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ROUNDTABLE ON SCIENCE AND TECHNOLOGY FOR SUSTAINABILITY

A Brief Update on the Sustainability Roundtable 2015 Sessions on Sustainability Indicators and Metrics

January 14, 2016

David Dzombak, Roundtable Co-Chair, Carnegie Mellon University

Roundtable on Science and Technology for Sustainability

Goal

To mobilize, encourage, and use scientific knowledge and technology to help achieve sustainability goals and to support the implementation of sustainability practices.

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Roundtable on Science and Technology for Sustainability

Three principles

- Focus on strategic needs and opportunities for science and technology to contribute to transition toward sustainability
- Focus on issues for which progress requires cooperation among multiple sectors
- Focus on activities where scientific knowledge and technology can help to advance practices that contribute directly to sustainability goals

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Roundtable Members

- **David Dzombak (Co-Chair) (NAE)**, Carnegie Mellon University
- **Lynn Scarlett (Co-Chair)**, The Nature Conservancy
- **Ann Bartuska**, U.S. Department of Agriculture*
- **Steve Bergman**, Shell International Exploration & Production Company
- **Paulo Ferrão**, University of Lisbon
- **Marilu Hastings**, Cynthia and George Mitchell Foundation
- **Lek Kadelı**, Environmental Protection Agency*
- **Michael Kavanaugh (NAE)**, Geosyntec Consultants
- **Jack Kaye**, National Aeronautics and Space Administration*
- **Mehmood Khan**, PepsiCo Inc.
- **Suzette Kimball**, U.S. Geological Survey*
- **Steven E. Koonin (NAS)**, New York University
- **Franklin Orr (NAE)**, U.S. Department of Energy*
- **Francis O' Sullivan**, Massachusetts Institute of Technology
- **Prabhu Pingali (NAS)**, Cornell University
- **Richard W. Spinrad**, National Oceanic and Atmospheric Administration*
- **Michael Webber**, University of Texas at Austin

*Denotes ex-officio members

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Measuring Progress towards Sustainability: The State of the Science on Indicators and Metrics of Sustainability

➤ Focus:

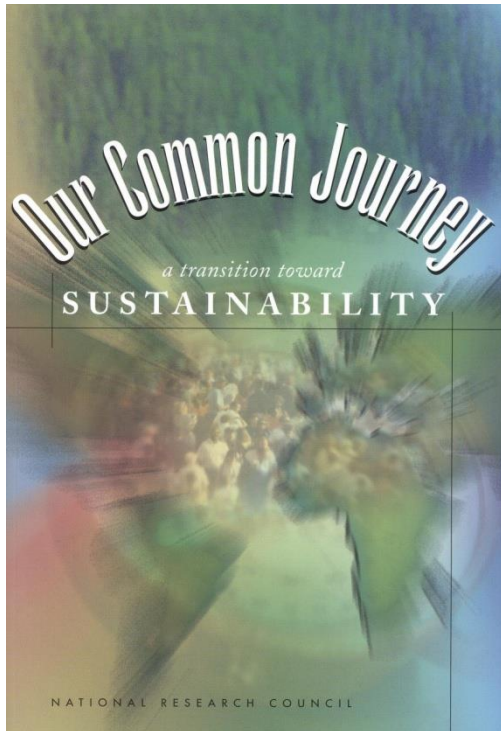
- **June 2015:** Indicators and Metrics for Climate Change and Infrastructure Vulnerability
- **November 2015:** Social and Economic Indicators and Metrics for Urban Sustainability
- **January 2016:** This workshop
- **June 2016:** Results from the series will be used to shape future activities of the STS program

SCIENCE AND TECHNOLOGY FOR SUSTAINABILITY PROGRAM

Measuring Progress towards Sustainability: The State of the Science on Indicators and Metrics of Sustainability

- 3 Roundtable discussions on metrics and indicators for sustainability (June 2015, November 2015, and June 2016)
- **Goals:**
 - Assess progress in development & use of indicators & metrics for promoting sustainability
 - Identify knowledge gaps related to developing indicators that integrate across ecological, social, and economic sciences

Our Common Journey: A Transition toward Sustainability (NRC, 1999)

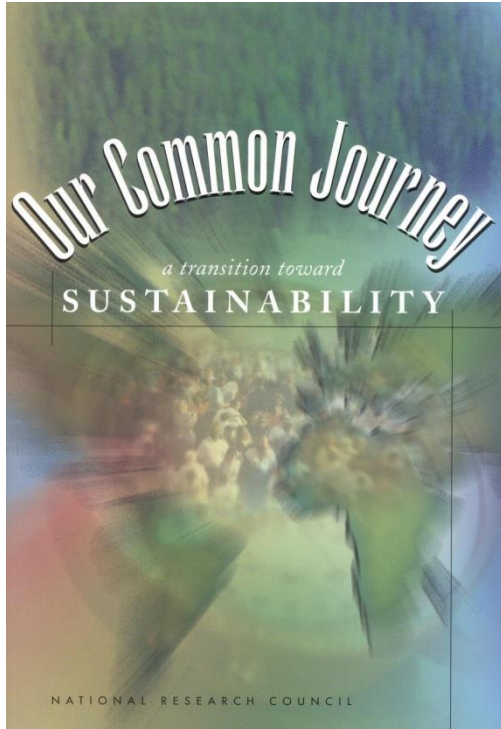


“Success in achieving a sustainability transition will be determined not by the possession of knowledge, but by using it, and using it intelligently in setting goals, providing needed **indicators** and incentives, capturing and diffusing innovation, carefully examining alternatives, establishing effective institutions, and, most generally, encouraging good decisions and taking appropriate actions.

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Our Common Journey: A Transition toward Sustainability **(NRC, 1999)**



“**Indicators** are essential to inform society over the coming decades how, and to what extent, progress is being made in navigating a transition toward sustainability... There is no consensus on the appropriateness of the current sets of **indicators** or the scientific basis for choosing among them.”

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Sustainability Indicators and Metrics: Progress and Challenges

- Nearly 20 years after publication of *Our Common Journey*, there has been substantial progress in sustainability indicators and metrics. For example, we see:
 - Wide development and use of corporate sustainability metrics for nearly a decade
 - Examples of ecological indicators for assessing health of ecosystems
 - Estimates of the quality of sustainability governance for individual countries using the Environmental Sustainability Index and Environmental Performance Index

Sustainability Indicators and Metrics: Progress and Challenges (*Cont.*)

- Despite this progress, significant challenges remain. For example:
 - Need for science-based indicators and the types of data and knowledge needed to support these indicators
 - Need for indicators and metrics that can integrate and inform across the three pillars of sustainability (economics, society, and environment)

Sustainability Indicators and Metrics: Progress and Challenges (*Cont.*)

- United Nations Sustainable Development Goals (SDGs):
 - Highest profile sustainability effort worldwide
 - Set of targets relating to future international development, including 17 goals, 169 targets, and 304 associated indicators.
 - Given the broad nature of the SDGs, there is a need for wide availability of well-defined indicators grounded in science, with data to support them and underpin targets for each of the goals




Measuring Progress towards Sustainability: Indicators and Metrics for Climate Change and Infrastructure Vulnerability

June 4, 2015

MEETING IN BRIEF
June 2015

Roundtable on Science and Technology for Sustainability
Science and Technology for Sustainability Program
Policy and Global Affairs



MEASURING PROGRESS TOWARD SUSTAINABILITY
INDICATORS AND METRICS FOR CLIMATE CHANGE
AND INFRASTRUCTURE VULNERABILITY

In 1999, the landmark National Academies of Sciences, Engineering, and Medicine's report *Our Common Journey: A Transition toward Sustainability* proposed a research strategy for using scientific and technical knowledge to better inform the field of sustainability science. The report noted that "indicators are essential to inform society over the coming decades how, and to what extent, progress is being made in navigating a transition toward sustainability.... There is no consensus on the appropriateness of the current sets of indicators or the scientific basis for choosing among them." Nearly twenty years after the report was developed, despite the proliferation of sustainability metrics by a wide range of sectors, at different scales, and in various aspects of sustainability (environmental, economic, and social), the selection and application of sustainability indicators and metrics remains challenging. To spur a discussion of these challenges, the Academies' Roundtable on Science and Technology for Sustainability began an initiative in 2015 focused on the development and use of sustainability indicators.

Given the broad nature of this topic, the Roundtable decided to focus the first meeting in the series on the development and use of sustainability indicators and metrics in a specific context, climate change and infrastructure vulnerability. The purpose of the session, held on June 4, 2015, was to identify indicators and metrics that have been found to be useful for promoting sustainability, as well as knowledge gaps related to developing indicators that integrate across the ecological, social, and economic sciences in the context of climate change and infrastructure vulnerability.

To open the Roundtable meeting, **Lynn Scarlett** of The Nature Conservancy, who co-chairs the Roundtable, described the goals of the session to look at how to measure progress toward sustainability and in particular the state of the science on indicators and metrics in the context of climate change and infrastructure vulnerability.

In the last 25 years, as sustainability has become commonplace, there has been a proliferation of metrics and indicators. The Roundtable's goal over the next year is to examine the state of development of those indicators and their utilization and to identify gaps, needs, and challenges that remain. How do we drive the indicators forward in a way that makes them useable?

David Ziemba of Carnegie Mellon University, who also co-chairs the Roundtable, provided additional context for the session, noting that in addition to corporate sustainability metrics, which have been widely developed and used for nearly a decade, there are numerous examples of ecological indicators for assessing the health of ecosystems. However, remaining challenges include the need for science based indicators and the data and knowledge necessary to support them, as well as indicators and metrics that can integrate and provide information across the three pillars of sustainability (economics, society, and environment).

**CLIMATE CHANGE AND
INFRASTRUCTURE VULNERABILITY**

Andrew Hoffman of the University of Michigan offered keynote remarks focusing on the evolution of sustainability metrics in the private sector. Bringing sustainability into the business sector is critically important, he said; if we are going to solve the sustainability issues of our day, they need to be solved by business.

Dr. Hoffman described the evolution of sustainability reporting, noting that in the mid-1970s only 1 percent of Fortune 300 companies provided social responsibility material in their financial report, while in 2011, 33 percent of S&P 500 and 57 percent of Fortune 500 companies reported on their environmental sustainability goals. This indicates good progress and penetration into the market in terms of what companies are measuring and reporting, said Dr. Hoffman.

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Measuring Progress towards Sustainability: Indicators and Metrics for Climate Change and Infrastructure Vulnerability

Key issues discussed during the June 2015 meeting:

- Effectiveness and Use of Indicators
- Indicators Framework – “utility of sustainability metrics is in the eye of the user”
- Addressing Uncertainty
- Availability and Reliability of Data
- Lack of Indicators to Address Social Issues



Measuring Progress towards Sustainability: Social and Economic Indicators for Urban Sustainability

November 12, 2015

MEETING IN BRIEF
November 12, 2015

Roundtable on Science and Technology for Sustainability
Science and Technology for Sustainability Program
Policy and Global Affairs

MEASURING PROGRESS TOWARD SUSTAINABILITY
SOCIAL AND ECONOMIC INDICATORS AND
METRICS FOR URBAN SUSTAINABILITY

Nearly 20 years ago, a landmark National Research Council report, *Our Common Journey: A Transition Toward Sustainability*, challenged the field of sustainability science to focus on developing a strong scientific basis for indicators and metrics, particularly given their importance in informing society about the extent to which “progress is being made in navigating a transition toward sustainability.” The report noted that “there is no consensus on the appropriateness of the current sets of indicators or the scientific basis for choosing among them.” Today, despite the widespread proliferation of sustainability indicators and metrics by a wide range of sectors, their selection and application remain challenging and there remains no consensus on what indicators are most useful for informing decision making.

To facilitate a discussion on these challenges, the Roundtable on Science and Technology for Sustainability convened three events focused on the indicators and metrics found to be the most effective in promoting sustainability. This is a summary of the second event, held on November 12, 2015, which featured discussions on social and economic indicators and metrics in the context of urban sustainability and on practical opportunities for strengthening and expanding indicators. Participants of the first event held on June 4, 2015, discussed sustainability indicators and metrics in the context of climate change and infrastructure vulnerability. The third event, to be held in June 2016, will examine the results of the June and November 2015 sessions on sustainability indicators and metrics to chart a path forward for sustainability science and technology activities.

Heather Tallis of The Nature Conservancy (TNC) opened the meeting with a keynote presentation on the importance of sustainability indicators and

how they can be developed in an integrated way to address pressing global challenges. While there is a rich history of developing sustainability indicators to set environmental priorities and measure progress toward a goal, these indicators have not fully considered social consequences. Dr. Tallis provided two examples: early indicators of deforestation not considering conservation refugees excluded from their natural resource base, and early assessments of energy security focusing on the development of fossil fuels but not considering societal implications. These are examples, Dr. Tallis noted, where decision making and measuring progress led to unsustainable choices, and the question still remains about which indicators can truly measure progress toward sustainability goals.

Dr. Tallis said a major challenge for implementing sustainability is in understanding key issues that cut across sectors. There are 17 United Nations Sustainable Development Goals (SDGs) identified by the global community as major challenges; assessing which of those is truly the highest priority can be difficult, she said. TNC has begun to identify major challenges that can most effectively be addressed through conservation and environment-based solutions.

Through a literature review and discussion with the global community, TNC identified key issues and developed a 5- to 10-year plan of how to address those issues. For example, the TNC analysis showed that sanitation is the largest single challenge in the SDGs. Almost 40 percent of the human population does not have access to sanitation. Another key challenge is water withdrawals, which is the single largest threat to freshwater biodiversity and habitat conservation. There is a nexus point, Dr. Tallis noted, between freshwater biodiversity and water security that intersects at water withdrawals. Identifying such interconnections can help establish collaborations to achieve the SDGs.

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Measuring Progress towards Sustainability: Social and Economic Indicators for Urban Sustainability

November 12, 2015

Key issues discussed during the November 2015 meeting:

- **Progress:** Substantial thought and investment in the development of indicators and metrics with increasing sophistication over the past 15 years
- **Engagement:** Preferences and needs of stakeholders need to be incorporated into indicators broadly and inclusively
- **Approach:** For any indicator, the integration of processes and outcomes will be important

Measuring Progress towards Sustainability: Social and Economic Indicators for Urban Sustainability (*Cont.*) November 12, 2015

Key issues discussed during the November 2015 meeting:

- **Incentives:** Disseminating and providing training on tools and metrics will help incentivize adoption of those tools
- **Metrics:** There are four key drivers to what is measured:
 - (1) indicators with available data
 - (2) indicators that identify significant threats and/or drivers of the limitations of well-being
 - (3) indicators that represent what people care about
 - (4) indicators that form a nexus—a collection of actions that drive multiple outcomes

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Additional Information

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