United States

Materials Marketplace

Pilot Project Report, November 2015

United States Business Council for Sustainable Development

wbcsd

CORPORATE ECOFORUM

Forging Next Practice in Corporate Sustainability

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Executive Summary

The United States Materials Marketplace launched as a pilot project in the summer of 2015 to test the feasibility of a national exchange where traditional and non-traditional industrial waste streams could be matched with new product and revenue opportunities. The Marketplace leverages the expertise and networks of three founding partners: The US Business Council for Sustainable Development (US BCSD), the Corporate Eco Forum (CEF), and the World Business Council for Sustainable Development (WBCSD).

23
companies

Initial results from phase one of the pilot project, which ran from June to August 2015, include: 23 participating companies, 78 facilities engaged, 150 materials—2.4 million tons total—uploaded to the marketplace, 59 materials being sought, 68 recommended matches and 19 transactions in development, with another 49 possibilities that were still pending action at the close of the pilot. As a result, the project team plans to extend the pilot through March 2016, allowing time to bring potential matches to fruition, incorporate platform improvements, and recruit additional companies to participate. A compelling long-range objective also emerged: to create an expanded United States Materials Marketplace—with hundreds, or thousands, of companies reusing their material flows—to help pave the way to a future "circular economy" in which landfills become obsolete. The Marketplace not only provides a way for companies to align material streams, but also serves an increasingly important convening role. It amplifies the voices of like-minded businesses seeking to understand and reform the regulatory environment and exchange materials across borders and boundaries.

78
locations

2.4
million tons available

The project builds on two decades of successful regional materials management projects conducted by the US BCSD. The US BCSD, CEF, and WBCSD each seek ways to help their member companies shift from traditional linear waste flow systems to new circular approaches that transcend industries, sectors, and geographies. Such approaches could also be instrumental in helping companies identify "hot spots" in their material flows where reuse is impossible and redesign may be necessary for true circularity to be achieved. Andrew Mangan, founder and Executive Director of the US BCSD, likens the process to opening curtains for the first time. He summarizes the vision of the project team:

"The increasing pressure on our natural resources sends a clear message: we need to find value in discarded materials. Growing cross-industry collaboration for the efficient use of our resources opens up new business opportunities while creating economic, environmental, and societal benefits."

Companies participating in the 2015 U.S. Materials Marketplace pilot project include: Armstrong World Industries, Alcoa, BASF, CH2M, Dow Chemical, Essroc, Fairmount Santrol, General Motors, Goodyear, Greif, LafargeHolcim, Nike, Novelis, Procter & Gamble, Swisstrax, Tetra Pak, Veolia, Waste Management, and others. Their sectors include a diverse mix of cement, primary metal manufacturing, chemicals, and consumer products manufacturing. In 2014, these 23 companies accounted for over $600 billion in revenue, operated over 600 facilities in the United States, and employed over 1.7 million people worldwide.

Evolving the successful regional model to create a viable national-level platform presented new challenges, as well as opportunities. Interviews with companies that participated in the first phase of the project revealed a number of challenges to be addressed during the second phase and future expansion. These include personalized support to better understand how the marketplace works and what sorts of materials can be uploaded, help uploading data,

assistance to assess the feasibility of potential transactions, and more hands-on facilitation. The goal is to have more than 100 companies participating by the end of 2016. International scale up is also on the horizon, in partnership with the WBCSD and its Global Network of national business councils. Peter Bakker, President and CEO of the WBCSD, says of his organization's commitment:

"The Materials Marketplace project is a key step toward the shift to a circular economy — one where waste becomes the new engine for creating value. Unlocking business-to-business reuse opportunities ensures effective waste management and deliver integrated benefits."

The key to this future is the secure cloud-based marketplace software platform, through which project members share materials data, review recommended materials from the project team, negotiate trades, and receive notifications of potential obstacles. The platform also serves as a proving ground for companies to brainstorm new supply chain pathways for reusing ubiquitous materials. Members can even identify opportunities around wasted transportation and logistics space. The US BCSD adapted, refined, and expanded the software during a materials reuse project in Hebei Province, China, as part of the U.S.- China EcoPartnerships program in 2013. Further refinements will be an ongoing and important element of the project.

59
wishlist materials

68
opportunities identified

19
transactions underway/ explored

Like China, other countries are paying attention to the United States Marketplace pilot and expressing interest in establishing their own marketplace systems. The WBCSD's Global Network of 70 national business councils offers a natural growth path to scale the marketplace system and link it globally within a cooperative structure. This structure would allow participants to maintain national ownership and responsibility for each marketplace while sharing results and outcomes with other co-op countries or sub-regions.

The idea for a pilot project originated at a Corporate Eco Forum event in June 2014 that brought together leading thinkers and actors focused on making circular business processes a reality. Amy O'Meara, Director of the Corporate Eco Forum explains:

"The US BCSD's expertise and software were exactly what our members were looking for. And joining forces with US BCSD and WBCSD was a natural fit, given the significant complementarity of our memberships. By leveraging each of our organizations' strengths, we can deliver increased value to participating companies."

The project received a major boost from the early and enthusiastic enlistment of its co-champions, General Motors and Nike. In recent years, GM has generated nearly $1 billion in annual revenue through reuse and recycling of its by-products, resulting in a 10 million metric ton CO2-equivalent emissions reduction. Each year Nike generates natural leather, synthetic leather, and other textile scraps that can be used as smaller product pieces and artistic designs or utilized as filler material for insulation.

Forms of the circular economy have been around at least since the 1970s, under varying names in places as diverse as Kalundborg, Denmark and Midlothian, Texas. These activities have produced many successful outcomes. The principle, also known as "industrial symbiosis" or "by-product synergy", has grown in popularity around the world recently, provoking action from public and private sectors alike. By taking advantage of and contributing to the Materials Marketplace software platform, participating companies will continue finding opportunities to lower operational costs and waste disposal expenses while reducing energy consumption and GHG emissions. They will also spend less for raw materials, create new business opportunities and jobs, and join a respected collaborative network of diverse like-minded companies that are eager to explore new pathways to more efficient production and environmental protection.

United States Business Council for Sustainable Development

ABOUT THE US BCSD: The US BCSD is an action-oriented and member-led business association that harnesses the power of collaborative projects, platforms and partnerships to develop, deploy and scale solutions to ecosystems, energy, materials and water challenges. US BCSD activities are designed to generate economic returns and address environmental and societal challenges. The US BCSD is one of 70 national councils affiliated with the World Business Council for Sustainable Development.

wbcsd

ABOUT THE WBCSD: The World Business Council for Sustainable Development is a CEO-led organization of forward-thinking companies that galvanizes the global business community to create a sustainable future for business, society and the environment. Its member companies represent a wide variety of business sectors with global impact. They generate combined annual revenue of more than $8.5 trillion, and employ a workforce of 19 million people. The WBCSD applies its respected thought leadership and advocacy to generate constructive solutions and take shared action. Leveraging its strong relationships with stakeholders, the WBCSD helps drive debate and policy change toward sustainable development solutions.

CORPORATE ECOFORUM
Forging Next Practice in Corporate Sustainability

ABOUT THE CORPORATE ECO FORUM: The Corporate Eco Forum (CEF) is an invitation-only membership organization comprised of Fortune and Global 500 companies from 18 industries with combined revenues of over $3 trillion. CEF's mission is to help accelerate sustainable business innovation by creating a neutral "safe space" for influential business leaders to strategize and exchange best-practice insights. Participants are exclusively top-level executives, including chief sustainability officers, chief financial officers, and chief technology officers, and other VP-level executives with responsibilities affecting the supply chain.

Project Results

Key Partners and Project Participants

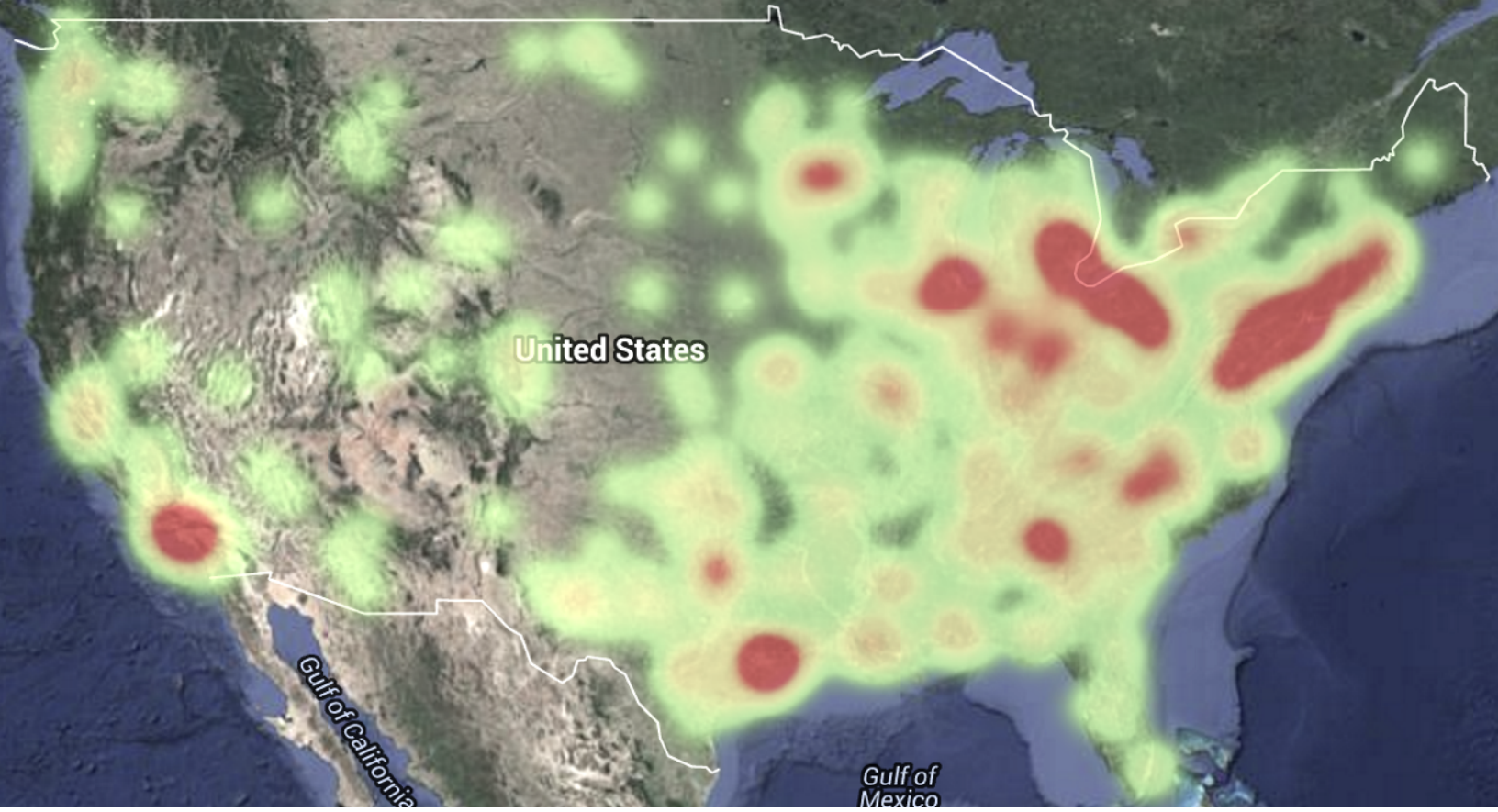
The United States Materials Marketplace project is a unique collaboration between the US BCSD, WBCSD and Corporate Eco Forum, each bringing their respective business membership, communities and stakeholders. Just as the companies in the Marketplace are seeking new partnerships through the program, the three founding associations are seeking creative ways of collaborating. All three strive to support their constituencies in achieving scalable circular economy solutions.

After several months of recruitment, 23 of the corporate members joined the pilot[1]. These companies come from a diverse mix of sectors that include cement, primary metal, chemicals, and consumer products. Together, they generate over $600 billion in annual revenue, with over 600 facilities in the United States, and over 1.7 million global employees[2].

Seventy-eight facilities from these 23 companies participated in the pilot project, representing 13% of the total number of United States facilities these companies operate. Sixty-three users had access to the marketplace to manage their company's data. Some companies elected to engage individual facility managers at each location, while some managed information across multiple facilities from one central account. The Materials Marketplace software allows for either configuration depending on company needs.

[1] Some participants wished to remain anonymous and are not shown in the logos below.

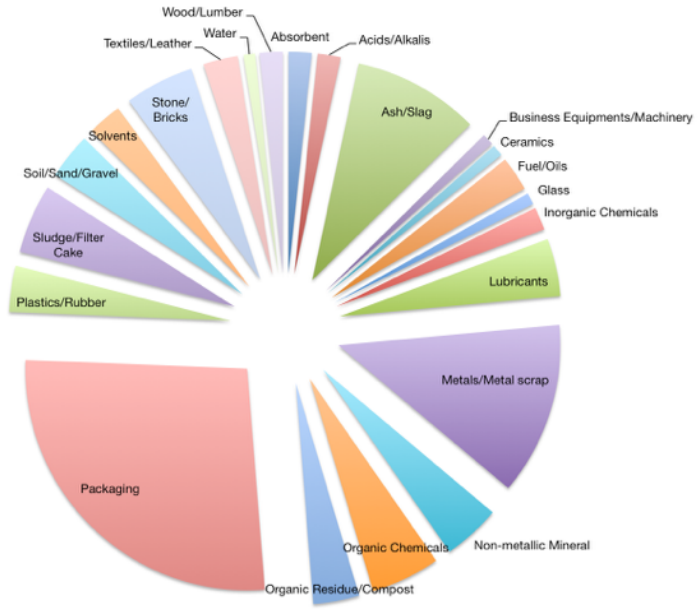
[2] 2014 data



This map shows the distribution of project participant facilities across the United States. Geographic distribution plays an important role with respect to logistics and transportation, since owners and buyers in close proximity spend less and create less environmental impact transporting materials. As more company participants and their facilities come online, we anticipate that existing clusters will become denser, and new clusters will emerge.

Data Collection and Materials Highlights

MATERIALS AVAILABLE BY RESOURCE TYPE



As of October 31, 2015, a total of 150 materials were available in the Marketplace pilot project, totaling around 2.4 million tons per year of underutilized materials. Of this total, members were pursuing transactions involving more than 2 million tons. This figure demonstrates a tremendous opportunity for environmental, social and economic improvement. Chemicals, packaging, and metals are the top three material categories identified by the 23 participants in the project to date. The materials highlighted below represent a small subset of the total materials available.

The marketplace also includes over 50 wishlist entries - materials that project participants are seeking from other project participants. Cement industry participants posted the most wishlist entries, seeking materials for cement kiln co-processing. Other wishlist postings requested specific feedstocks for product manufacturing.


Steel Offal


Bauxite Residue


Drums and Totes


Textile Scraps


Multi-layer Packaging


Wood Scrap


Carbon Dust

Steel Offal | SURPLUS RAW MATERIAL

General Motors' steel offal is a surplus raw material produced by its stamping operations. These are consistently sized, high-quality pieces of steel that are produced when windows and other spaces are stamped out of body panels on the assembly lines.

Because of their consistent size, shape, and quality, these steel pieces are valuable for much more than traditional scrap markets. Offal pieces are 0.5 to 3.2 mm thick, have various coatings, and total 1,500 metric tons per year. Several companies have initiated conversations with GM on how to reuse these steel pieces in their production lines. Enormous cost-benefit values are available through reuse of these materials for GM and for future users of the reclaimed steel.

"Material management is a business opportunity, not just a cost-reduction strategy," says John Bradburn, GM's Global Manager of Waste Reduction. "We have to reach the state where by-products are viewed the same way we view product development — part of constant improvement and innovation."

Too often in manufacturing, engineers may not have the time or opportunity to work closely with designers. On hearing about GM's offal, an architect in New York envisioned using the low-cost offal as attractive outer sheaths of multi-story buildings.

In 2014, General Motors generated nearly $1 billion in annual revenue through reuse and recycling its by-products and avoided releasing over 10 million tons of CO_2-equivalent emissions into the atmosphere.

Surplus Raw Materials

Materials that the business owner does not need, but that can be reused as an original resource by other companies. The best possible outcomes in this category are when other manufacturing companies recognize they can use the materials directly, or after reprocessing them in their production; or when innovative products and businesses are created that can take advantage of low-cost raw material.

Textiles, Synthetic & Natural Leather | SURPLUS RAW MATERIAL

One clothing and textile company has a variety of surplus raw materials available in the marketplace, including natural leather, synthetic leather, and other textiles. These remnants are well suited for direct use. They can be cut into smaller pieces for smaller products, stitched together to create larger pieces, or shredded and reused as insulation material.

Wood Waste | SURPLUS RAW MATERIAL

One manufacturer's primary surplus raw material is 960 tons per year of wood waste. Manufacturers can reuse this material directly in less demanding construction and architectural applications, while some smaller workshops prioritize use of recovered wood.

Off-spec Polyalkylene Glycols (PAG) | INDUSTRIAL BY-PRODUCT

Broadly categorized as industrial by-products, Polyalkylene glycols (PAG) are high-performance synthetic lubricants, offering quality lubricity, high natural viscosity, and good temperature stability. PAG base fluids are available in both water soluble and insoluble forms and in a wide range of viscosity grades. Common uses include quenchants, metalworking fluids, food-grade lubricants, textile lubricants, and lubricants in hydraulic and compressor equipment.

Large amounts of off-spec/expired PAG lubricants are available in the Materials Marketplace. Though not applicable in their original forms, these materials represent possible reuse options as fuels and as lubricants in other applications.

Bauxite Residue | INDUSTRIAL BY-PRODUCT

Some of the most important discoveries concern materials produced in the refining of aluminum. The refining generates a number of industrial by-products, including significant amounts of bauxite residue every year. This slurry residue, commonly known as red mud, is a mixture of oxide and hydroxide minerals with high alkalinity. Bauxite residue is a by-product in the production of alumina that remains after the refining process separates the alumina from the bauxite. Although the clay-like residue is high in alkalinity, it is possible to neutralize this. After a filter press dries the residue, moisture content can drop to between 20 and 40 percent, and the residue turns into a soil-like material of fine particle size. Because of the iron ion in the residue, it is generally red in color.

Industry experts have explored several applications for Bauxite residue, including in wastewater treatment as Phosphors absorbent, cement production process as Al and Fe additive, and as an amendment to acidic coal refuse piles for reclamation.

Using bauxite residue and phosphogypsum as alternative construction materials for the levee core is a promising beneficial reuse opportunity. The US EPA has conducted a series of geotechnical, leaching, and erodibility studies[3], which verify that a mixture of aged bauxite residue and aged phosphogypsum at the ratio of 4:1, with high compaction level at optimum moisture level, has a high likelihood of meeting all levee construction-related requirements[4].

Industrial By-Products

More complex industrial by-products requiring thorough examination of their elemental composition, physical and chemical properties before being reused for other purposes. These represent the majority of materials identified in the marketplace for which multiple reuse solutions can now be feasibly identified.

Industry should continue to optimize the red mud-phosphogypsum (RM-PG) mixture and design appropriate engineering procedures for large-scale testing. This will not only help verify the conclusions from the laboratory experiments, but also advise levee design that will best immobilize the RM-PG mixture, thereby minimizing the ecological and human health risks by reducing exposure.

Cold Mill Filter Media | INDUSTRIAL BY-PRODUCT

Cold Mill Filter Media are diatomaceous earth and fuller earth industrial by-products generated by the aluminum cold rolling process. This material consists of 40 percent diatomaceous earth, 20 percent fuller earth, oil and grease. The non-metallic mineral composition and the calorific value embodied in the oil and grease make this material an ideal alternative fuel or raw material for cement kiln co-processing.

Foundry Sand | INDUSTRIAL BY-PRODUCT

Spent foundry sands are safe to reuse in soil-related applications. The sand industry has promoted the beneficial reuse of these materials for over two decades. Earlier this year, the US EPA and the United States Department of Agriculture endorsed the beneficial use of silica-based, spent foundry sands produced by iron, steel and aluminum foundries in manufactured soils, soilless potting media, and as a foundation layer in road construction.

The EPA's risk assessment[5] of the evaluated uses of foundry sand concluded that they are appropriate because the constituent concentrations in the sands are below the agency's health and environmental benchmarks. The EPA estimates that environmental benefits from using silica-based, spent foundry sands at the current use rate would result in energy savings equivalent to the annual electricity consumption of 800 homes, CO_2 emissions reductions of 840 cars, and water savings of 7.8 million gallons.

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[3] Red Mud Phosphogypsum Risk Assessment Final Report, prepared by: SRC/SERAS, prepared for: US EPA, 2010.

[4] Final Report for Sampling and Analysis Project - Beneficial Use of Red and Brown Mud and Phosphogypsum as Alternative Construction Materials, prepared by MSE Technology Applications, Inc., prepared for US EPA, 2008.

[5] http://www3.epa.gov/epawaste/conserve/imr/foundry

Drilling Mud | INDUSTRIAL BY-PRODUCT

Different types of by-product materials have been successfully co-processed as alternative fuels and raw materials in cement kilns in Europe, Japan, the United States, Canada and Australia. Among many opportunities identified with cement kiln co-processing is drilling waste generated by heightened oil and gas production in the United States. 500 tons of drill cuttings per well are oil-based mud with 30% oil content. This solid slurry material could meet the technical specifications of cement kiln co-processing due to its heat value (5000 Btu/lb minimum, 8000 Btu/lb preferred), minimal halogen and heavy metal content, low radioactivity, and other pH value and sulfur content requirements.

Transportation is the biggest obstacle for this material. Generators are concerned with the liability associated with transporting the mud over long distances. Loading and unloading can also be an issue. For now, cement plants cannot feed this solid slurry material into the kiln. Industry must invest in R&D solutions to develop a feeding mechanism. Oil and gas companies may collaborate with rail companies to drive down shipping costs.

Spent Sulfuric Acid | INDUSTRIAL BY-PRODUCT

Spent sulfuric acid is a pH neutralizer and recovered globally. Spent sulfuric acid is a source of sulfur for a producer of SO_2 or H_2SO_4 and is recoverable from spent H_2SO_4 regeneration companies. Fertilizer manufacturers and the metals industry may have interest in reusing this material.

Spent sulfuric acid reuse not only helps eliminate the waste stream, but also reduces the alkali needed to neutralize the significant spent acid and wastewater treatment cost. Techniques for removing organic or inorganic impurities from the spent sulfuric acid is a research opportunity. Knowledge already exists regarding removal of chlorinated organics with activated carbon, removal of solid chlorinated organics by filtration, and treatment of the Cl_2 with bisulfite without affecting the acid.

Packaging & Shipping

Packaging and shipping materials make up a large portion of materials available in the marketplace. Some materials in this category, like pallets, are relatively simple to reuse or recycle. Others, like beverage cartons and multi-layered packaging presents a more difficult challenge.

Pre and Post-consumer Beverage Cartons | PACKAGING & SHIPPING

A significant volume of aseptic beverage carton material is available in the marketplace. These materials are printed, may have a poly coating, and have a thin layer of aluminum foil. Though this material can be recycled and made into new paper products, there are likely more cost-efficient and direct reuse opportunities in other applications, such as reusing the fiber and insulation composition of the carton into ceiling products.

Pallets | PACKAGING & SHIPPING

While they are easily reusable, large quantities of pallets often remain sitting in warehouses due to damage or logistics challenges. Reuse opportunities available include repair and remanufacturing, using the wood to make furniture or other new products, or co-processing in cement kilns as an alternative fuel.

Drums and Totes | PACKAGING & SHIPPING

Most manufacturers use drums and totes to transport hazardous and non-hazardous liquids. They are drums and totes listings in the marketplace from multiple participants. One marketplace participant offers a reconditioning service which will serve as a good solution for these used containers if direct reuse is not an option.

Opportunities in Development

The following opportunities are currently in discussion between project participants as of October 2015. The majority of these transactions originated from recommendations made by our project team through the Materials Marketplace software. Environmental[6] and economic impact metrics are estimated - actual numbers may vary pending logistics and final quantity confirmations.

Sand Reuse: By-Product Silica Sand and Ground Silica

Quantity Available	4,200 tons/year
Opportunity	Silica sand and ground silica are important feedstocks for sand production. Two companies are exploring the reuse of a silica by-product to to replace virgin feedstock.
Environmental Impact	1,110 MT CO_2e avoided 4,200 tons/year diverted from landfill
Economic Impact	$172,000 per year in disposal savings and value creation

Co-processing: Cleaning Solvents

Quantity Available	500 tons/year
Opportunity	These cleaning solvents meet the minimum calorific value requirements for cement kiln co-processing. Co-processing is a secure form of waste management that recovers both energy and mineral components from waste for use as fuel, and for product additives used in manufacturing processes.
Environmental Impact	787 MT CO_2e avoided 500 tons/year diverted from incineration or alternative disposal
Economic Impact	$700,000 per year in disposal savings and value creation

[6] $MTCO_2e$ avoided calculated using Eco-LCA™, http://www.resilience.osu.edu/CFR-site/eco-lca.htm

Sand Additive: Bauxite Residue

Quantity Available	2 million tons/year
Opportunity	One participant is researching and testing the use of bauxite residue to replace virgin feedstock, or as an additive in sand production. Both opportunities are being explored, however the later is more likely to be feasible.
Environmental Impact	14,400 MT CO_2e avoided if all 2 million tons can be diverted 2 million tons/year diverted from storage and/or disposal

Co-processing: Bauxite Residue

Quantity Available	2 million tons/year
Opportunity	Bauxite residue does not have as high of a calorific value as other materials typically used in cement kiln co-processing, however the material composition is similar. Co-processing may be able to recover a small amount of energy, but more importantly, the mineral components in the material.
Environmental Impact	14,400 MT CO_2e avoided if all 2 million tons can be diverted 2 million tons/year diverted from storage and/or disposal
Economic Impact	$40 million per year in disposal/storage savings and value creation

Constructed Wetlands: Bauxite Residue

Quantity Available	2 million tons/year
Opportunity	Two participants are currently exploring the use of bauxite residue in a constructed wetland wastewater treatment system to remove phosphorous.
Environmental Impact	14,400 MT CO_2e avoided if all 2 million tons can be diverted 2 million tons/year diverted from storage and/or disposal
Economic Impact	TBD

Co-processing: Aqueous Methanol

Quantity Available	1,100 tons/year
Opportunity	Aqueous Methanol does meet the minimum calorific value requirements for cement kiln co-processing. Co-processing is a secure form of waste management that recovers both energy and mineral components from waste for use as fuel, and for product additives used in manufacturing processes.
Environmental Impact	1,731 MT CO_2e avoided 1,100 tons/year diverted
Economic Impact	$1.5 million per year in disposal savings and value creation

Co-processing: Drilling Mud

Quantity Available	5,000 tons/month
Opportunity	In certain situations, oil well drilling mud meets the minimum calorific value requirements for cement kiln co-processing, however transportation of the material presents a challenge. Co-processing is a secure form of waste management that recovers both energy and mineral components from waste for use as fuel, and for product additives used in manufacturing processes.
Environmental Impact	TBD
Economic Impact	TBD

Chemical Reuse: HCl By-Products

Quantity Available	TBD
Opportunity	Bauxite residue is high in alkalinity, and needs to be neutralized by acids before being stored or disposed of. Acidic by-product streams available in the marketplace may prove to be a good source after testing.
Environmental Impact	TBD
Economic Impact	TBD

Container Reconditioning: Totes and Drums

Quantity Available	83 tons/year
Opportunity	One participant collects, cleans, reshapes, reconditions, remanufactures and tests industrial drums and intermediate bulk containers (IBCs) for reuse and recycling, extending the life of the products and responsibly recycling their component materials at the end of their life cycles.
Environmental Impact	390 MT CO_2e avoided 83 tons/year diverted from landfill
Economic Impact	$32,700 per year in disposal savings and value creation

Opportunities Explored & Dismissed

Data on what doesn't work is equally important as data that does work, often revealing detailed information on material composition and applications, and important logistics barriers to be applied in future transactions down the road. The following transactions were initiated through the materials marketplace software, but ultimately canceled or put on hold.

Totes and Drums

Recipient	Container Industry
Opportunity	The recipient collects, cleans, reshapes, reconditions, remanufactures and tests industrial drums and intermediate bulk containers (IBCs) for reuse and recycling, extending the life of the products and responsibly recycling their component materials at the end of their life cycles.
Reason for Cancellation	This transaction was put on hold due to logistics challenges, but will be revisited in Phase 2 of the pilot project.

Aqueous Methanol

Recipient	Chemical Industry
Opportunity	Reuse in manufacturing processes
Reason for Cancellation	The ethanol and propanol are undesirable impurities that created side reactions.

Vinyl Acetate Bottoms

Recipient	Cement Industry
Opportunity	Co-processing in cement kilns
Reason for Cancellation	The Btu value for VA Bottoms is sufficient for cement kiln co-processing, however, receiving facilities must be willing and able to accept hazardous materials. No facilities accepting hazardous materials are near the production site.

Vinyl Acetate Bottoms

Recipient	Metals Industry
Opportunity	pH neutralizer for bauxite residue
Reason for Cancellation	VA bottoms has some constituents that are prohibited from direct ground application by RCRA. However, this research did lead to the discovery of a HCl by-product for the same application.

Resin Oil C

Recipient	Cement Industry
Opportunity	Cement kiln co-processing - a secure form of waste management that recovers both energy and mineral components from waste for use as fuel, and for product additives used in manufacturing processes.
Reason for Cancellation	The flash point of the material is too low for co-processing.

Steel Offal

Recipient	Chemical Industry
Opportunity	Reuse in new products
Reason for Cancellation	The recipient's fabricators require a very specific type of steel, with certifying paperwork to insure those specifications. This by-product stream did not meet those specifications.

Steel Offal

Recipient	Container Industry
Opportunity	Reuse in new products
Reason for Cancellation	This by-product did not meet the right specifications to be used in the recipient's manufacturing and remanufacturing processes.

Additional Opportunities Identified

Material Name	Reuse Idea
Ceramic microsphere	Cement kiln co-processing
Powder coating fines	Cement kiln co-processing
Nitrile clay	Cement kiln co-processing
Wet aluminium oxide	Al recovery
Wet aluminium oxide	Al recovery
Electrolytic paste	Cement kiln co-processing
Geopolymer	Cement kiln co-processing
Carbon dust	Cement kiln co-processing
Underpot material	Cement kiln co-processing
Carbon dust	Raw materials replacement
Flat fiberglass mats	Reuse in products
ME hydrocarbons	Cement kiln co-processing
ME hydrocarbons	Chemical recovery
Heat transfer salt	Chemical recovery
Spent sulfuric acid	Chemical recovery
Offspec Saran resin	Cement kiln co-processing
Polypropylene glycol ether	Cement kiln co-processing
Propanol flush	Cement kiln co-processing
Glycol Ether Product	Cement kiln co-processing
MagSil filter solids	Cement kiln co-processing
Cellulosic Product	Cement kiln co-processing
PAG lubricants	Cement kiln co-processing
Copolymer beads	Raw materials replacement
Polypropylene glycol ether	Chemical recovery
Glycol Ether Product	Chemical recovery
Cellulosic Product	Chemical recovery
Wood pallets	Reuse to make furniture

Wood	Raw materials replacement
Wood	Raw materials replacement
Resourcinol	Cement kiln co-processing
Sand	Raw materials replacement
Used oil	Cement kiln co-processing
Resourcinol	Chemical recovery
Natural leather scrap	Raw materials replacement
Textile scrap	Raw materials replacement
Spent lime dust	Cement kiln co-processing
Hot baghouse material	Cement kiln co-processing
Cold baghouse material	Cement kiln co-processing
Refractory	Cement kiln co-processing
Cold mill filter media	Cement kiln co-processing
Biological WWTP sludge	Cement kiln co-processing
Neutralite baghouse waste	Cement kiln co-processing
Spent lime dust	Mine reclaimation
Aluminum bed filter media	Al recovery
Aluminum dross	Al recovery
Kraft paper pulp tea bags	Textile production
Kraft paper pulp tea bags	Textile production
Kraft paper pulp tea bags	Reuse in ceiling products
Pre and post-consumer beverage cartons	Reuse in ceiling products

Supply Chain Innovation

As the United States Materials Marketplace project evolves, select opportunities to rethink and disrupt complex and challenging market segments are emerging. These opportunities will be captured and organized into working groups within the marketplace project. Through these working groups, the project will engage with critical stakeholders and work to establish new, more efficient, and/or higher value links in the supply chain. Two working groups have surfaced during the pilot project focusing on plastics and transportation, outlined below.

Plastics

Project participants provided feedback that materials like PET and polypropylene are in short supply. The project team anticipates utilizing the marketplace to examine, discover, and connect industrial, pre-consumer and post-consumer sources of these and other materials.

For example, GM is examining ways to manufacture various auto parts from recycled plastics. The company is finding ways to collect and process PET bottles from its own internal waste streams and feed the material into its manufacturing process. It is adopting a supply chain approach toward increased circularity, which not only helps secure supply base, but also close the loop of plastics. Currently, this project is under development with processes started, end users identified, and PET material earmarked to flow through the project after full implementation.

Transportation

Supply chain innovation isn't limited to physical materials, but extends to a variety of underutilized resources. A second working group focused on transportation and logistics is in development, with a goal of helping transportation companies avoid "moving air" and establish a low-cost secondary transportation market that matches excess transportation resources with moving reusable materials. This solution may be common on a company level, but it has not been applied across industries using a systems approach.

Transporters, material owners, and users could work through the details of a secondary transportation market by using the marketplace as the negotiating, testing and proving ground. One example is excess carbon fiber from an industrial manufacturer that is an input to the computer manufacturing industry. Due to its light weight, transportation costs make reuse unfeasible. If negotiations result in empty freight-miles substituted by partial freight capacity miles at discounted prices, all parties involved could win. This kind of cross-industry supply chain arrangement could be enabled through the marketplace platform.

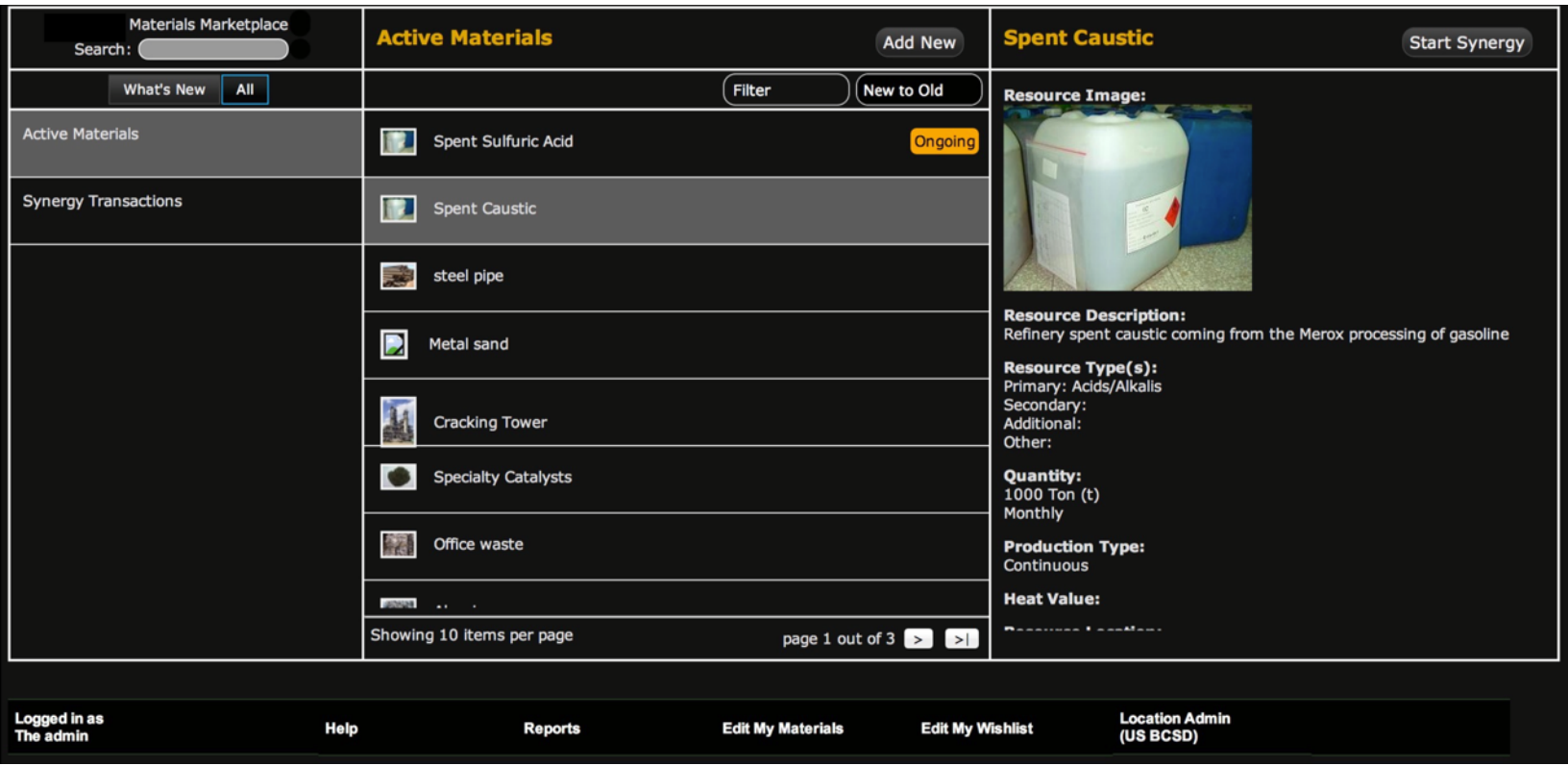
Software Platform

How it Works

The foundation for the United States Materials Marketplace is the US BCSD's cloud-based Materials Marketplace software, originally developed by the US BCSD to support the Hebei By-Product Synergy Project under the U.S. - China EcoPartnerships program in May 2013. The concept is a cloud-based landing zone for companies to post details about their material flows in expectation of identifying collaborative reuse possibilities. The US Business Council for Sustainable Development used its 20-plus years of experience in complement to the online materials marketplace software to gather materials data, help identify possible synergies and share them with the participating companies. The Materials Marketplace software and its operational team allows users to:

1. **Post available or desired materials**
2. **Help identify reuse opportunities**
3. **Negotiate and exchange underutilized materials**
4. **Convene working groups around specific materials types**

Through a built-in interface, the project team monitors marketplace activity, identifies possible reuse opportunities and actively pushes those out to relevant companies as recommendations. If the parties involved need assistance, the project team facilitates transactions between companies. All marketplace users can generate real-time reports on key metrics.



The Materials Marketplace also includes the following additional features:

- Startup templates based on industry and facility type to expedite initial data entry and to encourage users to consider resources available creatively.
- Users may sort or filter available resources by potential for synergy match (determined by the system) or other factors, including location and material type. This includes a robust search function to locate specific resources desired. The software notifies users when a high match potential resource becomes available.
- Once the project team identifies a potential match, the software tracks and executes all steps of the transaction. Project staff will monitor transaction progress closely to work through any difficulties.
- Synergy participants complete additional confidentiality agreements, if needed, to protect sensitive business information.
- Members may generate detailed reports on savings and environmental benefits for specific resource transaction or benefits of all transactions.
- Users have the ability to upload photos of available resources, giving other marketplace users a more detailed and visually appealing way of browsing.
- All users from participating companies attain secure log-ins and train on software use and data entry. The software also ensures fast and responsive technical support. The project team provides immediate assistance to users, addressing any technical difficulties. The software also produces “bug reports” and performance issues for resolution by our software developers.
- The project team is working on a list of software enhancements to make it more powerful, visually appealing, and user friendly.

Software Development Roadmap

The vision for succeeding generations of the marketplace software includes development of a comprehensive, trusted, online materials management tool and business-to-business materials exchange platform. In the next generation of the software, the software will perform an automatic reuse identification function, helping to shift human input from time-consuming research to verification and supervision. The project team expects this functionality due to the development of a digitized global materials reuse knowledge base. This database will record all matches made, regardless of final implementation result. It will also capture the environmental, economic and societal performance metrics for each case. The software will match the materials supply and demand based on the chemical properties, physical properties, and elemental compositions. It will allow users to customize recommendations based on the metrics that matter the most to their corporate sustainability goals.

This “intelligent” knowledge base will grow and become more robust with each material posting and synergy match. It could potentially include other materials management options such as recycling or composting to provide users a suite of choices.

Data collection and analysis is the most critical step of the process. The project team realizes that this can be time consuming for many users. In addition to some small enhancements that may expedite this process, true breakthroughs and innovations are possible by leveraging the new IT technologies. We envision an information processing system that builds on publicly available information and a materials input/output Life Cycle Analysis (LCA) database to help users pre-populate their listings of available and wishlist materials.

Through further analysis using Geographic Information System (GIS) and optimization tools, the software will generate an “optimal virtual synergy network” on a map before the actual data collection process begins. This will help the

project team identify more high density regions, provide participants with pre-loaded data and pre-identified opportunities, and allow governmental agencies to visualize the reuse potential of any geographic region. In the future, when materials reuse has become institutionalized in business operations, a desirable improvement will be establishing a safe and direct communication between the software and companies' internal material data. This would result in more real-time, accurate, and complete materials information automatically uploaded to the software for analysis.

Project Background

The Circular Economy Concept

In a true circular economy, all by-products recirculate back into the economy. The intent is to keep resources in productive use for as long as possible by recovering and regenerating new products and materials. One critical component of the circular economy is "by-product synergy" or "industrial symbiosis", matching wastes and under-valued resources at one facility with the needs of another facility. The result is the redesign of systems to establish circular flows of valuable materials.

As companies recognize the risks and costs of sustaining linear supply chains and the financial benefits of managing materials in a more sustainable way, they have helped accelerate international interest in transforming the circular economy from theory to practice. Zero-waste regulations have hastened this trend. Though the private sector is often the driving force, governments at all levels are beginning to embrace applications of the circular economy model that enhance their broad and complex objectives.

The US BCSD has a 20-year history of achieving tangible results on regional projects based on this principle, which it called by-product synergy. The benefits of the approach to materials management include reductions in operating costs, generation of new revenues, improved environmental performance, reductions in CO_2 emissions, lowered health risks, and job creation and retention.

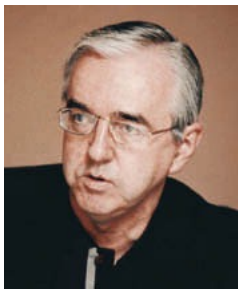
By-product synergy (BPS) is the matching of under-valued waste or by-product streams from one facility with potential users at another facility to create new revenues or savings with potential social and environmental benefits. The process may involve the physical exchange of materials, energy, water and/or by-products. By-product synergy represents a crucial business opportunity to innovate across industrial processes and organizations by exercising best practices in waste reduction and environmental mitigation. Turning waste output from one company into a product stream for another company reduces waste, greenhouse gas emissions, and the need for virgin-stream materials. Concurrently, it creates great opportunities for innovating new products and processes.

Several terms describe similar concepts to BPS. A waste exchange refers to a static process. Whereas BPS is a proactive and facilitated process that may lead to process changes that allow synergies that would otherwise not be feasible. Unlike eco-industrial parks, BPS networks do not depend upon establishing co-located industries, but rather take advantage of existing heavily industrialized areas. The US BCSD has cultivated and facilitated BPS networks throughout the United States, including Chicago, Houston, Columbus, Kansas City, Austin and the Pacific Northwest.

The project team established a replicable process to get companies working together to discuss opportunities and tackle obstacles. It also created new tools to make those tasks easier for companies and cities to participate. This led to development of an initial software solution and then to the more advanced Materials Marketplace. The US BCSD first deployed the marketplace in Austin, Texas, in 2014. To this day, 120 companies use it daily. In June 2015, the US BCSD, in collaboration with the WBCSD and CEF, launched the United States Marketplace pilot. This report documents the first three months of the pilot period.

The Climate for Change

In the town of Midlothian, Texas, near the metropolitan area of Dallas-Fort Worth, a Ph.D. metallurgist named Gordon Forward was recognized by peers as one of the top United States steelmakers in the 20th century. In the late 1970s, he became CEO of a pioneering company that utilized the "mini-mill," in which used steel is the raw material, eliminating the logistics and costs of relying on mining, smelting, purchase, and transport of iron ore processed into steel. Junked vehicles, the major resource, became coin-sized pieces in nine seconds. Within the same corporation and location, the partner cement manufacturer tapped Forward to serve as CEO.



Gordon Forward

Under his leadership, engineers and business tacticians from both companies discovered and tested with objective results that the slag from the steel mill contained quantities of dicalcium silicate, an essential ingredient in the manufacture of cement. Consequently, the steelmaking company increased production output by 10 percent and decreased nitrogen oxide emissions by nearly 40 percent. Meanwhile, the cement company saved energy by reducing the temperatures of its kiln. The cement company that had been producing a million tons per year increased its productivity by 10 percent, to 1.1 million tons. By using pre-calcined lime, cement manufacturers could skip an energy- and CO_2-intensive step in their process. The value of slag increased 20 times over its previous use as road construction fill.

> "We did this with two companies," Mr. Forward said. "Imagine if you did it with twenty companies."

In 1989 two members of the research and development staff of General Motors, R.A. Frosch and N.E. Gallopoulos, published a seminal article in Scientific American titled "Strategies for Manufacturing[7]." They laid out the conceptual groundwork for "industrial ecosystems" in which "the consumption of energy and material is optimized, waste generation is minimized, and the effluents from one process serve as the raw material for another."

Expanding on that article's premise, Marian Chertow and Jooyoung Park wrote in their book "Scholarship and Practice in Industrial Symbiosis: 1989 to 2014" that industries intent on sharing water, energy, and material by-products should study the catalytic role first played in the 1970s by the cross-industries synergy in Kalundborg, Denmark,. A coal-fired power plant manager in Kalundborg and his wife, a pharmacist, applied the term "industrial symbiosis" to achievements that had been driven by the city's industrial leaders who were social friends, which facilitated their creative inter-action. The power plant's scrubbers accumulated gypsum, which required periodic replacement. This material had traditionally gone to a landfill. A peer observed that gypsum wallboard and excess butane from a local refinery enabled the creation of a wallboard manufacturing company. This brought a new enterprise to the city and created new jobs. The Kalundborg symbiosis continues to evolve, with several new organizations today, including two biomass power plants. A total 33 demonstrations of inter-firm resource sharing have occurred.

In July 2014, the European Commission issued proposals to increase recycling and phase out landfills. Aimed at moving the European Union toward a lean circular economy, the legally binding targets include a 70 percent reduction in municipal waste by 2030; an 80 percent recycling target for glass, paper, metal, and plastic packaging waste by 2030; and a ban on landfilling of all recyclable and biodegradable waste by 2025[8]. In addition, the Commission laid out "aspirational" goals that include phasing out the landfilling of all recoverable waste by 2030. Janez Potočnik, European commissioner for the environment, said in announcing those targets:

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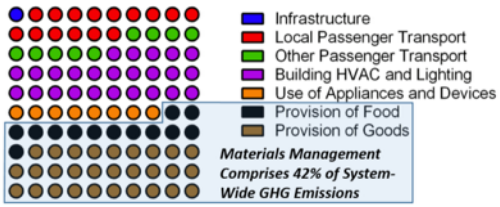
[7] Frosch, R.A. and N. Gallopoulos. 1989. Strategies for Manufacturing. Scientific American 261(3):144-152

[8] http://ec.europa.eu/ireland/press_office/news_of_the_day/eu-calls-for-increased-recycling-rates_en.htm

"We are living with linear economic systems inherited from the 19th Century in the 21st Century world of emerging economies, millions of new middle class consumers, and inter-connected markets. If we want to compete we have to get the most out of our resources, and that means recycling them back into productive use, not burying them in landfills as waste."

A Practical Carbon Reduction Strategy

According to climate change estimates, global resource extraction rose nearly 125 percent between 1980 and 2011. A framework to identify enhanced materials reuse and recycling practices represents one carbon reduction strategy that may contribute to the U.N. Climate Change Agreement approaching in Paris in December 2015.



Systems-based GHG emissions estimate in the US (2006 data) and share of GHG emissions from materials management (adapted from previous work by the US EPA)

In 2013, the United States emitted 6,673 million metric tons of carbon dioxide equivalent ($MMTCO_2$-eq) from a multitude of sources. Estimates by the US EPA of system-based GHG emissions in the United States indicate that approximately 42 percent of greenhouse gas emissions originate from the provision of food and goods, with the rest resulting from infrastructure, transport, building heating and cooling, and use of appliances and devices[9].

Attaining a substantial portion of the GHG emissions reduction requires creative implementation. Fortunately, existing emissions inventory and offset crediting schemes, such as the Clean Development Mechanism, can provide guidance for potential directions that a materials reuse and recycling carbon-crediting approach could take. Research indicates that as much as 85 to 90 percent of early-adoption technologies and innovative approaches to carbon emission reduction is attributable to the presence of incentives such as offset schemes[10]. Incentives for new or enhanced materials management approaches under the U.N. Climate Change Agreement have the potential to spur further activity and innovation.

The Materials Marketplace pilot project and software can help enhance the transactions and trading of credits that are the foundation of that approach. To realize the potential of incentive programs for materials reuse, firms must be aware of and positioned to shift data collection procedures. Firms will collect appropriate baseline and future data as part of implementing new material reuse practices.

The Birth & Growth of the Materials Marketplace

The first by-product synergy project launched in 1997 in Tampico, Mexico. Heavily industrialized, Tampico had a large Pemex oil refinery, a General Electric manufacturing plant, a large Coca-Cola plant, and other major facilities. Mangan says in looking back:

"We decided to try to take the example of Gordon Forward's steel and cement making and the collaborations in Kalundborg and try to make it happen in one year. We were hoping to get three or four synergy opportunities in Tampico. We wound up with sixty or seventy."

[9] United States Environmental Protection Agency. Opportunities to reduce greenhouse gas emissions through materials and land management practices; 2009.

[10] Barnes B, Southwell D, Bruce S, Woodhams F. Additionality, common practice and incentive schemes for the uptake of innovations. Technol Forecast Soc 2014, 89: 43-61.

In a dozen successive projects across North America and the United Kingdom, the by-product synergy process continued to produce similar results and turn up opportunities to reuse materials across industries and cities.

The US BCSD BPS methodology involves establishing a forum where companies, regulators and municipalities explore reuse opportunities through collected information and facilitated interactions. Participants sign an agreement that spells out deliverables, confidentiality issues and intellectual property rights. Rather than simply declaring potential exchanges, the BPS process fosters relationships among companies and municipalities. The process is about information gathering and facilitation, but also about trust and bridge building.

Implementation requires broad based support from local, state and federal government agencies as well as network participants. The government's role in developing synergy networks has been to provide technical expertise, fund grants, coordinate learning and resource sharing , and ensure the appropriate regulations. However, there are limits to what the government can enforce; by-product synergy networks need to evolve synergistically, with the support of agencies.

The BPS process provides many opportunities for businesses and municipalities; however, in order for networks to be implemented successfully, participants must overcome substantial challenges and barriers. These include regulatory, technical, economic, organizational, or communicative hurdles.

In the fall of 2005, the Department of Environment for the City of Chicago was looking for a proven, exciting process for developing eco-industrial activities in the Chicago region. Coincidentally, the Chicago Manufacturing Center (CMC) had begun collaborating with the US BCSD to create a by-product synergy process. Through this relationship, support from the US EPA, and leadership of Mayor Richard M. Daley, the City of Chicago established the Chicago Waste to Profit network the following year. As many as 80 companies became part of this network and pursued more than 100 synergies. The program saw the implementation of 50 synergy opportunities.

Building upon these and other successes at the regional level, the US BCSD, WBCSD, and CEF launched the United States Materials Marketplace pilot project in the spring of 2015. With General Motors and Nike as its corporate co-champions, the marketplace project provides participants with cloud-based software that enables them to collaborate on solutions for materials reuse opportunities. The United States Materials Marketplace pilot project is a key step toward establishing a national network of materials efficiency.

Challenges & Lessons Learned

Participant Engagement

Working with 23 different company cultures, organizational and decision-making structures, people and systems takes time and patience. All were interested in making the marketplace work, a refreshing level of support that helped pace the program forward.

Sixty-six users from 23 companies were given access to the marketplace to manage their company's data. Some companies elected to engage individual facility managers at each location, while others managed information across multiple facilities from one central account.

While the Materials Marketplace software allows for either configuration, some users in the "managing multiple facilities" role reported difficulty in accessing information and transaction records for individual locations. We have some user interface modifications in the enhancements pipeline to streamline this functionality.

We also received feedback requesting more in-depth training materials for utilizing the marketplace and interacting with other participants. These materials need to be easily sharable from the company admin level to the location admin level so participants can more easily bring other employees into the marketplace. For some, participating in the marketplace program highlighted the need for wider engagement across company departments and facilities, including procurement, plant-level operators, waste contract managers, and others.

User Experience

Overall, participants were able and willing to utilize the marketplace software to upload materials available and wishlists, and pursue transactions. Some participants quickly became "power users", making full use of the software's functionality, while for others, the learning curve has been a challenge. As noted above, the project team will be creating better training materials to help get all participants up-to-speed.

Most participants appreciated weekly email updates on the program, materials available and materials desired prepared and sent by the project team. Making time to log into the marketplace software can be difficult for many users, so additional channels of communication proved helpful.

Participants have also requested a mechanism to "learn more" about a material from the material owner before entering into a transaction. This is especially important for complex materials like chemical by-products. We've added this function to our enhancements list as well.

Data Collection and Trade Facilitation

We spent the first six weeks of the three month summer pilot helping the participant companies understand the uploading process and getting their materials on the marketplace. Many obstacles came up along the way, but in the end most were successful and many extremely skilled and confident in the software and process. In the future, we will be spending more time with the company participants on the first through last stages of the program, helping those who are newer to the program and empowering those who are ready to speed ahead.

Path Forward

The project team has decided to extend the pilot into 2016 to allow time for more opportunities to develop, and for companies that joined late or expressed interest to join the pilot to get engaged. The project team also plans to continue developing our collaborations with solution providers from academia, materials handlers, governments and nonprofits to bring more options to the table for consideration by the participating companies.

The US Materials Marketplace will open participation to a much broader audience in mid-2016, with targeted recruitment focusing on US BCSD, WBCSD and Corporate Eco Forum members not in the pilot, and companies affiliated with other collaborators outlined below. The project team's goal in the US is that by the end of 2016, we will have established a permanent and active Materials Marketplace with at least 100 participating companies.

In parallel, we are working with colleagues at the WBCSD and its Global Network Partners to develop similar materials marketplace projects in other countries with the goal of scaling up and connecting them in a global movement toward a circular economy. Other potential collaborators expressing interest in working with us on global scale up include the European Commission, the G-7 Alliance for Material Efficiency and the Ellen MacArthur Foundation.

Funding

The three organizations leading the pilot implementation funded the pilot, with the US BCSD bearing the majority of costs through company onboarding, materials research and transaction facilitation. In phase two, participants will be asked to make contributions to help offset the costs of operating the marketplace. The central goal in phase two will be to allow more time for companies to experience the value of the marketplace in their business operations. There are a number of long term revenue models, including membership and pay-per-transaction, for example, that will be more fully developed in 2016 during phase two of the pilot.

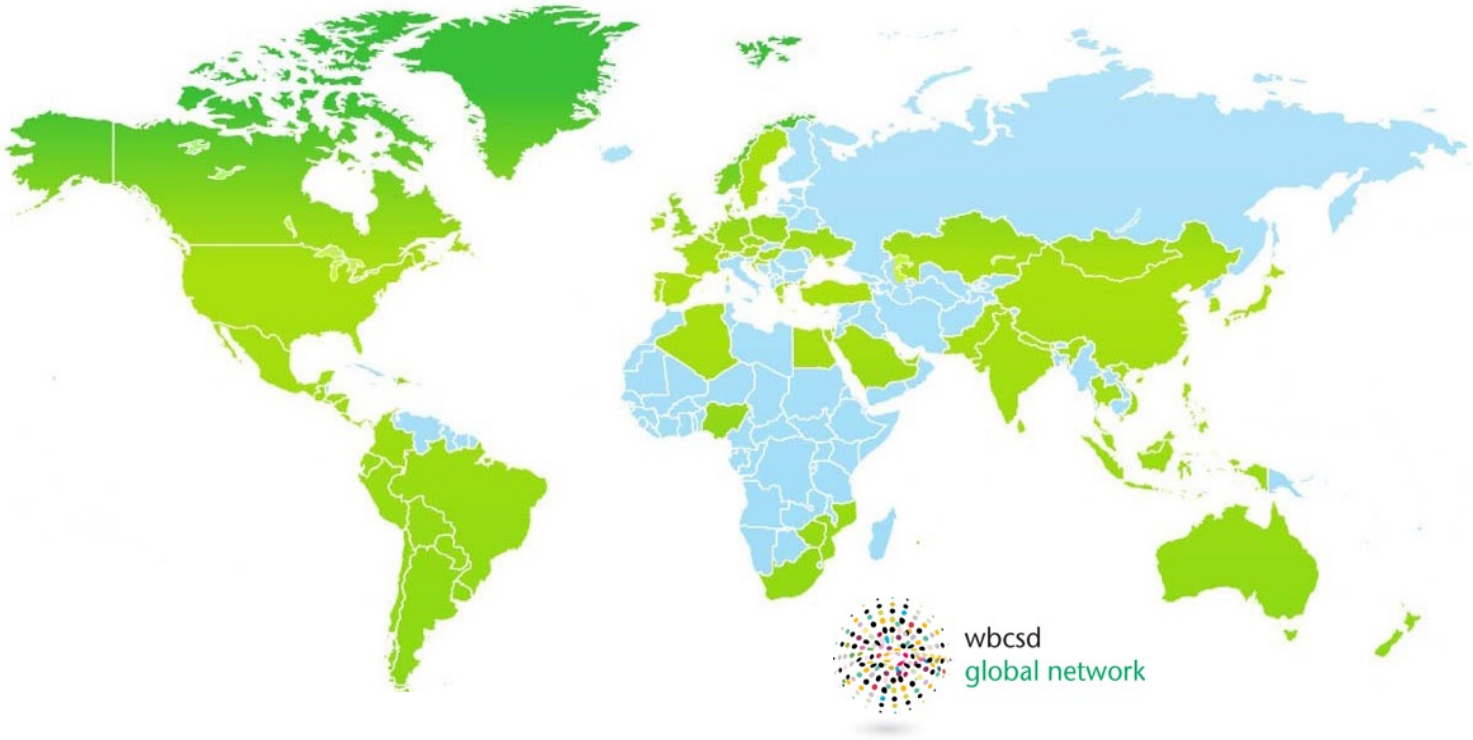
Regional, National & International Collaboration

Since 1995, the US BCSD has worked in more than a dozen city and state-level by-product synergy networks in North America, the United Kingdom and China. Each of these regional projects - examples highlighted below - share similar objectives, including landfill diversion, positive environmental impacts, economic development, and local business engagement on zero-waste objectives. We see an opportunity for collaboration between regional and national projects in both the United States and around the world.

To this end, we're designing a cooperative model in which regional marketplaces join the co-op under agreement to share outcomes with other co-op members, and in return gain access to marketplace activities from other regions. This nonprofit system allows for city-level, state-level and national-level participation and information exchange between each type of project. As other countries implement their own marketplace programs, this co-op structure will connect them with others in the network while allowing them to retain control and ownership of their country's data and activities. The co-op approach should allow for growth and increase knowledge exchange about what is working, what's not, policy developments that help accelerate the marketplace and those that are in the way. The system will be inclusive and not exclusive.

WBCSD Global Network

The WBCSD Global Network of 70 national business councils offers a natural growth path to scale the marketplace system internationally and link it globally through the same cooperative structure that would allow for national ownership and responsibility for each marketplace, while simultaneously committing to share results and outcomes with all other co-op countries. Countries in green have active national business councils.



Select US BCSD Regional Projects

austin materials marketplace

Geographic Scope: Travis County, Texas

Timeline: August 2014 to Present

120+ Users	30+ Trades	~264 $MTCO_2E$ Avoided	$60505 Saved or Created

Greater Houston By-Product Synergy Project

Geographic Scope: Houston, Texas

Timeline: 2010 to 2013

20+ Users	Multiple Trades	~19,000 $MTCO_2E$ Avoided	$4.5mil Potential Economic Impact

ROC DETROIT

Geographic Scope: Greater Detroit, Michigan

Timeline: September 2014 to Present

100+ Engaged	Trades TBD	MTCO2E Avoided TBD	Value TBD

Ohio By-Product Synergy Network

Geographic Scope: Central Ohio

Timeline: October 2009 to Present

30+ Users	Multiple Trades	~230,000 $MTCO_2E$ Avoided	$3.5mil Potential Economic Impact

Front Range Synergy Network

Geographic Scope: Denver, Colorado

Timeline: July 2015 to Present

Project In Development - Metrics To Be Determined

Tennessee Materials Recovery Network

Geographic Scope: State of Tennessee

Timeline: Q1 2016 Launch

Project In Development - Metrics To Be Determined

Established and Potential Collaborators

The United States Materials Marketplace pilot project has received overwhelming interest from organizations, government entities and academic institutions around the world. It's been very clear from the beginning that the end goal - a global transition to a circular economy - will require a strong, well-aligned and collective effort from business, government, thought leaders, educators, and on-the-ground implementers.

The Materials Marketplace provides an easily deployable and scalable business solution that is putting companies on the path to circularity. But as a part of the broader objective, we're fully committed to collaborating with other organizations to ensure complementary strengths, ideas and solutions are brought to the table as well. Here are a few collaborators the project team has been in touch with during the span of the pilot project:

US EPA: Collaborative discussion on sustainable materials management with the US EPA's Office of Solid Waste and Emergency Response started early on in the pilot project timeline. Through this collaboration, representatives of the project team are active members in the G7 Alliance on Resource Efficiency. The marketplace project also creates a safe space for both businesses and EPA representatives to inform policy to more effectively promote materials reuse. More technical collaboration is also on the table, for example, developing built-in integration of EPA's WARM model to the materials marketplace software for easy calculation of greenhouse gas reductions.

US State Department and US Department of Energy: Officials in both departments are excited to see how the Materials Marketplace software - as a direct descendant of our US-China EcoPartnership project - can begin fueling the United States economy's pursuit of sustainable growth. The marketplace project has been recognized for its contribution to the US-China environmental collaboration, and the potential energy efficiency benefits and positive climate change impacts align well with the Department of Energy's objectives. As a result, both departments have expressed their support in project promotion and have put us in touch with a number of companies interested in getting involved.

Yale University and The Ohio State University: These two academic institutions are natural collaborators for this project and would be in the vanguard of what could grow into an international network of academic collaborators. Both are thought leaders in industrial ecology, and leaders in the connection between real-world business application and cutting-edge academic research. The project team has been interacting closely with the Yale Center for Industrial Ecology and The Ohio State University's Engineering School for assistance with technical analysis of materials data, reuse opportunity identification, and detailed feasibility studies.

National Recycling Coalition: The National Recycling Coalition is a nonprofit organization focused on promoting and enhancing recycling in the United States, and has a network of more than 6,000 members working in the waste reduction, reuse, recycling, and composting space. The reality is that not all materials in the Materials Marketplace are applicable for business-to-business reuse. Materials with sporadic and inconsistent availability, low quantities, and unusual qualities may be better utilized by smaller regional players. The National Recycling Coalition's network will allow us to tap into these solution providers when direct Materials Marketplace connections are non-existent.

Ellen MacArthur Foundation: The Ellen MacArthur Foundation's mission is to accelerate the transition to a regenerative, circular economy. As a global thought-leader, EMF can be largely credited with bringing the circular economy to the forefront of discussions around the world, including through the Circular Economy (CE) 100 platform, which brings together leading global companies and emerging innovators. Recognizing the potential for collaboration, EMF invited the project team to present the US marketplace pilot methodology and preliminary results to CE100 companies in October 2015 in Milan, and we are actively exploring ways to work together as we head into the second phase of the pilot.

Acknowledgements

This project would not have been possible without the commitment of the three business organizations leading it, each of which found strong reasons to join as a coalition to make it happen. Special thanks go to Amy O'Meara with the Corporate Eco Forum, Andrea Brown and Brendan Edgerton with the World Business Council for Sustainable Development and to their members and colleagues who helped set the stage for this historic collaboration.

Key United States Business Council for Sustainable Development staff contributing directly to the implementation and organization of the marketplace pilot are Daniel Kietzer and Rui He, without whose commitment and leadership the project would not have made it off the ground. And to Andrew Mangan, founder of the US BCSD, and his 20-year commitment to making material reuse a standard business practice; and to all of his mentors and their thought and action leadership capabilities and skills.

Co-champions of the project, John Bradburn with General Motors and Kevin O'Donnell formerly with Nike, were critical to gaining momentum at the start of the project and contributed greatly to its substance and outcomes.

Skilled staff engagement from the pilot project participants was equally essential:

Disclaimer

This publication is released in the name of the US Business Council for Sustainable Development (US BCSD), World Business Council for Sustainable Development (WBCSD), and Corporate Eco Forum. This document, and the action plans within it, are the result of a collaborative effort between the US BCSD, WBCSD, Corporate Eco Forum and representatives from companies participating in the United States Materials Marketplace. A wide range of project participants and collaborators reviewed the material, thereby ensuring that the document broadly represents the majority view of the project. It does not mean, however, that every company within the project agrees with every word.

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