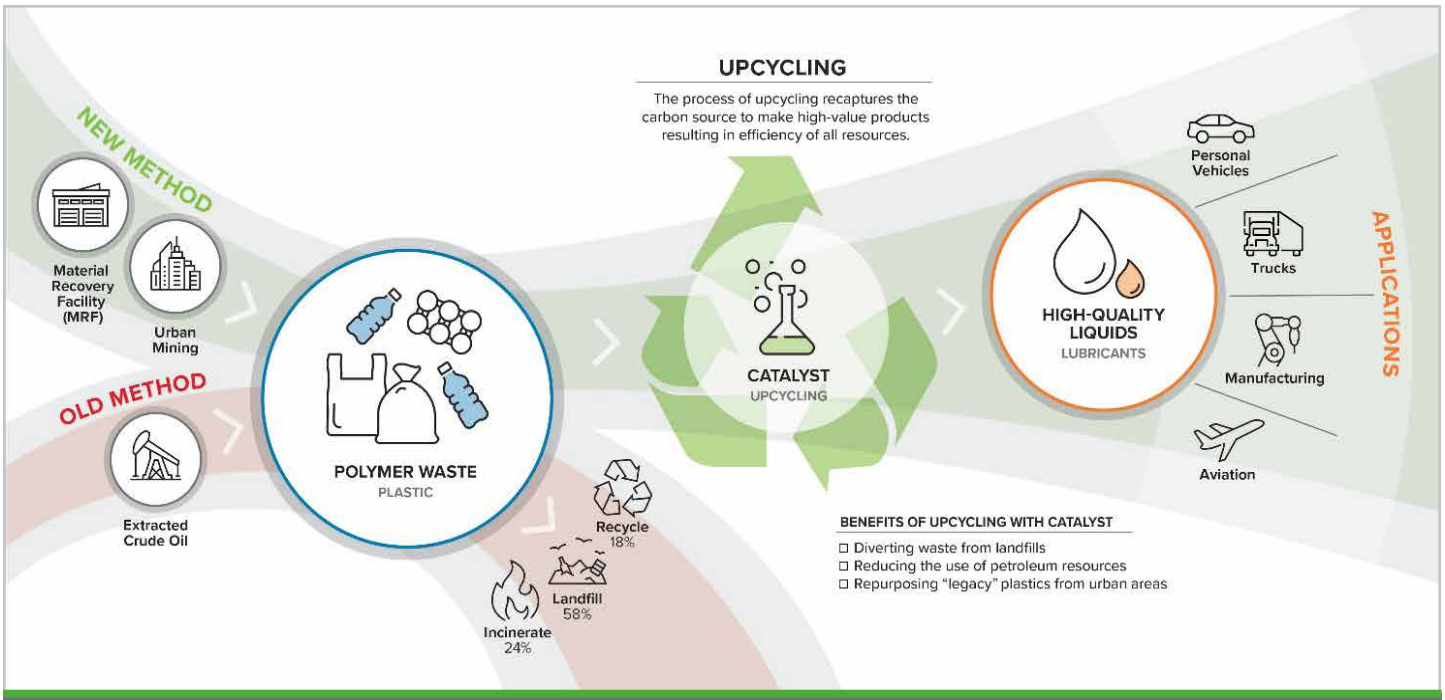
U.S. DEPARTMENT OF
ENERGY

Office of
ENERGY EFFICIENCY &
RENEWABLE ENERGY

Upcycling: Could My Plastic Bag Someday Become the Sustainable Alternative?

Bioenergy Research and Education Bridge (BRIDGES) Program Case Study Fact Sheet



Finding novel ways to reuse plastics, Argonne National Laboratory is working on upcycling, which uses the same building blocks of one material to make something of greater value, like turning plastic bottles into automotive lubricants. *Image from Argonne National Laboratory.*

Student Introduction to Upcycling of Plastic Materials

Plastic has become an integral material in our everyday lives. Developed using petroleum-based feedstocks, plastics are used in numerous products, including tires, milk jugs, straws, clothing, and shopping bags. But what happens when the useful life of a plastic product is over? Difficult to recycle, plastics are typically discarded as waste into landfills.

Students will be introduced to the challenges and benefits of bioenergy technologies, as well as to exciting careers in the bioenergy industry. Students will assume the role of a reaction chemist to learn how scientists and industry professionals reimagine the life cycle of plastics in the U.S. economy.

In a circular economy, waste can be transformed by using materials at the end of a product's life as a resource for another high-value product. This inspires scientists to develop creative solutions for plastic waste.

BRIDGES Content Advisors

- U.S. Department of Energy (DOE) Bioenergy Technologies Office (BETO)
- Energy Sciences Division, Argonne National Laboratory
- Environmental Sustainability, United Airlines
- DOE's BETO BRIDGES National Review Board

Students will explore one solution for upcycling plastic waste to valuable chemicals by learning about the challenges of recycling plastics and polymer types used in plastic creation. Then, students will conduct an evaluation of catalysts that convert old plastic bags into something valuable and useful.

Activity Highlights

- Case studies and materials are designed by scientists and industry professionals.
- Learn about bioenergy-related career pathways.
- Sharpen your skills in reading scientific papers, collaboration, and communication.
- Explore this problem using science data from Argonne National Laboratory.
- No prior knowledge in bioenergy or biochemistry required.

Learning Goals

- Explain the economic, logistical, and scientific challenges of recycling plastic, with emphasis on the chemical conversion.
- Understand the concepts of a circular economy and upcycling.
- Assess a catalyst's impact on the rate of a chemical reaction and determine optimum operating conditions for the reaction from an experimental data set.
- Gain experience using primary sources such as data sets and literature.
- Describe the role and skills necessary for a reaction chemist working in the bioenergy industry.

Classroom Implementation

- Designed for use in high school, community college, technical institute, or university courses.
- Requires approximately 3 hours of class time to complete.
- Students will need computers with internet access.
- Can be taught in-person or online, either synchronously or asynchronously.
- All instructional materials for both students and instructors are provided.

About the BRIDGES Program

The Bioenergy Research and Education Bridge (BRIDGES) is an education and workforce development program designed to assist educators in teaching bioenergy topics to prepare a national bioenergy workforce. Funded by the U.S. Department of Energy (DOE) Bioenergy Technologies Office (BETO), the BRIDGES Program includes real-world case studies and scenarios with expertise from education and community partners as well as industry and government partners. Learn more at energy.gov/BRIDGES.

More Information

For questions about BRIDGES or if you are interested in partnering, please email Bioenergy_Bridges@ee.doe.gov. ■

Bioenergy Research and Education BRIDGES
U.S. Department of Energy Bioenergy Technologies Office

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Office of ENERGY EFFICIENCY & RENEWABLE ENERGY
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For more information, visit: energy.gov/eere/bioenergy/bioenergy-research-and-education-bridge-program

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