EPA
United States
Environmental Protection
Agency



Forum on Life Cycle Approaches to Sustainably Manage Materials in Building and Infrastructure Projects

Summary Report



January 30 – February 1, 2018

Crystal Gateway Marriott

1700 Jefferson Davis HWY, Arlington, VA 22202

July 2018
Office of Resource Conservation and Recovery
530-R-18-003

This page is intentionally left blank.

Disclaimer

This document was prepared by the Office of Resource Conservation and Recovery, United States Environmental Protection Agency (U.S. EPA) and CSRA, Inc. under contract number EP-W-14-020. Neither the United States Government nor any of its employees makes any warranty, expressed or implied, or assumes any legal liability for any third party's use of or the results of such use of any information, product, process, or business models discussed in the document. Mention or illustration of company or trade names, organizations, or of commerical products does not constitute endorsement or recommendation for use by the U.S. EPA. As of the date of this document, external links are current and accurate, and are offered by way of example only for reference purposes. The U.S. EPA is not responsible for content of non-U.S. EPA links. This document is for informational purposes and does not constitute policies of the U.S. EPA or the United States Government.

TABLE OF CONTENTS

ACRONYMS

ASCE – American Society of Civil Engineers

BMRA – Building Materials Reuse Association

DOT – Department of Transportation

EPA – U.S. Environmental Protection Agency

EPD – Environmental Product Declaration

FAR – Federal Acquisition Regulation

GSA – General Services Administration

HPD – Health Product Declaration

IRS – Internal Revenue Service

LBC – Living Building Challenge

LCA – Life Cycle Assessment

LEED – Leadership in Energy and Environmental Design

NCSE – National Council for Science and the Environment

PCR – Product Category Rule

PVC – Polyvinyl Chloride

RCI – Recycling Certification Institute

SMM – Sustainable Materials Management

TRB – Transportation Research Board

USGBC – U.S. Green Building Council

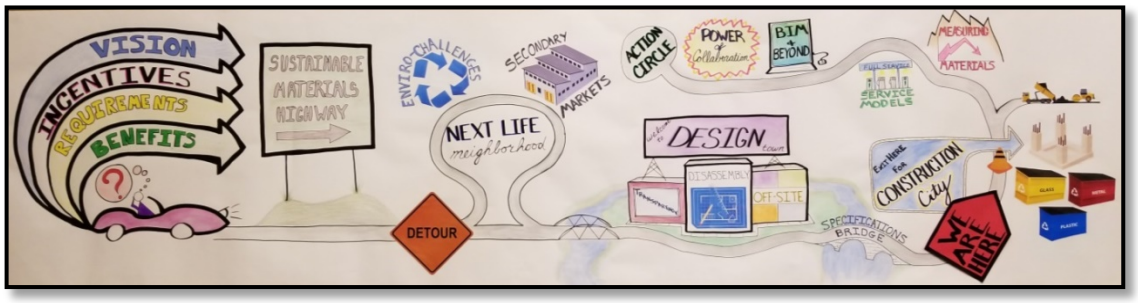
BACKGROUND AND PURPOSE OF THE FORUM

The built environment is a part of nearly every aspect of our lives – the homes we live in, the buildings we work in, the roads we travel on, and the factories and businesses that are the engine of the American economy. In the coming decades, billions of tons of materials will be needed to maintain and expand this infrastructure. As construction increases, new solutions will be needed to make more efficient use of materials and resources and to minimize the associated negative environmental, social, and health impacts. In particular, it will be important to apply life-cycle thinking to find the most productive and efficient solutions to the challenges facing these materials.

To help advance this important movement, U.S. Environmental Protection Agency (EPA) and its partners convened the two-and-a-half-day *Forum on Life Cycle Approaches to Sustainably Manage Materials in Building and Infrastructure Projects* (the Forum) January 30 – February 1, 2018, with a wide range of stakeholders who work across the spectrum of the built environment – policy makers, non-governmental organizations, architects and engineers, developers, builders, and waste management professionals. The purpose of the Forum was to:

- Establish a common understanding of what it means to apply life-cycle approaches such as design for adaptability, recycling, and disassembly; materials reuse; and life-cycle impact analysis to sustainably manage materials in building and infrastructure projects.
- Discuss key challenges and opportunities to expand the use of life-cycle thinking to achieve sustainable materials management (SMM) goals in the built environment – from project design and construction to end-of-life management and next-life markets.
- Identify potential solutions and next steps for a variety of stakeholders to advance this work across the public and private sectors.

Over 100 people attended the Forum and contributed their insights as participants and presenters. This summary includes a brief, high-level summary of themes and potential actions that emerged based on the conversations from the Forum.



The Forum roadmap above illustrates the flow of the agenda. The group began with a discussion of incentives, requirements, and benefits for adopting sustainable materials approaches. They moved on to discuss next life markets to reflect the important concept of beginning with the "next" life of materials in mind. The group then explored topics related to design and construction and wrapped up with sessions that were designed to prompt additional thinking on topics not already covered.

SUMMARY OF THEMES AND POTENTIAL ACTIONS

The Forum was designed to be broad in scope – both in terms of types of participants and in the topics discussed. Discussions were meant to be a starting point for further conversations and actions as opposed to in-depth discussions about specific topics or sectors.

The six themes identified as critical to advancing life-cycle thinking in the built environment were:

- **Collaboration and Partnerships**
- **Innovation and Research**

- **Life-Cycle Data and Tools**
- **Telling a Better Story About Sustainable Materials Approaches**
- **Enhancing Secondary Materials Markets**
- **Shifting Paradigms**

THEME 1: COLLABORATION AND PARTNERSHIPS

Collaboration and engagement across the project life cycle (manufacturers to end-of-life) on sustainability topics is critical. It helps ensure that everyone understands and owns the sustainability components of a project, and helps to inspire the most effective sustainable solutions. This theme was emphasized by a variety of participants for a range of purposes, for example, multiple participants noted the importance of including the full project team at the earliest stages to improve cost estimating and maximize achievement of sustainable solutions. Participants also noted that collaboration and coordination are also important to reduce duplication of effort and information overload, given the wide range of activities that are already happening in the area of sustainable materials and the built environment.

There was particular energy around the topic of embodied carbon and participants noted that collaborative groups have already been formed around this topic, specifically the Embodied Carbon Networks' Carbon Smart Building Initiative. Participants spoke highly of this group and the work they are conducting related to sustainably managing materials, suggesting there might be a need for better coordination and standardization in the built environment community.

Participants emphasized that benefits of collaboration and partnerships span a range of purposes, for example:

- Specifications are critical for "bridging" documents that translate design into reality and require collaborative input and understanding from everyone across the project life cycle.
- It is beneficial to work closely with construction contractors and subcontractors from the earliest stages of the project to help them understand the unique sustainability components of the project and how their work was an integral part of meeting sustainability goals. This type of engagement is also important because effective sustainability solutions may be at different parts of the project life cycle. For example, it may be easier to reformulate a product than it is to invent new ways to recycle that product at the end of its life.
- Early engagement is especially important from a sustainability consulting perspective. Successful projects engage the full project team at the earliest stages. This early engagement not only helps with accurate cost estimating, but also helps to ensure that everyone takes ownership of project sustainability goals.

Potential Actions:

National/Regional Level:

- Facilitate communication among stakeholder groups to build trust in innovation across the life cycle and understand the total value (both now and in the future) of emerging practices and policies that promote reuse and SMM.
- Work with the American Society of Civil Engineers (ASCE) and the Transportation Research Board (TRB) to continue conversations on infrastructure (not buildings). Lessons learned from the building sector could inform infrastructure efforts.
- EPA could consider reviving the Beneficial Use Summits sponsored in the past or connect with existing conferences where some of the same people may be gathered (e.g., the Building Materials Reuse Association (BMRA), National Council for Science and the Environment (NCSE), ASCE). These potential events should focus on creating opportunities for participants from other parts of the system life cycle or industry sectors to interact. Similarly, they could focus on bringing the infrastructure community together with the building community.

    - Reconnect the impacts of chemicals with the potential waste produced from disposal of products that contain those chemicals.
    - Engage with the Product Stewardship Institute and public health sector to develop assessment standards for key product categories specific to chemical composition of materials.
- **Local/Project Level:**
    - Convene local contractors to identify shared barriers and seek collective solutions to minimizing waste on sites.
    - Need to increase understanding and up-front collaboration between designers/architects and modular/offsite builders (also applies industry-wide).
- **Specific topics**
    - Continue the conversation on resiliency and the relationship between improving resiliency and SMM.
    - Examine the relationship between polymers and composites to evaluate how these materials impact recycling systems. Evaluate the potential to develop markets for recycled or reused polymer and composite materials in the built environment or of the materials need to be redesigned to prevent disposal at end-of-life.
    - Have a focused effort on treated wood to determine how best to ensure it is identified appropriately and stays out of certain recycling streams.
    - Work with the BMRA to develop a vehicle for collecting information, studies, example case studies, and best practices.

THEME 2: INNOVATION AND RESEARCH

Several sessions highlighted the fact that sustainable solutions are often innovative solutions. They will require research and testing to ensure that they are accomplishing sustainability goals, performance goals, and can be replicated on other projects.

Successful projects are building the idea of research into their project execution so that they can learn from these innovative approaches and share their results with others. For example, one presenter highlighted that they have very specific test areas where they can try out new materials and assess performance. Other projects have specifically integrated ongoing data and information collection about some of their materials and process choices to improve their understanding of the performance. It was noted that innovation can be a real challenge, especially in the infrastructure space, because the public often doesn't notice successes, only failures. This attention to failures can contribute to State Department of Transportation (DOT) agencies' reluctance to use innovative materials. Innovation can also be applied to product-service systems to address functional needs. Innovative approaches to address functional needs (e.g., mobility, lighting, floor coverings) instead of making products could lead to less materials-intensive approaches.

Potential Actions:

- Government (federal, state or local) could facilitate the testing of new materials/approaches. Governments could do this by having demonstration projects as a proof-of-concept that would help convince skeptical audiences such as engineers and government officials. Governments can provide an environment to support innovation at the federal, regional, state and local levels.
- Innovative techniques are necessary to modify tenant behavior to achieve high performance building criteria. For example, General Services Administration (GSA) uses work desk bookings (renting out desk space on a daily/weekly basis) to allow more people to use the same building space; and incorporates building components that do not take much effort on the tenants' part (e.g., smart lighting).
- Infrastructure is needed to help move reused products to markets. Transfer stations are already existing infrastructure that could be a place for people to separate or recover materials. Also, modular construction facilities routinely maintain an inventory of materials and thus could potentially function as a site to store reusable materials.

- Building codes have the potential to promote resiliency to influence materials selection. There are many layers of building codes (e.g., city ordinances, school board rules, and federal government rules) which could be used to promote sustainability.

THEME 3: LIFE-CYCLE DATA AND TOOLS

Forum conversations highlighted a critical need for data about materials and products as well as information management tools to support decision making. This need is becoming increasingly urgent as people are being asked to consider a growing number of variables as they make material choices and related project decisions. There is significant interest in having life-cycle information about materials and products including:

- Building and infrastructure life cycle assessments that cover multiple attributes (e.g., greenhouse gas emissions, human health impacts, and eutrophication potential) as opposed to single attributions (e.g., only greenhouse gas emissions).
- Environmental Product Declarations (EPDs), Health Product Declarations (HPDs), and Product Category Rules (PCRs) (e.g., how to manage information to make these more standardized).
- Where materials are sourced from and what are the impacts associated with a material's source (e.g., sourcing materials within 100 miles of the building site with little recycled content or sourcing a material from >100 miles away with a high recycled content).
- Material ingredients (e.g., what is the composition of materials, environmental and human health impacts of materials ingredients, recyclability of materials).
- Recycled content (e.g., performance of materials with recycled content).
- Social equity impacts (e.g., how can we ensure benefits of sustainable materials approaches are spread equally across society and do not disproportionately benefit certain communities).
- Embodied carbon (e.g., how can we track the quantity of carbon embedded in building and infrastructure materials and construction processes).
- Recyclability (e.g., how can we improve the rate of and ability to recycle building and infrastructure materials).

This information is starting to become more available, but participants identified challenges with data access (i.e., some information is proprietary), consistency in the way that data is reported, and the difficulty in interpreting this technical information. They also noted that this information becomes increasingly difficult to gather across supply chains.

Potential Actions:

- Work on the North American Life Cycle Database has stalled due to lack of funding. It was suggested that the government or others could help jump start this work and make the database publicly available. To expedite this work, it might be easier to focus on just core products or materials as opposed to the whole array of potential building products.
- More work needs to be done to improve the quality and consistence of PCRs, EPDs, HPDs and life cycle assessments (LCA). More standardization will help decision-makers compare products and make more informed materials choices. Specifically, a more unified approach in how EPDs, PCRs, and LCAs are used by federal agencies in their purchasing of products and materials is needed.
- There is a need to track other information about materials, such as how and where materials were made and used. In particular, it was suggested that the Federal Government do more work to inventory the materials in their buildings so that they could use buildings as materials banks that could be accessed in the future.

THEME 4: TELLING A BETTER STORY ABOUT SUSTAINABLE MATERIALS APPROACHES

Participants discussed the need to tell a better story about sustainable materials approaches. Although we know a lot about energy and water use impacts for buildings, we know less about materials-related impacts. U.S. Green Building Council

(USGBC) is starting to build a better story as more projects adopt the materials credits in Leadership in Energy and Environmental Design (LEED) V4 and the Embodied Carbon Network is helping distribute and develop information regarding the embodied carbon in building materials and the associated environmental impacts.

One element of the story that emerged during some of the Forum discussions was the potential impact on local economies from choosing more sustainable materials paths. One presenter noted that in their building project, they were able to purchase a significant amount of their materials and products within 200 or 500 miles from the project site. Another participant noted changing city ordinances to promote the deconstruction of older homes helped develop an entire local industry to deconstruct buildings then manage the resulting materials. Taking advantage of local economies by sourcing materials near site of construction or by developing innovative materials sources helps promote markets for local material suppliers and producers.

Given that projects are taking similar approaches all over the country, the local economic and transformational benefits of building sustainably may be emerging. These stories need to be captured, quantified and conveyed to contribute to the overall story of the benefits of sustainable materials approaches.

Participants noted that there are a variety of potential benefits of SMM to convey. Although the audiences will vary, below are examples of the types of information that could be helpful for telling a better story:

- Equity impacts of materials choices (e.g., impact of supply chains on human rights, impact on fenceline communities).
- Impact of secondary materials markets on local economies.
- Reduced environmental impacts of materials.
- Waste generated or diverted during construction or operation, including tipping fees avoided and wages/jobs created.
- Understanding the drivers behind diverting solid waste during building operation is important for replicating results.
- Decreases in the amount of materials purchased over time.
- Improved materials performance has a potentially positive relationship with improved resilience.
- Health impacts of materials choices.

Potential Actions:

- Enlist economists to help make a better economic case for sustainable materials approaches. Natural capital accounting is a way to translate life-cycle data into dollars. Some of the stories that would benefit from economists are:
    - Enhancing the "local economy" and transformation message associated with sustainable materials projects.
    - Demonstrating cost savings, now and in the future, of incorporating SMM into projects and secondary materials markets.
    - Explore opportunities to apply "natural capital accounting" methods to tell a better story about sustainable materials approaches.
    - Benefits of reuse compared to costs of waste disposal (e.g. heath and economic costs of waste disposal).
- Create a clearinghouse of success stories and best practices at each stage of the life cycle. An example is a virtual resource center called, "Further with Food: Center for Food Loss and Waste Solutions" (www.furtherwithfood.org). Further with Food is a jointly funded effort among government, non-profits, and the private sector that is a repository of information related to food waste reduction, including success stories and best practices.
- Compile a list of people willing and able to talk at similar events to the Forum.
- Gather and disseminate best practices and/or publish a best practice guide on different topics related to materials management in the built environment.
    - Share similarities between green building rating systems (e.g., LEED, Living Building Challenge (LBC), WELL Building Standard)

    - Share similarities between ecolabels used in the built environment
- Strengthen the connections between the circular economy and resource efficiency efforts with SMM. Those movements have a lot of traction domestically and internationally. Similarly, connect advancing SMM in the built environment to larger carbon reduction strategies, which is the focus of many industry initiatives.

THEME 5: ENHANCING SECONDARY MATERIALS MARKETS

There were several discussions at the Forum that focused on how to enhance secondary markets – markets in which materials are reused or recycled into next-life uses as opposed to disposal. Promoting next-life uses through secondary markets plays an essential part in promoting sustainable materials approaches. However, the continued development of these faces several challenges, including:

- Variability in availability of secondary materials relative to where there is a need for the materials.
- Higher costs for secondary materials versus primary raw materials.
- Variability in the quality of secondary materials compared to raw materials.
- Difficulty in recycling or reusing certain materials (e.g., Polyvinyl chloride (PVC)).
- Concerns about the environmental/human health impacts of secondary materials.

One presenter described their work to help address some of the challenges through the development of online marketplaces that help connect secondary materials sellers with potential buyers. This system is expanding and being adopted by state and local governments to help match secondary materials to potential users.

Potential Actions:

- Promote adaptive reuse first; identify ordinances to support it; highlight in EPA's SMM in the Built Environment Program.
- Government could promote and incentivize end market development by providing guidance on how to collect and process materials into new construction projects (e.g., encourage wallboard recycling and support with development of more facilities).
- Work with designers/contractors on reverse supply chain for the largest quantity materials/products and connect to haulers/end markets.
- Develop incentives for smaller players (e.g., waste haulers and recyclers) or collection and buying. These groups can influence material disposition and drive demand for secondary materials.
- Promote Recycling Certification Institute (RCI) facility certification. RCI uses third-party verification networks to help certify the accuracy and reliability of construction and demolition recycling facilities' reported recycling rates thereby ensuring more responsible next-life management of materials.
- Enact policies to require that higher-risk materials are kept intact (e.g., formaldehyde-based resins).
- Change policies/practices at transfer stations to favor reuse – for example, to allow access for salvage.
- Explore the role federal agencies could play in enhancing secondary materials and markets. For example:
    - EPA encourages reuse and recycling; however, there are regulatory challenges with industrial waste and the regulations are often not clear, especially for material reuse. EPA could provide more clarity to help companies evaluate how to manage waste for reuse.
    - Department of Defense, Veterans Administration, and GSA set the standards for the construction of federal buildings and could require more secondary materials use in the procurement process.
    - GSA can set and/or modify the Federal Acquisition Regulations (FAR) to support the Federal Government's use of secondary materials.
    - The Internal Revenue Service (IRS) can encourage reuse and recycling via revising the tax code, tax abatement/incentive programs and policies to support secondary/reuse markets.
- Develop a risk assessment framework for recycled building products to inform reuse decisions.

- EPA's Beneficial Use Methodology could be used as a starting point.

THEME 6: SHIFTING PARADIGMS

Throughout the Forum, participants noted a number of important paradigm shifts that are taking place across the country. These included:

- Reducing the quantity of materials needed or the quantity of products needed upfront.
- Shifts from thinking about first costs to life-cycle costs, although many procurement systems are not set up to accommodate this new type of thinking.
- Moving from planned obsolescence of products to designing for durability and next-life uses.
- Moving from separate teams and roles on individual building projects to more integrated teams and collaborative environments.
- Seeing infrastructure and buildings as materials banks that could be accessed in the future, instead of as just infrastructure and buildings.
- Changing financial incentives to promote more sustainable materials approaches (e.g., defraying costs of reused materials, incentivizing materials separation, etc.).

These changes are also reflected in the sentiment that science and rating systems are outpacing market activities. Project teams are being forced to adopt new approaches that they may not be familiar with or that the market yet fully supports. In all cases, we need to be thinking about ways to bridge these gaps and facilitate the evolution of thinking.

Potential Actions:

- Post the resources, such as the websites identified during the meeting, on the EPA website to make the information known and available.
- Compile list of all the many tools already created for the built environment and work on getting them used (do not make duplicate guides/tools), possibly through a virtual web-based clearinghouse.
- Identify and share existing tools in use at the state and/or regional level.
- Educate stakeholders about potential benefits of sustainable materials approaches by including this topic in professional association conferences and other learning/development opportunities for:
    - owners;
    - building scientists;
    - architects/designers; and
    - municipalities/government entities.
- Enhance life-cycle cost approaches to facilitate the shift in emphasis from first costs to accounting for life-cycle costs.
- Stop designing materials for "planned obsolescence." Make the longer-term savings associated with using more resilient products and materials more obvious.

NEXT STEPS

The built environment represents an area of both great need and great opportunity to manage materials such that resources are used most productively and sustainably throughout their life cycles. Billions of tons of materials are needed to simply maintain the infrastructure we have and billions of tons more will be needed in the future to expand this infrastructure. The sheer magnitude of resources required combined with the complexities of the materials used in our infrastructure further complicate the picture. Life-cycle thinking and understanding the relationships between disparate components is critical to helping the built environment community work together to ensure our limited resources are used efficiently and economically.

Participants suggested that similar forums in the future should be held to ensure that the dialogue on these topics continues. Future events should consider the suggested improvements below:

- Increase the level of small-group interaction and action-oriented discussions.
- Focus on smaller-scale examples and potentially use mock projects to focus discussions.
- Have discussions that are more focused on specific materials or processes.
- Have more prominent roles for product manufacturers, waste management companies, and policy makers.
- Increase focus on transportation and infrastructure-related issues.
- Engage in a prioritization of potential action items at the end of the event.

It is only through our collective action that these challenges will be addressed. The *Forum on Life Cycle Approaches to Sustainably Manage Materials in Building and Infrastructure Projects* addressed a critical need to bring stakeholders from across the life cycle of building and infrastructure projects together. The Forum provided a setting for diverse stakeholders to discuss the challenges and opportunities for managing materials. This document outlined some of the themes heard during those discussions and the potential actions that could be taken to address the identified challenges. From collaboration and partnerships to shifting paradigms, the themes can help frame future conversations needed to drive significant changes and ensure we are resilient against future resource limitations.

The discussions at the Forum were just a starting point and EPA will continue to play a role in facilitating sustainable materials management in the built environment. Using the themes and potential actions identified, EPA will continue to foster collaborative conversations and work with the built environment community to make progress toward a more resource efficient and resilient future.

APPENDIX I: MEETING AGENDA

TUESDAY JANUARY 30, 2018

8:30 – 9:00 **Welcome, Purpose, and Forum Roadmap**
Kathleen Salyer, Deputy Director, U.S. EPA Office of Resource Conservation and Recovery
Tommy Wells, Director, District of Columbia Department of Energy and Environment

9:00 – 9:45 **Life Cycle Thinking and the Future of the Built Environment**
Michelle Wyman, Executive Director, National Council for Science and the Environment
At the construction crossroads – the compelling case for investing in sustainable infrastructure and buildings.

9:45 – 10:00 **BREAK**

10:00 – 11:15 **Sustainable Materials Success Stories**
Participants will hear real-world insights about how life cycle thinking is being used to make more sustainable materials management decisions on projects. Presenters and participants will explore what drives decisions, what contributes to successful sustainable materials outcomes, challenges, and what resources or actions are needed to expand adoption of these approaches.

- Illinois Tollway Project
  Pete Foernssler, Deputy Chief of Program Implementation, Illinois Tollway
- RW Kerns Center at Hampshire College in Amherst, Massachusetts
  Jason Jewhurst, Principal, Bruner/Cott & Associates

11:15 – 11:30 **Primer for Breakout Discussion Round 1: Key Incentives for Using Sustainable Materials Management Approaches in Building and Infrastructure Projects**

11:30 – 12:45 **LUNCH**

12:45 – 2:15 **Breakout Discussions Round 1: Key Incentives for Using Sustainable Materials Management Approaches in Building and Infrastructure Projects**
Participants will proceed to breakout sessions where they will explore how to enhance important incentives that promote increased use of sustainable materials management approaches in the built environment. Participants should choose from one of the following topics:

- **SALON C: How can we enhance state <u>infrastructure</u> policies and regulations to encourage life cycle thinking and sustainable materials approaches?**
  Conversation Starters: Dr. Heather Dylla, Federal Highway Administration; Charleen Fain-Keslar, California Department of General Services
- **LEE: How can we increase the visibility or priority of sustainable materials concepts in national/state/local <u>building</u> policies and requirements?**
  Conversation Starter: Jordan Palmeri, Oregon Department of Environmental Quality

- **JACKSON: How can we better convey the benefits of sustainable materials approaches? What can we learn from the latest high performance building examples?**
  Conversation Starter: Kinga Porst Hydras, General Services Administration

2:15 – 2:35 **BREAK and Return from Breakouts**

2:35 – 3:05 **Report Back from Breakouts**

3:05 – 3:30 **Primer for Breakout Discussion Round 2: The Critical Role of End-of-life Management and Next-life Markets to Successful Sustainable Materials Management Approaches**
Amanda Kaminsky, Building Product Ecosystems
Briefly review the important role that recycling, reuse, and end-of-life management play in the successful application of sustainable materials solutions.

3:30 – 3:45 **BREAK and Move to Breakout Room**

3:45 – 5:15 **Breakout Discussion Round 2: The Critical Role of End-of-life/Next-life Markets**
Participants will proceed to breakout discussions related to "end-of-life/next-life" markets. Participants should choose from one of the following topics:

- **LEE: How do we address real or perceived environmental challenges associated with secondary materials to make it easier for them to be reused and still protect the environment?**
  Conversation Starter: Dr. Timothy Townsend, University of Florida
- **SALON C: How do we improve our ability to support fundamental and innovative secondary markets?**
  Conversation Starters: Andrew Mangan, U.S. Business Council for Sustainable Development – Materials Marketplace; Joseph Klatt, Ohio Environmental Protection Agency

5:15 – 5:25 **BREAK and Return from Breakouts**

5:25 – 5:45 **Report Back from Breakouts**

5:45 – 6:00 **Closing Thoughts for Day 1**

WEDNESDAY JANUARY 31, 2018

8:30 – 8:40 **Morning Welcome**
Alexandra Dapolito Dunn, U.S. EPA Region 1 Administrator

8:40 – 8:50 **Day 1 Recap and Preview of Day 2**

8:50 – 9:15 **Primer for Breakout Discussion Round 3: Integrating Life Cycle Thinking into Project Design and Execution**
Anne Hicks Harney, Green Long Specs; Melissa Wackerle, American Institute of Architects (AIA)

Learn about the current work AIA is doing to promote life cycle thinking among architects and designers.

9:15 – 9:30 BREAK and Move to Breakout Rooms

9:30 – 11:00 Breakout Discussion Round 3: Integrating Life Cycle Thinking into Project Design and Execution

After brief topic insights from session leaders, participants will explore how to advance sustainable materials decisions in the design and execution of projects and identify best practices or words of advice for project teams. Key topics include:

- **SALON C: How do we encourage product transparency, especially about embodied carbon and environmental impacts, to facilitate more informed materials choices?**
  Conversation Starter: Dr. Dhvani Parikh, U.S. Green Building Council
- **LEE: How can we better design for adaptability, recycling, and disassembly?**
  Conversation Starter: Bradley Guy, American University
- **JACKSON: How do we capitalize on the sustainable materials opportunities of modular and offsite construction?**
  Conversation Starter: John Erb, NRB

11:00 – 11:20 BREAK and Return from Breakouts

11:20 – 11:50 Report Back from Breakouts

11:50 – 1:00 LUNCH

1:00 – 2:15 Specifications Discussion

Lisa J. Goodwin Robbins, Kalin Associates and Paul Bertram, Construction Specifications Institute
Specifications professionals will share the challenges and opportunities associated with using specifications and standards to implement sustainable materials design and planning decisions.

2:15 – 2:30 BREAK

2:30 – 4:15 Sustainable Materials Management During Construction – A Panel Presentation and Full Group Discussion

Divya Natarajan, Paladino; Geoff Brock, Lendlease; and Peter Ukstins, Davis Construction
Contractors and construction teams are the critical link in making sustainable materials goals a reality. We will briefly explore the onsite practices that have implications throughout the project life cycle and hear what three companies are doing to promote sustainable materials management practices. The full group will engage in a follow-on discussion to identify additional successful practices, challenges, and ideas for further progress.

4:15 – 4:30 BREAK

4:30 – 5:00 Review and Discuss Key Learnings and Messages, Preview of Day 3

THURSDAY FEBRUARY 1, 2018

8:30 – 8:45 Recap from Day 2 and Preview of Day 3

8:45 – 10:15 "TED"-style Talks to Inspire Further Thinking

- Measuring our Impact – Assessing Society-Wide Progress Towards More Sustainable Materials Management through National and City Level Material Footprint Measures
  Dr. Anu Ramaswami, University of Minnesota
- Moving to Service Models – New Approaches to Reduce Materials and Waste
  Monica Miller, ThyssenKrupp
- Building Information Modeling (BIM) and Beyond – Tools and Technologies and their Implications for Sustainable Materials Management in Design and Construction
  Kurt Maldovan, Jacobs Engineering
- The Power of Collaboration in Developing the New York Zero Waste Design Guidelines
  Clare Miflin, Kiss + Cathcart, Architects

10:15 – 10:30 BREAK

10:30 – 11:00 Review of Key Themes and Advice that Emerged During the Forum

11:00 – 11:45 Discuss Immediate Actions and Longer-term Next Steps

11:45 – 12:00 Closing Remarks

Barry Breen, Principal Deputy Assistant Administrator, U.S. EPA Office of Land and Emergency Management

APPENDIX II: SPEAKERS AND PRESENTERS

Paul Bertram is a Distinguished Member, a Fellow and former President of CSI – the Construction Specifications Institute. He is now President of his consulting firm, PRB Connect after opportunities within the manufacturing sector and his firm PRB Design. He coordinated development of the first of its kind, in the US, Cradle to Grave ISO compliant Environmental Product Declaration. His recent work includes advocacy for resilient and high performance, low carbon retrofit buildings. His 30 years of expertise includes building product environmental lifecycle functional performance, and envelope first energy efficiency strategies. In Laboratory mockup testing of exterior systems is a current focus. He serves on the Board of the National Institute of Building Sciences and liaison for the Building Enclosure Technology and Environment Council as well as a member of the Off-Site Construction Council. He also is a member of the GSA High Performance Green Advisory Committee. He started his career as part of Design & Development at Walt Disney World. His passion, as a Vietnam veteran, is volunteering for the Guardian Angels Medical Service Dogs preventing veteran suicides that are reported at 22 per day.

Barry Breen is the Principal Deputy Assistant Administrator of the EPA's Office of Land and Emergency Management (OLEM). He is responsible for managing the EPA's hazardous and solid waste management programs, hazardous waste cleanup programs under the Resource Conservation and Recovery Act, Superfund and federal facilities cleanup and redevelopment, Brownfields program, oil spill prevention and response program, chemical accident prevention and response program, underground storage tank program, and emergency response program.
Before joining OLEM in 2002, Barry was the Director of the EPA's Office of Site Remediation Enforcement, and before that led EPA's Federal Facilities Enforcement Office. Prior to joining the EPA, Barry was Editor-In-Chief of the Environmental Law Reporter and Director of Publications at the Environmental Law Institute. He was a trial attorney in the Justice Department's criminal division, and an Assistant to the General Counsel, Department of the Army.

Barry teaches environmental law as an adjunct professor at American University law school. He has an undergraduate degree from Princeton University, and a law degree from Harvard Law School. Barry received the Presidential Rank Award for Meritorious Executive Service, the EPA's Award for Exemplary Leadership in Human Resources Management, the Army's Meritorious Service Medal, and American University's Faculty Award for Outstanding Adjunct Teaching.

Geoff Brock has worked in Construction Management at Lendlease for almost 12 years, in both Project Management and corporate Sustainability. With an academic background in Civil Engineering, Architecture, Urban Studies, Environmental Management and Real Estate Development, Geoff has focused his efforts on the urban built envioronment with research in the material supply chain, construction site logistics and waste management infrastructure. He is responsible for the environmental reporting and management of Energy, Water and Waste for the entire Lendlease Americas portfolio consisting of around 50 large scale construction projects at any given time. He credits much of his success to industry collaboration efforts and multi-stakeholder initiatives with a goal of sharing knowledge and building critical mass. Geoff is also a board member of Smiling Hogshead Ranch, a non-profit urban farm collective in Long Island City, NY. He currently resides with his family in Philadelphia, PA.

Alexandra Dapolito Dunn serves as the Regional Administrator for EPA Region 1. Her responsibilities include overseeing the states of Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont and ten tribal nations. Prior to joining EPA Region 1, Ms. Dunn served as executive director and general counsel for the Environmental Council of States (ECOS), a national nonprofit, nonpartisan organization committed to helping state agencies improve environmental outcomes for all Americans. Since 2014, Ms. Dunn has helped state governments improve water infrastructure, air pollution control, site cleanup, chemical management, and economic development. Prior to joining ECOS, Ms. Dunn served as executive director and general counsel for the Association of Clean Water Administrators.

Ms. Dunn has been published in the areas of the ethics of community advocacy, environmental justice, urban sustainability, water quality, cooperative federalism, and the Clean Water Act. She has taught on the subjects of environmental justice, and human rights and the environment as dean of Environmental Law Programs at the Elisabeth Haub School of Law at Pace University. She has also taught at the Columbus School of Law, Catholic University of America, where she served as faculty adviser to the student Environmental Law Society. Ms. Dunn most recently taught environmental justice as an Adjunct Associate Professor of Law at the American University's Washington College of Law.

In 2015, Ms. Dunn was elected to the American College of Environmental Lawyers and served in leadership roles through the end of 2017. She also served through the end of 2017 on the executive committee and board of directors of the Environmental Law Institute. She has chaired the American Bar Association's (ABA) section of Environment, Energy, and Resources, its World Justice Task Force, and served on the ABA Presidential Force on Sustainable Development.

Ms. Dunn received a B.A. in political science from James Madison University followed by a J.D. from the Columbus School of Law, where she was elected editor-in-chief of the law review. She is a member of the bar in D.C., Maryland, and New York, and the U.S. Supreme Court.

Dr. Heather Dylla is the Sustainable Pavement Engineer for the Federal Highway Administration, where she manages the FHWA Sustainable Pavements Program and Pavement Life Cycle Cost Analysis Program. Prior to joining FHWA, Heather was the Director of Sustainable Engineering for the National Asphalt Pavement Association where she managed programs that assisted producers, contractors, and designers in improving the sustainability of pavement construction. In this role, she led an industry effort to develop an Environmental Product Declarations Program for asphalt mixtures. Heather obtained her doctorate from the Louisiana State University where she focused on quantifying the environmental impacts of photocatalytic concrete pavements.

John Erb has over 20 years of technical sales experience in the modular construction industry and has a degree in Architecture, with additional studies in structural engineering and construction management. John is responsible for the Sales and Business Development for NRB (USA). John has accumulated a vast amount of experience in the design, build and installation of permanent modular construction projects, and in particular within the Multi-family residential market."

Pete Foernssler, as a deputy chief of program implementation for the Illinois Tollway, successfully delivered the $2.5 billion Jane Addams Memorial Tollway (I-90) Rebuilding and Widening Project as part of the Tollway's 15-year, $14 billion capital program, Move Illinois: The Illinois Tollway Driving the Future.

Mr. Foernssler has more than 26 years of engineering experience and has been employed by the Tollway for nine years. Prior to joining the Tollway in 2008, he was an engineering business owner and worked for multiple consulting engineering firms as a program manager, structural, civil and construction engineer on major highway, airport and railroad projects throughout Illinois.

Mr. Foernssler earned his Bachelor of Science in Civil Engineering and Master of Science in Structural Engineer from the University of Illinois in Champaign-Urbana. He is a licensed Professional Engineering and Structural Engineer in Illinois.

Bradley Guy is an Associate Professor of Practice and Director of the MS in Sustainable Design program, School of Architecture + Planning, The Catholic University of America, Washington, DC. He is also the Director of the Center for Building Stewardship, and Director of the MS in Facilities Management Program at CUArch. His teaching and research focus on sustainable and healthy materials and C&D waste, life cycle assessment, prefabrication and modular design, design with reclaimed materials, and design for deconstruction. Brad has received The Graham Foundation for Advanced Studies in the Fine Arts Research Fellowship and is currently a member of the LEED Social Equity Pilot Credit Working Group and the AIA Materials Knowledge Working Group. Brad was a co-editor for the book "Construction Ecology," and co-author of a book on building deconstruction titled, "Unbuilding: Salvaging the Architectural Treasures of Unwanted Houses". Mr. Guy also wrote the on-line "Design for Disassembly in the Built Environment" guide for King County, WA. He has a M.S. in Architectural Studies from the University of Florida, and a B.Arch. from the University of Arizona, and is an Associate of the AIA and an USGBC LEED AP BD+C.

Kinga Porst Hydras, serves as an energy and water efficiency expert in the GSA Office of Federal High-Performance Buildings, with particular focus on sub-metering, energy efficiency programs, renewable energy, and indoor environmental quality. She has been working on improving the usage of Energy Savings Performance Contracts (ESPCs) in the federal government, forming public-private partnerships to achieve deep energy retrofits in existing buildings. She is a member of the GSA ESPC Program Management Office. Kinga is also a member of the Interagency Energy Management Task Force, Better Buildings Alliance, Building Technology Research and Development Committee. Kinga has over 20 years experience in the public and commercial building industry with extensive knowledge in energy management, energy analysis, air conditioning and high performance building practices and policies coupled with 10 years experience in sales and marketing management. In 2010 Kinga served as the elected President of the National Capital Chapter of ASHRAE for a one-year term, she was the first female President of the Chapter. Kinga has an MBA from Case Western Reserve University and a Masters in Engineering Degree from the Technical University of Budapest. Kinga is a CEM and a LEED-AP.

Jason Jewhurst is a Principal at Bruner/Cott Architects, where his passion for reconnecting with the natural environment informs his work as a specialist in sustainability and high-performance building design. With a strong technical background in building systems and technology, Jason welcomes sustainable design challenges that demand innovative solutions. His work includes projects that transform academic campuses with net-positive design, including the Regenerative Village at Yale Divinity School and the R. W. Kern Center at Hampshire College, both designed to meet the Living Building Challenge. In 2015, Jason helped establish the International Living Future Institute's East Coast Congress, a think tank for sustainable policy and advocacy. Jason is a frequent presenter at conferences and in college classrooms, and volunteers with several organizations seeking to create a healthier, more sustainable building and design industry.

Charleen Fain-Keslar is the Standards and Quality Control Manager for the California Department of General Services (DGS), where she guides and directs state buyers to incorporate quality, sustainability and competition into public procurements through DGS' Standards and Specifications and Environmentally Preferable Purchasing (EPP) programs. In this role she is leading implementation of the Buy Clean California Act to establish a maximum global warming potential and Environmental Product Declarations for construction materials in public works contracts. Charleen has more than two decades of California state service in testing and materials and program management. Her participation in several multi-stakeholder initiatives has contributed to a shared understanding of the complexity in public institutional purchasing organizations. She earned a Bachelor of Science in chemistry from California State University, Sacramento

Lisa J. Goodwin Robbins, RA, CCS, LEED AP, has been writing specifications for over 20 years and is employed by Kalin Associates, an independent specifications consulting firm in the Boston area. Working on a wide variety of project types, she supports other Architects, both designers and project managers, in their efforts to be green, to solve problems, and to get their projects built. She helps to develop and maintain Kalin Associates' sustainable design specifications, LEED, LBC, and WELL documentation requirements, and master specification systems.

Amanda Kaminsky is Founder and Principal of Building Product Ecosystems [BPE] LLC, operating multi-disciplinary collaboratives that evolve feedstocks, infrastructure, and logistics for optimal systemic health and performance of major building materials on behalf of building owners and their supply chains and recycling networks. Amanda carefully pilots improvements on projects under active development with building owners, manufacturers, recyclers, contractors, designers/engineers, regional policy makers, and academic researchers. Collective pilot learnings are shared amongst collaborators for expedited industry progress. Informed by piloting and lab testing, solutions are quality-controlled and streamlined for scaled implementation via evolution of existing codes/standards, and creation of new ones.

BPE was originally founded by Amanda and the Durst Organization as a public private partnership with The New School, City University of New York, Healthy Building Network, and Vidaris. Before and during early stages of BPE, Amanda also led sustainable construction and procurement efforts at The Durst Organization from 2005-2015. In collaboration with NYC Department of Sanitation, she also managed execution of New York City's first high rise residential organics collection/compost program, and further deployed those learnings rollout of the first portfolio-wide commercial organics collection program in NYC. Amanda Chairs the Health Product Declaration Collaborative Board, and is a Director on the Board of Healthy Building Network. She holds a Bachelor of Science degree in Architecture from University of Virginia.

Joseph Klatt is an environmental specialist in the Sustainability Unit at the Ohio Environmental Protection Agency. He is the project lead for the Ohio Materials Marketplace, a free online software platform allowing Ohio businesses and organizations to connect and find ruse and recycling solutions for waste and by-product challenges. He holds a Master of Public Affairs degree from Indiana University's School of Public and Environmental Affairs.

Kurt Maldovan is the Director of Virtual Design and Construction (VDC) at The Practice Technology group at Jacobs Buildings, Infrastructure, and Advanced Facilities (BIAF). This group is focused on interrogating the most forward thinking approaches in design and construction. As Director VDC, Kurt Maldovan is actively developing and implementing technology based strategies to continuously add value and reduce waste within the practice and with clients who Jacobs supports. Maldovan has been actively engaged with academic outreach and research, including the advisory board for Penn State's BIM Project Execution Planning Guide (PxP) and the BIM Planning Guide for Facility Owners and the USACE Industry BIM Consortia. He is a graduate of Penn State University's Architectural Engineering Program and published seven industry articles as a member of the Computer Integrated Construction research team.

Andrew Mangan is founder and president of Pathway21, a company that enables business-to-business industrial reuse through the award-winning Materials Marketplace software platform, supporting a culture shift to a circular, closed-loop economy. Mr. Mangan is also founder of the United States Business Council for Sustainable Development, a non-profit association of businesses launched in 1993. The Council combines the capabilities of its members to develop, test and scale sustainability solutions. The Materials Marketplace is scaling after more than 20 years of work.

The Materials Marketplace is driven by expert facilitators who help companies find reuse opportunities, bring the parties together, and work toward a deal. It also facilitates communication between senior government decision makers and company operators, helping uncover barriers and opening the door to sound solutions.

Mr. Mangan received a master's degree from the Columbia University Graduate School of Journalism and attended the Columbia School of International Affairs as an International Fellow. He served as deputy commissioner for natural resources with the Texas General Land Office, as a congressional correspondent for the Associated Press, and as a commercial salmon fisherman in Southeast Alaska.

Clare Miflin has over 20 years of architectural experience, mostly from her work at Kiss + Cathcart, Architects —a firm well known for their philosophy of "productive" architecture focusing on human, environmental and economic benefits. Having designed buildings to meet LEED Platinum, Passive House and Living Building Challenge rating systems, Clare realizes the importance of rigorous metrics, but knows that inspiration, hope and vision also have a crucial role to play. Clare led the development of the AIANY Zero Waste Design Guidelines - a multidisciplinary collaboration to develop strategies to reduce waste through the design of the built environment. These guidelines provide architects and design teams with inspiration and guidance to reduce the materials that compose our buildings as well as those that pass through them daily.

Fascinated by what we can learn from natural systems, she is part of the 2016-2018 Biomimicry Professional Cohort. She is also co-chair of the AIANY's Committee on the Environment; a member of NYC's Living Building Collaborative and the Sustainability Coordinator for her local food cooperative.

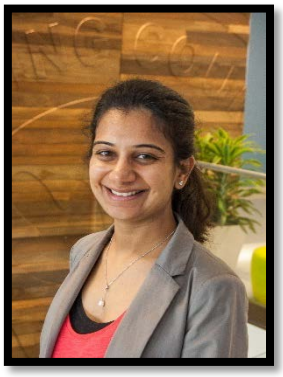
Monica Miller is ThyssenKrupp Elevator's Sustainable Design Manager and is serving ThyssenKrupp as their sustainable building expert. Monica is also a licensed landscape architect. Her previous experience as a project manager for design and construction projects both internationally and in the United States, allows her to fully understand the construction and design process. She has participated on LEED project teams and led ThyssenKrupp's manufacturing facility to achieve LEED Gold in 2015. Monica is also a Living Building Challenge Ambassador as well as a WELL Accredited Professional advocating for the growth of healthy buildings and healthy materials.

Other projects Monica is working on include: developing Health Product Declarations, a Declare label for Living Building Challenge projects, and working with manufacturing to continually develop healthy materials. As well as facilitating LEED Gold certification for ThyssenKrupp's almost 700,000 square feet manufacturing facility, in Middleton, TN.

Monica was reared as a fourth generation farmer and rancher. This experience of being a steward of the land coupled with her pragmatism allow her to practically apply sustainability. Monica has a Bachelor of Landscape Architecture degree from Kansas State University with a secondary degree in Natural Resources and Environmental Sciences. She has also completed graduate work in Sustainability at Southern Methodist University.

Divya Natarajan is a sustainability & wellness consultant with experience in high aspirational buildings for commercial office, hospitality, healthcare, residential and institutional buildings. Divya's combined background in architecture, sustainability and business gives her a unique perspective on the implementation of sustainability strategies in real estate.
As a consultant Divya has worked on over 10 million sf of certified projects using certifications such as LEED, WELL, Fitwel, Sites and Living Building Challenge. She has experience in both design and construction management and has worked with local and international teams to streamline documentation processes. Divya has conducted brown bag and training sessions on best practices in, materials management, green codes and the emerging sustainability landscape for architects, contractors and real estate organizations.

Jordan Palmeri is a Senior Policy Analyst in the Materials Management Program at the Oregon Department of Environmental Quality, where he coordinates projects around the built environment, life cycle assessments, and purchasing. He's worked on building and zoning codes, rating systems, and served as a technical and policy expert for small housing initiatives. He recently finished a 2-year term on the US Green Building Council's Materials and Resources Technical Advisory Group and is now leading a program to help Oregon concrete producers develop Environmental Product Declarations (EPDs). Jordan holds a MS in Environmental Science from Tulane University.



Dr. Dhvani Parikh is a toxicologist at USGBC and staff liaison to LEED Materials and Resources Technical Advisory Group (MR TAG), supporting technical development and implementation in the area of materials in LEED. Prior to that within USGBC, Dhvani led a year-long technical working group developing standard criteria for performance based indoor air assessment in the area of indoor environmental quality. Dhvani has master's and doctoral research degrees in environmental health sciences and molecular toxicology from New York University and University of Pittsburgh respectively.

Dr. Anu Ramaswami is the Chair Professor of Science Technology & Environmental Policy at the University of Minnesota and among the leading scholars on sustainable urban infrastructure. She has seen her work adopted as policies and protocols for developing sustainable cities in the United States and internationally. She is lead PI and Director of the US National Science Foundation's interdisciplinary Sustainable Healthy Cities Network.
Ramaswami's research spans environmental science, industrial ecology, sustainable infrastructure design, urban systems analysis, and integration of science and technology with policy and planning for real-world implementation in communities. She has developed novel interdisciplinary research and education in these diverse areas. She is the author of a graduate level textbook on integrated environmental modeling, and is presently developing a Social Ecological-Infrastructural System framework to study Sustainable Urban System.
Ramaswami received her B.S. in chemical engineering from the Indian Institute of Technology–Madras, India, and her M.S. and PhD in civil and environmental engineering from Carnegie Mellon University in Pittsburgh. Ramaswami serves on the United Nation's International Resource Panel and co-chairs its inaugural report on SDGs to the UN.

Kathleen Salyer is the Deputy Director of the Office of Resource Conservation and Recovery at the United States Environmental Protection Agency (U.S. EPA), a position she has held since January 2015. The Office is responsible for promoting resource conservation through sustainable materials management, ensuring safe management of solid and hazardous waste and cleaning up environmental contamination at hazardous waste management facilities. Kathleen leads efforts on Sustainable Materials Management, including wasted food, life cycle analysis, built environment, and sustainable packaging. She is actively engaged in the G7 Alliance on Resource Efficiency and collaborations with other international partners. Prior to her current position, Kathleen was an Assistant Director of the Superfund Program in U.S. EPA Region 9 in San Francisco, California. She has over 20 years' experience in environmental management. Kathleen has a BA in Geology from Whitman College and a Masters in Environmental Public Policy from University of Maryland, College Park.

Dr. Timothy Townsend is a Professor in the Department of Environmental Engineering Sciences in the Engineering School for Sustainable Infrastructure and the Environment at the University of Florida. Dr. Townsend teaches and conducts research related to solid and hazardous waste management. His courses cover subjects such as waste management fundamentals, landfill design, recycling, construction and demolition debris, and waste management in developing countries. He has published many papers and reports on topics related to bioreactor landfills, recycling and environmental implications of construction and demolition debris, waste leaching, beneficial use of solid wastes, and special wastes such as electronic scrap.

Peter Ukstins is the Director of Integrated Construction for James G. Davis Construction. As Director, Peter delivers leadership, guidance, and oversight for the Corporate Quality Management, Lean Project Delivery, and Sustainability Programs.

Peter works directly with operations to help develop, coach and promote the use of advanced construction techniques, project delivery methods and project planning. A true details man, and a DAVIS veteran for close to 20 years, Peter is focused on innovative methods and industry trends to promote continuous improvement and learning. In 2014, Peter took over complete responsibility and oversight for sustainable construction at DAVIS. Drawing from his award-winning operations experience, Peter is fearless, forward-thinking, and innovative; his credo is as simple as it is successful - at DAVIS we build it right the first time. Every time.

Peter serves as chair for the Lean Construction Institute DC Metro Community of Practice, President Elect of the Construction Quality Executives Council, and is an active participate with USGBC National Capital Region.

Melissa Wackerle, LEED AP BD+C, ND is Senior Director, Sustainable Practice & Knowledge, with the American Institute of Architects. She came to the organization in January 2014 with 14 years of experience in the design and construction industry and a master's degree in Sustainability and Development. Her experience ranges from green building certification management to enterprise and community consulting, Carbon Disclosure Project reporting, energy and water efficiency recommendations and green construction practices. Melissa directs programming for the AIA's Energy and Materials initiatives coordinating with working groups dealing with the 2030 Commitment, Energy Education, and Materials Knowledge.

Tommy Wells is the director of the Department of Energy & Environment (DOEE). Appointed January 2015, he is chiefly responsible for protecting the environment and conserving the natural resources of the District of Columbia. Tommy's team is comprised of approximately 300 environmental professionals collectively working to improve the quality of life for residents and the natural inhabitants of the Nation's Capital.

Most recently, Tommy served as the DC Councilmember representing Ward 6—a position he held since 2006. During his time on Council, he garnered broad support for his efforts to make the District livable and walkable for all. Tommy worked with the City's leadership and, in particular, residents of Ward 6 to create a shared and respected place where drivers, cyclists, pedestrians, and exercise enthusiasts can co-exist safely. Known for his neighborhood-focused development, Tommy championed efforts to ensure availability of public transit, including the construction of new streetcar lines and the expansion of the DC Circulator. As Chair of the DC Council Committee on Transportation and the Environment, he worked to double the city's Capital Bikeshare program.

With a career in public service that spans 32 years, Tommy's commitment to District residents--particularly children--is unwavering. In 1996, he led a successful class action lawsuit, LaShawn v. Barry, to address the city's failure to protect children in its care. In 1991, he took the helm of the DC Consortium for Child Welfare, where he helped to create neighborhood-based family service collaboratives to coordinate the delivery of city and nonprofit resources to underserved District residents. He was the architect of a groundbreaking program to match foster families with children affected by HIV/AIDS and he led the drive to create the DC Family Court,–resulting in a 300 percent increase in the number of foster children adopted into permanent homes each year.

A passionate innovator and student of cutting edge solutions, Tommy earned his law degree from the Columbus School of Law at Catholic University in 1991 and a master's degree in social work from the University of Minnesota in 1983. He and his wife, Barbara, a writer and arts enthusiast, are residents of Ward 6 in the District

Michelle Wyman has worked on energy and environmental policy with states and local governments for over 15 years. In close consultation with regional and local governments and their constituencies, she developed strategic and tactical solutions to their energy planning, climate mitigation, and adaptation challenges.

She previously served as the Director of Intergovernmental Affairs at the U.S. Department of Energy (DOE). In that role, Michelle led the Department's engagement activities with state, regional, and local governments on issues across the DOE complex, including renewable energy, science, fossil energy, and environmental clean-up.

Michelle's experience prior to joining the Department of Energy includes founding Applied Solutions- Local Governments Building a Clean Economy, and leading ICLEI USA, both of which are nonprofits engaging directly with cities, counties, and states on clean energy, environmental, and sustainability issues.

Michelle has served in a wide variety of leadership capacities including work with the World Bank, United Nations, and other multilateral institutions. Michelle has served as the Natural Resources Director for the City of Fort Collins, Colorado, and established a public sector practice focused on the environment and sustainable development working with states, local governments, and related national nonprofits, based in Washington DC.

Presented by

EPA United States Environmental Protection Agency

WM WASTE MANAGEMENT

And many thanks to our Planning Partners

AGC of America THE ASSOCIATED GENERAL CONTRACTORS OF AMERICA Building on Experience 100 YEARS

The American Institute of Architects

CDRA Construction & Demolition Recycling Association

CSI Building Knowledge Improving Project Delivery

CLOSED LOOP fund

ECOS

ISRI Voice of the Recycling Industry™