Embodied Carbon Workshop: Market Transformation for Cement and Concrete

Workshop and Roundtable:	**Embodied Carbon Market Transformation:** How States, the Federal government and Private Sector can Collaborate through Policy, Pilots, and Investment Mechanisms to scale up supply and demand of low-carbon concrete/cement and build the pipeline for new technologies to fully decarbonize the sector.
Co-host(s):	ACEEE, Breakthrough Energy
Date:	Tuesday, July 11, 2023, from 1:00 – 5:00pm ET (4 hours)
Location:	Amber Room, 3rd floor, MGM Grand (see map)
Theme:	How R&D (research and development) informs D&D (demonstration and deployment) and vice versa to form a feedback loop for continuing technology advancement; How data and knowledge from RDD&D can effectively feed into policy development and investment decisions to transform the market

Background and Objectives:

With unprecedented federal funding available to decarbonize the industrial sector, opportunities exist to make substantial progress in the next 3-5 years on goals laid out in various roadmaps such as the DOE Industrial Decarbonization Roadmap and industry-driven initiatives (e.g., cement decarbonization roadmap). On the other hand, significant barriers exist on both supply and demand sides and require collaborative and coordinated efforts to address them through a suite of technology and policy solutions. For example, pilots and demonstration projects coupled with iterative RD&D can facilitate market acceptance and adoption over the long term.

This workshop will bring together key stakeholders from federal and state governments, past, current and planned pilot ventures, cement/concrete companies, technology providers, utilities, NGOs and funding and financing entities to discuss and showcase opportunities for how to successfully implement and create the right environment to scale up supply and demand of low-carbon concrete/cement technologies. The workshop will (a) identify available resources and best practices that can be leveraged to advance implementation of low-carbon concrete pilots and complementary RD&D efforts, (b) develop a coordinated plan to support top-priority actions, and (c) build stakeholder networks to support longer term efforts to transform the concrete market.

Expected Outcome(s): Jointly identified top priorities for the next 18 months and the key strategies, roles, and actions to support market transformation.

a) **Strategies:** What is the state of the market? How can we define and agree on a baseline from which to measure emissions reductions? What near-term policies and investments can build supply and demand simultaneously over the next 3-5? What mid-term policies and investments can lay the groundwork to transition the market over the next 5-7 years?

b) **Roles:** What should all stakeholders (federal and state governments, academia and research labs, standard development and testing entities, industry, utilities, financiers, philanthropies, and NGOs) coordinate and jointly to implement cohesive strategies across the market? How do we support each other to achieve zero-concrete goals?

c) **Actions:** What are 3-5 key joint activities to engage over the next 6-12 months? How can ACEEE and partners facilitate these collaborative activities?

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Agenda

No.	Session Title	Facilitator/Moderator/Speaker	Time	Length
I.	**INTRODUCTION**		**1:00–1:30p**	**30 mins**
1.	Welcome/Agenda Overview/What We Want to Accomplish in Workshop	Pavitra Srinivasan (ACEEE)		5 mins
2	ACEEE Role/Approach in Industrial Decarbonization and our Partnerships	Nora Esram (ACEEE)		5 mins
3.	Opportunity to Decarbonize Industry through RDD&D	Joe Cresko (DOE)		20 mins
II.	**SUPPORT FOR MARKET TRANSFORMATION**	**Scene Setting Speakers**	**1:30–2:30p**	**60 mins**
Session A	Federal and State Perspectives	Facilitator: Pavitra Srinivasan	1:30–1:50p	20 mins
Topic 1	IEDO's strategy to decarbonize the **cement and concrete industry**	Isabelle Sgro Rojas (DOE IEDO)		5 mins
Topic 2	Update on GSA's "Buy Clean" Embodied Carbon Initiatives	Brad Nies (GSA)		5 mins
Topic 3	Interaction between Specifications and Pilots for New Concrete Technologies/NRRA	Maria Masten (MNDOT)		5 mins
Topic 4	Optimizing concrete mix designs for pilots	Leif Wathne (Iowa State, CPTC)		5 mins
Session B	Industry -- New Technologies, Pilots and other Key Considerations	Facilitator: Pavitra Srinivasan	1:50–2:10p	20 mins
Topic 5	New Low Carbon Concrete Materials Pilots	Lucas Moreno Kristiansen (Argos)		5 mins
Topic 6	New Materials and Other Avenues to Reduce Embodied Carbon in Concrete	Prof. Zachary Grasley (Texas A&M, OSL, Build with Circle)		5 mins
Topic 7	Workforce Development – Role of IACs	Prof. Annick Anctil (MSU IAC, IPU)		5 mins
Topic 8	Philanthropic/VC Support for Emerging Clean Technologies	Abigail Regitsky (BE)		5 mins
Session C	Benchmarking Carbon Intensity, Standards, Testing, TEAs, LCAs, New Methods	Facilitator: Pavitra Srinivasan	2:10–2:30p	20 mins
Topic 9	Infrastructure Materials Testing and Standardization Process	Aron Newman (NIST LCCCC)		5 mins
Topic 10	LCA/Clean Energy Renewables for Pilots	Xingang Zhao (ORNL)		5 mins
Topic 11	Early Product TEAs for Decision-making	Samantha Reese (NREL)		5 mins
Topic 12	Benchmarking of Carbon Intensity/Performance Based Standards	Andrew Mullholland (Amcrete/ConcreteZero)		5 mins
	BREAK		2:30–2:40p	
III.	**ROUNDTABLE DISCUSSION of Invited Key Stakeholders**	**Co-Moderators: Andrew Mullholland, Abigail Regitsky, Pavitra Srinivasan, Nora Esram**	**2:40–4:50p**	**130 mins**
Topic 1	Baselines, Target setting, and State of the Market; Private Sector Demand	Lead: Andrew Mullholland (Pavitra Srinivasan)	2:40–3:40p	60 mins
Questions	Target Setting, Carbon Intensity Benchmarking, Private sector commitment demand; Data Definition and Current Market Status; TRL-ARL-CRL			
	BREAK		3:40–3:50p	10 mins
Topic 2	Emerging Technologies, Pilots, and Evaluating Impact of Public Sector Investment	Lead: Abigail Regitsky (Nora Esram)	3:50–4:50p	60 mins
Questions	How to transition technologies up the pipeline (policy to pilot); Framework for evaluating technologies; Evaluating impact of public sector investment			
D.	**WRAP UP / KEY TAKEAWAYS**	**Moderator: ACEEE**	**4:50 – 5:00p**	**10 mins**
1.	Key Takeaways/ Next Actions			10 mins
	ADJOURN		5:00p	

Attendees

First name	*Last name*	*Organization*	*Job title*
Jonas	Algers	Lund University	PhD Candidate
Annick	Anctil	Michigan State University - Industrial Assessment Center	Associate Professor Civil & Environmental Engineering
Micah	Anglin	Boston Government Services	Intern
Kate	Ascher	Columbia University	Milstein Professor of Urban Development
Cynthia	Austin	Sacramento Municipal Utility District	Senior Strategic Business Planner - Evaluation
Peter	Bassett	Energy Performance Services (EPS)	President
Alberta	Carpenter	National Renewable Energy Laboratory	Sr. Researcher, Distinguished Member of Research Staff
Hellen	Chen	ACEEE	research analyst
Joe	Cresko	US DOE - Industrial Efficiency & Decarbonization Office	Chief Engineer
Karen	Gould	State of Michigan	Energy Efficiency Manager, Public Service Commission
Zachary	Grasley	Texas A&M University	Department Head and Professor
Qingxu "Bill"	Jin	Michigan State University	Assistant Professor
Glen	Junor	Sublime Systems	Program Manager, Public Sector
Ian	Kelsey	DNV	Product Manager
Ovais	Khan	UC Davis	Graduate Student Researcher
Maria	Masten	Minnesota Dept of Transportation	MnDOT Concrete Engineer
Steven	McKnight	Department of Energy	Director (A) Advanced Manufacturing and Materials Technology Office
Lucas	Moreno Kristiansen	Argos	VP of Growth & New Business Development
Andrew	Mullholland	Concrete Zero	Consultant
Ron	Munson	US DOE National Energy Technology Laboratory	Technology Manager Point Source Carbon Capture
Aron	Newman	NIST	Group Leader

First name	Last name	Organization	Job title
Brad	Nies	US General Services Administration	Green Buildings and Sustainability Advisor
Nathan	Phillips	DNV	Sr. Analytics Engineer
Melissa	Popeil	Colorado school of mines	Graduate student researcher
Tiffany	Reed-Villarreal	National Ready Mixed Concrete Association	Director Sustainability Standards
Samantha	Reese	National Renewable Energy Laboratory	Analyst
Abigail	Regitsky	Breakthrough Energy	Senior Manager
Steve	Schultz	International Energy Consultants, LLC	President
Isabelle	Sgro Rojas	Energetics (representing IEDO)	Senior engineer-Principal scientist cement and concrete
Brooke	Smallwood	OASIS Energy Partners	CEO
Huw	Spencer	Office of the Governor, State of Michigan	Policy Fellow
Pavitra	Srinivasan	ACEEE	Sr. Researcher
Jason	Strano	Eversource	Energy Efficiency Consultant
Milani Sureka	Sumanasooriya	NEU: An ACI Center of Excellence for Carbon Neutral Concrete	Technical Director
Nora	Wang Esram	ACEEE	Senior Research Director
Kathleen	Warsing	National Grid	Lead Energy Engineer
Leif	Wathne	National Concrete Pavement Technology Center	Associate Director
André	Yvon-Bessette	Dow	Associate Research Scientist
Xingang	Zhao	Oak Ridge National Laboratory	R&D Scientist

Co-hosts: ACEEE

Pavitra Srinivasan is a Senior Researcher with the Industry Program at ACEEE. She conducts research and analysis on technologies, programs and policies that facilitate industrial decarbonization with a focus on reducing the embodied carbon of building materials such as concrete/cement. She joined ACEEE in 2021. Prior to joining ACEEE, Pavitra was a public health scientist assessing and addressing environmental health, occupational risks and industrial hygiene for government and industry. Her past academic research focused on the technical, economic, and behavioral aspects of decarbonizing the cement sector through the use of novel electrochemical process technologies, renewable energy and carbon capture and utilization. Pavitra holds a doctor of public health and master of public health in environmental and occupational health from The George Washington University in Washington, DC and a bachelor of science in microbiology and immunology from McGill University, Canada. Her areas of expertise include low carbon technologies, renewable energy and lifecycle and techno-economic assessment.

Nora Wang Esram oversees ACEEE's research programs including Buildings, Industry, Transportation, Behavior, and Health and Environment. She leads and manages ACEEE's research activities. She joined ACEEE in 2020. Prior to joining ACEEE, she was a chief engineer and team lead at the Pacific Northwest National Laboratory for over ten years and spearheaded a variety of multi-disciplinary projects advancing building energy efficiency and decarbonization. She is a licensed architect and holds a Ph.D. in architecture from the University of Illinois, Urbana-Champaign.

Hellen Chen is a Research Analyst in the Industry Program at ACEEE. Hellen conducts research on technologies and policies for reducing embodied carbon, the cement and concrete industries, and the utility sector. She joined ACEEE in 2023. Prior to joining ACEEE, Hellen worked as a graduate research assistant at the Baylor Energy and Renewable Systems lab, where she explored behavior and mitigation techniques for bearing currents, a key issue in advanced motor drive systems. Hellen has a master of science in electrical and computer engineering and bachelor of science in engineering, both from Baylor University.

Co-host & speaker:

Abigail Regitsky works on Breakthrough Energy's U.S. Policy and Advocacy team, where she helps implement Breakthrough Energy's climate policy priorities, focusing on industrial decarbonization, embodied carbon in buildings and other materials, and carbon management. Prior to joining Breakthrough Energy, Abigail worked on Capitol Hill, most recently as professional staff for the majority on the House Select Committee on the Climate Crisis. Her work focused on climate change mitigation, primarily developing policy recommendations for the industrial and manufacturing sector, buildings, and clean energy innovation. Previously, Abigail was an AAAS Congressional Science Fellow for Senator Tina Smith, where she helped develop and introduce the Senator's Clean Energy Standard Act of 2019, among other energy and environment work. Before working on the Hill, Abigail earned a PhD in materials science and engineering from MIT, where her research tried to better understand biomineralization for future applications in sustainable materials processing. Originally from Indonesia, she grew up in the Atlanta suburbs and received a BS from Georgia Tech.

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Keynote Speaker:

Joe Cresko is the Chief Engineer and Strategic Analysis Lead in DOE's Industrial Efficiency & Decarbonization Office (IEDO), where he leads efforts to assess the life cycle and cross-sector impacts of emerging industrial technologies. Joe led the development of DOE's Industrial Decarbonization Roadmap, launched DOE's Industrial Heat Shot, and supports the Industrial Deep Decarbonization Initiative (IDDI) which is a Clean Energy Ministerial coalition designed to stimulate global demand for low carbon industrial materials. Joe first joined DOE in 2008 as Science & Technology Policy Fellow in the Industrial Technologies Program, and supported the Office of Policy & International Affairs where he led a State Department sponsored project to assess the inventories, transport, and fate of black carbon (BC) emissions from Soviet-era industrial and district heating sources that impact the Arctic. In 2013 Joe joined the Advanced Manufacturing Office where he advanced to Chief Engineer. Prior to federal employment, Joe was the Director of the Emerging Technology Applications Center where he helped manufacturers to improve their productivity and reduce their environmental footprint through energy efficiency assessments as well as applied R&D of electrotechnologies for a range of industries including aerospace, ceramics, polymer, composites, foundry and food manufacturing. Joe graduated from Bucknell University with a BS in Chemical Engineering in 1987 and started his career with Jacobs Engineering group. After receiving his MS in Engineering Sciences from Penn State University in 1991, he ran a start-up company with his advisors to scale and commercialize materials and technologies developed in Penn State's Center for the Engineering of Electronic and Acoustic Materials.

Speakers

Isabelle Sgro Rojas representing DOE IEDO

Isabelle Sgro Rojas is a certified Project Management Professional and Principal Scientist at Energetics with 20 years of experience in the building industry. She is an expert in sustainable cement and concrete with deep proficiency in product development from bench scale to industrial pilot scale. At Energetics, Isabelle exercises her cement and concrete expertise, primarily in support of the U.S. Department of Energy, with IEDO, in its efforts to decarbonize those two sectors. Prior to arriving at Energetics, she was a Senior Engineer and a Project Manager for the private sector for 10 years. She directed projects in Europe and in North America for ready-mix and precast concrete applications and delivered new carbon sequestration/mineralization techniques for new applications. She holds two patents: one for a fast hydraulic binder containing a calcium salt, meant for construction made of concrete, and another for the use of cellulose ether for reducing plastic shrinkage/cracking in concrete. Isabelle graduated with a master's in manufacturing project management from l'Ecole Superieure des Mines de Saint-Etienne in 2014. She also has two bachelor's degrees: one in materials and chemistry, earned through both Joseph Fourier University and Heriot-Watt University and another in synthesis and technology of organic-based polymer materials from the University of Montpelier.

Brad Nies from GSA

Brad is a licensed architect in GSA's Office of Federal High-Performance Green Buildings (OFHPGB). Over the past year Brad has been part of the White House Council on Environmental Quality's (CEQ) Buy Clean Technical Advisory Group and dedicated to furthering GSA's embodied carbon efforts. One of his main projects includes GSA's execution of the Inflation Reduction Act (IRA) Section 60503 Use of Low-Carbon Materials. Prior to joining the OFHPGB Brad served five years as the R6 Facilities Management Division Deputy Director. He earned that role after serving seven years as the region's first ever Sustainability Program manager. Brad was recognized with a 2013 GreenGov Award from the White House for his work on GSA's climate Adaptation pilot. Prior to joining GSA Brad enjoyed 15 years in the private sector, finishing out as an Associate Principal at BNIM Architects. Brad's project leadership includes many US Green Building Council (USGBC) LEED Certified projects, 6 Platinum and 4 AIA Committee on the Environment Top 10 award winners. Brad's design experiences can be found in his book "Green BIM: Successful Sustainable Design with Building Information Modeling". Brad founded the Kansas City Construction Waste Forum which led to recyclespot.org. Brad was a founding board member of the USGBC's Great Plains Chapter and chair of the Greater Kansas City Chamber of Commerce Climate Protection Partnership. Brad is board chair for Bridging the Gap.

Maria Masten from MnDOT

Maria Masten is the State Concrete Engineer in the MnDOT Office of Materials and Road Research. Maria has previously held positions as a student worker in the MnROAD Research Section and Pavement Management. She graduated from the University of Minnesota in 1996 with a Bachelor of Science in Civil Engineering and is a registered professional engineer in the State of Minnesota. Ms. Masten has worked at MnDOT for 28 years, serves on a variety of concrete-related national committees and she was the previous chair of the National Concrete Consortium from 2013-2018.

Leif Wathne from Iowa State Institute for Transportation, CP Tech Center

Mr. Leif G. Wathne is Associate Director of the National Concrete Pavement Technology Center at Iowa State University's Institute for Transportation. He has 28 years of experience with concrete materials, pavements and engineering and is a recognized authority on concrete pavement technology, pavement policy and stewardship. Prior to joining the National Concrete Pavement Technology Center, Leif served for seventeen years with the American Concrete Pavement Association, most recently as Executive Vice President, and nearly a decade with Federal Highway Administration's Office of Pavement Technology and Turner-Fairbank Highway Research Center. Leif is a registered professional engineer (PE), and holds a Master of Science degree from Pennsylvania State University and a Bachelor of Science degree from University of Connecticut.

Lucas Moreno Kristiansen from Argos

Lucas Moreno Kristiansen is currently Vice-President of Growth and New Business Development at Argos – one of the largest cement and ready-mix concrete producers in the eastern United States. In his current position and previous role as Corporate VP of Innovation in 15 countries, he has been responsible for the development and commercialization of novel materials and for implementing practical solutions to reduce the environmental footprint of this industry. Under his business portfolio, he has been responsible for R&D and construction of one of world´s largest commercial Calcined Clay production facilities in the world currently in operation. He is currently leading Argos´ effort to grow the production of Calcined Clays in the US market as a cost effective and high-quality solution to meet the increasing demand for cementitious binders. Some of his other projects to support transition of the cement industry towards lower emissions include the development of a microalgae-based approach to capture CO_2 and transform it into Sustainable Aviation Fuels and the large-scale recycling of concrete. Lucas' background is in mechanical engineering and mechatronics and he holds a master´s degree in Technology Management and Innovation from the University of Queensland in Australia.

Zachary Grasley from Texas A&M University

Zachary Grasley, PhD, PE is a chaired professor and Department Head of Civil & Environmental Engineering at Texas A&M University. Grasley is a world-renown expert in concrete materials, a subject in which he mentors many students, teaches, and performs extensive research. He has published over 75 journal articles while executing more than $10M in sponsored research and has won several teaching awards. Grasley has been honored as a Fellow of ASCE, the American Concrete Institute (ACI), and the American Ceramic Society (ACerS). In addition to his academic impacts, he is also keen on seeing his discoveries and technological developments impact civil engineering practice directly. He has multiple patents and is helping two start-up companies focused on innovating the concrete material, precast, and production industries. Prior to becoming Department Head, Grasley led the Center for Infrastructure Renewal at Texas A&M.

Annick Anctil from MSU IAC

Dr. Annick Anctil is an associate professor in Civil and Environmental Engineering at Michigan State University, where she leads research on Sustainable Energy Systems. She holds a BE and MS in Materials Engineering and a PhD in Sustainability. The core of her research is evaluating the environmental impact of photovoltaics and battery technologies. She uses proactive sustainability assessment to reduce the environmental impact of new technologies. Process based life-cycle assessment (LCA) is used to identify critical steps in current technologies and guide greener alternatives by combining theoretical environmental assessment and experimental work. She is the assistant director of the DOE-MSU Industrial Assessment Center and received an NSF CAREER award in 2021 to work on the impact of the solar photovoltaics industry in the US. At MSU, she teaches classes on sustainability and life cycle assessment of energy and received the Withrow Teaching Award in 2020.

Aron Newman from NIST

Dr. Aron Newman is the leader of the Infrastructure Materials Group (IMG) of the Materials and Structural Systems Division (MSSD) of the Engineering Laboratory (EL) whose team focusses on evaluating the durability of materials, including cements, concretes, and polymers. Material durability impacts resiliency of our infrastructure. Use of materials for infrastructure applications are impacted by both chronic, i.e. long term exposure, and acute hazards, e.g. hurricanes and earthquakes. The frequency and intensity of these hazards are increasing due to climate change and both adaptation and mitigation strategies are needed to ensure our infrastructure is resilient. IMG is investigating service life of these materials and developing new measurement methods to improve predictive tools that can aid in the design of greater resiliency. Dr. Newman joined the Engineering Laboratory in 2020 and is leveraging his research and development experience to manage current projects and to investigate future research directions with input from staff and stakeholders. Prior to joining NIST, Dr. Newman was at Booz Allen Hamilton from 2010 – 2020 and supported technical program management of various research projects at Advanced Research Project Agency – Energy with the Department of Energy. The research areas include cement, batteries, fuel cells, permanent magnets, and polymer membranes. From 2003 to 2010, Dr. Newman was at Physical Sciences, Inc. and had a succession of promotions with increasing responsibility from Physical Scientist to Principal Research Scientist to Group Leader, Energy Technologies. From 2000 to 2003, Dr. Newman was at Energizer working on alkaline cathodes for primary batteries. After getting his Ph.D., Dr. Newman served as a postdoctoral appointee at Argonne National Laboratory from 1998 to 2000 working on diagnostic testing and characterization of lithium ion batteries.

Xingang Zhao from ORNL

Dr. Xingang Zhao is an R&D Scientist at Oak Ridge National Laboratory (ORNL). His research interests span multiple disciplines of clean energy systems and their intersections with artificial intelligence and decision science (life cycle assessment, techno-economic analysis). He has been leading LCA efforts for ORNL and DOE projects with R&D teams and companies on low-carbon concrete technologies and their commercial deployment. He received his B.S. in Energy and Environmental Engineering in France and his M.S. and Ph.D. in Nuclear Science and Engineering from Massachusetts Institute of Technology.

Samantha Reese from the National Renewable Energy Laboratory (NREL)

Samantha Bench Reese is a senior engineer at the Strategic Energy Analysis Center at National Renewable Energy Laboratory (NREL). As an analyst, Samantha helps put early-stage research problems in context of technoeconomic tradeoffs, and analytically shows technology potential through supply-chain analysis, trade-flow mapping, market research, and building bottoms-up cost models. She also explores the embodied carbon and energy of technology. Prior to joining NREL, she helped transition products from R&D to volume manufacturing, spending considerable time in across the world and more specifically in Asia. Samantha's background is in mechanical and electrical engineering. She received her M.S. in Engineering and Applied Science from Yale University, and her B.S. in Engineering and Applied Science from California Institute of Technology (Caltech).

Andrew Mullholland from Amcrete & ConcreteZero

Andrew is the ConcreteZero Technical Workstream Coordinator and has been instrumental in developing the fundamentals that are underpinning our commitment. He is the CEO of AMCRETE UK and the chair of the Low Carbon Concrete Group established by the Green Construction Board which is led by UK Government. Andrew is a Chartered Construction Manager and a member of the Institute of Concrete Technology. He regularly develops testing programs and reports on performance of innovative cement technologies for concrete producers, clients and contractors whilst advising on concrete related investigations and solutions. This practical application and current knowledge have been invaluable in developing best practice guidelines and CZ principles of establishing market targets based on improvement against BAU.