

## Final Program

### Urban Sustainability Assessment and Management Workshop

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- Date** July 20-21, 2016
- Sponsor** U.S. Environmental Protection Agency, Office of Research and Development
- Location** U.S. EPA Region 5  
Ralph H. Metcalfe Federal Building (Illinois Room)  
77 West Jackson Boulevard  
Chicago, IL 60604
- Overview** The workshop brings together leading experts to examine critical challenges faced by urban communities and explore opportunities to use scientifically valid metrics and frameworks to help communities find long-term, sustainable solutions. Participants are encouraged to actively engage in discussions of the state-of-practice, state-of-science, and innovations in urban sustainability assessment and management. Through this workshop, EPA hopes to further the dialogue and research on this important topic.

#### Day 1 – Wednesday, July 20, 2016

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- 9:00 am Sign In**
- 9:30 am Welcome and Introduction**
- 10:00 am Urban Sustainability Assessment and Management**  
*Framing the workshop: an overview of urban sustainability assessment and management challenges, opportunities, and innovations*  
Speaker: Heriberto Cabezas, EPA Office of Research and Development
- 10:30 am Break**
- 11:00 am Urban Challenges and Sustainability**  
*Large group discussion of the challenges facing urban communities and their relationship to urban sustainability*  
Framing questions:
- What are the most pressing challenges facing urban communities?
  - How will the way communities approach these challenges affect urban sustainability (or unsustainability)?
- 11:30 pm Integrated Sustainability Metrics**  
*Scientifically valid, integrated metrics and their practical uses*  
Speaker: Arunprakash Karunanithi, University of Colorado Denver
- 12:00 pm Lunch Break**

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- 1:00 pm**      **State-of-Practice in Urban Sustainability Assessment and Management**  
*How urban communities define “sustainability” and how urban communities measure urban sustainability for decision making, management, and accountability*  
1:00–1:45 Panel Presentations and Discussion  
Speakers: John Crittenden, Georgia Institute of Technology  
James Schwab, American Planning Association  
Thomas Theis, University of Illinois at Chicago  
1:45–2:00 Panel Q&A
- 2:00 pm**      **New Directions for Urban Sustainability Assessment and Management**  
*Emerging innovations in the science and practice of urban sustainability assessment and management*  
2:00–2:45 Panel Presentations and Discussion  
Speakers: Charlie Catlett, Argonne National Laboratory  
Ravi Srinivasan, University of Florida  
Moira Zellner, University of Illinois at Chicago  
2:45–3:00 Panel Q&A
- 3:00 pm**      **Break**
- 3:30 pm**      **Practical Considerations in Urban Sustainability Assessment and Management**  
*Small group discussions and large group report-out on practical considerations in urban sustainability assessment and management*  
3:30–4:00 State-of-Practice
- What does “sustainability” mean to urban communities?
  - How is sustainability measured for decision making, management, and accountability?
- 4:00–4:30 Available and Emerging Approaches, including Metrics, for Sustainability Assessment and Management
- How could these be applied to address pressing issues in Chicago?
  - What if anything is missing?
- 4:30–5:00 Practical Challenges
- What are the technical challenges to implementing these approaches, including metrics?
  - What are the conceptual and/or organizational challenges?
- 5:00 pm**      **Wrap-up**
- 5:30 pm**      **Adjourn**

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### Day 2 – Thursday, July 21, 2016

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**8:30 am**     **Sign In**

**9:00 am**     **Recap of Day 1**

**9:20 am**     **A System of Sustainability Metrics**

*Opportunities and challenges for developing integrated metrics and systems of metrics to provide practical guidance for solutions to urban sustainability issues*

9:20-10:15   Panel Presentations and Discussion

Speakers:   William Rees, University of British Columbia  
                  David Tilley, University of Maryland

10:15-10:30   Panel Q&A

**10:30 am**     **Break**

**11:00 am**     **Making Sustainability Relevant**

*How to make the connection between urban sustainability and pressing urban social needs*

11:00–11:45   Panel Presentations and Discussion

Speakers:   Ning Ai, University of Illinois at Chicago  
                  Joseph Dufficy, EPA Region 5  
                  Karen Weigert, The Chicago Council on Global Affairs

11:45–12:00   Panel Q&A

**12:00 pm**     **Lunch Break**

**1:00 pm**     **Core Research Needs**

*Group discussion on research priorities for advancing the state-of-science and state-of-practice in urban sustainability assessment and management*

Framing questions:

- What are the most critical gaps and associated research needs identified during the workshop?
- What are the key priorities for advancing the state-of-science and state-of-practice in urban sustainability assessment and management?

**1:30 pm**     **Wrap-up and Next Steps**

**2:00 pm**     **Adjourn**

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### **Session Abstracts (Day 1)**

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#### **Integrated Sustainability Metrics**

Scientifically valid, integrated metrics and their practical uses. *Arunprakash Karunanithi, University of Colorado Denver*

This presentation will focus on the development of a metrics based framework for integrated sustainability assessment of regions. Utilizing results from a four year project conducted in San Luis Valley Colorado, we will examine the utility of multiple metrics, all capturing different aspects of a system, in understanding the long-term sustainability of regions. Further, we will also elaborate on how in depth engagement with local stakeholders can assist in conceptualizing realistic, feasible, and attainable pathways for sustainable development. Technical aspects related to translating the conceptual pathways into quantitative scenario models and analysis tools will also be presented. The usefulness of the metrics based framework in assessing these scenarios, and more importantly, its role in credible and easy communication of the findings to stakeholders and policy actors leading to securing community buy-in for intervention will be addressed. Particular emphasis will be placed on a discussion around advantages and best practices related to formal and continuous engagement with the community in co-developing the metrics and scenarios.

#### **State-of-Practice in Urban Sustainability Assessment and Management**

Gigatechnology: Developing Sustainable Urban Infrastructure to Solve Gigaton Problems. *John Crittenden, Georgia Institute of Technology*

Gigaton problems refer to those most severe problems challenging humanity, which can often be measured at the “gigaton (billion tons)” scale. For example, the annual world energy consumption is around 12 billion tons of oil equivalent (Gtoe), 80% of that from nonrenewable fossil fuels. The combustion of these fossil fuels emits approximately 29 billion tons (Gton) of CO<sub>2</sub>. In addition, the world uses more than 79 Gton of materials each year, only about 29% of which are renewable. These gigaton problems call for solutions which can meet the gigaton scale, or gigaton solutions.

Urban centers are the largest complex, adaptive gigatechnology systems that humans create and within which humans manipulate mass and energy. Accordingly, properly designed urban system can solve the gigaton problems. A new transformative science for gigatechnologies has been established called, “Infrastructure Ecology,” with new engineering standards, protocols, tools, and workers to apply its laws and rules for building cities that are sustainable, resilient, equitable, and efficient. Analogous to natural ecology, the urban system of systems are combined to produce larger functional wholes, and new properties emerge (e.g., quality of life, air quality, traffic congestion) that were not present or evident at the next level below. By examining the complex interactions among social decision making, economic drivers, (re)development, sustainability metrics, Infrastructure Ecology is being developed to allow stakeholders to design and choose infrastructure solutions that consume fewer resources and generate less waste.

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The Role of Resilience in Long-term Sustainability. *James Schwab, American Planning Association*

In recent years, the concept of resilience has gained nearly as much traction as that of sustainability, which has been in circulation somewhat longer. What has not generally been explored in great depth, however, is the functional relationship between these two ideas. The larger question is whether the two ideas can be complementary in an urban setting.

Resilience is central to the notion of recovery. Resilience, by emphasizing the ability to rebound from a disaster, involves a relatively short-term capability based on more long-term traits that enable that capability. The foresight embodied in planning for long-term recovery prior to a disaster cultivates a culture of preparedness that cannot be generated on short notice.

Sustainability seeks to preserve opportunities for future generations by trying to rely more on renewable resources and not depleting resources for current use. A quintessential example of resilience leading to sustainability has been the vision of Greensburg, Kansas, to embrace a renewable energy future in the wake of a devastating 2007 tornado.

This leads to a straightforward but complex question: Can a community be truly sustainable over the long term without incorporating resilient qualities that help it recover from major short-term setbacks? How does resilience facilitate true long-term sustainability?

Urban Regions: A System of Systems. *Thomas Theis, University of Illinois at Chicago*

Urban systems are formed by a diversity of actors and activities, and consist of complex interactions involving financial, information, energy, health, ecological, and material stocks and flows that operate on different spatial and temporal scales. The urban systems that emerge from these interactions are continually in flux as they are constructed, replaced, and regenerated. While scholars of all disciplines agree that urban systems form and grow from the economic surplus that they capture, less transparent are the manner in which social and organizational factors should be integrated with the ecological landscape and infrastructure decisions and designs to enhance robustness in the face of change. This presentation will examine the urban “system of systems” that comprise urban regions and contribute to urban livability with emphasis on two in particular: urban food systems and capital resources for infrastructure construction and renewal.

### **New Directions for Urban Sustainability Assessment and Management**

Web-based Dynamic-Sustainability Information Modeling (D-SIM) Data Analytics Platform for Urban Sustainability. *Ravi Srinivasan, University of Florida*

As economies develop and living standards improve worldwide, the demand for energy is increasing at unprecedented rates. The largest consumers of energy, globally and domestically, are buildings. As a result of this large scale consumption, buildings generate large amounts of carbon dioxide, sulfur dioxide, and nitrogen oxide emissions. This traditional building sector model, based upon high levels of consumption and waste, is unsustainable and must be changed in order to avoid energy shortages and reduce hazardous impact to its environment. What we need is a robust, web-

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based, and interactive tool to track and draw meaningful comparisons of energy and non-energy qualifiers across multiple scales.

This presentation will discuss the development of a web-based D-SIM platform that allows mapping and meaningful peer-to-peer benchmarking process covering a swath of scales namely parcels, neighborhoods, cities, counties, states and countries. While the main focus of D-SIM has been in the context of buildings, the true beauty of this platform is that it will be applicable at many different scales with available tools varying along with the scope of analysis. This ability to cut across a broad swath of scales is what allows the platform to achieve its ultimate goal: to model, simulate, and visualize the linkages and the interplay of all elements of the urban fabric, regardless of scale. Work is in progress to expand D-SIM data analytics to identify fine-resolution community-specific action priorities using AI techniques and through integration of socio-economic databases in the analyses. Additionally, this presentation will discuss the recently developed web-based Build-Em tool that assesses building's environmental impacts on the surroundings such as ecological toxicity, biodiversity, human health, and ecosystem services.

Engaging Stakeholders in Green Infrastructure Solutions to Urban Flooding. *Moira Zellner, University of Illinois at Chicago*

Moira Zellner and her research team at University of Illinois at Chicago have developed process-based models to examine the effectiveness of green infrastructure (GI) for neighborhood stormwater management, and to derive landscape GI design principles that can help determine thresholds and priority locations within a study area. In addition, they have developed innovative community engagement protocols that include simulation models, mobile and paper interfaces, and facilitation guidelines to help stakeholders collectively make sense of the flooding problem, design solutions, and discuss these solutions.

## **Session Abstracts (Day 2)**

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### **A System of Sustainability Metrics**

Toward the 'Eco-City': Essential Metrics for Urban Sustainability. *William Rees, University of British Columbia*

The world is in 'overshoot'—the human enterprise is depleting and polluting ecosystems faster than the latter can regenerate resources and assimilate wastes. (Even climate change is a waste management problem.) Ecosystems degradation can be attributed largely to consumption in cities, yet most urban sustainability efforts remain ill-conceived and ineffective. Conceptual problems include little appreciation of cities as heterotrophic ecosystems, the failure of analysts to frame their efforts in global context; inadequate measuring/monitoring; and a lack of biophysically meaningful targets. Bottom-up ecological footprint analysis addresses these problems in the context of global biocapacity using data on energy use, material flows and waste generation commonly collected by cities. We show that typical high-income cities functionally 'occupy', and are

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dependent upon, a productive extra-urban ecosystem area hundreds of times larger than the cities' political or geographical areas. Assuming greater material equity and a common goal of 'one-planet living', the method shows that modern cities should plan to reduce their ecological footprints (material and energy throughput) by 50-80% if the world is to achieve global sustainability. Such reductions are technically possible with policies to address food systems/diet, transportation, building construction/maintenance and consumer life-styles.

*Ecology, Empathy, & Relationships: an entrepreneurial approach to creating sustainable value in cities.* David Tilley, *University of Maryland*

Social media technology has empowered people in democratic societies far beyond their historic levels. Information is readily available; mass communication is easy, spreads quickly, and empowers individuals to form effective clusters of thought and action. Authority in the classic sense of a few elected officials and enabled bureaucracies is weakened as a driver of change.

Entrepreneurship and the innovation that accompanies free-enterprise can transform the empowering force of social media to advance social learning and self-actualization to promote sustainable behaviors. New metrics of sustainability are needed to reflect this 'New Normal' of the personally empowered citizen, so public and private institutions can adapt to help cities become more sustainable. The authors will present their experience using new tools of innovation and entrepreneurship, such as Lean Startup, to affect the relationship citizens have with their environment and contrast it with emergy analysis, a classic biophysical metric. Ecological Entrepreneurship offers some promise for society to evolve sustainable habits.

### **Making Sustainability Relevant**

*A Metabolic View of Urban Sustainability: A Case Study of Neighborhood-Based Food Waste Management.* Ning Ai, *University of Illinois at Chicago*

This presentation will discuss the connection between community needs and sustainability goals in an urban metabolism (UM) framework, which is an analogy to the metabolic process in ecological systems. UM connects inputs with outputs as well as stocks of elements of urban systems, and thus facilitates the identification of inefficiencies in operation for long-term planning processes. In particular, this presentation will focus on data-driven research and policy-making about sustainable management of system outputs, or waste residuals. The current waste management practice, which focuses on short-term impacts and end-of-pipe solutions, is reactive in nature and inadequate to promote sustainability within urban systems, across jurisdictions, and across generations. Through material flows in and out of urban systems, many potential opportunities exist to reduce waste generation and to minimize the negative impacts on the environment, the economy, and the society. Case illustrations are provided for neighborhood-based food system planning, with a focus on bottom-up approaches to achieving urban sustainability goals. Numerical data analysis demonstrates the need of community- and material-specific policy design.

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### **List of Confirmed Participants**

Ning Ai, University of Illinois at Chicago\*

Stephen Balogh, EPA Office of Research and Development

Tatiana Bogdanova, EPA Office of Research and Development

Carole Braverman, EPA Region 5

Kyle Buck, EPA Office of Research and Development

Heriberto Cabezas, EPA Office of Research and Development\*

Dan Campbell, EPA Office of Research and Development

Charlie Catlett, Argonne National Laboratory\*

Christopher Choi, EPA Region 5

John Crittenden, Georgia Institute of Technology\*

Bayou Demeke, EPA Office of Research and Development

Joseph Dufficy, EPA Region 5\*

Brian Dyson, EPA Office of Research and Development

Gary Foley, EPA Office of Research and Development

Herb Frederickson, EPA Office of Research and Development

Tim Gleason, EPA Office of Research and Development

Thomas Holdsworth, EPA Office of Research and Development

Laura Jackson, EPA Office of Research and Development

Arunprakash Karunanithi, University of Colorado Denver\*

Cheryl Newton, EPA Region 5\*

David Olszyk, EPA Office of Research and Development

William Rees, University of British Columbia\*

James Schwab, American Planning Association\*

Ravi Srinivasan, University of Florida\*

Thomas Theis, University of Illinois at Chicago\*

David Tilley, University of Maryland\*

Henry Walker, EPA Office of Research and Development

Karen Weigert, Chicago Council on Global Affairs

Moira Zellner, University of Illinois at Chicago\*

Junjun Zheng, University of Illinois at Chicago

\* Presenter