

REMADE Institute: Investing in R&D to accelerate the transition to a Circular Economy

Ed Daniels, Senior Project Manager

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The REMADE Institute – Accelerating the Transition to a Circular Economy

The Problem:

For the last 150 years, our economic growth has depended on our ability to extract resources from the ground, convert them into products we use, and eventually throw them away. This “Take, Make, Dispose” approach, referred to as the linear economy, is no longer sustainable.

The Solution:

To solve this problem, we must transition to a Circular Economy, where we fundamentally alter how we consume materials, design and use products, and preserve and extend the life of what’s already been made. This “Make, Use, Recycle” approach is truly sustainable.



**The Circular Economy
Could Add \$1 Trillion Per
Year To The U.S. Economy**

– US Chamber of Commerce Foundation Circular Economy Best Practices.pdf (uschamberfoundation.org)

**Consumption of Primary
Materials Could Be Reduced
by 32% Within A Decade**

– Ellen MacArthur Foundation The Circular Economy In Detail (ellenmacarthurfoundation.org)

**For Every 1,000 Tons of
Materials Recycled,
A Job Is Created**

– U.S. Environmental Protection Agency Recycling Basics | Reduce, Reuse, Recycle | US EPA

Accelerating the Circular Economy Transition Through Innovation

REMADE's approach focuses on the core principles of the Circular Economy:

ADOPT a systems-level perspective

REDUCE raw materials consumption

DESIGN products that can be reused, remanufactured, and recycled

PRESERVE and **EXTEND** the life of products and materials

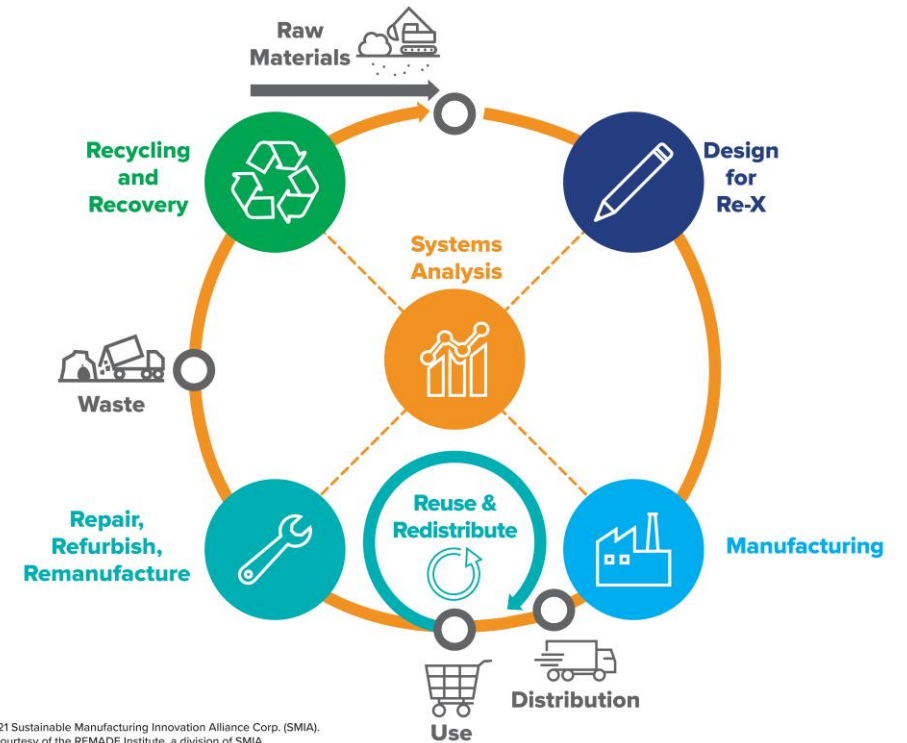
USE waste as a resource

In partnership with our members, we work to accelerate the transition to a Circular Economy as we:

DEVELOP innovative technologies to recover, reuse, remanufacture and recycle products and materials

FOCUS on four material classes - metals, plastics, fibers, and e-waste

EDUCATE and train engineers, scientists, and technicians in the incumbent workforce to develop and use these technologies



The REMADE Institute

A national consortium of member organizations comprised of industry, academia, national laboratories, trade associations, and non-profit entities collaborating on applied research, development, and demonstration of key industrial technology initiatives



Systems Analysis & Integration

Data collection, standardization, metrics, and tools for understanding material flow



Design for Re-X

Design tools to improve material utilization and reuse at End-of-Life (EOL)



Manufacturing Materials Optimization

Technologies to reduce in-process losses, reuse scrap materials, and utilize secondary feedstock in manufacturing



Remanufacturing & EOL Reuse

Efficient and cost-effective technologies for cleaning component restoration, condition assessment, and reverse logistics



Recycling & Recovery

Rapid gathering, identification, sorting, separation, contaminant removal, reprocessing and recycling



Metals



Polymers



E-Waste



Fibers

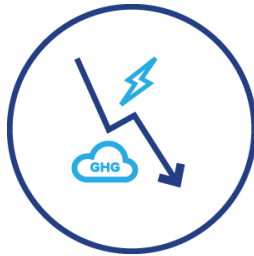
REMADE Mission

Reduce embodied energy and carbon emissions through applied research & development

REMADE STRATEGIC GOALS



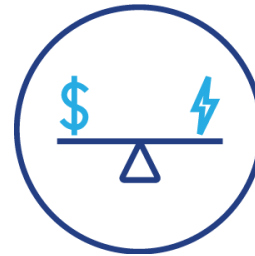
Develop **transformational technologies** to expand material recycling, recovery reuse and remanufacturing



Reduce **energy use & emissions** by **decreasing primary material use** in energy-intensive industries



Replace **primary feedstock materials** through **increased use of secondary feedstocks**



Achieve **better than cost & energy parity** between secondary feedstocks & primary feedstocks



Educate and train the **incumbent & future workforce** to deploy and use REMADE technologies

REMADE TECHNICAL PERFORMANCE METRICS

↓30%

Primary Feedstock (FS) Consumed

↓30%

Secondary Feedstock (FS) Consumed

↑25%

Embodied Energy Efficiency

↓20%

GHG Emissions



Cross-Industry Reuse



Cost and Energy Parity



Solving these issues requires a comprehensive **systems level approach** guided by **national goals and metrics** addressing **industry needs and priorities** with a path to **implementation & commercialization**



University of Iowa Ohio State University University of Michigan Michigan State University Light Metal Consultants, LLC Kent County Department of Public Works

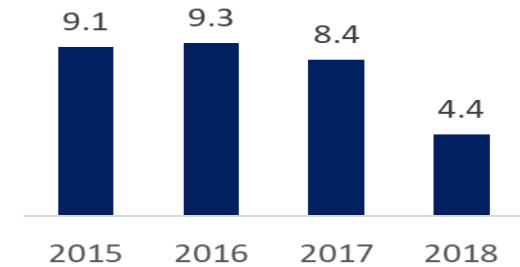
REMADE R&D Portfolio

- Five RFP's Released to date
 - ✓ RFP 5 closed on July 15, 2021
- 62 projects awarded to date from RFP 1-4
 - ✓ 12 are complete,
 - ✓ 27 active,
 - ✓ 23 selected from RFP 4; expected to launch in the Fall
- \$63.1 million allocated to date
- Polymer recycling projects are about 1/3 of the project portfolio

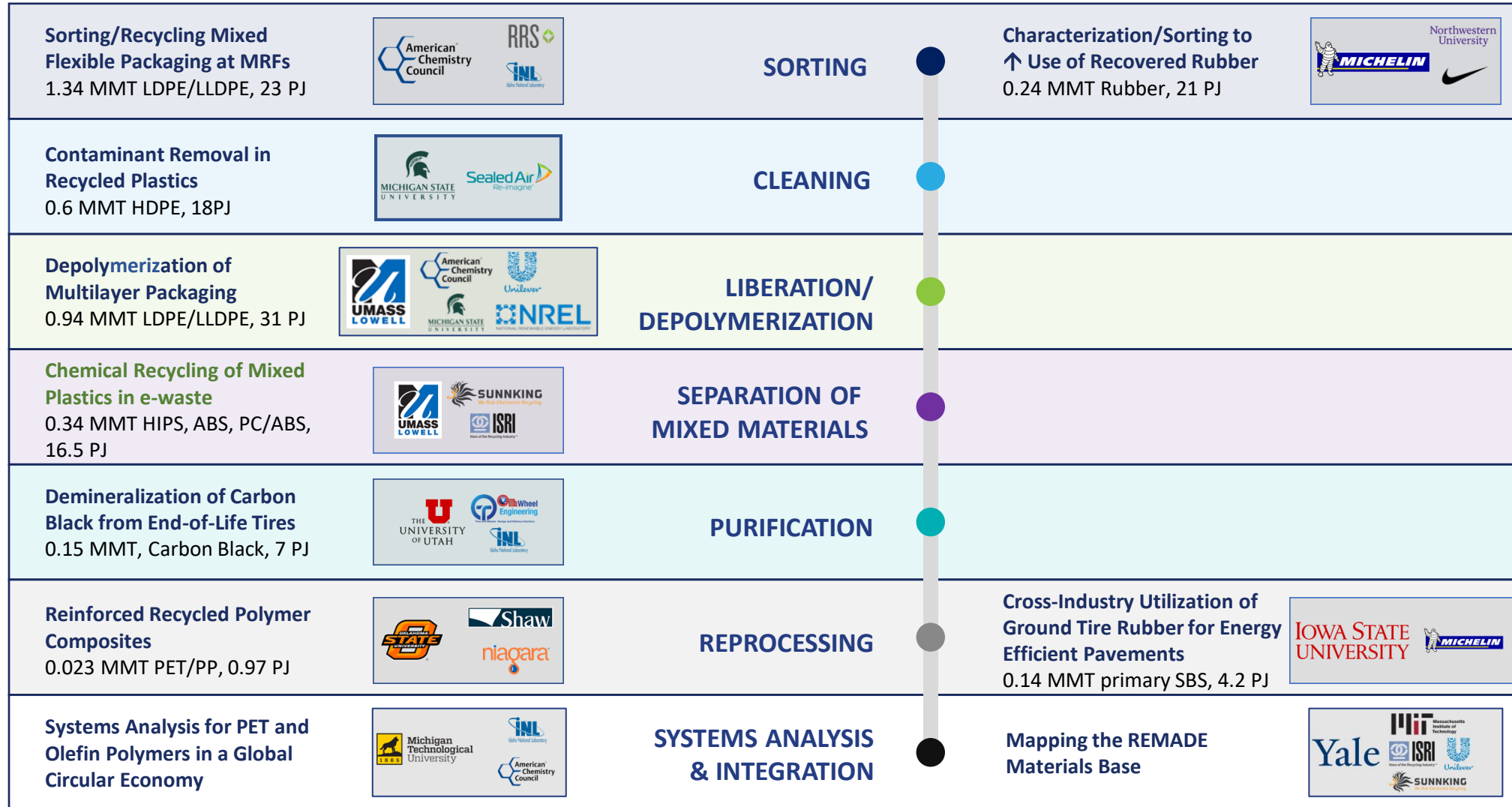
REMADE Polymer Recycle Overview

- REMADE Polymer Recycling R&D focuses on the development of technology solutions to increase the recovery and recycling of plastics.
- There are no “silver bullets”---the complexity of the plastics recycling challenge will require a suite of technology solutions to recover, purify, and process waste plastics into secondary feedstocks that meet the demanding requirements of a diverse market.
- More effective “mechanical” and “chemical” (including solvent-based, bio-based and thermo-chemical) recycling technologies are needed to increase the recycling of plastics.
- Advanced manufacturing processes and/or process control technologies to accommodate variabilities in secondary feedstocks can also enable increased use of recycled plastics.
- Meeting the challenges inherent in increasing the recycling of plastics requires the input, cooperation and collaboration of all stakeholders

U.S. Plastics Recycling Rate



Polymer Recovery and Recycling Projects



Polymer Recovery and Recycling Projects

Systems Analysis for PET and Olefin Polymers in a Circular Economy

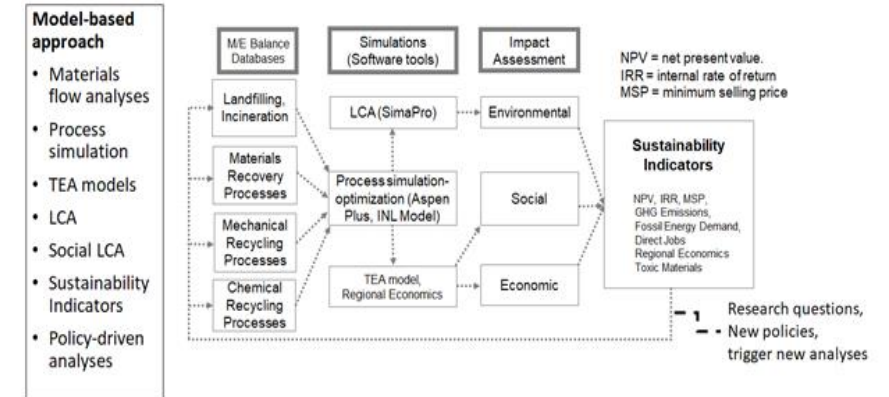
Team: Michigan Technological University, Idaho National Laboratory

Problem

- Consistent protocols and plastics recycling data sets are required to support material flow analysis (MFA), techno-economic analysis (TEA) and life cycle assessments (LCA) research within REMADE
- A systems analysis is needed to understand the impacts of a future closed-loop material cycles for olefin and PET polymers.

Project Goals

- To define and develop a conceptual modeling framework to predict REMADE TPMs at system level for PET and olefin polymers.
- Develop TEA models to benchmark state-of-the-art recycle technologies



Systems analysis framework to predict environmental, economic, and societal impacts of closed-loop cycles for olefin polymers and PET.

Sorting and Recycling Mixed Flexible Packaging and Plastic Wrap

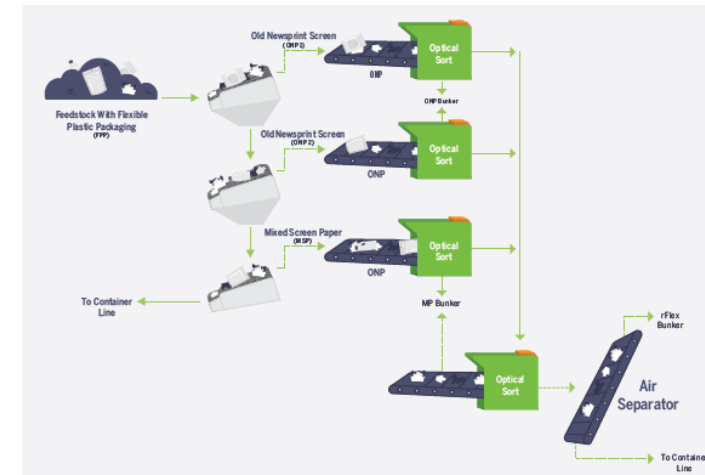
Team: American Chemistry Council, Resource Recycling Systems

Problem

- Currently FPP is not sorted for recycling at a MRF and very little FPP is recycled in the U.S.
- Most MRFs were not built to sort for FPP and, because little FPP is recycled, there are no end markets for FPP to provide an economic incentive to recycle FPP.

Project Goals:

- This project will build upon research conducted by the Materials Recovery for the Future (MRFF) program that identified a path for capturing FPP in a MRF through optical sortation equipment.
- The goal is to recover 90% of the FPP in an rFlex product containing less than 15% paper (by volume) using MRF sortation equipment.
- Four potential end markets for rFlex (wallboard, durable goods, pellets, and film) will be evaluated with a goal identifying at least one that results in a 25% reduction in energy use compared with using primary (virgin) materials in the product.



The illustration to the left demonstrates the flow of FPP through a MRF as developed by the MRFF project. This research will help this project meet its first goal of recovering 90% of the FPP in an rFlex product containing less than 15% paper (by volume).

REMADE Education & Workforce Development Tiered Certificate Program



Over 2,400
people trained



400
trainers trained



Over 40
training events



Over 50
hours of content

- 1. Outreach Training:** brief overviews of REMADE relevant technologies, industries, or best practices. **(28)**
- 2. Short Courses:** concepts, technologies, and practices tailored for the incumbent workforce at three competency levels: Awareness, Practitioner, or Expert. **(12)**
- 3. Certificates Pathways** - grouping similar short courses together to provide a deeper level of understanding by competency level of a broad technology subject **(3)**

- Program has been building over last two years
- Certificates are greatest value, will play an important role in workforce development

The Path Forward

- REMADE will continue to expand its membership base and to develop Strategic Partnerships to achieve the goals of the Institute and to increase the recycling and remanufacturing of materials including polymers, metals, fibers and e-waste
- REMADE will continue to invest in technology R&D to accelerate the transition to a Circular Economy
- There are no “silver bullets” ---a suite of technology solutions will be required

edaniels@remadeinstitute.org

Thank You