Integrity Research Institute

Annual 2019

featuring

IRI Activity Highlights for 2019

IRI Annual Report for 2019

Thomas Valone, PhD, Editor

CREDITS

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

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www.IntegrityResearchInstitute.org

- IRI Mission Statement -

Dedicated to researching scientific integrity in the areas of energy, propulsion, and bioenergetics, with programs in each area.

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PRESIDENT's LETTER

IRI distributed a two-sided flyer on Capitol Hill to all of the Senate and House offices in January to educate the staffers, besides advocating **carbon sequestration** as a solution to the atmospheric accumulation of the carbon pollutant, which is trapping heat, easily leading to **5° to 6°C or higher increase** in global temperature by 2100. We also published two papers in 2019: a 32-pager in the ***International Journal of Environment and Climate Change*** as well as a shorter, summary article in the ***IEEE Proceedings of the International Symposium on Society and Technology*** (ISTAS). I also presented a slideshow accompanying that second paper at the IEEE ISTAS Tufts University, which we are including in this Annual Report 2019.

The **Spiral Magnetic Motor (SMM)** has been moved along with the fabrication of the long-awaited *magnetic switch* at the commutation point using piezoelectric and magnetostrictive materials (MS-PZT), thanks to the expertise of Hathaway International in Toronto, Ontario. The next phase involves testing and optimizing the performance of the switch, including matching it with the proper SMM. After my **2019 World Energy Engineering Conference** presentation here in DC, I received a personal email from the Session Chair encouraging this research and expressing genuine interest in its efficiency.

As you will learn in the Highlights 2019 section, we were honored to receive a volunteer filmmaker named Austin Hines (contact info: 817-938-3244, www.doubleapictures.com) who did some extraordinary promotional videos for IRI at no charge. You can see some of his handiwork at **www.BioenergyDevice.org** and at https://tinyurl.com/IRI-YouTubeChannel.

The IRI propulsion projects with Mike Gamble (Control Moment Gyro for electrically powered unidirectional force as Boeing has been doing for years on their satellites) and with Robert DeBiase (Casimir Force Generator for unidirectional force on a microscopic scale) have benefited from a generous benefactor who started working with IRI in 2019. Both projects are also progressing and have continuing presentations at our COFE events **www.futurenergy.org.**

Lastly, this ***IRI Annual Report 2019*** is the most valuable and practical energy innovation ideas that can be packed into one report. It is online http://www.integrityresearchinstitute.org/links.html with previous IRI Annual Reports in **PDF**, in order to use any of the hot links which give you a glimpse of the source reference articles and websites that we referenced. This Report contains lots of investor-ready energy inventions. For more, see future energy in person…attend COFE12 in August 14-15, 2019.

Thomas Valone, PhD, PE
President

HIGHLIGHTS 2019

We are very proud of IRI's accomplishments for the past year. After revamping our IRI **Electronic Catalog** with the award-winning software by Shopify, we were able to have videos of our products added which were produced by **Austin Hines** of Double A Pictures, a professional outfit that offered their services to IRI as a donation. Austin also produced several videos showcasing IRI's mission, and our IRI President Valone accomplishments for the past 30 years. He also designed new graphics for our Facebook page and produced and organized our new https://tinyurl.com/IRI-YouTubeChannel, where the videos have had hundreds of hits. Next for the upcoming months, we will be revamping our complete website, including the homepage and program pages. We are most excited about this and expect to have it all completed by 2021. View some of Austin's masterpieces at www.BioenergyDevice.org. The Prometheus Production company was also at IRI Lab during 2019 filming for another episode of "Ancient Aliens" which aired in 2020 as S15, E8 on www.History.com or the History Channel on cable TV.

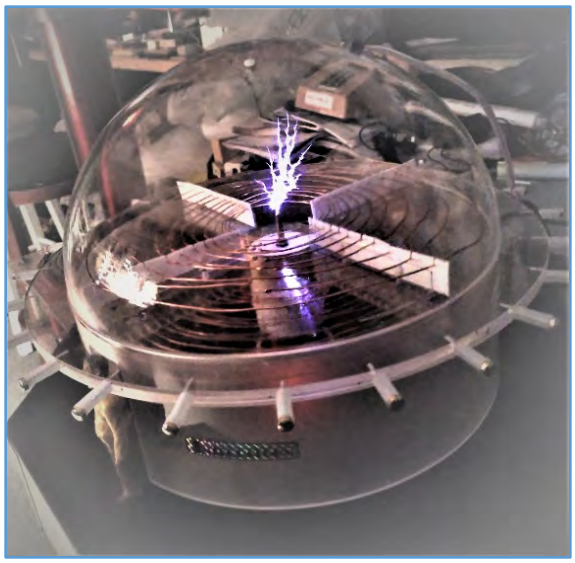
Conferences and Appearances. President Valone and Executive Director, Dr. J. Panting attended the **EESI Energy Forum** at the Rayburn House Building on Capitol Hill (top left pix), sponsored by the Energy and Environment Studies Institute and Dr. Valone was one of the speakers, which is posted in the www.EESI.org website. There were many environmental exhibitors there, providing networking opportunities for us (top middle pix). Drs. Valone and Panting fielded questions from Congressional staffers at the IRI booth (top right & middle left pix). The lecture hall was filled to capacity (center pix). Dr. Valone's 7-minute presentation is cued up at https://tinyurl.com/EESI-2019 . A few senators gave short speeches too (middle right pix).

IRI President Valone and Dr. Panting at Capitol Hill for the EESI Forum.

We held our 11th **Conference on Future Energy** (COFE11) on August 9-10th, at the Crown Plaza Suites in Albuquerque NM. It featured 14 speakers including: Dr. Robert Gray "Making Classical Electrodynamics Consistent". Mike Gamble "Control Moment Gyro Experiment, Part 3" Dr. Bruce Cornet "Unconventional Aircraft and Their Performances, as Part of Disclosure of US Hardware Advancements" Bob DeBiase "Propellantless Propulsion Based Upon Casimir Wedges" Dr. Paul LaViolette "Secrets of Antigravity Propulsion – which was a very popular talk and was attended with standing room only! Paul Murad "The Morningstar Energy Box- Part Redux" also very well attended as many wanted to know his results. Dr. Jim Purvis "Capacitive-Discharge Electromagnetic Propulsion System - patented Nov. 2018" plus many other speakers.

In January, Dr Valone was interviewed and taped at the Gaia Studios in Boulder Co by George Noory for his show "Beyond Belief" that showcased the theme "**Future Challenges and Solutions**". The show is available via live-stream on the **GAIA.com** website. DVD copies of his interview were sent to every IRI Member for their Holiday gift in December.

He also presented a lecture on Modern Meditation Training at the Natural Living Expo sponsored by **Pathways.** The entire presentation is available on the IRI Media "Watch the Videos" webpage.



IRI President Valone built this Integratron Model for the Ancient Aliens episode on the History Channel (S15 E8)

In November he presented at the **ISTAS IEEE** In Boston his seminal paper: "Quantitative Carbon Dioxide, Temperature and Sea Level Relation for the Future". His slideshow is reproduced in this *IRI Annual* in the next section which summarizes the coming climate.

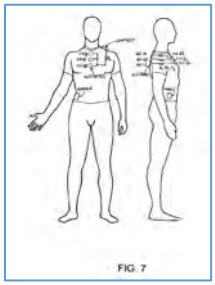
Then last but not least, to close out the year of 2019, **Prometheus Production Co.** came again to interview and feature our President, in their latest show for the History Channel, Ancient Aliens. Dr Valone was asked to reproduce a smaller scale model the Integratron for the episode, which exceeded everyone's expectations, since it contained a working Tesla Coil in the base which discharged into the upper chamber. The model (seen here) is now in exhibition at the Prometheus Studios in Los Angeles California.

President Valone also presented a slideshow at the **World Energy Engineering Conference (WEEC)** in Washington DC on September 25, 2019 on the Spiral Magnetic Motor, which was enthusiastically received, especially by the Session Chair of the Association for Energy Engineers.

Energy Program: Initial funding has been provided by our Institute and now we are pleased to say that we have a Sponsor who is providing a substantial amount on financial support to continue with our research, specifically for the SMM. Regarding our SMM project, we have had much advancement. Yes, a magnetic gradient has been implemented into a permanent magnet motoring cycle. This past year yielded a breakthrough with an affordable, proper choice of a magnetic switch. 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

Propulsion Program: The CMG Project or Control Moment Gyro Project continued with more data and measurements being done. Dr Valone is the principal director and Mike Gamble the 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.

The Bioenergetics Program: The Microcurrent Electrotherapy clothes project is moving forward since we have the Patent No: 8825174B2 by the US Patent and Trademark Office. We have to offers to license our patent and the negotiations are moving forward. We hope to have signed agreements by 2021. Our line of PREMIER electrotherapy devices now includes the PREMIER 2000, which has become very popular as well as EM Pulsers, EmPulsePad, OsteoPads and Maximat continue to be improved and sold. We plan for 2021 to develop a commercial version of our Energy Chair prototype, which has many therapeutic benefits and much public appeal.



Electrogravitics Program: The scientific validation of a science that connects gravity to electricity continues to be researched by us. Starting with our 1994 publication of Electrogravitics Systems: Reports on a New Propulsion Methodology, fourteen years later, a follow-up second volume called Electrogravitics II: Validating Reports on a New Propulsion Methodology has been updated and released which contains journal articles by the Army Research Lab and Honda Corporation on their experiments and theory of how electrogravitics and electrokinetics can work, besides patents by NASA and others. Our discovery that the classical "electrokinetic field" equation can predict how and why pulsed electrogravitics will work best was a great breakthrough. We continue to research the electrogravitics properties of the “arts parts”, generously made available to study by the journalist Linda Moulton Howe. We have taken measurements and are trying different methods for achieving an antigravity-electrogravitic effect. Some new

equipment was purchased to do more measurements and we are awaiting the final report. This work will continue for at least until 2022.

<u>Zero Point Energy Program</u>. The research continues on the possibility of tapping zero point energy through zero biased diodes. One of our many projects is the ***"Quantum Fire Project***" which was started shortly after Bob DiBiase's COFE8 presentation. Because the Casimir forces are ultimately the result of quantum effects, If asymmetric forces are observed, it would unleash the most disruptive technology ever seen since humans first harnessed fire. The Casimir equations are very convincing. IRI received some funding this year and preliminary data and tests with suitable polymers have been produced. In Germany, Dr Ludwig along with Bob DeBiase, continue to experiment with many designs to see which is the most effective and efficient. Much research is still being done for this paper and completion is slated for 2022. Also we have some students that are researching many different possibilities with zero biased diodes to harvest ambient energy and we plan to have some papers published when more data is accumulated and reviewed.

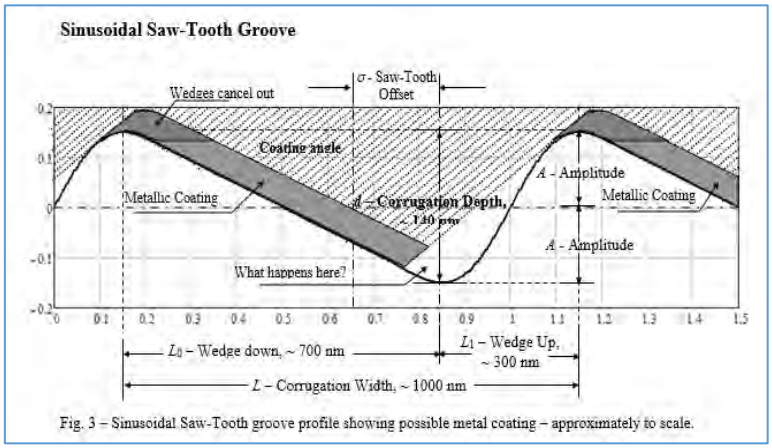
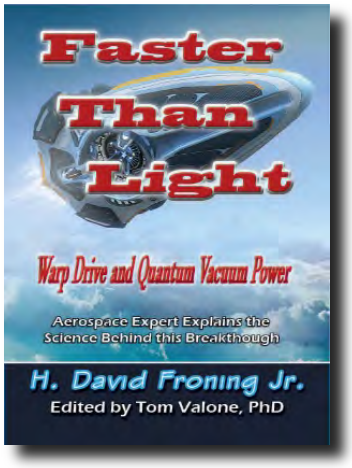
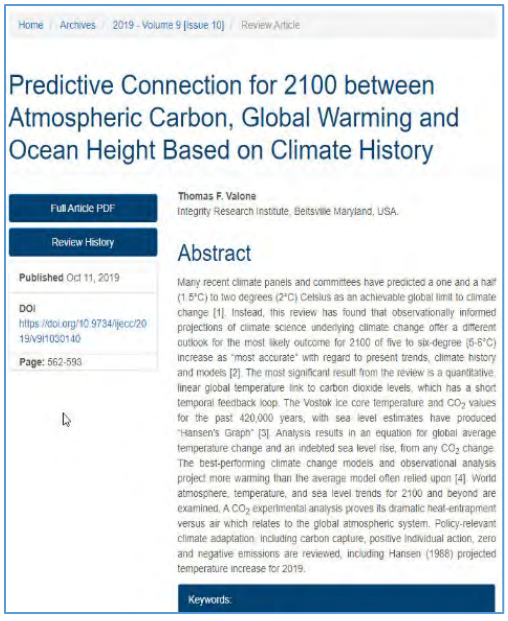


Fig. 3 – Sinusoidal Saw-Tooth groove profile showing possible metal coating – approximately to scale.



<u>IRI Publications and Books</u> : We are happy to report that the new book by Retired Aerospace Engineer and past COFE Award Speaker, H. Dave Froning is now in print: "**Faster Than Light: Warp Drive and Quantum Vacuum Power**" The book is more than 350 pages, full of aerospace anecdotes and futuristic aerospace designs along with many personal memories of the author and invaluable insights into the aerospace world history. Also the "Future Energy Annual 2018" was published and mailed free to our membership. Includes our latest papers on Energy, including Zero Point Energy, Electrogravitics, Energy generation, Bioelectromagnetics.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Predictive Connection for 2100 between Atmospheric Carbon, Global Warming and Ocean Height Based on Climate History

Full Article PDF

Review History

Published Oct 11, 2019

DOI https://doi.org/10.9734/ijecc/2019/v9i1030140

Page: 562-593

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Abstract

Many recent climate panels and committees have predicted a one and a half (1.5°C) to two degrees (2°C) Celsius as an achievable global limit to climate change [1]. Instead, this review has found that observationally informed projections of climate science underlying climate change offer a different outlook for the most likely outcome for 2100 of five to six-degree (5-6°C) increase as "most accurate" with regard to present trends, climate history and models [2]. The most significant result from the review is a quantitative, linear global temperature link to carbon dioxide levels, which has a short temporal feedback loop. The Vostok ice core temperature and CO_2 values for the past 420,000 years, with sea level estimates have produced "Hansen's Graph" [3]. Analysis results in an equation for global average temperature change and an indebted sea level rise, from any CO_2 change. The best-performing climate change models and observational analysis project more warming than the average model often relied upon [4]. World atmosphere, temperature, and sea level trends for 2100 and beyond are examined. A CO_2 experimental analysis proves its dramatic heat-entrapment versus air which relates to the global atmospheric system. Policy-relevant climate adaptation, including carbon capture, positive individual action, zero and negative emissions are reviewed, including Hansen (1988) projected temperature increase for 2019.

Keywords:

We are also very proud of Dr Valone's journal paper on climate change entitled: "Predictive Connection

for 2100 between Atmospheric Carbon, Global Warming and Ocean Height Based on Climate History" which was published in the peer-reviewed ***Inter. J. of Env. and Climate Change*** in October, 2019. This is a 32-page journal paper with all the latest findings on climate changes.

This was followed up by a personal presentation at Tufts University in November, 2019 by Dr. Valone at the IEEE International Symposium on Technology and Society (ISTAS), where a shorter, summary paper was published **("Quantitative Carbon Dioxide, Temperature and Sea Level Relation for the Future")**, as well as a 20-minute slide presentation, which are online and featured in this IRI Annual 2019 in its entirety. The slideshow is a special presentation explaining the relationship between CO2 levels and temperature, in the same quantitative manner as the previous, longer journal article, both based in the work of famed climatologist, Dr. James Hansen.

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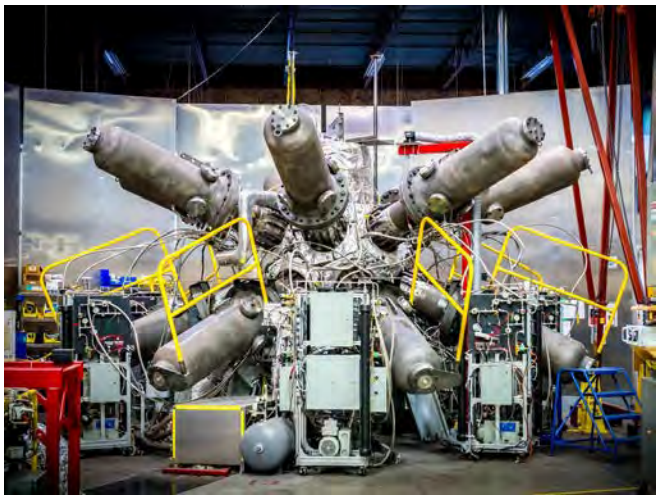
"Future Energy eNews" is sent via email, monthly, to over 5000 recipients worldwide, free of charge through Constant Contact email service. Anyone may sign up for this educational service from the IRI homepage, www.IntegrityResearchInstitute.org. This electronic newsletter showcases five best emerging eco-friendly technologies in the areas of energy, propulsion, and bioenergetics that are being developed worldwide and published in Journals, Magazines and Newspapers. Also we published the "Future Energy" Quarterly Magazine, or provide affinity groups' magazines which are mailed to all members for free. The 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. Below is a featured story from Future Energy eNews, Dec., 2019

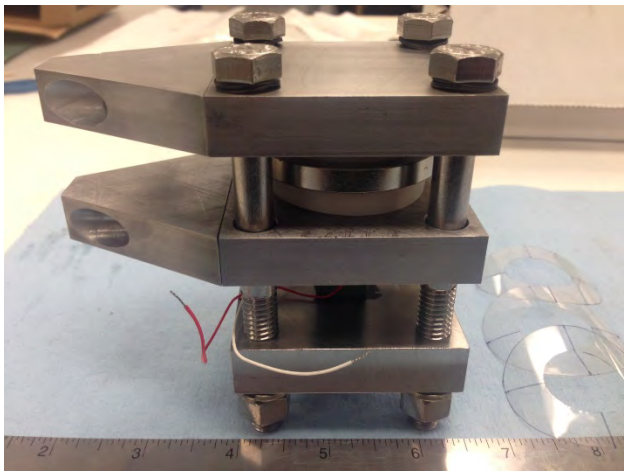


Fusion energy startup General Fusion just raised another $65 million. The money will go towards constructing a demonstration power plant to test out its technology. Here, an early-stage prototype of the company's unique piston technology, which is designed to compress hydrogen plasma and spur fusion. - Business Insider, Dec. 16, 2019

Spiral Magnetic Motor – Progress on IRI Research Project Low Energy Magnet Switching

Some physicists remind us on science documentaries that electrons in the mountains have been spinning for millions of years. Yet, the key to unlocking zero-point energy and the negative energy of the quantum vacuum is the spinning electrons which create magnetic fields and also the overlooked "**Magnetic Gradient**." Along with the help of the University of Maryland, Aerospace Department, IRI has also been collaborating with Hathaway International to make a magnetic switch for the Spiral Magnetic V-Track Motor.

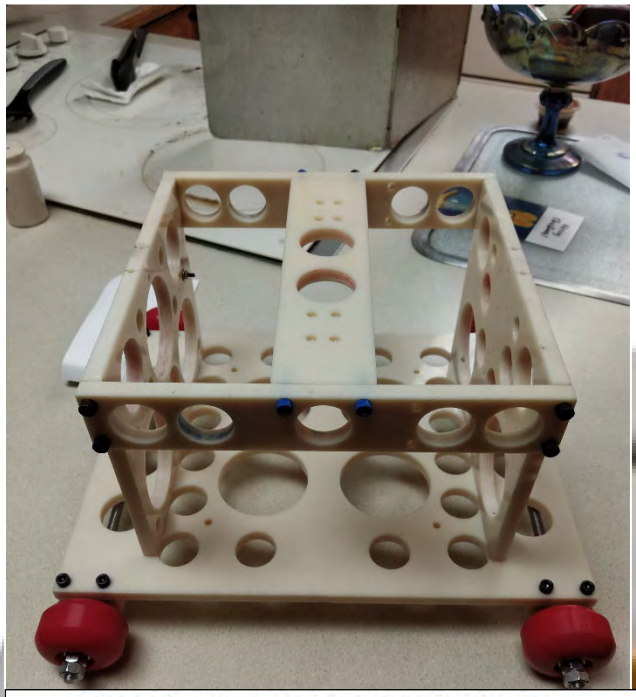
While we use the voltage gradients, thermal gradients, and even gravity gradients all of the time to perform useful work, our world has not mastered the magnetic gradient (a change in magnetic field intensity over a distance of space). The Spiral Magnetic Motor (SMM) is just the kind of magnetic gradient motor which is ripe for scientific research today because the practice of energy harvesting is gaining a wide range of possible options. Capitalizing on an ambient source of energy, such as a passing magnet causing a voltage spike with Wiegand wires, will lead to a viable method of magnetic switching for the SMM rotor so that the cycle can be repeated. This is very exciting for the serious inventor since IRI has shown that 90% of the cycle is already powered by permanent magnets in an SMM. IRI has built many SMM models and published the results in peer-reviewed journals.[1] The next phase of research is to test and optimize the MS-PZT switch seen here for commutation, with an energy harvester.



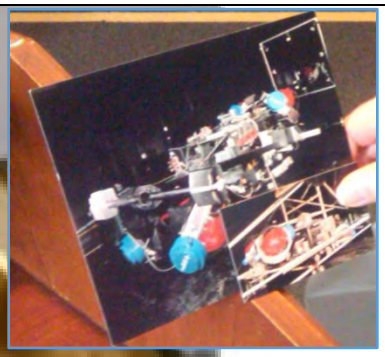
Peer-reviewed journal paper is online https://tinyurl.com/SMMpaper. A short video is also posted online: www.tinyurl.com/IndiegogoSMM IRI has been funding the materials for the Spiral Magnetic Motor Research Project, up until now with the volunteer labor of engineer, Thomas Valone, whose SMM paper has already received popular achievement award notification of "5000 reads" on ResearchGate, from research done with multiple test models of the axial design. The exciting part is that we now have all of the statistics necessary to predict angular momentum, torque, power, and energy production. This helps tremendously for considering energy harvesting for any electronic motion sensor, speedometer, piezoelectric switching controls, etc. The development objectives for this spiral magnetic motor (SMM) and generator project, apply to providing a motor or generator. Both applications utilize an increasing magnetic field strength (gradient) surprisingly present in 90% of the spiral magnetic cycle. An SMM Microturbine will free all the countries of the world from dependence on coal and natural gas, while an SMM Magnetic Motor will supplant oil usage for vehicles, thus raising the standard of living for everyone with long-lasting, clean energy.

[1] E.g., "Permanent Magnet Spiral Motor for Magnetic Gradient Energy Utilization: Axial Magnetic Field" Presented to the Space, Propulsion & Energy Sciences International Forum (SPESIF), February 23-26, 2010, Applied Physics Lab – Johns Hopkins University, sponsored by the American Institute of Physics

Control Moment Gyroscope – Exciting *IRI Project* Designed to Duplicate Boeing' CMG for Commercial Transportation with Inertial Propulsion



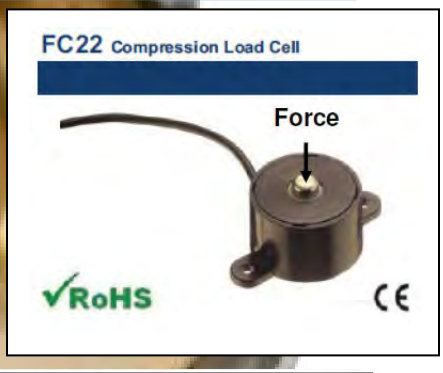
Project Engineer Mike Gamble shows the Boeing CMG (below) that he worked on for their space satellite maneuvering to keep them in orbit. While the basic design uses only two gyros in a tabletop version with a 2" pair of gyroscopes, the next phase involves at least a 4" pair of gyros to increase the force. His calculated prediction and measured load cell forces (below) match each other within 10% accuracy, producing about 0.4 lb. of peak force. Reducing noise and weight has been the goal of movement driven solely by electrical power and thus controllable directionality. In that respect, the NEW design (left) uses plastic for light weight sturdy frame and larger gyros. It is noted that every physicist consulted has said this process violates the conservation of momentum law.

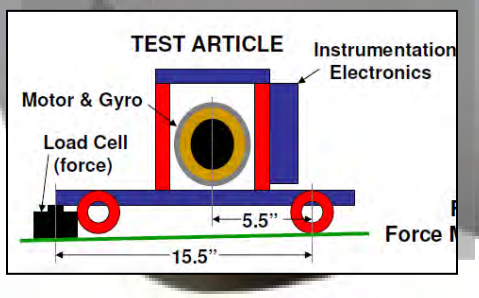


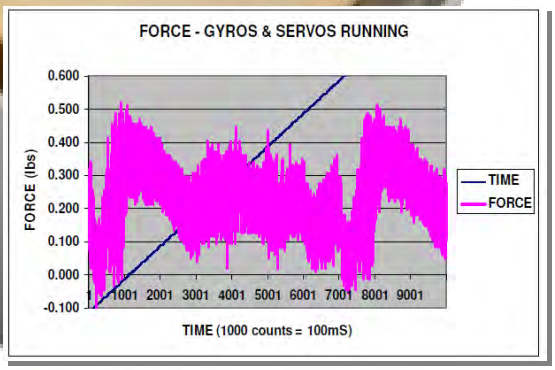
FORCE(max) EQUATION

$$\text{Force (pk)} = \frac{1.77\text{e-}8\ \pi^2\ Fs\ Fr\ Mr\ (IDr^2+ODr^2)\ D}{4\ K^2 + D^2}\ [\text{lbs}] = 0.4004\ \text{lbs}$$

Fs = Freq of Servo [Hz] (0.877)
Fr = Freq of Rotor [Hz] (266.67)
Mr = Mass of Rotor [g] (112)
IDr = Inner Dia of Rotor [mm] (41.3)
ODr = Outer Dia of Rotor [mm] (53.0)
D = Gyros Separation [in] (4.50)
K = Radius of Gyration [in] (7.28)







Quantum Fire Project – Third *IRI Project* for Testing an Asymmetric Design to Rectify the Microscopic Casimir Force

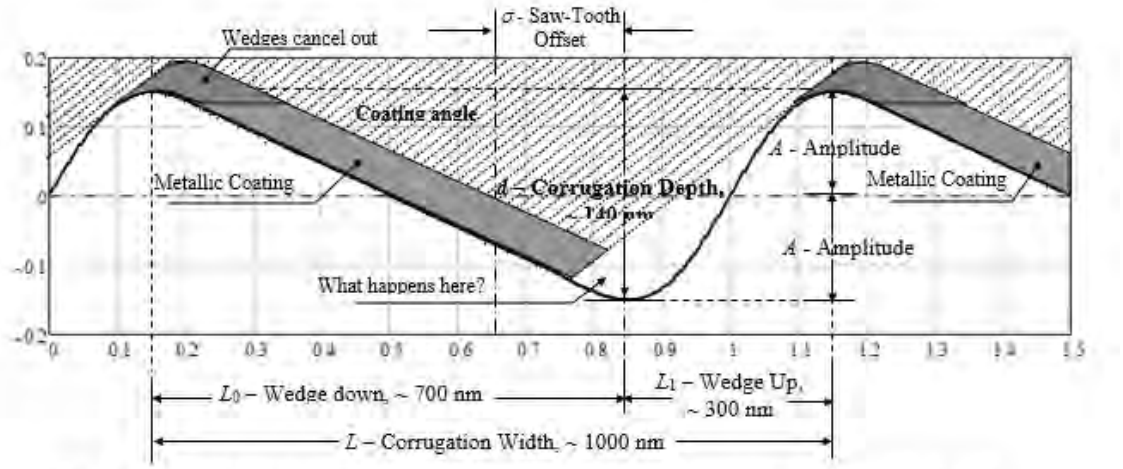


Fig. 3 – Sinusoidal Saw-Tooth groove profile showing possible metal coating – approximately to scale

The **Quantum Fire Project**, under the direction the Project Engineer Robert DeBiase and Physicist Thorsten Ludwig, PhD, seeks to experimentally test certain force predictions of the proximity force approximation and a theoretical calculation for a perfectly conducting wedge, using an atomic force microscope that has been suitable modified. Preparations for the experiments include carefully manufacturing clean, smooth saw toothed shaped corrugated surfaces on a non-conducting sphere, which then has one slope of the saw tooth coated with metal. This metallically coated diffraction grading, when brought close to a metallically coated un-corrugated flat plate will create wedge shaped cavities (see diagram above). The experiment will then measure the nano-newton lateral **Casimir forces** on the sphere, in the vicinity of the adjacent surface of a diffraction grating with favorable microscopic grooves. The project aims to clarify the practical use of quantum fluctuations and zero-point energy with a 2018 update to use a FULL metallized version.

IRI has directed the team to make use of the nonsymmetric saw-tooth impressions in diffraction gratings to simplify the design. The material needs to be soft enough that impressions can be made by bringing a polymer coated metal ball against a diffraction grating while the ball is attach to an AFM cantilever. Such a process is necessary in order for the grooves to be properly aligned for taking AFM measurements. But it needs to be hard enough that metal can be coated onto one slope of the saw-tooth without damaging the sawtooth groove, thus creating the asymmetric propulsive Casimir force on each wedge which are expected to add up to a significant and measurable summation. Calculations have been made for the theoretical lateral forces to be expected for the arrangement using the perfectly conducting wedge theory. If lateral forces are proven to be present, fulfilling theoretical predictions, a prototype development of a **force production engine** can proceed and commercial applications will be explored.

On the next nine pages are the complete **IRI Climate Slideshow** that was presented in November at the Institute for Electrical and Electronic Engineers special International Symposium on Technology And Society, giving everyone a Quantitative CO2, Temperature, and Sea Level Relationship for Predicting the Future Increases in all Three Variables.


IEEE ISTAS 2019
Tufts University, Boston MA, November 15-16, 2019
QUANTITATIVE CARBON DIOXIDE, TEMPERATURE, AND SEA LEVEL RELATION FOR THE FUTURE
Thomas Valone
Integrity Research Institute
Beltsville MD USA
15 - 16 November 2019
IEEE ISTAS 2019

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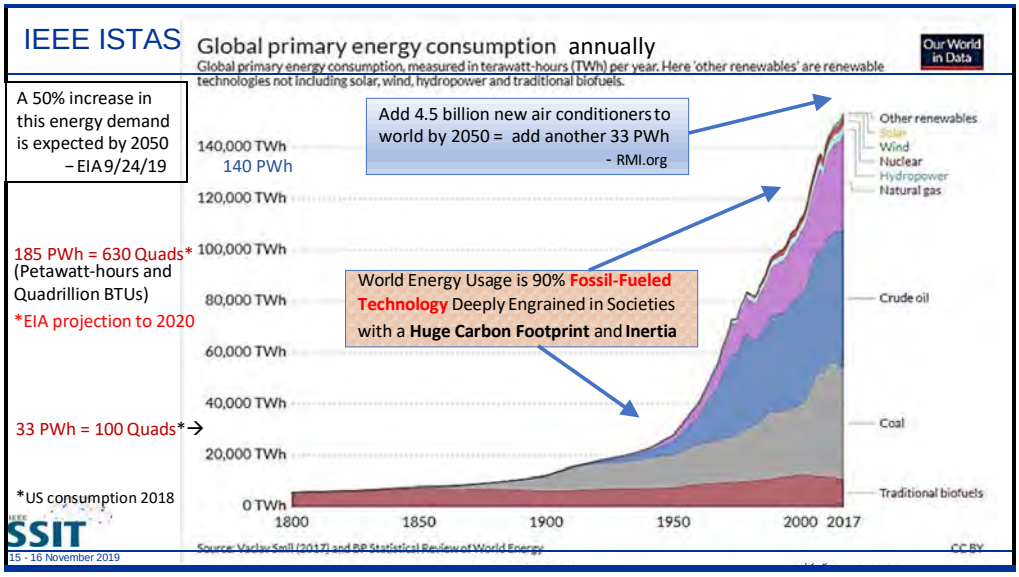
IEEE ISTAS
Global primary energy consumption annually
Global primary energy consumption, measured in terawatt-hours (TWh) per year. Here 'other renewables' are renewable technologies not including solar, wind, hydropower and traditional biofuels.
Our World in Data
A 50% increase in this energy demand is expected by 2050 – EIA 9/24/19
Add 4.5 billion new air conditioners to world by 2050 = add another 33 PWh - RMI.org
140,000 TWh
140 PWh
120,000 TWh
100,000 TWh
80,000 TWh
60,000 TWh
40,000 TWh
20,000 TWh
0 TWh
1800
1850
1900
1950
2000
2017
Other renewables
Solar
Wind
Nuclear
Hydropower
Natural gas
Crude oil
Coal
Traditional biofuels
185 PWh = 630 Quads* (Petawatt-hours and Quadrillion BTUs)
*EIA projection to 2020
World Energy Usage is 90% Fossil-Fueled Technology Deeply Engrained in Societies with a Huge Carbon Footprint and Inertia
33 PWh = 100 Quads*→
*US consumption 2018
SSIT
15 - 16 November 2019
Source: Vaclav Smil (2017) and BP Statistical Review of World Energy
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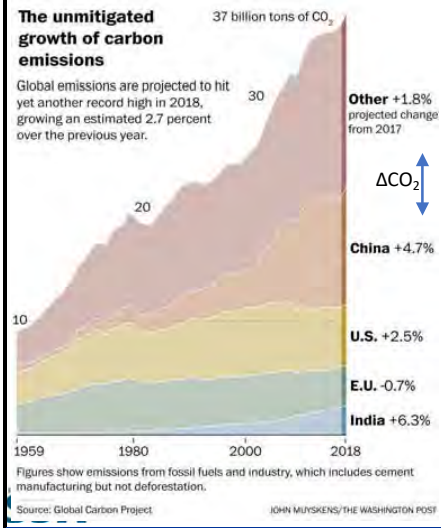
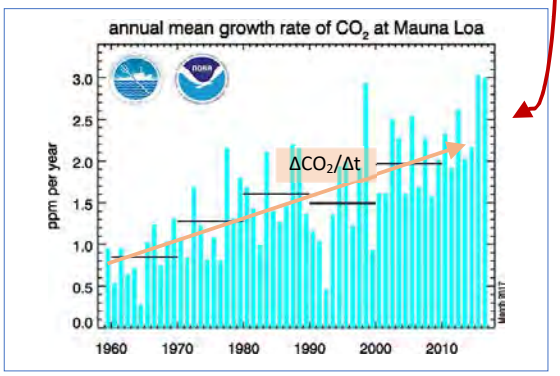
2

CARBON EMISSIONS PER ANNUM



- **CO_2 up to 40 gigatons per year worldwide rapidly *increasing rate***
- **compared to 30 Gt/yr ten years ago**



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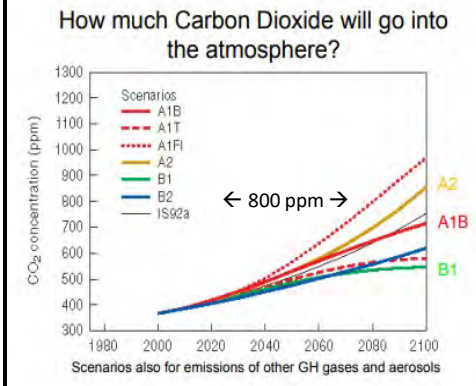
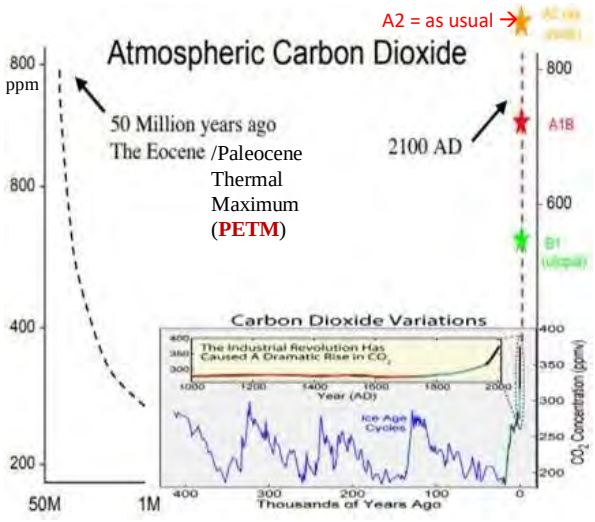
Paleoclimatology – Geo Past is Key to Future



SSIT Graphs from University of Washington



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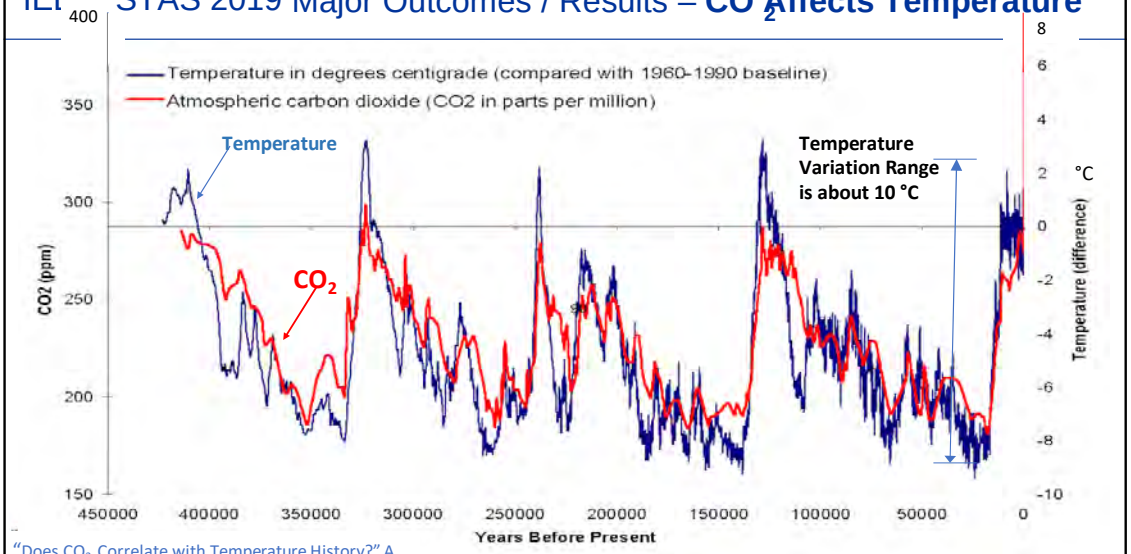
IEEE ISTAS 2019 Major Outcomes / Results – **CO_2 Affects Temperature**



"Does CO_2 Correlate with Temperature History?" A. Watts, Wordpress.com, after Shakun, *Nature*, 2012

5

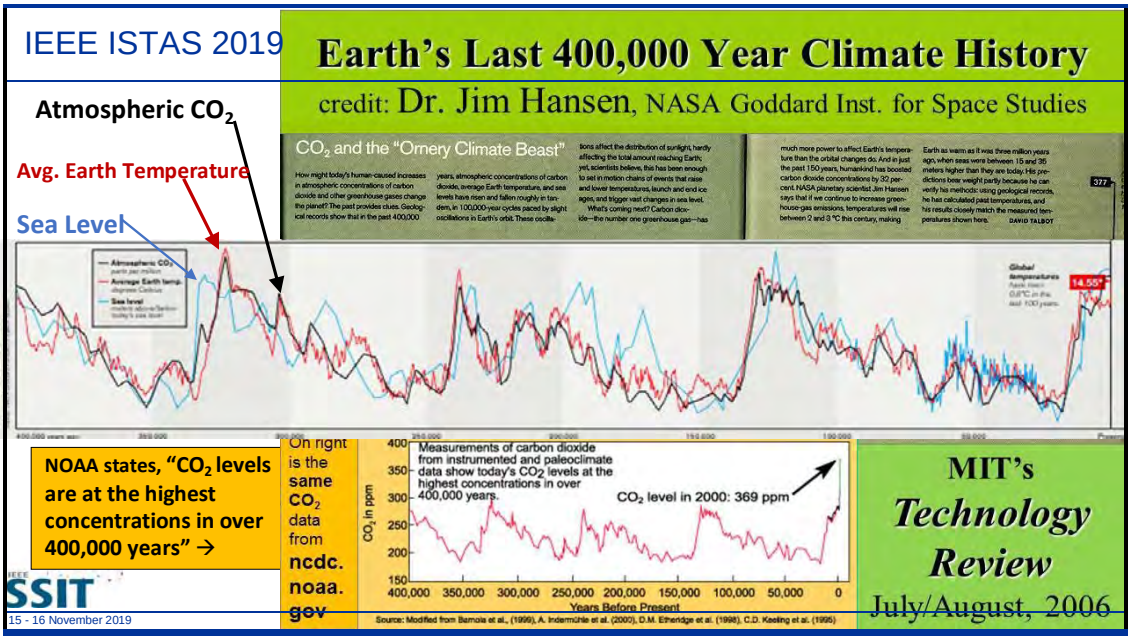
IEEE ISTAS 2019 **ALASKA Columbia Glacier ONLY SIX Years Apart**

Columbia Bay, Alaska – Photographer James Balog, Nat. Geo. magazine: **Extreme Ice Survey of 18 Glaciers**

The most extreme: Columbia Glacier is losing one mile every three years – so two miles of loss are shown below.

Since 1980, this glacier has lost height equal to the Empire State Building!

6

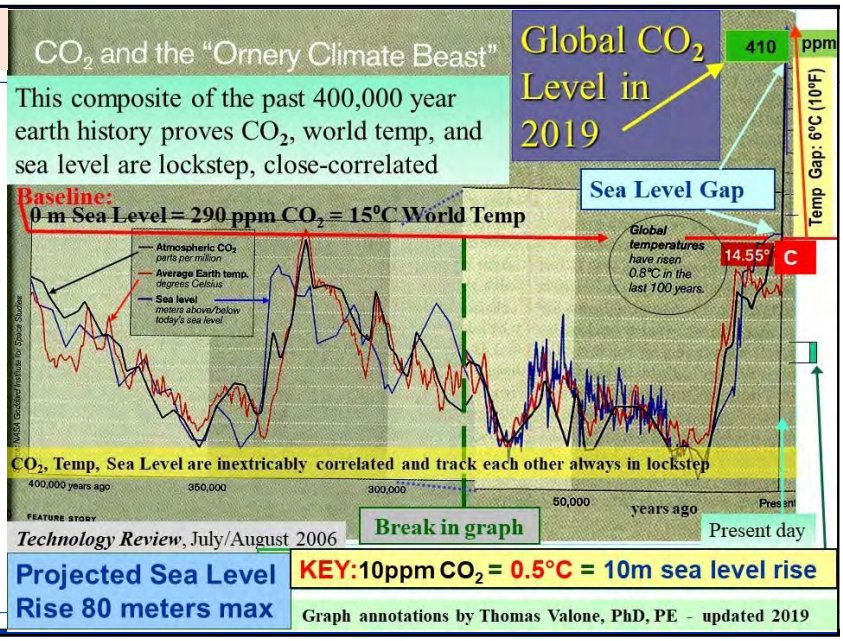


7

Jim Hansen's Table of Vostok data points for 400,000 years

Carbon dioxide p.p.m.	Average Earth temp. °C	Sea level meters
300	15.5	10
290	15.0	0
280	14.5	−10
270	14.0	−20
260	13.5	−30
250	13.0	−40
240	12.5	−50
230	12.0	−60
220	11.5	−70
210	11.0	−80
200	10.5	−90
190	10.0	−100
180	9.5	−110
—170	9.0	−120

15 - 16 November 2019



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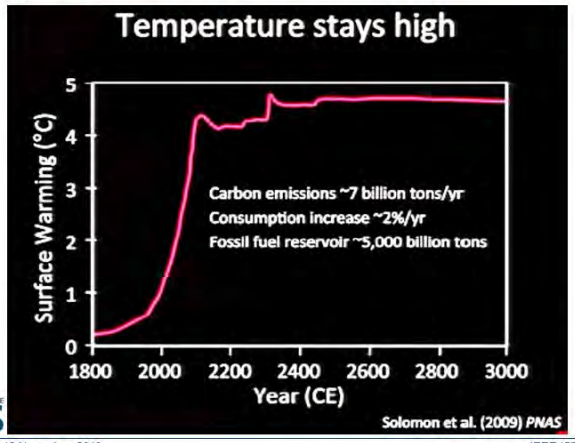
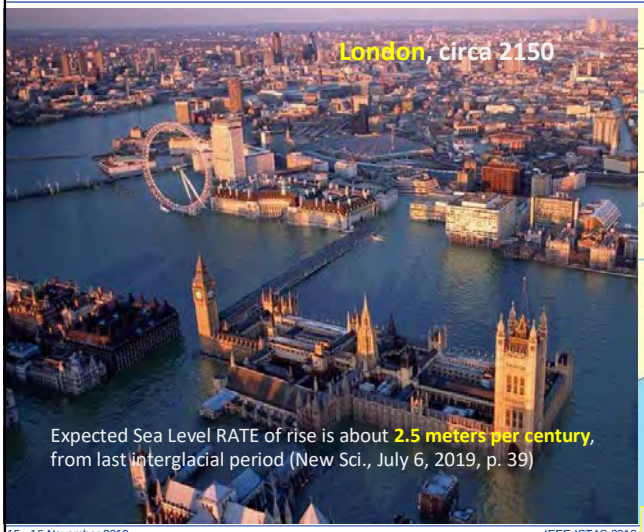
IEEE ISTAS 2019 Hansen Formula for CO_2, Temperature, and Sea Rise

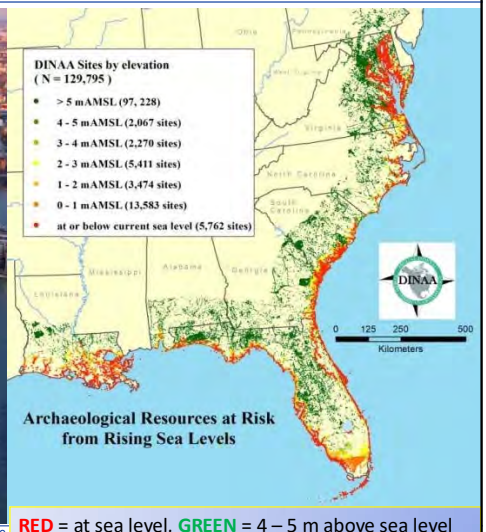
+/- (20 ppm CO_2 = 1 °C = 20 m sea rise)



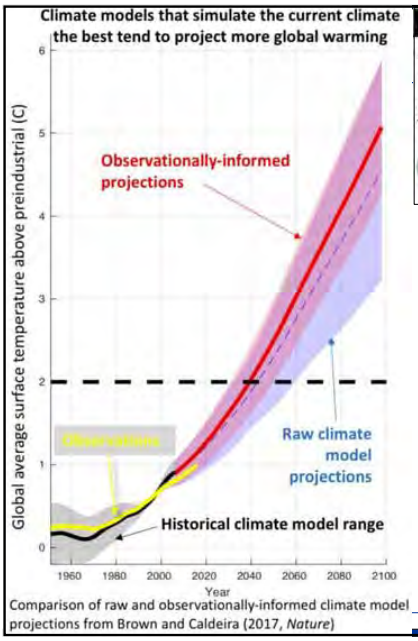
- Formula becomes nonlinear past 500 ppm CO_2 as global temperature response lessens
- In 2009, Dr. Solomon (NOAA) projected 4 – 5 °C by 2100, assuming a CO_2 peak at around 2100 – wishful thinking 7→11 Gt
- Hansen's Formula prediction of **6 °C by 2100** will continue to increase if business as usual 2100s

IEEE ISTAS 2019 Sea Encroachment After 2100 in Major Cities





RED = at sea level, GREEN = 4 – 5 m above sea level



Comparison of raw and observationally-informed climate model projections from Brown and Caldeira (2017, *Nature*)

World Africa Americas Asia Australia China Europe India Middle East United Kingdom LIVE TV

11,000 scientists warn of 'untold suffering' caused by climate change

By Emma Tobin and Ivana Kottasová, CNN

Nov. 6, 2019 CNN

Latest numbers show at least 5 metres sea-level rise locked in

It's too late to stop the seas rising at least 5 metres and only fast, drastic action will avert a 20-metre rise, New Scientist calculates based on recent studies

SCIENCE ADVANCES | RESEARCH ARTICLE

MASS EXTINCTION

Rothman, *Sci. Adv.*, Sept., 2017

Thresholds of catastrophe in the Earth system

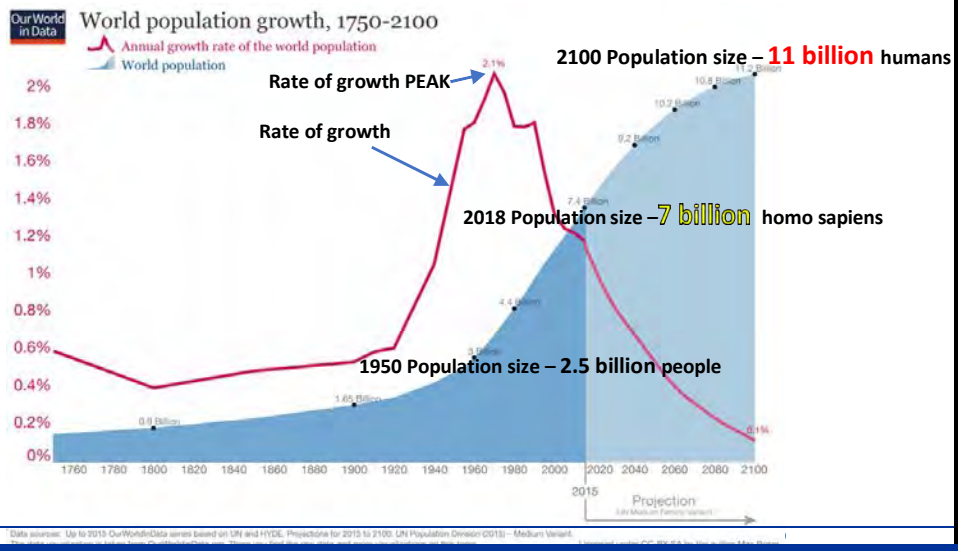
Daniel H. Rothman

The history of the Earth system is a story of change. Some changes are gradual and benign, but others, especially those associated with catastrophic mass extinction, are relatively abrupt and destructive. What sets one group apart from the other? Here, I hypothesize that perturbations of Earth's carbon cycle lead to mass extinction if they exceed either a critical rate at long time scales or a critical size at short time scales. By analyzing 31 carbon isotopic events during the past 542 million years, I identify the critical rate with a limit imposed by mass conservation. Identification of the crossover time scale separating fast from slow events then yields the critical size. The modern critical size for the marine carbon cycle is roughly similar to the mass of carbon that human activities will likely have added to the oceans by the year 2100.

11

IEEE ISTAS 2019 **World Population Growth** – conservative est.

Global population has tripled (3x) since 1950; CO_2 emissions have quadrupled (4x); and global energy demand has quintupled (5x), all in the same time period.



12

IEEE ISTAS 2019 **Solutions, Suggestions, Adaptations besides renewables**

Phase Change Materials

Absorb and release energy naturally - without consuming energy

Phase change insulation is a vital adaptation technique for the immediate future and beyond. **InsolCorp** leads the industry with **InfiniteR** insulation only one centimeter thick has **100 BTU/ft²** of energy storage, **314 Watts/m²** of energy.

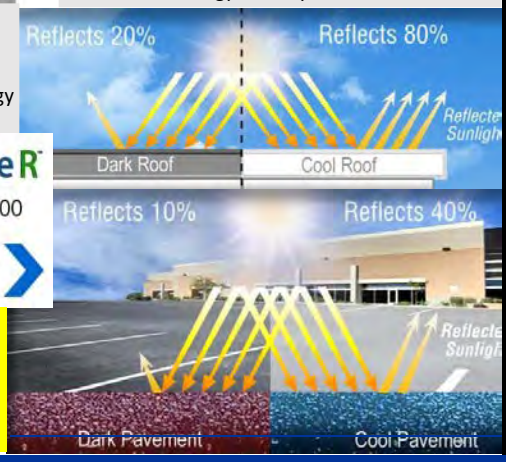
InfiniteR	InfiniteR	InfiniteR	InfiniteR
24" - 21C M100	24" - 23C M100	24" - 25C M100	24" - 29C M100
21°C 70°F	23°C 73°F	25°C 77°F	29°C 84°F

Choose you preferred TEMPERATURE for the phase change. It will **maintain that temperature INDOORS (+/- 2 °F)** while the outdoors swings wildly with 100 °F hot and 20 °F cold.

Like ICE, it freezes and thaws at the chosen TEMPERATURE above.

Western Colloid Fluid – Cool Roof System

- High Reflectivity
- Reduces energy costs by 30%



13

IEEE ISTAS 2019 **Conclusion and Outlook**

How to make a carbon tax popular

Politicians are cautious but a survey of 3000 people in the US found **attitudes to it are positive** if the money raised goes toward renewable energy or is redistributed to people as a rebate.

-Sci. Adv., Sept., 2019 doi.org/dbqd

World needs a huge carbon tax by 2030 to limit climate change, IMF says

BY CHRIS MOONEY AND ANDREW FREEDMAN

A global agreement to make fossil-fuel burning more expensive is urgent and the most efficient way of fighting climate change, an International Monetary Fund study found on Thursday.

The group found that a global tax of $75 per ton by 2030 could limit the planet's warming to 2 degrees Celsius (3.6 degrees Fahrenheit), or about double what it is now. That would greatly increase the price of fossil-fuel-based energy — especially from the burning of coal — but the economic disruption could be offset by rerouting the money raised straight back to citizens.

"If you compare the average level of the carbon tax today, which is $2 [a ton], to where we need to be, it's a quantum leap," said Paolo Mauro, deputy director of the fiscal affairs department at

low to hold climate change to 2 degrees, noting that he had expected the figure to be closer to $100 per ton, given the world's high emissions path.

Gernot Wagner, who studies climate policy at New York University, agreed. He co-wrote a paper published Monday arguing that a carbon price should [illegible] gradually be reduced account the costs o age from global war

"If one takes cli uncertainty seriou bers rise much higher still," Wagner said in an email.

Most economists and policymakers have designed carbon tax policies that start relatively low and ramp up quickly over time. Proponents say it would minimize economic hardship for consumers and companies for their past choices while changing future decisions such as purchases of polluting equipment or automobiles.

that analysis.

"The climate cri and public/popular tion to attack it in strong and unque even $75/ton by 2 too moderate a t Komanoff, director Tax Center, wrote response to the IM IMF repor omic pol ical feas is as well ght affec ments of society a them more polit such as by redirec to people through rect dividend pay

It shows that 20's largest eco would raise em average of $3 pe ty abd 14 percen the countries co This reflects t nition that poli cial burden particular c trigger u France's ta diesel, for

Wash. Post, Nov. 2019

Can we stabilize CO_2 to 350 ppm or lower?

FELIPE DANA/ASSOCIATED PRESS

The IMF found that a global fossil-fuel levy of $75 per ton by 2030 could limit the planet's warming, which has drastically affected Greenland, above — to 2 degrees Celsius.

Young Evangelicals Welcome Bipartisan Carbon Tax Bill

Posted by Victoria Goebel Sept. 26, 2019

Today, Representative Brian Fitzpatrick (R-PA) introduced the bipartisan Market Choice Act, an ambitious plan to incentivize a free-market transition toward clean, renewable energy. The bill will significantly drive down greenhouse gas emissions, direct most of the revenue raised toward much-needed infrastructure investment,

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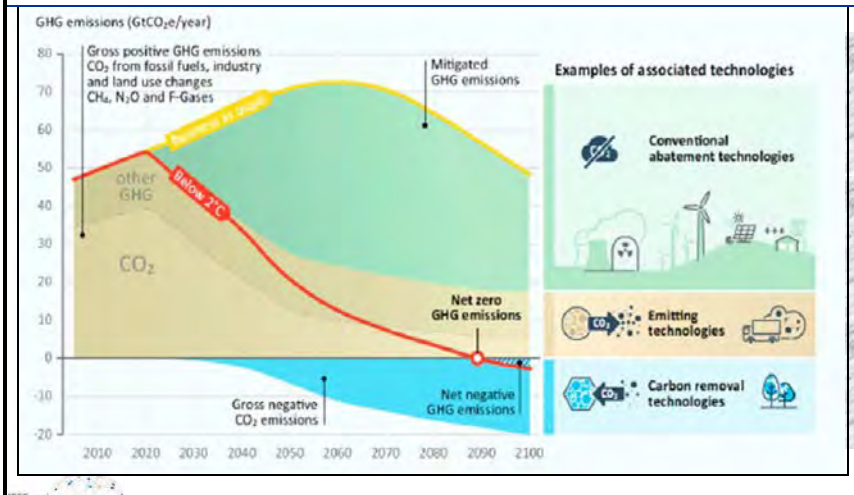
IEEE ISTAS 2019 Negative Emissions and Carbon Sequestration



"Negative Emissions Technologies and Reliable Sequestration: A Research Agenda"
(2019) National Academies Press
www.NAP.edu/10766

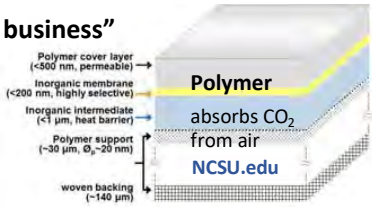
FREE download (PDF)

15

IEEE ISTAS 2019 Carbon Capture & Utilization (CCU) or Carbon Capture & Storage (CCS) in Gigatons?

"Pulling CO_2 out of the air and using it could be a trillion-dollar business"
Put CO_2 to work making valuable products. www.**vox.com**/energy-and-environment

1 ppm CO_2 = 2 Gt Carbon = 7.77 Gt CO_2

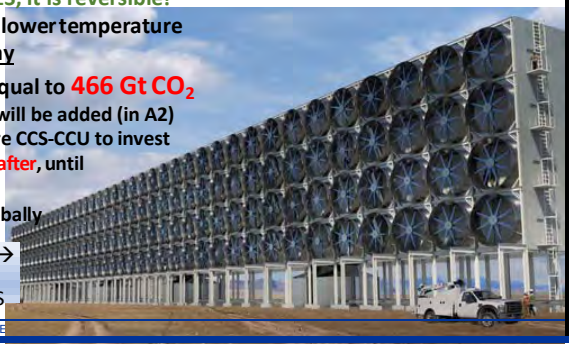


THE HANSEN CHALLENGE

Can we REDUCE the CO_2 level to lower temperature ? YES, it is reversible!

- **Choose 350 ppm (+3 °C) as the target CO_2 level just to lower temperature**
- **Calculate gigatons (Gt) to remove in total if done today**
- **Take present 410 ppm – 350 ppm = 60 ppm which is equal to 466 Gt CO_2**
- **However, *every year* an average of 5 ppm CO_2 or +40 Gt/yr will be added (in A2)**
- **Therefore, any Global Carbon Reduction Program will require CCS-CCU to invest enough to remove say, 100 Gt/yr for 10 years and 50 Gt/yr after, until**

the hoped-for carbon emission rate peaks and a century later,
the emissions slow down, level off, as population has done globally



Carbon Engineering out of Calgary, Canada →

Tested **Direct Air Capture** (DAC) for CCU, CCS

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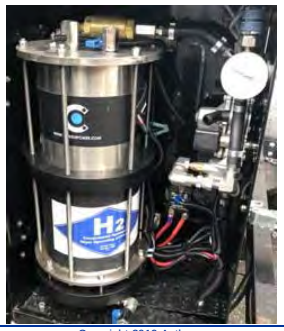
Transformative Zero or Negative Emissions Tech

"A Process for Capturing CO_2 from the Atmosphere"
DAVID KEITH ET AL., **JOULE,** VOLUME 2, ISSUE 8, P1573-1594, AUGUST 15, 2018

→ Estimates low cost can be around
$100/ton of CO_2 presently
→ $50 billion/yr for 50 Gt/yr @$1/t

Carbon Engineering – very low-carbon fuels, powered by renewables, using CO_2 from the air, drawing **hydrogen** from electrolysis to produce hydrocarbons. The company calls the process "**air to fuels**," or **A2F,** and it is targeting wide commercialization in 2021.

HyTech is targeting a big market – diesel engines – the source of 50% of urban smog, especially in winter



Onboard electrolyzers are the game plan for turning existing → diesel engine fleet into **zero-emissions vehicles (ZEV) by making them run on pure hydrogen.**

-- **HyTech Power**, based in Redmond, Washington

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NOTE:

1) **The 32-page article "Predictive Connection for 2100 between Atmospheric Carbon, Global Warming and Ocean Height Based on Climate History " by Thomas F. Valone, *Int. J. Env. & Climate Chg*., Oct. 2019 is at www.tinyurl.com/ValoneClimate to make it easy to remember, as an open access publication.**
2) **This IEEE ISTAS Climate Slideshow (PDF) is also posted conveniently at https://tinyurl.com/ValoneClimateSlideshow**

(Either www or https:// as the prefix will work)

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It is hoped that the simple, 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. Hundreds of gigatons of CO_2 must be removed from the earth's atmosphere. - TV

A Clean Energy Revolution Is Rising in the Midwest, with Utilities in the Vanguard

Reprinted from Future Energy eNews, Jan. 2019

Xcel is leading the pack, with a pledge to go 100% zero carbon by 2050. Other major electricity providers are trading coal for wind and solar sooner than planned.

BY DAN GEARINO, INSIDE CLIMATE NEWS, JAN. 3, 2019

This was a fulcrum year for the clean-energy transition in the Midwest as Xcel announced plans to go zero carbon and other utilities said they would shut down coal-fired power plants early. Credit: Joe Amon/The Denver Post via Getty Images

Even with all the evidence that renewable energy has become less expensive than fossil fuels, it doesn't seem real until utilities start to stake their futures on it. For some Midwestern utilities, 2018 is the year that happened. Xcel Energy of Minnesota in early December said it would go to **zero carbon emissions** throughout its eight-state territory by 2050, the first major utility to do so. That followed some big steps by Consumers Energy in Michigan and NIPSCO in Indiana, which issued plans to shut down coal-fired power plants sooner than previously planned while also accelerating development of wind and solar power.

These corporate decisions are part of what has made 2018 a fulcrum year for the clean-energy transition, a time when long-building trends in energy consumption and pricing have led to a clear shift in the market, according to analysts and clean-energy advocates. These dynamics are most noticeable in the Midwest because of **extremely low wind energy prices**, but they are spreading to other regions.

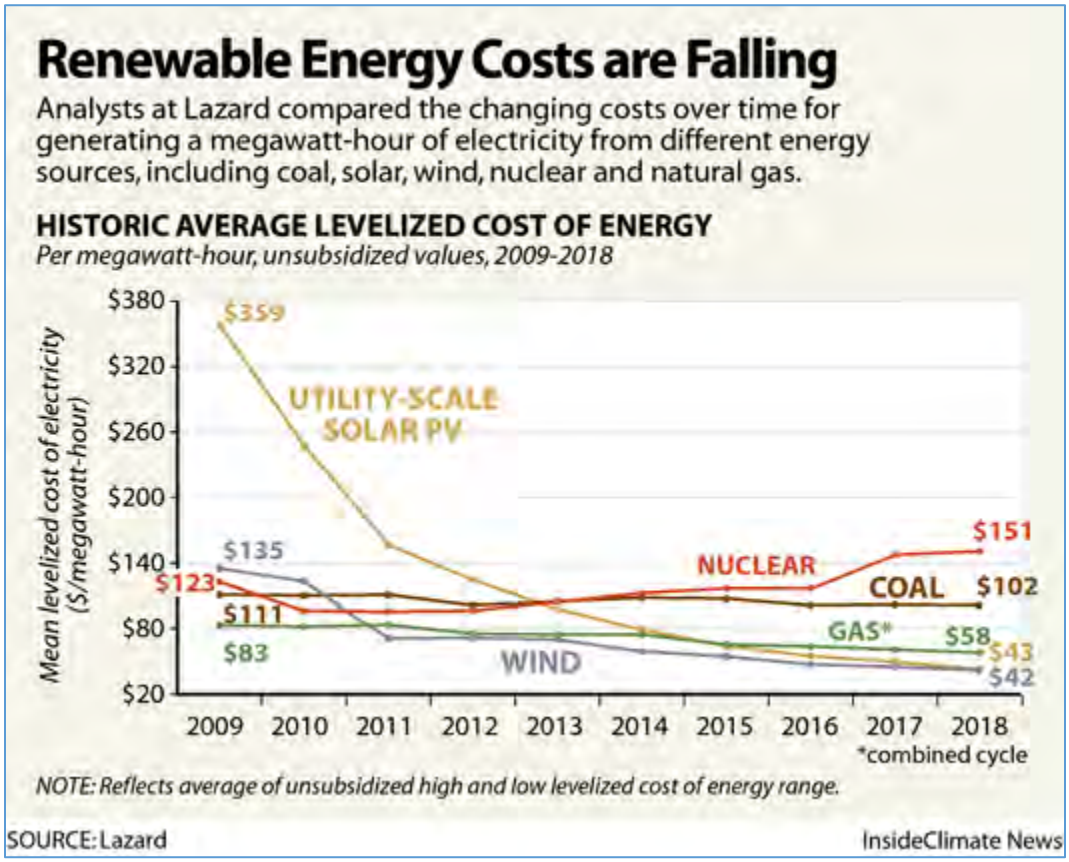
Consumers Energy, which provides electricity to 1.8 million customers, issued a plan in June to overhaul its electricity generation fleet over the next two decades and embrace solar power. It was a striking change of course for a company that has relied heavily on coal.

"Our vision considers people, the planet and the prosperity of our state and the communities we serve," Patti Poppe, the company's CEO, said in a statement released with the plan.

Planning for the Future, Coal Doesn't Make Sense

NIPSCO, which stands for Northern Indiana Public Service Company, distinguished itself among its Midwestern peers in 2018 by proposing to close of all of its coal-fired power plants within 10 years. The plan, which is still being reviewed by regulators, is striking because coal is 65 percent of the company's power plant capacity, which is unusually high.

NIPSCO, which has 468,000 electricity customers, says its proposal is workable and desirable because building new renewable energy is more cost-effective than maintaining old coal plants. One of the financial risks is that future state or federal laws or changes in commodity prices will make natural gas fired power plants unable to compete on the market.



Xcel, Consumers and NIPSCO were able to make their plans in large part because the cost of generating wind energy is unusually low in the Midwest. This puts Midwestern utilities ahead of the curve in their ability to rely on renewable energy, and may indicate what is on tap in other parts of the country as renewable energy becomes more affordable in other regions, Learner said. "It's a matter of environmental value and economic justification," he said.

Lightning's electromagnetic fields may have a weird "healing" effect on living cells

By Michael Irving, New Atlas, February 11, 2019
(Reprinted from Future Energy eNews, Feb. 2019)

You definitely don't want to be on the receiving end of a lightning strike, but in the right doses the stuff may have a healing effect. A new study from Tel Aviv University suggests that the electromagnetic fields given off by lightning activity around the world could protect living cells from certain kinds of damage, which may have had implications for the evolution of life on Earth. At any given time, there are some 2,000 thunderstorms raging somewhere on Earth. The energy from those constant lightning strikes resonate through a cavity between the Earth's surface and the ionosphere. These are known as Schumann Resonances, and they in turn produce extremely low frequency (ELF) electromagnetic fields (https://en.wikipedia.org/wiki/Schumann_resonances).

For as long as life has existed on Earth, it's been bathed in these incredibly weak fields, but they were generally not thought to have any real impact. But in the new study, scientists at Tel Aviv University found that these fields could be exerting influence on life after all – thankfully though, it's a good thing. "We found that under controlled conditions, the Schumann Resonance fields certainly had an effect on living tissues," says Professor Colin Price, lead

researcher on the study. "The most important effect was that the atmospheric ELF fields actually protected cells under stress conditions. In other words, when biological cells are under stress – due to lack of oxygen, for example – the atmospheric fields from lightning appear to protect them from damage. This may be related to the evolutionary role these fields have played on living organisms."

In their experiments, the researchers recreated the kinds of magnetic fields produced by Schumann Resonances, and cultures of rat heart cells were exposed to them. Within 30 to 40 minutes of exposure to fields with frequencies between 7.6 and 8 Hz – levels often found in nature – the cells changed in several beneficial ways. There were reductions in spontaneous contractions, calcium transients and the release of Creatine Kinase (CK), all three of which are measures of damage to heart cells. When the fields were switched off, the cells were found to revert back to their original state.
Of course, this study was only conducted on rat cells in culture, so the results may not apply to other organisms, or even living rats. But it's still an interesting bit of evidence linking the effects of global lightning strikes to the evolution of life on Earth.
"It is the first study that demonstrates a link between global lighting activity and the Schumann Resonances and the activity of living cells," says Price. "It may explain why all living organisms have electrical activity in the same ELF spectral range, and it is the first time such a connection has been shown. This may have some therapeutic implications down the line, since these ELF fields appear to protect cells from damage, but this requires further research."

The research was published in the journal *Scientific Reports*.
Source: Tel Aviv University via AFTAU

Related Articles

FDA Clears OTC Electromagnetic Pulse Therapy for Musculoskeletal Pain Relief
Rheumatology Advisor, 2020

> **Editor's Note:** IRI is working diligently to release a new improved EM Pulser to the market with a switchable 8 Hz and 2500 Hz pulse rate based on:

Cardioprotection from stress conditions by weak magnetic fields in the Schumann Resonance band

January 2019, Nature Scientific Reports 9(1):1645, DOI: 10.1038/s41598-018-36341-z

‘Plastic-eating’ bacteria found in Zambales

Janvic Mateo, The Philippine Star,- March 28, 2019 – featured in Future Energy eNews, 3/19

MANILA, Philippines — Microorganisms capable of “eating” plastic have been discovered in a hyperalkaline spring in Zambales, paving the way for research on new approaches to dealing with the country’s growing plastic problem.

Researchers from the biology department of the University of the Philippines-Baguio have discovered four strains of bacteria that are capable of biodegrading low-density polyethylene (LDPE), which is commonly used for plastic bags, cling wrap, shampoo bottles and other containers.

The study, written by Denisse Yans dela Torre, Lee delos Santos, Mari Louise Reyes and Ronan Baculi, was published in the Philippine Science Letters last year. It revealed that some bacterial strains collected from rock crevices of the Poon Bato spring in Botolan, Zambales are capable of degrading LDPE, which is highly resistant to degradation under natural conditions.

The researchers said four of the nine bacteria that they isolated from the spring significantly reduced the weight of plastic polymer they were introduced to during the 90-day incubation period.

After consuming the plastic, the bacteria produced byproducts that are environment friendly, according to the researchers. Results revealed changes in physical structure and also chemical composition of the films. Another method which determined plastic utilization of the bacteria was the evident decrease in the weight of the films,” the office of the UP vice president for academic affairs said in a brief about the study.

“Protein analysis also indicated that bacterial cells could live and proliferate with films as the source of energy. Looking at the physical and chemical changes of the plastics before and after some time with the bacterial isolates, it was deduced that these minute organisms can possibly end plastic domination by making a meal out of it,” it added.

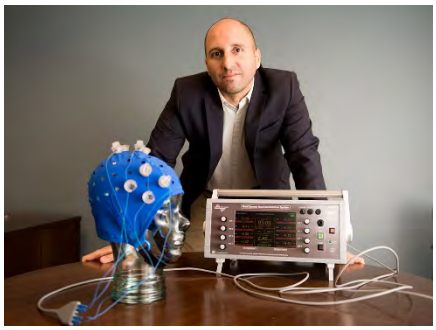
Read more: https://www.philstar.com/headlines/2019/03/28/1905258/plastic-eating-bacteria-found-zambales

As Memories Fade, Can We Supercharge Them Back to Life?

BU brain scientist shows electrostimulation can restore a 70-year-old's working memory to that of a 20-year-old

APRIL 9, 2019 KERRY BENSON, The Brink, Boston University.
Featured in Future Energy eNews, April, 2019

Rob Reinhart, an assistant professor of psychological and brain sciences at Boston University, says we've



reached a point where we not only understand this language—we can speak it and harness it to enhance the functioning of the mind. In a groundbreaking study published April 2019 in *Nature Neuroscience*, Reinhart and BU doctoral researcher John Nguyen demonstrate that electrostimulation can improve the working memory of people in their 70s so that their performance on memory tasks is indistinguishable from that of 20-year-olds. Reinhart and Nguyen's research targets working memory—the part of the mind where consciousness lives, the part that is active whenever we make decisions, reason, recall our grocery lists, and (hopefully) remember where we left our keys. Working memory starts to decline in our late 20s and early 30s, Reinhart explains, as certain areas of the brain gradually become disconnected and uncoordinated. By the time we reach our 60s and 70s, these neural circuits have deteriorated enough that many of us experience noticeable cognitive difficulties, even in the absence of dementias like Alzheimer's disease.

During the study, which was supported by a National Institutes of Health grant, they asked a group of people in their 20s and a group in their 60s and 70s to perform a series of memory tasks that required them to view an image, and then, after a brief pause, to identify whether a second image was slightly different from the original. At baseline, the young adults were much more accurate at this, significantly outperforming the older group. However, when the older adults received 25 minutes of mild stimulation delivered through scalp electrodes and personalized to their individual brain circuits, the difference between the two groups vanished. Even more encouraging? That memory boost lasted at least to the end of the 50-minute time window after stimulation—the point at which the experiment ended.

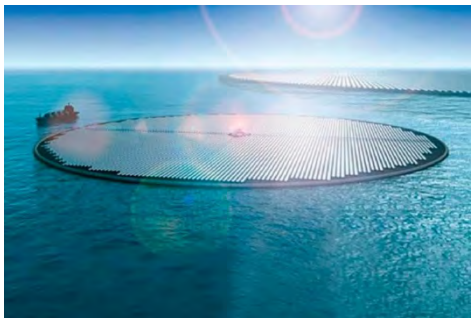
Reinhart and Nguyen's work suggests that by using electrical stimulation, we can reestablish these pathways that tend to go awry as we age, improving our ability to recall our experiences by restoring the flow of information within the brain. And it's not just older adults that stand to benefit from this technique: it shows promise for younger people as well.

Read More: https://www.bu.edu/articles/2019/electrostimulation-can-improve-working-memory/

Related Articles: https://www.nature.com/articles/s41593-019-0371-x
Working memory revived in older adults by synchronizing rhythmic brain circuits
https://www.nature.com/articles/s41593-019-0386-3
Reversing working memory decline in the elderly

GIANT FLOATING ISLANDS THAT TURN ATMOSPHERIC CO2 INTO FUEL COULD PREVENT CLIMATE CHANGE, SCIENTISTS SAY

BY **HANNAH OSBORNE** ON 6/3/19, NEWSWEEK
Featured in Future Energy eNews, June 2019



Millions of floating islands that convert atmospheric carbon dioxide to fuel could help protect our climate from the burning of fossil fuels, scientists have said. These proposed islands would be clustered together to create large-scale facilities that—if enough were built—could eventually offset the total global emissions from fossil fuels.

A team of researchers from Norway and Switzerland has put forward a proposal for 'Solar Methanol Islands' in a paper published in *PNAS*. The article argues that most of the technology to build these facilities already exists, and that by creating them on a large scale in ocean regions where they would be safe from large waves and extreme weather, we could drastically reduce the need for fossil fuels, thereby limiting the extent of global warming over the coming decades.

"Humankind must cease CO2 emissions from fossil fuel burning if dangerous climate change is to be avoided," they wrote. "However, liquid carbon-based energy carriers are often without practical alternatives for vital mobility applications. The recycling of atmospheric CO2 into synthetic fuels, using renewable energy, offers an energy concept with no net CO2 emission." In the paper, the researchers suggest floating islands similar to large-scale floating fish farms. They would use photovoltaic cells that could convert solar energy into electricity. This would then power hydrogen production and CO2 extraction from seawater. The gasses produced would then be reacted to form methanol that can be reused as a fuel, "which is conveniently shipped to the end consumer," they wrote.

The team says 70 of these artificial islands would make up a single facility that covers an area of around one kilometer squared (0.4 square miles). Facilities could be placed in areas where wave height reaches less than seven meters, where there is a low probability for hurricanes and the water depth is less than 600 meters, so the islands can be moored properly. Locations for facilities were found across the globe, with the coasts of South America, Australia and Southeast Asia particularly suitable. The team estimates that the output from 3.2 million floating islands would exceed the total global emissions from fossil fuels.

Read More: https://www.pnas.org/cgi/doi/10.1073/pnas.1902335116

Improved carbon capture turns CO_2 into energy storage material

09 Mar 2019 Joshua Lewis, **Physics World**, also in Future Energy eNews, July, 2019

Carbon dioxide (CO_2) can be transformed back into carbon at a minimal energy cost thanks to a new catalyst reported by researchers at the University of New South Wales (UNSW) and the Royal Melbourne Institute of Technology (RMIT) in their recent *Nature Communications* article.

Carbon dioxide emitted by human activity is a critical factor in accelerating climate change, and must be addressed to reduce the resulting harmful impacts of rising sea levels and extreme weather. In an attempt to arrest emissions, carbon capture and storage projects have been initiated around the world that aim to trap CO_2 at power plants and store it in deep geological formations, but there are concerns about the CO_2 leaking back into the atmosphere. This new discovery by Torben Daeneke and Kourosh Kalantar-Zadeh transforms dissolved CO_2 into solid carbon, which could be stored more easily or even used as an energy storage material.

Liquid benefits

Transforming waste CO_2 into useful chemicals has long been a fixation for chemists. However, CO_2 is a very stable molecule so most successful approaches have required high temperatures or pressures, or have been resource intensive in other ways, making them commercially impractical.

Kalantar-Zadeh and Daeneke have now developed a catalyst that electrochemically converts CO_2 to solid carbon at room temperature using a technique that requires very little electrical energy. They use cerium nanoparticles in a mixture of metals called galistan, which is liquid at room temperature. The use of a liquid metal surface stops the carbon from building up and slowing the reaction, and means the carbon can be removed easily.

The researchers show that the carbon generated by their process is as good as commercial carbon products for storing electricity. Although the electrocatalytic system is relatively complex and uses some costly metals it is an early demonstration of a very exciting prospect. Optimization might lead to viable carbon-negative processes that could produce useful materials and chemicals, with economically inviting resource requirements, while offering environmental benefits.

Read More: https://doi.org/10.1038/s41467-019-08824-8

Stanford Researchers Develop Battery to Harness Energy From Seawater

POSTED ON JULY 30, 2019, **Natural Blaze** and Future Energy eNews, August, 2019

Stanford researchers develop technology to harness energy from mixing of freshwater and seawater

Salt is power. It might sound like alchemy, but the energy in places where salty ocean water and freshwater mingle could provide a massive source of renewable power. Stanford researchers have developed an affordable, durable technology that could harness this so-called blue energy.

The paper, recently published in American Chemical Society's ACS Omega, describes the battery and suggests using it to make coastal wastewater treatment plants energy-independent. "Blue energy is an immense and untapped source of renewable energy," said study coauthor Kristian Dubrawski, a postdoctoral scholar in civil and environmental engineering at Stanford. "Our battery is a major step toward practically capturing that energy without membranes, moving parts or energy input."

Dubrawski works in the lab of study co-author Craig Criddle, a professor of civil and environmental engineering known for interdisciplinary field projects of energy-efficient technologies. The idea of developing a battery that taps into salt gradients originated with study coauthors Yi Cui, a professor of materials science and engineering, and Mauro Pasta, a postdoctoral scholar in materials science and engineering at the time of the research. Applying that concept to coastal wastewater treatment plants was Criddle's twist, born of his long experience developing technologies for wastewater treatment.

The researchers tested a prototype of the battery, monitoring its energy production while flushing it with alternating hourly exchanges of wastewater effluent from the Palo Alto Regional Water Quality Control Plant and seawater collected nearby from Half Moon Bay. Over 180 cycles, battery materials maintained 97 percent effectiveness in capturing the salinity gradient energy.

Every cubic meter of freshwater that mixes with seawater produces about .65 kilowatt-hours of energy – enough to power the average American house for about 30 minutes. Globally, the theoretically recoverable energy from coastal wastewater treatment plants is about 18 gigawatts – enough to power more than 1,700 homes for a year.

Read More: https://www.naturalblaze.com/2019/07/stanford-researchers-develop-battery-to-harness-energy-from-seawater.html

Editor's Note: IRI has published a report on this multinational effort. We call it: **Harvesting Osmotic Power Hydroelectricity** and clearly should subtitle it "Blue Energy from Sea and Fresh Water"

First hint that body's 'biological age' can be reversed

05 SEPTEMBER 2019, NATURE, and in Future Energy eNews, October, 2019

In a small trial, drugs seemed to rejuvenate the body's 'epigenetic clock', which tracks a person's biological age.

For one year, nine healthy volunteers took a cocktail of three common drugs — growth hormone and two diabetes medications — and on average shed 2.5 years of their biological ages, measured by analysing marks on a person's genomes. The participants' immune systems also showed signs of rejuvenation.

The results were a surprise even to the trial organizers — but researchers caution that the findings are preliminary because the trial was small and did not include a control arm.

I'd expected to see slowing down of the clock, but not a reversal," says geneticist Steve Horvath at the University of California, Los Angeles, who conducted the epigenetic analysis. "That felt kind of futuristic." The findings were published on 5 September in *Aging Cell.* "It may be that there is an effect," says cell biologist Wolfgang Wagner at the University of Aachen in Germany. "But the results are not rock solid because the study is very small and not well controlled."

Marks of life

The epigenetic clock relies on the body's epigenome, which comprises chemical modifications, such as methyl groups, that tag DNA. The pattern of these tags changes during the course of life, and tracks a person's biological age, which can lag behind or exceed chronological age.
Scientists construct epigenetic clocks by selecting sets of DNA-methylation sites across the genome. In the past few years, Horvath — a pioneer in epigenetic-clock research — has developed some of the most accurate ones

Researchers are already testing metformin for its potential to protect against common age-related diseases, such as cancer and heart disease. Fahy says that the three drugs in the cocktail might contribute separately to the effect on biological ageing through unique mechanisms. Intervene Immune is planning a larger study that will include people of different age groups and ethnicities, and women.

Read More: Fahy, G. M. *et al. Aging Cell* https://doi.org/10.1111/acel.13028 (2019). and *Nature* **573**, 173 (2019)

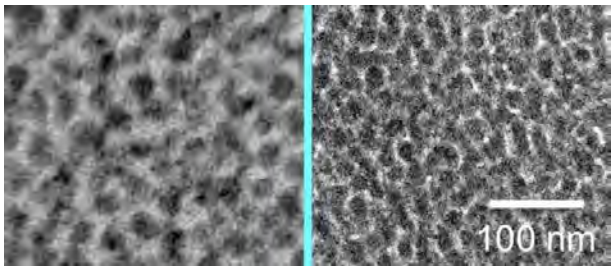
A Surprising Substance May Be Key in Capturing CO2 in the Atmosphere

By NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY, DECEMBER 11, 2019, also in Future Energy eNews, December, 2019

Wetting a Polymer Membrane Improved Its Ability to Capture CO_2

Reducing the level of CO2 in the atmosphere will probably require carbon capture. A surprising substance just might be the ticket.

Climate worries go hand in hand with CO_2 emissions concerns. Emissions hit an all-time high last year. The CO_2 level in the atmosphere may be higher than it's been in 3 million years. Carbon capture will most likely be necessary to reduce the level of CO_2 in the atmosphere. To accomplish that we need the technology and materials to do the job. Recently a promising and surprising new candidate has emerged.



"The results are first and foremost important in terms of climate change," says Professor Liyuan Deng at NTNU's Department of Chemical Engineering. Professor Deng is leading the work of the membrane research group at NTNU, and their results are gaining attention.

Water altered the material

Power plants that use fossil fuels require a membrane that can filter the emissions and separate out the carbon. These membranes need to be both permeable for CO_2 and also separate the CO_2 from the other gases, such as nitrogen. "We didn't think this membrane material was going to be suitable," says Deng.

But a simple move changed that. The hopeless membrane candidate needed another substance to work properly. This second substance was simply – water. The material in question is a polymer. Polymers are relatively inexpensive and easy to make. Many researchers therefore regard them as promising candidates for separating different gases on the large scale that will be needed. The membranes must also be stable and durable. This particular polymer bears the name poly[tert-butylstyrene-b-(ethylene-alt-propylene)-b-(styrene-r-styrenesulfonate)-b-(ethylene-alt-propylene)-b–tert-butylstyrene].

Fortunately, someone gave it the nickname TESET instead. The material is already in commercial use and is therefore readily available.

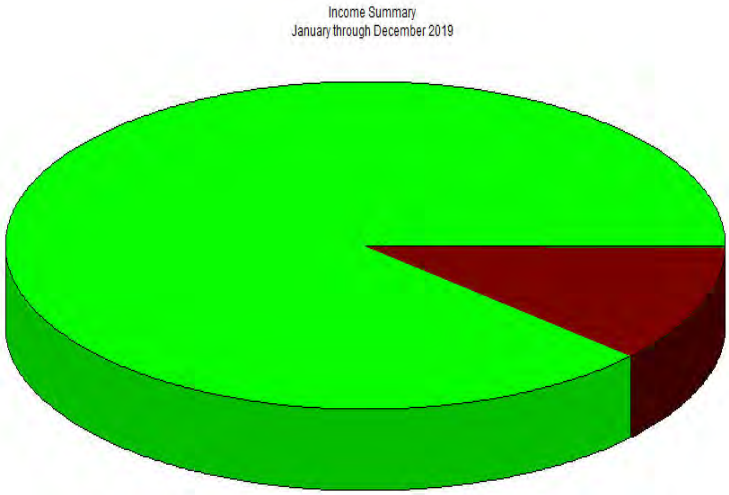
"The company holding the patent is interested in this new field of application," says Deng.

Read More: Highly CO2-permeable membranes derived from a midblock-sulfonated multiblock polymer after submersion in water
https://www.nature.com/articles/s41427-019-0155-5

RELATED ARTICLE
https://www.weforum.org/agenda/2019/12/climate-change-carbon-capture-conditions/

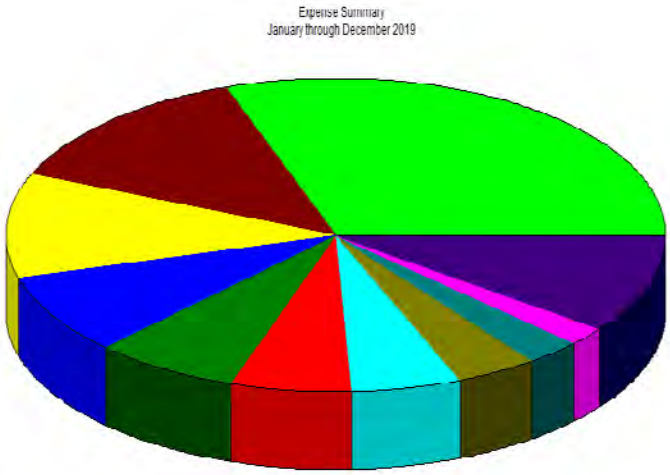
IRI FINANCIAL REPORT 2019

Total Income: $125,378.52



Sales	88.29%
Direct Public Support	11.64
Uncategorized Income	0.03
Indirect Public Support	0.02
Direct Public Grants	0.02
Total	$125,376.52

Total Expenses: 131.090.37



Parts for products	30.43%
Facilities and Equipment	13.27
Travel and Meetings	10.86
Shipping costs	8.40
Telephone, telecommunications	7.25
Awards and Grants	6.02
Books printed	5.47
Other Types of Expenses	4.03
Equipment parts	2.74
Printing supplies	1.91
Other	9.61
Total	$131,099.37