack on building solar plants here on Earth



The other day I was watching the hugely entertaining Amazon Prime documentary series Clarkson's Farm, which depicts the broadcaster Jeremy Clarkson's attempts to run a farm in Oxfordshire. In one episode, Clarkson is named the National Farming Union's "farming champion for 2021" for highlighting the challenges farmers face in making a living from the land. Particularly difficult for him are the rules that let local planning officials stop him from doing stuff that he feels ought to be allowed.

Clarkson appealed against some of the decisions and eventually won his case. But his experience inspired me to look into the UK's planning system to see how objections have slowed the progress of wind farms and solar farms to a snail's pace. Despite it being government policy to deploy more of these renewable forms of energy, I soon discovered that the country's thorough but overly bureaucratic planning process is being hijacked by the "not in my back yard" (NIMBY) brigade.

Space-based solar power is not a new idea of course, first being mooted in a 1941 science-fiction short story by Isaac Asimov

These are people who want all the benefits and upsides of renewable energy systems – so long as they're installed somewhere else, well out of eyeshot. One comment I read even suggested that the best place for solar power farms would be in space. Having written about

the favourable economics of photovoltaic panels and the unfavourable economics of "solar concentrators", I immediately wondered if "space-based solar power" could stack up financially let alone technically, especially in such an extreme and unforgiving environment.

Space-based solar power is not a new idea of course, first being mooted in a 1941 science-fiction short story by Isaac Asimov called Reason. It sounds simple in principle: all you have to do is place a solar array at a location in space where the Sun always shines. You then convert the electrical energy from the solar cells into microwaves and beam them to a ground station down on Earth, where they can be collected and turned into electricity for the grid.

Because the Sun's always shining on the array, the electricity's permanently on tap and there's no need for storage. The upshot is that such an array – if it were ever built – would count as baseload generation like a coal, gas or nuclear plant. The UK government is certainly taking the idea seriously, having commissioned an independent report from Frazer-Nash Consultancy into space-based solar power back in 2021.

As *Physics World* discussed at the time in a news story and feature, the report examined two main concepts – the US-led SPS Alpha and the UK-led CASSIOPeiA. The report called for a thorough cost and economic analysis of both options, which surely is the whole point. The best way of doing this would be by using the "levelized cost of energy" (LCOE), which compares different energy-generation technologies taking all the various costs into account.

Space-based solar power

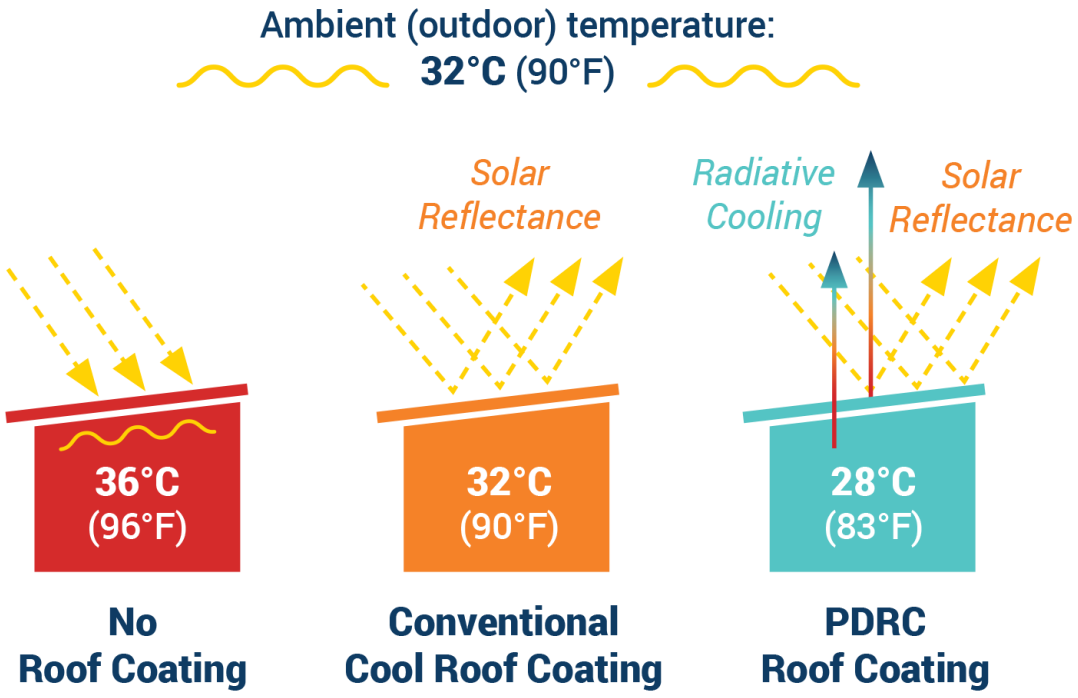
What is space-based solar power and could it help us avert climate catastrophe?

Play Video online

Given how many cool and fantastic technical ideas can be dashed on the rocks of reality by economics, I was intrigued to find that the UK government's feasibility report had already crunched through the numbers. It said that space-based solar power has a 2050 projected LCOE of £50/MWh compared to £33/MWh for Earth-based solar farms (as of 2023 this sat at £41/MWh) and £96/MWh for large nuclear reactors.

Turning Down the Heat in Really Cool Ways

Rocky Mountain Institute, July, 2024, RMI.org, Reprinted in Future Energy eNews



After a year of deadly and costly high temperatures, July 2024 brought on the hottest days humans have ever measured. The need for efficient cooling has never been more critical. RMI is working on innovative and sustainable cooling solutions that reduce energy consumption, lower greenhouse gas emissions, and enhance public health and safety by integrating technological advancements, policy support, and public awareness.

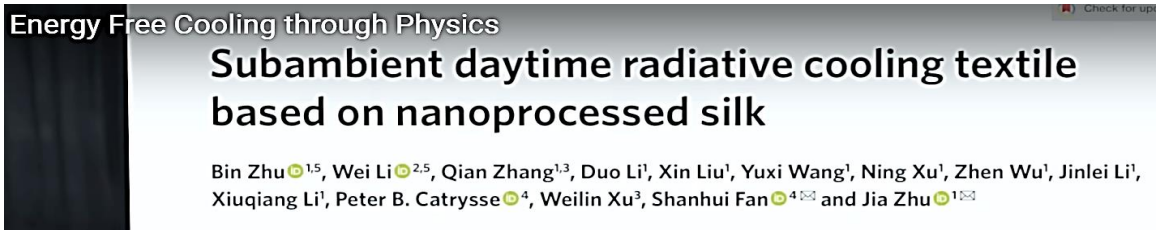
In many of the world's hottest countries, most people live without air conditioning and the ability to escape life-threatening heat. Many heat-related deaths occur in informal or self-built settlements, home to over one billion people worldwide.

At RMI and our climate tech innovation accelerator, Third Derivative, we're particularly excited about a class of advanced materials that provide a **passive daytime radiative cooling** (PDRC) effect. A sheet metal or asbestos roof, typical of many informal settlements, can heat up to 88°C (190°F) in direct sunlight when ambient air temperatures are around 38°C (100°F). A PDRC solution applied to the roof could reduce its surface temperature to at or below ambient temperatures — a potential 30°C–50°C (54°F–90°F) difference. Incredibly, this could translate to indoor temperatures 16 to 20 percent cooler on a hot day. This great explainer 11-minute video explains how it works » https://youtu.be/2iwXdGxyzYw to create an inverse greenhouse effect for clothes and cars.

In areas most impacted by extreme heat, where electricity is often scarce, and where many families cannot afford air conditioning, PDRCs hold great promise. If scaled across informal settlements and low-income housing in India alone, they could save 317,000 lives and over 68 million tons of CO_2 equivalent in cooling-related emissions between now and 2030 — and far more when scaled globally.

RMI and Third Derivative are working to get PDRC solutions to market and scale. This includes testing leading products in real-world conditions and brokering partnerships between PDRC developers and **leading paint manufacturers** capable of producing needed quantities. We are also exploring a coalition of governments, corporations, and philanthropists that could make an advanced commitment to purchase a specific volume of PDRC products at a certain price to underpin the market at its outset.

Making PDRC roofs the easy choice will be a complex, multi-stakeholder exercise that needs careful, robust planning. It will also take real leadership — from governments in particular. But the potential climate and health impacts more than justify the effort. However, PDRC also works for textiles and clothing as we find below. – Ed. Note

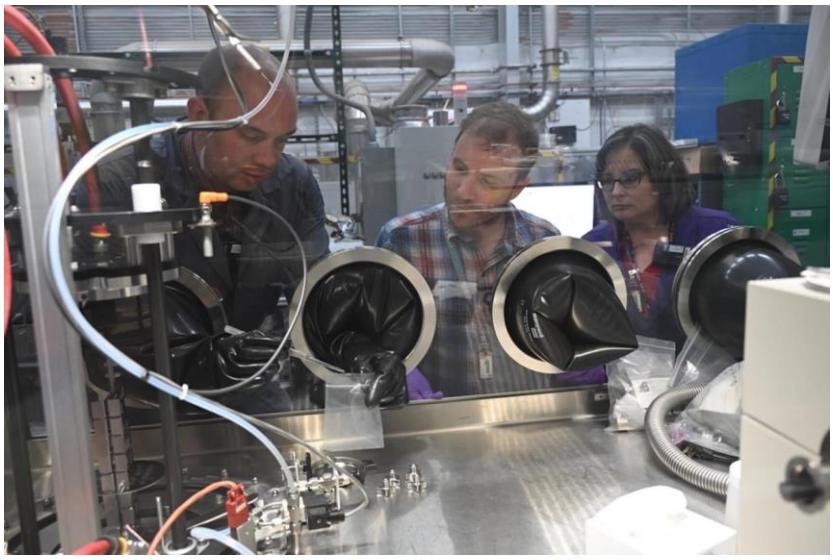


Paper available online at https://pubmed.ncbi.nlm.nih.gov/34750560/ - Abstract below:

Decreasing energy consumption is critical to sustainable development. Because temperature regulation for human comfort consumes vast amounts of energy, substantial research efforts are currently directed towards developing passive personal thermal management techniques that cool the human body without any energy consumption[1-9]. Although various cooling textile designs have been proposed previously, textile-based daytime radiative cooling to a temperature below ambient has not been realized[6-13]. Silk, a natural protein fabric produced by moth caterpillars, is famous for its shimmering appearance and its cooling and comforting sensation on skin[14-17]. It has been recently recognized that silk, with its optical properties derived from its hierarchical microstructure, may represent a promising starting point for exploring daytime radiative cooling[18-21]. However, the intrinsic absorption of protein in the ultraviolet region prevents natural silk from achieving net cooling under sunlight. Here we explore the nanoprocessing of silk through a molecular bonding design and scalable coupling reagent-assisted dip-coating method, and demonstrate that nanoprocessed silk can achieve subambient daytime radiative cooling. Under direct sunlight (peak solar irradiance >900 W m^{-2}) we observed a temperature of ~3.5 °C below ambient (for an ambient temperature of ~35 °C) for stand-alone nanoprocessed silks. We also observed a temperature reduction of 8 °C for a simulated skin when coated with nanoprocessed silk, compared with natural silk. This subambient daytime radiative cooling of nanoprocessed silk was achieved without compromising its wearability and comfort. This strategy of tailoring natural fabrics through scalable nanoprocessing techniques opens up new pathways to realizing thermoregulatory materials and provides an innovative way to sustainable energy.

US approves game-changing technology that turns used nuclear waste into fuel: 'A critical step'

Mike Taylor, Sat, November 2, 2024 at 6:45 AM EDT, TCD Tech.Yahoo.com



A nuclear power plant that has been decommissioned for 30 years will soon help power a new facility with recovered nuclear waste.

The Department of Energy approved Oklo's conceptual safety design report (CSDR) for the Aurora Fuel Fabrication Facility, as Interesting Engineering reported. It will use high-assay low-enriched uranium (HALEU) from the Experimental Breeder Reactor-II and be located at the Idaho National Laboratory. "The approval of the CSDR is a critical step toward fabricating fuel for Oklo's first commercial deployment," Jess Gehin, INL associate laboratory director for nuclear science and technology, said in a news release. "As the nation's nuclear energy research laboratory, we are committed to partnering with companies like Oklo to advance fission technologies and deliver clean energy solutions."

The next steps include a preconstruction preliminary safety analysis and a documented safety analysis after construction and commissioning. The recovered highly enriched uranium will be cleaned and mixed with lower-enriched uranium to make HALEU, Interesting Engineering detailed. It requires a high-temperature molten salt chemical bath and an electric current, which separates the highly enriched uranium from the fission products. After it is formed into ingots, it is broken down into smaller shapes with low doses, which can power advanced reactors such as Oklo's microreactor.

The developments are promising, and the use of spent fuel minimizes one risk of the generally safe industry. But renewable energy such as solar and wind is even safer and cheaper. In that vein, researchers are working to improve nuclear safety by testing a compound molecule, designing robots to handle radioactive waste, and creating power plants that don't need water for cooling.

The United States has dozens of nuclear reactors, though the number has been ticking down. Twenty-five are in the process of being decommissioned, though the industry is gaining

traction in repurposing sites and even building new ones as the demand for clean power and the desire to slow the rapid heating of the planet grows. Join our free newsletter for weekly updates on the latest innovations **improving our lives** and **shaping our future**, and don't miss this cool list of easy ways to help yourself while helping the planet.

Sodium-ion battery startup scores large automotive supply contract for a 10 GWh production line

Sodium-ion batteries are gathering customers not only from the energy storage business, but are also becoming a viable alternative for automotive manufacturers now.

Daniel Zlatev, *Published 11/04/2024* PL FR ...E-Mobility NotebookCheck.net

The drop in the price of lithium hasn't deterred sodium-ion battery makers, it seems. The world's largest EV battery makers CATL and BYD have both announced Na-ion battery projects, but there are already dedicated startups that are ahead of the curve when it comes to commercialization. A case in point is **Zoolnasm Energy**, whose sodium-ion battery technology has now been picked by a large automotive supplier. The company will start delivering Na-ion cells for the four-year contract next year, with volume supply beginning by **July 2025.**

The sodium-ion battery contract amounts to the equivalent of $28.1 million, too, so it is not an insignificant contract, as the battery maker plans up to 10 GWh annual battery pack output. So far, Zoolnasm has unveiled several Na-ion battery types for both automotive applications and grid storage, with energy density of up to 190 Wh/kg. Back in the spring, the company announced the NFS-50, an iron sulfate sodium ion battery cell that has been designed for hybrid powertrains or start-stop vehicle systems. While it didn't specify the applications that its sodium-ion batteries will be used for in the contract with the unnamed automotive parts manufacturer, there are hints that its cells will go towards low-voltage vehicle systems.

The big advantage of Zoolnasm's Na-ion battery technology, besides the typical for the chemistry high safety and charging rates, as well as a lifespan of several thousand cycles, is their price. Compared to lithium batteries, the company's sodium-ion cells can cost 50% less, making them an attractive choice for low-cost vehicles.

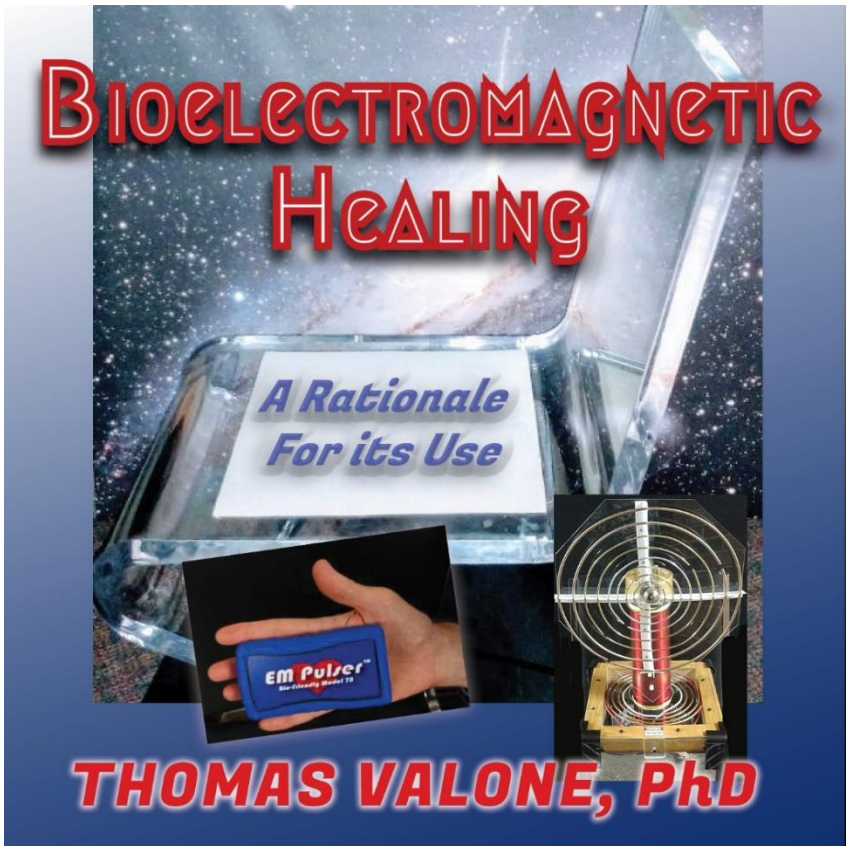
There are already electric cars with sodium-ion batteries in production, and as supplier contracts like these increase, the technology is bound to become more popular among battery companies and automakers alike.

Statement of Activity by Month

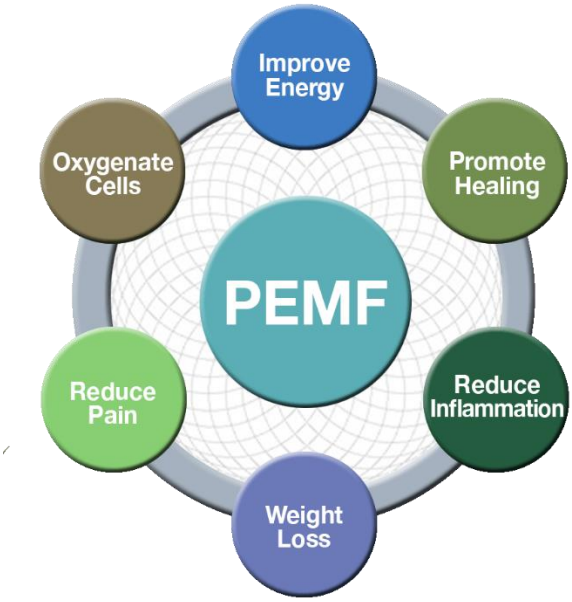
Integrity Research Institute

January-December, 2024

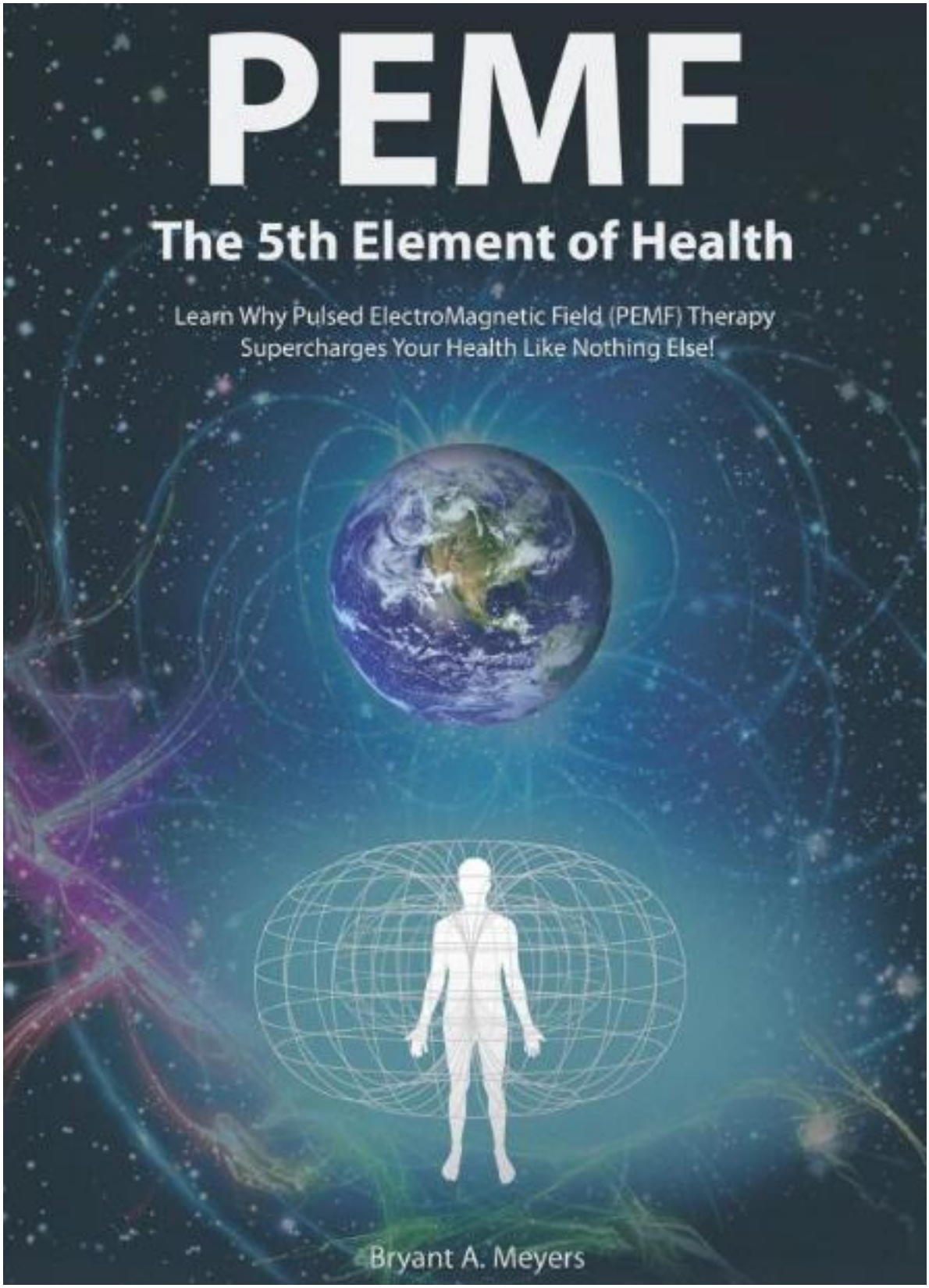
Distribution account	2024
Income	
Direct Public Support	106,108.75
Membership Dues Revenue	911.90
Retail Sales	44,499.59
Sales	66,882.14
Total for Income	**218,402.38**
Cost of Goods Sold	
Book Printing Costs	5,172.74
Equipment Parts	1,682.50
Printing Supplies	505.86
Product Parts	42,060.81
Product Shipping Costs	8,469.53
Total for Cost of Goods Sold	**57,891.44**
Gross Profit	**160,510.94**
Expenses	
Advertising & Marketing	3,120.06
Bank Charges & Fees	520.12
Contractors	1,903.21
Gifts for members and Volunteers	2,020.27
Insurance	420.68
Legal & Professional Services	7,033.00
Meals & Entertainment	5,213.09
Memberships & Dues	1,857.26
Office Supplies & Software	3,951.77
Rent & Lease	16,860.00
Repairs & Maintenance	747.00
Repairs & Maintenance Office	556.37
Software Expense	2,053.77
Subscriptions & Dues	3,151.89
Telephone & Communications	9,801.25
Travel	3,154.26
Utilities	30.00
Web Site & Internet Expense	3,424.27
Total for Expenses	**65,818.27**
Net Operating Income	**94,692.67**
Other Income	
Other Expenses	
Net Other Income	**0.00**
Net Income	**94,692.67**



Bioelectromagnetic Healing audiobook on Amazon



A sample of the many PEMF reference books available is next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EM Pulser
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Rechargeable Internal Battery, More Powerful Pulse, Faster Pulse Rate, Bigger Coil, but still with the SAME Nanosecond Risetime!
OsteoPad.org
Increase Bone Density While You Sleep
High Voltage Electrotherapy
30 DAY
BioenergyDevice.org
Integrity Research Institute 800-295-7674