

REPORT FOR THE NATIONAL SCIENCE FOUNDATION
WORKSHOP ON SUSTAINABLE URBAN SYSTEMS

How Does Infrastructure Shape Equity and Well-being across the Urban-Rural Gradient?

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CENTER FOR SUSTAINABLE COMMUNITIES
TEMPLE UNIVERSITY
PHILADELPHIA, PA



 Temple
University
College of Liberal Arts

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Report on the workshop 'How Does Infrastructure Shape Equity and Well-being Across the Urban-Rural Gradient'

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Executive Summary

The workshop entitled ‘How Does Infrastructure Shape Equity and Well-being across the Urban-Rural Gradient?’ took place on September 11th to September 13th, 2019 at Temple University’s Center for Sustainable Communities (CSC). It was supported by the National Science Foundation (NSF) under Grant No. 1929834 and Temple University in partnership with Drexel University, Hunter College, CUNY, Indiana University Bloomington, Oak Ridge National Labs, The Franklin Institute, the Delaware Valley Regional Planning Commission, the Sustainable Business Network, and Planet Philadelphia. The event aimed to contribute to the next generation convergence science for sustainable systems, a key area highlighted in the NSF report on Sustainable Urban Systems (SUS) research¹. The workshop was attended by 68 participants representing a range of disciplines, including the social, engineering, health, data and environmental sciences, and sectors, including researchers, practitioners, industry leaders, government agencies, educators, journalists, and community organizers. The workshop addressed the impact of infrastructure on equity and well-being across the urban-rural gradient through a case study of the Philadelphia metropolitan region. This area emerged in the planning process as a compelling and important site to explore infrastructure across the urban-rural gradient due to its aging infrastructure, prevalence need for environmental justice, and dearth of regional sustainability planning despite an extensive network of nonprofits and city politicians committed to these issues.

The workshop provided this diverse group of sustainability researchers and practitioners with an opportunity to familiarize themselves with each other’s disciplinary backgrounds, and theoretical and practical expertise in sustainability. The participants explored how the integration of sets of knowledge and skills across diverse perspectives can develop a sustainability science to better understand and address how infrastructure shapes equity and well-being across the urban-rural gradient. As a result, attendees left the workshop with a shared understanding of these concepts and a readiness to continue working collaboratively on sustainability research.

Recurring topics of discussion included:

- How to create and evaluate models for knowledge co-production
- How to meaningfully prioritize equity and wellbeing in sustainability research and planning
- How to incorporate an analysis of health outcomes, disparities and impacts into infrastructure research
- Possible re-conceptualizations of the urban-rural gradient
- The need for comparative research on infrastructure systems

While participants did not reach consensus on a single framework, they demonstrated how substantive engagement with each other’s disciplinary backgrounds and sustainability expertise might produce a synergistic transdisciplinary scientific research approach. Participants felt that the workshop gave them an increased understanding of the significance of the challenges ahead for improving how infrastructure impacts health, well-being, and environmental

¹ <https://www.nsf.gov/ere/ereweb/ac-ere/sustainable-urban-systems.pdf>

sustainability. Participants also believed that continued co-produced research and transdisciplinary approaches to research will produce the knowledge needed to address this urgent set of challenges. They expressed an interest in continuing to collaborate and expand the network of participants.

The workshop concluded with discussions of how to disseminate the outcomes of the event through this report, publications, media dissemination and public activities with various stakeholders. A concluding meeting among the workshop organizers and interested others reflected on and synthesized the three days of presentations and discussions and explored the way forward. This meeting served to clarify the processes for the continuation of the participants' work, lay out plans for upcoming publications and outreach, and discuss potential funding sources for building a research network.

Workshop deliverables developed by the organizers

- This report on workshop outcomes to be posted on research centers from each participating university
- A concept paper as well as manuscripts for papers in a special issue of a journal that articulates the gaps within and proposed priority areas for research on how infrastructure shapes equity and well-being across the urban-rural gradient
- Presentations of workshop outcomes to The Franklin Institute's Climate and Urban Systems Partnership (CUSP) network and the Delaware Valley Regional Planning Commission's Climate Adaptation Forum
- A public broadcast and podcast about the process and outcomes of the workshop on the radio show Planet Philadelphia

Introduction

Given the inherent complexity of sustainability challenges, gathering researchers and practitioners from different disciplines and backgrounds is a powerful way to envision and create a more sustainable society. For several decades, scientific and policy communities have explored infrastructure, equity, and health in relation to sustainability generally, as well as in specific (primarily urban) places. However, they have largely ignored the interrelations among these three realms, and the ways in which these interrelations manifest across urban and rural spaces. Moreover, academics conducting research on these topics often operate within disciplinary silos where they tend to reproduce the same findings, encounter the same limitations, and lose sight of the many potential collaborators within nonprofits, policy circles, media, and neighborhoods who might contribute more holistic and nuanced understandings of sustainability².

This workshop, hosted by Temple University's Center for Sustainability Communities, set out to break down these disciplinary silos and engage non-academic collaborators in order to build new frameworks for sustainability science research centering around infrastructure analysis. The workshop answered the National Science Foundation's (NSF) call to develop the next generation of convergent Sustainable Urban Systems (SUS) research through laying the groundwork for a science of equity and well-being across the urban-rural gradient. These new collaborations are intended to incorporate multiple conceptual approaches, visions, and tools in order to robustly address contemporary and future sustainability challenges. From the workshop presentations, discussions, and brainstorming sessions, we identified key gaps and opportunities within sustainability research/policies, such as the need to more accurately conceptualize the urban-rural gradient, to integrate assessment of health impacts into infrastructure analysis, and develop effective and ethical models for knowledge co-production. Ultimately, the outcomes of this workshop, namely the relationships forged among different academics, policymakers, and practitioners, are intended to support the advancement of the next generation of SUS convergence science³.

² "Sustainable urban systems (SUS) are those that are transforming their structures and processes with the goal of measurably advancing the well-being of people and the planet (page 5)." (<https://www.nsf.gov/ere/ereweb/ac-ere/sustainable-urban-systems.pdf>)

³ "This type of science relates to both definitions of trans-disciplinary research, in which new science and methods are generated as a function of deep integration across disciplines and the explicit consideration of how to transition from basic scientific discovery to practitioner application (page 11)." (<https://www.nsf.gov/ere/ereweb/ac-ere/sustainable-urban-systems.pdf>)

Aims and structure of the workshop

Aims

The overall aim of the workshop was to contribute to the NSF's call to develop a convergence science of sustainable urban systems by exploring how infrastructure shapes equity and well-being across the urban-rural gradient with a transdisciplinary group of participants.

The expected outcomes of the workshop were to:

- Identify methodological challenges and data gaps, and develop new conceptual frameworks and research questions for a convergence science of equity and well-being for SUS across the urban-rural gradient;
- Identify challenges and develop new models of co-production of actionable knowledge for SUS; and
- Determine the scalability of the conceptual frameworks developed in the Philadelphia metropolitan area to other cities and regions in the US and globally.

Structure

The workshop took place over the course of three days and consisted of a combination of formal presentations, a keynote address, panel discussions, and breakout group discussions. Each day addressed one of the workshop objectives and advanced a research agenda about how infrastructure shapes equity and well-being across the urban rural gradient, as it is described below.

Day 1: Identify the gaps and challenges in the study of equity and well-being in Sustainable Urban Systems with a focus on infrastructure systems along the urban-rural gradient: Day 1 featured panels and breakout sessions aimed at conceptualizing dimensions of the proposed research agenda, reviewing case studies and identifying collective gaps in our knowledge pertaining to the integration of the five themes of the workshop: sustainable infrastructure, equity, health and well-being, urban-rural gradient, and co-production of knowledge.

Day 2: Define research questions, methods, and objectives to address the gaps and challenges identified in Day 1 and their scalability: Day 2 focused on methodological approaches to address the challenges identified on Day 1, including how best to co-produce knowledge, through a panel discussion and two breakout sessions in which participants further developed and refined research questions, and discussed the scalability of the research agenda.

Day 3: Discuss the dissemination of workshop and next steps (Organizing Committee and Interested Others): Day 3 featured reflections on the workshop, along with small group planning sessions in which deliverables and next steps were discussed.

A total of 68 experts attended the workshop. The organizing committee explicitly aimed to ensure the participation of people from diverse backgrounds in terms of disciplines, sectors, stage of career, gender, race and ethnic origin. Workshop participants included 30 academic

researchers at various stages of their careers from natural science, social science, engineering, public health, and medical fields, and an additional 38 participants from local and state government, industries, non-profits, and community organizations. The participation was broad but attendance by some participants, particularly policymakers and community organizers was limited to a few sessions because of their time constraints. With the workshop's focus on data production, participants directly discussed the importance of overcoming such constraints in future initiatives.

Day 1: Identify the gaps and challenges in the study of equity and well-being in Sustainable Urban Systems, with a focus on infrastructure systems along the urban-rural gradient

Opening Remarks:

Michele Masucci, Vice President for Research, Temple University

Melissa Gilbert, Director, Center for Sustainable Community, Temple University

Kay Wood, Producer and Host of Planet Philadelphia

Michele Masucci, Vice President for Research at Temple University, welcomed participants to Temple University and explained how this workshop was part of a broader strategy to promote environmental and global change research at the university. Melissa Gilbert, Director of the Center for Sustainable Communities at Temple University, welcomed participants on behalf of the organizing committee and explained the objectives and deliverables of the workshop. Kay Wood, producer and host of Planet Philadelphia, an environmental radio show, explained that she was developing a radio show and podcast based on the workshop and that she and graduate students would be conducting interviews throughout the workshop.

Conference presentations I: Setting the Framework: How infrastructure shapes equity along the urban-rural gradient.

Moderator: Victor Gutierrez, Assistant Professor of Geography and Urban Studies, Temple University

Eduardo Brondízio, Distinguished Professor of Anthropology and Director, Center for the Analysis of Social-Ecological Landscapes (CASEL), Indiana University Bloomington

Simi Hoque, Associate Professor of Engineering, Drexel University

Eugenia South, Assistant Professor, Department of Emergency Medicine, University of Pennsylvania

Hallie Eakin, Professor and Senior Sustainability Scientist, Julie Ann Wrigley Global Institute of Sustainability, Arizona State University

Lara Roman, Research Ecologist, Philadelphia Field Station – Northern Research Station, USDA Forest Service

Catherine Brinkley, Assistant Professor, Community and Regional Development, UC Davis

This session introduced participants to each of the five themes of the workshop (sustainable infrastructure, equity, well-being, urban-rural gradient, and co-production of knowledge) in relation to the main question of the workshop through a series of presentations from experts in the fields.

- Eduardo Brondízio used his work examining rural family networks in the Amazon to discuss the concept of an **urban-rural gradient** and critiqued the urban-centric focus, arguing for a reconceptualization based on the interdependencies of urban and rural places.
- Simi Hoque discussed **sustainable infrastructure** focusing on the close relationship between it and human well-being, and defining sustainable infrastructure as those infrastructures that support living well with minimal harm to the environment. She challenged the participants to think closely about how infrastructure shapes both cities and non cities in the context of accelerated urban population growth, and might produce harms and benefits across an urban-rural gradient. Her concerns include how to extend the services provided by infrastructure to rural areas as well.
- Gina South argued for centering a framework of **health and well-being** in all levels of infrastructure planning, implementation and evaluation. She used a series of examples from her own work in Philadelphia pertaining to urban greening initiatives and the resulting positive health impacts to illustrate the strong link between infrastructural conditions and health outcomes.
- Hallie Eakin used her research on household vulnerability in Mexico City to highlight the imperative of **equity** and justice in infrastructure planning and the importance of recognizing non-expert knowledges, perspectives and values as a foundation for equitable processes.
- Lara Roman raised important questions regarding the **co-production of knowledge** and collaborative processes for co-managing natural resources including what institutional arrangements best facilitate co-production of knowledge, how can we alleviate burdens placed on participants from outside academia, and ensure the meaningful inclusion of marginalized voices in our research processes?
- In discussing the **urban-rural gradient**, Catherine Brinkley, shared her approach to conceptualizing connections between urban and rural areas through recognizing the complexity of the urban-rural interface, an area that she has researched extensively through studies of food systems in US cities. She argued for better methods for identifying the interfaces between urban and rural systems as a means of further developing our understanding of how these systems relate and where sustainability initiatives might be most useful and impactful.

Several related themes emerged across the presentations. Multiple presenters used case studies across the Global North and the Global South to illustrate the complexity and context-specific nature of these systems. The issue of inequity in knowledge production and the imperative for more equitable knowledge co-production was central to many presentations. Finally, a common thread that ran through all of the presentations was the need to think about sustainability issues comprehensively, in their full complexity, from multiple perspectives and scales, and with particular attention paid to the interconnections of places and systems.

Conference presentations II: Case studies: How infrastructure shapes equity along the urban-rural gradient.

Moderator: **Hamil Pearsall**, Associate Professor of Geography and Urban Studies, Temple University

Christine Knapp, Director of the Office of Sustainability, City of Philadelphia

Laura Toran, Professor of Earth and Environmental Science, Temple University

Jerome Shabazz, Executive Director, Overbrook Environmental Education Center

Nagiarry Porcena-Meneus, Community Organizer, Tookany/Tacony-Frankford Watershed Partnership, Inc.

Russ Zerbo, Advocate at Clean Air Council

Erik Johanson, Director of Innovation, Southeastern Pennsylvania Transportation Authority

Brett Fusco, Manager, Office of Long-range Planning, Delaware Valley Regional Planning Commission

This session provided case studies by policymakers, practitioners, and researchers that explored how infrastructure shapes equity and well-being along the urban-rural gradient in the Philadelphia metropolitan area. Topics addressed included stormwater runoff, the urban heat island effect, and the need to engage community members in sustainability work in ways that value their dignity and expertise. Each panelist presented not just challenges, but potential solutions and current interventions. While all of the panelists highlighted important measures being pursued and implemented, panelists representing local and regional government tended to highlight the positive outcomes of sustainability initiatives, while those representing community organizations expressed concerns about how the dearth of representation of marginalized communities in decision-making may negatively impact the effectiveness of interventions while increasing existing inequalities. Collectively, the panelists highlighted two key themes: 1) The necessity of emphasizing environmental justice within any examination of Philadelphia's current or future sustainability challenges and 2) the need for Philadelphia's existing infrastructure systems to both address the historical legacies which have produced distinct environmental justice issues, while simultaneously positioning themselves to effectively adapt to future challenges.

Keynote Address: Leslie Richards, Secretary, Pennsylvania Department of Transportation

In her keynote address, Pennsylvania Secretary of Transportation, Leslie Richards told her impressive story of becoming the first woman to head Pennsylvania's Department of Transportation (PennDOT). Richards described her own role and that of PennDOT as both maintaining and developing Pennsylvania's transportation infrastructure, and engaging in "beyond the Pavement work," meaning programs and initiatives which address social and environmental issues. This work includes programming which is focused on sustainability, but also addresses issues of social equity through programming such as creating a system by which formerly incarcerated people receive a PennDOT ID upon release, creating a gender neutral option on licenses, and hiring policies aimed at greater inclusion of persons with disabilities. Richards also spoke to the transportation challenge of an urban-rural gradient, noting that shifts in labor markets and demographics are resulting in a growing population living outside of urban

centers who have a need for transit which serves both urban and non-urban communities. Rural areas tend to be underserved and the already limited transit access in those areas is particularly vulnerable to shifts in funding. Richards emphasized the fact that while the department continues to move away from highway-based transportation and focus on the aspects of multimodal transit, the transition to more sustainable transit presents its own challenges. Electric and self-driving vehicles, while exciting for their potential contribution to sustainability, may require modifications to existing funding mechanisms in that PennDOT receives almost all of their funding from the gas tax which is in steep decline due to these changes. She concluded with the vision of PennDOT as creating a better quality of life built on transportation excellence.

Breakout group discussion I: Identify gaps in knowledge and expertise in various themes of the workshop

Chair: Hamil Pearsall, Associate Professor of Geography and Urban Studies, Temple University

Moderators:

Sustainable Infrastructure: Simi Hoque, Associate Professor of Engineering, Drexel University

Equity: Christina Rosan, Associate Professor of Geography and Urban Studies, Temple University

Health and Well-Being: Jeremy Mennis, Professor of Geography and Urban Studies, Temple University

Urban-Rural Gradient: Eduardo Brondízio, Distinguished Professor of Anthropology, Indiana University

Co-Production of Knowledge: Rachel Valletta, Environmental Scientist, The Franklin Institute, Director of the Climate and Urban Systems Partnership and Bill Solecki, Professor of Geography and Environmental Science, Hunter College

In the first breakout session, each group identified gaps in knowledge within one of the themes of the workshop: sustainable infrastructure, equity, health and well-being, the urban-rural gradient, and co-production of knowledge. The knowledge gaps identified in this session were used as a basis for the development of research questions in later breakout sessions.

Sustainable Infrastructure

The discussion centered around the high level of uncertainty associated with the future of sustainable infrastructure, concerns around securing long-term funding, and the equitable distribution of costs and benefits across communities. A related question was how to best frame equity in relation to technological developments and changing needs. Main concerns and discussion points centered on the feasibility of developing, funding and scaling up sustainable infrastructure, convincing stakeholders and taxpayers of its importance, identifying possible trade-offs, measuring impacts at multiple levels (social, spatial, environmental and economic) and concern about who carries the associated burden or benefits. The group also discussed the increasingly complex nature of infrastructure planning processes wherein stakeholders are given more active roles.

The group identified three key gaps in knowledge:

1. There is a lack of knowledge as to how best to manage uncertainty associated with the future of infrastructure development.
2. There is a lack of certainty as to whether infrastructure can truly be sustainable in the long term.
3. There is a lack of ability to quantify direct and indirect impacts (both positive and negative) of infrastructure development.

Equity

The group discussed the possibility and potential of equitable planning for sustainable infrastructure. There was a general agreement that current planning practices are focused on addressing the problematic legacy of structural and historical inequalities; however, participants from several local groups noted that planning processes are still in many ways difficult for community members to access and participate in substantively. The group agreed that academia has put forth critiques of inequity of planning processes, planning for equitable infrastructure provision is still hampered by jurisdictional barriers, outdated planning tools, unfair political processes, the existence and legacy of structural racism, etc. Thus, existing planning tools and governance are inadequate to conceptualize and address equity holistically and across scales. Additionally there is a general lack of knowledge on the part of policy experts and planners as to what equity means to many communities. Finally, urban centric views of habitats and regions do not address the diversity of challenges and needs across the urban-rural gradient. A focus on equity across the gradient is crucial for sustainability planning along the gradient.

The group identified three key gaps in knowledge:

1. There is a lack of knowledge about the diversity of urban and rural spaces, and their mutual relationships.
2. There is a need for better conceptual frameworks and implementation models which recognize the multiscalar and multidimensional nature of inequity.
3. The governance tools are inadequate to plan for sustainable urban-rural-regional equity.

Health and Well-Being

The group discussed the relationship between health outcomes and infrastructure with special focus on issues of equity and environmental sustainability. There was a general consensus that health and well-being are related to physical environments and infrastructure. For example, behavioral health outcomes are frequently related to infrastructure characteristics. However, the group acknowledged that typically health receives little attention or consideration in discussions of infrastructure development. One key consideration for this group was how best to investigate causal links between infrastructure and health outcomes. The group discussed leveraging new technologies and big data, as well as natural experiments to query causal linkages. Identifying causal relationships is even more challenging within an urban-rural framework given the need for a clearer conceptualization of the urban-rural gradient. Finally, there was a significant conversation regarding whether research priorities should be placed on addressing health disparities or improving overall health outcomes.

The group identified three key gaps in knowledge:

1. There is a lack of understanding as to how infrastructure impacts health and well-being in the context of the urban-rural gradient.
2. There are no clear methodological pathways for investigating health and well-being in the context of the urban-rural gradient. Can new kinds of data and natural experiments be leveraged to address these questions?
3. There needs to be a sustained discussion regarding interventions which aim to narrow the gap in health disparities vs. improving overall health.

Co-production of Knowledge

The group discussed their experiences of using co-production of knowledge models in contexts ranging from science education at The Franklin Institute to research on hydraulic fracking regulation. They agreed on the importance of co-production of knowledge in addressing the complex interrelationships between environmental quality and social equity, but also brought up the potential pitfalls and obstacles of these co-production approaches. In particular, the discussion centered on the necessity of sustained relationship building in co-production models and the challenges that funding, evaluation and the urgency of the issues being addressed presents to long term relationship building.

The group identified three key gaps in knowledge:

1. There is a lack of critical evaluation of co-production projects. Many models exist but it is often difficult to know which models are most appropriate for specific situations and contexts.
2. There is a lack of both funding for co-production research--especially for compensation of community partners--and critical evaluation of failure (what didn't work) in the co-production literature.
3. There needs to be more discussion of ethics and inclusion and transparency about what these partnerships can and cannot do. Dignity, recognition, and self-empowerment are essential concepts in guiding collaborations with non-academic partners. What happens when the participatory process brings up an opinion that does not fit with the academic researchers' aims/values?

Urban-Rural Gradient

The group first focused on working on the definitions of the urban-rural gradient, its spatial and physical characteristics, and how to best assess the associated sustainability challenges. The group agreed that the nature and characteristics of the gradient are highly context dependent. Variables to be considered in characterizing the urban-rural gradient include: demographics, spatial extent, identities, prevalent land covers, modes of production, economic diversity, environmental risk exposure and scale. Characterizing these systems has to be done carefully, because definitions have important implications in terms of informing research, policy initiatives and resource allocation. The discussion focused in particular on the governance of urban-rural gradients, with consideration for the mutually dependent relationship between the urban and the rural, how to manage these relationships, and where within these systems power is situated. The group discussed the role of capital in informing the decisions that produce inequitable infrastructure processes across the urban-rural gradient, along with emphasizing how

innovations developed in rural areas, such as small decentralized, voluntary systems designed to address the absence of centralized capacity, can provide valuable lessons for urban areas.

The group identified three key gaps in knowledge:

1. There is a need for conceptualizations of urban-rural relationships that can represent their multidimensional nature.
2. There is a need for an understanding of the historical and emerging challenges and opportunities in the governance of urban-rural relationships.
3. There is a need for an understanding of how best to integrate different conceptual frameworks in order to understand the multiple processes that constitute urban-rural relationships.

Day 2: Defining research questions, methods, and objectives to address the gaps and challenges identified in Day 1 and their scalability

Panel session I: Conceptual and methodological opportunities for data production in transdisciplinary Sustainable Urban Systems

Moderator: Victor Gutierrez, Assistant Professor of Geography and Urban Studies, Temple University

Robert Cheetham, President and CEO, Azavea

Jennifer Baka, Assistant Professor of Geography, Penn State University

Alan Wiig, Assistant Professor of Urban Planning and Community Development, University of Massachusetts

Rachel Valletta, Environmental Scientist, Franklin Institute, Director of the Climate and Urban Systems Partnership

Emily Grubert, Assistant Professor of Civil and Environmental Engineering, Georgia Tech

Akira Rodriguez, Joint Lecturer, University of Pennsylvania Weitzman School of Design School of Social Policy and Practice

Michelle Kondo, Research Social Scientist, USDA- Forest Service, Philadelphia Field Station

Rhiannon Jerch, Assistant Professor of Economics, Temple University

This panel featured a range of differing views concerning data collection, production and access, ensuring the utility of data for sustainability questions, and the challenges of knowledge co-production. Panelists spoke of employing a variety of different data sources, including historical data to address such challenges. A key discussion related to the role of private and public sector organizations in data creation and maintenance. Some felt that governments should be competing for access to as much data as private companies in order to create good policy, while others expressed concern over individual privacy and suggested that the government has sufficient data to create good policies, but is deploying that data ineffectively. There was general concern around the role of biases in the production and deployment of data for sustainability challenges. Panelist tended to frame the utility of data in terms of how the data is being mobilized and who benefits most from its use.

Regarding co-production, there were differing views about the means by which knowledge is co-produced and what the composition of research partnerships should be. Several panelists recognized co-production as a “gold standard” for engaged research, but argued that researchers need to think more critically about what is being asked of community partners and how exactly those communities might benefit from engaging in these projects. The issue of temporary or precarious research funding and the associated difficulties in maintaining community partnerships and compensating community partners was stressed by several panelists. Many panelists framed compensating community partners as an ethical imperative. Other ethical issues related to co-production of knowledge were discussed, including

unintended consequences, power asymmetries in research on/with vulnerable communities, and insider-outsider dynamics.

Synthesis of sessions on conceptualizations and case studies

Rachel Valletta, Environmental Scientist, Franklin Institute, Director of the Climate and Urban Systems Partnership

Bill Solecki, Professor of Geography at Hunter College and Founder Director, Emeritus, CUNY Institute for Sustainable Cities

Christina Rosan, Associate Professor of Geography and Urban Studies, Temple University

Three members from the organizing committee provided a synthesis of the presentations and discussions over the course of the workshop.

Rachel Valletta reflected on issues of knowledge co-production, with particular emphasis on the discussions relating to how researchers develop and maintain long-term relationships. Valletta drew from her own work with The Franklin Institute in arguing that creating sustainable communities means maintaining relationships with those communities engaging with researchers. She suggested that the participants consider themselves as part of Philadelphia's learning ecology.

Bill Solecki highlighted the importance of "social infrastructure" or the immaterial and social dimensions of the urban-rural gradient. He suggested that making social infrastructure visible may have powerful implications for sustainable transitions. Solecki then moved on to what he deemed to be a bigger question; what are the intersecting elements which connect infrastructure, the urban-rural gradient and equity? To answer that question, Solecki proposed four goals; 1) making the process and interactions that constitute the urban-rural gradient more transparent, visible, understandable; 2) investigating the governance systems that shape these processes; 3) emphasizing flexibility, dynamism, urgency in our approaches to sustainable transformations; and 4) focusing on the process of urbanization, the always emergent nature of urban systems.

Christina Rosan challenged participants to more clearly articulate what equity is and how we are or should be measuring it. She reiterated Valletta and Solecki's assertion that linkages exist between infrastructure and equity, adding that we should also be considering rights in this framework. She defined infrastructure fundamentally as the ability of people to live in communities and have access to goods and services and argued that stronger networks of infrastructure creates security and well-being. She pointed to the block to block inequities in Philadelphia in suggesting our units of analysis must be more granular. She concluded that given how complex the urban-rural gradient is as a system, the job of participants should be to clearly articulate the nature and extent of this system (to make it visible) in order that communities and governments can best advocate for and produce equitable systems.

Summary of the previous day

Hamil Pearsall, Associate Professor of Geography and Urban Studies, presented a synthesis of the research gaps emerging from the themes in Breakout Session I. The following cross-cutting gaps were proposed to the groups. Groups were then encouraged to compose questions that would address these gaps:

1. A better conceptualization and measurement of how inequity impacts health and well-being across the urban-rural gradient;
2. A conceptualization of the distribution of costs and benefits of infrastructure across rural-urban processes;
3. Methods to quantify the impacts of infrastructure on health and well-being;
4. Definitions of good governance tools for managing infrastructure to improve urban-rural regional equity;
5. Models of co-production that are effective in fostering collaboration across the urban-rural gradient; and
6. Determining what a focus on infrastructure across an urban-rural framework might reveal about connections between health and well-being.
7. Need to better understand the tradeoffs among all stakeholders and communities, also which items are commensurable with each other across different communities and along the urban-rural gradient;
8. Need for an explicit focus on environmental and non-human impacts of infrastructure;
9. Need to understand the causal chain and mechanisms.
10. Thinking about health and other equity in the context of power structures that revolve around money so we need to have this conversation in a way that speaks to those with power and money in a way that is not a moral argument but some other argument

Break out group discussions II: Brainstorm research questions

Facilitators:

Simi Hoque, Associate Professor of Engineering, Drexel University

Christina Rosan, Associate Professor of Geography and Urban Studies, Temple University

Jeremy Mennis, Professor of Geography and Urban Studies, Temple University

Rachel Valletta, Environmental Scientist, The Franklin Institute, Director of the Climate and Urban Systems Partnership

Bill Solecki, Professor of Geography and Environmental Science, Hunter College

Eduardo Brondízio, Distinguished Professor of Anthropology, Indiana University

Workshop participants reconvened in smaller groups to conceptualize research questions that have the potential to be pursued as projects. Each group had participants with expertise and interests from each of the workshop themes. At the end of the session, the facilitators presented the questions to the larger audience.

Emerging questions from this session are as follows:

1. Questions on framing relationships in the urban-rural gradient
 - a. How do we study the individual connections to infrastructure and the impacts on health and well-being? What are the best mechanisms to capture human experience?
 - b. What are the trade-offs, feedbacks and amplifying effects between the services provided by different types of infrastructure? How does this vary across urban and rural gradients and over time?

- c. How are different institutional arrangements governing appropriation and provisioning of infrastructures interacting, aligning and conflicting along urban and rural gradients?
 - d. How do we design research that test for causal mechanisms among infrastructure, well-being and equity outcomes?
 - e. What criteria determines good governance, investment and management of infrastructure across the urban-rural gradient? What are the appropriate temporal scales and spatial scales to identify the criteria?
 - f. What roles can multiscale infrastructure (such as transportation networks, waterways, cultural institutions) and the understanding of such infrastructure play in connecting urban-rural people? Are there kinds of infrastructure that can facilitate bridging relationships among people?
2. Questions on infrastructure investment, health, and equity
- a. What do we know about the distribution of benefits of public and private investment in green infrastructure?
 - b. Can (and if yes, how can) new investments and transformations in existing infrastructure help to improve health and health equity in systems across the urban-rural gradient?
 - c. How can infrastructure adapt to past and changing economic processes (such as deindustrialization)?
 - d. How can we develop and implement information infrastructure and how effective is it in improving health and equity?
 - e. How do we implement program evaluations that can measure effect size and cost/efficiency of interventions given specific goals?
 - f. How do we utilize existing infrastructure for urban environment monitoring and develop a more active way to monitor?
 - g. Are there trade offs or limits to community involvement in infrastructure development?
3. Questions for improving the state of knowledge on urban-rural gradient, infrastructure and equity
- a. Can infrastructure ever be sustainable or equitable? How can we have both equity and trade-offs?
 - b. How can we create tools that better integrate different forms of knowledge? (including knowledge of previous failures as well as incommensurate data)
 - c. How do communities perceive, utilize, and interact with both gray and green infrastructure across urban, suburban, and rural communities?
 - d. What kind of interactions/connections that are enabled by infrastructure foster effective co-production of knowledge?

Break-out group discussions III: Elaborate on research questions in terms of conceptual frameworks, data availability, methodological approaches, and potential applications

During this session, the break-out groups reconvened to elaborate on one of the research questions. Each group discussed conceptual frameworks, data availability, methodological approaches, and potential applications for their questions.

Group 1, Facilitator Simi Hoque

In this session, Group 1 explored together what an alternative conceptual framework that uses health and equity rather than economics to research infrastructure limitations. The group then put different systems into that map such as the food system, water system, and criminal justice system. They noted that: 1) large infrastructure investments are inevitable because of climate change and health/health equity needs to be prioritized within that context, 2) new models may arise by replacing economics with health/health equity as a key metric, and 3) this research would be informed by an urban-rural comparative analysis.

Group 2, Facilitator Eduardo Brondizio

Group 2 focused on how a range of variables including socio-economic diversity, population size, environmental factors/hazards, and the nature of technology affect transitions in infrastructure systems and the potential consequence for equity along the rural-urban gradient. Group 2 was interested in how these variables might be understood in relation to the success of transitions and the ultimate outcomes for equity. The group proposed examining this question by using a cross-sectional sample of cities and integrating a range of data sources relevant to those cities. Ultimately the group was interested in collecting and aggregating data from across systems that span the urban rural gradient (eg. energy, transportation, water) at points along that gradient and over an extended time period in order to best understand the interrelations of social, technological and environmental variables on transitions and equity.

Group 3, Facilitator Christina Rosan

Group 3 developed a research agenda aimed at understanding how best to identify targets for improving sustainability with a particular focus on energy systems. The group argued for the need for a regional perspective so that synergies can be built and recognized among communities using different, but complementary strategies. They also argued for a network/life cycle approach to mapping/making visible the entirety of energy systems across space and time and across the urban-suburban-rural gradient. Group three argued that this approach of focusing on one sector and its impact on the urban-suburban-rural gradient would allow us to better understand synergies and conflicts across the gradient and identify ways to create equitable and sustainable linkages. In short, the group was looking at how data pertaining to sustainable interventions could be gathered, evaluated and disseminated so that different models for success can be applied in the appropriate contexts.

Group 4, Facilitator Jeremy Mennis

Group 4 questioned how existing built infrastructure, both in urban and rural contexts, can be adapted and transformed in response to changing social, physical, and economic contexts to maximize sustainability. They focused specifically on how methodological approaches, which can account for temporal dimensions of sustainability challenges, might be deployed in order to envision and evaluate transitions. Group 4 also looked at how new information infrastructures might be developed to support real-time, fine spatial-temporal scale data capture. In particular, the group focused on data capture at the individual and streetscape levels across the urban-rural gradient. Developing these kind of data capture methodologies might prove useful for addressing questions pertaining to which infrastructures are most useful for or impactful in advancing well-being and health disparities.

Panel session II: Synthesis and scalability to other regions in the US and beyond

Moderator: Hamil Pearsall, Associate Professor of Geography and Urban Studies, Temple University

Usama Bilal, Assistant Professor of Epidemiology and Biostatistics, Drexel University

Eduardo Brondízio, Distinguished Professor of Anthropology, Indiana University Bloomington

Hallie Eakin, Professor and Senior Sustainability Scientist, Julie Ann Wrigley Global Institute of Sustainability, Arizona State University

Peleg Kramer, Assistant Professor of Geography and Environment, Villanova University

Joe Pierce, Assistant Professor of Geography and Environmental Sustainability; Regional and City Planning, University of Oklahoma

Bill Solecki, Professor of Geography and Environmental Science, Hunter College

Mark Stone, Associate Professor of Civil, Construction, and Environmental Engineering, University of New Mexico

Clare Hinrichs, Professor of Rural Sociology, Penn State University

Panelists in this session reflected upon the previous day's conversations and discussed the issues and opportunities for scaling up and applying the urban-rural gradient framework to differing sites and contexts. There was a consensus among each panelist regarding the opportunities for and necessity of comparative research, at the national scale as well as within the global north context, the global south context and between north/south contexts. The consensus among panelists seemed to be that urban-rural systems were a key arena for future research and more work was needed to better conceptualize these systems. Several panelists suggested that a "gradient" conceptualization of the connections across urban and rural places implied a linear change and missed differentiation within systems. Many of the panelists favored language that framed urban-rural systems as a "mosaic", while the need to weigh and compare frameworks that are place based, networked, and/or relational was also discussed.

The richness and complexity of the questions presented by the frameworks discussed demanded attention to methodological issues; panelists posed questions about how to sample

large, heterogeneous populations across an urban-rural system gradient, what forms of data might be most appropriate for understanding such systems, what role experimentation might play in implementing and evaluating interventions and whether existing forms of knowledge co-production are appropriate for these complex systems. Finally, several panelists reflected on the need for a better understanding of the complex governance systems guiding sustainable transformations and how social movements in shaping processes and outcomes within urban-rural systems.

Day 3: Discussion relating to the dissemination of workshop findings and next steps

The concluding day of the workshop focused on developing deliverables from the workshop. The morning began with Melissa Gilbert (Temple University) outlining the six (6) deliverables: the National Science Foundation (NSF) community report, a collaboration that would reach the broader public community, a policy-oriented deliverable, a podcast, a concept paper as a result of the workshop, and a special journal issue covering work from this and other related NSF workshops.

For the broader public community, Rachel Valletta, an environmental scientist representing The Franklin Institute in Philadelphia, PA was present to offer her suggestions and resources as potential partners in this endeavor. She suggested holding a workshop for public participants to explore their understandings of the concept of sustainability and why it mattered to them.

Brett Fusco, manager of long-range planning at the Delaware Valley Regional Planning Commission (DVRPC), is leading the effort to reach out to policymakers from the area to disseminate the results and themes from the workshop. He suggested holding an event with policymakers to receive feedback on the results of the workshop and to develop an ongoing relationship with policymakers in the Philadelphia metropolitan region.

Dr. Eduardo Brondízio, editor-in-chief of *Current Opinions in Environmental Sustainability* provided information on the process of proposing a special issues in the journal. *Current Opinions in Environmental Sustainability* publishes short review papers of mostly recent literature on the topic from the past 2-3 years in a field, as well as synthesis and agenda-setting papers. The organizing committee is exploring the possibility of pursuing a special issue along the themes of the workshop and is currently drafting a conceptual paper to guide the development of the special issue.

Conclusion & Next Steps

The workshop concluded with a consensus on the need to develop a science of equity and well-being across the urban-rural gradient. We laid the groundwork by identifying important gaps in knowledge that will anchor our work moving forward including: e on are:

- **How to create and evaluate models for knowledge co-production:** Participants agreed that co-production of knowledge (among academic researchers, policymakers, educators, and nonprofit workers, etc) must be a priority for developing a science of equity and well-being across the urban-rural gradient. However, much more must be done in terms of developing feasible and ethical models for this approach to research as well as methods for evaluating these models.
- **How to meaningfully prioritize equity and well-being in sustainability research and policy-making:** Participants discussed the fact that academia has put forth several critiques of equity issues in planning and policy-making, but has offered few solutions. They identified a significant gap in research, policy-making, and planning, specifically a lack of knowledge about what communities actually think about equity, infrastructure, and sustainability, which underscores the importance of co-produced knowledge.
- **How to bring analysis of health into infrastructure research:** Participants found that there is very little research that looks at the impacts of specific infrastructures on health outcomes and proposed that this should be a key area of future research.
- **Possible re-conceptualizations of the urban-rural gradient:** Participants debated the usefulness of the concept of “urban-rural gradient” and whether the terms “mosaic” or “network” might be more accurate. The consensus was that urban-rural systems are in fact a key arena for future research given the sustainability challenges we are experiencing in many types of infrastructure systems such as food, energy, water, transportation, education etc. Therefore more thought should be put into how best to conceptualize these systems.
- **Comparative research on infrastructure systems:** While the Philadelphia metropolitan area was the case study for exploring these topics, participants identified the need for comparative research across the urban-rural gradient, between different urban-rural sites, and especially between the Global North and the Global South.

Next steps include:

- **Distributing this report** to community partners and others’ interested in organizing similar workshops.
- Small groups **maintaining relationships** and continuing to discuss their emerging transdisciplinary research projects.
- **Publishing** outcomes of the workshop and developing frameworks in academic journals.
- **Connecting with organizers of other NSF SUS workshops** to reflect on experiences and synthesize findings for additional publishing collaborations.

Annexes

Annex 1: Members of the Workshop Organizing Committee

Chairperson:

Melissa R. Gilbert, Director, Center for Sustainable Communities, Temple University

Committee:

Jocelyn Behm, Assistant Professor, Department of Biology, Temple University

Christa Brelsford, Liane Russell Fellow at Oak Ridge National Laboratory

Eduardo Brondízio, Distinguished Professor of Anthropology and Director, Center for the Analysis of Social-Ecological Landscapes (CASEL), Indiana University Bloomington

Brett Fusco, Manager, Office of Long-Range Planning, Delaware Valley Regional Planning Commission

Victor Gutierrez, Assistant Professor of Geography and Urban Studies, Temple University

Simi Hoque, Associate Professor of Engineering, Drexel University

Franco Montalto, Associate Professor of Engineering, Director of Sustainable Water Resource Engineering Laboratory at Drexel and Director for the Northeast hub of the Urban Climate Change Research Network

Hamil Pearsall, Associate Professor of Geography and Urban Studies, Temple University

Christina Rosan, Associate Professor of Geography and Urban Studies, Temple University

Anna Shipp, Executive Director, Sustainable Business Network of Philadelphia

Bill Solecki, Professor of Geography at Hunter College and Founder Director, Emeritus, CUNY Institute for Sustainable Cities

Laura Toran, Professor of Earth and Environmental Science, Temple University

Rachel Valletta, Environmental Scientist, Franklin Institute, Director of the Climate and Urban Systems Partnership (CUSP)

Kay Wood, Producer and Host of Planet Philadelphia

Administrative Staff at Temple University:

Vicki Giammarco, Senior Administrator, Center for Sustainable Communities

Liz Janczewski, Program Coordinator PSM in GIS, Department of Geography and Urban Studies

Cyril Ireland, Information Technology, College of Liberal Arts

Research Assistants, Center for Sustainable Communities, Temple University:

Praise Akanbi

Rebecca Croog

Stephen Dickinson

Sarah Heck

Shrobona Karkun

Dirk Kinsey

Matthew Marcus

Naida Elena Montes

Jeronimo Rodriguez

Alisa Shockley

Melissa Tolosa

Annex 2: Workshop Participants

Eliza Alford, Government Relations Manager, Sustainable Business Network of Greater Philadelphia

Jennifer Baka, Assistant Professor of Geography, Penn State University

Usama Bilal, Assistant Professor of Epidemiology, Drexel University

Catherine Brinkley, Assistant Professor, Community and Regional Development, UC Davis

Robert Cheetham, President and CEO, Azavea

Rebecca Collins, Director of Sustainability, Temple University

Liang Du, Assistant Professor, Department of Electrical Engineering, Temple University

Hallie Eakin, Professor and Senior Sustainability Scientist, Julie Ann Wrigley Global Institute of Sustainability, Arizona State University

Emily Grubert, Assistant Professor of Civil and Environmental Engineering, Georgia Tech

Megan Heckert, Associate Professor, Geography and Planning, West Chester University

S. Blair Hedges, Carnell Professor and Director, Center for Biodiversity, Temple University

Kevin Henry, Associate Professor, Geography and Urban Studies, Temple University

Clare Hinrichs, Professor of Rural Sociology, Penn State University

Rhiannon Jerch, Assistant Professor of Economics, Temple University

Erik Johanson, Director of Innovation, Southeastern Pennsylvania Transportation Authority

Christine Knapp, Director of the Office of Sustainability, City of Philadelphia

Michelle Kondo, Scientist, USDA Forest Service Northern Research Station, Philadelphia Field Station

Peleg Kremer, Assistant Professor, Department of Geography and the Environment, Villanova University

Fran Lawn, GSI Partners Manager, Sustainable Business Network of Greater Philadelphia

Robin Leichenko, Professor and Chair, Department of Geography, Co-Director Rutgers Climate Institute, Rutgers University

Xiaojiang Li, Assistant Professor of Geography and Urban Studies, Temple University

Michele Masucci, Vice President for Research, Temple University

Mahbubur Meenar, Assistant Professor, Geography, Planning, and Sustainability. Director, Community Planning + Visualization Lab, Rowan University

Jeremy Mennis, Professor of Geography and Urban Studies, Temple University

Howard Neukrug, Executive Director, The Water Center, University of Pennsylvania

Joe Pierce, Assistant Professor, Department of Geography and Environmental Sustainability and Division of Regional and City Planning, University of Oklahoma

Leslie S. Richards, Secretary of Transportation, Pennsylvania Department of Transportation

Akira Drake Rodriguez, Joint Lecturer, University of Pennsylvania Weitzman School of Design, School of Social Policy and Practice

Lara Roman, Research Ecologist, Philadelphia Field Station-Northern Research Station, USDA Forest Service

Karl Russek, Director: Programs and Applied Research at The Water Center, University of Pennsylvania

Jerome Shabazz, Executive Director, Overbrook Environmental Education Center

Julie Slavet, Executive Director, Tookany/Tacony-Frankford Watershed Partnership, Inc.

Eugenia South, Assistant Professor, Department of Emergency Medicine, University of Pennsylvania

Mark Stone, Associate Professor and Regents' Lecturer, Department of Civil, Construction and Environmental Engineering, Director of the UNM Resilience Institute, University of New Mexico

Max Jordan Nguemeni Tiako, Doctor of Medicine Candidate, Yale School of Medicine

Sandra Suarez, Senior Associate Dean for Faculty Affairs and Research, Temple University

Kimberley Thomas, Assistant Professor of Geography and Urban Studies, Temple University

Alan Wiig, Assistant Professor of Urban Planning and Community Development, University of Massachusetts Boston

Celeste Winston, Assistant Professor of Geography and Urban Studies, Temple University

Russ Zerbo, Advocate at Clean Air Council

Annex 3. Workshop Program

September 11 – Day 1 Alter Hall – 7th Floor (MBA Commons)	
Day 1: Identify the gaps and challenges in the study of equity and well-being in Sustainable Urban Systems with a focus on infrastructure systems along the urban-rural gradient	
8:00am-8:45am	Registration and breakfast
8:45am-9:15am	Opening Remarks <ul style="list-style-type: none"> ● Michele Masucci, Vice President for Research, Temple University ● Melissa Gilbert, Director, Center for Sustainable Communities, Temple University ● Kay Wood, Producer and Host of Planet Philadelphia
9:15am-11:00am	Setting the Framework: How infrastructure shapes equity and well-being along the urban-rural gradient Moderator: Victor Gutierrez , Assistant Professor of Geography and Urban Studies, Temple University <ul style="list-style-type: none"> ● Eduardo Brondizio, Distinguished Professor of Anthropology and Director, Center for the Analysis of Social-Ecological Landscapes (CASEL), Indiana University Bloomington ● Simi Hoque, Associate Professor of Engineering, Drexel University ● Eugenia South, Assistant Professor, Department of Emergency Medicine, University of Pennsylvania ● Hallie Eakin, Professor and Senior Sustainability Scientist, Julie Ann Wrigley Global Institute of Sustainability, Arizona State University ● Lara Roman, Research Ecologist, Philadelphia Field Station – Northern Research Station, USDA Forest Service ● Catherine, Assistant Professor, Community and Regional Development, UC Davis
11:00am-11:15am	Break
11:15am-12:30pm	Case studies: How infrastructure shapes equity along the urban-rural gradient Moderator: Hamil Pearsall , Associate Professor of Geography and Urban Studies, Temple University <ul style="list-style-type: none"> ● Christine Knapp, Director of the Office of Sustainability, City of Philadelphia ● Laura Toran, Professor of Earth and Environmental Science, Temple University ● Jerome Shabazz, Executive Director, Overbrook Environmental Education Center ● Nagiarry Porcena-Meneus, Community Organizer, Tookany/Tacony-Frankford Watershed Partnership, Inc ● Russ Zerbo, Advocate at Clean Air Council ● Erik Johanson, Director of Innovation, Southeastern Pennsylvania Transportation Authority ● Brett Fusco, Manager, Office of Long-range Planning, Delaware Valley Regional Planning Commission

September 11 – Day 1
Alter Hall – 7th Floor (MBA Commons)

Day 1: Identify and converge on the gaps and challenges in the study of equity and well-being in Sustainable Urban Systems with a focus on infrastructure systems along the urban-rural gradient

12:30pm-1:45pm	<p>Lunch</p> <p>Welcome:</p> <ul style="list-style-type: none"> • Richard Deeg, Dean, College of Liberal Arts, Temple University <p>Introduction:</p> <ul style="list-style-type: none"> • Sandra Suarez, Senior Associate Dean for Faculty Affairs and Research, College of Liberal Arts, Temple University <p>Keynote:</p> <ul style="list-style-type: none"> • Leslie Richards, Secretary of Transportation, Pennsylvania Department of Transportation
1:45pm-2:15pm	<p>Synthesis of morning sessions on conceptualizations and case studies</p> <p>Facilitators:</p> <ul style="list-style-type: none"> • Bill Solecki, Professor of Geography at Hunter College and Founder Director, Emeritus, CUNY Institute for Sustainable Cities • Rachel Valletta, Environmental Scientist, Franklin Institute, Director of the Climate and Urban Systems Partnership • Tina Rosan, Associate Professor of Geography and Urban Studies, Temple University
2:15pm-3:30pm	<p>Break-out group discussions to identify frameworks, concepts, gaps/challenges in knowledge, data, and methods</p> <p>Chair: Hamil Pearsall, Associate Professor of Geography and Urban Studies, Temple University</p> <p>Moderators:</p> <p><i>Infrastructure:</i> Simi Hoque, Associate Professor of Engineering, Drexel University <i>Equity:</i> Tina Rosan, Associate Professor of Geography and Urban Studies, Temple University <i>Health and Well-Being:</i> Jeremy Mennis, Professor of Geography and Urban Studies, Temple University <i>Co-Production of Knowledge:</i> Rachel Valletta, Environmental Scientist, Franklin Institute, Director of the Climate and Urban Systems Partnership and Bill Solecki, Professor of Geography and Environmental Science, Hunter College <i>Urban-Rural Gradient:</i> Eduardo Brondizio, Distinguished Professor of Anthropology, Indiana University</p>
3:30pm-3:45pm	Break
3:45pm-5:00pm	<p>Plenary discussion of break-out group session on frameworks, concepts, gaps/challenges in knowledge, data, and methods</p> <p>Chair: Hamil Pearsall, Associate Professor of Geography and Urban Studies, Temple University</p>
5:00pm-7:00pm	Reception

September 12 – Day 2
Howard Gittis Student Center Room 200 C

Day 2: Define research questions, methods, and objectives to address the gaps and challenges identified in Day 1 and their scalability

8:00am-8:45am	Breakfast
8:45am-9:00am	<p>Review of key gaps and challenges from first day's activities</p> <p>Facilitators:</p> <ul style="list-style-type: none"> ● Victor Gutierrez, Assistant Professor of Geography and Urban Studies, Temple University ● Hamil Pearsall, Associate Professor of Geography and Urban Studies, Temple University
9:00am-10:15am	<p>Panel Discussion: "Conceptual and methodological opportunities to data production for transdisciplinary Sustainable Urban Systems"</p> <p>Moderator: Victor Gutierrez, Assistant Professor of Geography and Urban Studies, Temple University</p> <ul style="list-style-type: none"> ● Robert Cheetham, President and CEO, Azavea ● Jennifer Baka, Assistant Professor of Geography, Penn State University ● Alan Wiig, Assistant Professor of Urban Planning and Community Development, University of Massachusetts Boston ● Rachel Valletta, Environmental Scientist, Franklin Institute, Director of the Climate and Urban Systems Partnership ● Emily Grubert, Assistant Professor of Civil and Environmental Engineering, Georgia Tech ● Akira Rodriguez, Joint Lecturer, University of Pennsylvania Weitzman School of Design, School of Social Policy and Practice ● Michelle Kondo, Research Social Scientist, USDA- Forest Service, Philadelphia Field Station ● Rhiannon Jerch, Assistant Professor of Economics, Temple University
10:15am-10:30am	Break
10:30am-11:15am	<p>Summary of panel and plenary discussion connecting gaps and opportunities for Sustainable Urban Systems</p> <p>Facilitators:</p> <ul style="list-style-type: none"> ● Victor Gutierrez, Assistant Professor of Geography and Urban Studies, Temple University ● Hamil Pearsall, Associate Professor of Geography and Urban Studies, Temple University
11:15am-12:00pm	<p>Break out group discussions to brainstorm research questions</p> <p>Chair: Melissa R. Gilbert, Director, Center for Sustainable Communities, Temple University</p>
12:00pm-12:30pm	<p>Brief presentations of research questions</p> <p>Chair: Hamil Pearsall, Associate Professor of Geography and Urban Studies, Temple University</p>

September 12 – Day 2
Howard Gittis Student Center Room 200 C

Day 2: Define research questions, methods, and objectives to address the gaps and challenges identified in Day 1 and their scalability

12:30pm-1:30pm	Lunch
1:30pm-2:00pm	Plenary exercise prioritizing research questions in terms of relevance and feasibility Chair: Victor Gutierrez , Assistant Professor of Geography and Urban Studies, Temple University
2:00pm-3:15pm	Break-out group discussions to elaborate on research questions in terms of conceptual frameworks, data availability, methodological approaches, and potential applications Chair: Melissa R. Gilbert , Director, Center for Sustainable Communities, Temple University Facilitators: <ul style="list-style-type: none"> ● Jocelyn Behm, Assistant Professor, Department of Biology, Temple University ● Victor Gutierrez, Assistant Professor of Geography and Urban Studies, Temple University ● Simi Hoque, Associate Professor of Engineering, Drexel University ● Hamil Pearsall, Associate Professor of Geography and Urban Studies, Temple University ● Tina Rosan, Associate Professor of Geography and Urban Studies, Temple University
3:15pm-3:30pm	Break
3:30pm-4:00pm	Presentation of future projects to the plenary Chair: Victor Gutierrez , Assistant Professor of Geography and Urban Studies, Temple University
4:00pm-5:00pm	Panel Discussion: Synthesis and scalability to other regions in the US and beyond Moderator: Hamil Pearsall , Associate Professor of Geography and Urban Studies, Temple University <ul style="list-style-type: none"> ● Usama Bilal, Assistant Professor of Epidemiology and Biostatistics, Drexel University ● Eduardo Brondízio, Distinguished Professor of Anthropology, Indiana University ● Peleg Kramer, Assistant Professor of Geography and Environment, Villanova University ● Joe Pierce, Assistant Professor of Geography and Environmental Sustainability; Regional and City Planning, University of Oklahoma ● Bill Solecki, Professor of Geography and Environmental Science, Hunter College ● Mark Stone, Associate Professor of Civil, Construction, and Environmental Engineering, University of New Mexico ● Hallie Eakin, Professor & Senior Sustainability Scientist, Julie Ann Wrigley Global Institute of Sustainability, Arizona State University ● Clare Hinrichs, Professor of Rural Sociology, Penn State University
5:00pm-5:15pm	Closing remarks <ul style="list-style-type: none"> ● Melissa R. Gilbert, Director, Center for Sustainable Communities, Temple University
5:15pm-7:00pm	Reception

September 13 – Day 3
Howard Gittis Student Center Room 200 C

Day 3: Discuss the dissemination of workshop and next steps (Organizing Committee and Interested Others)

8:00am-8:45am	Breakfast
8:45am-10:15am	Reflections on the workshop
10:15am-10:30am	Break
10:30am-11:45am	<p>Small group planning sessions for deliverables</p> <ul style="list-style-type: none"> ● Rachel Valletta, Environmental Scientist, Franklin Institute, Director of the Climate and Urban Systems Partnership, will lead the group in the discussion of approaches for presenting the final report to a public audience ● Kay Wood, Producer and Host of Planet Philadelphia, will lead the group on the development of the podcast ● Brett Fusco, Manager, Office of Long-Range Planning, Delaware Valley Regional Planning Commission, will lead the group in a discussion of approaches for presenting the report to a policy-maker and practitioner audience ● Eduardo Brondizio, Distinguished Professor of Anthropology and Director, Center for the Analysis of Social-Ecological Landscapes (CASEL), Indiana University Bloomington and Bill Solecki, Professor of Geography at Hunter College and Founder Director, Emeritus, CUNY Institute for Sustainable Cities editors with <i>Current Opinions in Environmental Sustainability</i> will provide guidance on the process for developing manuscripts for the special issue, including a discussion of the appropriate scope, length, and audience for prospective articles. ● Laura Toran, Professor of Earth and Environmental Science, Temple University and Melissa R. Gilbert, Director, Center for Sustainable Communities, Temple University will lead the discussion of the final report.
11:45am-12:15pm	Moderators report back to the group
12:15pm-12:30pm	<p>Closing remarks</p> <ul style="list-style-type: none"> ● Melissa R. Gilbert, Director, Center for Sustainable Communities, Temple University
12:30pm-1:30pm	Lunch