U.S. EPA

America Recycles

Voice of the Recycling Industry™

Institute of Scrap Recycling Industries, Inc.

KEEP AMERICA BEAUTIFUL

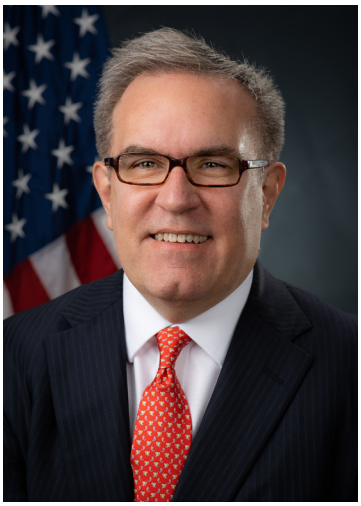
SWANA
SOLID WASTE ASSOCIATION of North America

THE RECYCLING PARTNERSHIP

America Recycles: Innovation Fair Exhibitor Booklet

NOVEMBER 2019

LETTER FROM THE ADMINISTRATOR



Welcome to the 2019 America Recycles: Innovation Fair! We are excited to showcase innovations that span the recycling system: from research, to education and outreach, to innovative processing technologies and products. This first-ever innovation fair features entrepreneurs from across the recycling system showcasing their innovative products and research.

Exhibitors include not-for-profit organizations, small businesses, Fortune 500 companies, municipalities and local governments, recyclers, technology providers and many others.

Organizations are using innovative technologies and practices throughout America's recycling system to increase composting; to reduce food and plastic waste; to increase glass, furniture, and plastics recycling and reuse; and much more.

Please make your way around the foyer and the exhibit hall to see sorting robots that employ artificial intelligence to automate the sorting and processing of material streams, and meet local-area students with a passion for environmental protection proposing a reusable take-out container program. You will see products reusing materials, and ways to better reclaim valuable materials. There are also many innovative educational and outreach campaigns, all of which help to improve recycling across our country.

America Recycles Day®, a Keep America Beautiful national initiative, is the only nationally-recognized day dedicated to promoting and celebrating recycling in the United States. Each year, on the day and in the weeks leading up to November 15, thousands of communities and organizations across the country participate by promoting environmental citizenship and taking action to increase and improve recycling in America.

In addition, EPA invites U.S.-based organizations to sign EPA's America Recycles Pledge. We encourage your organization to join others that have signed the pledge to work toward a more resilient materials economy. Visit: www.epa.gov/americarecycles to take action with other pledge signers to improve America's recycling system.

EPA thanks our co-sponsors for this event, the Institute of Scrap Recycling Industries, Keep America Beautiful, the Solid Waste Association of America and The Recycling Partnership. This event reflects their contributions and support.

Sincerely,

Andrew R. Wheeler

DISCLAIMER

These exhibits and descriptions are for informational purposes only. U.S. EPA does not endorse any of these entities, products, nor their services.

Exhibitors were selected based on their applications' narratives describing how their innovations addressed the evaluation criteria: impact, scalability, financial feasibility, and life-cycle approach. Additionally, selected exhibitors have been grouped in the categories below to assist you in locating exhibits of interest to you.

Category 1 - Concepts, prototypes, or products made completely of recycled content

Category 2 - Technologies, designs, or measurement strategies that promote more effective recycling

Category 3 - Research that advances recycling systems or infrastructure

Category 4 - Innovative materials and products that can be recycled more effectively

Category 5 - Innovative education and communication methods or materials that promote more effective recycling

Exhibitor List

America Recycles: Innovation Fair Co-Sponsors

Institute of Scrap Recycling Industries, Inc.

Keep America Beautiful

Solid Waste Association of North America

The Recycling Partnership

Exhibitors

AMP Robotics

AXION

Berry Global

Colgate

Continuus Materials

Critical Materials Institute, Ames Laboratory

CTC Foundation

District of Columbia's Department of Public Works

Don't Waste Durham

Eco Teen Action Network's Plastics Hub

EcoRich

End of Waste Foundation

First Solar, Inc.

Food Rescue

GO Box

Hallotex

Igloo RECOOL

Interior Removal Specialist

Keurig Dr Pepper

Machinex

MariMatic Oy

Maryland Environmental Service

Materials Recovery for the Future

Mattress Recycling Council

MSW Consultants

Nestlé Waters North America

Pennsylvania Recycling Markets Center

Plastics Industry Association

PourAway

ReCell Center

Recycle Across America

Recycle Coach

RecycleGO

Recyclist

RePolyTex LLC

Revolution

Revolution Systems

SCRAPP

Titus MRF Services

U.S. EPA Small Business Innovation Research

Van Dyk

Official Co-Sponsors of the America Recycles: Innovation Fair

Category 5: education/communication

Institute of Scrap Recycling Industries (ISRI): Safe, economically sustainable, and environmentally responsible recycling through networking, advocacy, and education, isri.org

Institute of Scrap Recycling Industries (ISRI) is the Voice of the Recycling Industry™. ISRI members collect, transport, process and broker valuable, specification-grade recycled commodities used as raw materials by manufacturers around the globe, including steel mills, foundries, paper mills, consumer-packaged goods producers, and plastics formulators. Last year, ISRI's members processed 138 million metric tons of materials that are economically competitive and environmentally friendly manufacturing feedstock alternatives to carbon-intensive virgin materials.

Successful recycling requires market demand. ISRI is actively working with brand owners, manufacturers, engineers and designers to promote the use of recycled content in their products, as well as the recyclability of those products at the end of their life. Launched more than 30 years ago, the ISRI Design for Recycling® initiative encourages manufacturers to consider the ultimate destiny of their products during the design stage of a product's development.

Category 5: education/communication

Keep America Beautiful: Three innovative recycling initiatives launched in 2019, kab.org Keep America Beautiful annually sponsors America Recycles Day on November 15.

America Recycles Day (ARD) is a collaborative effort of businesses, organizations, and individuals to collectively promote and celebrate the benefits of recycling. Across the nation, recycling collection events are held to encourage individuals to become everyday recyclers. KAB encourages innovation fair participants to sign the individual pledge and commit to recycling. KAB is showcasing three innovative recycling initiatives launched this year. The first is a partnership to provide recycling infrastructure and messaging at playground builds in underserved neighborhoods across the United States. The second is an innovative program to collect 50 and 100ml bottles. Such miniature plastic bottles are a commonly littered item and due to their size, represent recycling challenges when collected as mixed recyclables. KAB is launching a collection project in communities throughout Massachusetts to collect and potentially recycle these containers. Finally, KAB is showcasing the KAB Stand for the Land program, which has distributed 10,000 cigarette butt collection stands. The program includes a partnership with TerraCycle to recycle the collected cigarette butts, turning the plastic recycled from the filters into usable products.

Category 5: education/communication

Solid Waste Association of North America: Educating the public about recycling through education, advocacy, and research, SWANA.org/Recycle

The Solid Waste Association of North America (SWANA) is an organization of more than 10,000 public and private sector professionals with the core purpose to advance the responsible management of solid waste as a resource. Through education, advocacy and research, SWANA has supported municipal solid waste leaders and their private sector partners, informed local, state and national leaders of the value of recycling and how to support it and helped to guide the national narrative on recycling. One of the biggest challenges facing recycling over the past two years has been the proliferation of misinformation about the state of the recycling industry and the perceived futility of making change. SWANA has developed resources to help correct that view, such as a "Myths vs. Facts" one-pager that succinctly refutes some of the most commonly asserted myths about recycling.

Category 5: education/communication

The Recycling Partnership: Non-profit that leverages corporate funding to transform recycling, recyclingpartnership.org

The Recycling Partnership is a national non-profit organization that leverages corporate partner funding to transform recycling for good in cities and towns all across America. As the only organization in the country that engages the full recycling supply chain from the corporations that manufacture products and packaging to local governments charged with recycling to industry end markets, haulers, material recovery facilities, and converters, The Recycling Partnership positively impacts recycling at every step in the process.

The Recycling Partnership has served more than 1,300 communities with tools, resources and technical support, helped place nearly 600,000 recycling carts, reached 60 million households, and helped companies and communities invest more than 55 million dollars in recycling infrastructure.

Exhibitors

Category 2: technologies

AMP Robotics™: Advanced artificial intelligence guided robotics, amprobotics.com

AMP Robotics™ is transforming the economics of recycling using advanced artificial intelligence (AI) guided robotics. The company's high-speed industrial robotics system, AMP Cortex™, precisely automates the identification, sorting and processing of material streams to extract maximum value for businesses that recycle municipal solid waste, electronic waste (e-waste) and construction and demolition materials. The AMP Neuron™ AI platform operates AMP Cortex using advanced computer vision and machine learning to continuously train itself by processing millions of material images within an ever-expanding neural network that experientially adapts to changes in a facility's material stream. AMP Insights™ captures material stream data providing insights and important alerts via a web-based application for operators so they can optimize their recycling processes even further.

Category 1: recycled products

AXION: Composite rail ties and construction products sourced from waste, axionsi.com

Axion Structural Innovations LLC ("AXION") engineers, manufactures and markets ECOTRAX® composite rail ties and STRUXURE® composite construction infrastructure products, such as heavy-lift crane foundations. AXION's products use 100% recycled polymers and polymer composites. The recycled polymer raw materials for AXION's products are sourced from high-quality post-consumer and engineered post-industrial waste streams that would otherwise be sent to landfills. AXION's products provide improved long-term value, superior performance, consistent properties over time, reduced maintenance costs, and feature a closed-loop life cycle in comparison to conventional materials.

Category 4: innovative materials

Berry Global: Sustainable packaging solutions, berryglobal.com

Berry is focused on providing packaging solutions which deliver on sustainability without sacrificing on performance. As a longstanding leader in packaging, Berry has the expertise to deliver on this promise. Examples of this execution include recyclable, high-performing films, substrate conversions to reduce greenhouse gas emissions, increased use of post-consumer recycled content in packaging, and lightweight options across packaging lines. Recent advancements include Verdant: a complete line of packaging for personal care which contain between 25-100% post-consumer recycled content, many of which are also recyclable; Entour: high-performing, recycle-ready flexible films for packaging; and Versalite: a widely recyclable cup for foodservice which has thermal management properties similar to expanded polystyrene (EPS) foam.

Category 4: innovative materials

Colgate: Recyclable toothpaste tube, colgatepalmolive.com

As part of Colgate's efforts to have all products use recyclable packaging by 2025, the company has developed a recyclable toothpaste tube, and is also working with The Recycling Partnership and other stakeholders to address industry acceptance of tubes in the high-density polyethylene (HDPE) bottle stream. The new tube, which took five years to develop, will roll out in the United States beginning late this year under its natural products brand, Tom's of Maine.

A global leader in toothpaste, Colgate recognized the need to address the problem of toothpaste packaging recyclability. Most toothpaste tubes are made from sheets of different plastics, often sandwiched around a

thin layer of aluminum that protects the toothpaste's flavor and active ingredients; however, it is impossible to recycle through conventional methods. As a result, over 25 billion toothpaste tubes are landfilled or are not managed properly. Colgate's new recyclable tubes will debut across its brands and regions within the next five-and-a-half years.

Category 1: recycled products

Continuus Materials: Composite building material from mixed paper and plastic, continuusmaterials.com/

The Continuus Materials company's recovery and upcycling platform is a large-scale closed loop solution that can lead the implementation of broad-scale circular economies in the U.S. and around the world. Continuus produces an engineered composite building material from a proprietary blend of plastic and cellulose fiber, sourced from post-industrial and post-consumer waste streams called EVERBOARDTM. This proprietary system recovers and separates materials that are pervasive, broadly used and problematic - the mixed papers and plastics that by virtue of their highly engineered nature are almost impossible to recycle from the broader waste and recycling streams. Economic benefits are two-fold. One, EVERBOARD is competitively priced with construction boards like gypsum and oriented strand board that are the primary materials used in building construction. Two, by using the "fluff" from materials recovery facilities, this product will reduce landfill costs and space.

Categories 2: technologies, 3: research

Critical Materials Institute, Ames Laboratory: Acid-free hydrometallurgical process for recovering rare earth elements from e-wastes, cmi.ameslab.gov

This technology is a novel acid-free hydrometallurgical process for recovering rare earth elements (REEs) from electronic wastes (e-wastes). Unlike acid-based processes, this innovative technology employs oxidative dissolution to leach REEs from e-wastes using a water-based neutral solution of copper (II) salts. A unique feature of the technology is selective acid-free dissolution of REE-bearing alloys in e-wastes.

This technology offers an easily-deployable process for recycling REEs, reducing reliance on mining. It offers clear opportunities for significant revenue generation and eliminates the need for supplies, containment, and disposal of hazardous acids, while resulting in 99.9% pure REEs and 98% efficiency. Applied to e-wastes, the process selectively dissolves REE metals, leaving other valuable components for further recycling. Reinsertion into the supply chain has been demonstrated by using the recycled REEs to make new products.

Categories 2: technologies, 3: research

CTC Foundation: High-temperature gasification of unsorted plastics to yield a syngas, ctcfoundation.org

Cumulatively, 8.2 billion tons of all kinds of plastics have been produced from 1965 to date, with current annual world production of 335 million tons expected to quadruple by 2050. Overall, only 9% of plastics are recycled, and 12% are incinerated, with the remaining 79% entering landfills or oceans. Using conventional steelmaking high-temperature technology can thoroughly transform all unsorted plastics into a very pure synthesis gas, or syngas, which is a combination of hydrogen, carbon monoxide, small quantities of carbon dioxide and other trace gases and has 50% of the energy density of natural gas. It cannot be burned directly, but it can be used as a fuel source or to produce other chemicals. The gasification process is sustainable since a new product is created from a waste stream; it is non-polluting; and nothing goes to the landfill.

A circular model requires innovation, a shift from fossil fuels to recurrently available, sustainable inputs. This end-of-life solution -- high-temperature gasification -- yields a syngas that is usually lower cost than conventional fuels for making plastics. Almost nine million dollars from private and public sources have been

invested into this technology. The most recent pilot proved that REEs could be extracted from coal fly ash. Funding a demonstration is the logical next step for this high-temperature technology that will ultimately be commercialized. Since this technology is based on modified steel industry electric arc furnaces, the volumes that can be processed can be as high as 100 tons per hour, and there is no engineering limitation on size.

Categories 2: technologies, 5: education/communication

District of Columbia's Department of Public Works (DPW): Waste Less, Recycle More outreach campaign, zerowaste.dc.gov

The District of Columbia's Department of Public Works (DPW) proactively implements innovative education and outreach strategies to reduce contamination, improve the quality of recyclables, and increase the volume of collected recyclable materials. In FY 2018, DPW introduced foodservice packaging to the list of materials accepted for recycling and rolled out a multi-media "Waste Less, Recycle More" outreach campaign, which resulted in a nearly 10% increase in the volume of recyclables collected and an 8% decrease in contamination. This year, DPW will begin visually inspecting recyclables at its transfer station, reclassifying contaminated portions of recyclables loads as trash, and using intelligence gained to implement targeted tagging and outreach campaigns. Combining screening and tagging has the potential to assist DC and other communities to implement contamination outreach strategies in a targeted, cost-effective way and increased delivery of higher quality recyclables to MRF partners.

Categories 2: technologies, 3: research

Don't Waste Durham: Demonstrating the role of technology in the advancement of recycling, dontwastedurham.org

Don't Waste Durham creates solutions to shift society to the mainstream use of reusable packaging. The ReCirc project shows how durable, Internet of Things (IoT)-enabled containers intended for reuse can travel through the city's recycling infrastructure to be sorted out for wash/sanitization, redistributed back to companies, and reused. The city identifies adaptations that are necessary to existing infrastructure to make this logistically possible and to the value chain to make this profitable for manufacturers, MRFs, and municipalities. ReCirc uses technology to incentivize the recovery of materials through IoT/applications, and it uses robotics and AI to sort through waste, so the project has the potential to improve efficiency in Solid Waste Management departments, provide cost savings and/or earnings to the local government and business community, and advance city and county strategic plan objectives. The ReCirc project is a partnership between Don't Waste Durham, the City of Durham, Sonoco Recycling, and technology sponsors Trilliott and Impinj.

Category 5: education/communication

Eco Teen Action Network's Plastics Hub: Teen-led project of the Smithsonian Conservation Commons and the Global Co Lab Network that is proposing a reusable take-out container program in the DC-Maryland-Virginia (DMV) area, styrofoammom.com/eco-teen-action-network-proposes-reusable-to-go-box-for-national-landing/

The Plastics Hub is working with mentors and supporters to propose a reusable take-out container program in the DMV region, starting with the National Landing development – future home of Amazon and Virginia Tech. The Network presented its proposal to JBG Smith, Crystal City Business Improvement District, and BMS on July 16, 2019 to positive interest from all parties in pursuing this project.

The implementation of a reusable to-go container system aligns with the top action of the U.S. Environmental Protection Agency's "Waste Reduction Hierarchy" under source reduction and reuse. This system would complement National Landing and its unique location and qualities, which could then serve as a replicable model for expansion to other locations across the region and beyond. The urban atmosphere, brimming

with new restaurants, recreational spaces and apartments, provides the ideal framework for a reusable to-go box system. It would connect the rapidly growing community around a deep appreciation for sustainable development and serve as a catalyst for other sustainable initiatives. The teens envision that this subscription-based system could become as much of a necessity as a metro card.

Category 2: technologies

EcoRich: Industrial composters that can be used in on-site composting on a large scale, ecorichenv.com

The EcoRich Elite II line of composters were designed for commercial kitchens and are capable of recycling anywhere from 25 to 4000 pounds of food waste in one 24-hour cycle. Each feature included with this machine is specifically designed to minimize labor and maximize output. Operation is simple: the user simply drops the food waste into the chamber and touches "start cycle." Unloading is just as easy, only requiring the user to touch "remove compost" with a collection bin ready to catch the falling compost. The process is fully aerobic, deploying special bacteria in a controlled environment to break down the waste and transform it into compost. With EcoRich composters, each load of organic material is reduced in volume by up to 90%. This allows clients to effectively minimize the damaging effects of transporting their food waste with many large trucks. This saves the user money while also limits the use of fossil fuels. The EcoRich Elite II series is an ideal way to practice on-site composting on a large scale.

Category 2: technologies

End of Waste (EOW) Foundation: Uses blockchain technology to subsidize losses for MRFs and glass processors through contributions by environmentally-conscious businesses and consumers, endofwaste.com

The state of glass recycling in its current iteration is not economically or environmentally sustainable. Currently, the value of cleaned and sorted glass cullet is approximately 35 dollars per ton, while it costs nearly 70 dollars per ton to haul and process the material into acceptable manufacturer specifications. In this economic climate, it's simply more cost effective to throw glass into a landfill rather than process the material for future use. This one-way stream creates numerous environmental problems and is not an efficient use of natural resources or energy. In order to address the economic losses associated with glass recycling and give manufacturers the opportunity to source local cullet, EOW has created a revolutionary new business model that relies on proprietary blockchain technology and distributed shared responsibility (DSR). This works by subsidizing losses for MRFs and glass processors through contributions made by environmentally-conscious businesses and consumers. Currently, 80% of contributions are used to offset negative costs associated with glass recycling and research and development. This entire process makes glass recycling profitable again for industry stakeholders.

Category 4: innovative materials

First Solar: Enabling a circular economy through high-value recycling for thin-film photovoltaics, firstsolar.com

As one of the cheapest sources of new energy generation, photovoltaics (PVs) have emerged as a leading way to tackle climate change. Developing PV recycling infrastructure will be key to ensuring that today's clean energy solutions do not pose a future waste burden. First Solar, the largest solar manufacturer in the U.S., established the industry's first global recycling program. First Solar designs its thin-film PV modules for high-value recycling to maximize resource recovery at end-of-life, resulting in both virgin material and energy savings. More than 90% of a First Solar module can be recovered for reuse in new modules, glass and rubber products. The company's third-generation recycling technology achieves superior glass and semiconductor purity using 30% less capital, chemicals, waste and labor. With greater economies of scale, PV recycling could become more economical than landfill with the recoverable value exceeding 15 billion dollars by 2050.

Categories 2: technologies, 5: education/communication

Food Rescue: A tool that helps students log, personalize, and prevent food waste, foodrescue.net

Imagine calculating school food waste preservation data instantaneously with a graphic that includes a photo of the student food waste warrior, along with the amount of meals their work preserved, and number of pounds of carbon dioxide equivalents that have been prevented from entering the environment as a result of their work -- all in less than 30 seconds. The K-12 Food Rescue Story Graphic Log Tool does exactly that. It allows students who are leading food waste prevention initiatives in their schools to connect with the impact of their work on a deeper level. The tool converts rescued pounds of food or food items into meals preserved and carbon dioxide equivalents prevented. The tool also allows students to take a picture in real time as they enter their food waste data, and it uses facial recognition technology to place their image into the graphic.

Each entry creates its own story to market within a school district, community, state, and nation. Data is the gold standard of not-for-profit work, but personalized data in the form of a story is even more valuable for its ability to motivate behavior change. The tool is already designed and free to use. Students and schools just need to generate their own link to begin making entries.

Categories 2: technologies, 5: education/communication

GO Box: User-friendly software and durable hardware that empowers food vendors and their customers to choose reusables that eliminate single-use plastic containers and cups, goboxpdx.com

The mission at GO Box is to empower reuse systems that eliminate single-use plastic waste. The company is working to change the single-use status quo with a simple, circular system of user-friendly software and durable hardware that empowers food vendors and their customers to choose reusables that eliminate single-use plastic containers and cups. Enjoying food and drink to-go shouldn't come with a side of environmentally harmful packaging.

Launched in 2011 in Portland, Oregon, GO Box was the first public reuse system in North America. GO Box continues to lead the growing reuse industry, providing access to clean, durable and sustainable food and drink ware to nearly 4,000 subscribers and 140 food vendors across its systems in Portland and the San Francisco Bay area. GO Box has already helped to eliminate over 226,000 single-use containers and cups.

Categories 1: recycled products, 2: technologies

Hallotex: Collects old textiles, shreds the garments and upcycles garments currently viewed as waste into new textile fibers, theloop.hallotex.com

The Loop™ recycles used garments, textile waste, and obsolete inventory, and turns them into new yarns. The yarns that Hallotex produces are turned into new clothing, extending the life cycle of fibers, avoiding apparel waste, and reducing the environmental impact of producing garments. The company's hope is to support new business models that focus on waste management and circular production through the licensing of its technology, or investment in re-creating factories in other places where the need is evident. The garments Hallotex produces are more durable than most recycled garments, due to its ability to preserve the length of recycled fibers in the shredding process. Less than one percent of all clothing collected is recycled into new textile fibers. The Loop technology actively reduces the amount of virgin materials five to 20%, increases the reuse and recycling of textile waste, and reduces greenhouse gas emissions 40-60% per garment.

Categories 1: recycled products, 4: innovative materials

Igloo RECOOL: World's first cooler made from biodegradable materials, igloocoolers.com

RECOOL, by Igloo, is an environmentally sensitive alternative to harmful single-use EPS foam coolers. Drinks and food stay fresh and chilled on the go. RECOOL keeps ice for 12 hours and will retain water for up to five days. It is totally reusable, won't chip or break apart, can hold up to 75 pounds, and doesn't make those annoying squeaks. EPS (resin code #6), commonly known as Styrofoam, is a petroleum-based plastic used to make single-use coolers, food service containers, egg cartons, clamshells, and packaging peanuts. EPS foam is nearly impossible to recycle, and it doesn't break down in the environment. It's estimated that 25 billion EPS products are disposed of each year in the United States alone. Seventy-nine percent of plastic waste ends up in landfills or in the natural environment. In the ocean, it breaks down into microplastic particles that are ingested by marine animals, negatively impacting the food chain from sea creatures to humans. Importantly, once a RECOOL cooler has completed its useful life, it can be recycled, biodegraded, or composted – all options the single-use EPS products cannot achieve.

Categories 2: technologies, 5: education/communication

Interior Removal Specialist: Furniture removal and recycling program, irsdemo.com

To keep office spaces looking fresh, many tenants in high-rise buildings move every five to seven years. Rather than have their staff work in a construction zone, they simply rent, build out, and furnish a new space, and then move the staff when it is ready. The older furniture and fixtures generally end up in the landfill. Interior Removal Specialist, Inc. is a commercial interior demolition contractor, waste hauler, and recycling facility operator with a repeatable program to help stop this waste.

Because of their control of the waste stream, IRS Demo transports, warehouses, and donates 30 to 60 tons of reclaimed materials worth tens of thousands of dollars every month. These materials go to any non-profit agency that can use them. This helps the community while decreasing the company's landfill fees.

Categories 3: research, 4: innovative materials, 5: education/communication

Keurig Dr Pepper: Recyclable K-Cup® pods, keurigdrpepper.com

In Keurig Dr Pepper's ongoing efforts to design, source, and manufacture products in support of a circular economy, the company is committed to making 100% of its K-Cup® pods recyclable by the end of 2020. To make K-Cup® pods recyclable, Keurig Dr Pepper had to rethink the design with a second life in mind. The original single-serve coffee pod is made with polystyrene, which has limited recyclability. By redesigning the pod to use polypropylene (#5 plastic), the company is enabling a more circular flow of materials where the value drives reuse: the coffee grounds can be composted, the used containers collected and recycled, and the reclaimed material used to produce plastic bins, pallets, outdoor furniture, and more.

Keurig Dr Pepper's holistic approach to supporting the circular economy encompasses its products and operations, the recycling industry and many working to improve it, leverages partnerships, and aspires for continual transparency and innovation. The recyclable K-Cup® pods carry the How2Recycle label to educate consumers on "recycle right" behaviors.

Category 2: technologies

Machinex: SamurAI®, a sorting robot that employs artificial intelligence to identify materials, machinextechnologies.com

For over 35 years, Machinex has been developing innovative technologies to design and deliver custom-made sorting and recycling solutions for Material Recovery Facilities. The latest technology launched by the company is the SamurAI™, a self-aware sorting robot that employs superior artificial intelligence technology

to identify materials for accurate, fast and relentless performance. The sorting robot is a crucial technology to solve the material purity crisis and meet the market requirements, while reducing the dependence on the workforce in recovery facilities. The SamurAI™ directly contributes to a flourishing circular economy by sorting the material so precisely, the purity can reach 100%. By integrating a robotic sorter employing Artificial Intelligence, the facility operator can now base decisions on reliable, real-time data coming from the MRF. Machinex also offers a full range of high-quality recycling equipment to efficiently sort the commingled recyclables, such as Optical Sorters, Ballistic Separators, Disc Screens Separators, Balers, Trommels, Glass Cleanup Systems, Conveyors, and much more.

Category 2: technologies

MariMatic Oy: Pneumatic waste collection system – collects waste via vacuum through underground pipes, metrotaifun.com/automatic_solid_waste_collection_system/en/

MariMatic Oy demonstrates the convenience of using the unique process of Pneumatic Waste Collection (i.e., PWC: collecting waste using vacuum through underground pipes), which has had a very positive impact on waste recycling and, in particular, recycling systems in the U.S. The PWC system allows access to waste recycling inlets in the immediate area and operates 24 days a week/365 days a year, which dramatically increases the possibility that residents are willing to adopt a permanent recycling mentality. This produces a very positive response compared to other existing less convenient, less clean and less logical systems.

Categories 2: technologies, 4: innovative materials, 5: education/communication

Maryland Environmental Service: Variety of innovative and effective recycling programs, menv.com

Maryland Environmental Service (MES) is an independent, self-supporting state agency that enhances and protects Maryland's environment through innovative solutions to the region's most complex environmental challenges. With more than 1,000 projects in the Mid-Atlantic Region, MES is at the forefront of environmental management solutions. From the reuse of dredged material for habitat restoration to the operation of recycling facilities, MES provides a variety of innovative and effective recycling programs for Maryland residents.

Category 3: research

Materials Recovery for the Future (MRFF): First curbside recycling pilot program in U.S. to research flexible plastic packaging with other single-stream materials, materialsrecoveryforthefuture.com

The MRFF program provides leading members of the flexible plastic packaging value chain an opportunity to collaborate through a shared vision and a focused research program to recover rather than landfill the evolving ton of packaging. Flexible packaging sustainability benefits include lighter weight, use of less material, and reduced food waste. It is one of the fastest growing consumer packaging formats, twice the size of traditionally recycled plastic like polyethylene terephthalate (PET). Currently, in North America, flexible packaging is not typically accepted in curbside recycling programs. MRFF has launched the first curbside recycling pilot demonstration in the U.S. to research removing flexible plastic packaging from paper and making a new feedstock for post-consumer recycled (PCR) building materials and consumer products. The 2019 equipment upgrade at the TotalRecycle MRF in Birdsboro, PA serves as a living laboratory to identify the best way to collect, sort, and manufacture new PCR products from flexible packaging, improving the quality of both paper and plastic bales available for domestic end market manufacturing.

Categories 2: technologies, 3: research, 4: innovative materials, 5: education/ communication

Mattress Recycling Council (MRC): Recycling 1.5 million mattresses a year through Bye Bye Mattress program, MattressRecyclingCouncil.org

In the U.S., an estimated 15 million mattresses are discarded every year, or an average of 50,000 per day. More than 80% of mattress components can be recycled, diverting valuable resources from local landfills. More than 1.25 million mattresses are recycled by MRC annually.

MRC is a non-profit organization formed by the mattress industry to operate recycling programs in the U.S. in states that have enacted mattress recycling laws. The program is currently running in Connecticut, California and Rhode Island. Each state's program is funded by a recycling fee collected when a mattress or box spring is sold. MRC invests in research to identify new end markets to increase recycling rates, improve the efficiency of used mattress collection and to help MRC's recyclers increase their profitability by identifying mattress dismantling and recycling best practices.

Categories 2: technologies, 3: research, 5: education/communication

MSW Consultants: The GAP System: a customizable platform for characterizing recyclables, wasteinsight.net/

MSW Consultants recently developed its Grading and Purity System, (or GAP), a customizable platform for inputting and analyzing recyclables composition. The GAP System is designed to enable uniform and routine recyclables audits, allowing program managers and MRF operators better understanding of the makeup of the recycling stream and contamination levels. This more informed understanding can assist in reducing contamination and allow for more transparent contract pricing.

The GAP System includes sampling methodology development, on-site management, data analysis, as well as equipment such as a portable scale, sorting platform, and tablet computer. It also includes a subscription to MSW's WasteInsight™, cloud-based platform used to upload data and run analyses.

Category 1: recycled products

Nestlé Waters North America: Poland Spring: on track to be the first major bottled water brand in the U.S. to convert its portfolio to 100% recycled plastic, nestle-watersna.com

Poland Spring® Brand 100% Natural Spring Water, America's leading spring water brand, has started the transition to making its 1 Liter and 1.5 Liter still water sizes with 100% recycled plastic, and plans to be the first major bottled water brand to reach 100% recycled plastic across its still water portfolio by 2022. In addition, earlier this year, the brand launched a premium offering, Poland Spring® ORIGIN in 900mL bottles, which are made entirely of recycled plastic. This is part of Nestlé Waters North America's commitment to achieve 25% recycled plastic across its U.S. domestic portfolio by 2021 and 50% recycled plastic by 2025.

Categories 1: recycled products, 3: research

Pennsylvania Recycling Markets Center: The keystone of circular economy, pennrmc.org

The Pennsylvania Recycling Markets Center (RMC) is an independent, Pennsylvania non-profit corporation with mission to reduce or eliminate barriers that lead to new expanded end use of Pennsylvania's recycled materials. The RMC team brings markets development assistance to a near endless list of stakeholders including entrepreneurs, manufacturers, recycled material processors, recycling programs, haulers, and agency officials. In operation since 2005, RMC has an affiliation with Penn State and is headquartered at Penn State Harrisburg with an office in Pittsburgh. Core areas of RMC outreach include feedstock conversion

pairing, applied research and commercialization assistance; technology acceleration; and service as a concierge to technical and business growth information. Building and supporting Pennsylvania's $22.6 billion recycling marketplace, the Pennsylvania Recycling Markets Center bridges relationships between economic development and recycled materials supply. Expediting time-to-market of recycled-content products and related processes, RMC creates circular economy in Pennsylvania.

Category 3: research

Plastics Industry Association: Innovative model for exploring new end market opportunities for recycled plastics, plasticsindustry.org

The Plastics Industry Association has developed an innovative model for exploring and building new end market opportunities (NEMO) for recycled plastics through connecting the plastics supply chain to solve for common challenges. This model has driven impactful projects such as its End of Life Vehicle recycling project, NEMO for film, ground breaking research on recycled plastics in asphalt, and the Pacific Northwest Secondary Sorting Demonstration Project. These projects are advancing the circularity potential of a wide range of plastic products and packaging. The association welcomes everyone's participation in these efforts and aims to use the Innovation Fair as a way to further connect with potential end users of recycled plastics and broaden its reach for cross-supply chain stakeholder engagement in these critical efforts.

Category 2: technologies

PourAway: Liquid recycling system that separates liquids from trash before disposal/recycling, pourawayusa.com

The PourAway liquid recycling system is a state-of-the-art product that gives liquid separation and recycling functionality to trash receptacles. PourAway products provide the convenience of separating liquids from trash when disposing of waste. Systems fit any new or existing 23-gallon Slim Jim/Wall Hugger or 32-gallon Brute trash can. Custom solutions are also available.

PourAway is a two-piece recycling separation system designed with two orifices. The lid and tank are placed in the opening of any trash container. The system is designed with both a chute orifice that can receive waste or recyclables and a catch area for liquid waste. When liquid is poured in the sink area, the liquid is funneled down a drain and stored in a reservoir tank for future disposal. Once the reservoir tank is full, the tank can be removed, and the waste liquid can easily be discarded or recycled by removing a screw cap and pouring the liquid content into a sink/drain or proper recycling container. The solid trash or recyclable material is placed in the trash orifice, and liquid passes directly through the lid and reservoir tank of the receptacle. The solid trash is directed dry into the trash container. Once the trash container is full, an individual can lift off the lid and reservoir tank of the trash receptacle and remove the solid trash from the trash container.

Categories 2: technologies, 3: research

ReCell Center: Advanced battery recycling research and development program, anl.gov

As the number of electric vehicles on the roads increases, so too will the number of batteries from these vehicles that need to be recycled. The current technologies used to recycle these batteries pose a real challenge to the current infrastructure that takes place with end-of-life vehicles today. The Department of Energy's Vehicle Technologies Office has created the ReCell center, an advanced battery recycling research and development program that is a collaboration among Argonne National Laboratory, National Renewable Energy Laboratory, and Oak Ridge National Laboratory to develop technologies that profitably recycle batteries. An economical process is critical to ensure reduced environmental impacts, energy consumption, and the use of limited natural resources while adding jobs. Importantly, recovering these materials in the United States bolsters national security by reducing the need to import these energy materials from other countries.

Categories 2: technologies, 3: research, 5: education/communication

Recycle Across America: Society-wide standardized labels for recycling bins, RecycleAcrossAmerica.org

Referred to by The New York Times as "…one of the top environmental fixes taking root today" and deemed a "world-changing solution" by Ashoka, Recycle Across America has created the first and only society-wide standardized labels for recycling bins to make it possible for people to recycle properly, wherever they are. As an analogy, consider how standardized road signs allow millions of people to drive properly wherever they are, even when the driving rules change from road to road.

With 10 years of proof and millions of standardized labels displayed on bins throughout the U.S., Recycle Across America can confidently assert that this is the number one solution to fix the recycling crisis today. The society-wide standardized labels increase recycling levels 50-400% and often eliminate costly contamination, thereby improving the quality, quantity, cost, and demand for recycled commodities. Recycle Across America has created a society-wide standardized label for every unique recycling system and every bin style.

Category 3: research

Recycle Coach: Recycling education made fun, engaging, and memorable, recyclecoach.com

Recycle Coach is a digital solution empowering local U.S. governments to address a critical recycling issue: contamination. Contamination costs local governments up to $2.0B in lost revenue every year. Curbing contamination starts with educating residents. Recycle Coach Campaigns deliver recycling education in an interactive and fun way – often in under a minute. Each Campaign addresses specific problems with the guidance of Coachlings: four characters who target micro-moments of learning in a dynamic and fun way. With the library of Campaigns regularly growing to cover more topics, the short and sweet Campaigns are key in targeting behaviors that contribute to contamination.

Categories 2: technologies, 5: education/communication

RecycleGO: Distributed ledger platform bringing transparency to recycling, recyclego.com

RecycleGO is providing recyclers with a distributed ledger platform that brings transparency to the current recycling system -- using proof of impact to align incentives for all stakeholders behind the objective of increased diversion rates. For years governments and businesses have had to subsidize recycling and lower their quality standards to motivate consumer participation, only to send this low-quality material through inefficient supply chains. While past technologies have increased profitability, RecycleGO aims to leverage blockchain and other technologies to improve system-wide functionality via increased participation, product quality and sustainability throughout the product's life cycle. By providing a suite of software that records user participation on a decentralized, unbiased ledger, RecycleGO will establish accountability in the recycling system, as well as illuminate achievements and areas for improvement. In this way, stakeholders are able to align their environmental values with financial profit and infrastructural improvements.

Categories 2: technologies, 5: education/communication

Recyclist: Software that takes a data-first approach to offer real-time visibility into recycling programs, recyclist.co/

Recyclist's Software is used by cities, counties and waste haulers serving more than six million Americans. It provides new insights into waste stream data, streamlines outreach and regulatory compliance processes, and leverages state-of-the-art digital channels to educate residents about recycling. The triple-bottom-line company is continually innovating new ways to use technology to empower citizens, government and business with the information they need to reduce waste, maximize diversion, and move the world toward a more sustainable future. Founded in 2014, Recyclist is certified as both a small business and a disadvantaged

business enterprise.

Recyclist is challenging the status quo by leading its customers toward a new era in which the waste and recycling industry reaps the benefits of synced and standardized data, just as industries such as transportation, health and media have already done. Recyclist's most popular product, the Program Tracker, takes a data-first approach to optimizing the often-overlooked, but hugely impactful work of municipal program managers and recycling coordinators, offering real-time visibility into programs so that efforts can be organized, informed and precisely targeted. The Recyclist product team is continually innovating new features that reflect the best ideas and best practices from the cities, counties and haulers that use the Program Tracker.

Categories 1: recycled products, 2: technologies, 4: innovative materials

RePolyTex LLC: Processes mixed plastics into fine powder to create construction products, repolytex.com

RePolyTex was formed to overcome the challenges that historically have made it impracticable to recycle mixed scrap plastics in a commercially sustainable manner. RePolyTex has developed and operates a facility in North Carolina for the processing of mixed plastics that otherwise would be disposed of in landfills or shipped to other countries. The product resulting from this process is a fine powder. That powder is the primary ingredient in a manufacturing process that will produce valuable items for use in construction and other industries. The end product initially will be 4x8-foot sheets of "plastic plywood," and other products will follow.

On average, plastic represents 40% of the weight of a consumer electronic device. The various polymer types and additives used in the manufacturing of electronics make this a difficult item to recycle. RePolyTex offers an unprecedented domestic outlet that can consume each polymer type in this material stream. Many companies are able to recycle certain polymers, but RePolyTex has developed technologies that make use of mixtures of previously unusable scrap plastics to make valuable products. This process adds considerable value to what is currently a net-zero or negative-value material. Because this mixed plastic product will have an increased value, the overall value associated with recycling consumer electronic devices should increase. This will encourage recycling of the material, helping to prevent electronic devices from ending up in landfills.

Categories 2: technologies, 5: education/communication

Revolution: Collects and recycles agricultural plastic to create new products, revolutioncompany.com

Revolution is a global brand unified by a single mission: creating better plastics that help preserve our environment. Revolution believes in manufacturing products with the highest amount of postconsumer recycled resin possible through its innovative Closed-Loop System that diverts millions of pounds of plastic waste from landfills each year. Consumers and companies rely on Revolution to provide sustainable, high-quality products through its family of brands, including Delta Plastics, Revolution Bag, Rodeo, and Command.

Agricultural plastic includes plastic sheets, rods, tubing, and films used in the cultivation, harvesting and processing of agricultural products, as well as plastics used in equipment and machinery for bins, chutes, liners and hoppers. Revolution collects agricultural plastic that previously was often sent to landfills, cleans and washes that material, and then manufactures it back into a variety of applications, such as carryout reusable bags, trash can liners, sheeting in industrial markets, and agricultural film. Since its beginning, Revolution has diverted over 1.5 billion pounds of plastic waste material from landfills.

Category 2: technologies

Revolution Systems: Equipment that brings recycling to smaller communities, RevolutionSystems.net

The Revolution sorting system brings sustainable, convenient recycling to smaller communities that are far from large recovery facilities. Applying manufacturing best practices to sorting, the system is 30-50% more productive, takes 30% of the space and costs one-third of competing systems. Installed strategically, Revolution equipment eliminates the need for transfer stations and the associated transportation costs to take collected recyclables to distant MRFs. This saves 25 to 50 dollars per ton (more in remote areas). Additionally, the convenience of local sorting eliminates the environmental impact of transfer trucks and the associated "dead leg" back to the transfer station. It also ensures that the residue collected is sent to a local landfill instead of a distant one, further reducing carbon footprint and cost. In addition, each Revolution creates between six and 15 local jobs. The Revolution is sorting made simple: convenient, affordable and sustainable.

Categories 2: technologies, 5: education/communication

SCRAPP: A cloud-based, consumer-led initiative to increase participation in recycling, https://youtu.be/mvQTvNdWtNU

Three students from the University of New Hampshire with a passion for sustainability have devised a cloud-based (IoT), consumer-led initiative called "SCRAPP" that will increase participation and efficiencies of current recycling methods. SCRAPP adds three retrofitted components to existing recycling dumpsters. In return for recycling their solid municipal waste, consumers are given reward points via a cloud-based app. Using a QR code identifying each bin, consumers scan with their smartphone to verify their waste deposits through the application. Incorporating a competitive element and reward-based system has been proven by research to increase consumer engagement. Monitoring of this engagement can help analyze recycling patterns, separating waste at the source to save energy in processing, and increase efficiencies in the collection methods. The ease of accessibility of a smart phone device can be used to increase awareness of environmental issues, educate consumers of correct recycling techniques and compare district performances.

Category 2: technologies

Titus MRF Services: Secondary MRF to address sorting limitations at primary MRFs, titusmrfservices.net

Titus MRF Services invented the secondary MRF to address the sorting limitations related to economies of scale at existing primary MRFs. Titus's solution is to build regional secondary MRFs to process residual waste and any other materials that primary MRFs are unable or choose not to sort by material type. Secondary MRFs aggregate low-volume and difficult-to-recycle materials along with systematic machine yield losses from a regional network of existing primary MRFs to reach the critical mass necessary to justify investments in automated technologies for sorting by material type. This allows Titus to increase diversion from landfill and reduce greenhouse gas generation by displacing virgin materials with recycled content. Secondary MRFs also provide a domestic sorting solution for mixed plastics, thereby eliminating U.S. reliance on export markets and reducing the potential for leakage to the marine environment.

Category 5: education/communication

U.S. EPA Small Business Innovation Research (SBIR) Program: Source of early capital for innovative small businesses in the green technology space, epa.gov/sbir/

One of 11 federal SBIR programs launched 30 years ago, EPA's SBIR is the small program with a big mission: to protect human health and the environment. The mission is big, and the areas of focus are broad: air, water, land, materials, chemicals and homeland security. Through the years, EPA has been a source of early-stage

capital for innovative small companies in the green technology arena. The program provides phased funding to small businesses to develop and commercialize novel environmental technologies.

Categories 2: technologies, 3: research, 5: education/communication

Van Dyk: Newly-built, 18,000-square foot Material Test Center to research and improve recycling, vdrs.com

Van Dyk's Material Test Center demonstrates its commitment to its customers and the environment. Van Dyk understands the importance of continually researching the sortability of materials and improving the collection process to achieve purity of recyclable grades. The test center allows customers to experiment with new equipment and conceive of how to reach and improve their operating goals. It also helps product makers understand why their product and packaging may not be recyclable, and how to fix that. The test center helps educate and guide sustainability initiatives toward a greener solution or help those in the municipal sector familiarize themselves with how a sorting system works. The 18,000-square foot system is the largest recycling material test center in the world and is fully capable of replicating real in-plant operations. It features the latest technology in optical sorting, screening separation, and air separation.

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