The Potential Economic Impact of Advanced Recycling and Recovery Facilities in the United States

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American Chemistry Council

EXECUTIVE SUMMARY

In recent years, the plastics industry has invested heavily in innovation that will help to achieve a more sustainable future. Since 2017, companies from areas across the United States have announced $8.7 billion in investments for 83 new projects in advanced recycling and recovery, as well as mechanical recycling (as of April 2022), aimed at revolutionizing the use and reuse of plastic resources.

Advanced recycling and recovery technologies are transforming used plastics into new products, rather than relying on virgin resources for new plastic production. Advanced recycling, also called "chemical recycling," refers to several different processes to extract value from used plastics by converting them into their original building blocks, specialty chemicals, feedstocks for new chemicals and plastics, and other valuable products. Advanced recycling and recovery technologies complement ongoing recycling efforts and can help dramatically reduce the amount of waste sent to landfills while generating a diverse range of marketable products.[1]

In addition to reducing waste, advanced recycling and recovery facilities could have a significant impact on economic output and job creation in the U.S. Using 2018 EPA data as a reference baseline, the American Chemistry Council (ACC) found that the U.S. could support more than 150 new advanced recycling and recovery facilities which could result in:

- **48,500 jobs**, including:
  - 12,500 directly employed by the facilities.
  - 17,800 in supply chain industries that support these facilities.
  - 18,300 payroll-induced jobs supported by workers in these plants and their supply chains spending their earnings.

- **$3.3 billion** in annual payrolls.

- **$12.9 billion in annual U.S. economic output** from new advanced recycling and recovery operations, including:
  - $4.3 billion related to increased products generated by the facilities.
  - $8.6 billion in additional supplier and payroll-induced impacts.

[1] "Advanced recovery" in this context refers to the conversion of used plastic materials into transportation fuels such as jet fuel for airlines or ethanol for use in automobiles.

INTRODUCTION

Advanced recycling and recovery technologies complement existing mechanical recycling methods, allowing more types of used plastics to be recaptured and remanufactured into new plastics and products. While more than 2.8 million metric tons of plastics—including bottles, containers, bags, wraps and film—were recycled in 2018, advanced recycling makes it possible to recover large volumes of used plastics that currently go unrecycled.

Today's versatile technologies can convert used plastics into a range of useful outputs, such plastic and chemical building blocks, industrial waxes, fuels, coatings, and other products to help grow communities and other key parts of our economy. These technologies also offer important environmental benefits, such as diverting valuable materials from landfills, reducing the use of virgin natural resources such as crude oil and natural gas, and helping to reduce greenhouse gas emissions otherwise associated with production of materials from virgin resources. Investments in advanced recycling and recovery technologies (and associated facilities) will contribute to a more circular economy, create jobs, and have the potential to add billions of dollars to the economy.

This report presents the results of an analysis conducted to quantify the potential economic impact of investments in advanced recycling and recovery facilities that process used plastics into synthetic hydrocarbon feedstocks, which can be processed in a range of valuable products including plastic resins, waxes, and coatings, among others. For the purposes of this report, the analysis focused on the chemical recycling technology of pyrolysis and related catalytic depolymerization, referred to here as advanced recycling. However, there are other technologies such as gasification, solvolysis, and methanolysis that can also convert plastics to useful raw materials, chemicals, and other valuable products of chemistry.

Advanced recycling and recovery facilities have the potential to create thousands of jobs for skilled workers, result in as much as $4.3 billion in direct economic output per year and divert over 12 million metric tons of used, recoverable plastics from landfills each year. In addition to these direct effects, supply chain (indirect), and payroll-induced effects account for an estimated additional $8.6 billion output gain elsewhere in the economy. There is potential for the creation of as many as 12,500 direct jobs in advanced recycling facilities, with an additional 36,100 jobs supported throughout the supply chain and payroll-induced impacts, totaling 48,500 jobs.

BACKGROUND AND METHODOLOGY

Background

In October 2014, the American Chemistry Council released its initial report *Economic Impact of Plastics-to-Oil Facilities in the U.S.* That report explored the potential impact of investments in facilities that use the conversion technology of pyrolysis to convert used recoverable plastics into synthetic crude oil.

In February 2019, ACC released an updated report, *Economic Impact of Advanced Plastics Recycling and Recovery Facilities in the U.S.,* that extended the analysis to consider the impact of advanced recycling and recovery facilities that transform used plastics into a range of products, including valuable feedstocks for new plastics and chemicals, other raw materials for manufacturing, and transportation fuels, through processes such as pyrolysis and depolymerization. In both studies, ACC found tremendous opportunity for the advanced recycling industry to boost economic output and create jobs across the country.

Since the release of the initial report, interest and investments in advanced recycling and recovery have grown. The technologies continue to evolve and are increasingly flexible. While initially focused on converting mixed used plastics into synthetic crude oil, today's technologies have a range of inputs and outputs. In addition to mixed used plastics, some companies are focused on specific inputs which generate specific outputs, such as used polystyrene to styrene monomer; polyolefins such as polyethylene and polypropylene to chemical building blocks; and polyethylene terephthalate (PET) into synthetic feedstock and new PET resin.

It should be noted that the methodology and assumptions for each report differ based on factors such as current market conditions, changing industry dynamics, and availability of data. As such, the results presented in this analysis are not directly comparable to the results from previous analyses.

Methodology

The analysis is based on metrics developed by the American Chemistry Council. To determine the potential economic impact of the advanced recycling and recovery industry, ACC developed metrics for two hypothetical model facilities. Each model facility was developed using data collected from publicly available sources and information provided by members of ACC's Plastics Division. The model facilities are intended to be representative of the industry but are not reflective of any one individual company or technology. The assumptions for each of the model facilities are as follows:

> *Model 1: Advanced recycling and recovery facility processing mixed used plastics* - assumes the facility has the capacity to process 100,000 metric tons of used, mixed plastics on an annual basis, generating 495,000 barrels of synthetic hydrocarbon feedstocks.

Model 2: Advanced recycling facility processing polystyrene - assumes the facility has the capacity to process 25,000 metric tons of used polystyrene on an annual basis, generating 17,500 metric tons of styrene monomer.[2]

The objective of the analysis was to quantify the economic impact of new investment which generally manifests through the following channels:

- *Direct impacts* include the employment, output value, and fiscal contributions generated by the advanced recycling and recovery facilities themselves; these refer to the response of the economy to the change in the final demand (output) of a given industry.
- *Indirect impacts* (or supplier impacts) include the employment and output supported by the sector via purchases from its supply chain; these refer to the response of the economy to the change in the final demand of the industries that are dependent on the direct spending industries for their input.
- *Payroll-induced impacts* include the employment and output supported by the household spending of those employed directly or indirectly by the sector (e.g., employees—both direct and indirect—purchase groceries, use medical facilities, etc.). These refer to the response of the economy to changes in household expenditure as a result of payroll generated by the direct and indirect effects.

The effect of private investment in advanced recycling and recovery facilities on employment, supply chain, and other economic effects was assessed using IMPLAN, an input-output model based on a social accounting matrix aimed at incorporating all flows within an economy.[3] Using detailed spending patterns for an industry and labor-to-output ratios, the economic impact of a change in final demand for that industry can be estimated at a relatively fine level of granularity. For a single change in final demand (i.e., change in industry spending), IMPLAN can generate estimates of the direct, indirect, and induced economic impacts.

ECONOMIC IMPACT

Post-consumer recoverable plastics have the potential to be one of the largest sources of feedstock for advanced recycling and recovery facilities. Based on the volume of used plastics that are not, or cannot be, mechanically recycled each year, it is reasonable to assume that multiple facilities could be supported. According to the U.S. Environmental Protection Agency (EPA)'s 2020 report "Advancing Sustainable Materials Management," an estimated 24.5 million metric tons of plastics were landfilled in the United States in 2018.[4] Assuming that 50% of the volume of these used plastics could be diverted to, and processed by, advanced

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[2] All analysis was conducted on the basis of metric tons. 1 metric ton = 2,204.6 pounds
[3] https://www.implan.com/
[4] Polystyrene accounted for 8.1% (2.0 million metric tons) of landfilled plastics in 2018.

recycling and recovery facilities, ACC estimated that the available amount of recoverable plastics currently landfilled each year could support 40 polystyrene recycling facilities and 112 mixed used plastics advanced recycling and recovery facilities, for a total of 152 facilities.[5] To determine the total potential economic impact, the impact for a single facility was then extrapolated to reflect the economic impact of multiple facilities.

Added output and job creation

The output and employment generated by advanced recycling and recovery facilities and supply chain industries could be significant: an additional $12.9 billion in annual economic output could generate as many as 48,500 jobs in local communities across the country.

In addition to the estimated 12,500 skilled direct jobs the facilities would create, these facilities—and their employees—would generate purchases of raw materials, services, and other products throughout the supply chain. Thus, another 17,800 indirect jobs could be supported by the ongoing operations of advanced recycling and recovery facilities. Finally, wages earned by new workers, both at the facilities and throughout the supply chain, would be spent on household purchases and taxes. In turn, the response of the economy to changes in household expenditures, due to payrolls generated by the direct and indirect effects, is estimated to result in an additional 18,300 jobs. Many of these jobs would be in the local communities where the advanced recycling and recovery facilities would be situated. All told, the additional $4.3 billion in output from 152 facilities could generate three times that amount in total output to the economy and as many as 48,500 jobs in the United States, generating an annual payroll of $3.3 billion.

Total Economic Impact of Advanced Recycling and Recovery Facilities			
	Employment	Labor Income ($mil)	Output ($mil)
Direct Effect	12,500	$800	$4,300
Indirect Effect	17,800	$1,400	$5,200
Induced Effect	18,300	$1,100	$3,400
Total Effect	**48,500**	**$3,300**	**$12,900**
See individual data tables for each type of advanced recycling facility at the end of the report.			

[5] In previous reports, ACC used a more conservative assumption that 25% of used plastics could be diverted to advanced recycling and recovery facilities. The assumption was increased for this analysis to reflect increased industry commitments to transition toward a circular economy for plastics.

CONCLUSION

The potential economic effects of investment in advanced recycling and recovery in the United States are overwhelmingly positive. Advanced recycling and recovery facilities have the potential to bring about tens of thousands of new jobs and billions of dollars in annual U.S. economic output, while reducing the amount of waste sent to landfills.

ADDITIONAL DATA TABLES

Economic Impact of Model 1. *Advanced recycling and recovery facility processing mixed used plastics*			
Total facilities supported = 112			
	Employment	Labor Income ($mil)	Output ($mil)
Direct Effect	11,200	$700	$3,800
Indirect Effect	15,700	$1,300	$4,600
Induced Effect	16,100	$900	$3,000
Total Effect	**43,100**	**$2,900**	**$11,400**

Economic Impact of Model 2: *Advanced recycling facility processing polystyrene*			
Total facilities supported = 40			
	Employment	Labor Income ($mil)	Output ($mil)
Direct Effect	1,300	$100	$500
Indirect Effect	2,000	$160	$600
Induced Effect	2,100	$120	$390
Total Effect	**5,400**	**$390**	**$1,500**

ACC'S ECONOMICS & STATISTICS DEPARTMENT

The Economics & Statistics Department provides a full range of statistical and economic analysis and services for ACC and its members and other partners. The group works to improve overall ACC advocacy impact by providing statistics on American Chemistry as well as preparing information about the economic value and contributions of American Chemistry to our economy and society. They function as an in-house consultant, providing survey, economic analysis, and other statistical expertise, as well as monitoring business conditions and changing industry dynamics. The group also offers extensive industry knowledge, a network of leading academic organizations and think tanks, and a dedication to making analysis relevant and comprehensible to a wide audience. The lead authors of this report were Heather Rose-Glowacki and Martha Gilchrist Moore.