



Bi-State Chapter Exchanger

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Serving the Hudson Valley and Western Connecticut

April 2015

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ASHRAE Bi-State Chapter presents

earth Day

at Stone Barns Center

for Food & Agriculture

630 Bedford Road, Pocantico Hills, NY 10591

April 22, 2015 12:00PM - 3:00PM

Networking * Buffet Lunch *

Presentations (2 PDH's pending)

\$40 Members, \$50 Non-Members

Details on page 3.

President's Message

By James F. Dolan, P.E.



I owe a bit of catch up as we have had quite a bit going on and we have a great spring program ahead of us. In February, we had a wonderful tour of the Belimo new Headquarters in Danbury. We not only had a first rate tour and meal, we also had an insightful presentation on managing flow in piping systems to help optimize the performance as well as solve some operational issues. Our thank you goes out to Belimo for their hospitality. I recommend if you weren't on the tour to contact them and see if you can get look at their HQ. I am sure you will appreciate this local company that provides a product we see in most every building. Thank you to David, Nadia and Bob for your continued support of the Chapter and for the great tour.

We continued exciting weather (snow, snow, snow) start to March and were able to get another clear evening for a great presentation on Air Valves. Thank you Tim and Craig of Accuspec for taking us thru some of the airside physics as well as the performance characteristics of this advanced technology. This March we also had a tech session on wireless devices to help save energy and improve the occupants comfort and life of equipment. Mitch - thank you for sharing your Budderfly presentation with us.

In April we look forward to our meeting at **Stone Barns – Next Wednesday!** We are anticipating outstanding presentations on sustainable engineering approach, the new Energy Code and other ways to appreciate the world we live at this demonstration of sustainable farming on **Earth Day, April 22nd, 2015**. See the Flyer on page 3 of this issue and *RSVP – ASAP!*

Our Chapter has been very active in Student Activities. Years ago I had started to help get our Chapter rolling by getting the Manhattan College Student Chapter rolling. We have continued that focus on our younger engineers and recently Stephanie O'Dea (this year's Student Activities Chair) and I visited Fairfield University to speak about engineering and ASHRAE. What a great engineering program they have, dedicated professors and students. Our Chapter also had a table at the recent Engineering Expo here in Westchester that seems to gain more momentum each year. This Friday I plan to talk to my daughter's 1st grade class. ASHRAE and other Engineering organizations encourage us to reach out to young folks, not just juniors and seniors in HS, to help them understand that a career in the built environment is exciting and something they can be passionate about. Talk to myself or Stephanie to find out more about how you can help in this mission.

Don't forget to save the date for the **Golf outing** on May 13th and get your sponsorships in early. In June we plan to do a Brewery Tour...stay tuned for more details.

Jim

3-D Printed Concrete Structure Heralds Future Building Technology

A research team at the University of California, Berkeley recently unveiled what it says is the largest powder-based 3-D printed cement structure to date. The pavilion, called Bloom, is 9 ft (2.7 m) tall, with a 12 ft by 12 ft (3.65 m by 3.65 m) footprint. It was designed at the university's PrintFARM (Print Facility for Architecture, Research, and Materials). The structure's undulating surface consists of 840 printed bricks fastened together with stainless-steel hardware. The pieces, each a unique shape, come together in a floral pattern. Unlike many architectural 3-D printing projects, the Berkeley team used small powder-based printers that the researchers adapted to print cement. The team says its method reduces waste and the need for formwork and storage, and will significantly reduce the cost of concrete buildings as the technology develops. Because they are printed as individual components, rather than as architectural-sized pieces, the bricks can be fine-tuned for additional performance benefits, such as heat retention.

New National Guidelines Promote Consistent Training for Commercial Building Professionals

The U.S. Department of Energy (DOE) has partnered with the National Institute of Building Sciences (NIBS) to develop new guidance designed to enhance and streamline commercial building workforce training and certification programs. The voluntary Better Buildings Workforce Guidelines provide a national framework for certification agencies across the country to roll out consistent programs. They are targeted to professionals who work in energy auditing, building commissioning, building operations and energy management fields. "As building technologies become more advanced, professionals need better training and certification options to increase the quality and scalability of our nation's energy workforce," said Kathleen Hogan, DOE deputy assistant secretary for Energy Efficiency. "Employers, building owners and program administrators can also use these established guidelines to identify qualified workers who are trained to deliver energy savings."



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Next Generation Infrastructure: Principles for Post-Industrial Public

Speaking from topics covered in her new book, "Next Generation Infrastructure: Principles for Post Industrial Public," Hillary Brown will speak about how we attain a move diversified, distributed, and interconnected infrastructure. **Hillary Brown, FAIA, LEED AP** is Founding Principal of the sustainability consultancy, New Civic Works, and Professor at the Spitzer School of Architecture at the City College of New York. She leads that school's contribution to CCNY's interdisciplinary Master of Science degree in Urban Sustainability, jointly established with the Grove School of Engineering and the Division of Science.

New NYS and NYC Energy Conservation Codes

Covering changes between IECC 2009 and 2012, ASHRAE 90.1-2007 and 2010, and discussing NYS and NYC changes to IECC 2012 and ASHRAE 90.1-2010, Ian Graham will help participants understand how NYS and NYC Energy Codes are enforced and applied to new and existing building projects. **Carl Ian Graham, PE** has performed HVAC sustainable design consulting for commercial, multi-family residential, and institutional buildings for more than 20 years. He has authored and provided technical content for various high-performance building publications, including the General Services Administration (GSA) LEED Cost Study (2004), the HVAC Resource Page for the GSA's Whole Building Design Guide, the New York State Green Building Tax Credit regulations, and contributed to the New York State Energy Conservation Construction Code (NYS ECCC).

See www.ashraebistate.org for more information or call Jim Dolan @ 914 919-3106
RSVP by **April 17** to ashraebistateRSVP@olace.com



2015 Annual Golf Outing



Save the Date

May 13, 2015

for the ASHRAE
Bi-State Chapter
Annual Golf Outing
hosted at

The Links at Union Vale





ASHRAE Research

ASHRAE's Research Program sets ASHRAE apart from other professional societies and associations of its kind. ASHRAE's Handbook series, technical programs, standards, and special publications all utilize the results of Research conducted through ASHRAE funding. ASHRAE conducts timely research to remain the foremost, authoritative and responsive international source on the interaction between people and the indoor and outdoor environment through the operation of HVAC&R systems in buildings and other applications.

Research Donations in particular are the foundation of the ASHRAE Research Program. We at the Bi-State Chapter of ASHRAE would like to invite you to invest in ASHRAE Research. ASHRAE is a not-for-profit organization and needs your support for continued success! The Bi-State Chapter of ASHRAE has continued to raise the bar for research funding, and we couldn't have done it without your help. We would like to thank last year's contributors shown below.

We hope that we can count on you to help us reach our goal of \$6,250 for the 2014 – 2015 campaign year. You can do this by filling in the form below or by contributing on-line at: <https://xp20.ashrae.org/secure/researchpromotion/rp.html>.

For further information or assistance contact Cliff Konitz, RP Chair, at 845-297-5864 or <mailto:c.konitz@verizon.net>



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Major Donor - Silver \$1,000 - \$2,499

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ASHRAE Research and YOU

HOW IS ASHRAE RESEARCH USED?

- Update the Society's standards and guidelines
 - Special ASHRAE publications
- Articles published in the ASHRAE Journal



WHAT FUNDS ASHRAE RESEARCH?

- Contributions from members and corporations
- A percentage of member dues
- Income from the ASHRAE cosponsored AHR Expo
- Interest earned on the Research Reserve and ASHRAE Foundation

HOW IS MONEY RAISED?

- Personal contact made by volunteers
- Special contracts with major donors
 - Direct solicitation of ASHRAE members at the time of dues billing



HOW DOES ASHRAE RESEARCH HELP ME?

- Decreasing the spread of airborne diseases
- Conserving energy in hot and humid climates
- Understanding the relationship between occupant health and ventilation rates
- Decreasing the risk of spoiled food



Shaping Tomorrow's
Built Environment Today

PLEASE COMPLETE THE INFORMATION BELOW AND RETURN WITH YOUR CONTRIBUTION TO:

Clifford Konitz
4 Dennis Road
Wappingers Falls, NY 12590

Phone: 845-297-5864 Fax: 845-297-5864

Please accept my research investment in the amount of \$ _____
Make checks out to **ASHRAE Research**.

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Company _____ Chapter Bi-State

Address _____

City _____ State _____ Zip _____

Please check one: Personal contribution
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Charge my gift to: Visa Master Card American Express

Credit Card # _____ Expiration Date _____

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Donors are recognized for their contributions as follows:

Honor Roll contributors are listed in the October ASRHAЕ Journal and receive the commemorative coin recognizing Giants in HVAC&R invention or innovation.

Individual Honor Roll beginning at \$100
Corporate Honor Roll beginning at \$150

Investors with contributions of \$250 or more receive a wall plaque that can display six commemorative coins.

Contributions in any amount are gratefully received and 100% of the contribution goes directly to research. All contributions are tax deductible.

New York Moves to Make Utilities Distributors, Not Owners, of Energy

The New York Public Service Commission (PSC) has issued an order largely barring utilities from owning distributed energy resources (DERs). DERs are small, decentralized grid-connected systems that distribute energy, often from renewable sources. The state PSC issued a 133-page order establishing a “policy framework” for the development of markets for DERs and changes the role of traditional utilities in a move that fundamentally reshapes how core electric and natural gas utilities have always conducted business as the central mover behind the grid. In most cases, utilities will be barred from owning DERs, including demand response, distributed generation, and distributed storage. The directive envisions thousands of small power sources joining to replace baseload power. The PSC has ordered the state's electric utilities to file plans for the implementation of distributed system platforms by December 15.

EPA Approves New Climate-Friendly Refrigerants

The U.S. Environmental Protection Agency (EPA) issued a final action that increases the options for refrigerants used in various kinds of refrigeration and air-conditioning equipment that offer better climate protection without harming the ozone layer. The final action addresses refrigerants under the Climate Action Plan that calls on the EPA's Significant New Alternatives Policy (SNAP) Program to identify and approve additional climate-friendly chemicals. Under the authority of the Clean Air Act, the EPA's SNAP Program evaluates substitute chemicals and technologies that are safe for the ozone layer. The final rule expands the list of SNAP-approved substitutes to include more low-global warming potential (GWP) alternatives that can replace both ozone-depleting substances and high-GWP hydrofluorocarbons (HFCs). Among the refrigerants and applications the EPA is approving are ethane in very low temperature refrigeration and in nonmechanical heat transfer; isobutane in retail food refrigeration and in vending machines; propane in household refrigerators and freezers, vending machines, and in room air-conditioning units; and HFC-32 (difluoromethane) in room air-conditioning units.

Researchers Develop Window Screen that Cleans the Air

Researchers at Stanford University have developed a low-cost filter that captures tiny airborne particles while remaining largely transparent. The nanotechnology-based system, the researchers say, might someday be used in window screens that would allow light and air to pass through while improving indoor air quality. The technology would function without requiring any outside energy source or costly equipment and ductwork. The scientists aim to capture particulate matter less than 2.5 microns in size—invisible particles small enough to penetrate into the lungs and damage health. After testing their invention on a bad air day in Beijing, the researchers found that it captured nearly 99% of particulates while maintaining 77% transparency. A normal screen has 80% to 85% transparency. After measuring absorption rates, the scientists estimate that, in heavy pollution, such a screen could continue capturing particulates for more than 300 hours. To make it disposable, the researchers envision the screen as a film that could be applied to and taken off a conventional window screen.



Join us at **ASHRAE's 2015 Annual Conference**
June 27–July 1 | Atlanta, Georgia | www.ashrae.org/atlanta

Special first
time attendee
registration
fee available!

Join ASHRAE in its hometown of Atlanta! Take advantage of the opportunity to discuss and examine the latest topics in the building industry, such as high performing buildings and modeling, through the technical program; participate in technical tours; attend ASHRAE Learning Institute courses; sit for an ASHRAE certification exam; and earn professional development credits.

Conference Technical Program—includes the third annual Research Summit, which brings together researchers to present and discuss the latest research. Tracks focus on the design, construction and operation of high performance buildings, specifically advanced design guidance, modeling, operation and optimization, and indoor air quality. Laboratories, refrigeration, fundamentals, applications, systems and equipment round out the program.

Networking—share ideas and learn from fellow members from your hometown and around the world.

ASHRAE Learning Institute—choose from two full-day professional development seminars and seven half-day short courses to stay current on new HVAC&R technologies.

ASHRAE Certification—to gain a competitive edge, apply by June 9 to sit for an ASHRAE Certification exam.



Brought to you by the ASHRAE Chapter Technology Transfer Committee

New Tomorrows for Today's Buildings: Existing Building Commissioning

April 23, 2015 | 1-4pm EDT



www.ashrae.org/webcast



Thomas H. Phoenix,
P.E., Fellow ASHRAE,
BEAP, BEMP



Robert G. Baker,
OPMP, Fellow
ASHRAE

This webcast will feature industry experts who will define the benefits of existing building commissioning for the environment, occupants, operations staff, and overall ownership costs. Viewers will be able to recognize the varied scopes of commissioning, when to apply comprehensive versus focused commissioning, and best practices in existing building commissioning specifications & contracting.



James K. Vallort,
Fellow ASHRAE



Ronald J. Wilkinson,
P.E., CPMP

Earn PDHs!

Attend this FREE webcast program and you may be awarded three Professional Development Hours (PDHs).



ASHRAE/IES Publish Updated Standard on Energy Efficiency in Existing Buildings

A newly revised standard from ASHRAE and IES seeks to provide greater guidance and a more comprehensive approach to retrofit of existing buildings for increased energy efficiency. ANSI/ASHRAE/IES Standard 100-2015, *Energy Efficiency in Existing Buildings*, provides comprehensive and detailed descriptions of the processes and procedures for the retrofit of existing residential and commercial buildings in order to achieve greater measured energy efficiency. Appendices are included for life-cycle cost analysis procedures as well as identification of potential energy conservation measures.

“The total primary energy used in both residential and commercial building sectors is expected by the U.S. Energy Information Administration to rise each year for the next several decades in spite of aggressive efficiency improvements in new construction,” Rick Hermans, chair of the Standard 100 committee, said. “In order to reduce the overall impact of energy used by residential and commercial buildings, the existing building stock must become more efficient. This revision to Standard 100 provides the means to accomplish that goal.”

The standard addresses both residential and commercial buildings. It addresses single and multiple activity buildings with variable occupancy periods and identifies the approach for 53 building types in 17 climate zones/subzones. It identifies requirements for buildings undergoing retrofits that do not fall under the scope of either ANSI/ASHRAE/IES Standard 90.1-2013, *Energy Standard for Buildings Except Low-Rise Residential Buildings*, or ANSI/ASHRAE/IES Standard 90.2-2007, *Energy Standard for Low-Rise Residential Buildings*.

Standard 100 directly addresses a building’s energy-use efficiency in a quantitative manner and provides a means to improve that efficiency with an objective benchmark created with the assistance of the Energy Information Administration, the Federal Energy Management Program and Oak Ridge National Laboratory.

Recognizing that the actual occupancy of the building plays a key role in its performance, the standard establishes the need for development of an energy management plan and an operation and maintenance program. It also addresses the requirements for ongoing commissioning.

The standard takes advantage of the fact that any building that has been in operation for at least twelve months can quickly determine its performance relative to some benchmark, which is defined in the standard as an energy-use intensity target. This concept is the new paradigm for energy conscious design, construction and operation of buildings, according to Hermans.

The revision of the standard, last published in 2006, also brings the standard in line with other published ASHRAE documents, specifically Standard 90.1-2013, Standard 90.2-2007 and ANSI/ASHRAE Standard 105-2014, *Standard Methods of Determining, Expressing and Comparing Building Energy Performance and Greenhouse Gas Emissions*.

The cost of ANSI/ASHRAE/IES Standard 100-2015, *Energy Efficiency in Existing Buildings*, is \$72 (\$61, ASHRAE members). To order, contact ASHRAE Customer Contact Center at 1-800-527-4723 (United States and Canada) or 404-636-8400 (worldwide), fax 678-539-2129, or visit www.ashrae.org/bookstore.

EU Releases Climate Change Plan, Challenges U.S., China to Follow Suit

The European Commission presented its EU Energy Union package recently. The plan sets out the European Union’s climate-change goals for the United Nations’ talks in Paris in December. It calls for carbon emission reductions of at least 40% of 1990 levels by 2030. It also proposes a global long-term carbon emissions target proposed of 60% below 2010 levels by 2050. Referring to its document as a template that should be used by other nations, the Commission called on G20 countries—the wealthiest and most powerful UN-member nations—to release similar plans by March 31. It specifically mentioned the United States and China.

Renewable Energy Obtained from Wastewater

Researchers from the Universitat Autònoma de Barcelona have devised an efficient way to obtain electrical energy and hydrogen by using a wastewater treatment process. Wastewater contains an elevated amount of chemical energy in the form of organic contaminants. In order to make use of this energy, researchers from around the world study ways to recover it in the form of hydrogen, a process which efficiently eliminates organic matter from wastewater. It not only reduces the amount of energy needed during the process, it also obtains energy from the produced hydrogen. The key to achieve this is what is known as microbial electrolysis cells (MEC). What is needed is a very special type of bacteria, exoelectrogenic bacteria, capable of oxidizing organic material and generating electricity which in turn produces hydrogen. These cells only need a bit of added voltage, much less than what is used for water electrolysis, and which is recovered with the hydrogen, thereby generating clean energy.

Researchers from the Bioelectrochemistry group of the Universitat Autònoma de Barcelona (UAB) Department of Chemical Engineering have improved the energetic efficiency of the cells. The experimental results were very positive and demonstrated that these systems would have a market niche at industrial scale. The scientists, coordinated by professors Albert Guisasola and Juan Antonio Baeza, used real wastewater instead of the biodegradable synthetic water used in most experiments, and achieved a biological production of hydrogen and, to a large extent, the recovery of a good part of the energy contained in the residues. To achieve this, researchers selected a set of bacteria capable of transforming complex substrates such as methanol, dairy waste, starch and glycerol, into simpler compounds which could, in turn, be degraded by exoelectrogens.

The results were very positive and high hydrogen production and energy intensity was obtained through the wastewater treatment. In the long term, the MEC fed with dairy wastewater yielded the best results in terms of current intensity (150 amps per cubic metre of reactor), in hydrogen production (0.94 cubic metres of hydrogen per cubic metre of reactor and day), and in recovery of electrons at the cathode (91%); all that with an applied voltage of only 0.8 V. These results are the basis for a potential industrial development of this technology and therefore for the creation of systems capable of producing hydrogen from wastewater treatment.



APPLY

Each year the ASHRAE Foundation awards scholarships of up to \$10,000 each to qualified students.

DONATE

Help support ASHRAE's student scholarship programs.

www.ashrae.org/scholarships

Bi-State Chapter Officers and Governors 2014—2015

Position	First Name	Last Name	Email	Phone
Officers				
President	James (Jim)	Dolan	jdolan@olace.com	(914) 919 3106
President-Elect	TBD		TBD	
Vice President	TBD		TBD	
Secretary	Brendan	Smith	bsmith@lynstaar.com	(914) 741-1290 ext 17
Treasurer	Dennis	LaVopa	dlavopa@dIFlowTech.com	(845) 265-2828
Governors				
BOG (term ends June 2017)	John	Fusco	jfusco@kohleronan.com	(203) 778-1017
BOG (term ends June 2017)	Cliff	Konitz	c.konitz@verizon.net	(845) 297-5864
BOG (term ends June 2017)	Stephanie	O'Dea	Stephanie.L.Odea@jci.com	(914) 593-5245
BOG (term ends June 2016)	Michael	Circosta	mjcarmonk@optonline.net	(914) 273-9173
BOG (term ends June 2016)	Dennis	LaVopa	dlavopa@dIFlowTech.com	(845) 265-2828
BOG (term ends June 2016)	Robert	Roston	bob@rostonfamily.com	(914) 761-3364
BOG (term ends June 2015)	Tom	Quartuccio	tquart@optonline.net	
BOG (term ends June 2015)	Brendan	Smith	bsmith@lynstaar.com	(914) 741-1290 ext 17
BOG (term ends June 2015)	Larry	Sturgis		
Chapter Delegate	James	Dolan	jdolan@olace.com	(914) 919 3106
Chapter Alternate	TBD	TBD		
Committee Chairs				
CTTC	Marc	Wilson	Marc.Wilson@victaulic.com	(571) 271 8955
Government Affairs	Michael	Circosta	mjcarmonk@optonline.net	(914) 273-9173
Research Promotion	Cliff	Konitz	c.konitz@verizon.net	(845) 297-5864
Student Activities	Stephanie	O'Dea	Stephanie.L.Odea@jci.com	(914) 593-5245
Young Engineers in ASHRAE	Brendan	Smith	bsmith@lynstaar.com	(914) 741-1290 ext 17
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Administrator	Cliff	Konitz	c.konitz@verizon.net	(845) 297-5864
Golf	Steven	Abbattista	sabbattista@olace.com	(914) 919-3102

Why Be Involved in a Local Chapter?

- Learn about the latest technologies presented in the program sessions
- Attain continuing education credits
- Meet industry associates and discuss local concerns
- Network amongst designers, installers, vendors, educators, in your local area to help improve business for all
- Share experiences with others
- Enjoy a social hour
- Carry out ASHRAE's mission on a local level

To advance the arts and sciences of heating, ventilating, air conditioning and refrigerating to serve humanity and promote a sustainable world.

Notice to business card advertisers:

We are currently accepting business card advertisements for this year's newsletters. The cost of a business card ad is \$125.00. The newsletter is published monthly, September through June (ten issues). That means for \$125.00 (\$12.50 an issue), your business card ad will circulate to approximately 300 recipients a month or an advertising cost of approximately 4 cents/recipient.

If you are interested in placing an ad, please forward a business card and check (payable to ASHRAE Bi-State) to:

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 Hopewell Junction, NY 12533



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Employment Opportunities

Employment ads may be submitted for inclusion in **The Exchanger** as follows:

- 1.\$100,000 from companies placing ad for one (1) month.
- 2.\$150.00 from companies placing ad for two (2) months.
- 3.No charge for members looking for employment.

16th Century Architecture Offers Lessons for Modern Passive Cooling Designs

A nearly 500-year-old architecture style could still be used today to provide passive cooling in hot, dry areas, according to an article in the *New Indian Express* newspaper. Mughal architecture in India takes its name from a Persian dynasty that took over large parts of Northern India in the 1500s through the 1800s. The Mughals developed ingenious ways to beat the summer heat in the arid desert areas. Each design element was a response to the climate. One of the hallmarks of Persian buildings is a four-part garden laid out with axial paths or water channels that intersect at the center. This controls the microclimate around the building with the help of vegetation and water. Mughals introduced unique layered spaces to Indian architecture. They realized that rooms should not be flooded with direct daylight. Therefore, they used intermediary spaces such as courtyards and verandas to buffer and protect interiors from extreme weather conditions. Mughals used the thermal mass of thick walls of masonry or other materials with low thermal conductivity that have low transmittance value of heat. According to the article, some modern architects have successfully adopted environmental features of Mughal architecture and incorporated them into contemporary designs.



ASHRAE, founded in 1894, is a building technology society with more than 50,000 members worldwide. The Society and its members focus on building systems, energy efficiency, indoor air quality and sustainability within the industry. Through research, standards writing, publishing and continuing education, ASHRAE shapes tomorrow’s built environment today.

ASHRAE will be the global leader, the foremost source of technical and educational information, and the primary provider of opportunity for professional growth in the arts and sciences of heating, ventilating, air conditioning and refrigerating.

Upcoming Meetings

Month	Date	Promotion	Main Presentation	Tech Session
April	4/22/2015	Sustainability	Hillary Brown, FAIA, LEED AP will speak on: Next Generation Infrastructure: Principles for Post-Industrial Public at Stone Barns Center, Pocantico Hills	Carl Ian Graham, PE will speak on: New NYS and NYC Energy Conservation Codes
May	5/13/2015	Student Scholarships	Golf Outing	
June	6/10/2015	Membership Promotion	Bronx Brewery Tour	

First Direct Observation of CO₂'s Increasing Greenhouse Effect at the Earth's Surface

Scientists have observed an increase in carbon dioxide’s greenhouse effect at the Earth’s surface for the first time. The researchers, led by scientists from the US Department of Energy’s Lawrence Berkeley National Laboratory (Berkeley Lab), measured atmospheric carbon dioxide’s increasing capacity to absorb thermal radiation emitted from the Earth’s surface over an eleven-year period at two locations in North America. They attributed this upward trend to rising CO₂ levels from fossil fuel emissions.

The influence of atmospheric CO₂ on the balance between incoming energy from the Sun and outgoing heat from the Earth (also called the planet’s energy balance) is well established. But this effect has not been experimentally confirmed outside the laboratory until now. The research was reported in advance of online publication in the journal *Nature*.

The results agree with theoretical predictions of the greenhouse effect due to human activity. The research also provides further confirmation that the calculations used in today’s climate models are on track when it comes to representing the impact of CO₂.

The scientists measured atmospheric carbon dioxide’s contribution to radiative forcing at two sites, one in Oklahoma and one on the North Slope of Alaska, from 2000 to the end of 2010. Radiative forcing is a measure of how much the planet’s energy balance is perturbed by atmospheric changes. Positive radiative forcing occurs when the Earth absorbs more energy from solar radiation than it emits as thermal radiation back to space. It can be measured at the Earth’s surface or high in the atmosphere. In this research, the scientists focused on the surface.

They found that CO₂ was responsible for a significant uptick in radiative forcing at both locations, about two-tenths of a Watt per square meter per decade. They linked this trend to the 22 parts-per-million increase in atmospheric CO₂ between 2000 and 2010. Much of this CO₂ is from the burning of fossil fuels, according to a modeling system that tracks CO₂ sources around the world.

“We see, for the first time in the field, the amplification of the greenhouse effect because there’s more CO₂ in the atmosphere to absorb what the Earth emits in response to incoming solar radiation,” says Daniel Feldman, a scientist in Berkeley Lab’s Earth Sciences Division and lead author of the *Nature* paper. “Numerous studies show rising atmospheric CO₂ concentrations, but our study provides the critical link between those concentrations and the addition of energy to the system, or the greenhouse effect,” Feldman adds.

He conducted the research with fellow Berkeley Lab scientists Bill Collins and Margaret Torn, as well as Jonathan Gero of the University of Wisconsin-Madison, Timothy Shippert of Pacific Northwest National Laboratory, and Eli Mlawer of Atmospheric and Environmental Research. The research was supported by the Department of Energy’s Office of Science.

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