ECONOMIC IMPACT OF ADVANCED PLASTICS RECYCLING AND RECOVERY FACILITIES IN THE U.S.

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EXECUTIVE SUMMARY

In this updated report, *Economic Impact of Advanced Plastic Recycling and Recovery Facilities in the U.S.*, the American Chemistry Council (ACC) explores the potential opportunities that expanding advanced plastic recycling and recovery technologies, referred to within the industry as chemical recycling, could have on economic output and job creation in the U.S. This burgeoning class of recycling and recovery technologies can convert used plastics into a range of products, including raw materials such as crude oil, chemicals and chemical feedstocks, transportation fuels and other petroleum-based commodities. ACC found that that the U.S. could support investment in 260 new facilities using these advanced technologies and this could result in:

- 38,500 jobs supported by new advanced plastic recycling and recovery facilities, including:
  - 9,400 directly employed by the facilities.
  - 15,100 jobs in supply chain industries that support these facilities.
  - 14,000 payroll-induced jobs supported by workers in these plants and their supply chains spending their earnings.

- $2.2 billion in annual payrolls.

- $9.9 billion in U.S. economic output from new plastics recycling and recovery operations, including:
  - $4.1 billion related to increased products generated by the facilities.
  - $5.8 billion in additional supplier and payroll-induced impacts.

This report is an update to an October 2014 report, *Economic Impact of Plastics-to-Oil Facilities in the U.S.*, which was limited to facilities that only convert recoverable plastics into synthetic crude oil. Even in that narrower study, ACC found a tremendous opportunity for the plastics-to-oil industry to boost economic output and create jobs across the country.

This new report extends the analysis to consider the impact of advanced plastic recycling and recovery (APRR) facilities that transform post-use 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, often referred to within the industry as chemical recycling.

INTRODUCTION

Many types of plastics, including bottles, containers, bags, wraps and film can be recycled with 3.1 million tons of plastics mechanically recycled in 2015.[1] While reuse and mechanical recycling are currently more common methods of plastics recovery, there are still tons of valuable, recoverable post-use plastics and other materials that end up in the municipal waste stream each year.

Plastics, because they are derived from hydrocarbons, have a high energy content that can be converted to feedstocks for new plastics and chemicals, crude oil and lower carbon transportation fuels, and other petroleum products such as waxes and lubricants. Advanced plastic recycling and recovery technologies, often referred to inside the industry as “chemical recycling,” are able to recycle and recover post-use plastics. Converting these abundant resources into new raw materials, feedstocks, chemicals and fuels complements existing mechanical recycling and reduces the amount of useful materials that would otherwise be sent to landfills.[2] Investment in the technologies — and associated facilities — that capture this value will contribute to a more circular economy, create jobs and has the potential to contribute billions of dollars to the economy.

This report presents the results of the analysis conducted to quantify the potential economic impact of investments in advanced plastic recycling and recovery facilities that process these plastic feedstocks into plastic and chemical feedstocks, crude oil, transportation fuels, or other valuable products. 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 Plastic Recycling and Recovery (APRR). However, there are other technologies such as gasification that can also convert plastics to useful raw materials, chemicals, and transportation fuels.

Pyrolysis is the technical description for a process by which recoverable plastics are source-separated and converted into a portfolio of refined products. In general, the steps in the conversion process are: the plastic, which can be co-mingled mixed plastics, is collected and processed to remove metals and other contaminants; the plastic is heated and converted to a gaseous state and any non-plastic materials (char) are removed; the gas is distilled into a liquid (e.g. oil/fuel) and either sold as is or further refined into chemical and plastic feedstocks such as naphtha, fuels or other petroleum products such as wax before entering the market. There are variations in the technical process, and there are a range of both inputs (types of plastic feedstocks) and outputs. For example, polystyrene can be converted back to styrene oil and styrene monomer via this process. This enables closed loop recycling of polymer right back to monomer.

This report is based on metrics developed by ACC’s Economics and Statistics department for a hypothetical, generic APRR facility using data collected from publicly-available sources and information provided by members of the ACC’s Chemical Recycling Alliance.

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[1] https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling

[2] This report focuses on the economic impact of building APRR facilities, rather than the environmental and other benefits associated with reducing waste in landfills.

These facilities have the potential to create thousands of jobs for skilled workers, result in as much as $4.1 billion in direct economic output per year, and eliminate the landfilling of 6.5 million tons of post-use, recoverable plastics each year. In addition to these direct effects, supply chain (indirect) and payroll-induced effects account for an estimated additional $5.8 billion output gain elsewhere in the economy. There is potential for the creation of as many as 9,400 direct jobs in APRR facilities, with an additional 29,100 jobs supported through the supply chain and payroll-induced impacts, totaling 38,500 jobs.

METHODOLOGY AND ASSUMPTIONS

To determine the potential impact of the advanced plastics recycling and recovery industry, we developed a hypothetical model facility. The model facility is intended to be representative of the industry and is not reflective of any one individual company or technology.[3] The assumptions for the model facility are as follows:

- A one-time $36 million private investment for a single APRR facility and associated equipment.
- Capacity to process 25,000 tons of post-use, mixed plastics on an annual basis.
- Annual production of 82,500 barrels of diesel; 41,000 barrels of naphtha; and 2,000 metric tons of waxes.

Post-consumer recoverable plastics have the potential to be one of the largest sources of feedstock for APRR facilities. Given the amount of post-consumer plastics landfilled each year, it is reasonable to assume that multiple facilities could be supported. According to EPA's 2018 Report "Advancing Sustainable Materials Management," the amount of post-use, recoverable plastics landfilled in the United States in 2015 was estimated at 26.0 million tons. Using a conservative assumption that 25% of these post-use, recoverable plastics could be recovered and processed by APRR facilities, ACC estimated that the available amount of recoverable plastics currently landfilled each year could support 260 APRR facilities.[4] To determine the total potential economic impact, the impact for a single facility was then extrapolated to reflect the economic impact of multiple facilities.

The objective of the analysis was to quantify the direct effects of private investment in APRR facilities on the economy, as well as indirect and payroll-induced effects. The economic impact of new investment is generally manifested through four channels:

- **Direct impacts** include the employment, output value and fiscal contributions generated by the advanced plastics 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

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[3] There are economies of scale associated with APRR facilities; however, as these estimates are difficult to quantify with accuracy, they are not reflected in the models.

[4] This analysis only takes into consideration the volume of post-use, recoverable plastics that are landfilled. It should be noted, however, that post-consumer recoverable plastic is not the only source of feedstock for APRR facilities. Feedstock can also be derived from post-industrial plastics; however, due to the limited availability of statistics on the volumes of available post-industrial plastics, it is not accounted for our in this report.

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 impact** 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, would be purchasing groceries, using 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.
- **Spillover (or catalytic) impacts** refer to the extent to which the activities of the relevant sector contribute to improved productivity and performance in other sectors of the economy.

This analysis focused on the first three channels listed. Though there would also be spillover effects from new investment in APRR facilities, these positive externalities (e.g., improvements in existing waste and materials management infrastructure, expansion of technologies to other materials) are difficult to reliably quantify and thus were not examined in the analysis.

The effect of private investment in APRR facilities on employment, indirect and other economic effects was assessed using the IMPLAN model, an input-output model based on a social accounting matrix that incorporates all flows within an economy. The IMPLAN model includes detailed flow information for 440 industries.[5] 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), the IMPLAN model can generate estimates of the direct, indirect and induced economic impacts.

ADDED OUTPUT AND JOB CREATION

The output and employment generated by APRR facilities and supply chain industries could be significant: an additional $9.9 billion in economic output could generate 38,500 jobs in local communities across the country.

In addition to the estimated 9,400 skilled direct jobs the facilities would create, they would generate purchases of raw materials, services and other supplies throughout the supply chain. Thus, another 15,100 indirect jobs could be supported by the ongoing operations of APRR facilities. Finally, the wages earned by new workers—both at the facilities and throughout the supply chain—are spent on household purchases and taxes. In turn, the response of the economy to changes in household expenditure, as a result of payrolls generated by the direct and indirect effects, is estimated to result in an additional 14,000 jobs. Many of these jobs are in the local communities where the APRR facilities are situated. All told, the additional $4.1 billion in output from 260 APRR facilities could generate more than twice that

[5] Because there was not existing industry information in IMPLAN for plastics conversion facility technologies, ACC used data collected and existing information for similar industries to develop a model industry for this project.

amount in total output to the economy and as many as 38,500 jobs in the United States, generating a payroll of $2.2 billion. Moreover, the new jobs primarily would be in the private sector.

Table. Potential Economic Impact from Advanced Plastics Recycling & Recovery Facilities (U.S)			
	Employment	Payroll ($bil)	Output ($bil)
Direct Effect	9,400	$0.5	$4.1
Indirect Effect	15,100	$1.1	$3.5
Payroll-Induced Effect	14,000	$0.7	$2.3
TOTAL EFFECT	**38,500**	**$2.2**	**$9.9**
Note: Totals may not sum due to independent rounding.			

CONCLUSION

The potential economic effects of investment in advanced plastics recycling and recovery facilities in the United States are overwhelmingly positive. Recycling and/or recovering energy from recoverable plastics through advanced technologies has the potential to bring about thousands of new jobs and billions of dollars in U.S. economic output, while reducing the amount of waste sent to landfills.

ACC'S ECONOMICS & STATISTICS DEPARTMENT

The Economics & Statistics Department provides a full range of statistical and economic advice 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.