Circular Economy in the High-Tech World

Detailed Workshop Agenda

WEDNESDAY

10:00 am Welcome, Drs. Martin Green and Kelsea Schumacher, NIST
Dr. Green will provide an overview of NIST's mission and role in the circular economy. Dr. Schumacher will then introduce the workshop, including objectives, goals, and outcomes.

10:15 am Plenary Speech: William McDonough
Mr. McDonough is an architect, designer, author, and thought leader on sustainable design and development. Co-author of *Cradle to Cradle: Remaking the Way We Make Things* (2002) and *The Upcycle: Beyond Sustainability – Designing for Abundance* (2013), Mr. McDonough is widely recognized for his message that we can design materials, products, systems, companies, buildings, and communities with a beneficial footprint that continuously improves over time.

Mr. McDonough's plenary address is titled: TBD

11:15 am Break

11:30 am Session 1: How do we Create a Circular Economy?
How can we increase the circularity of critical raw materials? What are existing frameworks and metrics for a circular economy? How do mineral commodities flow throughout their lifecycle, from mining and processing to use and end-of-life planning? These questions and more will be discussed by subject experts in our first workshop session.

Speakers:

- Nik Engineer, Ellen MacArthur Foundation
- Gregory Keoleian, University of Michigan
- Alessandra Hool, ESM Foundation and Chair of the International Roundtable on Materials Criticality
- Maria Curry-Nkansah, National Renewable Energy Laboratory
- Nedal Nassar, United States Geological Survey (USGS)

1:00 pm Lunch + Networking

1:45 pm Session 2 (concurrent sessions)

A: Electronics Recycling Challenges

A panel of five, including electronics recyclers, metals refiners, and an academic researcher will discuss the status and advances of recycling technologies for electronic waste as well as technical and economic challenges facing electronics recycling. Following the panel discussion, participants and panelists will break out into virtual roundtable discussions to

further identify challenges to electronics recycling and discern research, data, and standardization needs to overcome barriers.

Panelists:

- John Shegerian, ERI
- Peter Afiuny, Urban Mining Company
- Julie Daugherty, Multimetco, Inc.
- George Lucas, Gannon & Scott, Inc.
- Julie Schoenung, University of California, Irvine

B: Battery Recycling Challenges

A panel of five, including battery recyclers and researchers from academia, a national lab, and a nonprofit research organization will discuss the status and advances of recycling technologies for batteries as well as technical and economic challenges facing battery recycling. Following the panel discussion, participants and panelists will break out into virtual roundtable discussions to further identify challenges to battery recycling and discern research, data, and standardization needs to overcome barriers.

Panelists:

- Jean-Christophe Lambert, Lithion Recycling
- Todd Coy, KBI Recycling
- Linda Gaines, Argonne National Laboratory
- Stephanie Shaw, Electric Power Research Institute (EPRI)
- Callie Babbitt, Rochester Institute of Technology

C: Solar Panel Recycling Challenges

A panel of five, including solar panel recyclers and researchers from academia, a national lab, and a nonprofit research organization will discuss the status and advances of recycling technologies for solar panels as well as technical and economic challenges facing solar panel recycling. Following the panel discussion, participants and panelists will break out into virtual roundtable discussions to further identify challenges to solar panel recycling and discern research, data, and standardization needs to overcome barriers.

Panelists:

- Parikhit (Ricky) Sinha, First Solar
- Kristina Whitney, Recycle PV Solar
- Garvin Heath, National Renewable Energy Laboratory
- Cara Libby, Electric Power Research Institute (EPRI)
- Meng Tao, Arizona State University
- Evelyn Butler, Solar Energy Industries Association (SEIA)

3:15 pm Break

3:30 pm Session 3: Boundary-Spanning Tools to Support the Circular Economy
Four experts from academia, national labs, and the US government will present boundary-spanning tools designed to track and evaluate material flows and assess techno-economic and environmental impacts of electronics, batteries, and/or solar panels throughout their life cycles.

Speakers:

- John Glaser, US Environmental Protection Agency: ADEPT: A tool to evaluate electronics flows for the US
- Alberta Carpenter, National Renewable Energy Laboratory: Lifecycle assessment and inventories
- Carol Handwerker, Purdue University: Ostrom Framework for self-managing sustainable social-ecological systems
- Melissa Bilec, University of Pittsburg: Materials flow through industry tool

THURSDAY

10:00 am Introduction to Day Two

10:15 am Plenary Speech: Dr. Thomas Graedel
Dr. Graedel is Professor Emeritus of Industrial Ecology and Chemical Engineering at Yale University. His research is centered on developing and enhancing industrial ecology, the organizing framework for the study of the interactions of the modern technological society with the environment. His current interests include studies of the flows of materials within the industrial ecosystem and the development of analytical tools to assess the environmental characteristics of products, processes, the service industry, and urban infrastructures.

Dr. Graedel's plenary address is titled "Are there limits to circularity?"

11:15 am Break

11:30 am Session 4: Reuse, Repair, and Refurbishment in a Circular Economy
Reuse, repair, and refurbishment are equally important in a circular economy as recycling. In this session, five speakers from different sides of the reuse/repair/refurbish/remanufacture industry will discuss their role in the circular economy and specific challenges to keeping products (i.e., not just materials) in motion.

Speakers:

- Kyle Weins, iFixit
- Eric Lundgren, Big Battery
- Adam Shine, Sunnking
- Nabil Nasr, The Remade Institute
- Josh Lepawsky, Memorial University

1:00 pm Lunch + Networking

1:45 pm Session 5: Best Practices for a Circular Economy
What are the roles and responsibilities of government and the private sector in a circular economy? This session will explore this question and provide examples of business models, company practices, and tools to support circularity. Presenters will include the following:

- Adina Renee Adler, Institute of Scrap Recycling Industries (ISRI): The role and responsibility of government and the private sector in a circular economy
- Joanne Larson, Seagate: Closing the loop on hard disk drives
- Kathleen Fiehrer, Intel: Circularity at Intel
- Mark Buckley, One Boat Collaborative: Business models for circularity
- Corey Dehmey, Sustainable Electronics Recycling International (SERI): The role of standards and certification programs in a circular economy

3:15 pm Break

3:30 pm Breakout Sessions

This 75-minute session will be divided in half and the discussion sessions will each run twice. Four discussion topics will run concurrently as outline below. So don't worry, if you want to participate in more than one you have that ability! And if one doesn't meet your expectations, you can switch to another at any time.

The four discussion topics will run concurrently as outline below. To maximize everyone's chance to participate in different rooms, the discussions will start over at the half way mark to allow new participants to join. So don't worry if you'd like to participate in more than one room, you'll have that ability! And, if you'd like, you are also welcome to switch rooms at any time.

"Room"	A	B	C	D
Topic:	**Design**	**Use/Reuse**	**End-of-Life Management**	**Enabling the Circular Economy**
Content	○ Choice of materials ▪ Earth abundant vs rare ▪ Virgin vs recycled ○ Product design for end-of- life ▪ Ease of disassembly; shredding	○ Repair ○ Remanufacturing ○ Refurbishing	○ Collection ○ Sorting ○ Disassembly ○ Shredding ▪ Management of fluff, e-plastics ○ Recycling	○ Data challenges/needs ○ Metrics and measurement ○ Certifications and standards ○ Life-cycle analysis, techno-economic analysis, etc.

4:45 pm Closing Remarks