Economic Impact of Plastics-to-Oil Facilities in the U.S.

American Chemistry Council
October 2014

Executive Summary

In its new report, *Economic Impact of Plastics-to-Oil Facilities in the U.S.*, the American Chemistry Council (ACC) explores the potential impact that building plastics-to-oil (PTO) facilities in the U.S. could have on economic output and job creation.

Through our analysis, we found that the U.S. could support as many as 600 PTO facilities (depending on the production characteristics and size of the facility), generating up to:

- 38,900 jobs supported by new PTO operations.
  - 8,800 would be directly employed by the facilities.
  - An additional 17,200 jobs would be in supply chain industries that are related to the plastics recovery industry and supporting the facilities.
  - Another 12,900 payroll-induced jobs would be supported by the spending of the earnings of workers in new PTO plants and throughout the supply chain.

- $2.1 billion in annual payrolls generated by PTO facilities.

- $6.6 billion in capital investment by the plastics-to-oil industry to build new facilities.

- $8.9 billion in U.S. economic output from PTO operations.
  - $3.7 billion related to increased oil production.
  - $5.2 billion in additional supplier and payroll-induced impacts.

- $18.0 billion of economic output during the investment phase.

Introduction

Plastics recycling has continued to grow in the United States over the past few decades, with a total of 2.8 million tons of plastics recycled in 2012.[1] While reuse and recycling are the preferred methods of plastics recovery, it is not always economically feasible – or even possible - for all plastics to be recycled, illustrating the opportunity for other economical means of recovering plastics. Because they are derived from hydrocarbons, plastics have a high energy content that can be converted to crude oil and fuels, synthetic gas, and recycled feedstocks for new plastics and other products of chemistry. Various conversion technologies such as mass burn waste-to-energy, gasification and pyrolysis, are able to recover the energy contained in plastics. Recovering this valuable energy through conversion technologies reduces waste sent to landfills and complements plastics recycling.[2] Investment in the technologies — and associated facilities — needed to capture this energy value will contribute to sustainable development, 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 that investments in conversion technology facilities could have on the United States. For the purposes of this report, the analysis focused only on the conversion technology of pyrolysis, referred to here as "plastics-to-oil" or "PTO" technology. Pyrolysis is a process by which non-recycled plastics (NRP) are source-separated and converted to synthetic crude oil or other types of fuel oil by means of thermal treatment. Although there are several manufacturers of PTO technologies, each with some variation in its technology, the basic steps of the process are the same: first the NRP, which can be mixed plastics, is collected and pretreated; then heat converts the plastics to a gaseous state and any non-plastic materials (char) are removed; finally, the gas is distilled into a liquid (oil/fuel) and either sold as is or further refined into fuels or other petroleum products before entering the market.

This report is based on metrics developed by the American Chemistry Council (ACC) for two variations of hypothetical PTO facilities using data collected from publically-available sources and information provided by members of the American Chemistry Council's Plastics-to-Oil Technologies Alliance.[3] Using the conservative assumption that 20% of the amount of post-consumer NRP[4] landfilled each year could be diverted to PTO facilities,[5] we estimate that the U.S. could support between 350 and 600 PTO facilities, depending on the production characteristics and size of the facility.

These facilities have the potential to create thousands of jobs for skilled workers, result in up to $8.9 billion in direct economic output per year, and eliminate the landfilling of 6.5 million tons of non-recycled plastics each year. In addition to these direct effects, indirect and payroll-induced

[1] See http://www.epa.gov/osw/conserve/materials/plastics.htm.
[2] This report focuses on the economic impact of building PTO facilities, rather than the environmental and other benefits associated with reducing waste in landfills. For more information on recycling and waste reduction, visit http://chemistrytoenergy.com.
[3] The Plastics-to-Oil Technologies Alliance members include Agilyx Corporation, Americas Styrenics (affiliate), Cynar Plc, RES Polyflow, and Sealed Air (affiliate).
[4] It should be noted that post-consumer NRP is not the only source of feedstock for PTO facilities. Feedstock can also be derived from post-industrial waste; however, due to the limited availability of statistics on the volumes of available post-industrial waste, it is not accounted for our in this report.
[5] Using information provided by PTO Alliance members as well as industry research, it was determined that 20% was a realistic, albeit conservative, assumption for the purpose of the model.

effects account for an additional $5.2 billion output gain elsewhere in the economy. There is potential for the creation of as many as 8,800 direct jobs in PTO facilities, with an additional 30,100 jobs supported through the supply chain and payroll-induced impacts, totaling 38,900 jobs.

Methodology and Assumptions

There are a number of variables that affect the output of a PTO facility, including the quality and type of plastic feedstock. To take into account these variations, we developed two "model facilities," with variations in the nameplate capacity and effective throughput (barrels of oil per ton of plastic), and quality of material being processed. The assumptions for each facility are as follows:

1. *Model 1*: assumes a one-time $10.5 million private investment for one PTO facility and associated equipment. It assumes that each facility would process 10,600 tons of plastics on an annual basis and produce 42,500 barrels of synthetic crude oil each year. It is estimated that approximately 600 facilities of this production capability and size could process 20% of the amount of NRP landfilled each year.

2. *Model 2*: assumes a one-time $18.8 million private investment for one PTO facility and associated equipment. It assumes that each facility would process 18,300 tons of plastics on an annual basis and produce 106,000 barrels of synthetic crude oil each year.[6] It is estimated that approximately 350 facilities of this production capability and size could process 20% of the amount of NRP landfilled each year.

Post-consumer NRP has the potential to be one of the largest sources of feedstock for PTO facilities. Given the amount of post-consumer NRP landfilled each year, it is reasonable to assume that multiple facilities (Models 1 and 2, as defined above) could be supported. According to a 2014 report by Columbia University's Earth Engineering Center, [7] the amount of NRP landfilled in the United States in 2011 was estimated at 32.5 million tons. Assuming 20% of that NRP could be made available to be processed by a PTO facility, the U.S. would be able to support between 350 and 600 PTO facilities. To determine the total potential economic impact, the impact for a single facility was then adjusted to reflect the economic impact of multiple facilities.

The objective of the research was to quantify the direct effects of private investment in PTO 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* - the employment, output and fiscal contributions generated by the PTO facilities themselves.
- *Indirect impacts* - the employment and output supported by the sector via purchases from its supply chain.
- *Payroll-induced impacts* – the employment and output supported by the household spending of those employed directly or indirectly by the sector.
- *Spillover (or catalytic) impacts* - the extent to which the activities of the relevant sector contribute to improved productivity and performance in other sectors of the economy.

[6] There are economies of scale associated with PTO facilities; however, as these are difficult to quantify, there are not reflected in the models.
[7] Columbia University Earth Engineering Center, "2014 Energy and Economic Value of Municipal Solid Wastes (MSW), including Non-Recycled Plastics (NRP), Currently Landfilled in the Fifty States," July 2014.

This analysis focused on the first three channels listed. Though there would also be spillover effects from new investment in PTO facilities, these positive externalities (e.g., improvements in existing waste management infrastructure, expansion of technologies to other materials) are difficult to quantify and thus were not examined in the analysis. In addition to economic output (the value of the oil generated by the facilities), the effect of private investment in PTO facilities on employment was assessed. To accomplish the goal of the analysis, a robust model, using reasonable assumptions, of the direct, indirect and other economic effects was needed. To estimate the economic impacts from building a PTO facility, the IMPLAN model was used. The IMPLAN model is 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.[8] 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. Direct impacts – the employment, output and fiscal contributions generated by the PTO facilities themselves – refer to the response of the economy to the change in the final demand (output) of a given industry. Indirect impacts (or supplier impacts) – the employment and output supported by the sector via purchases from its supply chain – 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 – the employment and output supported by the household spending of those employed directly or indirectly by the sector – 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 analysis was broken into two parts: (i) the one-time change in final demand that occurs during the initial capital investment phase when the new facility is built and associated equipment is purchased (to simplify the analysis, we assumed that investments were made during a one-year period), and (ii) the ongoing changes in final demand that could occur once the facility is operational.

Added Output and Job Creation

The output and employment generated by PTO facilities and supply chain industries could be significant. The additional $6.2-$8.9 billion in economic output could generate 26,700 to 38,900 jobs in local communities.

In addition to the estimated 6,000-8,800 skilled direct jobs the facilities would create, the facilities would generate purchases of raw materials, services and other supplies throughout the supply chain. Thus, another 11,800-17,200 indirect jobs could be supported by the ongoing operations of PTO 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 8,900-12,900 jobs. Many of these jobs are in the local communities where the PTO facilities are situated. All told, the additional $2.6–$3.7 billion in output from the 350-600 PTO facilities could generate $6.2-$8.9 billion in total output to the economy and

[8] Because there was not existing industry information in IMPLAN for PTO technologies, ACC used data collected and existing information for similar industries to develop the IMPLAN model for this project.

as many as 38,900 jobs in the United States, generating a payroll of $1.4-$2.1 billion. Moreover, the new jobs would primarily be in the private sector.

Table 1: Potential Economic Impact from Plastics-to-Oil Facilities in the U.S.*

	Employment		Payroll ($bil)		Output ($bil)	
	Low	High	Low	High	Low	High
Direct Effect	6,000	8,800	$270	$390	$2.6	$3.7
Indirect Effect	11,800	17,200	$710	$1,030	$2.2	$3.2
Induced Effect	8,900	12,900	$430	$630	$1.4	$2.0
Total Effect	**26,700**	**38,900**	**$1,410**	**$2,050**	**$6.2**	**$8.9**

*Figures are shown in ranges, based on the two model facilities.

New buildings and equipment would be required for the PTO technologies.[9] Investments in 600 Model 1 facilities or 350 Model 2 facilities with a one-time estimated investment of $10.5 or $18.8 million per facility, respectively, over a one-year period could generate 36,600-38,100 jobs, mostly in the construction and capital equipment-producing industries. Indirectly, another $5.3-$5.5 billion in output and 23,100-24,100 jobs could be generated throughout the supply chain. Finally, a further $5.7-$5.9 billion in output and 36,500-38,000 jobs could be created through the household spending of the workers building, making and installing the new plant and equipment and those throughout the supply chain. All told, investments of $6.3-$6.6 billion in the PTO industry could support over 100,000 jobs and $6.0 billion in payrolls during the build-out phase.

Table 2: Economic Impact from New Investment in Plant and Equipment*

	Employment		Payroll ($mil)		Output ($bil)	
	Low	High	Low	High	Low	High
Direct Effect	36,600	38,100	$2,470	$2,570	$6.3	$6.6
Indirect Effect	23,100	24,100	$1,540	$1,600	$5.3	$5.5
Induced Effect	36,500	38,000	$1,770	$1,850	$5.7	$5.9
Total Effect	**96,200**	**100,200**	**$5,780**	**$6,020**	**$17.3**	**$18.0**

*Figures are shown in ranges, based on the two model facilities (small and large).

Conclusions

The potential economic effects of investment in plastics-to-oil facilities in the United States are overwhelmingly positive. Recovering energy from non-recycled plastics through plastics-to-oil technologies has the potential to bring about thousands of new jobs, billions of dollars in U.S. economic output, while reducing the amount of waste sent to landfills.

ACC's Economics & Statistics Department

[9] Although this report analyzes the economic impact of new construction, existing sites may also be converted to accommodate PTO technologies. Since the capital costs of refurbishing existing site can widely vary, they were not included in this analysis.

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.

Dr. Thomas Kevin Swift
Chief Economist & Managing Director
(o) 202.249.6180
kevin_swift@americanchemistry.com

Heather R. Rose-Glowacki
Director, Chemical & Industry Dynamics
(o) 202.249.6184
heather_rose@americanchemistry.com

Martha Gilchrist Moore
Senior Director- Policy Analysis and Economics
(o) 202.249.6182
martha_moore@americanchemistry.com

Emily Sanchez
Director, Surveys & Statistics
(o) 202.249.6183
emily_sanchez@americanchemistry.com