October 2012

# Sustainable Mobile Phone Design Charrette

## July 11-12, 2012

## Meeting Summary


Lowell Center for Sustainable Production
University of Massachusetts Lowell
One University Avenue
Lowell, MA 01854
978-934-4943
lcsp@uml.edu
www.sustainableproduction.org

For more information about this project, contact Sally Edwards:
sally_edwards@uml.edu


UMASS University of Massachusetts Lowell
Learning with Purpose

SUSTAINABLE SILICON VALLEY

CCA CALIFORNIA COLLEGE OF THE ARTS

Electronics TakeBack Coalition

# Executive Summary

On July 11-12, 2012, the Lowell Center for Sustainable Production at the University of Massachusetts Lowell convened an invitation-only Sustainable Mobile Phone Design Charrette[1] at the University of Santa Clara in collaboration with Sustainable Silicon Valley, the Electronics Take-Back Coalition, and the California College of the Arts. Participants were selected from a broad cross-section of the mobile phone industry, including brands, service providers, repair/recyclers, along with sustainability experts from non-governmental organizations, government and academia.

A charrette is a time compressed, facilitated problem-solving process that brings together diverse representatives of a system to work collaboratively on specific issues and strategies. The intent is to create a shared vision and develop ideas for holistic solutions. Together, participants explored opportunities for increasing the sustainability of mobile phones and the business and social ecosystem that surrounds their design, manufacture, use and disposal. The facilitators for the charrette were two sustainable design experts from the MBA in Design Strategy program at the California College of the Arts, Nathan Shedroff and Susan Worthman.

The desired outcomes of the charrette were four-fold:

- Identify key factors and drivers that inhibit or promote the development of sustainable mobile phones throughout their life cycle.
- Identify key design opportunities to advance sustainable mobile phones.
- Develop a new vision for sustainable mobile phone design.
- Motivate commitment towards the vision and agree on next steps.

The participants shared the perspective that customers, brands and service providers are the primary and necessary change agents that can influence designs that are more sustainable. While the ability of customers to significantly influence demand for a more sustainable phone will require increased industry transparency and consumer education regarding ecosystem and health impacts, product designers for the brands and service providers have more immediate opportunities for advancing sustainable innovations.

Numerous imaginative ideas and solutions emerged throughout the charrette process, including many concepts that worked holistically with others. The need for increased transparency and access to information was an integral and cross-cutting element in the discussions. Three significant themes that emerged included:

1. **Design more user-friendly phones.** A sustainably designed phone is, by definition, easier for customers—not just manufacturers—to disassemble, replace parts, update, repair and recycle. A sustainably designed phone is based on parts and services that are user-configurable, updateable and recyclable (this was labeled the "Lego® phone" by participants).
2. **Create safer phones**. There is a significant need to focus more attention on

[1]The original title of the workshop used the term "cell phone" rather than "mobile phone".

addressing health hazards of mobile phones throughout their life cycle and to develop safer chemicals and materials using "green" chemistry and alternatives assessment.

3. **Invigorate reuse/recycle streams.** The reuse, repair and recycling stream for mobile phones is substantially underutilized and new business models and incentive programs are needed to close the loop.

Participants identified many design and business model innovations throughout the mobile phone life cycle and across a wide array of stakeholders. These ideas were synthesized into sets of solutions for the increased sustainability of mobile phones that might be achieved within 2-5 years, 5-10 years, and more than 10 years. Three key ideas for near-term next steps that emerged during the synthesis process included:

- **Design competition.** Participants suggested launching an industrial and business design competition focused on more sustainable mobile phones that would be sponsored by 2-3 carriers. The competition was seen as an attractive strategy to stimulate design ideas, build industry collaboration, and increase engagement by a broader array of stakeholders, including students.
- **School partnerships to increase recycling.** Participants proposed partnering with schools, national sport teams, etc. in a mobile phone recycling and education initiative that would target young people to help move unused mobile phones from desk and dresser drawers into the reuse-repair-recycling stream.
- **Roadmap development.** Participants suggested convening a formal collaborative process to develop a Sustainable Mobile Phone Development Roadmap for achieving a more sustainable mobile phone using ideas from the design charrette as a foundation. This would involve reaching out to other stakeholders to create broader buy-in to these ideas and concepts.

The Sustainable Mobile Phone Design Charrette demonstrated that using a rapid brainstorming process to explore solutions to the sustainability challenges confronting mobile phones was valuable and effective. In their evaluations, participants noted the importance of mapping the initial ecosystem to lay the foundation for thinking in systems as so many of the solutions revealed across the 2-day experience are systems dependent. Participants also noted that many barriers and challenges to the visionary ideas generated lie in balancing industry's intellectual privacy needs with the need for greater transparency to enhance cooperation among stakeholders and educate consumers—all of which are important for advancing the innovations needed to achieve the vision of a sustainable mobile phone.

The Sustainable Mobile Phone Design Charrette began a conversation that holds much promise for stimulating new thinking and approaches to the design and manufacture of mobile phones that lessen negative impacts and increase positive impacts on individuals, the environment and society. There is tremendous opportunity for further action. This report has been generated as an invitation to all stakeholders to advance this conversation by implementing the short-term steps identified and fleshing out the dozens of other ideas that were generated.

# Meeting Summary

## BACKGROUND

Mobile phones have changed nearly every facet of life. From making it easier to keep in touch with family and friends, to conducting business, to making life more entertaining and convenient, mobile phones have completely revolutionized the way people do just about everything. Consumer demand for smaller, lighter and cheaper mobile phones and an appetite for an array of technologies contained in one device have catalyzed tremendous innovation in the industry.

Because mobile phones are so small and lightweight, they generate a negligible quantity of waste per unit. However, the hazards to workers engaged in mobile phone and component manufacturing for the 1.6 billion mobile phones sold globally in 2011 are not negligible. Nor are the environmental and human health impacts associated with mining rare earth metals and the improper disposal of mobile phones that can lead to air, soil and water contamination and toxic exposures. Stockpiles of reusable and recyclable phones that can minimize some of these impacts remain in the drawers of their users, who in the United States, replace phones every 22 months. Of concern, as well, is the radiofrequency energy emitted by mobile phones, a form of non-ionizing electromagnetic radiation that can be absorbed by tissues closest to where the phone is held. Current evidence suggests that exposure to non-ionizing radiation is a possible human carcinogen.[2]

[2]Based on a review and classification by the International Agency for Research on Cancer in 2011.

On July 11 and 12, 2012, representatives of the mobile phone supply chain—including brands, service providers and repair/recyclers—as well as academic researchers, representatives from non-governmental organizations (NGOs) and experts in design and sustainability gathered in Santa Clara, CA to consider the following challenges:

- What if the industry's product designers, material scientists and engineers, and business strategists focused their resources on designing mobile phones that were manufactured with safer chemicals, comprised of easily repairable and reusable components, used minimal energy and were always recycled at the end of life?
- Is it possible to co-optimize the goals of profit, performance, and protection of public and environmental health?
- Is a sustainable mobile phone possible?
- If so, what would it be made of and how would it be produced, used, reused, recycled, and disposed?

## THE CHARRETTE PROCESS

A design charrette is a time compressed, facilitated creative problem-solving process that brings together diverse representatives (stakeholders) of a system to work collaboratively on specific issues and strategies. The intent is to create a shared vision with ideas for holistic solutions. There are few actual 'rules' for a charrette, as it is intended to be an organic process of discovery and ideation. Dialogue, brainstorming, analysis and consensus opinion are the drivers. Participants are encouraged to

"talk with a pen," capturing ideas visually.
The purpose of the Sustainable Mobile Phone Design Charrette was to identify opportunities across a broad range of sustainability criteria and to explore potential solutions that might fit some of these opportunities, using a rapid, brainstorming process. The desired outcomes of the charrette were to:

- Identify key factors and drivers that inhibit or promote the development of sustainable mobile phones throughout their life cycle.
- Identify key design opportunities to advance sustainable mobile phones.
- Develop a new vision for sustainable mobile phone design.
- Motivate commitment towards the vision and agree on next steps.

The charrette process was employed for a variety of reasons. First, sustainability is a systems-level issue. Impacts are generated and experienced across a wide variety of stakeholders and subject to decisions made in a large, complex timeline. Stimulating creative, significant progress toward more sustainable solutions requires the participation of stakeholders with experience from across the domains of business, design and sustainability that offer a wide range of varying perspectives.

Second, improving the sustainability of mobile phones has focused primarily on reducing energy impacts. While energy use is a significant concern that must be addressed, there are additional economic, social, environmental health and cultural impacts throughout the life cycle that are often overlooked but can become critical influences that are unanticipated by stakeholders who have not considered these risks.

Additionally, because these impacts are far-reaching, it is important to examine the entire range of life cycle activities including: sourcing of raw materials, manufacturing and assembly of components and phones, distribution, customer use, and end of life issues including reuse, recycling, and disposal. By considering this spectrum, opportunities and solutions that otherwise might not come to light may be identified.

Because the purpose of this investigation was primarily generative, rather than definitive, the charrette process of collaborative brainstorming and synthesis was chosen, as opposed to other formal methods that focus on research or analysis. Charrettes are traditional activities in architecture, usually lasting 24-48 hours, favoring creative, rapid, collaborative generation of solutions. They are not intended to be exhaustive investigations nor do they generate finished solutions. Further activities can make use of these opportunities, and more traditional methods, to evaluate and develop solutions identified in this way. While two days is too short a period of time to do the latter, it is sufficient—even preferred—for the former.

## THE SIX EXERCISES OF THE DESIGN CHARRETTE

The charrette consisted of six different exercises, each focused on a different aspect of the mobile phone ecosystem and life cycle. The exercises were designed to flow from general investigations into more specific ones as the charrette progressed. The final exercise served as an opportunity for a cumulative synthesis of much of the work uncovered in the previous exercises.

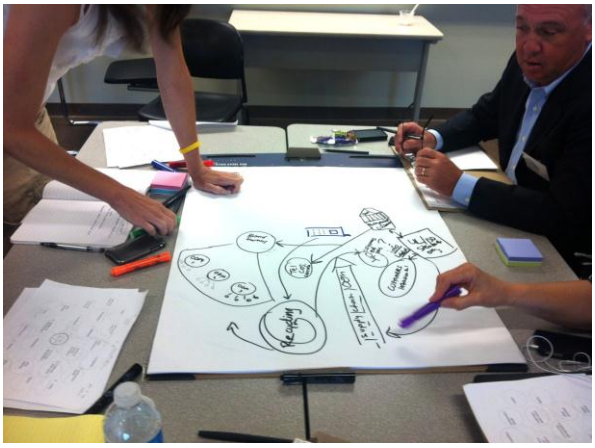
For the first exercise, **"Reveal,"** attendees were

asked to map the stakeholders within the large ecosystem that impacts and is impacted by mobile phones. Using a suggested template of categories, attendees identified not only a wide variety of influencers and those impacted, but began to catalog the value exchanged between each stakeholder across the four types of sustainability: ecological, economic, social, and cultural. Some of the stakeholders identified included government, NGOs, media, designers, consumers, manufacturers, retailers, institutional purchasers, standard setting organizations, service providers, financial institutions, and recyclers.

There was some consensus among participants that the stakeholders with the greatest leverage for change in promotion of sustainability, included: (a) consumers, (b) service providers, and (c) brands. While the potential for customers to significantly influence demand for a more sustainable mobile phone requires increased industry transparency and consumer education regarding ecosystem and health impacts, product designers for the brands and service providers have more immediate opportunities for advancing sustainable innovations. As with all of the exercises, further refinement of the mapping of the exchange of value between the relevant stakeholders could identify additional opportunities for stakeholders to give, receive, and exchange more value.

For the second exercise, **"Reduce,"** participants were asked to identify opportunities to reduce energy and material use, transportation distances and costs, and toxic materials, using strategies such as dematerialization, substitution, localization and design for use. Some of the opportunities identified included: requirements for increased transparency regarding chemical and material inputs throughout the supply chain; use of green chemistry as a strategy for sustainable materials; universal chargers and optional universal charger at point-of-sale; longer life batteries; eliminating point-of-sale packaging; and exploring more localized transmission opportunities and antennae shielding advances to reduce user radiofrequency exposure levels.

For the third exercise, **"Reuse,"** attendees considered strategies for reuse and brainstormed ideas to increase durability by making phones upgradable and easier to repair. Participants discussed the need to change the dominant business model in the US that subsidizes the cost of phones thereby encouraging a short product replacement cycle and lowering market demand for reuse. In addition, attendees discussed how to support small businesses that are repairing mobile phones through making schematics and repair manuals more widely available as well as innovative ideas that repurpose mobile phones into a variety of new uses, from solar energy generators to universal clickers.



For the fourth exercise, **"Recycle,"** participants were encouraged to identify opportunities for upcycling of components and materials and for remanufacturing. Attendees discussed the need

for modular designs, replaceable batteries that are easy to remove, avoidance of glues, and increased use of common materials and fasteners. In addition, participants discussed the need for new business models to increase consumer returns of their used mobile phones for reuse and/or recycling, such as financial incentives and education of retail store employees.

For the fifth exercise, **"Design for Positive Impacts,"** participants were asked to consider what materials, processes and use scenarios could enable phones to be restorative of ecological, economic, social and cultural capital. Attendees identified a wide range of software applications that could support improved energy efficiency, health and safety, and access to information and services.

## SYNTHESIS

The last exercise focused on combining as many applicable ideas from the first five exercises into sustainability strategies and product concepts within three different time ranges. These ideas can serve as anchor concepts for further exploration and development, as well as starting points for later workshops and more refined investigations. The following ideas and concepts emerged from the synthesis exercise that identified short-term (2-5 years), mid-term (5-10 years), and long-term (10+ years) opportunities.

### *2-5 Year Timeframe: Stimulating Ideas and Building Industry Collaboration*

Within this time period, participants noted that the most important activities are to promote and support ongoing conversations, workshops, collaborations, and potential awareness-raising events. Two specific strategies were highlighted:

**Sustainable mobile phone design competition.** A sustainable mobile phone design competition, sponsored by 2-3 carriers, was seen as an excellent way to engage more stakeholders in sharing ideas and developing solutions. An "X-prize"-type competition could attract individuals and teams to develop approaches to improving mobile phone sustainability across the supply chain, product life cycle and business model. A competition could engage students as well as professionals and spur a dialogue and focus on sustainable solutions within this industry. NGOs and brands could serve as judges, advisors, and mentors for competitors. Components of a challenge to develop a "more sustainable mobile phone" might include:

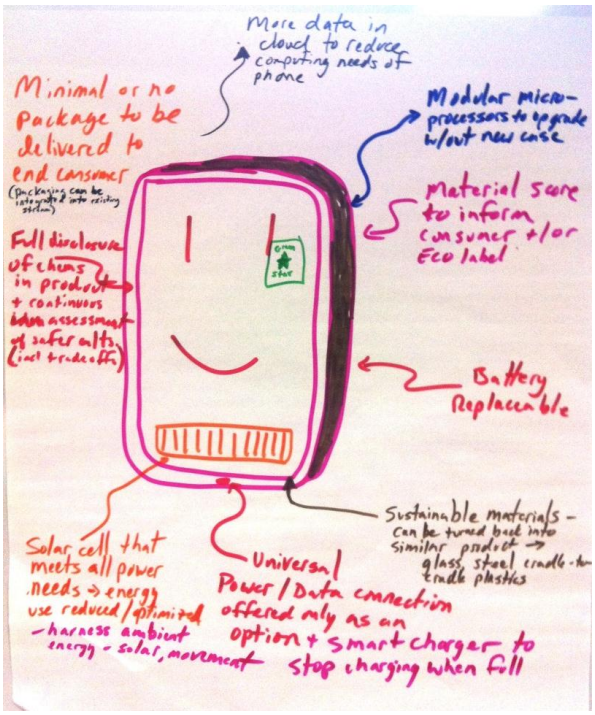
- Increased durability and ruggedness
- Modular and interchangeable parts for customization and longevity (as technology changes)
- Easily repaired (locally)
- Reduced use of toxic materials: chlorine, bromine, halogen, and other chemicals
- Transparency in the supply chain and material origins
- Supply chain monitoring for improved occupational safety and health, training and workers' rights
- Meets ULE 110 Platinum standard at minimum
- Redesigned accessories that enhance service, meet customer needs, and open new opportunities for business models

**Campaign to stimulate consumer recycling.** A campaign to stimulate consumer recycling of phones was seen as an important strategy to move the stockpiles of mobile phones in closets and drawers into the reuse/recycle stream. Participants proposed partnering with schools, national sport teams, etc. in a mobile phone

recycling and education initiative that would target young people to help move mobile phones into the reuse-repair-recycling stream.

### *5-10 Year Timeframe: New Solutions Come to Market*

In the 5-10 year timeframe, additional solutions are possible. Participants envisioned a wider variety of service options: phone leasing, microfinance, medical and personal sensory networks (such as Quantified Self, etc.), facilitation of car, tool, appliance, and other product sharing, peer-to-peer and mesh services, etc. To make advances in this timeframe it is important to start and support activities now that will pay off with new technologies, models, and developments in the future. For example, development of green chemistry and the use of alternatives assessment methods will be needed to design and select the safer materials of the future. In addition, advances in battery technology, unified interfaces (such as truly multi-band "world" phones), new business models that are more sustainable (economically, ecologically, socially, and culturally), distributed/shared computation (on phones), increased privacy standards and practices, integrated tower use in communities, common network standards and installations that allow for smaller "mobiles" and reduced radiation could all contribute to improved sustainability. All of these advances will require more transparent access to material and other product information. To be successful, a robust multi-stakeholder collaboration will be necessary to leverage the necessary knowledge and resources.




**Modular phones to meet higher recycling/reuse targets.**
Attendees imagined devices with a wider variety of sizes and styles and continued improvement in easy-to-learn-and-use interfaces. The group working in this timeframe posited targets for recycling within this timeframe of 50% recycled phones by 2022 and 33% of phones being reused by others or repurposed for different uses. This is aided by modular "Lego®-like" designs that allow phones to be upgradable and customizable. Participants also discussed strategies for addressing privacy concerns in reuse and recycling of mobile phones.

**New business models to capture revenues in the face of longer phone life cycle.**
This group noted the need for new business models, particularly for revenues to make up the difference between phones that last 4-5 times longer (and are kept longer by customers) and current phones that last on average 18 months. Phones in this timeframe were envisioned to last 10 years or more. One of these models might

include a percentage of revenues for resold phones that returns to the original manufacturers. In addition, device manufacturers might earn additional revenue on modules sold to upgrade or repurpose phones (much like razor blades traditionally serving as the revenue generator rather than the razor itself).

### *10+ Year Timeframe: Reinventing the Whole Ecosystem*

Lastly, in the 10+ year time-frame, changes in business models were envisioned alongside changes in products and services.

**Design principles: universal access, customizable, zero waste, wide utility.**
Phones are universally accessible across all global networks with interchangeable, standardized parts that make customization easy, as well as enabling local repair and replacement (including parts printed locally via 3D printers). All phones are unlocked and not only recyclable but appropriate parts, accessories, and packaging are compostable and upcyclable (through easy to find kiosks). In use, phones can access any nearby screen device, such as a television or monitor, but also signage or window-sized public displays for temporary use, such as directions or maps. Phones include the necessary hardware for biometric security (authentication), personal health monitoring and sensing, as well as environmental sensing. This creates new use cases that support personal healthcare and community health applications that build on the ubiquity and mobility of these devices. Devices might even include new, less intrusive input mechanisms like sub-vocalization technology.

**Better systemic design creates greater value for all.**
Privacy standards are strengthened to support these applications and enable trusted healthcare applications. Phone use eventually creates a truly paper-free workflow in office and home environments, enabling mobile services, documentation, records, and archiving. Mobile commerce is the norm for transactions and phones are integral to new education models. Along with new, ubiquitous network standards and universal connectivity, all data lives simultaneously on the device and in the cloud, seamlessly. The price of phones (all of which are automatically unlocked) reflects the externalities in the industry, of use and manufacture.

Phones are easily repaired because companies open-source their phone specifications, truly enabling local repair and recycling. Manufacturing and service conditions data are also ubiquitous and transparent, rewarding those companies with best practices in material selection and recycling, as well as working conditions. This enables customers to choose phones, accessories, and service independently and in accordance with their values.

Phone return and recycling is aided by incentive programs that are promoted by celebrities and are particularly successful with younger users.

## CONCLUSIONS AND NEXT STEPS

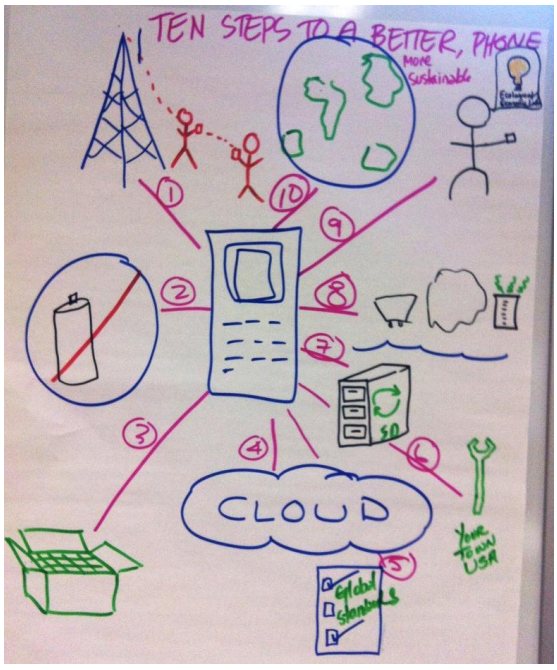
Numerous imaginative ideas and solutions emerged throughout the charrette process. The need for increased transparency and access to information was an integral and cross-cutting element of the discussions. Three significant sustainability themes that emerged included:

- **Design more user-friendly phones.** A sustainably designed phone is by definition

easier for customers—not just manufacturers—to disassemble, replace parts, update, repair and recycle. A sustainable designed phone is based on parts and services that are user-configurable, updateable and recyclable (this was dubbed the "Lego phone®" by participants).

- **Create safer phones.** There is a significant need to focus more attention on addressing health hazards of mobile phones throughout the life cycle and to develop safer chemicals and materials using green chemistry and alternatives assessment.
- **Invigorate reuse/recycle streams.** The reuse, repair and recycling stream for mobile phones is substantially underutilized and new business models and incentive programs are needed to close the loop.

Participants identified many design and business model innovations throughout the mobile phone life cycle and across a wide array of stakeholders.




Three key ideas for near-term next steps that emerged during the synthesis process included:

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- **School partnerships to increase recycling.** Participants proposed partnering with schools, national sport teams, etc. in a mobile phone recycling and education initiative that would target young people to help move unused mobile phones from desk and dresser drawers into the reuse-repair-recycling stream.
- **Roadmap development.** Participants suggested convening a formal collaborative process to develop a Sustainable Mobile Phone Development Roadmap for achieving a more sustainable mobile phone using ideas from the design charrette as a foundation. This would involve reaching out to other stakeholders to create broader buy-in to these ideas and concepts.

The Sustainable Mobile Phone Design Charrette demonstrated that using a rapid brainstorming process to explore solutions to the sustainability challenges confronting mobile phones was valuable and effective. In their evaluations, participants noted the importance of the initial ecosystem mapping to lay the foundation for thinking in systems as so many of the solutions revealed across the 2-day experience are systems-dependent. Participants also noted that many barriers and challenges to the visionary

ideas generated lie in balancing industry's intellectual privacy needs with the need for transparency to enhance cooperation among stakeholders and educate consumers—all of which are important for advancing the innovations needed to achieve the vision of a sustainable mobile phone.

This design charrette began a conversation that holds much promise for stimulating new thinking and approaches to the design and manufacture of mobile phones that can lessen negative impacts and to increase positive impacts on individuals, the environment and society. There is tremendous opportunity for further action and wider participation. This meeting summary has been generated as an invitation to all stakeholders to advance this conversation by implementing the short-term steps identified and fleshing out the dozens of other ideas that were generated. The Lowell Center for Sustainable Production and its collaborators welcome the input, expertise and energy of others in moving these concepts from vision to reality.

***October 2012***

# Charrette Participants

Rory Bakke, Sustainable Concepts Studio
Sue Chiang, Center for Environmental Health
Sally Edwards, Lowell Center for Sustainable Production, University of Massachusetts Lowell
Ken Geiser, Lowell Center for Sustainable Production, University of Massachusetts Lowell
Allison Gregg, Sprint
Marianna Grossmann, Sustainable Silicon Valley
Bill Hoffman, Underwriters Laboratory - Environment
Ted Howes, Business for Social Responsibility
Molly Jacobs, Lowell Center for Sustainable Production, University of Massachusetts Lowell
John Katz, US EPA
Barbara Kyle, Electronics Takeback Coalition
Bridget Luther, Cradle to Cradle Products Innovation Institute
Steve Manning, Recellular
Joe McKeown, Recellular
Phil Metz, Singing Dog Consulting
Colin Proietto, Underwriters Laboratory - Environment
Abby Ray, Samsung
Mark Rossi, Clean Production Action
Robin Schneider, Texas Campaign for the Environment
Nathan Shedroff, California College of the Arts
Roman Smith, AT&T
Ted Smith, Electronics Takeback Coalition
Kyle Wiens, iFixit
Susan Worthman, California College of the Arts