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U.S.-hosted Workshop on the Use of Life Cycle Concepts in Supply Chain Management to Achieve Resource Efficiency

March 22-23, 2016, Arlington, Virginia

Workshop Summary Proceedings

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2 PREFACE

These proceedings of the G7 Alliance on Resource Efficiency U.S.-hosted Workshop on the Use of Life Cycle Concepts in Supply Chain Management to Achieve Resource Efficiency summarize prepared remarks, presentations and discussions from the event. This document is not intended to contain any consensus findings, recommendations, or agreements made by participants or of the G7 Alliance on Resource Efficiency; rather, it should be viewed as a summary of individual workshop participant statements and ideas.

The Group of Seven (G7) consists of seven industrialized, democratic nations – Canada, France, Germany, Japan, Italy, the United Kingdom and the United States – whose heads of state meet annually, along with the leadership of the European Union (EU), to discuss global issues. The outcome of the annual meeting of the G7 leaders is captured in a "Leaders' Declaration." The presidency of the G7 rotates annually among the seven nations. The June 2015 Elmau Summit Declaration and Annex established the G7 Alliance on Resource Efficiency to serve as a forum to share knowledge and create information networks on a voluntary, non-binding basis, including collaboration with large and small businesses and other relevant stakeholders to advance resource efficiency, promote best practices and foster innovation. The Summit Declaration's Annex proposed a series of workshops to initiate the process for sharing best practices and experiences and the creation of information networks under the G7 Alliance on Resource Efficiency. The official launch of the Alliance occurred on October 2, 2015 in Berlin and was followed by a workshop on Industrial Symbiosis in the United Kingdom October 29-30, 2015. Germany hosted a second workshop on "Innovative bio-based products" in Berlin November 23-24, 2015.

After assuming the G7 presidency in January 2016, Japan hosted the "Promoting International Cooperation for Improving Global Resource Efficiency Workshop under the G7 Alliance on Resource Efficiency" on February 11, 2016 in Yokohama, Japan. Prior to the May 26-27, 2016 G7 Japan Ise-Shima Leaders' Summit, Japan reinstated the environment ministers' meeting (the last meeting was held in 2009) and held the G7 Toyama Environment Ministers' Meeting on May 15-16, 2016. The G7 Toyama Environment Ministers' Meeting Communique noted the ministers' strong commitment to continue implementing initiatives for resource efficiency and the 3 Rs (reduce, reuse and recycle), including the G7 Alliance on Resource Efficiency, and adopted the "Toyama Framework on Material Cycles" which was annexed to the Communique. The May 27, 2016 G7 Ise-Shima Leaders' Declaration endorsed the Toyama Framework on Material Cycles.

On March 22-23, 2016, the United States hosted a workshop on behalf of the G7 Alliance on Resource Efficiency in Arlington, Virginia. The purpose of this workshop was to share best practices and identify further opportunities to use life cycle thinking to achieve resource efficiency across supply chains. While the workshop used several examples from the auto sector to generate discussion, many conversations transcended any particular industry sector and generated more universal best practices and challenges. This success in identifying best practices and challenges was due in large part to the diversity of workshop participants. The workshop included approximately 190 representatives from nine countries (all G7 countries as well as South Korea and the Netherlands), individual industries and industry associations, non-governmental organizations, international organizations, academia and others.

3 ACKNOWLEDGEMENTS

The U.S. Environmental Protection Agency wishes to thank the government officials from all G7 nations who represented their countries at the workshop and who took the time to speak with the U.S. workshop development team on numerous occasions to craft a productive agenda. We wish to thank those officials for connecting us to key stakeholders within their respective countries for additional input on agenda development and workshop participation.

We are equally appreciative of the many individuals from the private, academic and NGO sectors who offered input on workshop content that led to engaging conversations throughout the two days of the workshop.

We would like to thank Mr. Masahito Fukami, Counselor, Ministry of the Environment, Japan; Dr. Wolfgang Scheremet, Director General, German Ministry for Economic Affairs and Energy; and Ms. Christine Harada, Chief Sustainability Officer for the U.S. Government for their inspiring opening remarks.

We would also like to thank Professor Steve Evans, Cambridge University for establishing a common understanding and tone for the workshop.

We are indebted to the over forty individuals from the private, public, academic and NGO sectors from across the G7 nations who enabled rich workshop discussions through their highly relevant and timely presentations.

Finally, we would like to thank the Japanese Embassy for hosting the workshop reception.

SUPPORT: The U.S. EPA workshop planning team was supported by SRA International, Inc. (now CSRA, Inc.) in planning, designing, and executing this workshop. Key CSRA support included: Stacey Burger, overall task manager for SRA; Patrick Tallarico of Enventive, Inc, principal facilitator and workshop planner and designer; and Nicole Henderson of SRA, for venue acquisition. Patrick Tallarico led a team of five facilitators that included: Mary Apostolico of CSRA; Doug Black of Consilium Consulting; Dana Goodson of RESOLVE, Inc.; Bryan Pai of CSRA; and Doug Sarno of Forum Facilitation Group.

4 MARCH 22, 2016

4.1 OPENING REMARKS (PLENARY SESSION)

4.1.1 Ms. Christine Harada, Federal Chief Sustainability Officer, White House Council on Environmental Quality

Ms. Harada thanked Germany for its previous leadership and Japan for its current leadership as G7 President. She noted that the U.S. government believes that management of materials has a major impact on the economy and is therefore considering the environmental, social and economic issues related to materials management, from using recycled materials as inputs to more complex activities. In addition, the U.S. is working on building on the Federal Government's significant progress in reducing greenhouse gas (GHG) emissions. The President of the United States issued Executive Order 13653 (Preparing the United States for the Impacts of Climate Change) in 2013, which outlines measures to make government operations more sustainable, energy secure and efficient while saving taxpayer dollars. Market innovation is going to be an important driver of change. Workshop participants should take advantage of having such a distinguished gathering of minds to drive the conversation forward.

4.1.2 Mr. Mathy Stanislaus, Assistant Administrator, Office of Land and Emergency Management, U.S. Environmental Protection Agency (EPA)

Mr. Stanislaus acknowledged that the Resource Efficiency Alliance started under Germany's leadership in order to foster collaboration among G7 countries, businesses and civil society organizations. The hope is that this workshop, like those previously held in Germany, the United Kingdom and Japan, can help identify best practices and find ways to help scale them up throughout the G7 and other developed economies as well as emerging and developing economies. Now is the time to act. Currently, half to three-quarters of inputs to global industrial economies is returned to the environment as waste within one year. Further, the Organisation for Economic Co-operation and Development (OECD) predicts that demand for materials will increase by 50 percent in 15 years unless global leaders can decouple economic growth from the use of raw materials. The annual cost of ecosystem depletion and pollution to the largest U.S. companies alone is estimated to exceed $1 trillion. These unaccounted for impacts are like the proverbial iceberg – largely unseen, but substantial in size and pose a real business risk.

To address these impacts, U.S. EPA promotes sustainable materials management and life cycle approaches to decision-making to minimize the use of resources and promote integrative systems thinking. A change in how the world thinks about environmental impacts and resource efficiency will be critical to success.

4.1.3 Mr. Masahito Fukami, Counselor, Ministry of the Environment, Japan

Mr. Fukami thanked U.S. EPA for organizing this meeting. He noted that in 2015, Japan, who would be assuming the G7 presidency in 2016, agreed to take ambitious action in the realm of resource efficiency during the launch of the G7 Alliance on Resource Efficiency in Germany. Japan would like to contribute to the international discussion as resource efficiency issues have great impacts throughout the supply chain. This workshop provides an opportunity to share stakeholder best practices to reduce environmental impact globally.

4.2 The Importance of Using Life Cycle Concepts to Achieve Resource Efficiency (Professor Steve Evans, Cambridge University) (Plenary Session)

Dr. Evans shared key concepts that helped established a common understanding among participants about the important role of life cycle thinking in accelerating and achieving resource efficiency. He stated that those involved in resource efficiency need to develop and agree on a common language to foster common understanding, although disagreement on some issues is to be expected. The standard academic definition of resource efficiency is the efficiency with which we use energy and materials throughout the economy. Currently, most waste is simply disposed of in landfills. However, advanced economies have managed to reduce waste and have moved up the waste hierarchy to energy recovery, recycling, reuse, reduction and prevention.

Dr. Evans emphasized that boundaries of analysis are important. National boundaries are not necessarily the most appropriate. When countries set resource efficiency goals based on their national boundaries, it encourages offshoring of waste and increased energy use in other countries. Resource efficiency practitioners need to be more nuanced when examining resource efficiency and consider the entire system.

He stated that when considering the concept of resource efficiency, value and not just price should be measured. Resource efficiency is a good thing, but countries have to be aware of potential unintended consequences. As countries improve their efficiency, they put more money into their economies which allows consumers to buy more and adds stress on the environment (rebound effects). As countries become more resource efficient, governments need to monitor what impact these efforts have on jobs. Are the jobs that are lost from resource efficiency fewer than the jobs created on the other end of the value chain?

Dr. Evans observed that some of the best practices in resource efficiency have come from the automotive sector. Although supply chains have generally become more efficient, this has not necessarily translated to resource efficiency. Resource efficiency is not easy, but is the responsible thing to do that also happens to be good for business. Improving resource efficiency does not require more money and new laws, it requires collaboration and invention.

4.3 Life Cycle Thinking Exercise: Creating a Vision for the Resource-efficient Vehicle (Product or Service) of the Future (Plenary Session)

Mr. John Bradburn (General Motors), Ms. Karen Cecil (Cummins), Mr. Jean-Francois Gaillaud (French Ministry of Economy, Industry and Digital Affairs), Ms. Antonia Gawel (World Economic Forum), Mr. Mike Swift (Auto Recycling Association) and Prof. Yasushi Umeda (University of Tokyo) served as a group of panelists who provided their perspectives on the resource efficient vehicle or product of the future through a series of facilitated questions and answers. Participants added their input to this vision. Attachment 1 provides a list of ideas about the resource-efficient product or vehicle of the future that were posted to the wall during the workshop.

- *What are the key trends impacting the resource efficiency of products and vehicles in the future?*
    - Ms. Gawel noted that there are an estimated 7.2 billion mobile devices now and there will be 28 billion by 2020. Digitization is having a profound impact on consumers and what they demand. The World Economic Forum is looking at the digital transformation for industries and its implications. For the automotive sector specifically, consumer-side expectations and demands are shifting. People do not want to own a car anymore; they want a means for

getting from point A to point B. When thinking about resource efficiency, it is not about "what can a sector do?" it is about "how can you impact the system?" In the next 10 to20 years, more innovation in the automotive sector will occur than in the past 100 years as a result of these three trends: digitization, mobility, and connectivity.

- Mr. Swift noted that the innovation and technology being incorporated into automobiles in recent years is staggering. With the advancement of technology in cars and communication, one of the biggest issues recyclers have is trying to get information from manufacturers about parts. Often, manufactures think of recyclers as competition instead of as teammates. Currently, there is some interchangeability of parts, but with cars becoming more digital and interconnected, it is becoming increasingly difficult. There is a need for recyclers to have partnerships with manufacturers in order to recycle effectively. Partnerships are a key to success throughout the supply chain, especially at the end of life stage.

- Ms. Cecil mentioned that vehicle automation, such as self-driving cars, is the next major driver for change in the auto industry. It will provide an opportunity to redesign products to be more resource efficient.

- *What does the product or vehicle of the future look like? Automated features to prevent accidents, etc.? What are the other elements?*

  - Mr. Bradburn pointed out that everyone at the workshop plays a role in addressing some of the world's challenging situations. If we are to create a more sustainable world, it will involve creating jobs and growing economies. Products or vehicles of the future will have higher recycled content and amounts of bio-based materials. They will also provide more opportunities for upcycling material. The real challenge is not the idea of a sustainable product or vehicle, it is getting it done and working with suppliers to incorporate these ideas into the product. It's not easy. Light-weighting is another element and fuels are key. It will be important to see things as they could be and not as they are.

  - Professor Umeda said that the key feature of the circular economy is not waste management, but looking at the entire system. The two system enablers are Information Communication Technology (ICT) and design. Vehicles of the future will be designed to be manufactured with almost no raw materials and instead with almost all recycled materials and remanufactured components. Also, a manufacturer may design an automobile only for car sharing, which may have very long life and very good fuel efficiency for short trips, with very low cost. ITC will enable life cycle management, and the amount of resource consumption will be determined by design. Design should be an integrated model of business and services so that companies can employ sharing in addition to traditional product sales.

  - Mr. Gaillaud noted that consumers are expecting vehicles to consume less fuel. Consumers are now focusing on the cost of maintenance and fuel. Electric cars seem to make sense for them, but electric batteries are very expensive and consumers are concerned about the long-term value of the batteries. Should you buy a new battery when the current one is no longer good, or should the manufacturer replace it and find new life for the batteries? Does this mean that manufactures share the long-term value of the car and the battery?

  - Ms. Gawel emphasized that the new business models mentioned have several implications. First, consumers are not necessarily interested in buying a car, instead they are interested in mobility (e.g. servicizing). For example, Michelin established a scheme in which customers pay for tires per mile instead of buying them outright. This changes incentives for manufacturers – the longer they can keep the tire on the road the longer they can profit from it. Therefore, this would make manufacturers focus on making tires that last longer instead of focusing on making more tires. Second is the digitization piece. Shifts in business models

and systems can impact resource efficiency. The question is how to implement technologies in the right way.

- Ms. Cecil said that from a supplier's perspective, partnerships, systems thinking and innovation are the path forward. Cummins is working with stakeholders (e.g., customers, government agencies) on the upfront design to find the best way to achieve the desired gain in fuel and emissions efficiencies. For example, the company is working with the U.S. Department of Energy (DOE) program on the SuperTruck initiative (http://social.cummins.com/supertruck-project-ready/). They have been able to achieve increased fuel efficiency of classic trucks by 75 percent. Cummins is looking to disrupt its own business practices and is thinking more broadly than before – it's not only decreasing the amount of direct natural resource use, but looking at the embodied energy and water in the materials used in its products. For example, Cummins engines are 95 percent metal and 88 percent of embodied water comes from raw material extraction and processing. Another question is how do we broaden this discussion to involve community health? How do we design our products to maintain the integrity of metal for a continuous loop? Cummins is not there yet but is working toward a vision of designing for disassembly and ensuring every component can be reused.

- Mr. Bradburn also noted that product life spans are increasing. The average age of a car on the road is 11.5 years. That increased life means more engagement with the collision industry and the repair and maintenance industry and requires new partnerships. For example, how long do manufacturers keep supplying parts for old cars and when do they rely on recyclers for that function? How can the original equipment manufacturer (OEM) help consumers who cannot afford a brand new part, but can afford a recycled one?

- *What kind of policies/programs need to be in place to support this vision?*

  - Mr. Gaillaud stated that all stakeholders must work together to find the right solutions. Governments can introduce some policies in the field of labeling so consumers know what they are buying. Resource efficiency practitioners also have to think about the link between the producer and the recycling industry. A key tool is to extend producer responsibility and to build a bridge between the producer and the recycler. In addition, practitioners have to focus on innovation, because that will be important for advancing resource efficiency. Government has to partner with private entities in new business models. Some regulations may be needed to support these new business models, but there need to be incentives as well. Finally, training is important to make sure everyone in the supply chain is aware of these issues. Suppliers throughout the supply chain need access to information. One of government's most important roles is to facilitate the exchange of information.

  - Ms. Gawel noted that society is moving quickly and new business models are emerging. To address this, we need to form public-private partnerships and identify and exploit new incentives to encourage more sustainable products. There are challenges related to car sharing platforms in certain industries and sectors. What is the role that policies can play in making sure there is a platform for the population that is in alignment with demands of consumers? Public-private collaboration is huge for delivering new business models to the public. In addition, policy must be designed as a system; otherwise, you tackle pieces, but do not address the whole.

  - Ms. Cecil observed that industry needs certainty and direction, especially because technology is expensive to develop. Industry wants clear, tough and enforceable regulations to drive innovation and progress.

Questions from workshop participants to panelists:

- *Question:* Who is working to get auto shredder residue out of landfills given that the mixture of materials in the residue is impossible to separate?
    - This question was deferred to the Day 2 discussion that would address this topic, but participants noted that better interaction between manufactures and recyclers could lower the amount of material that ends up in landfills. It was suggested that the government could help recyclers by encouraging better communication between manufacturers and recyclers and using recycled parts in the maintenance of its vehicle fleet.
- *Observation*: There is a need for better part number information given that the Hollander Interchange system was developed in 1934 and needs to be fundamentally updated or replaced. More availability of part numbers would result in greater reuse and recycling of parts. Every part from every vehicle could be reused if the information was available, because new parts are not needed for a used vehicle.
    - Mr. Bradburn mentioned that there are a number of examples of reuse of parts in General Motors (GM) plants. For example, GM has a commodities research manager in each plant to look for blemished pieces that could be reused or sold for scrap. The auctioning of these blemished parts has generated over $10 million after the first year. This sort of mind set led to some other interesting outcomes. For example, the Chevy Volt battery covers are very difficult to recycle, but by looking at them as a commodity and not waste, GM is considering turning them into nest structures and bat houses. This has removed waste from landfills and improved the environment. It is a truly sustainable solution.
- *Question:* Are auto manufacturers designing for dismantling?
    - Mr. Bradburn said that there was some work done with dismantlers on the Volt itself so GM has a lot of data on recovering some of those materials. It is a matter of connecting the green dots.
- *Question:* Do we need to change standards, codes and insurance in order to advance resource efficiency? The University of Waterloo in Ontario, Canada did a 5-year study looking at reuse of batteries. The research team discovered that environmentally battery reuse is a great idea, but economically it is inefficient. The great barrier to reusing batteries was that they could not be used in regular buildings because electrical codes would not allow it. If the batteries could be used, then the insurance industry did not know how to insure them.
    - Ms. Gawel agreed this is exactly the challenge. At the macroeconomic level you see an opportunity, but in terms of playing it out with actors in the system, it does not work well. Another issue is financing. How to account for the value of the materials up front when commodities are volatile, and who benefits? The bank? The building owners? The users? These barriers need to be lowered.
    - Commenting on the circular economy discussion, Mr. Gaillaud stated that a key role of government is to make sure that initiatives get off the ground by helping to remove some of the barriers. For example, France is going to work with private companies through mutual agreements to remove identified barriers and make sure that those pioneers who expect to run new business models can find the right insurance.

4.4 Upstream Efforts to Address Resource Efficiency (Plenary Session)

4.4.1 Mr. Philippe Dauphin, CanmetMaterials at Natural Resources Canada – Energy Mines Resources.ca, an Integrated Resource Cycle

Mr. Dauphin described integrated resource cycling and sustainable development related to the extractive sector in Canada. He noted that a full fifth of Canada's exports are minerals and metals based. In the mid-1990s, they developed a policy that: defined a sustainable development approach to minerals and metals; identified issues around competitiveness and societies; promoted markets and stewardship; established Canada's role in engaging with aboriginal communities; and defined the role of the government in international relations and trade to make sure technology barriers to trade were not introduced.

Canada is a complicated regulatory space. Extraction and ownership of natural resources is a provincial and territorial responsibility. There are a number of shared responsibilities with the federal government including research, sustainable development and economic development. On the federal side, the focus is on national statistics and trade issues. The Canadian government just implemented an extractive sector transparency measures act based on experience with Canadian companies operating abroad.

Mr. Dauphin noted that Canadian mining is working on four points related to resource efficiency: footprint reduction; waste management; mine closure and rehabilitation; and ecosystem management.

Mr. Dauphin also noted that CanmetMaterials, the laboratory he directs, focuses three quarters of its activities at the nexus of minerals and metals and energy. The largest program at CanmetMaterials is focused mostly on automobiles, reducing emissions through lightweighting, powertrain efficiency and heat management.

- *Question:* As you look at the life cycle of minerals and metals management, are you exploring opportunities for collaboration up and down the supply chain? Have you found any natural partners?
    - Probably 90 percent of CanmetMaterials work is done through partnerships. Right now CanmetMaterials is looking at developing materials, so its role is not at the functional end of things, but rather at the material properties end of things.

4.4.2 Ms. Ursula Mathar, BMW Group – Using Life Cycle Thinking and Supply Chain Engagement to Achieve Resource Efficiency

Ms. Mathar discussed how BMW uses life cycle thinking and supply chain engagement as it works toward resource efficiency. In order to make sure BMW is fit for the future, the company continuously invests in integrating sustainability into its business model. BMW sees global sustainability challenges as an opportunity to develop innovative products and services. In this way, sustainability makes a long-term contribution to the business success of the BMW Group. BMW's innovations are not developed to be of benefit to its customers only – BMW also wants them to have a positive impact on society and the environment. Taking social and environmental responsibility for all BMW does is an integral part of how it perceives itself as a company. BMW is convinced that the lasting economic success of any enterprise in today's world is based increasingly on acting responsibly and ensuring social acceptance. BMW wants to achieve a clear competitive advantage with efficient and resource-friendly production processes and state-of-the-art solutions for sustainable individual mobility for its customers.

One example from a life cycle point of view is BMW's new 7 Series. It is 25 percent better with respect to its carbon footprint than its predecessor.

Another example: Since 2011, the BMW Group and Sixt SE have been offering their joint venture car-sharing service DriveNow. BMW and Sixt SE are also integrating electric vehicles into the range of cars

available from DriveNow. For example, in 2015 DriveNow introduced over 800 BMW i3 vehicles into its car-sharing fleets worldwide. By December 31, 2015, DriveNow had a total of around 490,000 customers in Germany and around 580,000 worldwide (in 2014: over 390,000 worldwide).

As part of the global growth of the BMW Group, the company is shifting its value creation more strongly towards the respective sales markets. Increasing internationalization of procurement leads to great opportunities but also to new sustainability risks. In view of BMW's large number of suppliers and sub-suppliers, maintaining sustainability standards is a huge challenge. Only if BMW works closely with its business partners can it increase transparency and resource efficiency in the supply chain and ensure that sustainability standards are complied with.

Ms. Mathar stated that BMW also knows that sustainability must extend across the value chain – currently 53 percent of its suppliers go through the company's Carbon Disclosure Project (CDP) Supply Chain Program. Sustainability requirements are part of supplier's contracts and BMW asks them to pass the requirements down to their lower-tier suppliers. There are four areas where BMW is working with suppliers: 1) principles and standards for supplier network; 2) sustainability risk management; 3) sustainability training (suppliers are invited to participate); 4) participation in initiatives and networks – BMW feels this type of collaboration helps everyone.

She also noted there are a few key challenges to achieving a more sustainable supply chain: 1) complexity and dynamics of the supply chain itself; 2) lack of transparency along the supply chain; 3) minimum standards in industry.

Ms. Mathar said at the division level, BMW's sustainability strategy needs to have very concrete, measureable targets for management. By incorporating a life cycle approach in the strategies, it helps drive down through the supply chain.

- *Question:* You mentioned having 10 times more customer contact, have you gotten feedback that this is helpful to the life cycle process?
    - Some consumers are really interested, but most of them are only looking for a personal advantage.

4.4.3 Dr. Lee Davies, Department for Environment, Food and Rural Affairs, United Kingdom – Developing Policy to Support Sustainable Innovation

Dr. Davies described some of the UK's work on supporting sustainable innovation. He briefly outlined the Action Based Research approach which the UK government is using to explore how policy makers can most effectively enable the transition to a resource efficient economy.

The program starts with the development of a broad set of outcome-focused research questions; a central principal is that policy makers do not have all the answers and that it is much more likely that valuable insights will develop if the government opens up the process of shaping the research question as broadly as possible.

The process is also designed to generate the broadest possible range of ideas for new projects, encouraging bids from actors across academia, business and civil society and promoting the development of new collaborations – for example between academics and business – to operationalize new ideas and concepts.

The procurement process is a critical element in the success of the program. It is designed to minimize the burden and risk on applicants – to encourage new partners to engage and to support them through the process of developing their proposals.

Once identified, the projects adopt a highly iterative approach based on a formative evaluation process that lets the program identify new learnings early and feed them back into the project, leading to a more

natural process of learning. This also allows the program to feed learnings directly into policy thinking as they emerge, delivering on-going value throughout the lifetime of the project.

An example of an actual project facilitating resource efficiency is the Shared Resource Efficiency Manager Project. It is a collaborative model where a cluster of small- and medium-sized enterprises working in the same sector can get together and share a Resource Efficiency Manager.

The Shared Resource Efficiency Manager (SREM) is not a consultant but more of a shared employee. This role helps to alleviate issues when companies do not have the capability or time to allocate someone to tackle resource efficiency questions. The goal of the project was to see whether the program could build a collaborative model in which an employee could be shared between a group of businesses who could access the expert in a more efficient, flexible way and also benefit from the opportunity to learn from other businesses in the cluster.

The SREMs employed a three stage process. In the first stage, the manager undertook a structured data collection review and analysis of the businesses' systems and processes. In the second stage, the manager developed action plans and focused on getting buy-in from senior management and key actors on the shop floor. The third stage was delivery. It was a very circular process with learnings being constantly fed back into the process – both within and between businesses in the clusters – allowing for development and refinement of the process throughout the trial. The wider project partners, including the project team and policy makers, were also actively engaged throughout the process, providing advice and taking away learnings as they emerged.

The initial findings indicate that even within the trial period the SREMs paid for themselves in terms of resource efficiency savings. They generated £125,000 in short-term actual savings. A further £450,000 in savings was identified through improved processes. The broader benefits associated with the model included building business networks.

However, Dr. Davies noted that there were challenges. First, many companies see material resource efficiency activities as a cost, at least up front. Second, some companies do not feel that they have the ability to change processes and practices, especially when they have one or two big clients that dictate processes. Third, material costs are not as salient to businesses as energy costs. Finally, working with larger businesses at the top end of the supply chain can be a very effective mechanism, but companies need to develop the relationship and trust and need to ensure that the services they are providing are a benefit and not a burden.

- *Question:* Did you notice any common themes or key moments in time where people could get past key barriers?
    - Once savings were realized, the participating businesses were reassured. The message is that it is still challenging to convince businesses that they need to try resource efficiency. The only way to tackle this doubt is to use the people who are already engaging in resource efficiency as advocates since they have the real credibility here; government cannot do it alone.

4.4.4 Dr. Alessandro Peru, Ministry of the Environment, Italy – New Voluntary Approach for Assessment and Communication of Environmental Footprint

Dr. Peru described a new voluntary approach Italy has taken for assessing and communicating environmental footprints. He began by noting that Italy has one national law (Collegato Ambiente) that covers a wide range of environmental issues, including resource efficiency and circular economy issues.

Before this law was enacted, Italy launched the Environmental Footprint National Program. It started in 2011, and the Ministry of the Environment initiated an intensive program on voluntary environmental

footprinting. It covers design and implementation of carbon and water footprinting and is aimed at promoting voluntary commitments from small- and medium-sized enterprises.

Italy is also launching a campaign to raise consumer awareness including adding an "Environmental Annex" to Italy's Financial Stability Law (February 2016). This annex is a strategic tool to support recycling.

Dr. Peru pointed out that the regulatory framework will involve both binding and voluntary instruments. Green Public Procurement dictates mandatory use of goods and services that meet "minimum environmental criteria." There is also the "Made Green in Italy" national voluntary scheme that will be set up to increase competitiveness of Italian eco-products.

Finally, Italy is currently working on a comprehensive Green Act that will provide useful tools to further de-carbonize the economy, promote efficient and sustainable use of resources, and enable financing for sustainable development. Italy is also working on an updated National Sustainability Strategy.

- *Question:* Has Italy seen any public attitude changes based on outreach?
    - Yes, the public has indicated that it is a good time to promote this effort. The Ministry of Environment will launch a communication strategy in the coming months and one of the aims is to include consumers to make them more knowledgeable of what we are doing and how they can play a role.

4.4.5 Ms. Yuko Sakai, Toyota – Toyota's Challenge for Resource Recycling Management

Ms. Sakai described Toyota's Challenge for Resource Recycling Management. In October 2015, Toyota unveiled Toyota's Environmental Challenge 2050 – a zero environmental impact challenge.

Ms. Sakai noted that Toyota has a history of automobile recycling and actively engages with automobile recycling at every stage of the life cycle. For example, Toyota has the Automobile Recycling Technical Center – the world's first dedicated recycling facility by a vehicle maker. Toyota leverages the center to develop techniques to recycle cars and develop recycling information and training that could be provided to suppliers and other automobile recyclers.

Toyota is using plant-base polymers in some seat cushions of its cars as well as using recycled plastics throughout the vehicle (about 100 parts account for about 20 percent of the plastic weight in the car). Toyota has been recycling replaced bumpers since the early 1990s leading to the collection and recycling of one million bumpers in Japan.

Toyota has been investigating the recycling of minerals (ferrous metals, coper, etc.) as well. The company has established and implemented the world's first automobile shredder residues (ASR) recycling process.

Toyota is also engaging in recycling of car batteries to be primarily used in stationary energy storage such as solar photovoltaic energy storage at Yellowstone National Park. In addition, Toyota started a pilot program to sell refurbished hybrid batteries in November 2015. Assuming this project is successful, Toyota envisions expanding it nationwide.

Ms. Sakai indicated that Toyota hopes to deploy these recycling and circular economy efforts to more countries where Toyota does business.

Questions from workshop participants to speakers:

- *Question:* Were Toyota's plastic recycling activities supported with life cycle analysis (LCA) studies to determine environmental hotspots and benefits?

  - Toyota is still working on this project. Toyota still has several issues it needs to overcome, but knows it's a beneficial program to increase resource efficiency.

- *Question:* Is Toyota only recycling batteries for electric vehicles or is it recycling batteries from all vehicles? Are non-Toyota batteries recycled?

  - Currently, Toyota recycles only Toyota hybrid car batteries.

- *Question:* How is Italy engaging local governments to support the voluntary footprinting effort?

  - Local governments participate on a voluntary basis; the Ministry of Environment has been engaging them to help with selection of methodologies for how to test and quantify emissions and how to assess whether the work has been done correctly. Now that the ministry has reached the more formal phase, it has provided support to a technical committee that helps local governments.

- *Question:* What is the role of engineering schools and business schools in making efforts such as the program started by the UK Department for Environment, Food and Rural Affairs sustainable? About 10 years ago, Canada had a program where students helped small- and medium-sized enterprises, but once they left, the companies went back to their old ways. What is the role of schools? Can resource efficiency be turned into a discipline?

  - There are a number of different models, but the program found that larger organizations could really play a role in terms of actually seeing the benefits resource efficiency can play in improving the performance of their supply chains. Schools certainly have a role to play here as they often are the source of innovation. However, by working with larger businesses to share and test new practices, they may have more impact.

- *Question:* What is the best way to keep the keeping momentum going? There have to be monetary incentives. For example, PepsiCo looked at resource conservation in its plans and found ways to save water and energy, and it is money that drove those reduction efforts. Showing monetary value and the associated data to plant managers is key to promoting resource efficiency efforts. In addition, how do companies make sure what they manufacture gets to the consumer and gets used, rather than wasting the time and energy making products that do not get used? Is anyone studying how much that might cost?

  - Ms. Mathar stated that at the division level, BMW's sustainable strategy needs to have very concrete measureable targets for management. By incorporating LCA into strategies, resource efficiency is driven down through the supply chain.

- *Question:* Chrysler has internally identified a lot of opportunities to use recycled content and encourages its suppliers to present these types of solutions. However, issues arise when Tier 1 suppliers are reluctant to use recycled materials because they already have approved materials. How can this be addressed?

  - For the BMW Group, it is essential that its business partners meet the same environmental and social standards BMW has set for itself. The BMW Group Supplier Sustainability Standards are the foundation on which this process is based. The standards establish basic principles that are to be adhered to by all BMW Group suppliers. This includes compliance with all internationally recognized human rights as well as environmental, labor and social standards. The BMW Group Sustainability Standard is an integral part of the request for proposal documentation for new suppliers and is thus a key tool in the integration of sustainability aspects into the procurement process.

- Ms. Mathar said BMW makes it part of yearly discussions with its top 100 Tier 1 suppliers. These are high-level discussions between BMW Senior Managers and Supplier owners and/or board members. The outcomes of these meetings are concrete sustainability measures. In addition, this makes it a topic of conversation within the supplier groups that helps embed it into their culture. In addition, BMW's procurement staff is trained on the relevance of sustainability aspects for their procurement decision. A supplier has to meet certain levels of sustainability to be deemed an option.

4.5 Breakout Sessions – Upstream (Conversation Starter Summaries)

Each breakout session began with one or more success stories or best practices (conversation starters) followed by group discussion. Conversation starter summaries are captured below. Participants reported on the results of their breakout sessions to the full plenary. These report outs represented the statements and ideas of individuals and not consensus among the group. **See Attachment 2** for full summaries from these sessions where additional best practices, challenges and opportunities, and potential practical ideas for action were discussed.

4.5.1 How can we use the design process to improve resource efficiency from a life cycle perspective?

Ms. Carrie Pearson, 3M – Integrating Sustainability into the Design Process. Ms. Pearson provided an overview of 3M's efforts to infuse life cycle thinking into its design process using a standardized handbook that helps ensure designers consider life cycle impacts. All new products undergo life cycle management (LCM), a qualitative process that embeds life cycle thinking into the design process. If necessary, some products then undergo a full LCA. She emphasized that this handbook, which helps standardize the process and a corporate commitment to sustainability helps instill a level of awareness about the importance of resource efficiency across the organization. This corporate commitment is reflected in the company mission statement including explicit language about the importance of sustainability by leadership, a dedicated LCA team that is available to anyone across the company, processes and procedures that integrate life cycle thinking into regular business processes, and company participation in corporate sustainability indexes.

Mr. Werner Loscheider, Federal Ministry for Economic Affairs and Energy, Germany – Light-weighting**.** Mr. Loscheider provided insights into how Germany is handling one design challenge in industry – lightweighting. Given that the majority of production costs are driven by raw material costs, industry is particularly attuned to resource efficiency. Industry feels that resource efficiency is a win for all stakeholders; the economy benefits from higher competitiveness, the environment benefits from lower emissions and there is beneficial social development from safeguarding and creating jobs.

4.5.2 How can we improve how we use life cycle information and life cycle thinking to set goals and better inform resource efficiency decisions?

Dr. Jim Fava, Co-chair (with Mark Barthel) of the Hotspot Project (prerecorded video introduction). Dr. Fava discussed the work that he is involved in with the United Nations Environmental Programme (UNEP) and the Society of Environmental Toxicology and Chemistry to develop a hotspots analysis methodology framework which can be applied at the product category, sector, city and national levels.

Hotspots analysis is used to identify high priority impacts (e.g., water, energy waste, etc.) and life cycle stages (e.g., raw materials acquisition, manufacturing, transportation, use and end-of-life) to inform decisions. Hotspots analysis is often used to identify actors who are most appropriate to work towards taking actions to reduce the negative impacts identified by the hotspots analysis. It is also used as a pre-cursor to developing more detailed or granular sustainability information. Additional information about the UNEP's Hotspots Project can be found in the report at the following website: http://www.life

cycleinitiative.org/wp-content/uploads/2014/12/UNEP-Hotspots-Mapping-Project-Final-Report-Phase-1.pdf

Mr. Ron Voglewede, Whirlpool. Mr. Volgewede discussed the ways in which Whirlpool has used hotspots analysis in its processes and provided recommendations for how this tool can be used successfully. Whirlpool has used hotspots analysis to look at a variety of different factors to reduce waste and increase viability of its products. Whirlpool has looked at the raw materials used to produce its products, how it packages its products to reduce waste, emissions from the production and use of its goods, and the social and economic impacts its products have. Hotspots analyses are designed to focus on a specific issue; however, it is important to identify the right issue and have the scope clearly defined. The hotspots analysis should be driven by the end goal or outcome of the analysis. Engaging stakeholders, including small- and medium-sized enterprises (SMEs), and looking at other hotspots analyses and LCAs are all beneficial to the process because they help to identify the desired outcome and inform the work that is being done while reducing redundancies and improving the process. Hotspots analysis not only informs a single desired outcome, but also aids in broad-level impacts beyond a single project. Development of standardized and harmonized views by types of products by how they are produced, their uses (especially energy usage) and where those use cases occur will inform better focus on those relevant impacts that promote better design.

Dr. William Flanagan, General Electric (GE). Dr. Flanagan shared GE's structure and process for using key decision support tools that incorporate life cycle information. He described how the tools facilitate more informed decision-making. Initially, Dr. Flanagan and his team quickly recognized that measuring the carbon footprint of GE's supply chain would distract resources away from the company's real opportunity to contribute to sustainability, which is its ability to develop game changing products and technologies and deploy them on a global scale. So, while GE developed internal capability to perform detailed LCAs following the International Organization for Standardization (ISO) 14044 guidelines, it also developed a screening LCA tool and a qualitative environmental LCM tool, which is designed to rapidly identify issues which would not necessarily be identified in a typical LCA.

The content of the LCM tool was developed based on external stakeholder mapping with the intent of educating and guiding tool users about life cycle perspectives that are important to a broad range of stakeholders, and the importance of particular stages of a product's life cycle. The tool also includes customizable business context filters that allow content (topic areas) to be weighted differently depending on the product category or industry.

The GE LCA screening tool does not require substantial data collection. GE has populated the tool with average impact scores for a broad range of materials, such as plastics, which prevents the over-collection of detailed materials information that may not be necessary at the screening level. This allows the company to quickly analyze, for example, whether the materials impacts are significant relative to use-phase impacts, given how a product is used. GE has also developed custom tools for specific product applications and strategic customers.

GE has been "dashboarding" to identify areas, products or customers that might benefit most from conducting an LCA. This is important, since GE cannot conduct LCAs for every single product. This process allows the company to be strategic and selective in how it conducts LCAs, and how they add market value, differentiation and so forth. In general, GE tries to customize every strategy in order to maximize value for its customers, since GE would like to develop solutions that would "change the game" rather than make incremental improvements to existing products. These tools also may be used to perform priority assessment of supply chains. It is also important to look at material flows and translate those variables into life cycle costs. The idea is to lower barriers for entry for companies to begin thinking about LCAs, because making LCAs easier to understand, conceptualize and use is critically important if their use is to be widely employed.

4.5.3 How do we do a better job of identifying, communicating, and addressing social impacts across the supply chain?

Mr. Jeff Morgan, MARS Corporation. Mr. Morgan provided an overview of MARS' efforts to identify and communicate social impacts across the supply chain. MARS' goal is to have sustainable supply chains – economic, social and environmental sustainability. A major challenge is in the agricultural supply chains and those within underdeveloped countries. Some specific challenges encountered include: 1) high levels of poverty among small holder farmers due to low yields; 2) poor farm practices; 3) exclusion of women from income; and 4) poor education opportunities.

Cocoa, as a crop, is highly labor intensive; however, farmers may not be well organized. MARS worked to take a holistic approach to address productivity and social issues. Mr. Morgan highlighted key practices such as a focus on women's empowerment, availability and access to better planting material, improving training and working to improve labor practices (i.e., reducing hazardous conditions). He stressed the need to consider the cultural aspects of a country where the supply chain resides when determining actions for improvement. For example, in some cultures, the family, including the children, traditionally farms the land.

Mr. Morgan's major lessons were: 1) knowledge and understanding of the culture and social environment of the supply chain is critical before taking action; 2) media plays an important role – both positive and negative; and 3) positively addressing social impacts takes time (25-30 years).

While his comments were focused on cocoa, he felt these practices could be applied more broadly to agricultural processes and artisanal production of goods and materials.

Mr. Kevin Funk, U.S. General Services Administration (GSA). Mr. Funk provided an overview and demonstration of GSA's tool created to help organizations incorporate social impacts into purchasing requirements. The tool came online in February 2016 and will be updated as new best practices and tools are identified. It helps users identify and address their high-risk areas. The tool can be found at: https://sftool.gov/plan/545/social-sustainability.

4.5.4 How can we improve communication and share information about resource efficiency across the supply chain?

Mrs. Sue Rokosz, Ford Motor Company. Mrs. Rokosz provided an overview of Ford's Partnership for a Cleaner Environment (PACE) Program through which leading environmental practices are shared between Ford and its suppliers. As participants in the program, suppliers select leading practices applicable to their operations, create a roadmap for improved efficiencies, collect relevant baseline data, implement the leading practices and report environmental metrics to Ford. The PACE Program ensures two-way communication between Ford and its suppliers and that they are able to share information, leading practices and lessons learned.

Mr. Jason Pearson, Sustainable Purchasing Leadership Council (SPLC). Mr. Pearson described the work of SPLC, a group of over 150 leadership organizations across the public, private and civil society sectors that collaborate to develop a shared program for guiding, benchmarking and recognizing leadership in sustainable purchasing. SPLC equips procurement professionals with resources to make strategic institutional purchasing decisions that send a collectively harmonized message down the supply chain regarding the value of sustainable products. One such resource is SPLC's Guidance for Leadership in Sustainable Purchasing, released in 2015. This document provides recommendations and best practices for creating a strategic sustainable purchasing program using the concept of a strategy cycle. The document also provides guidance on sustainable purchasing for eight priority purchasing categories. Overall, the SPLC provides a forum through which purchasers and suppliers can work together to share best practices, encourage alignment and promote market transformation

4.6 CIRCULAR ECONOMY PRINCIPLES IN ACTION (PLENARY SESSION)

4.6.1 Mr. Jean-Francois Gaillaud, Ministry for Economy and Industry, France

Mr. Gaillaud described the efforts of the French government to apply the concept of the circular economy (CE). He noted that in France, resource efficiency is closely associated with combating climate change. Therefore, resource issues and CE have been integrated in a bill for energy transition and green growth. He reminded the audience of the success of the Conference of Parties 21 (COP21) in Paris.

CE is a keystone for France's transition to green growth. The energy transition bill also recognizes that prevention and recovery of waste are key elements of a more circular economy, which is itself a mean to become more resource efficient. Waste is a resource: it is a source of added value and a source of security of raw materials and energy supply. Reuse and recycling can decrease the need for virgin resources and support the decoupling of growth and resource consumption.

France expects to create 25,000 jobs related to CE and is trying to develop a strategy to move towards CE more fully. France is also focusing on a more sustainable public procurement policy to meet national objectives to cut landfill use in half by 2025 and increase recycling rates to 65 percent by 2025. France is engaging the business community by working with the National Council of Industry on the different aspects of resource efficiency and CE.

Mr. Gaillaud noted that the Committee for Strategic Metals was established in 2011 to strengthen the security of the supply of raw materials for the French economy and increase its sustainable competitiveness. France also established an information platform to enable easy access to knowledge about mineral resources, including criticality sheets.

Mr. Gaillaud also noted that research and development are an important component of the transition to sustainability.

4.6.2 Dr. Philippe Schulz, Groupe Renault

Renault has worked to apply the concept of CE in its day-to–day business practices. CE is not just one concept. At Renault, investments have been realized in different steps of the various CE loops. The economic stakes for car manufacturers are huge, since raw materials account for about 15 percent of the vehicle manufacturing cost. Moreover, metallic scraps usually represent 30 percent of the input materials in plants.

Dr. Schulz noted that Renault wants to secure strategic material supplies, such as copper, aluminum and plastics, because material price variability can have significant impacts. Renault has a subsidiary, Renault Environment, with different CE-related subsidiaries. For example, Indra, a 50:50 joint venture (JV) between Renault and Suez Environment has a network of 300 dismantlers in France, providing access to roughly 20 percent of French end-of-life vehicles (ELV). By linking the experiences of Renault as a manufacturer to these end-of-life resources, it provides valuable insights for car dismantling. By recovering wires from ELV and re-treating them, Renault has been able to recover enough copper through recycling to meet its current copper needs in French foundries (powertrain production). Current low commodity prices reinforce the need to close the loops.

Remanufacturing mechanical parts is another example of activity performed in the Renault CE program, in a dedicated plant at Choisy (France), driving annual revenues of about 200 million euro.

It is absolutely a necessity to be part of all those loops to make a competitive business case. Renault has also a lot of research and development partnerships, because technology is different from one loop to the next.

- *Question:* The presentation by Steve Evans noted the challenge of national boundaries and rebound effects and then normalization. The narrowest definition of CE is a closed loop of technical materials.

The most open definition is a substitute for world sustainability. It seems that France's national policy seems to follow the narrow definition. Are there complementary approaches are being used in tandem?

  - Mr. Schulz stated that Renault is a member of the Ellen MacArthur Foundation on CE, assessing criteria potential to assess boundaries effect on resource efficiency and CE. Renault believes that CE is a very broad concept that needs to be properly defined, for all kinds of loops (e.g., remanufacturing, reuse, recycling).

- *Question:* How does Renault interact with auto dismantlers?

  - In France, there are many small dismantlers with specific processes and that are not always very professional, but in the past 10 years there has been a shift toward more professionalism. There is still a lot of room for additional improvement, but it has improved.

4.7 TOOL TIME: TOOLS AND RESOURCES TO ACCELERATE RESOURCE EFFICIENCY (PLENARY SESSION)

4.7.1 Mr. Paul Yaroschak, U.S. Department of Defense (DoD) – Sustainability Analysis Tool

DoD is a big purchaser of very complex systems that often last many years. These systems use large quantities of resources during manufacturing, operation and maintenance. In order to make better design decisions that minimize impacts to human health and the environment, DoD has developed a sustainability analysis that combines LCA and Life Cycle Costing (LCC). The LCC element is particularly important because most decisions are based on financial considerations such as total cost of ownership.

A web-based tool is being developed that automates the process for people who are not LCA experts. The results provide the relative human health and environmental impacts of alternatives and the total life cycle costs. There are three types of costs displayed: Internal costs (DoD will pay at some point in life cycle); external costs (those that society pays); and contingency costs (may occur depending on future events such as costs due to non-availability of a chemical due to regulatory phase-outs).

DoD has completed five successful pilot projects to test the sustainability analysis with Boeing, Sikorsky, Lockheed Martin, 3Ma and GE-Aviation. DoD plans to provide demonstrations of the web-based tool to a DoD review group, an industry peer review group, and state and federal agencies.

4.7.2 Mr. Joe Cresko, U.S. Department of Energy (DOE) – LIGHTEn-UP and MFI Tools

DOE is trying to develop tools and techniques to address loss within the industrial sectors.

The goal of Lifecycle Industry GHgas, Technology and Energy through the Use Phase (LIGHTen-UP) is to have a transparent tool that is easy to use. The underlying data for the tool comes from environmental impact assessments. Using this tool and its datasets, you can get a sense of the impacts of material changes. The goal is to have a web-based version available to the public in 2017.

The goal of the Materials Flows through Industry (MFI) tool is to determine the embedded energy in a product, material or process.

These tools are currently under development and if any workshop attendee is interested in participating in a pilot of these tools, please reach out to Mr. Cresko (joe.cresko@ee.doe.gov).

4.7.3 Ms. Elisa Tonda, UNEP – Global Network of Interoperable LCA Databases

The development of the Global LCA Database Network is being led by a UNEP steering committee composed of thirteen governments and facilitated by UNEP.

The steering committee of the initiative established three technical groups to support the development of the global network (network architecture and technology; nomenclature; and metadata descriptors).

The product will be a database of databases that will allow for a central user interface, enabling access to nodes worldwide and ensuring interoperability through agreed nomenclature and metadata descriptors.

UNEP is anticipating a test phase before spring of 2017.

4.7.4 Mr. Charles Shoopman, University of Tennessee – Investing in Manufacturing Communities Partnership (IMCP)

The IMCP program can be used as a successful model for promulgating best practices. It was conceived as a way to get federal agencies who have shared interests to leverage economic development initiatives and funds while making it easier for leaders of local efforts to access federal assistance. It encourages communities to develop comprehensive strategies that strengthen their competitive edge for attracting global manufacturing and supply chain investments.

Launched in 2014, there are now 24 federally designated IMCP communities across the country with 12 federal agencies participating in a program awarding more than $1.3 billion annually.

Some current plans address: workforce and supply chain challenges; infrastructure; research and innovation; trade and investment; capital access; and operational improvement for manufacturing companies.

4.7.5 Mr. Andrew Mangan, U.S. Business Council on Sustainable Development and Andrea Brown, World Business Council on Sustainable Development – The Materials Marketplace

The Materials Marketplace is a web/cloud-based collaboration tool developed over the past 20 years. It allows companies to upload data about materials flowing through their operations and share that data with peers from other companies. Business council experts work with the companies to find and test possible material reuse ideas. The Materials Marketplace can be thought of as a place to explore reuse and new supply chain opportunities.

The Marketplace also serves as a convening ground for diverse companies to work together on common circularity goals, such as logistics, supply chains and policy development. For example, the Materials Marketplace is working to define how and why materials reuse should qualify as a carbon reduction strategy – both in the US and internationally. The World Business Council on Sustainable Development is collecting the science and organizing the systems and verification techniques needed to support this idea.

As part of the scaling strategy, the World Business Council for Sustainable Development has put forward a proposal to enact a similar program in Europe and is working with the European Bank for Reconstruction and Development to implement a Materials Marketplace in Turkey.

In the United States, states are looking to support this as a statewide or citywide deployment. The plan is to get over 100 companies in the U.S. involved in the Materials Marketplace.

4.7.6 Mr. Steve Gutmann – Stuffstr

Stuffstr is developing a platform to help reuse durable goods; this platform is meant to increase resource efficiency in the retail sector (e.g., personal, physical assets). Rather than spending most of its useful life in a basement or storage unit, a product can be recycled, donated or sold (downstream services) through the Stuffstr platform. The Stuffstr app is currently available on request.

4.7.7 Mr. Kevin Funk – Social Impact Tool

GSA has developed a social impact tool that can provide a framework for assessing and addressing social impacts as part of the procurement process. It can be found at https://sftool.gov/plan/545/social-sustainability

See Attachment 3 for a list of tools and resources suggested by participants.

5 MARCH 23, 2016

5.1 OPENING REMARKS (PLENARY SESSION)

5.1.1 Dr. Wolfgang Scheremet, Director General, German Ministry for Economic Affairs and Energy

Director General Scheremet noted that this workshop builds on the successful G7 events in Berlin, Germany; Birmingham, UK; and Yokohama, Japan. He emphasized that everyone benefits from sharing information with one another and networking at the G7 level. Cooperating at the international level is essential to tackling bigger challenges such as sustainability, demographic change, globalization and climate change.

Dr. Scheremet pointed out that resource efficiency, CE and understanding of the entire life cycle of products are essential economic issues which affect every sector and every possible economic activity, but also every consumer and every institution, both private and public. These issues need to be viewed from a positive perspective. They have tremendous potential for value creation, if careful decisions – driven by economic sense and technical feasibility – are made. Ultimately, resource efficiency has to be accepted and implemented by companies, and is part of delivering products needed by consumers. The industrial sector is therefore key to sustainability, growth, employment and environmental protection.

Dr. Scheremet underlined that digitalization and ICT will play a central role as enablers of environmental innovations. New technology makes it possible to actually see products throughout their life cycle and to view the entire value chain.

In 2013, Germany invested around 53 billion euros in research and development, partly for using raw materials more efficiently. Because raw materials are a significant part of production costs, it is in a company's best interest to use these materials efficiently. Germany is highlighting this in its revision of its national resource efficiency program. It lists opportunities for action along the entire value chain. Germany wants to take action through a voluntary approach and continue to emphasize cooperation with the business community and provide incentives to encourage progress. Germany also wants to strengthen links between material efficiency and energy efficiency to take advantages of synergies. In the end, resource efficiency is not just a measure of the G7, but of all countries that produce goods.

5.1.2 Ms. Gina McCarthy, Administrator, U.S. Environmental Protection Agency

U.S. EPA Administrator McCarthy discussed the environmental and economic benefits of sharing knowledge and best practices on resource efficiency, known as sustainable materials management in the United States. She reiterated that countries share the goals of meeting global resource challenges, keeping businesses prosperous and sustaining the natural resources that future generations will depend on. She noted that resource efficiency also offers opportunities for meeting the Intended Nationally Determined Contributions (I.N.D.Cs) that underpin the Paris Agreement.

In laying out U.S. progress in resource efficiency, Ms. McCarthy cited EPA's on-going support for the Suppliers Partnership for the Environment, and the agency's commitment to LCA research and development. She urged colleagues to seize the opportunities that sustainable materials management presents, and welcomed the chance to share knowledge and best practices.

5.2 Improving Resource Efficiency in Operations, Use and at End-of-Life (or Second Life) with Supply Chain Engagement (Plenary Session)

5.2.1 Mr. Yuji Yamaguchi, Ministry of the Environment, Japan - Japan's Initiatives to Promote Resource Efficiency and the 3Rs in the Auto Sector

Mr. Yamaguchi described Japan's initiatives to promote resource efficiency and the 3Rs in the auto sector. In Japan, by law, users are required to pay modest recycling fees at the time of a new car purchase. The recycling fee is used for recycling of automobile shredding residue, airbags, etc.

Japan is actively promoting design for environment (DfE), recovery and utilization of secondary materials. For example, Japan conducted a project, including a cost-benefit analysis, to evaluate the efficiency of the dismantling process. The purpose of this project was to identify opportunities to influence the design process to improve the recycling process and to assess the effects of these design changes on car selection by consumers. Results did suggest a possible effectiveness of DfE approaches to reduce the dismantling time, especially for parts that normally take longer to dismantle than others.

A second project looked at how to promote proactive selection of "eco-premium" cars (e.g., cars that are easier to recycle or uses more recycled materials) by lowering recycling fees for these cars. This could not only drive demand for "better" cars, but also increase the availability of recycled parts.

Finally, a third project was designed to investigate ways to incentivize higher use of reused parts. The project looked at pre-agreement type production and supply models for reused parts and included stakeholders such as car leasing companies, repair factories and parts suppliers. This effort led to a 30 percent increase in the use of reused parts.

5.2.2 Ms. Lynn Laszewski, PepsiCo – The Realities of End of Life Resource Efficiency

Ms. Laszewski described PepsiCo's experiences in trying to enhance its polyethylene terephthalate (PET) plastic recycling, commonly used to make bottles and other containers. In 2010, PepsiCo started a program to bring used bottles and cans back to PepsiCo. The company began looking at this issue in an attempt to increase the amount of recycled PET in its bottles. To do this in a cost effective manner, PepsiCo had to identify potential new sources for recycled PET and also tried to increase the supply of PET which was being recycled. PepsiCo developed a pilot program of electronic kiosks that encouraged recycling by giving consumers rewards for recycling. This program provided some insight into consumer recycling habits, but was ultimately decided to be a niche solution because the electronics used in the program are difficult to maintain and expensive.

PepsiCo has also developed programs with schools to encourage kids to collect bottles to earn money for their schools. This program will not only provide material to be recycled, but it teaches children how to recycle and instills in them the idea that recycling is the correct path going forward.

PepsiCo decided to focus its efforts on venues that generate a lot of waste. Specifically, they have focused on recycling at sporting events by partnering with the National Football League and Major League Baseball. These organizations were very interested in having recycling at their events to lower their amount of waste. The PepsiCo program found a method that increased recycling without having to place static bins throughout the tailgating area. Therefore, in addition to focusing on venues with high amounts of waste, PepsiCo developed systems to make it easier for people to recycle.

PepsiCo also focused on recycling at its own facilities and events. Through this work, the organization has found ways to increase recycling in similar environments.

PepsiCo has been successful because it collects data and uses it to make programs more nimble and agile. Being able to make changes quickly allows the programs to not only survive but thrive.

Ms. Laszewski concluded by noting that it cannot be assumed that recycling program costs will be covered by recycling revenues. By incorporating PET recycling into its processes, PepsiCo has lowered its cost of recycled PET material. Companies have to be willing to commit to programs even when they do not generate a lot of revenue.

5.2.3 Mr. Adam Muellerweiss, Johnson Controls – Insights from the Circular Economy of Automotive Batteries

Mr. Muellerweiss described Johnson Controls experiences in establishing a closed loop for automotive batteries. He noted that lead acid batteries have a recycling rate approaching 99 percent across the G7 countries, especially when compared to the fact that in industrial economies, three-quarters of raw materials used in most products end up in landfills.

He mentioned that the automotive battery recycling model is radically different from the traditional linear model – the supply chain begins and ends when a customer returns a battery. There is no upstream or downstream and no real producer responsibility. There is no end of life, just end of use; this is a radically different concept that the battery recycling industry learned and now takes for granted.

End of life should not be considered as simply waste and pollution and an externality – it is system loss which is inefficiency and potentially harmful to the environment. What Johnson Controls learned and continues to learn is that everything in the cycle and every player is linked. Even internally, silos must be traded for systems. There is a lot of complex cycling when the supply chain begins and ends with customers.

Mr. Mullerweiss noted that standardized materials help drive efficiency. The lack of standardization can be a significant issue. For example, in the 1990s, one battery manufacturer introduced silver into its product, which improved battery performance, but disrupted the recycling system because the system was not designed to account for the minor addition of silver. To be successful, every step of the process must be considered. It is more than just vertical integration of the supply chain; it is participation in a circular process.

In many countries, it is not possible to follow a model where batteries are delivered to the store and old batteries are taken from there to be recycled, because the Basel Convention treats used batteries as hazardous materials. Well-intentioned regulations and rules can in reality erode value proposition for recycling and reuse.

It would be beneficial to develop a similar cycle for advanced batteries, but given that their formulations are evolving so frequently the corresponding recycling technology would have to continually change.

5.2.4 Mr. Peter Bartel, Robert Bosch – Ensuring Long-term Availability of Remanufactured Spare Parts

Mr. Bartel discussed the importance of life cycle thinking and ensuring the long-term availability of remanufactured spare parts. When designing parts, industry should think about the use phase and then the possibility of recycling. The critical point is to optimize production because in the use phase spare parts are needed.

He pointed out that in general, people should look to reuse and remanufacturing before recycling. In recycling, you can lose all of the functionality of the original product. However, it is more difficult to design a product with reuse and remanufacturing in mind.

In Mr. Bartel's experience, the only difference between a remanufactured part and an original part is that the raw materials being used are components from used cars not raw materials. There are many

advantages of using remanufacturing including decreases in raw material use (88 percent), CO2 emissions (53 percent), and energy (56 percent).

Industry can only achieve reuse through eco-design by ensuring the product can be recycled or remanufactured at the end of the day.

Finally, Mr. Bartel noted that to truly embrace the CE mindset, industry must educate consumers that purchasing a remanufactured part or a product in its second life does not mean you have a subpar product. Consumers should be proud to use a product in its second or third life.

5.2.5 Dr. Paolo Masoni, Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA) – Extracting Value from End-of-life Materials: Car Shredding Residues and Tires

Dr. Masoni discussed two new technologies that are aimed at adding value to car shredding resides and exhausted tires. He began by noting that all innovations have hotspots and tradeoffs that should be carefully assessed. This is particularly true for closed-loop processes.

Car shredding residues are an example. The EU generates approximately 2.4 million tons of car shredding residues each year. ENEA is examining treatment of this residue. Its LCA shows that an industrial-scale plant treating this residue can recover almost 74 percent of the energy content of the residue; moreover, LCA can inform the scaling up from pilot tests identifying strategies to reduce the environmental impacts.

ENEA is also trying to add value to used tires by using gasification and pyrolysis treatments and a plasma torch to produce silicon carbide. ENEA is testing processes and performing a life cycle sustainability analysis (LCSA) and LCA. ENEA has also performed a preliminary market analysis. Electricity production is a byproduct of the process, and the environmental impacts are also comparable for reference technology. ENEA also assessed the social impacts through social LCA.

Overall, Dr. Masoni sees LCA and LCSA as powerful methodologies to identify hotspots and tradeoffs. They provide recommendations for the full development and deployment of innovative technologies.

5.3 Breakout Sessions – Operations, Use and End-of-life (Conversation Starter Summaries)

Each breakout session began with one or more success stories or best practices (conversation starters) followed by group discussion. Conversation starter summaries are presented below. Participants reported on the results of their breakout sessions to the full plenary. These report outs represented the statements and ideas of individuals and not consensus among the group. **See Attachment 4** for full summaries from these sessions where additional best practices, challenges and opportunities, and potential practical ideas for action were discussed.

5.3.1 How do we incorporate and improve efficiency in other areas such as water, energy, land, etc…?

Mr. Bruce Uhlman, BASF. Mr. Uhlman provided an overview of BASF's sustainability programs and resource efficiency initiatives, including its programs with suppliers to meet resource efficiency targets in the areas of energy, water (through its efforts to develop a comprehensive water management system), safety, and health and security. The goal of these programs is to engage with suppliers around the various issues and challenges surrounding sustainability. As a global leader in sustainability management and measurement, BASF has developed a comprehensive, science-based Applied Sustainability Tool Box for integrating life cycle thinking and LCA into its strategic decision-making processes and customer engagements. Holistic assessments consider all three dimensions of sustainability: economic,

environmental and societal. Most recently, BASF developed a process to systematically and consistently evaluate the unique sustainability contributions of its entire portfolio. Through Sustainable Solution Steering®, BASF was able to analyze over 60,000 products and their value chains considering industry- and region-specific sustainability requirements. This detailed analysis and transparent classification and communication allowed BASF to both improve individual solutions and steer its entire portfolio. The results enabled further integration of sustainability into strategic, research and development (R&D) and customer support processes (e.g., educating BASF's sales force on how to communicate product sustainability information). The methodology and approach used by BASF for this effort have been licensed by thinkstep, and are thus available to all companies.

5.3.2 How can we create value from waste materials?

Mr. John Bradburn, General Motors. Mr. Bradburn provided an overview of GM's sustainability efforts, primarily focusing on GM's landfill-free manufacturing goal. GM has seen a total waste reduction of 40 percent. He noted that zero waste is a good barometer for success, but the ultimate goal is to establish the programs that drive zero waste. GM is looking at creative reuse of materials in addition to recycling. For example, materials from old tires are being used in new air bags and shipping boxes are used as roof liners. Everyone has the ability to come up with ideas for reuse. Manufacturers have to be willing to harness this input and have a commitment to continual progress.

Mr. Kevin Butt, Toyota. Mr. Butt provided insights into how Toyota views the business case for sustainability: it appeals to some consumers and reduces long-term risks. Toyota is a zero-landfill company, but not every plant is zero waste. Toyota is looking into ways to make that waste stream a revenue stream. Toyota has some ambitious goals, like zero CO2 from tailpipes by 2050, but Toyota only can have so much impact on the environment. He noted that others need to get together around good ideas to scale them up to have a lasting impact. Mr. Butt presented a pilot project that used spent hybrid batteries to create a power plant for a Yellowstone lodge that is off the grid. While no longer useful in cars, these batteries can provide decades of additional use in such an environment.

5.3.3 How might we improve the recycling of vehicles at the end of life, both increasing recycling rates and improving the recyclability of components?

Mr. Steve Fletcher, Auto Recyclers Canada (ARC). Mr. Fletcher provided an overview of Canada's efforts to infuse life cycle thinking into the recycling of products. Not only are parts extracted that can be refurbished or reused, but materials are processed, typically by shredding, so that they can be recycled. He provided an overview of the National Vehicle Scrappage program in Canada, which was a program to minimize emissions by reducing the number of high emitting vehicles on the road. There was a $300 incentive for vehicle owners to retire their cars, and all of the vehicles that were recycled as part of "Retire Your Ride" were sent to audited auto recycler locations that agreed to follow a standard code of practice. This code of practice served as the foundation for the Canadian Auto Recycler Environmental Code, a voluntary program that is half compliance, half best practice. The Code was developed by industry from the ground up, and approximately 500 businesses have gone through the certification process and are participating in a variety of vehicle retirement programs managed by ARC. Mr. Fletcher also noted that ARC coordinates with and communicates regularly with manufacturers on the recycling process. Finally, Mr. Fletcher highlighted that access to parts data is a priority, and can improve the reuse and recycling of vehicles, in addition to recalls.

5.3.4 How can we expand the use of remanufactured or refurbished parts?

Dr. Nabil Nasr, Rochester Institute of Technology. Dr. Nasr discussed his work with leading companies to encourage remanufacturing and reuse. Dr. Nasr presented a holistic, systems perspective on remanufacturing and refurbishment. He sees remanufacturing as the most important issue for getting to a closed loop economy and for improving resource efficiency – i.e., how to move the industrial world from pollution control to industrial ecology.

Dr. Nasr shared two specific examples of success stories. First, DoD is the largest remanufacturer and refurbisher in the world, particularly with military vehicles. The second example was Cardone, a small company with 5,500 employees that is taking innovative strides to get to zero environmental waste discharge. Cardone remanufactures over 65 different product lines as part of waste elimination efforts.

In the 2011, the U.S. Council on Competitiveness, a collaborative effort between industry and the U.S. Department of Commerce, led a strategic dialogue on remanufacturing. The dialogue identified challenges and opportunities in three areas: research and development; trade and federal policy; and public relations and legal issues.

Dr. Nasr also updated participants on the work of the UNEP International Resource Panel. That group has identified remanufacturing as a key focus of future work and research because of its important role in advancing the circular economy (CE) and innovation.

5.3.5 How might we expand the use of recycled materials to minimize raw material use in a way that promotes resilience and competitiveness?

Ms. Jessica Sanderson, Novelis. Ms. Sanderson showed a video and discussed the process used by Novelis to recycle aluminum. Novelis has developed an extensive network that allows the company to process two million metric tons of scrap. Novelis recycles aluminum that is used in a number of different industries from beverages to auto to architecture and promotes recycling of materials through designing with recycling in mind and advanced sorting technology, including sorting different aluminum alloys. Ms. Sanderson discussed the importance of partnerships and collaboration to increase the amount of scrap taken back from customers, increase post-consumer recycling rates and enhance recycling infrastructure. She also described some of the challenges associated with recycling, including: identifying materials that are able to be recycled; negative public perception of using recycled materials; and the varying life spans of different aluminum materials. Addressing these challenges is critical because there is not enough recycled aluminum to meet demand.

5.4 AFTER LUNCH VIDEOS (PLENARY SESSION)

5.4.1 Dr. Alessandro Peru, Ministry of the Environment, Italy – *Italian Professionalism at the Service of the Environment*.

When tires reach the end of their life, they are no longer considered “waste” but a valuable resource instead. In order to collect and recycle the tires from the dismantling sector, Italy established a Management Committee (Comitato per la gestione degli PFU), which deals with the overall cycle.

Setup by the Ministry of the Environment in 2011, which oversees its functions, the PFU includes the Italian Automobile Association (ACI-Automobile Club d’Italia), the federation which represents the interests of all Italian drivers. The Committee is composed of five members, including ACI, which holds the presidency and representatives of associations of: vehicle producers and importers; tire producers and importers; and car dismantlers and consumers.

Thanks to the work of the PFU, in 2015, Italy collected 22,468 tons of end-of-life tires (ELTs) from dismantled vehicles.

The number of collections made from dismantlers has increased. In comparison with 2014, the same amount of ELTs was collected with fewer pickups. The number of pickups has increased from 3.231 to 3.295 (+2 percent).

Due the success of the initiative and through the wide involvement of the stakeholders, in the last three years the fees of the recovery service have been reduced for motor vehicles by over 57 percent and for trucks by 60percent. The Committee has chosen not to contract operators for energy recovery (fuel for

cement factories or waste-to-energy incinerators) and instead it was decided to recycle 100 percent of ELTs collected. Thus it follows a more environmentally sustainable path with two advantages: 1) production of secondary raw materials; and 2) non-renewable raw materials are not consumed. By recovering the materials, atmospheric emissions of 2 kg of CO2 for every kg of ELTs are avoided.

The main components recycled from ELTs are: rubber, equal to 70 percent of weight; iron metals (20 percent); and textile fibers (10 percent). The Committee is working to promote the emerging markets for secondary raw materials.

5.4.2 REALCAR Innovate UK (video provided by Mr. Adrian Tautscher, Jaguar/Land Rover)

To improve the environmental performance of its vehicles, Jaguar Land Rover needed to innovate and incorporate aluminum into its design and manufacture process. Incorporating aluminum would lower the vehicle body mass, improve fuel efficiency and, as a result, reduce the environmental footprint and running costs for customers. However, Jaguar Land Rover wished to mitigate the energy and cost-intensive nature of using primary (virgin) aluminum in the production process. To do this Jaguar Land Rover worked collaboratively with its material supplier Novelis, Innovate UK (the UK's innovation agency) and other partners. The result was a closed loop value chain that minimized the use of primary material and maximized the use of recycled aluminum during manufacturing.

5.5 Critical Factors for Successful Implementation (Plenary Session)

A panel discussion was held to explore two critical factors for successful implementation, namely scaling up ideas and engaging in collaborative relationships across the supply chain and beyond.

5.5.1 Mr. Robert Larsen, Composite Recycling

Mr. Larsen provided information on the Composite Recycling Technology Center, a non-profit manufacturing center whose business model is to divert carbon fiber from the landfill. The center's mission is to benefit communities through job creation, education, environmental responsibility and economic growth. The center focuses on proving there is a demand for recycled composite material and is currently obtaining its material from large aircraft manufactures in the state of Washington. The goal is to divert 1,000,000 pounds of carbon fiber in five years or less.

Mr. Larsen noted how low tipping fees remove some of the incentives companies have to recycle their materials.

He has found that leveraging partnerships with universities and businesses in the State of Washington has given them access to both researchers and testing facilities.

Mr. Larsen mentioned that making new products out of recycled carbon fiber takes only 5 percent of the energy that went into the originally created material, creating a completely win-win situation. The longer-term vision of the center is to install recycling processes at the end of production runs in factories that are producing the scrap material.

Currently, the center is looking to stack investments from government, foundations and environmentally responsible investment vehicles.

Overall, to move from the idea phase to the implementation phase takes visionary leadership and a willingness to build coalitions across government agencies.

5.5.2 Mr. Mike Mullin, Brambles Limited

Mr. Mullin described the company's commercial brands, CHEP Pallets, IFCO Reusable Plastic Crates or RPCs and CHEP Containers and explained the company's business model. The company shares its unit load devices (pallets for the fast moving consumer goods industry and other industries, reusable plastic crates for the agriculture sector and containers for automotive, agriculture, general manufacturing and oil and gas industries). These unit load devices are reused by its customers and designed for maximum efficiency in transport. By reusing these devices and managing the logistics of moving the devices for its customers the company is able to enhance the efficiency, cost-effectiveness and sustainability of its customers' supply chains. The company's business model epitomizes the virtues of the circular economy which emphasizes reuse and resource efficiency.

Some of the critical factors touched on were building understanding and trust between the various stakeholders in the supply chain as well as those who influence the business environment such as government. It is important to first understand the customers' goals and pain points or obstacles to meeting the goals and then map out the customer's supply chains to identify opportunities for improvement.

This is not a one way conversation but is a partnership between CHEP and IFCO and their customers. In some markets solutions rely on multiple stakeholders including government and community organizations. For example, companies that depend on farm products produced by small holders ask CHEP and IFCO to help identify ways to strengthen the small holders' and SMEs' successful participation in the value chain. Helping to reduce post-harvest food loss through a combination of better packaging technology and improved logistics improves the financial wellbeing of small holders, strengthens the consistent sourcing of fruits and vegetables to processers, manufacturers and retailers.

Brambles has found that governments are very interested in helping business and increasing trade from an economic point of view. However at times, laws, regulations and tariffs (for example on reusable packaging) can stifle the adoption of more environmentally preferable and economically viable solutions.

5.5.3 Mr. Steve Hellem, Suppliers Partnership for the Environment

Mr. Hellem described the Suppliers Partnership for the Environment's successful collaborative environment. The Suppliers Partnership is a unique organization – it was created by a group of leading OEMs and suppliers, with the supportive engagement of EPA, who were looking for constructive ways to work within the supply chain.

The Suppliers Partnership is unique in that it is not an advocacy organization. This has positioned the organization to have a great relationship with EPA. The organization's focus is to get the right people to the table so they can really make constructive progress. It is about taking one step at a time, while taking a long term view.

The key to making change is to have "spark plugs" – people who have vision and also an ability to work within their organizations to make change and fuel corporate commitment. It can be difficult to push change, especially when the global economy is down. The Suppliers Partnership focuses on the value that resource efficiency can provide to overcome these concerns and address opportunities.

The Suppliers Partnership also has been able to support successful collaborations between large and small companies. For example, GM collaborated with a number of Suppliers Partnership members with special technologies and experience to turn used oiled booms from the Deep Water Horizon oil spill into parts for the Chevy Volt.

5.5.4 Dr. Wolfgang Scheremet, German Ministry for Economic Affairs and Energy

Dr. Scherement described his thoughts on key elements for successful implementation of resource efficiency. Successful implementation of resource efficiency requires the "Triple As" (awareness,

acceptance and ambition). First, there is awareness. Public awareness and discussion about the advantages of efficient use of resources is necessary. These conversations can be controversial, but they are fundamental to the second "A," acceptance. Acceptance of resource efficiency across society, including industry is important. Finally, ambition is needed to drive society and the economy towards ambitious and realistic targets.

Each "A" is necessary for success and they operate sequentially. Awareness must come first. In Germany, the public started a discussion about scaled use and the necessity to protect the environment starting in the mid-70s. Now Germany has 30-40 years of public discussion on this topic. This has strongly influenced acceptance in the society. Finally, after Germany had public discussion and acceptance, the country was able to set ambitious, but achievable, targets. This is a cycle and not a linear path. Once the goals are set, a country must work to achieve to maintain positive awareness. Positive awareness drives acceptance, which provides support to the ambitious goals.

To ensure the highest level of success, countries must have effective, efficient and non-arbitrary instruments to meet the targets.

The German program for resource efficiency has tried to follow these ideas. Germany has awareness in the public and in industry. Germany has acceptance, and it has ambitious, but realistic targets that the country is able to reach. It is not easy, but Germany is on track for success as it is 50 percent of the way toward its targets and has five years left.

The corporate level has an analogous three "I"s for driving change – incentives (e.g., positive returns), investment and innovation. To foster the three "I"s, Germany has R&D programs that support SMEs on an industry-wide basis when they develop new resource efficiency technologies or services. There also are corporate industrial research programs where SMEs form alliances with university research departments.

5.6 Key Observations and Potential Next Steps or Actions Identified by Sector-Specific Groups (Plenary Session)

Participants were invited to separate into sector-specific groupings to consider key next steps or actions individuals within the groups would like to see based on workshop discussions. Below are the outputs that were shared from those sector-specific discussions.

5.6.1 Academia and Environmental Groups

Several areas could benefit from additional academic research and support from non-governmental organizations. They include:

- Examining how to better incorporate remanufacturing and reuse of products into the supply chain. Academia is ideal for this research because the subject matter requires a systems/multi-disciplinary approach and would benefit from not being constrained by the paradigms of industry. This research could then be used to inform government guidance and policy. Industry can support this effort by providing data and resources necessary to complete the research.
- Designing a car, or other complex product, that requires no virgin material and has a transparent supply chain (e.g., providing all stakeholders with detailed information on the materials, parts, end of life options, preferred and expected usage). This design would allow for increased recycling efficiency and lower the impact of the car compared to today's cars. Information on the material and energy used throughout the car's or product's life cycle could then be made available to the international community to be leveraged to make more environmentally preferable designs of other products. Systems would have to be developed that would allow the sharing of this information in a manner that does not negatively affect the firms that would have to manufacture and sell the cars.
- Developing national and international recognition programs or awards for resource efficiency champions. This could encourage others to support resource efficiency. By staging these programs or

awards through well-respected national and international organizations, it would encourage buy-in and magnify the impact of the programs.
- Developing a national or international program to scale resource efficiency through the sharing of best practices across sectors.

5.6.2 Other Industry Sectors

- Explore developing public-private partnerships to advance resource efficiency to transform the economy and benefit society. These partnerships would include several different sectors and could be value-chain specific. These partnerships also could help promote a common nomenclature and provide an opportunity for information sharing.

5.6.3 Automotive Sector

- The automotive sector faces a number of challenges to the full implementation of resource efficiency, including little communication between manufacturers and auto recyclers. Some of these issues could be alleviated by manufacturers designing their cars to be recycled and sharing that design insight with the recycling and waste management sector. Recycling could also be encouraged and improved through greater standardization of parts and materials across manufacturers.
- The WCDSD platform is used to visualize progress of defined areas. It could be used to standardize nomenclature, encourage disclosure, and share best practices. Perhaps at the next G7 meeting in Japan, time could be allocated to better flesh out ideas. The G7 should provide a clear scope and visualization of progress towards targets.
- Governments could allow the use of recycled parts in their fleets, not just remanufactured parts, which could provide an incentive for further recycling of automobiles. To accomplish this, governmental policies would have to be updated and industry would need to develop a standardized list of part numbers to aid in procurement. Once the policy is proven successful (e.g., recycled parts perform well in government vehicles), the program can be publicized to drive private sector interest in recycled automotive parts. Resource efficiency efforts would benefit if manufactures would be willing to coordinate and standardize common parts and recycling procedures.

5.6.4 Waste Management/Recycling

- The ultimate goal is to drive material to its highest use through market incentives that use clear measurement tools applicable across sectors. This can be achieved through public-private partnerships, potentially initially convened by EPA, that create guidance including boundaries and definitions for metrics.
- Consider the 4Rs when designing new materials and parts and minimize barriers to 4R material. To accomplish this, there needs to be leadership from large organizations and governments to set the market expectations for 4R material through corporate policies and government regulations that ensure good market conditions for 4R material.
- Promote materials destined for recycling and reuse as valuable resources and commodities and not waste.

5.6.5 Government and Intergovernmental Organizations

- Use outcomes from this workshop to inform a G7 roadmap on resource efficiency.
- This work needs to be managed through a coordinating or facilitating mechanism to maintain continuity because each year the G7 (and G20) presidency moves to another country which may have somewhat different emphases than the previous presidency holder.
- It is important that we quickly take these ideas and determine short and long term goals.
- Governments face some specific issues in driving resource efficiency. First, there is a need for access to standardized data across sectors. Perhaps, governments could work with other organizations like the World Business Council for Sustainable Development who are working on similar issues. Second, there needs to be institutional buy-in from governments. To aid with this, the

May 2016 declaration of the G7 should contain language about identifying a coordinating or facilitating mechanism to support the Alliance on Resource Efficiency and developing a roadmap.

5.7 CLOSING REMARKS (PLENARY SESSION)

5.7.1 Mr. Mathy Stanislaus, Assistant Administrator, Office of Land and Emergency Management, U.S. Environmental Protection Agency (EPA)

Mr. Stanislaus thanked everyone for their level of participation in the workshop. He found this workshop created one of the best conversations in which he has participated. He noted that the participants form a real brain trust for resource efficiency. He found the participants to be insightful leaders who bring passion to this work. He believes that the outcomes that all participants want will require continuing engagement by everyone.

5.7.2 Mr. Masahito Fukami, Counselor, Ministry of the Environment, Japan

Mr. Fukami noted his appreciation for everyone's participation over the last two days. He expressed his sincere gratitude to EPA in coordinating the workshop. Through this workshop, he noted that all participants have been able to deepen their understanding about supply management and promoting the 3Rs. Participants shared best practices and promoted key concepts of life cycle thinking.

Japan, as president of the G7 in 2016, recognizes the importance of promoting the 3Rs. The next meetings of the G7 will be held in Japan. As a result of this workshop, Japan will carefully consider G7's continued role in this area.

6 ATTACHMENT 1 – RESOURCE EFFICIENT VEHICLE OR PRODUCT OF THE FUTURE IDEAS POSTED TO THE WALL DURING THE WORKSHOP

6.1 RECYCLING

- The challenge of auto shredder residue
- Work at Argonne National Lab on Auto Shredder Residue is promising. Use of hydrophilic and hydrophobic principles of polymers to separate
- MBA polymers use ASR feedstock to produce PP, PE, etc.

6.2 RE-USE

- Do we need to change standards, codes, insurance for reuse?
- Barriers for reuse of materials – building codes are an institutional barrier
- Recovering metals and materials from electric vehicles
- Pass on company electrical vehicles to teenager and grandmother
- Process improvements to enable resale of materials at end-of-life, driven by waste/byproduct market palaces (e.g., waste hub – www.waste-hub.com)
- Use 3D printing to "create" replacement parts
    - Printer inputs should come from recycled/reused materials
- Auction of imperfect auto parts
- Government fleets reuse recycled auto parts
- Can put recycled parts, no new parts on all vehicles
- Use old part for new uses – for example, they are using Chevy Volt battery covers as animal habitats
- Reuse of spare parts from auto industry

6.3 INFORMATION SHARING

- Access to part numbers is crucial – using part numbers allows connecting consumers with needed parts
- Incentive for auto manufacturers to share information
- Valuable to have conversations across the supply chain
- STDs to be develop to review new technology and validate it to know it is effective both environmentally and cost wise. Lastly, to publish these finding as a resource so they can use the knowledge. And be sure that these steps to achieve the end goal will be shared…???

6.4 INFLUENCING CONSUMER PREFERENCE

- Something that is missing from the discussion is how to influence consumer preference. Currently, a relatively small segment of consumers consider sustainability or environmental impact in their automotive purchase decisions. They are about cost, performance, style, safety and saving money at the pump. So how can we change or influence consumers to make environmental impact and sustainability a key factor in their purchase? Consumer demand preferences drive change.
- Need programs to educate the consumer about their influence and responsibility with respect to product use and consumption and their impact on product end-o- life. To change the mind set of our "throw away" society, and influence behavioral change, education is vital.

- Educate about re-use and recycling in the schools (e.g., old stop smoking campaigns play, in part, on kids pressuring parents. Why not the same for recycling electronics, plastics, paper, etc.?)

6.5 VEHICLE CHARACTERISTICS

- Can be powered easily by a variety of energy sources, especially renewables
- Uses only materials absolutely needed → avoid excess

6.6 N/A

- We all want to be part of the family – not take over the family
- Circular economy
- Context of the ELV problem/opposition
    - USA = 15 million ELVs/year
    - Would form a line from NY to LA. Lots of vehicles.

6.7 FINANCE

- Challenge of financing of system – how to account for value of dismantled building?
- Consider number of man hours in both manufacturing and recycling as part of life cycle costs

6.8 LIFE CYCLE

- UCSB Automotive Materials Comparison Model
    - Vehicle Energy and GHG Model
    - Authored by Dr. Roland Geyer, UCSB
- Design Advisor
    - First order component Model
    - MASS, COST, and GHG Analysis at vehicle vel.
- Available at www.worldautosteel.org
- Connect the dots – swing a deal
- Concerning vehicles – LCA reflects that fuels are the biggest environmental impact of cars – yet limited discussion on that. Need to make connection between electric and the fossil fuel grid that runs them in the U.S. Is that an improvement?

6.9 POLICY

- Another tool for change is adapting policies like zero waste and setting up certification systems to drive change like U.S.-Green Building Council did with LEED

6.10 GOVERNMENT MANDATES

- Government mandates availability of parts including recycled
- Problems with recalls is with parts – government could include recyclers in the solution
- National governments are not the sole policy influencers. State and local governments in U.S., provincial and prefectural governments in other nations play important roles too. Also, insurance and financial firms play a significant role in making policy work or fail.

7 ATTACHMENT 2 – UPSTREAM RESOURCE EFFICIENCY BREAKOUT DISCUSSION NOTES

(Note: Items captured reflect individual (or organization) input during discussions and should not be viewed as consensus statements.)

7.1 HOW CAN WE USE THE DESIGN PROCESS TO IMPROVE RESOURCE EFFICIENCY FROM A LIFE CYCLE PERSPECTIVE?

7.1.1 Conversation Starters

Ms. Carrie Pearson, 3M – Integrating Sustainability into the Design Process. Ms. Pearson provided an overview of 3M's efforts to infuse life cycle thinking into its design process using a standardized handbook that helps ensure designers consider life cycle impacts. All new products undergo life cycle management (LCM), a qualitative process that embeds life cycle thinking into the design process. If necessary, some products then undergo a full LCA. She emphasized that this handbook, which helps standardize the process and a corporate commitment to sustainability helps instill a level of awareness about the importance of resource efficiency across the organization. This corporate commitment is reflected in the company mission statement including explicit language about the importance of sustainability by leadership, a dedicated LCA team that is available to anyone across the company, processes and procedures that integrate life cycle thinking into regular business processes, and company participation in corporate sustainability indexes.

Mr. Werner Loscheider, Federal Ministry for Economic Affairs and Energy, Germany – Light-weighting. Mr. Loscheider provided insights into how Germany is handling one design challenge in industry – lightweighting. Given that the majority of production costs are driven by raw material costs, industry is particularly attuned to resource efficiency. Industry feels that resource efficiency is a win for all stakeholders; the economy benefits from higher competitiveness, the environment benefits from lower emissions and there is beneficial social development from safeguarding and creating jobs.

7.1.2 Best Practices

- Successfully integrating life cycle thinking into the design process requires that all key stakeholders throughout a product's life cycle are involved. In particular, getting those involved in end-of-life/second life management (recyclers, dismantlers, etc.) engaged with designers provides opportunities to design products with "next life" in mind. Tools like design handbooks that speak to this engagement can help to standardize practices across organizations. (Carrie Pearson, 3M)
- When designing new products, companies should design for the end-of-life phase and just not assume that others will do it for them. By thinking of recycling and reuse at the onset, it can lower the cost and barrier to the recycling and reuse of their products. This design information could be shared with the greater recycling/reuse community in order to further lower barriers to the recycling/reuse of the products. (Werner Loscheider, German Federal Ministry for the Economic Affairs and Energy; Russ Balzer, World Auto Steel & Michael Wilson, Automotive Recyclers)
- Easier access to data for LCAs has the potential to lower the cost and time requirements to conduct a useful LCA. Partnerships and communications across companies and sectors can provide an avenue for this improved access and quality of data. (Susan Sawyer-Beaulieu, University of Windsor)
- LCA is not an end point; it is only a tool that can be used to help make better decisions. It should be integrated into larger business practices to ensure that companies consider issues such as resource efficiency. (Carrie Pearson, 3M)

7.1.3 Challenges

Communication

- Communication between companies can be difficult because of a perceived loss of intellectual property or competitive data.
- Existing regulations and policies (e.g., anti-trust laws) can make cooperation and communication between corporations difficult.

Costs

- LCAs are expensive, time consuming and require a great deal of expertise.
- Incorporating the outcomes of an LCA into existing designs (e.g., material substitution) can be difficult and expensive due to the need to prove new solutions can provide the desired performance.
- There are many country-specific rules and regulations that make collecting and dispersing life cycle data very difficult, such as anti-trust or corporate collusion laws.

Data Quality and Availability

- At times, there is a lack of cost and performance data available to successfully execute an LCA. Often these data are protected by individual companies as proprietary and therefore not shared with competitors or the general public.
- The necessary data and information is often compartmentalized within an organization. Some companies and industries are so large that it is difficult to get to the right person.
- Obtaining the necessary experts and expertise to execute an extensive LCA can be very difficult, especially for companies who have limited resources and cannot employ in-house LCA experts.

Other

- Third-party actors, such as insurance companies, can be drivers or barriers to the adoption of life cycle approaches as they have large financial interests in the potential impacts and uses of products.
- There is a need to promote standardized education and nomenclature across academic programs in order to ensure that students are being trained to an appropriate level on life cycle concepts.
- Organizations are often making decisions based on the way the world is today and not how it will be in the future. Things are changing so quickly that decisions based on how things are may be the wrong decisions when they are implemented in even the near future.

7.1.4 Suggested Changes, Improvements or Actions

- Corporations and SMEs involved in life cycle and resource efficiency work should reach out and participate in the larger LCA and resource efficiency communities. This participation will help drive common and interoperable nomenclatures and expose individuals to best practices and lessons learned from other companies. One example of such an organization is the American Center for Life Cycle Assessment (www.lcacenter.org).
- For those interested in incorporating a life cycle approach into their product design process but are concerned about the time and resources required to conduct a full LCA, investigate if qualitative processes, such as LCM, can be embedded early in the design process. This could lower barriers to life cycle thinking by making the process easier for companies.

7.2 How can we improve how we use life cycle information and life cycle thinking to set goals and better inform resource efficiency decisions?

(Note: Two breakout sessions covered this question.)

7.2.1 Conversation Starters

Dr. Jim Fava, Co-chair (with Mark Barthel) of the Hotspot Project (prerecorded video introduction). Dr. Fava discussed the work that he is involved in with the United Nations Environmental Programme (UNEP) and the Society of Environmental Toxicology and Chemistry to develop a hotspots analysis methodology framework which can be applied at the product category, sector, city and national levels.

Hotspots analysis is used to identify high priority impacts (e.g., water, energy waste, etc.) and life cycle stages (e.g., raw materials acquisition, manufacturing, transportation, use and end-of-life) to inform decisions. Hotspots analysis is often used to identify actors who are most appropriate to work towards taking actions to reduce the negative impacts identified by the hotspots analysis. It is also used as a pre-cursor to developing more detailed or granular sustainability information. Additional information about the UNEP's Hotspots Project can be found in the report at the following website: http://www.lifecycleinitiative.org/wp-content/uploads/2014/12/UNEP-Hotspots-Mapping-Project-Final-Report-Phase-1.pdf

Mr. Ron Voglewede, Whirlpool. Mr. Volgewede discussed the ways in which Whirlpool has used hotspots analysis in its processes and provided recommendations for how this tool can be used successfully. Whirlpool has used hotspots analysis to look at a variety of different factors to reduce waste and increase viability of its products. Whirlpool has looked at the raw materials used to produce its products, how it packages its products to reduce waste, emissions from the production and use of its goods, and the social and economic impacts its products have. Hotspots analyses are designed to focus on a specific issue, however, it is important to identify the right issue and have the scope clearly defined. The hotspots analysis should be driven by the end goal or outcome of the analysis. Engaging stakeholders, including small- and medium-sized enterprises (SMEs), and looking at other hotspots analyses and LCAs are all beneficial to the process because they help to identify the desired outcome and inform the work that is being done while reducing redundancies and improving the process. Hotspots analysis not only informs a single desired outcome, but also aids in broad-level impacts beyond a single project. Development of standardized and harmonized views by types of products by how they are produced, their uses (especially energy usage) and where those use cases occur will inform better focus on those relevant impacts that promote better design.

7.2.2 Best Practices

- Stakeholders play a critical role in hotspots analysis. They help to shape the goal and scope of the analysis, assist in data gathering, validate the hotspots that are identified and act on the results. As a result, to be successful, those conducting the hotspots analysis must identify and engage stakeholders throughout the process. Stakeholders can be part of the supply chain, communities that make up the supply chain, consumers, policy makers and/or financial institutions. Engaging stakeholders throughout the process is beneficial in shaping analysis because they will contribute different perspectives and ideas, as well as highlight areas for education. Depending on the scope of the assessment, stakeholder engagement can be at a global scale or at a small scale. In addition, these stakeholders may change for each assessment, because each assessment will have a different scope. When an analysis is complete, the results should be shared with a company's competitors to help drive the larger goal of unified change.
- Different types of LCAs may be more appropriate depending on an organization's goals and resources. Before beginning any type of analysis, the parameters for the analysis need to be explored

and articulated – this includes the priorities of the analysis and the amount of time and resources available. These factors will help determine the best kind of analysis to be conducted. Although there is no set criteria for when to use one type of analysis versus another, there are certain guidelines to aid in the process. Companies should use a hotspots analysis when a specific or narrow result is sought that usually pertains to a single part of a life cycle. A coldspots analysis (points in the process that are less hot) can be used to identify areas that can be leveraged to work toward solutions. Both hotspots and coldspots analyses are recommended when there are limited funds and a short amount of time to conduct the analysis. A full LCA is recommended when there is a broad goal and most of a product life cycle is being analyzed. This option is only viable when there is sufficient time and funding for the process.

- When setting parameters for a new assessment, looking at previous assessments provides information about what has already been done. Looking at the best examples and those which have been most groundbreaking can lead to more innovative results as opposed to looking at the average of previous assessments. The average can show what has been done, but the best will show what is really driving the industry forward.
- The thinking and decisions that inform an assessment are very important because if those are not clearly stated, a successful outcome is not guaranteed. This ties into the setting of expectations for an analysis and understanding what the desired goal or outcome is. A lot of work goes into the supply chain, but it might not be part of the LCA. Looking at the tools that contribute to an LCA will help construct an effective LCA.
- The production phase of a product is very important because it helps to define other phases of the process and close gaps. For example, if the desired outcome is to reduce waste, a hotspots analysis can be conducted on the production of a product. Understanding and looking at all the materials needed to produce a single product will inform how a product can be changed in its design, production or packaging to reduce and eliminate waste.
- The establishment of EPA's LCA Center will help to regulate and standardize the assessment process. The Center will provide a central location where members of the LCA community can collaborate and continually improve LCA processes.

7.2.3 Challenges

- The level of assessment is sometimes difficult to determine. It is often bounded by what is feasible and not by what is possible. Because there are so many factors that are considered, these constraints often limit the work that is done. Instead, organizations should stay focused on the outcome as the most important consideration for establishing assessment boundaries. There is a mentality of incremental change instead of holistic thinking; there is a need to redefine the system and the thinking behind it.
- There is not a central location to find and share life cycle information, including best practices, process and case studies. More data and methodologies need to be made available to users. All of these things need to be made compatible and interoperable. There needs to be harmonization of LCAs and LCIs.
- The global nature of the supply chain presents a challenge for conducting adequate hotspots analysis and LCAs. Even if companies could track where products are made, sold and disposed, there are a number of inconsistencies that arise across geographic boundaries that inhibit large-scale analysis. These range from simple definitional differences to differences in underlying methodologies and different regulations and reporting requirements.
- An LCA presumes that there is an external stasis; the assessment can be done in a vacuum without any factors changing throughout the process. In reality, changes are occurring that can affect the assessment. In order to have an effective LCA, there needs to be a way to determine the changes that happen during the LCA and how to incorporate those into the assessment and its outcome.

- LCAs are necessary, but they need to be conducted and presented in such a way that the stakeholder can understand and recognize the importance of the assessment. There is an education gap in the way that LCAs are discussed among the industry and those outside of it.
- In order to determine when an LCA or hotspots analysis is necessary, set boundaries so that the assessment is focused, but will produce results. If there is not a narrow focus for the assessment, then the outcome is not clearly defined and a solution may not be reached at the end of the assessment process. Sometimes, making assumptions is necessary to move the assessment forward. There will be gaps in the information available; instead of getting stuck trying to fill in the gaps, an educated assumption can be made to continue with the assessment.
- There is a need to change the thinking and understanding of assessments as a cost and resource burden, when in fact, they are a benefit or value.

7.2.4 Suggested Changes, Improvements or Actions

- LCA experts should work and communicate with stakeholders to improve education. Experts need to listen to stakeholders and determine what changes are possible and what has the most value.
- The EPA's LCA Center will be a tool to help standardize the LCA process. It will help streamline the processes of conducting LCAs and can be a repository for best practices and case studies so that anyone can have access to LCA data and information.
- Find a way to automate the data collected and categorize it regionally or by industry. Create a database or forums for collaboration within the industry and share information with stakeholders so they can contribute as well. This is another area that the EPA's LCA Center could help create or regulate so that information is standardized and accessible.
- Industries must be more transparent with material flow information to expand knowledge about impacts and to generate new ideas for resource efficiency. By looking at an issue on a broader scale, it can help inform how an industry functions overall and help improve the processes it uses.
- Create mechanisms to share the cost burden of conducting LCAs across industry, government and other institutions. This will help reduce the overall cost burden and help communicate successes and promote learning from efforts that are not as successful.
- Use LCAs in conjunction with social science as well as economic and other environmental information. Social scientists can help inform LCAs in a different, but significant way that is different from the contribution of analytic scientists.

7.3 HOW CAN WE IMPROVE HOW WE USE LIFE CYCLE INFORMATION AND LIFE CYCLE THINKING TO SET GOALS AND BETTER INFORM RESOURCE EFFICIENCY DECISIONS?

(Note: Two breakout sessions covered this question.)

7.3.1 Conversation Starters

Dr. William Flanagan, General Electric (GE). Dr. Flanagan shared GE's structure and process for using key decision support tools that incorporate life cycle information. He described how the tools facilitate more informed decision-making. Initially, Dr. Flanagan and his team quickly recognized that measuring the carbon footprint of GE's supply chain would distract resources away from the company's real opportunity to contribute to sustainability, which is its ability to develop game changing products and technologies and deploy them on a global scale. So, while GE developed internal capability to perform detailed LCAs following the International Organization for Standardization (ISO) 14044 guidelines, it also developed a screening LCA tool and a qualitative environmental LCM tool, which is designed to rapidly identify issues which would not necessarily be identified in a typical LCA.

The content of the LCM tool was developed based on external stakeholder mapping with the intent of educating and guiding tool users about life cycle perspectives that are important to a broad range of stakeholders, and the importance of particular stages of a product's life cycle. The tool also includes customizable business context filters that allow content (topic areas) to be weighted differently depending on the product category or industry.

The GE LCA screening tool does not require substantial data collection. GE has populated the tool with average impact scores for a broad range of materials, such as plastics, which prevents the over-collection of detailed materials information that may not be necessary at the screening level. This allows the company to quickly analyze, for example, whether the materials impacts are significant relative to use-phase impacts, given how a product is used. GE has also developed custom tools for specific product applications and strategic customers.

GE has been "dashboarding" to identify areas, products or customers that might benefit most from conducting an LCA. This is important, since GE cannot conduct LCAs for every single product. This process allows the company to be strategic and selective in how it conducts LCAs, and how they add market value, differentiation and so forth. In general, GE tries to customize every strategy in order to maximize value for its customers, since GE would like to develop solutions that would "change the game" rather than make incremental improvements to existing products. These tools also may be used to perform priority assessment of supply chains. It is also important to look at material flows and translate those variables into life cycle costs. The idea is to lower barriers for entry for companies to begin thinking about LCAs, because making LCAs easier to understand, conceptualize and use is critically important if their use is to be widely employed.

7.3.2 Best Practices

Breakout participants offered some of the best practices that their companies are using, including:

- At Toyota, business continuity is one of its drivers, as well as energy use and the move towards renewables. So, getting its suppliers to follow suit is one of the reasons Toyota identified CO2 as one of its focus areas.
- The World Resources Institute (WRI) is working with companies to create science-based targets that include the full value chain of their company, using life cycle thinking. WRI is encouraging companies to track their performance and really think about how they will procure data that will objectively track their performance. (See www.sciencebasedtargets.org for more information.)

- The World Wildlife Fund (WWF) is working to include biodiversity, land use changes, greenhouse gas (GHG) emissions and other indicators that are not typically included in traditional LCAs. WWF believes that including an expanded set of indicators provides a more accurate analysis of the impacts to the environment.
- GE finds that when first starting an LCA, it is good to begin with the basics at a screening level. This helps identify where to focus, for example whether a product is a materials-intensive product or a use-phase intensive product.
- Covanta finds sensitivity analysis and estimation to be important tools to focus on uncertainties and drivers.
    - For example, the EPA Office of Research & Development (ORD) and Office of Resource Conservation and Recovery (ORCR) organized a team of industry professionals to examine landfill gas emission efficiency. It was very successful, and involved examining an array of defaults related to gas collection efficiencies at landfills. These tools are better refined through collaboration.
- EPA works with the General Services Administration (GSA) to conduct spend and hotspots analysis and see where change is needed in highly impactful and large purchasing categories. How can LCAs help drive market change and economics?
    - Conducting hybridized LCAs with a detailed foreground and a complete background can help affect this change.

7.3.3 Challenges

Obtaining Data to Conduct Complete LCA

- It is very difficult to get data from suppliers to conduct a comprehensive LCA of supply chains. This is due to proprietary concerns from suppliers. There is little transparency in the supply chain, so increasing visibility on what resources are involved and who supplies those resources is important. Having full visibility of the supply chain would allow companies to identify where they need to improve in becoming more resource efficient. Better data collection and decision-making tools would help with this challenge. Further, integrating resource efficiencies and LCAs into supplier contracts would help too.

Identifying Sustainability "Drivers"

- It is difficult to balance customer expectations and the profit-making responsibilities of a company with the need to drive sustainability forward. How is this dynamic optimized and how do we help raise consumer expectations and pressure on companies to become more sustainable?
    - Policy and regulations – including getting policy-makers comfortable with LCAs – along with education will help create these drivers.
    - Identifying internal drivers to motivate competitive efficiencies is critical.
- Toyota is beginning to address the challenge of getting to zero CO2 emissions in their LCAs; however, the challenge is getting data from their supply chain partners.

Communication and Coordination

- It is often difficult to translate LCAs. This makes it challenging to properly communicate the social, environmental or economic benefits of a product or process for specific audiences. To that end, having a single, federally managed repository or data center (e.g., Toxic Release Inventory) where various LCAs could be compared would help organizations from having to reinvent the wheel every time they plan to conduct an LCA. Having a set of guidelines or best practices to build LCAs is also an important consideration, as currently, companies do not have the data or the resources needed to conduct complete LCAs. If these guidelines or set of best practices existed, then there would be less effort on how to actually conduct an LCA. Currently, there is not a lot of industry support; however, incorporating LCAs into regulations will help direct resources to this need. EPA has traditionally been

a leader in providing guidelines, but it is important to support the market as well. Presently, market mechanisms to create incentives to perform LCAs do not exist.
- At the other end of the spectrum it was noted that currently, there is little communication between OEMs and recyclers. Improved coordination with recyclers at the end of the product life cycle could enhance remanufacturing and refurbishment initiatives. These concerns suggest that greater collaboration across academia, industry, non-governmental organizations and the government is needed.

7.3.4 Suggested Changes, Improvements or Actions

Government/Policy Action

- While some might suggest that LCA should become a required element in government-funded projects or be incorporated into some regulatory certifications, this may be a difficult and unpopular approach from an industry perspective given the cost and difficulty of conducting such assessments.
- A government-funded database that houses LCA information would be helpful, including a publicly accessible component.

Industry

- Consider developing guidance and "how-to" publications on LCAs.

Research & Collaboration Opportunities

- Explore how to develop new, remanufactured and recycled materials that exceed current physical properties and uses.
- Industry leaders should collaborate at pre-competitive stages to conduct major materials LCAs. This would help companies better understand the most resource intensive production stages, which in turn could help improve resource efficiencies across business sectors.
- There needs to be increased research on integrated models and future implications of major industry changes due to climate change and supply chain disruptions. This highlights the importance of improved cooperation and collaboration with developing countries.

7.4 HOW TO DO A BETTER JOB IDENTIFYING AND COMMUNICATING SOCIAL IMPACTS ACROSS THE SUPPLY CHAIN AND PREVENTING OR ADDRESSING NEGATIVE IMPACTS?

7.4.1 Conversation Starters

Mr. Jeff Morgan, MARS Corporation. Mr. Morgan provided an overview of MARS' efforts to identify and communicate social impacts across the supply chain. MARS' goal is to have sustainable supply chains – economic, social and environmental sustainability. A major challenge is in the agricultural supply chains and those within underdeveloped countries. Some specific challenges encountered include: 1) high levels of poverty among small holder farmers due to low yields; 2) poor farm practices; 3) exclusion of women from income; and 4) poor education opportunities.

Cocoa, as a crop, is highly labor intensive, however, farmers may not be well organized. MARS worked to take a holistic approach to address productivity and social issues. Mr. Morgan highlighted key practices such as a focus on women's empowerment, availability and access to better planting material, improving training and working to improve labor practices (i.e., reducing hazardous conditions). He stressed the need to consider the cultural aspects of a country where the supply chain resides when determining actions for improvement. For example, in some cultures, the family, including the children, traditionally farms the land.

Mr. Morgan's major lessons were: 1) knowledge and understanding of the culture and social environment of the supply chain is critical before taking action; 2) media plays an important role – both positive and negative; and 3) positively addressing social impacts takes time (25-30 years).

While his comments were focused on cocoa, he felt these practices could be applied more broadly to agricultural processes and artisanal production of goods and materials.

Mr. Kevin Funk, U.S. General Services Administration (GSA). Mr. Funk provided an overview and demonstration of GSA's tool created to help organizations incorporate social impacts into purchasing requirements. The tool came online in February 2016 and will be updated as new best practices and tools are identified. It helps users identify and address their high-risk areas. The tool can be found at: https://sftool.gov/plan/545/social-sustainability.

7.4.2 Best Practices

- Knowing your supply chain members is one of the most important factors in determining ability to address social impacts. This includes knowledge of who they are, how they work, and what their cultural and social practices are so that you can develop the most beneficial engagement.
- Supply chain knowledge is a critical step for procurement, so that cultural and social norms can be addressed and mitigated leading to a successful outcome.
- Accurately identify issues in the supply chain.
- Strong partnerships between companies, industry collaboratives and the supply chain are imperative for success.
- Set realistic targets for demonstrating and communicating progress.
- Consider the supply chain process from cradle to grave for development of a product or service.
- Collaboration and partnerships (public-private) in addressing social impacts are imperative to success. This includes collaboration between industry and individual companies.

7.4.3 Challenges

Communication/Coordination/Messaging

- Social impacts can be sensationalized, which can lead to positive or negative results. The media often reports on the negative side of an issue and the positive side is overlooked. The pro is that issues are highlighted and brought to the forefront; however, many times the information is incorrect. For example, in the cocoa industry, child labor was identified as an issue, when after investigation, it was determined that it was actually a cultural norm for children to farm the land with their family. This led to the identification of other issues such as illiteracy, poor farming practices and hazardous conditions, which are being addressed.
- It is often non-governmental organizations or journalists that bring issues to the forefront, and companies end up in response mode versus dealing with the actual issues.

Timing

- Addressing social impacts is a long-term challenge; it cannot be quickly or easily resolved, and often there are many obstacles and side issues. It is difficult to maintain a focus on the challenge being addressed as there are many side issues that arise and/or are part of the resolution. It is reasonable to expect that resolution of social challenges will take 20-25 years; it is not a short-term (end of year or 10-year goal). The challenge here is that many corporations/industries want a quick fix and this hinders a comprehensive approach to resolving the issue. For example, in the cocoa industry, poor farm practices resulting in low yields need to be addressed. Understanding the cultural and social norms of the region, a company was able to identify a long-term solution which included empowering women which will result in improved child literacy, better farm practices and higher yields for the farmer. This will take 20-30 years, but will result in more income for the farmer.

Knowledge of the Supply Chain

- Most extreme social issues are coming from artisanal and informal producers. Many times these issues are culturally based. A typical approach larger companies use is boycotting; however, this does not work in this type of supply chain when hundreds of families are relying on the business for sustainability. A more long-term, comprehensive approach can be taken by companies such as: education, standards and compliance mechanisms, engagement (on the ground), subsidies or financial incentives, and market incentives.
- When looking at social issues for the supply chain, it is important to consider downstream (end-of-life products), which present their own unique set of issues, and not just upstream considerations.
- Buyers are often removed from the original source, which makes it hard to manage the supply chain. For the auto industry, buyers care about prices and are removed from the original source. When purchasing a car, the focus is not on the materials, but the final product. However, in the agriculture industry, there is more visibility on the supply chain as the product produced is consumed and there is more of a focus and visibility on the original source supplier issues, such as labor practices.

7.4.4 Suggested Changes, Improvements or Actions

Communication/Coordination/Messaging

- When addressing social impacts, every attempt should be made to make the focus on positive actions and situations.
- Look for innovation potential in the change; there may be a way to bypass the 25-year-old solution by looking for and taking advantage of new innovation potential.
- Often it is not the company that supplies the ingredients that speaks to social issues, but the company responsible for the end product. The company(ies) that produce the ingredients that make up the final product should be incorporated into the social impact messaging. It is noted that this may depend upon where each company is in the supply chain.
- Companies should look for ways to collaborate and address social impact issues collectively – with trust and transparency. There is more power in being a unified force of good.
- When developing messages around social issues, companies should carefully consider the intended audience – audiences in developed countries can be very different than those in developing countries. These messages should explain the issue in the context of the mission of the organization and be as transparent as possible.

Knowledge of the Supply Chain

- When working with artisanal communities, approaches such as education, establishment of standards and compliance metrics, engagement, and financial incentives are typically the most effective approaches.

Timing

- Be realistic, and when possible, set intermediary goals to demonstrate successes and progress. In developing countries, it can take a generation to see the results of social changes and improvements.

Difficulty in Measuring Social Impacts

- Use data to inform and educate the public to assist them in understanding the issues, impacts, and ways to address social impacts. For example, labor wages and working hours are quantifiable data that can be used to convey how social impacts are being addressed. Unfortunately, there is not an equation to quantify social impacts broadly, like there is for environmental impacts. There is no way to measure if a company is successful in women's empowerment. Increasing of a workers income may

not help. Working with the Department of Labor could assist in identifying hazardous working conditions for children.

7.5 How can we improve communication and share information about resource efficiency across the supply chain?

7.5.1 Conversation Starters

Mrs. Sue Rokosz, Ford Motor Company. Mrs. Rokosz provided an overview of Ford's Partnership for a Cleaner Environment (PACE) Program through which leading environmental practices are shared between Ford and its suppliers. As participants in the program, suppliers select leading practices applicable to their operations, create a roadmap for improved efficiencies, collect relevant baseline data, implement the leading practices and report environmental metrics to Ford. The PACE Program ensures two-way communication between Ford and its suppliers and that they are able to share information, leading practices and lessons learned.

Mr. Jason Pearson, Sustainable Purchasing Leadership Council (SPLC). Mr. Pearson described the work of SPLC, a group of over 150 leadership organizations across the public, private and civil society sectors that collaborate to develop a shared program for guiding, benchmarking and recognizing leadership in sustainable purchasing. SPLC equips procurement professionals with resources to make strategic institutional purchasing decisions that send a collectively harmonized message down the supply chain regarding the value of sustainable products. One such resource is SPLC's Guidance for Leadership in Sustainable Purchasing, released in 2015. This document provides recommendations and best practices for creating a strategic sustainable purchasing program using the concept of a strategy cycle. The document also provides guidance on sustainable purchasing for eight priority purchasing categories. Overall, the SPLC provides a forum through which purchasers and suppliers can work together to share best practices, encourage alignment and promote market transformation.

7.5.2 Best Practices

- Corporate programs that share leading environmental practices with suppliers allow for information sharing and the promotion of a sustainability culture throughout the supply chain. (Sue Rokosz, Ford)
- Because the sustainability requirements in requests for proposal (RFPs) can be confusing, companies such as Lockheed Martin have begun to offer mentorship programs to help suppliers understand and comply with the standards being imposed on them, including how to report the required metrics. (Jason Pearson, SPLC)
- The Suppliers Partnership for the Environment and the Automotive Industry Action Group, two forums for interaction between automobile OEMs and their suppliers, provide an opportunity for significant pre-competitive collaboration, including working on initiatives to decrease "questionnaire fatigue" for suppliers by helping them understand and respond to the sustainability surveys they must frequently complete for their customers. (Sue Rokosz, Ford)
    - As part of its 2016 activities, SPLC will develop and implement a benchmarking survey that will enable participants to assess the maturity of their sustainable purchasing activities relative to their peers and will offer a baseline for SPLC's future development of a leadership rating for sustainable purchasing. (Jason Pearson, SPLC)
- Internal sustainability champions help to both get sustainability programs started as well as to keep them going. These figures play a critical role in obtaining executive-level approval and working to build key performance indicators (KPIs) and other sustainability measures into corporate strategies. These metrics are the key to success for sustainability programs because they serve as a tool to communicate progress and provide a framework to guide inputs from suppliers. (John Bradburn, GM)

- Cross-sector and cross-supply chain "brain trusts" or non-traditional/uncommon collaborations (including public-private partnerships and partnerships with universities) allow experts to effectively take on challenges such as developing secondary markets for used materials by addressing technical challenges related to using materials that are recycled or remanufactured.

7.5.3 Challenges

Data/Making the Business Case

- There is a general a lack of LCA data as well as a lack of consistency along supply chains in the LCA data that does exist. For this reason, LCA data is often not useful for procurement departments attempting to incorporate LCA data into the equation for purchasing decisions.
- There is not yet a good business case for sustainable purchasing, particularly because organizations do not have good measurements on their returns from engaging in sustainable purchasing.
    - SPLC sees this issue as an area for research; the main topic of its May 2016 Summit is making the business case for sustainable purchasing.

Communication/Coordination

- More communication is needed throughout the supply chain about how products can be repurposed at the end-of-life stage. Because the return on investment for manufacturers is usually higher at the upper level of the supply chain, there is a lack of investment in developing the secondary market and end-of-life opportunities that may exist for products. This is particularly troublesome because local governments are often responsible for end-of-life and post-consumer/post-commercial materials management, which means that taxpayer dollars are paying for these activities. In order to capitalize on the jobs generation and economic growth potential of the secondary market, more investment and communication throughout the supply chain must be dedicated to local recycling and remanufacturing programs.
    - Because the focus in the United States has historically been on landfill diversion, the secondary market for materials has lagged behind. Instead of recovering the highest economic value of material at the lowest environmental cost through recycling or remanufacturing, the opposite is true when manufacturers are focused only on reducing their disposal costs.
    - One specific challenge is that many communities do not see the value add of recycling, especially with the downfall in the commodities markets for plastics and glass.
- Suppliers receive multiple survey requests from multiple sources annually and are not able to adequately respond to customer demands both because of survey/questionnaire fatigue and a lack of understanding of the questions contained in these surveys/questionnaires.
- Supply chains are not linear; they are complex and sensitive networks or "webs." Companies need to figure out how to reach past their Tier I suppliers to ensure they are also engaging with their lower tier suppliers.

7.5.4 Suggested Changes, Improvements or Actions

Communication and Pre-competitive Coordination

- Specific to the automotive sector, the Automotive Recyclers Association (ARA) would like to improve its relationship with the OEMs in order to increase coordination between the two communities, specifically with regard to the issue of parts numbers.
- More communication and coordination is needed between local government, municipal networks (e.g., the U.S. Conference of Mayors) and industry groups to realize the potential of local secondary markets.

    - An example of a public-private forum that is tackling this challenge is the Curbside Value Partnership, through which industry members are working with municipalities to develop local opportunities in the secondary market.
- Conversations about life cycle thinking and sustainability between suppliers and purchasers must occur at the right level and within the right department in a company in order to be effective. The "right" individuals may be procurement officers, engineers or top-level decision makers depending on the organization.
    - The strategic value of procurement needs to be demonstrated in order to empower procurement professionals. This is already the case in some organizations (where procurement departments and sustainability departments work closely together) but not in others. In addition, future meetings such as the G7 workshop should include procurement professionals.
- Developing standard survey/questionnaire questions or survey/questionnaire templates will help to alleviate fatigue and confusion for suppliers.

Brain Trust/Encouraging the Next Generation

- Secondary markets benefit immensely from "brain trusts" that can develop innovative solutions to technical challenges and explain those solutions to the top of the supply chain. For example, there is now a robust secondary market for end-of-life rubber, which can be converted into micro-scale powders and sold back to the tire industry.
- Related to the "brain trust" concept, more partnerships are needed with higher education institutions in order to generate LCA research and, as a broader goal, ensure that life cycle disciplines are promoted among the next generation of engineers, chemists and other practitioners.
    - The American Center for Life Cycle Assessment is an important asset that promotes the responsible use of LCA and brings together universities and federal agencies that are currently engaged in this type of work.
    - The discipline of Industrial Ecology should be considered as a source of potential "brain trust" members.

Design

- As products are being designed or redesigned for sustainability in the manufacturing sector, the secondary/recycling markets downstream must be taken into consideration if a CE is to be achieved; product design ultimately impacts the tax bill at the local level when municipalities are responsible for managing end-of-life programs.

Incentives

- The right incentives (both market and non-market) for suppliers must be put into place if they are to embrace a culture of sustainability. Such incentives include metrics, internal champions, positive peer pressure, consistent signals from purchasers, making the business case and individual-specific performance goals for managers.

8 ATTACHMENT 3 – LIST OF TOOLS AND RESOURCES

- Stuffstr.com
- Global Network of Interoperable LCA Databases
  - http://www.scpclearinghouse.org/working-group-2.html
  - POC: Elisa Tonda
- Materials Marketplace
  - http://materialsmarketplace.org/
- Investing in Manufacturing Communities Partnerships
  - https://www.eda.gov/challenges/imcp/
- MFI and LIGHTen-UP
  - POC: Joe Cresko
- U.S. Zero Waste Business Council
  - https://www.uszwbc.org/
  - Scorecard to certify zero waste facilities
- Tuning in to zero waste - 5th Annual National Zero Waste Business Conference
  - Austin, TX
  - June 1 – 4, 2016
  - Sheraton Austin Hotel at the Capitol
  - Register: www.uszwbc.org
- Waste Hub
  - www.waste-hub.com
  - Marketplace & Tech Development
- CAScan
  - Smartphone chemical inventory app and chemical identifier
  - Brought to you by Waste Hub
- ERA-EHS Software
  - www.ERA-EHS.com
- Canadian Auto Recyclers Environmental Code
  - www.carec.ca
- DOD Acquisition Tool for Automated LCA Impact calculations and costing
  - POC: Paul Yaroschak
- U.S. EPA Managing & Transforming Waste Streams
  - https://www.epa.gov/managing-and-transforming-waste-streams-tool-communities
  - POC: Karen Irwin
- GSA Social Impact Tool
  - https://sftool.gov/plan/545/social-sustainability

9 ATTACHMENT 4 – IMPROVING RESOURCE EFFICIENCY IN OPERATIONS, USE AND AT END-OF-LIFE BREAKOUT DISCUSSION NOTES

(Note: Items captured reflect individual (or organization) input during discussions and should not be viewed as consensus statements.)

9.1 HOW DO WE INCORPORATE AND IMPROVE EFFICIENCY IN OTHER AREAS SUCH AS WATER, ENERGY, LAND, ETC.?

9.1.1 Conversation Starters

Mr. Bruce Uhlman, BASF. Mr. Uhlman provided an overview of BASF's sustainability programs and resource efficiency initiatives, including its programs with suppliers to meet resource efficiency targets in the areas of energy, water (through its efforts to develop a comprehensive water management system), safety, and health and security. The goal of these programs is to engage with suppliers around the various issues and challenges surrounding sustainability. As a global leader in sustainability management and measurement, BASF has developed a comprehensive, science-based Applied Sustainability Tool Box for integrating life cycle thinking and LCA into its strategic decision-making processes and customer engagements. Holistic assessments consider all three dimensions of sustainability: economic, environmental and societal. Most recently, BASF developed a process to systematically and consistently evaluate the unique sustainability contributions of its entire portfolio. Through Sustainable Solution Steering®, BASF was able to analyze over 60,000 products and their value chains considering industry- and region-specific sustainability requirements. This detailed analysis and transparent classification and communication allowed BASF to both improve individual solutions and steer its entire portfolio. The results enabled further integration of sustainability into strategic, research and development (R&D) and customer support processes (e.g., educating BASF's sales force on how to communicate product sustainability information). The methodology and approach used by BASF for this effort have been licensed by thinkstep, and are thus available to all companies.

9.1.2 Best Practices

- The organizational placement of a sustainability department is important to a company's ability to incorporate sustainability into its corporate strategy. For example, BASF has found that by moving its sustainability team into the company's strategy group, the sustainability team is now integrated into the decision-making process, which has created alignment across the company. BMW Group has also experienced success in having a sustainability function in its strategy department as well as placing sustainability teams in each division to ensure divisions understand the overall sustainability strategy. (Bruce Uhlman, BASF and Ursula Mathar, BMW Group)
- For smaller companies and organizations that do not have the resources that large businesses have to dedicate to sustainability programs, making the shift to incorporate the concept of life cycle thinking into an organization's culture and strategy across its operations can be much less expensive than engaging in more rigorous and focused LCAs, which requires significant expertise and resources. (Bruce Uhlman, BASF)
- Peer-to-peer sharing is occurring through the American Center for LCA, whose members are practitioners working in industry. Among the issues discussed by members are best practices for measuring land use, water use and other areas for resource efficiency.
- Sharing best practices and success stories of suppliers who have translated sustainability efforts to increased sales can help convince other suppliers of the value of sustainability programs.

- Setting specific targets related to resource efficiency in areas such as water, energy and land is important. In addition, it is critical to take into consideration the physical location of production sites when setting these targets (e.g., water conservation targets should be more stringent in water stressed locations than in non-water stressed locations). (Ursula Mathar, BMW Group)
- Although larger corporations may not necessarily include specific life cycle targets in their agreements with suppliers, companies have found success by putting sustainability and life cycle thinking onto the agenda for supplier meetings with top-level personnel. For example, by addressing sustainability at high-level meetings, BMW Group has shown that it is committed to transparency and that it expects innovation in sustainability from its suppliers. (Ursula Mathar, BMW Group)
- In addition, other companies have found success through incentives such as awards. GE incentivizes and rewards its sourcing team for conducting sustainability projects with suppliers through its Eco Awards Program. (Bill Flanagan, GE)

9.1.3 Challenges

Company Culture

- Even if an organization has a "sustainability mandate," it is often challenging to change the business culture, particularly within an organization's sales force. It is resource and time intensive to reeducate sales personnel on how to communicate product sustainability information to customers, and particularly on how to explain to customers that sustainable products are in line with customers' market goals. In addition, it is difficult to change the culture in R&D departments.

Data/Making the Business Case

- It is easy for customers to misinterpret LCA data. In some cases, it makes sense to share LCA data with a customer if it is translated in a way that ensures the customer understands the results. However, in other cases it is difficult to share this data.
- One issue related to making the business case for resource efficiency programs is that true costs are not necessarily reflected in a company's utility bill. Several organizations (e.g., Trucost) have tools to assist in monetizing natural capital; however, more work is needed on normalizing utility costs in order to conduct more accurate calculations.

Regulation

- Although intended to create positive effects, regulation can sometimes inhibit sustainability efforts in the private sector (e.g., used batteries being considered hazardous waste). In addition, the regulatory process specific to the United States does not encourage sharing of detailed product information by companies because of the likelihood of lawsuits and large damages.

9.1.4 Suggested Changes, Improvements or Actions

Data/Making the Business Case

- Building high-level dialogues with both customers and suppliers based on effectively explained LCA data is needed to help customers and suppliers understand the business case for life cycle thinking and sustainability initiatives. In addition, LCA data must be translated carefully for different audiences (e.g., design personnel, production personnel) because the value of an LCA may vary by audience.
- Because there can be institutional resistance to implementing resource efficiency measures related to water, energy, land and other factors, more data to figure out the true cost of such efforts is needed in order to make the business case and overcome institutional barriers.

Coordination/Collaboration

- In the building sector, more communication of best practices is needed in order to share information such as model contract language. In particular, there may be opportunities for cross-country collaboration in this area.
- Although pre-competitive consortia exist that aim to address the need for consistent, standardized sustainability criteria across product categories or specific products (e.g., labeling programs, the Green Supplier Network, etc.), more participation from manufacturers is needed to ensure the success of these types of efforts. In addition, such groups must keep up with the latest science in order to ensure that labeling programs stay relevant.
    - A related issue is that greater cooperation is needed at the federal level in order to reduce confusion regarding overlapping labeling and standards programs in the market place. If multiple programs are needed, it should be ensured that they are performing different functions.
        - The pilot of EPA Guidelines for Environmental Performance Standards and Ecolabels is attempting to address this issue (www.resolv.org/site-guidelines).
    - Participants noted that it is important to begin moving from single-attribute to multi-attribute labels and standards.
- Organizations should work together to establish a common terminology lexicon for talking about life cycle thinking. There is often a lack of consistency in the way that regulators, manufacturers, suppliers, and consumers discuss the topic.
- More communication platforms such as the Carbon Disclosure Project (CDP) Supply Chain Program are needed. Through the CDP program, suppliers are asked to respond to a questionnaire which allows companies to assess climate change risks and opportunities embedded in their supply chain.

Regulation

- More communication and collaboration is needed between regulators and industry to ensure that regulation does not inhibit sustainability innovation. Regulation of the private sector should be made in the context of life cycle thinking, and regulations should be consistent with life cycle approaches.

9.2 HOW CAN WE CREATE VALUE FROM WASTE MATERIALS?

9.2.1 Conversation Starters

Mr. John Bradburn, GM. Mr. Bradburn provided an overview of GM's sustainability efforts, primarily focusing on GM's landfill-free manufacturing goal. GM has seen a total waste reduction of 40 percent. He noted that zero waste is a good barometer for success, but the ultimate goal is to establish the programs that drive zero waste. GM is looking at creative reuse of materials in addition to recycling. For example, materials from old tires are being used in new air bags and shipping boxes are used as roof liners. Everyone has the ability to come up with ideas for reuse. Manufacturers have to be willing to harness this input and have a commitment to continual progress.

Mr. Kevin Butt, Toyota. Mr. Butt provided insights into how Toyota views the business case for sustainability: it appeals to some consumers and reduces long-term risks. Toyota is a zero-landfill company, but not every plant is zero waste. Toyota is looking into ways to make that waste stream a revenue stream. Toyota has some ambitious goals, like zero CO2 from tailpipes by 2050, but Toyota only can have so much impact on the environment. He noted that others need to get together around good ideas to scale them up to have a real lasting impact. Mr. Butt presented a pilot project that used spent hybrid batteries to create a power plant for a Yellowstone lodge that is off the grid. While no longer useful in cars, these batteries can provide decades of additional use in such an environment.

9.2.2 Best Practices

- Media recognition, through features on green-themed shows and specials on different programs, is a way to share information about successful projects and programs to consumers and other companies. This, in turn, leads to more conversation about the projects, both internally and externally, which can lead to more innovation; a potentially virtuous cycle. (John Bradburn, GM and Kevin Butt, Toyota)
- Zero waste is most effective when it is not viewed internally as an environmental challenge, but as a strategy to increase profits (e.g., eliminating waste processes, identifying a reuse for a product, etc.). Identifying a value for a given waste material can drive that value throughout the entire business chain, reducing costs and increasing profits. This gets the project the attention it needs.
- Eco-labels and certifications are not only ways to help consumers better understand the benefits and costs of a product, but they are also driving decisions at companies who are trying to meet their requirements to receive these forms of formal and informal recognition. Because educated consumers often care about their impacts, these eco-labels and certifications provide them with a reason to purchase a certain product. These consumers often seek out products that have been certified or have third party eco-labeling.
- Awards and other types of recognition – within companies or from outside organizations – are also motivational factors in implementing resource efficiency activities.

9.2.3 Challenges

Communication

- Competition between firms leads to barriers to transparency and disclosure. Limited sharing of information only slows the process of becoming more efficient.

Costs

- Management does not always see the “value” in life cycle thinking. Often it is difficult to make people understand there is a “better” way to conduct business when they have been successful in the past.
- Smaller companies often do not have the resources to work on these issues on their own.
- It is cost prohibitive to recover some materials, and sometimes the recycling process can change the material’s functionality.
- Decision makers are often focused on the short term (e.g., short payback periods or short return on investment horizons) versus longer-term benefits. This can lead to bad decisions when viewed from a life cycle perspective.

9.2.4 Suggested Changes, Improvements, or Actions

- A formal system that facilitates sharing of data, lessons learned and best practices between large and small companies needs to be developed. This would benefit both small and large companies and allow for the fast scaling up of positive initiatives. Informally, workshops like this one provide an opportunity for colleagues from different companies to sit down at the same table and exchange ideas, but a formalized process that did not require an international conference would be ideal.
- Improved industry and international standards and certifications on resource efficiency and manufacturing waste can be a path to drive change for the better throughout industry. This change partnered with more standardized and accepted consumer-side eco-labeling will push industry to better practices. This is a particular area in which the G7 and G20 could be serious change agents.
- To facilitate communication between competitors, there may be a role for government to gather best practices and synthesize them into industry-wide guidance that would be publically available.

- Governments, non-governmental organizations and trade associations have to continue to educate consumers so that they can make better, more informed decisions. This in turn will drive companies to develop better and better business practices to attract consumers.
- Often government regulations do not evolve as fast as the state of the art of industrial practices. Currently, there are regulations, like the Resource Conservation and Recovery Act (RCRA), that are limiting the reuse of materials across industries. Governments need to take a hard look at their regulations and update or modernize them when they become a barrier to better practices and innovation.
- More cooperation between government agencies would help to ensure that the government is talking with one voice and putting forward the best possible policies and guidance. For example, it seems that EPA and DOE are working at cross principles. This leads to uncertainty about federal regulations and guidance and acts as a barrier to corporations being able to act in a proactive manner.

9.3 HOW MIGHT WE IMPROVE THE RECYCLING OF VEHICLES AT THE END OF LIFE, BOTH INCREASING RECYCLING RATES AND IMPROVING THE RECYCLABILITY OF COMPONENTS?

9.3.1 Conversation Starters

Mr. Steve Fletcher, Auto Recyclers Canada (ARC). Mr. Fletcher provided an overview of Canada's efforts to infuse life cycle thinking into the recycling of products. Not only are parts extracted that can be refurbished or reused, but materials are processed, typically by shredding, so that they can be recycled. He provided an overview of the National Vehicle Scrappage program in Canada, which was a program to minimize emissions by reducing the number of high emitting vehicles on the road. There was a $300 incentive for vehicle owners to retire their cars, and all of the vehicles that were recycled as part of "Retire Your Ride" were sent to audited auto recycler locations that agreed to follow a standard code of practice. This code of practice served as the foundation for the Canadian Auto Recycler Environmental Code, a voluntary program that is half compliance, half best practice. The Code was developed by industry from the ground up, and approximately 500 businesses have gone through the certification process and are participating in a variety of vehicle retirement programs managed by ARC. Mr. Fletcher also noted that ARC coordinates with and communicates regularly with manufacturers on the recycling process. Finally, Mr. Fletcher highlighted that access to parts data is a priority, and can improve the reuse and recycling of vehicles, in addition to recalls.

9.3.2 Best Practices

There were no additional best practices shared by participants.

9.3.3 Challenges

Access to Data

- Currently, OEMs do not provide all source information electronically for each of their parts. This information is extremely important so that recyclers can provide correct and quality parts that are retrieved from recycled vehicles. Data access further allows recyclers to ensure that they are providing accurate parts and ensures that recalled parts are properly fixed. For consumers to be able to reuse components, the source data needs to be openly shared.
- In November 2015, the U.S. House of Representatives supported legislation that would require information on all parts of all vehicles to be shared openly; however, this was not passed by the Senate and was revised to limit this requirement only to recalled parts.

- There are three million vehicles declared a total loss annually. Auto recyclers have certified parts and OEMs have "certified pre-owned parts." The auto recycler parts could be used to minimize the number of vehicles that are declared a total loss annually.
- In most industries, there is intellectual data and property that is proprietary which would assist in the respective industry's recycling process. The challenge is how to provide that information or get access to it without jeopardizing the industry's competition.

Classification of Recycled Materials

- One challenge that recyclers face is that some recycled materials are classified as solid waste instead of as a resource. Solid waste has regulatory requirements thus restricting or delaying the collection, reuse and process of possible recycled materials. With the solid waste classification, more material is sent to a landfill versus being collected and used for the development of new products. Vehicles remain hazardous waste until they are de-polluted resulting in a heavier burden on the recycling industry. Getting retired vehicles to be seen as a recyclable material and not waste would be a huge improvement.

Commission on Parts

- One instance where the recycling industry and the United States would support additional regulation would be regarding commission on repair parts. The United States has several regulations regarding recycling, and most in the industry would be reluctant to codify the voluntary and best practices further by implementing additional regulation; however, this is an area where additional legislation would be supported. One example is that a collision repair shop loses money when using a recycled part versus a new OEM part. If a vehicle needs a new door; the new door is $1,000, and a recycled door is $500. The commission on the part is 35 percent; therefore, the collision repair shop loses money by using the recycled part. If a schedule of pricing was set, by part, whether new or recycled, a level playing field would be established.

Conflicting Environmental Priorities

- There are conflicting environmental priorities that face both OEMs and recyclers. One example is the need to lightweight vehicles to be more fuel efficient, but this results in use of materials that do not have a recycling market. For example, carbon fiber in vehicles cannot be recycled at this time as there is not currently a composite market for the material. A market would need to be established in order for it to be viable to recycle. (NOTE: A later presentation by Bob Larsen of Composite Recycling highlighted a new enterprise that is designed to address this specific problem.)
- Currently, not all of the components of vehicles are designed for reuse and recycling. For example, air bags are required in vehicles, but were not designed for recycling. Some key questions include: Can air bags be reused? Are there liability and safety concerns regarding reuse? If they cannot be reused, they need to be deployed prior to the shredding process; otherwise they can deploy during shredding and result in potential injuries.

Marketing/Messaging

- It is difficult to promote use of recycled materials if each OEM puts out a statement recommending against the use of recycled materials on their vehicles. Recyclers use parts and products with the same use, durability and life cycle as OEMs' parts.

9.3.4 Suggested Changes, Improvements or Actions

Access to Data

- The process to access data globally needs to be modernized. (Note: This is applicable to all recycling industries, not just automotive). To achieve this, all industries can work with recyclers directly to discuss and collaborate to identify options.
    - Action for the auto industry, which can be applied to all industries: The request was made for a meeting between decision makers from OEMs and recyclers to try to reach agreement without a need for legislation.

Classification of Recycled Materials

- Recyclers would support legislative changes to classify recycled materials as a resource versus a solid waste. Additional outreach, education and communication are needed to achieve support for this change.
- Recognition that recycled parts meet OEM standards is needed.
    - Action: Incentivize the use of recycled parts in repair shops. Government regulation of commission rates for collision repair shops should be generic to a part, with a flat fee, so that the part chosen for the repair is the best value for the consumer.

Conflicting Environmental Priorities

- The auto industry should design for recycling. Collaboration should be enhanced between OEMs and recyclers to design vehicles for reuse and recycling.
- Action: Create a common set of standard operating procedures (SOPs) for safety for the auto recycling process (i.e., to ensure that all airbags are deployed prior to the vehicle being sent to the shredder).
- Action: A market for recycled composite materials needs to be developed. Otherwise, these materials will continue to go straight to landfills. Incentivize the use of recycled composite materials to encourage businesses to develop a composite market.

Marketing/Messaging

- Everyone in the life cycle (i.e., OEMs, recyclers) needs to recognize the importance of working together to achieve a common goal.
    - Action: Dialogue is required between the OEMs and recyclers to identify a joint message that is beneficial to both.

9.4 HOW CAN WE EXPAND THE USE OF REMANUFACTURED OR REFURBISHED PARTS?

9.4.1 Conversation Starters

Dr. Nabil Nasr, Rochester Institute of Technology. Dr. Nasr discussed his work with leading companies to encourage remanufacturing and reuse. Dr. Nasr presented a holistic, systems perspective on remanufacturing and refurbishment. He sees remanufacturing as the most important issue for getting to a closed loop economy and for improving resource efficiency – i.e., how to move the industrial world from pollution control to industrial ecology.

Dr. Nasr shared two specific examples of success stories. First, DoD is the largest remanufacturer and refurbisher in the world, particularly with military vehicles. The second is Cardone, a private company with 5,500 employees that is taking innovative strides to get to zero environmental waste discharge. Cardone remanufactures over 65 different product lines as part of waste elimination efforts.

In the 2011, the U.S. Council on Competitiveness, a collaborative effort between industry and the U.S. Department of Commerce, led a strategic dialogue on remanufacturing. The dialogue identified challenges and opportunities in three areas: research and development; trade and federal policy; and public relations and legal issues.

Dr. Nasr also updated participants on the work of the UNEP International Resource Panel. That group has identified remanufacturing as a key focus of future work and research because of its important role in advancing the circular economy and innovation.

9.4.2 Best Practices

The following best practices were offered on issue cards, but were not discussed by the group. However, several of them are elaborated on in the challenges and opportunities sections that follow.

- Universal definitions are critical.
- Remanufacturing efforts should first focus on long-term use goods. These types of goods provide the most remanufacturing opportunities because the product may be around many years after OEMs stop making them or their associated parts.
- Utilize logistics chains to enable remanufacturing and recyclability. Suppliers should be set up to receive used parts as raw materials for either remanufacturing or recycling.
- The sharing economy can help increase the value and use of remanufactured products. Individuals and organizations that participate in sharing-based businesses have already adopted a “reuse” mentality that is critical in recognizing the value of remanufactured goods.
- The Xerox Company service model has been effective in maintaining a high standard of quality and use throughout the life of its products.

9.4.3 Challenges

Definitions of Terms

- It was noted that “remanufactured” and “refurbished” are terms that seem to create a lot of confusion. While the Basel Convention did develop strict conventions on the definitions, the concerns relate more to refurbishment and remanufacturing than to recycling and reuse.
    - Generally, refurbishment is defined as bringing a product back to a fully functional sate, but not brand new. Remanufactured, meanwhile, means that a new product has been created.
- Applying a definition across many different sectors can potentially dilute the meaning or make it vague.
- Remanufactured products are different from “as good as new,” as they are completely new products. Companies typically offer the same pricing and guarantees for a remanufactured product as they do for a product made of virgin-sourced materials.

Perception of Remanufactured Goods

- Currently, it is easier to sell remanufactured goods in business-to-business transactions, rather than business-to-consumer transactions. If we want to enhance automotive remanufacturing, then we need to educate the end user and make them proud to be using a remanufactured product.
- There is a misperception that companies do not extend the life cycle of products beyond the design cycle. Caterpillar, for example, upgrades engines to meet new engine standards, and in some circumstances, these remanufactured engines perform even slightly better.

Lease, Ownership, and Service Models and Adapting to a Sharing Economy

- The sharing economy is an approach to enhance the economic value of refurbished and remanufactured products, as the customer is looking for service, not a particular product.

- Supporting leasing, service and innovative ownership models could have significant impact in encouraging remanufacturing, as customers would then have an incentive to bring a product in for an upgrade rather than maximizing the use of the product or throwing the product out once it has been used.

Reverse Logistics & Feasibility of Remanufacturing

- Suppliers are typically providers of raw material. Remanufacturing reverses this paradigm making the supplier the recipient of raw materials. This shift requires a change in mindset. Logistically, it is more complicated, as remanufacturing supply chains are more vertically integrated; this means that companies must be involved in managing products in all phases of the life cycle, from beginning to end. Additionally, software and Enterprise Resource Planning (ERP) systems, in large part, are not currently structured to handle a CE. There are difficulties in tracking part numbers, as this information is usually not available to OEMs. As such, an open system, where companies have access to this information, would help in their ability to remanufacture items. This *may* require government standards to implement.
- In the computer/software industry model new products can be created by updating the same software, but the automotive industry has not been developed this way. If a transformation could occur, such as changing the way power trains are developed so that "plug and play" with different parts could occur, major changes in the industry would be possible.
    - It was noted that there is a manufacturer in the United States that is working on such a concept by converting the combustion engine to an electric engine.
- There are also very few instances in which parts are remanufactured by other industries to create completely new products. This cuts off a variety of potential remanufacturing opportunities.
    - Often this is due to institutional barriers, such as the repurposing of car batteries to be used in houses to generate energy; electric utility companies are opposed to this because of the potential negative impact on their bottom line; in addition, insurance companies see potential liability issues.
- In general, a macro review of the industry could be helpful in creating a "frictionless environment." Areas such as building codes (e.g., using car batteries in buildings), car warranties and car part warranties need to be examined. Changes in policies and regulations would also have to occur. For example, there are impediments related to transferring "universal waste" across state borders; therefore, the U.S. Department of Transportation (DOT) would need to address existing regulations.
- While industry needs to do a better job of designing for remanufacturing, this may be at odds with other eco-design objectives such as recycling materials.

The following additional challenges were offered on issue cards, but were not discussed by the group:

- The energy required to dismantle and recycle a vehicle.
- Lack of documentation of the environmental and economic benefits of remanufacturing and refurbishing.
- When cars are at the end of their life in the developed world, they may get recycled for parts or find new life (continue to pollute) in developing countries.
- Market and regulatory perceptions of remanufactured and refurbished products.
- Supply of quality "cores" suitable for remanufacturing – e.g., automotive parts for remanufacturing.
- Need to establish consistent standards for remanufacturing that spans all industries/products.
- Products with short lives, such as cell phones, present a huge challenge. Longer life span products like cars, health care equipment are better suited to remanufacturing and refurbishment.
- Universal waste rules can complicate remanufacturing refurbishment and limit backhauls.

9.4.4 Suggested Changes, Improvements or Actions

Government/Policy Action

- One suggestion, which was controversial amongst the group, was to apply for U.S. Corporate Average Fuel Economy (CAFE) standards for all cars on the road, not just new cars, as old cars release higher emissions. This could encourage the auto industry to design vehicles with updates in mind, driving remanufacturing and extending the life of cars.
- Addressing, or increasing, the availability of open systems with regard to parts data and software ownership, potentially by updating the Digital Millennium Copyright Act.
- It would be beneficial to examine policies that impede remanufacturing opportunities, such as the standardization of remanufactured product warranties that are the equivalent of new product warranties.
- Government could require remanufacturing and refurbished products when conducting public procurement.
- A campaign to publicize the benefits of remanufacturing to millennials in an effort to enlist their support for remanufactured products. The idea would be to work to make remanufacturing cool and commonplace and get remanufacturing into the daily conscious so that people look for it and want it – similar to the Energy Star initiative.
- Require corporations and government agencies to share their remanufacturing and refurbishing efforts in their annual reports, and make these initiatives part of their sustainability goals.
- Establish an international standard for remanufacturing similar to ISO 90001 that can be audited, inspected and certified.
- Define remanufactured parts as equal to new in [Free Trade Agreements] “FTA”.
- Right-to-repair policies should apply to parts in reuse and remanufacturing, meaning that all parts are warrantied and can be used when repairing or servicing products.

Industry

- It was suggested that companies move away from using the term “remanufactured” and just market the products like virgin-sourced products. However, there are legal implications to doing this.
- Industries should account for remanufacturing potential early in the product design cycle. They should establish design models for remanufacturing of whole vehicles or products, not just designing cars or products for remanufacturing of parts or assemblies.
- Companies should work to create alternative business models where consumers use/disuse products, rather than own products. Companies would then decide when and how to recycle products more efficiently.
- Research and development investment is needed in remanufacturing technologies.
- Companies should provide training or design programs to ensure effective collection of quality automotive parts “cores.”
- Explore with OEMs the potential for “Design to Upgrade” models. For example, design powertrains that can be upgraded later in life to enhance efficiency.

Research & Collaboration Opportunities

- Educate the remanufacturing community about the current Enterprise Resource Planning capabilities of the auto recycling industry.
- Improve the software to support reverse logistics to improve the efficiency and recovery of parts.
- Develop software systems focused on recyclability and remanufacturability of cars and car parts.
- Conduct research on how new ownership models and service systems impact resource efficiency. These new models will change consumer behaviors and may encourage remanufacturing, as customers would then have an incentive to bring a product in for an upgrade, rather than maximizing the use of the product, or just throwing the product out once it has been used.
- Work with industry stakeholders (e.g., insurance companies) to update codes, standards, warranties and related policies that discourage the practice of remanufacturing.

9.5 How might we expand the use of recycled materials to minimize raw material use in a way that promotes resilience and competitiveness?

9.5.1 Conversation Starters

Ms. Jessica Sanderson, Novelis. Ms. Sanderson showed a video and discussed the process used by Novelis to recycle aluminum. Novelis has developed an extensive network that allows the company to process two million metric tons of scrap. Novelis recycles aluminum that is used in a number of different industries from beverages to auto to architecture and promotes recycling of materials through designing with recycling in mind and advanced sorting technology, including sorting different aluminum alloys. Ms. Sanderson discussed the importance of partnerships and collaboration to increase the amount of scrap taken back from customers, increase post-consumer recycling rates and enhance recycling infrastructure. She also described some of the challenges associated with recycling, including: identifying materials that are able to be recycled; negative public perception of using recycled materials; and the varying life spans of different aluminum materials. Addressing these challenges is critical because there is not enough recycled aluminum to meet demand.

9.5.2 Best Practices

- Manufacturers need to look at the full life cycle of a product in order to understand which parts are made from recycled materials and which parts can be directly reused. Looking at the full life cycle helps to identify opportunities for efficiency and can help manufacturers and users understand a product's life span. The complexity of taking a full life cycle perspective varies based on the type of product. For example, soda cans have a much shorter life span and are much less complex and easier to recycle than cars or architectural components
- Novelis has partnered with auto manufacturers, like Ford, to create take-back programs, which helps control the recycling process and facilitates the tracking of parts throughout the entire life cycle.
- Closed loops are difficult to achieve, but critical to successful recycling efforts. Novelis has achieved a 99 percent recycled material rate and is working toward using as little primary material as possible by forcing a closed loop. Improving the information flow of products helps the company understand product life cycles and the ways products can be designed to promote recyclability.
- Using easily recyclable alloys aids in the ability to recycle multiple scrap types. Novelis, along with their auto partners, Jaguar and Ford, have developed a method to sort easily recyclable alloys, and those that are not easily recyclable can be reused, upcycled or downcycled.
- Stakeholder involvement and engagement is important because they can help drive the business forward. Stakeholders, like consumers and shareholders, have questions and expectations for how products are developed and used that can be helpful in marketing and in ensuring products are used and disposed of as anticipated. Whirlpool and the plastics and "bio-based" industries more broadly have worked with stakeholders to develop reused and recycled products that consumers want and have been able to provide consumers with understandable resource-related information. Additionally, continued development of recycling infrastructure has been a best practice, especially tools and processes that employ traceability of materials to allow for expanded uses and characterization of material to be reused and not just recycled.
- Stakeholder education and outreach is important because it helps them understand more about the products, how they should be used, and how they can be reused or recycled at the end of life. Often times, there is a gap between the manufacturer and the stakeholders in what recycled or reused products are and how they can be used. The plastics and "bio-based" industries have worked on educating stakeholders so that there is better communication and understanding. This has helped the stakeholders and consumers ask more specific and driving questions that the manufacturers can use to better inform their products.

- Plastics and “bio-based” industries have educated their consumers about the value and costs of recycled materials. This awareness helps increase recycling rates and promotes proper recycling methods.
- Because so many materials have a large, complex material make-up, it can be difficult to determine how to reuse or recycle different materials. The zinc industry has partnered with other industries to access information about how materials can be reused or recycled. This saves a lot of time and money, especially because the research has already been completed by experts. These partnerships have formed across industries so that people work together or can easily access and share information between and across industries. Once this information is shared, manufacturers can change their manufacturing and business processes so that they are better equipped to reuse or recycle many different materials, helping to eliminate waste.
- Metal recyclers identify materials that have the least amount of contaminants. Materials that have fewer contaminants are easier and more cost-effective to recycle. Manufacturers should target recycled materials that come from these “cleaner” sources.
- Understand the economics behind recycled materials and total costs of recycling versus raw materials. Manufacturers need to look at the life cycle of recycled materials to understand the total costs associated with that process compared to the total costs of acquiring and using raw materials.
- Capitalize on existing markets within or outside a particular industry. Manufacturers and recyclers are finding markets that already exist and are tapping into them to create partnerships and other avenues for recycled materials. Partnerships between manufacturers and recyclers enable them to work together to identify different markets that can reuse or produce new products with the recycled materials.

9.5.3 Challenges

- There are varying life cycles for materials. Cans have a very short life cycle, whereas vehicles have a longer life cycle and building materials have a very long cycle. It can be difficult to track materials if the life cycle is long, because the products have been in use for an extended amount of time. Tracking materials throughout their life cycle helps in being able to easily and effectively reuse or recycle them, but when the materials cannot be tracked, there is a challenge in understanding what materials comprise the product and how best to reuse or recycle it.
- Recycled products are hard to trace, because determining exactly where the mix of recycled materials derived from is almost impossible. There is little or no downstream data across certain industries and countries, so there are gaps in information. These gaps in information present a challenge because the full life cycle of a material is unknown, making it harder to determine all the components of a product and how best to recycle them.
- The commodities markets are unstable, and there are times when the market will not be favorable to recycling materials. There is a need to keep recycling a priority when there are fluctuations in the market.
- Markets for recycled materials are growing, but they will eventually plateau because the market will be saturated with product. Industry needs to identify uses for recycled materials when the markets do plateau and how to keep up the demand for recycled materials.
- There are a number of products that can be reused, reclaimed or recycled, but there does not seem to be a market for them. There should be a market that helps promote the availability of these excess products, especially if they are being stockpiled. For example, residuals from mines have alloys and other materials that have the potential to be reclaimed.
- The recycling industry is also competing with recent landfill investments. The creation of new landfills alleviates the need for consumers to find alternative solutions for their waste and also does not incentivize them to reuse or recycle products.
- Traceability is an important factor for stakeholders, but it is almost impossible to trace where the raw materials came from. Many industries have found that stakeholders would like to be able to trace the

materials used in products down to which mine the raw materials were pulled from. This is impossible, especially in products that use a mix of recycled and raw materials.
- Manufacturers need to work with their customers to get a better understanding about the intersection between consumer demand and recycled content. They need to know when consumers feel that more recycled content is needed and when it may spark concerns about product reliability, quality and cost.

9.5.4 Suggested Changes, Improvements or Actions

- Focus on areas of agreement between competitors, government and other entities. Find common goals across industries and look at those areas to move forward with making changes and improvements.
- Creating partnerships within and across industries will help recycling on a global scale. Companies and manufacturers see the value in recycling, and working together will advance the global effort of reusing and recycling materials. There is a need to look at the recycling industry as a whole and gett buy-in across different industries to support recycling. Also, manufacturers need to look at the whole life cycle of a product to see where there are gaps in material and use information. Creating partnerships will help to fill in the gaps in information.
- Governments have incentives in place that encourage recycling. These programs need to continue. Government also needs to be thinking of new and different ways to incentivize the recycling industry.
- The recycling industry also needs to have continued support for R&D so that new innovations can be made to move the industry forward.
- Having a shared understanding of reuse and recycling costs and benefits will help consumers, government, stakeholders and other industries share the costs of reuse and recycling.
- Identify products that make the most sense to recycle, such as those with the fewest contaminants. Parcel out the products that can be easily recycled from those that cannot. Instead of getting stuck on the problem of trying to figure out how to recycle a product with more contaminants, recycle the materials that can be recycled easily while actively looking for solutions for the products that present more challenges.

10 ATTACHMENT 5 – WORKSHOP AGENDA

G7 Alliance on Resource Efficiency

U.S.-hosted Workshop on the Use of Life Cycle Concepts in Supply Chain Management to Achieve Resource Efficiency

March 22-23, 2016
Ritz-Carlton Pentagon City
Arlington, Virginia

Agenda

Purpose

- Identify and document best practices related to the use of life cycle concepts in supply chain management that are scalable, replicable and transferrable across organizational and geographic boundaries
- Provide a forum for industry, policy makers, researchers, and interest groups to explore key challenges to implementing life cycle concepts and engage in conversations that will advance resource efficiency practices across the supply chain
- Share information about tools, resources, and programs available to help manufacturers, suppliers, and others improve their use of life cycle concepts to achieve greater resource efficiency
- Generate potential ideas for voluntary individual and collective action

March 22, 2016

7:30 – 8:30 **Registration**

8:30 – 8:40 **Announcements** *(Patrick Tallarico, Enventive Consulting, Facilitator)*

8:40 – 9:00 **Opening Remarks by Representatives from the United States and Japan** *(Ms. Christine Harada, White House Council on Environmental Quality; Mr. Mathy Stanislaus, U.S. Environmental Protection Agency; Mr. Masahito Fukami, Japan Ministry of the Environment)*

9:00 – 9:10 **Orientation to Workshop Agenda and Participant Assignments** *(Facilitator)*

9:10 – 9:30 **The Importance of Using Life Cycle Concepts to Achieve Resource Efficiency** *(Dr. Steve Evans, Cambridge University)*

- The presenter will help ensure a common understanding of the key concepts of the workshop and will demonstrate why it is important to look at product and service life cycles to accelerate resource efficiency.

Desired Outcome: Common understanding of key terms. Awareness about why it is important and urgent to rethink the way we approach resource efficiency.

9:30 – 10:30 **Life Cycle Thinking Exercise: Creating a Vision for the Resource-efficient Vehicle (Product or Service) of the Future** *(Panel Members: Mr. Mike Swift, Auto Recycling Association; Prof. Yasushi Umeda, University of Tokyo; Ms. Antonia Gawel, World Economic Forum; Jean-Francois Gaillaud, French Ministry of Economy, Industry and Digital Affairs; Karen Cecil, Cummins; John Bradburn, General Motors)*

- A facilitated panel discussion reflecting various perspectives will create a vision for the resource-efficient vehicle, product, or service of the future.
- The audience will be engaged in the discussion after the initial panel discussion to complete this vision.

Desired Outcome: A broader perspective on what it means to have a resource-efficient vehicle (product or service) from a life cycle perspective that can inspire thinking during the workshop.

10:30 – 10:50 **BREAK**

10:50 – 12:30 **Upstream Efforts to Address Resource Efficiency**

- Leaders from public and private-sector organizations will discuss new programs and/or share best practices and success stories from various industry perspectives. Presenters will be engaged in a discussion of factors that contributed to success.
    - Mr. Philippe Dauphin, Natural Resources Canada – Energy Mines Resources.ca, an Integrated Resource Cycle
    - Ms. Ursula Mathar, BMW Group – Using Life Cycle Thinking and Supply Chain Engagement to Achieve Resource Efficiency
    - Dr. Lee Davies, Department for Environment, Food and Rural Affairs, United Kingdom – Developing Policy to Support Sustainable Innovation
    - Dr. Alessandro Peru, Ministry of the Environment, Italy – New Voluntary Approach for Assessment and Communication of Environmental Footprint
    - Ms. Yuko Sakai, Toyota – Toyota's Challenge for Resource Recycling Management

Desired Outcome: Transferrable best practices that reflect the use of life cycle concepts to achieve resource efficiency across the supply chain.

12:30 – 1:30 **LUNCH On Own**

1:30 – 3:00 **Facilitated Breakout Series 1 – Upstream Efforts to Address Resource Efficiency**

Breakout Session Design

- *Conversation Starters will share brief success stories and "best" practices*
- *Participants will share their own "best" practices.*
- *Group will identify ideas that are transferrable across industry sectors*
- *Group will discuss remaining challenges and opportunities and brainstorm practical ideas for action: Policy (National/International), Research/Pilot, Collaborations, etc.*

- **GRAND BALLROOM:** How can we use the **design process** to improve resource efficiency from a life cycle perspective? (*Conversation Starters: Carrie Pearson, 3M – Integrating Sustainability into the Design Process; Werner Loscheider, Germany – Light weighting)* Facilitator – Doug Sarno
- **PLAZA A&B:** How can we improve how we use life cycle information and life cycle thinking to set goals and better inform resource efficiency **decisions**? *(Conversation Starter: Jim Fava, United Nations Environment Programme Hotspot Project; Ron Voglewede, Whirlpool)* Facilitator – Doug Black
- **PLAZA C:** How can we improve how we use life cycle information and life cycle thinking to set goals and better inform resource efficiency **decisions**? *(Conversation Starter: Bill Flanagan, GE)* Facilitator – Bryan Pai
- **PLAZA D:** How do we do a better job of identifying, communicating, and addressing **social impacts** across the supply chain? *(Conversation Starter: Jeff Morgan, Mars Corporation; Kevin Funk, U.S. General Service Administration)* Facilitator – Mary Apostolico
- **DIPLOMAT:** How can we **improve communication** and share information about resource efficiency across the supply chain? *(Conversation Starters: Mrs. Sue Rokosz, Ford PACE Program; Mr. Jason Pearson, Sustainable Purchasing Leadership Council)* Facilitator – Dana Goodson

Desired Outcome: Shared "best" practices as well as identification of remaining challenges and potential actions to advance resource efficiency.

3:00 – 3:20 **BREAK**

3:20 – 3:45 **Breakout Reports**

3:45 – 4:15 **Circular Economy Principles in Action (***Jean-Francois Gaillaud, Ministry for Economy and Industry, France; Philippe Schulz, Groupe Renault)*

4:15 – 5:00 **Tool Time: Tools and Resources to Accelerate Resource Efficiency**

- Participants will have the opportunity to briefly learn about innovative tools and resources that may help them improve their resource efficiency efforts.
  - Paul Yaroschak, U.S. Department of Defense – Sustainability Analysis Tool
  - Joe Cresko, U.S. Department of Energy – LIGHTEn-UP and MFI
  - Elisa Tonda, UNEP – Global Network of Interoperable LCA Databases
  - Chuck Shoopman, University of Tennessee – Investing in Manufacturing Communities Partnership (IMCP)
  - Andy Mangan, US Business Council on Sustainable Development and Andrea Brown, World Business Council on Sustainable Development – The Materials Marketplace
  - Steve Gutmann – Stuffstr

Desired Outcome: New information about tools, resources, and programs available to help manufacturers, suppliers, and others achieve greater resource efficiency.

5:00 – 5:15 **Day 1 Closing Exercise – Small Group Discussions at Tables to Reflect on Key Insights and Encourage Networking**

5:15 – 6:30 **Welcome Reception**

March 23, 2016

8:30 – 8:45 **Announcements, Recap of Day 1, Preview of Day 2, Assignment Reminder**

8:45 – 9:00 **Opening Remarks from Dr. Wolfgang Scheremet, Director General, German Ministry of Economic Affairs and Energy**

9:00 – 9:15 **Opening Remarks from Gina McCarthy, Administrator, U.S. Environmental Protection Agency**

9:15 – 10:30 **Improving Resource Efficiency in Operations, Use and at End of Life (or Second Life) with Supply Chain Engagement**

- Leaders from public and private-sector organizations will share best practices and success stories from various industry perspectives. Presenters will be engaged in a discussion of factors that contributed to success.
  - Yuji Yamaguchi, Ministry of the Environment, Japan - Japan's Initiatives to Promote Resource Efficiency and the 3Rs in the Auto Sector
  - Lynn Laszewski, PepsiCo – The Realities of End of Life Resource Efficiency
  - Adam Muellerweiss, Johnson Controls – Insights from the Circular Economy of Automotive Batteries
  - Peter Bartel, Robert Bosch – Ensuring Long-term Availability of Remanufactured Spare Parts
  - Dr. Paolo Masoni, Italian National Agency for New Technologies, Energy – Extracting Value from End-of-life Materials: Car Shredding Residues and Tires

Desired Outcome: Transferrable best practices that reflect the use of life cycle concepts to achieve resource efficiency in operations, use, and at end of life by engaging the supply chain.

10:30 – 10:45 **BREAK**

10:45 – 12:15 **Facilitated Breakout Series 2 – Improving Resource Efficiency in Operations, Use and at End of Life**

Breakout Session Design

- *Conversation Starters will share brief success stories and "best" practices*
- *Participants will share their own "best" practices.*
- *Group will identify ideas that are transferrable across industry sectors*
- *Group will discuss remaining challenges and opportunities and brainstorm practical ideas for action: Policy (National/International), Research/Pilot Collaborations, etc.*

- **GRAND BALLROOM:** *How do we incorporate and improve efficiency in other areas such as **water, energy, land**, etc.? (Conversation Starter: Bruce Uhlman, BASF)* Facilitator – Dana Goodson
- **PLAZA A&B:** *How can we create value from waste materials? (Conversation Starters: John Bradburn, GM; Kevin Butt – Toyota North America)* Facilitator – Doug Sarno

- **PLAZA C:** How might we improve the recycling of vehicles at the **end of life**, both increasing recycling rates and improving the recyclability of components? *(Steve Fletcher, Auto Recyclers Canada)* Facilitator – Mary Apostolico
- **PLAZA D:** How can we expand the use of **remanufactured or refurbished** parts? *(Conversation Starter: Nabil Nasr, RIT)* Facilitator – Bryan Pai
- **DIPLOMAT:** How might we expand the use of **recycled materials** to minimize raw material use in a way that promotes resilience and competitiveness? *(Conversation Starter: Jessica Sanderson, Novelis)* Facilitator – Doug Black

Desired Outcome: Shared "best" practices as well as identification of remaining challenges and potential actions to advance resource efficiency.

12:15 – 1:15 **LUNCH**

1:15 – 1:45 **Breakout Reports**

1:45 – 2:45 **Critical Factors for Successful Implementation**

- A panel discussion to explore two critical factors for successful implementation – scaling up ideas and engaging in cooperative relationships across the supply chain and beyond.
  - Bob Larsen, Composite Recycling
  - Mike Mullin, Brambles Limited
  - Steve Hellem, Suppliers Partnership for the Environment
  - Dr. Wolfgang Scheremet, German Ministry of Economic Affairs and Energy

Desired Outcome: Understanding of how some companies and countries are implementing innovative resource efficiency solutions.

2:45 – 3:10 **Exercise to Advance Innovative Ideas**

- Participants will be asked to discuss ideas for improving resource efficiency or addressing a key challenge. They will engage other participants, and each table will choose one idea to put forward for consideration during the subsequent breakout sessions.

Desired Outcome: Potential action plans to implement resource efficiency ideas.

3:10 – 3:20 **BREAK**

3:20 – 4:05 **Moving from Ideas to Action**

- Audience-specific breakout discussions (e.g., government-only, industry only, etc.) to process workshop findings, identify potential actions, and articulate transferrable themes.
  - **GRAND BALLROOM:** Government and Intergovernmental Organizations
  - **PLAZA A&B:** Other Industry Sectors
  - **PLAZA C:** Waste Management and Recycling
  - **PLAZA D:** Environmental and Academics
  - **DIPLOMAT:** Auto Sector

Desired Outcome: Ideas for action that may cut across organizations, industry sectors, and geographic borders.

4:05 – 4:15 **BREAK**

4:15 – 5:00 **Key Observations and Potential Next Steps**

- Participants will report out on the results of their audience-specific breakout discussions and focus on potential next steps and desired actions.

5:00 – 5:15 **Closing Remarks by Mr. Mathy Stanislaus, Assistant Administrator, Office of Land and Emergency Management, U.S. Environmental Protection Agency; and Mr. Masahito Fukami, Counselor, Ministry of the Environment, Japan.**

11 ATTACHMENT 6 – WORKSHOP PARTICIPANT LIST

Final Participant List

Name	Title	Organization
Ms. Chika Aoki-Suzuki	Researcher	Institute for Global Environment Strategies (IGES)
Mr. John Armstead	Director	U.S. EPA
Mr. Douglas Baltz	Einstein Fellow	National Science Foundation
Mr. Russ Balzer	Technical Director	WorldAutoSteel
Mr. Peter Bartel	Reman Process Owner	Robert Bosch GmbH
Dr. Alan Barton	Chief Executive Officer	Lehigh Technologies
Ms. Kit Batten	Executive Director	UC Davis Policy Institute for Energy, Environment & the Economy
Dr. Georg Bauml	Senior Manager	Volkswagen AG
Mr. Richard Beaumont	CEO	Green Standards
Ms. Patricia Beneke	Regional Director	UNEP
Ms. Delanne Bernier	Director of Policy and Political Affairs	Automotive Recyclers Association
Mr. Greg Bertelsen	Senior Director	National Association of Manufacturers
Mr. Randy Bertram	Director of Sustainability Services	Wisconsin Manufacturing Extension Partnership
Ms. Sara Bixby	Deputy Executive Director	Solid Waste Association of North America
Mr. Rasmus Boldsen		European Commission
Ms. Marijn Boll	Advisor for the Netherlands Network for Innovation	The Netherlands Embassy in Washington, D.C.
Ms. Melanie Bower	Credibility Manager	Green Electronics Council
Mr. John Bradburn	Global Manager Waste Reduction	General Motors
Dr. Sue Briggum	VP State and Federal Policy	Waste Management
Ms. Andrea Brown	Director, Sustainable Materials	World Business Council for Sustainable Development
Mr. Mark Buckley	VP Environmental Affairs	Staples
Ms. Bridget Burnell	Manager, Env. Sustainability	General Motors
Mr. Kevin Butt	Regional Environmental Director	Toyota Motor North America
Ms. Kerry Callahan	Senior RCRA Program Manager	ASTSWMO
Mr. Colin Carroll	Director, EHS	American Iron and Steel Institute
Ms. Karen Cecil	Director, Global Environmental Sustainability	Cummins Inc.
Ms. Holly Chapell	Director, Government Affairs	Umicore USA
Prof. Marian Chertow	Professor	Yale Center for Industrial Ecology
Mr. Peter Chipman	Senior Sustainability Officer	White House Council on Environmental Quality
Ms. Kim Cochran		U.S. EPA
Ms. Cheryl Coleman	Division Director	U.S. EPA
Mr. Brennan Conaway		U.S. General Services Administration
Ms. Sandra Connors	Director	U.S. EPA

Name	Title	Organization
Ms. Denise Coogan	Environmental Partnerships Manager	Subaru
Mr. Joe Cresko		U.S. Department of Energy
Ms. Cynthia Cummis	Deputy Director, Greenhouse Gas Protocol	World Resources Institute
Mr. Philippe Dauphin	Director General	CanmetMATERIALS
Dr. Lee Davies	Principal Social Scientist	UK DEFRA
Mr. Nico Dekker	Assistant to the Counselor	Embassy of the Kingdom of the Netherlands
Mr. Daniel Donatelli	Senior Manager, Sustainability	Brambles
Mrs. Jana Dörschel	Official	Federal Ministry of Economic Affairs and Energy, Germany
Mr. Tom Dower	Senior Director, Gov. Rel.	ArcelorMittal
Prof. Steve Evans	Professor	Cambridge University
Dr. Jim Fava*	Chairman	Thinkstep
Mr. Timothy Fields	Senior Vice President	MDB, Inc.
Dr. Joseph Fiksel	Executive Director, Sustainable Economy	The Ohio State University
Dr. William Flanagan	Director, Ecoassessment Center of Excellence	General Electric
Mr. Steve Fletcher	Managing Director	Automotive Recyclers of Canada
Mr. Michael Forbeck	Environmental Program Manager	Pennsylvania Department of Environmental Protection
Mr. Matthew Forman	Federal Affairs	FCA
Ms. Hilary French	Program Officer	UNEP
Mr. Masahito Fukami	Counselor	Ministry of the Environment, Japan
Mr. ColinScott Fulton	President	Environmental Law Institute
Mr. Kevin Funk	Sustainable Acquisition Program Lead	U.S. General Services Administration
Mr. Jean-François Gaillaud	Deputy at Eco-Industries and Sustainable Development	Ministry of Economy, Industry and Digital Affairs, France
Ms. Antonia Gawel	Associate Director	World Economic Forum
Mr. Bob Gedert	Director	Austin Resource Recovery
Ms. Nancy Gillis	Chief Executive Officer	Green Electronics Council
Mr. Michael Glikes		U.S. EPA
Mrs. Gretchen Govoni	Director Corporate Sustainability	SABIC
Mrs. Margaret Guerriero	Director	U.S. EPA
Mr. Steve Gutmann*		Stuffstr
Ms. Priscilla Halloran	Senior Environmental Health Scientist	U.S. EPA
Ms. Christine Harada	Federal Chief Sustainability Officer	White House Council on Environmental Quality
Mr. Eric Harris	Assistant Vice President of Government Affairs	Institute of Scrap Recycling Industries
Ms. Megann Head	Environmental Design Engineer	Steelcase
Mr. Steve Hellem	Executive Director	Suppliers Partnership for the Environment
Mr. Garth Hickle		Environmental Council of the States
Mr. John Howes	Principal	Redland Energy Group

Name	Title	Organization
Mr. Yoshihiro Iwata	Assistant Director	Ministry of Economy, Trade and Industry, Japan
Mr. Bryan Jacobs	Vice President, Government and External Affairs	BMW Group
Mr. Louis Johnston	Manager of Environmental Programs	FCA
Dr. Richard Kashmanian	Senior Economist	U.S. EPA
Minister Kunihiko Kawazu		Japanese Embassy
Mr. Kevin Kelley	Plant Manager	Xerox Corporation
Ms. Monika Kern	Executive Advisor to VP	NRC
Mr. Dohyeong Kim	Manager	Center of Resource Recirculation Promotion (TF)
Ms. Teri Kline	Public Policy Manager	General Motors
Counselor Hidechika Koizumi		Japanese Embassy
Mr. Kevin Koonce	VP Government Affairs	Vinyl Institute
Dr. Mark Kozdras	Program Manager, Automotive	Natural Resources Canada / CanmetMATERIALS
Minister Junichiro Kuroda		Japanese Embassy
Ms. Kathleen Laird	Vice President	Goodwill Automotive / Goodwill Industries of Greater Detroit
Mr. Jim Laney	Senior Manager North American Safety, Health & Env	DENSO International America Inc.
Mr. Robert Larsen	Chief Executive Officer	Composite Recycling Technology Center
Ms. Lynn Laszewski		PepsiCo
Mr. Mike Levy	Senior Director, Life Cycle Issues, Plastics Division	American Chemistry Council (ACC)
Mr. Gary Liss	Vice President	U.S. Zero Waste Business Council
Mr. Gary Litman	Vice President, Global Initiatives	U.S. Chamber of Commerce
Mr. Werner Loscheider	Head of Unit	Federal Ministry of Economic Affairs and Energy, Germany
Mr. Ted MacDonald	Senior Sustainability Officer	U.S. EPA, Office of Global Affairs and Policy
Ms. Christina Macken	Director of Programs	Sustainable Purchasing
Mr. Kellen Mahoney	Program Manager	Suppliers Partnership for the Environment
Mr. Andrew Mangan	Executive Director	U.S. Business Council on Sustainable Development
Mr. Paolo Masoni	Research Director	ENEA: Italian National Agency for New Technologies, Energy and Sustainable Economic Development
Mrs. Ursula Mathar	VP Sustainability & Environmental Protection	BMW Group
Mr. Carl Mattia	General Counsel	CLX Logistics LLC
Ms. Kelly McAllister	Chemist	U.S. EPA
Ms. Gina McCarthy	Administrator	U.S. EPA
Mrs. Heather McTeer Toney	Regional Administrator	U.S. EPA
Mr. Drew Merrill	Vice President, General Manager	CHEP
Mr. Anders Moeller	Managing Director	Hollander LLC

Name	Title	Organization
Mr. Jeff Morgan		Mars Corporation
Prof. Daniel Mueller	Professor	NTNU
Mr. Adam Muellerweiss	Global Director, Sustainability & Environmental Affairs	Johnson Controls
Mr. Mike Mullin	Senior Director Global Government and Public Affairs	Brambles Limited
Mr. Tom Murray	President	Tom Murray Environmental Consulting
Ms. Angela Nahikian	Director, Global Sustainability	Steelcase
Dr. Nabil Nasr	Associate Provost & Director, Golisano Institute	Rochester Institute of Technology
Mrs. Maria Negron Kneib	Council Director	Manufacturers Alliance for Productivity and Innovation
Ms. Jane Nishida	Acting Assistant Administrator	U.S. EPA Office of International and Tribal Affairs
Mr. Joshua Novikoff	Japan Program Manager	U.S. EPA
Ms. Masako Ogawa	Senior Environmental Specialist	Global Environment Facility
Mr. Jonghun Oh	Deputy Director, Resource Circulation Policy Division	Ministry of Environment, Republic of Korea
Ms. Gina Oliver	Senior Director, Automotive Plastics Division	American Chemistry Council (ACC)
Mr. Kazunobu Onogawa	Senior Fellow	Institute for Global Environment Strategies (IGES)
Ms. Carrie Pearson	LCA Supervisor	3M
Mr. Jason Pearson	Executive Director	Sustainable Purchasing Leadership Council
Ms. Deana Perlmutter	Principal	The Integral Group
Dr. Alessandro Peru	Coordinator of the European Public Affairs	Italian Ministry of the Environment Land and the Sea
Ms. Leah Pillsbury	Foreign Service Officer	U.S. Department of State
Mrs. Amy Porter	Deputy Federal Chief Sustainability Officer	White House Council on Environmental Quality
Mr. Emmanuel Pouliquen	Principal Industry Specialist, Manufacturing	IFC (World Bank Group)
Mr. Christopher Prins	International Coordinator	U.S. EPA
Mr. Robert Proctor	Manager	Honda R&D Americas, Inc.
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Mr. Dhruv Raina	Senior Manager	Owens Corning
Ms. Dörte Ratzmann	Policy Advisor	Federal Ministry for the Environment, Nature Conservation, Building and Nuclear, Germany
Ms. Elizabeth Resek	Chief	U.S. EPA
Mr. Robert Reynolds		U.S. Department of State
Ms. Susan Robinson	Sr. Public Affairs Director	Waste Management
Ms. Dania Rodriguez	Executive Director	ASTSWMO
Mrs. Sue Rokosz	Senior Environmental Engineer	Ford Motor Company
Mr. Gregory Rose	Director - Environment, Health & Safety	FCA
Ms. Erin Saal		U.S. EPA
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Mr. David Sarokin	Specialist	U.S. EPA
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Mr. David Schroeder	Sales Director	Covanta
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Mr. Eric Stuart	Vice President, Energy & Environment	Steel Manufacturers Association
Ms. Rieko Suzuki		Japanese Embassy
Mr. Mike Swift	Vice President	Swift's Trails End Auto Recycling
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Ms. Elisa Tonda	Head of Unit	UNEP
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Prof. Yasushi Umeda	Professor	The University of Tokyo
Mr. Jacob Vaillancourt	Chief Operating Officer	Waste Hub
Mr. Mike Van Brunt	Director Sustainability	Covanta
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Name	Title	Organization
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Miss Willemien Vlas	Policy Advisor	Ministry of Infrastructure and the Environment of the Netherlands
Mr. Ronald Voglewede	Global Sustainability Director	Whirlpool Corporation
Mr. Hinrich Voss	CEO	Oemeta Inc.
Mr. Mark Washko	Head of Federal Government Affairs	BASF Corp.
Mr. Michael Weber	Research Coordinator	German Embassy
Ms. Brooke Weizmann	Manager, Sustainability	BASF
Ms. Lecedra Welch	Program Manager	AIAG
Ms. Julie Wenah	Counselor and Policy Advisor	U.S. Dept. of Commerce/Economic Development Administration
Mr. Michael Wilson	CEO	Automotive Recyclers Association
Mr. Nathan Wittstruck	Economist	U.S. EPA
Mr. Jeffrey Wooster	Global Sustainability Director	The Dow Chemical Company
Mr. Yuji Yamaguchi	Deputy Director	Ministry of the Environment, Japan
Minister Kanji Yamanouchi		Japanese Embassy
Mr. Todd Yaney	Manager, Sustainability	Fiat Chrysler Automobiles
Mr. Paul Yaroschak	Deputy for Chemical & Material Risk Management	U.S. Department of Defense
Prof. Steven Young	Professor	University of Waterloo

*** Dr. Jim Fava provided a recorded presentation of the UNEP/SETAC Hotspot Project. Mr. Steve Gutmann presented a short video and led a discussion on Stuffstr remotely. Mr. Adrian Tautscher of Jaguar Land Rover provided the REALCAR Innovate UK video.**