WHITE PAPER

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ExxonMobil's advanced recycling takeback programs leverage Exxtend™ technology and value chain collaboration

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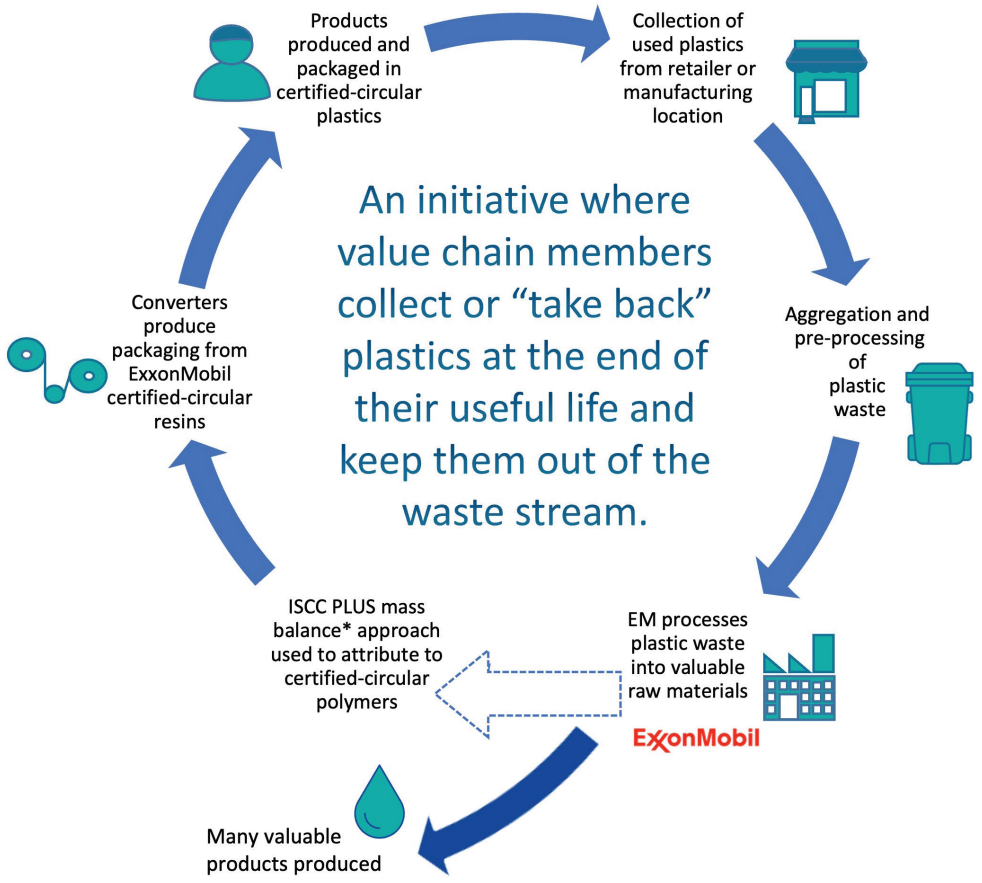
Advanced recycling can be a key enabler to recovering the inherent value from difficult-to-recycle plastic waste streams that are being landfilled or incinerated today. This white paper explores takeback programs – what they are, who participates, and why they are important to helping build a more circular economy for plastics.

What is a takeback program?

A takeback program is an initiative where value chain members collect (take back) products at the end of their useful life so they can be processed as feedstock for advanced recycling instead of being sent to landfill or incineration. These programs require multiple value chain parties to work together to help solve the challenges associated with recycling various types of plastics, which can be difficult to recycle.

Although each takeback program is unique, there are key common elements.



*ISCC PLUS mass balance approach using the "determined by mass" option with "certified free attribution" applied. Does not represent GHG emissions or recycled content.

Figure 1. Steps of a takeback program

It starts with plastic waste being generated when plastics, or the items contained within them, reach their end of life. This could include pre-consumer materials, such as trims in the manufacturing process from laminates that cannot be mechanically recycled. The plastic waste needs to be collected in a bin or Gaylord box on a production floor or in the backroom of a retail location.

Then, the material needs to be densified, which may be as simple as baling loose films. Densifying the material makes the storage and transportation steps more economical.

These materials are pre-processed either by shredding, granulating, or pelletizing, which is done by an aggregator, such as Cyclyx or iSustain. Densification is also necessary for the material to be fed pneumatically into ExxonMobil's facility in Baytown, Texas.

With Exxtend™ technology for advanced recycling, plastic waste is transformed at a molecular level into usable raw materials that are attributed via the ISCC PLUS mass balance approach using the "determined by mass" option with "certified free attribution" applied to the amount of certified-circular polymers we sell. These polymers can be made into new products that may be used and collected again.

For takeback programs to work, value chains need to be established, and members need to collaborate continuously. What happens to the plastic waste materials at one step in the process has a direct effect on what happens during subsequent steps along the value chain. The only way to implement solutions effectively and economically is by working together to identify barriers and overcome them.

Why are takeback programs important?

It is important to establish takeback programs globally because many plastics are used in short-duration applications, and only about 10 percent of those plastics get recycled.[1]

A key goal of takeback programs is to look at a specific waste stream and identify the gaps – the reasons why those plastics are not collected and recycled today – and then test solutions. Starting on a small scale allows the value chain to optimize processes, which in turn, allows takeback programs to be scaled up as more companies adopt them.

How to scope a takeback program

Scoping a takeback program opportunity starts with determining what should be collected, where to collect it, and then assembling the value chain. Typically, this includes a brand owner, a converter, an aggregator, and an advanced recycler, such as ExxonMobil.

The plastic waste materials will need to be analyzed for composition, and the sources of contamination will need to be assessed.

The next step is to generate cost estimates and determine how the costs will be shared. For example, if a location needs a baler, who in the value chain will pay for it – or any other special equipment that is required.

Value chain members should also schedule site visits, discuss employee training programs, and include a timeframe for both as part of the scope.

And finally, value chain members will need to agree on how to measure success.

What is the takeback process?

The first step in any takeback process is identifying what will be collected. Everything needs to be tested to understand what is in scope. This could be all the plastics at a particular location, or just some of them. The value chain participants need to decide as a group what will be collected and how much will be collected in each time period. These decisions will inform the pickup schedule.

The second step is figuring out what materials can be densified (using a baler or other equipment) at the source to make transport more efficient. The collected plastics will need to be aggregated and processed before being recycled. This part of the process is done by an aggregator.

Next, the collected materials will need to be transported to a facility for pre-processing and put into a physical form so that they can be pneumatically conveyed into a recycling unit. If the aggregator can pick up these in bales of flexible items (such as films and foams) and separate the bales, it saves a step downstream since these are processed on different types of machines.

The aggregator will then test the collected material to ensure it meets the proper specifications and to see what contaminants are present.

As with any other type of planning, details matter. When a takeback program launches, the key is to begin small, then test ideas and apply those learnings to a later investment so the program can be scaled up more efficiently and economically.

Addressing obstacles to success

There are three main challenges when dealing with difficult-to-recycle plastics: facilities, materials, and behavior.

Some facilities have limitations where the waste is generated, sorted, or aggregated. Examples include space constraints, which prevent the facility or location from separating out the plastics that could be recycled, or storage constraints where the facility generates a small amount of plastic waste but does not have anywhere to store it as it accumulates. Additionally, most facilities do not have equipment on site to bale film or to shred large rigid plastics to make them more economical to transport.

Facilities

- Limited space for collection bins
- Lack of aggregation points for fragmented streams
- Lack of equipment available, i.e. baler, shredder, etc.
- Inadequate recycling infrastructure

Material

- Challenging format, i.e. film, foam
- Multilayer/multimaterial
- Contamination

Behavior

- Lack of understanding by employees/ consumers on how to handle materials at end of life
- Complex procedures for separating plastic waste
- Perception that economic barriers cannot be overcome

Figure 2. Challenges of difficult-to-recycle materials

Material challenges refers to the format, such as film or foam, which most facilities are not set up to sort or process. Additionally, many plastic products are made of multiple types of plastic, and they have been designed that way to obtain a specific set of properties.

Contamination is an important topic that needs to be addressed. This could include types of plastics that are not a fit for the advanced recycling processes, such as polyvinyl chloride (PVC) or films containing polyvinylidene chloride (PVDC). Contamination could be dirt and sand for things like plastics that have been in contact with the soil. Another example is food or organic contamination, which is an issue for multiple reasons. The plastic waste will need to be tested for composition to ensure that there aren't any other contaminants present and that it meets the recycler's specifications.

The third challenge is educating takeback program participants who are in the collection part of the value chain. The key is to change procedures in such a way that you enable the most efficiency – cheaper, faster processing downstream. New procedures may need to be developed, and employees will need to be trained on how to sort the materials properly.

Part of the education process is changing the perception that the economic barriers associated with a takeback program cannot be overcome. These programs require an investment of resources by all value chain participants. Costs can be managed through close collaboration.

The value proposition is clear: giving plastic waste a second life, diverting these materials from landfills or incineration, and using them to produce new, valuable products that can be recycled again.

Conclusion

Takeback programs focus on value chain members who collect (take back) plastics at the end of their useful life and recycle them to keep them out of the waste stream. At ExxonMobil, we focus on difficult-to-recycle plastics that are not being recycled currently due to challenges with facilities or infrastructure, material format or composition, and behavior changes required.

Takeback programs allow value chains to select specific streams, identify why they aren't being recycled, and not only come up with solutions, but test and learn as the process gets streamlined. Once put into motion, these programs can help widen the range of plastic waste that can be recycled. They enable a more circular economy for plastics by diverting difficult-to- recycle plastics from landfill and incineration, which benefits all parties involved.

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[1]The World Bank. "Trends in Solid Waste Management." Accessed March 2024. datatopics.worldbank.org/what-a-waste/trends_in_solid_waste_management.html

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