5-13-2022

# Circular economy and the potential for extended producer responsibility policies

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Circular Economy and the Potential for Extended Producer Responsibility Policies

An Honors College Project Presented to

the Faculty of the Undergraduate

College of University Studies

James Madison University

by Erin Quinn

Accepted by the faculty of the College of University Studies, James Madison University, in partial fulfillment of the requirements for the Honors College.

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PUBLIC PRESENTATION

This work is accepted for presentation, in part or in full, at The JMU Honors College Symposium on April 22, 2022.

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# Acknowledgements

The foundation of this project would not have been possible without my opportunity to intern at RISE (a responsible industry for a sound environment), a standing committee of CropLife America. It was through that internship and being able to create a policy briefing on Extended Producer Responsibility policies that provided me a foundation for my research.

I would also like to thank my committee, my professors, and my family for their support during this entire process. I would also like to recognize my advisor, Dr. Alexander, Professor of Political Science, for all of his feedback and advice over the last two semesters. Thank you for your continued support. I have greatly appreciated all of the help you have provided. I would also like to thank my two readers, Dr. Coffman, Professor of ISAT, and Dr. Chamberlin, Director of the Independent Scholars Program. Lastly, I want to acknowledge the JMU Honors College, the Department of Political Science, and the Independent Scholars Program for making this thesis possible.

# Abstract

This thesis was developed based on an Extended Producer Responsibility (EPR) Policy briefing I created during my internship at RISE (Responsible Industry for a Sound Environment) during the summer of 2021. This project expands upon the work created during the internship. It examines the connection between circular economy and EPR policies, as well as how they can create effective strategies for waste reduction and recycling in the U.S. It demonstrates how the current linear economic system under which the U.S operates and its connection to single-stream recycling are inefficient at best. The thesis then describes how a circular economy (CE) can provide one pathway towards reducing waste and increasing recycling rates within the U.S. It examines EPR policies for plastic, packaging, and paper products (PPP) can help transition towards a CE. This thesis provides the foundation of EPR principles, the history of EPR as well as two case studies, one on EPR for rechargeable batteries in the U.S. and another focusing on national EPR policies in the European Union (EU). The benefits of EPR and CE are also described. A current state of the industry report is provided along with recommendations to help prepare businesses for the potential passage of EPR policies.

# Figures

# Introduction

The current economic market system in the United States is based on a linear system where producers are consistently developing new goods for consumers to buy and dispose of as they please. (Sharma et al 2020). It generates large profits for producers while keeping consumers satisfied. This system is facilitated by changing consumer trends, material importance, innovation, and the urge to always have the next best product (Molotch 2003). This if often referred to as affluenza, the ability, or the desire to continuously buy new luxury goods and products that follow societal trends and economic growth patterns (Ahlstrom et al. 2020). It keeps people continually wanting to buy more, leaving old products to be discarded. The combinational of the linear economy and consumer consumption patterns has created several issues. Under the current linear flow supply chain economic system, most products are not created with the idea of sustainability and reusability in mind (Sharma et al 2020). Producers today focus on developing products with specified lifetimes hoping to keep consumers eager for the next best make and model, often referred to as planned obsolescence (Milios 2021). Because of planned obsolesce and high rates of overconsumption by consumers it has led to a significant amount of waste being produced in the U.S. that most material recovery facilities (MRFs) in the U.S. are not equipped to handle (Cho 2020). This has contributed to high levels of pollution and environmental effects. Waste is also now being commodified and sold internationally to generate a profit. A common industry where this is done is e-waste (Moore 201). Although this is a has the potential to generate high profit it continues to incentivize overconsumption, heightening environmental impacts, and hurting the potential for long term economic growth.

Currently, in the U.S., recycling systems are funded by local governments that contract Material Recovery Facilities (MRFs) to take care of recycling duties such as collection,

transportation, sorting, and processing (LeBlanc 2020). These businesses collect recyclables and operate primarily through single-stream collection systems. Single-stream collection is when recyclables of all types are collected and disposed of within the same bin. There is no sorting done before the recyclables are collected (Leblanc 2020). Although this is easier for consumers as they dispose of all their recyclables together, it has prevented recycling rates from increasing. When all recyclables are placed together and disposed of in a large single stream it leads to higher rates of contamination from products, like dirty food containers (Cho 2020). When contaminated products end up in the recycling stream, it prevents a large number of products from being recycled, leading to higher rates of incineration and landfill disposal (Cho 2020).

High rates of contamination of recyclables, excessive production of recyclables, and a overall poorly constructed recycling system in the U.S. has lead MRFs and municipalities to rely on other countries to manage the recycling their products, specifically China (Katz 2019). However as of 2018 efforts to increase recycling through global strategies has become much harder. In 2018, China implemented the National Sword Policy, which states China will no longer accept recyclable materials from other nations with more than a 0.5% contamination rate. The ban specifically targets materials such as textiles, scrap paper, metals, and plastics (Katz 2019). Countries are no longer able to sell their recyclables to China unless they reach a 99.5% purity standard or above, which is extremely difficult to achieve (Katz 2019). MRs are responsible for screening and sorting recyclables to determining the purity standards through a screening and sorting processes (Exceeding Purity Standards 2021). China implemented this policy because roughly thirty percent of the recyclables they were receiving were contaminated causing them to have to discard them, ultimately leading them to end up in landfills in the countryside or oceans (Cho 2020). It has been estimated that 1.3 to 1.5 billion tons of plastic

ended up in China's ocean each year before the implementation of the Sword Policy (Cho 2020). Implementation of the Sword policy has ensured China is only receiving goods that they could recycle, preventing a future build-up of waste and unrecyclable materials (Katz 2019).

Prior to 2018, the U.S. recycling industry was heavily reliant on China for handling the processing of its recyclables. The U.S. would sell a majority of its recyclables to China to process each year (Katz 2019). In 2016, the U.S. sold 16 million tons of metals, plastic, and paper to be recycled (Cho 2020). Due to cheap transportation and high sales prices this allowed municipalities and MRFs to make large profits by selling their recyclables. For example, in 2017, Stamford, Connecticut, made $95,000 by selling their recyclables to China (Cho 2020). U.S. municipalities highly relied upon China to support their recycling efforts and primarily for generating a profit. MRFs were not concerned with the processing of recyclables and sorting (Katz 2019.) They only focused on collecting their goods and transporting their products at low costs to them to generate a significant amount of profit (Katz 2019). With our ability to no longer ship our recyclables to China, it has made it very difficult for U.S MRFs to process and recycle material domestically as they do not have the proper systems in place to manage such a significant number of materials (Katz 2019).

The implementation of the Sword Policies has put a significant amount of stress on U.S. recycling systems. Municipalities are struggling to find ways to deal with their recyclables as most U.S systems do not have the proper technology and are not willing to invest in processes to deal with the high influx of materials (Katz 2019). Because of this, most municipalities have currently decided to have their recyclables removed or transported to different countries, but this has come at extremely high costs (Katz 2019). For example, just a year later in 2018, Stamford, Connecticut, had to spend $700,000 to have their recyclables removed from the city (Cho 2020).

Bakersfield, California, was also another example, where after 2018, they had to pay $25 per ton of recyclables removed (Cho 2020). Some MRFs and municipalities have had so much trouble keeping up with these costs and the implementation of proper technologies that they have decided to cancel their recycling programs altogether to save money, especially in states such as Pennsylvania, Tennessee, and Florida (Lieber 2019) which has created a significant number of problems.

Overall, the poor industrial recycling practices in the U.S, excessive consumption habits, and the implications associated with the China Sword Policy it has led to low recycling rates, more recyclables ending up in landfills, and higher rates of incineration (Cho 2020). In the U.S., in 2018, only 30% of all municipal solid waste was recycled (National Overview, 2020), 8.7% of plastics (Plastics: Material-Specific Data,), and paper products had an overall recycling rate of 68.2% (Paper and Paperboard: Material-Specific Data). This is a stark comparison to European countries, like Germany, whose recycling rate was 60% in 2020 (Waste Recycling in Europe 2021). With a lower perceived cost to dispose of plastic in a landfill or ship it out of the country, many MRFs do not believe it is worthwhile to recycle goods because it is much more expensive, minimizing their potential to make a profit (Cho 1). It is important to remember MRFs are businesses and are seeking to generate a profit to continue to stay open. MRFs do not have to focus on increasing recycling rates if there is no legislation in place requiring them to do so. And although these actions save costs producers it places a significant cost on other human and non-human species related to negative externalities that stem from these actions.

The design of the linear economy and the high amounts of waste generated through it also create several economic inefficiencies. When goods that are recyclable go to waste it diminishes potential economic value created through recycling and reuse (Katz 2019). When

products can be recycled and reused it increases the value of a product and extends its materials lifecycle. Allowing for products continually to go to waste leads to greater economic resources and energy being spent on the development of new goods (Katz 2019). This causes unnecessary spending that could have been prevented if better recycling standards were established. High levels of waste also put pressure on municipalities, MRFs, and consumers. Municipalities are responsible for taking care of waste and contracting MRFs. When waste levels are high, it leads to more time and costs being spent to dispose of the waste. The costs to create a new landfill according to MSW Management are between $300,000 to $800,000 per acre (Duffy 2016). This leads to greater stress on consumers as it causes higher levels of municipal taxes to pay MRFs to create new landfills (Mooney 2014). Lastly, improper disposal of waste in the ecosystem and the environment leads to long-term economic inefficiencies. Cleaning up improperly discarded waste takes a significant amount of time and funding, as well as continues to exacerbate the costs and further the harmful environmental effects associated with post-consumer waste.

Over time, high rates of incineration and landfill disposal have caused several negative environmental externalities. Both landfills and incineration methods pollute ecosystems and release harmful greenhouse gasses, such as carbon dioxide and methane, into the atmosphere, driving the effects of climate change (Katz 2019). High levels of emissions also have the potential to create acid rain, which can run off into oceans polluting our waterways (Greenfelt et al. 2019). This ultimately threatens aquatic ecosystems as acid rain lowers the pH levels of water (Effects of Acid Rain). When pH changes, it can impact which species can live in that ecosystem as only certain species can survive at specific pH levels (Effects of Acid Rain 1). This can force certain types of species out of their ecosystem or possibly lead to localized or even overall

extinction (Effects of Acid Rain). It is clear that the current production and disposal system is creating numerous environmental issues that could create negative impacts across the country.

Therefore, due to low recycling rates and the numerous environmental externalities associated with our current recycling system, there has been a push to implement policies that help lead the U.S towards a Circular Economy (CE). CE is an economic system that emphasizes the reuse and refurbishment of products already within the market to limit high levels of material extraction for product development and cut down on the amount of waste being generated (McGinty 2021). CE focuses on diverting waste and incorporating it back into the production stream through the recycling process (McGinty 2021). The goal is to minimize the extraction of new resources, expand the lifespan and repairability of existing products, to help ensure that goods can be used as an input for another, system, product, or market. CE is considered a systematic change for the current economy and production system. It shifts our linear economic system of buying goods and simply disposing of them, to a closed-loop system where the products in the market are refurbished, reused, and sold back into the market for as long as possible (McGinty 2021). It works to prevent the cradle to grave mentality and implement a source to cradle to cradle system of product development (Kalin 2020).

Adopting a CE system can limit economic waste and increase the value of products. Creating products with reusability in mind it extends their life cycle increasing its economic value. By instilling a closed-loop system, it minimizes costs associated with resource extraction, production, and distribution (Towards a Circular Economy, 2013). This saves time, funding, and energy costs. When fewer materials and natural resources are being extracted it also limits the price volatility or fluctuation of products made from those materials by increasing their availability and supply (Towards a Circular Economy, 2013). Shifting towards a CE system also

decreases the costs associated with waste disposal. Less waste will need to be incinerated and fewer landfills will need to be created lowering municipality costs and the economic costs associated with the environmental impacts of waste (Towards a Circular Economy, 2013). CE also has several environmental benefits. It cuts down on the extraction of new goods, saves energy costs, extends our access to non-renewable resources through proper resource management, and minimizes the amount of waste being placed in landfills or incinerated all which have been mentioned above (McGinty 2021). It also limits the amount of greenhouse gases being emitted such as carbon dioxide and methane, helping mitigate pollution and the effects associated with it like climate change, acid rain, as well as air and water pollution (McGinty 2021).

There are several different policy options that have been evaluated to help reach a CE system within the U.S. This paper will specifically examine Extended Producer Responsibility (EPR) systems for plastic and packaging products, and how they can help lead to a sound recycling system within the U.S that is in line with the concept of CE. EPR is a regulatory policy focusing on the recycling system that shifts the responsibilities of recycling away from municipalities and onto the producers (Extended Producer Responsibility 2020). Under EPR policies, producers are required to reach a certain recycling rate for their products and post-consumer recycled content rates, which is a required percentage of recycled material included in new products (Extended Producer Responsibility 2020). These systems make producers responsible for the collection, transportation, and processing of their materials with the hope of increasing recycling rates and product reusability (Extended Producer Responsibility 2020). Within EPR policies, producers are given the option to comply individually or join a Producer Responsibility Organization (PRO). A PRO is a non-governmental organization that takes over

EPR responsibilities for businesses that join. Through this system, the goal is to minimize waste and increase recycling rates.

This thesis will be based on a public policy briefing I conducted during my internship at Responsible Industry for a Sustainable Environment (RISE), a standing committee of CropLife America. The briefing was created to educate and inform the trade associations members of the ways EPR for paper and packaging product (PPP) policies could affect them. Most of the organizations members consist of agriculture and pesticide companies that could be impacted by EPR for PPP policies due their use of plastic containers, drums, and packaging. The briefing that I created focuses on an EPR policy summary for plastics, as well as paper and packaging products (PPP), the history of EPR, a description of non-governmental organizations that can lead the change in EPR, a series of case studies for existing EPR programs in the U.S. and internationally, as well as a series of recommendations for RISE members to follow to best be suited for the change EPR policies will bring. This thesis will include many elements from the briefing I created during my internship. The original work will also be attached in the appendix to serve as a reference.

This thesis starts by examining the framework of the circular economy and how EPR policies are one option to help implement this systematic change. It will go on to break down the key pieces of EPR for packaging and paper product (PPP) policies and look at the modifications they will require producers to make. Next, it focuses on comparative analysis. It will look at existing EPR programs for other products in the U.S. like reusable batteries. Then, it will examine EPR programs in the EU. It will look at the different policy elements used in domestic and international programs, the requirements producers are required to meet, and the goals of each program. Recommendations will then be provided for future EPR programs for PPP

products in the U.S. They will provide potential program structures and cost-effective methods for adapting to the systematic changes required under EPR policies. This thesis will be able to serve as a document for producers to understand the background and basics of EPR and recommendations for how they can comply with EPR policies.

It is evident that in order to reduce waste and create a more efficient recycling system within the U.S. there needs to be a shift in the economic mindset of the country, specifically the creation and disposal of goods. U.S. markets currently run-in line with the linear economic market system (McGinty 2021). This is where producers are producing new goods with the intent of them eventually being disposed of when the newer version of the product is available. Under this system, producers are always seeking to produce the next best products to make a profit in a competitive market and fulfill consumer demands (McGinty 1). In linear economies, limited thought is taken towards what materials products are made of, if they are sustainable, and how long they will last. This system has led to inefficiencies and negative environmental externalities, which the first chapter will explore.

The crises precipitated by excessive waste provides the U.S. the opportunity to transition to a circular economy (CE), which can be done through the help of EPR policies. Shifting towards a CE system will help reduce resource extraction, increase the reusability of goods already present within the market, and limit the negative environmental externalities associated with the linear system (McGinty 2021). It can inspire innovative technological change long term profitable business habits, and cultural shift towards a focus on sustainability.

# Chapter 1

*The Current Linear Economic system and its Inefficiencies*

The current economic system of the U.S. is a linear economic system. This is a simple system where producers extract raw materials to create new products, and consumers buy and dispose of the products (Korhonen 2018). This system is rooted in a competitive market where several producers are competing against each other to earn the largest profit. This can be done by creating the highest quality or most durable product or selling a good at the lowest price in a common market such as the food industry (Towards a Circular Economy 2013). This system incites producers to consistently work towards making new products and trying to increase consumer demand. Because of this, the system leads to high rates of resource depletion and increased disposal (Jorgensen and Pedersen 2019). Producers also only amplify these effects as well through the concept of planned obsolescence (Guiltinan 2008). Planned obsolescence is when producers create products with a specific lifetime to keep consumers having to buy the newest version of the product (Guiltinan 2008). Planned obsolescence is evident in our consumer market today and is utilized by companies such as Apple and Microsoft (Hirsh 2021). Under this linear economic system, the value of a product diminishes as it makes its way through its life cycle in this system because it cannot be reused or refurbished in any way, it simply goes to waste (Towards a Circular Economy 2013). Although this system generates high levels of profits for businesses that rely on an economy of scale approach, it increases the amount of resources companies are using and the waste consumers are generating, which is often discounted when considering product "costs." Because of this, the linear economy has ultimately resulted in inefficiencies that are not capable of supporting producer and consumer needs in the long run (Towards a Circular Economy 2013). Green materialist such as Marx would consider this

primary contradiction of capitalism as it undermines the sole basis of production due to the significant negative externalities it creates (Benton 2018).

One inefficiency is price volatility. Price volatility is the fluctuation in the cost of raw materials that occur in relation to the materials supply (Towards a Circular Economy 2013). Under the linear economy system, we are starting to see price volatility associated with common materials like metals, increasing the price for products created farther down the supply chain. Because of the competitive nature of the linear economy and the drive to create a profit, resources are being extracted at high rates to meet the demand of consumers and keep up with the trends of innovation (Frankel 2010). When these products are being created, they are not designed with reusability in mind. This leads to most the raw material being wasted except for a few secondary markets in marginalized communities where individuals will often try to extract precious metals from discarded products like electronics, limiting their availability in the future (Frankel 2010). A decreasing supply of raw materials increases the costs for producers to extract materials because they are having to extract goods from harder-to-reach locations, ultimately raising the price of goods from consumers (Towards a Circular Economy 2013). This has been proven in research such as the McKinsey Price Commodity Index, where commodity sub-indices such as food, non-food agriculture, metals, and natural gas have shown fluctuations or increases in prices over the last several years due to limited resource availability (Towards a Circular Economy 2013).

Another inefficiency that stems from a linear economic system is the energy needed for production and the costs associated with it. In a linear economy, there is no energy being preserved within the system because all goods are going to waste. Products are sent through a single supply chain where they are produced and disposed of with minimal recycling (Korhonen

2018). Therefore, it is a highly intensive energy system through the extraction and production process because new products are always needed to be created to supply the supply chain and market. This takes considerable time and financial costs to producers. And when goods are hardly recycled it is creating heavy losses that could be avoided (Korhonen et al. 2018). Because of this, it continues a strict cycle of extraction and waste, increasing energy usage and financial costs. Goods being lost within the production process and not being incorporated into new products leads to an inefficient energy system that increases the environmental impact of the linear economic system (Korhonen et al. 2018). Through the circular economy, less energy is exerted in the production process because it cycles old products back through the production system rather than having to extract and develop new materials (Korhonen 2018). If products are well-made, they can also be used several times before having to go through the recycling process again. Glass is one type of material that can serve as an example. Although the original recycling process can be highly energy intensive it can be reused several times and recycled over and over (Pyzyk 2021).

Another inefficiency of the linear economy is lost product waste that occurs throughout the supply chain. In the linear economy, it is common for materials to be discarded in the production process or not incorporated into the product. In the early stages of extraction, waste can be created from over-extraction of raw materials and improper extraction preventing them from being incorporated into the product's development (Towards a Circular Economy 18). Waste can also be created in the transportation process if raw materials and finished products are not shipped or stored properly (Hicks et al. 2004). Contamination is also another threat in the early stages that can cause product waste if the product is not stored properly (Hicks et al. 2004). In the production, process waste can also occur if product additives are not added in the proper

quantities or are contaminated through the process (Hicks et al. 2004). During the production process, many items must also be shaped and molded. If this is not done properly or the edges of a product do not hold the proper shape they must be discarded (Hicks et al. 2004). Lastly, the waste occurs from the consumer when products reach the end of their life cycle or when a consumer chooses to dispose of them (Towards a Circular Economy 2013). It is estimated that in Europe, OECD Countries overproduce more than 21 billion tons of raw materials that are not incorporated into the supply chain each year. (Towards a Circular Economy 2013). When this happens, it increases financial losses for producers because the resources cannot be sold and generate a profit. Supply chain waste can occur for a variety of materials and packaging types. Industrial waste makes up the largest proportion of waste created throughout the supply chain. Industrial waste is considered any waste created in the manufacturing process or through industrial activities such as mining (Bell 2019). The EPA estimates that there is a total of 7.9 billion tons of material waste produced each year (Bell 2019). Almost all types of products and packaging can go to waste in the manufacturing process and throughout the supply chain. Plastics and glass are one example. They can potentially go to waste in the production process if they are not contaminated properly or resource the right colors (Hicks et al. 2004). Metals are another example, they can break during the extraction process, transportation, and the production process (Hicks et al. 2004).

Because the linear economy also focuses on a single stream of production, products are not made with reusability or recyclability in mind leading to high levels of waste at the end of the supply chain as well. Products are created to only be used for only a period and eventually being disposed of. Under the linear economy, the producer's goal is to continually create new products which takes away from the focus on creating products that are meant to last and be recycled

(Guiltinan 2008). This also links to the concept of planned obsolescence; a strategy producers use to try and minimize their products life expectancies to consumers to buy new ones (Guiltinan 2008). Companies such as Apple and Microsoft are often recognized as companies that produce their goods in line with their strategy (Hirsh 2021). This has led to low recycling rates across almost all product categories in the U.S and put a significant rate on MRFs to keep up with waste production, recycling, and disposal. As of 2018 the EPA estimated, the U.S. produces 292.4 million tons of municipal waste a year and only 30% of that waste is being recycled (National Overview... 2020). This has led to a significant buildup of waste within the U.S. and put a strain on the U.S. MRFs, forcing them to use disposal methods such as landfills and incineration. In 2018, 146.1 million tons of wasted ended up in landfills and 36.4 tons were burned with energy combustion (National Overview...2020). These effects have led to several negative environmental externalities.

The linear economy has led to significant environmental impacts. There are several environmental externalities caused throughout the entirety of the supply chain and linear economic system. One of the primary environmental concerns associated with the linear economic systems is the level of greenhouse gasses, particulate matter, and pollutants produced. Greenhouse gasses such as methane and carbon dioxide (CO2) and other pollutants are released through the entirety of the extraction, production, distribution, and disposal of goods due to fossil fuel combustion, such as oil, natural gas, coal, and biomass. Gases and pollutants are emitted in the extraction process through the use of equipment used to extract raw materials (Overview of Greenhouse Gases). They are produced in the production process at large factories that burn large amounts of oil, coal, and natural gas to create energy to power the equipment during the production process (Causes of Climate Change). These pollutants are released through the

distribution process through the use of cars and the gas they burn during transportation. Lastly, they are emitted in the incineration process and landfill disposal (Katz 2019). Incinerators burn large amounts of coal and oil leading to high rates of CO2 emission and methane is released during the decomposition of waste in landfills. Greenhouses gases and other pollutants are harmful to human health, the environment, and can also exacerbate the effects of climate change leading to long-term ecological consequences. As of 2020, greenhouse gases are 48% above pre-industrial levels, exacerbating the effects climate change (Causes of Climate Change).

Greenhouse gases (GHGs) play a large role in the rise we are seeing in global temperatures and the effects of climate change. Examples of GHGs include carbon dioxide and methane. GHGs are primary pollutants that are directly emitted through the industrial process like the burning of fossil to produce. They can also be released at the end of a products life through incineration (Causes of Climate Change). When the level of GHGs released is higher than what is necessary to keep the troposphere from freezing and what can be absorbed by the environment and natural biogeochemical cycles, like photosynthesis, it creates several problems Denchak 2019). High levels of GHG molecules in the atmosphere increase the absorption of lower frequency infrared radiation (IR). This causes the molecules to vibrate trapping heat in the atmosphere increasing the surface temperature of the earth (Denchak 2019). The increasing temperatures have brought and are expected to bring other environmental issues such as increased floods, droughts, hurricanes, severe weather patterns, a rise in sea level, ecosystem transformations of where certain species can live, unstable temperatures, poor farming conditions, and increased levels of secondary pollutants (Overview of Greenhouse Gases).

Particulate matter, smog, and nitrogen dioxide are all examples of secondary pollutants associated with industrial process, that can cause negative externalities. These pollutants are not

emitted directly through a source, but through chemical reactions with molecules in the atmosphere, with exception of particulate matter (Manisalidis et al. 2020). Each type of secondary pollutant causes a different type of impact. Particulate matter and smog are two types of secondary pollutants that are known to impact air quality human health. Particulate matter is small particles released into the atmosphere often associated with the industrial process and human activities (Particulate Matter). These particulates can range in size and are often forms of debris, soot, ash, and dust. The effect particulate matter has the on the atmosphere depends on this size of particulate and their quantity in the atmosphere (Particulate Matter). Smog is ground level ozone which is formed when chemicals associated with industrial processes react with heat and sunlight (Why Smog Standards...). When particulate matter and smog levels are high it can decrease the air quality and cause severe impacts on human health. Poor air quality can irritate the lungs of humans making it more difficult for those with asthma and allergies to breath (Why Smog Standards...). If individuals also face consistent exposure to particulates, they potential to break through the body's natural defense mechanism and reach the lungs. If lungs are repeatedly exposed to particulates is can led to long-term respiratory and cardiovascular diseases (Manisalidis et al. 2020). This has particularly been seen as an issue in several developing countries across the world like India, Ghana, and the Philippines, as their economies are dominated by industries, including high polluting manufacturing plants (Manisalidis et al 2020).

The release of other secondary pollutants like nitrogen dioxide can also cause other environmental impacts. Nitrogen dioxide is created through the chemical reaction of nitric acid and oxygen in the atmosphere. Nitrogen dioxide has the potential to produce is acid rain (Nitrogen Dioxide). When pollutants such as sulfur dioxide and nitrogen dioxide are released into the atmosphere they react with water and form sulfuric and nitric acid (What is Acid Rain).

These acids are then incorporated into rain when it falls (What is Acid Rain). Acid rain impacts ecosystems in several ways. It has the potential to affect aquatic ecosystems like lakes, oceans, and streams. When acid is introduced into these bodies of water it releases higher levels of aluminum in the water (Effects of Acid Rain). When aluminum levels are changed it impacts the pH of the water (Effects of Acid Rain. Increased acidity means lower pH levels of water. This impacts the type of species that can survive in those ecosystems as most are only able to tolerate a certain range of PH and aluminum levels (Effects of Acid Rain). Higher acidity levels can also affect the reproductive capacity of organisms over time (Effects of Acid Rain). Acid rain can affect plants and trees as well. When acid rain interacts with soil it can draw aluminum out from the ground (Effects of Acid Rain). This can prevent plants and trees from getting access to the minerals and nutrients necessary for their survival. Areas with high levels of acid rain can also impact farming due to this (Effects of Acid Rain).

*Life Cycle Assessments*

One useful strategy that can help provide an understanding of anproducts impact in the linear economy is Life Cycle Assessments (LCAs). LCA's track the total inputs and outputs throughout a products life to generate an understanding of the overall impact a product has (Alhazmi et al. 2021). There are typically four main phases of LCA's. The first phase is the goal and scope which outlines the format of the assessment and what it is hoping to achieve (Alhazmi et al. 2021). The second, is the life cycle inventory, this accounts for all the inputs used in the creation of a production and the outputs is generates (Alhazmi et al. 2021). Third, is the impact assessment, where the data gathered from the inventory report is sorted to into different categories based on its environmental impact (Alhazmi et al. 2021). The fourth phase is interpretation and examining the effects of the product and what could potentially be changed.

LCAs can also be conducted among multiple products to see which material has the lowest impact and should be utilized over others (Alhazmi et al. 2021). LCAs are typically isolated to a specific time and geographic location due to the significant amount of data they require.

LCAs under the linear economy are viewed examined through the cradle to grave approach. Examining the overall effects of the products production until it is discarded. Plastic packaging is one common product which LCAs have been performed on (Alhazmi et al. 2021). LCAs for plastics examine all the materials incorporated, costs, and energy utilized in the creation of the product (Alhazmi et al. 2021). They also examine all the outputs of the product such as GHG emissions, particulate emissions, water waste generated, and the overall amount of waste produced (Alhazmi et al. 2021). The results are typically sorted into impact categories and given a score based on the level of impact the LCA of a product has in that area. A higher impact would translate to a higher score (Alhazmi et al. 2021). Common impact categories for LCA's of plastic packaging products include global warming potential, particulate formation potential, acidification potential, eutrophication potential, and human toxicity (Alhazmi et al. 2021). Once impact scores are assigned an assessment is made of how significant the impact is based on the how high the scores are in each category. This also helps provide an understanding for which parts of the products development or life cycle could be altered to minimize the impact (Alhazmi et al. 2021).

One notable LCA for plastic packaging was done by the American Chemistry Council in 2018 (Groh 2018). The LCA conducted an analysis of several different plastic packaging including low-density polyethylene (LDPE), high-density polyethylene (HDPE), polypropylene (PP), polyvinyl chloride (PVC), polystyrene (PS), expanded polystyrene (PS), [and] polyethylene terephthalate (PET) and compared them to alternative packaging materials such as steel,

aluminum, glass, paper-based packaging, fiber-based textiles, and wood (Groh 2018). The study examined the inputs and outputs of each products scored each product in several impact categories including total energy utilized, global warming potential, eutrophication potential, smog formation, acidification potential, and ozone depletion potential of plastic packaging compared to the alternatives (Groh 2018). The results between all product categories were compared between each material (Groh 2018). The study showed that plastic packaging had an overall lower environmental impact than all other types of packaging products examined in the study. It determined plastic can be more efficiently recycling and has the potential to be more efficiently reused compared to other resources (Groh 2018). Studies like this show how life cycle analysis can help examine inefficiencies of products in the linear economy and guide us towards the ones that we should utilize more to minimize our impacts.

*Introduction to Circular Economy*

One alternative to the linear economy is the circular economy (CE). The idea of CE has been a topic of research since the 1960s and was first introduced to scholarly literature by Pearce and Turner in 1989 (Sariatli 2017). Since then, the concept of CE has continued to be studied and developed. Today, CE can be defined as an economic system that works to minimize waste and increase energy efficiency through an emphasis on recycling, reusability, and refurbishment of products already in the supply chain (Geissdoerfer et al. 2017). CE is considered a systematic change from the current linear economic system. The goal is to create a closed-loop system that minimizes the production of new products and goods instead, focusing on increasing the life expectancies of products already in the market (Jorgeson and Pederson 2019). This requires producers to shift product design and create products that are meant to last and can be incorporated into new products or easily refurbished, adding value to the supply chain rather than

destroying it (Stahel 2016). It is also important in CEs to continue to utilize LCAs to see which products are creating the lowest environmental impact and could be most successful for the creation of a closed loop system.

There are several companies that have worked to close the loop and proven the transition to a CE can be possible. One example is Adidas, which introduced a sneaker, the Ultraboost, made from fully recycled products in 2020. Ultraboosts are made from one single piece of recycled material without any glue being used within the production to hold the product together (Fleming 2020). Adidas also established a consumer take back program where consumers can return their used sneakers to the store once they no longer want them so they can be recycled and used into the development of new products (Fleming 2020). Nike has also taken strides in proving that utilizing circular economy practices does not have weaken product quality. For the 2021 Olympics athletes from France, the U.S., and Brazil competed in uniforms made from one hundred percent recycled polyester (Mazzoni 2020). Finally, Burger King also demonstrates how CE can be reached for packaging products (Mazzoni 2020). In 2020 Burger King began testing out reusable food and drink containers in partner with Terra cycle, a post-consumer content technology company. Burger King has also set a goal to have all packaging containers made from recycled, renewable, or certified sources by 2025 (Mazzoni 2020).

To instill a CE, several system changes must be implemented, and preconditions must be met. One precondition that Milios describes is incorporating eco-design principles in product design and choosing materials that can be reused easily. Eco-design principles work toward developing products to meet an extended life cycle and can easily be recycled by consumers (2021). This is helpful towards achieving policy initiatives like EPR as it can help producers meet recycling and post-consumer required content rates. Another precondition he describes is

Circular Business Models (CBMs). CBMs are a system where producers work to increase the residual value of their products over time through designing products with sustainability in mind and providing take-back products to increase circularity like leasing systems, pay-per-results, and sharing (Milios 2021). The third foundation for CE is reverse supply networks. This is the implementation of reverse supply chain logistics, which means establishing a system that provides a way for producers to retrieve products at the end of their life to reuse them or recycle them properly (Milios 2021). One final condition that is necessary, is implementing the proper technology. To implement a true CE system, there will need to be more accessible technologies available that can break down constituent materials and depolymerize different plastics so they can be incorporated into new materials (Stahel 2016). However, for any of these foundations to be met it will require an enabling condition that supports the transition to a circular economic system such as a policy mechanism, financing, or regulations. This paper will specifically look at one CE policy enabling condition known as Extended Producer Responsibility (EPR).

# Chapter 2

### *Introduction of EPR and an Overview of Single Stream Collection*

Extended Producer Responsibility (EPR) for plastic, as well as other packaging and paper products (PPP), has emerged as one type of policy enabler to help create a transition to a circular economy. EPR, also referred to as Product Stewardship, is a policy approach that shifts the post-consumption management of waste from local governments to manufacturers and producers. This means producers would be responsible for collecting, disposing, and recycling their products at the end of their life (Extended Producer Responsibility… 2020). Most policies also require producers to reach specific recycling rates, as well as meet minimum thresholds for post-

consumer recycled content. Under these policies, producers must not only recycle a certain percentage of their materials but create new material in the future with a certain percentage of recycled materials. Common products that are subject to these standards are glass containers, and plastic containers like wine bottles, soda bottles, and milk containers (Extended Producer Responsibility… 2020). The goal of this is to increase recycling and minimize the extraction of new materials in the production process.

EPR is a large change from the current post-consumption management of waste. Currently, local governments and municipalities are responsible for recycling and disposal of waste. Under this system, consumers pay for the programs through local taxes. The local governments then contract material recovery facilities (MRFs) to take control of waste collection, processing, and recycling responsibilities of municipal waste (Leblanc 2020).

Today, the most common way of collecting and recycling goods by MRFs is a single-stream collection process (Leblanc 2020). This means all recyclables of all different materials are disposed of in the same bin and are collected all together by MRFs. Although this makes it easier for consumers to recycle their products, it makes it significantly harder for MRFs to recycle products. When products are recycled in a single stream, MRFs must use equipment with the assistance of human labor to sort the products by whether or not they meet recycling standards and whether or not they are contaminated, a common disadvantage of the single-stream recycling

process (Cho 2020). Once goods are sorted based on their recyclability, they are then sorted based on their material type and weight. This process takes a significant amount of time and costs to account for the labor and energy costs of operating the facility (Leblanc 2020). Below is an image depicting the specific process of how materials are recycled through single-stream recycling.

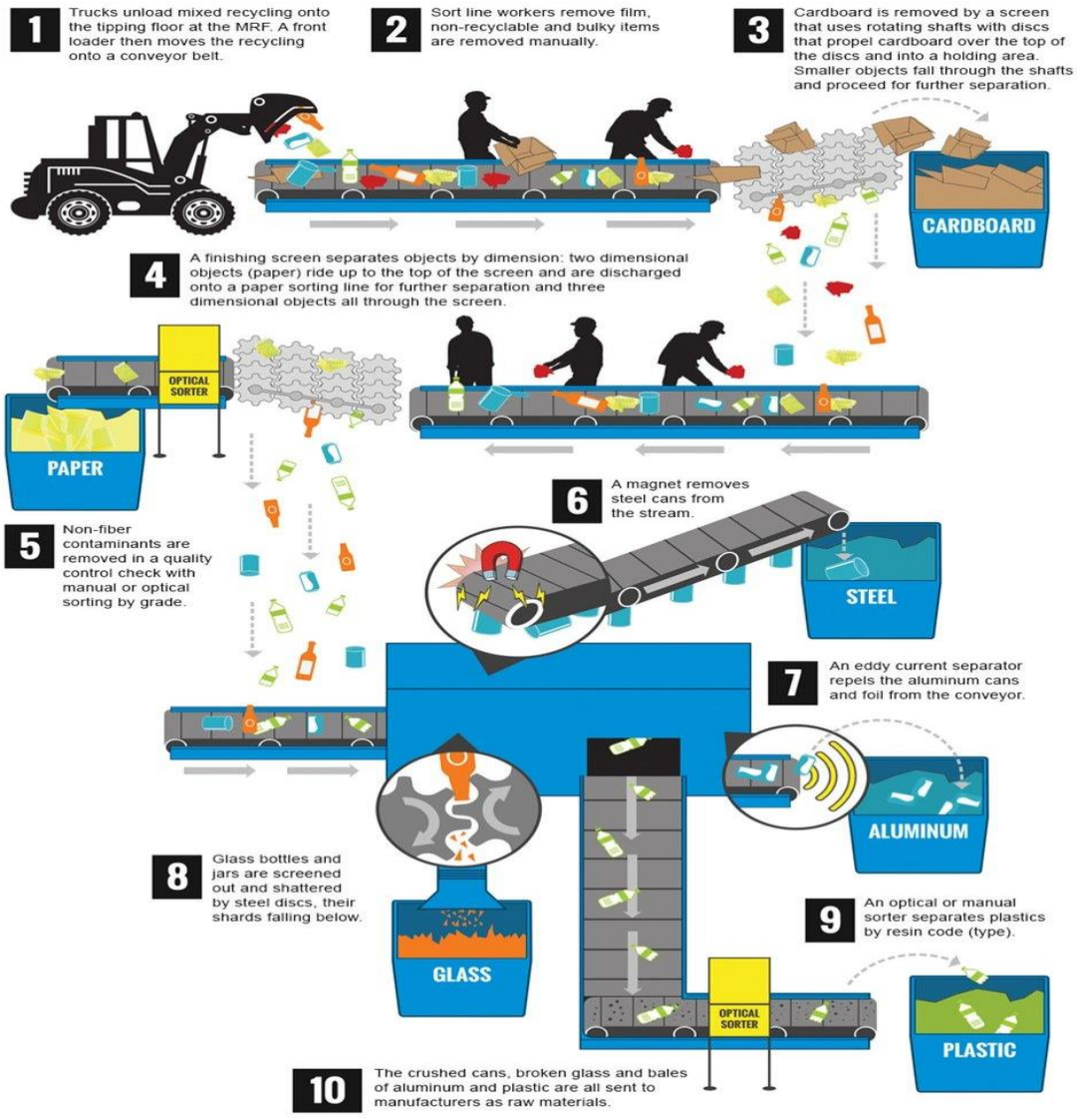



Figure 1: Single Stream Recycling, (Advanced Disposal)

EPR departs from the single-stream collection process because it puts the responsibility of collecting waste and recycling away from municipalities and onto product producers (Extended Producer Responsibility… 2020). EPR requires producers to meet policy components like creating drop-off centers for consumers to drop off old products, recycling rates, post-consumer content rates, and providing educational materials for consumers on EPR systems and the recycling process. Under EPR, producers must collect their products at the end of their life and contract material recovery facilities to assist with pickup, transportation, processing, and recycling of their products, to help work towards high post-consumer content rates in the development of new goods (Extended Producer Responsibility… 2020). EPR Legislation typically allows producers and companies to handle these responsibilities individually or join an organization such as a Producer Responsibility Organization (PRO). PROs are non-governmental organizations that take over the collection and recycling responsibilities for producers of specific products and materials (Extended Producer Responsibility… 2020). PROs typically help producers meet most components of EPR policies, such as setting up collection centers, reaching target recycling rates, creating educational programs, and providing yearly reports to the government in charge of the program (Gendell 2021). The cost of membership for a PRO is typically based on the weight of materials the PRO collects on behalf of the producer. Below represents a broad description of the way products are cycled through EPR systems. EPR programs also put greater pressure on producers to achieve higher recycling standards due to the fines producers will face if they fail to meet the standards the legislation sets out, something which local municipalities were ever subjected to.

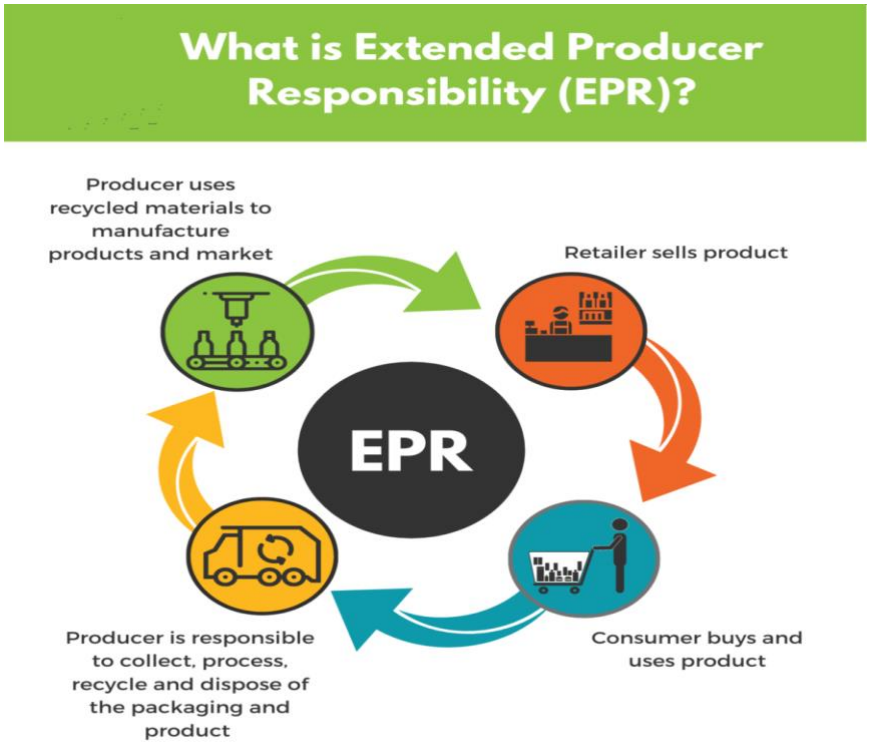



Figure 2: What is Extended Producer Responsibility, (Extended Producer Responsibility 2021).

*History of EPR in the U.S.*

The development of EPR policies within the United States has primarily taken place on the state level as the U.S. lacks any national comprehensive EPR policies. The development of the EPR in the U.S. has been slow as most pieces of state legislation only focus on instilling EPR programs for one specific product. The first EPR programs in the U.S were passed in 1991 in New Jersey and Minnesota, focusing on the recycling of rechargeable batteries. (Nash and Bosso 2013). These programs required producers to cover the costs and end-of-life management of the batteries. Manufacturers under these laws are allowed to comply with the policies individually or join the established industry PRO, Call2Recycle (Nash and Bosso 2013). Following the successful enactment in New Jersey, several other states created similar programs in the early

2000s including Maryland and Maine (Nash and Bosso 2013). A case study of Call2Recycle is included in Chapter 4 highlighting how the PRO operates and the EPR compliance mechanisms are reached.

Besides rechargeable batteries, the U.S. has also developed EPR programs for mercury thermometers, paint, auto switches, and electronic waste in the early 2000s. Maine, Vermont, California, Rhode Island, and Illinois are some of the states that have instilled programs in these product areas (Quinn 2021). The passage of the Basal Convention in 1992 played a large role in the implementation of these early EPR polices. The Basal Convention is an international agreement that works to protect the health of the environment and humans against result from the transboundary movement of waste and hazardous waste (Basal Convention on Hazardous Wastes 2021). The U.S. has showed its support to the convention through signing but has not ratified it preventing from having full legal powers (Basal Convention on Hazardous Wastes 2021).

Today, Electronic waste is now seen as one of the most common EPR pieces of legislation within the U.S. Currently, 25 states have electronic waste recycling systems in the U.S. (Regulations, Initiatives and Research on Electronics Stewardship). Most of these programs put full responsibility for recycling on the manufacturers and require them to meet specific performance rates such as the volume of materials collected, and a percentage of the total waste recycled (Nash and Bosso 2013). Some of the products covered under e-waste legislation include televisions, computers, fax machines, phones, and DVD players (Recycle Indiana 2021).

In the past few years, the U.S. has also begun to see a push toward broader EPR policies, specifically EPR for PPP. This can primarily be credited to the implementation of China's National Sword Policy in 2018, which prevented other nations from shipping and selling their recyclables to China. Before the enactment of the National Sword policy, the U.S. shipped and

sold 70% of its recyclables to China each year (Katz 2019). China is now only accepting the highest quality goods with a percent purity standard of 99.5 leading to higher levels of waste pileup in the U.S. Governments do not have the resources or the funds to recycle most materials leading to increased incineration of recyclables and a higher volume ending in landfills. This has led some municipalities to completely stop recycling due to the costs, lack of funding, and technology to process the high influx of recyclables (Katz 3). Because of this, EPR has emerged as one of the potential policy solutions for increasing recycling and creating a market for recycling for PPP and plastics in the U.S.

Overall, as of 2021, there are a total of 119 EPR programs in the United States, spanning 33 different states, and covering 14 different materials (Semuels 2020). Most programs primarily deal with heavy and high-cost recyclable materials such as paint, carpet, mattresses, fluorescent lighting, pharmaceuticals, and electronics. Currently Maine, Vermont, and California have the highest number of EPR programs in place compared to other states. However, more states are beginning to explore the potential for EPR programs especially those that cover a broader range of materials. In 2021 there were a total of 32 pieces of EPR focused legislation introduced with a majority focused on packaging and paper products (PPP) (Yang 2021). This includes materials made from plastic, paper glass, steel, and aluminum. California, Hawaii, New York, Oregon, and Washington have been some of the leaders in trying to pass EPR legislation that covers plastic and paper packaging (Yang 2021). There has also been a piece of federal legislation introduced, The Break Free from Plastic Pollution Act, that specifically focuses on plastic waste reduction, extended producer responsibility, and increasing post-consumer recycled content in new

materials (Break Free From...2021). Below provides a detailed map of how many different product areas there are for EPR policies and the number of EPR policies each state has in place.

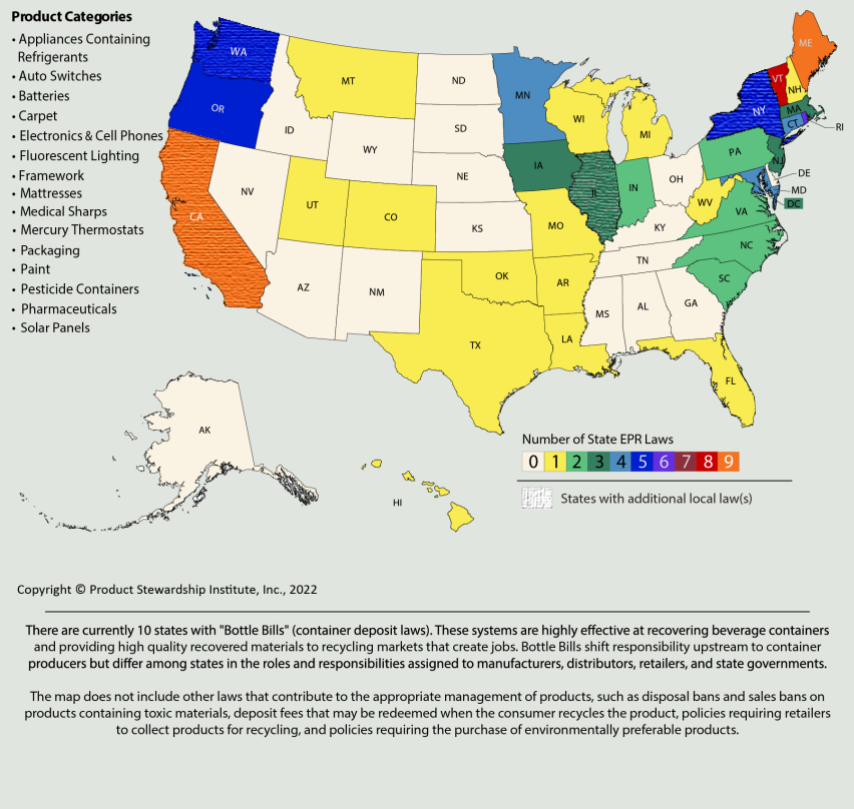



Figure 3, Map of U.S. States EPR Laws (U.S. State EPR Laws)

# Chapter 3

*Broad Overview of EPR Policy Components*

A majority of the EPR bills that have been introduced in legislatures across the United States and internationally follow a similar framework and requirements that producers must abide by. The key component is being enlisted in an approved producer responsibility plan, which can also be referred to as a stewardship plan. Producer responsibility plans have many requirements they must meet including a description of how the recycling process will be run, the development of educational resources, an annual report, the development of PRO, and a penalty fee structure (Extended Producer Responsibility… 2020). Producer responsibility plans

typically must be approved by state government departments, like the Department of Environmental Quality, Department of Agriculture, or Department of Health. For example, Connecticut's EPR programs must be approved by the state's Department of Energy and Environmental Protection (What is Product Stewardship). Producers who fail establish EPR programs or join a PRO will be fined. Each of the primary components of EPR polices is listed in the chart below and expanded upon in their own section.

**Table 1: EPR Program Components**

| **Policy Tool** | **Brief Description** |
|---|---|
| Producer Responsibility Organization (PRO) | A Nonprofit (501c3) organization that producers join to run their EPR programs. The organizations are responsible for creating an approved EPR plan that meets all of the legislative requirements. Producers must pay a membership fee to join these organizations (Extended Producer Responsibility… 2020). |
| Recycling Access | The availability of recycling opportunities for the consumers[?] (Extended Producer Responsibility…2020). |
| Performance Standards | Goals that the policies set for producers to meet within a given time frame. The most common performance standards included in EPR legislation are recycling rates and post-consumer recycled content rates (Gendell 2021). |
| Educational Programs | Materials the producers or PROs provide to consumers informing them of EPR programs for products. It includes information about the backgrounds of EPR, where their nearby drop-off locations are, and the benefits of EPR systems (Concerning the Management...2021). |
| Producer Responsibility or Stewardship Council | A group of stakeholders chosen to advise government departments and PROs on the creation of producer responsibility requirements. They also provide feedback and advice on producer responsibility plans (Concerning the Management...2021). |
| Annual Report | A report a company or PRO affected under EPR policies must submit each year. Should include a link to the PROs or organizations website. Include information about product collection, education resources, and recycling rates (An Act to Save Recycling Costs… 2021). |

| | |
|---|---|
| Penalty Structure | Costs producers face for not complying to EPR policies (An Act to Save Recycling Costs...2021). |

*Producer Responsibility Organizations*

Producer Responsibility Organizations (PROs) are non-profit organizations (501(c)(3)) that serve specific industries and take responsibility for their recycling and waste management (Extended Producer Responsibility… 2020). PROs can be industry-specific or cover a wide variety of materials. Joining a PRO is one-way producers can meet recycling requirements established under EPR legislation (Mayers and Butler 2013). PROs do this by creating producer responsibility plans that they run for their members, which meet all of the necessary EPR requirements. Plans typically include the creation of collection facilities for consumers to drop off producer's packaging, transportation of materials, processing of materials, development of post-consumer recycled materials, the development of performance standards for post-consumer recycled content and recycling rates, and educational material for consumers to learn about the program as well as what materials can be recycled.

Often PROs work to contract material recycling facilities (MRFs) to help operate the recycling and collection process. MRFs typically collect goods from collection facilities and take them to recycling facilities. At these facilities, materials are typically broken down physically and chemically to be used in the creation of new products (Mayers and Butler 2013). These materials are then sold or given back to producers to use in the development of new products. This helps assist producers in reaching recycling rates as well as post-consumer content rates (Mayers and Butler 2013).

In order to join a PRO, producers must pay a membership fee (Mayers and Butler 2013). This fee can either be a base fee or based on the number of materials collected from the

producers. PROs also typically have violations in place if producers do not comply. Some also offer incentives to reduce the costs for those who meet requirements or exceed post-consumer content and recycling rates. One example of well-established PRO is Call2Recycle, which has served as the PRO for the reusable battery industry since 1994 (Our History 2017).

*Recycling Access*

EPR legislation requires producers to provide easy recycling for consumers. Producers and PROs must provide several collection opportunities through drop off locations or other services such as curbside pickup. If they provide collection locations, there should be several across the state and easy for all consumers to access. Recycling drop-off centers should also be listed on the PRO's website and in educational materials (Extended Producer Responsibility… 2020). Drop off locations can be at stores like Adidas take back program or established drop off sites (Fleming 2020).

*Performance Standards*

Performance standards are the requirements that EPR policies set out for producers to achieve in a given amount of time. The most common performance standards included in EPR legislation are recycling rates and post-consumer recycled content rates. The recycling rate is the amount or proportion of materials producers are required to recycle each year under EPR policies. It is the total amount of goods a producer collects to be recycled based on the total amount of their waste generated with intention of being reused (Gendell 2021). It is typically expressed in a percentage. An example of recycling rate requirements outlined in EPR policies could be that the recycling rate for plastic packaging must reach a recycling rate of 65% by July 1, 2027, 85% by July 1, 2031, and 100% by July 1, 2035 (An Act to Save Recycling Costs…2020). Post-consumer recycled content rate is the amount of a new product that is made

from recycled goods. It is expressed as a percentage in relation to the total makeup of the product weight. Post-consumer content rates are typically achieved in EPR for PPP policies through the use of technology that breaks down plastic through a melting process where it is then purified, mixed with additives to reach the desired qualities, and then repelletized to be used again (Gendell 2021). An example of post-consumer content rate requirements outlined in EPR policies could be that plastics and paper products will be required to meet no less than 15% of postconsumer plastic requirements by weight from January 1, 2023, to December 31, 2025, no less than 25% from January 1, 2026, to December 31, 2030, and no less than 50% from January 1, 2031, and on (Concerning the management….2020).

An example of company that is being utilized to increase post-consumer content rates for PPP products is EREMA. EREMA uses two different technologies that each break down different types of material (Application Post Consumer). The first is the INTAREMA® TVEplus®, which can break down; lightly printed films, PE washed cuttings, PE film with paper content, metallized BOPP film, washed PE film flakes, agriculture film, PE film with paper labels, and PP film with solid contamination (Application Post Consumer). The process starts for the creation of new material through the INTAREMA® TVEplus® by first feeding the material onto the machine's conveyor belt, which takes it to the preconditioning unit (Application Post Consumer). Once in the preconditioning unit the material is cut, mixed, heated, dried, pre-compacted and buffered through innovative counter current technology. It is then moved to the extruder screw where it is plasticized and degassed in reverse (Application Post Consumer). Next, the material is then filtered and cleaned after being fully plasticized, where it is then sent back to the extruder for a second time. After being degassed for a second time it goes through homogenization. After homogenization the material is sent to the degassing zone to be degassed

for the third time. Finally, it goes to the discharge zone where it is pelletized at a very low pressure (Application Post Consumer). The pellets are then sold to end markets to be reused in the production of new materials.

The other technology EREMA utilizes is the INTAREMA® Regrind Pro® (Application Post Consumer). The INTAREMA® Regrind Pro® is like the INTAREMA® TVEplus® except it breaks down different materials. The INTAREMA® Regrind Pro® breaks down thick walled regrind particles, high bulk density, and HDPE rigid materials. The process for the creation of new material begins on the INTAREMA® Regrind Pro® once the materials are placed on a conveyor belt and taken to the preconditioning unit where they are warmed homogeneously and degassed for the first time (Application Post Consumer). The materials are then sent to the extruder screw where they are melted and degassed for the second time. Next, they are then sent to a laser filter where all contaminants are removed. The materials are then homogenized again and moved to a double venting chamber. In the venting chamber they are degassed for the third time and pelletized (Application Post Consumer). The new materials created from these processes are then sold back to consumers be incorporated into the development of new goods.

*Educational Programs*

Producers and PROs are responsible for providing educational outreach to consumers under EPR policies. Producers or PROs should provide material to consumers explaining how EPR systems work, what materials can be collected under the policy, where materials can be collected, and the benefits of recycling. Education resources should be provided through social media channels, campaign flyers, and through the PRO's or producer's website (Extended Producer Responsibility… 2020). An example of one of Call2Recycle's educational resources can be found here (Program Resources 2016).

*Producer Responsibility and Stewardship Councils*

A majority of EPR legislation calls for the establishment of a Producer Responsibility or Stewardship Council. These councils are made up of ten to twenty stakeholders involved in different stages of the recycling process. Most councils have members from national associations related to packaging, waste hauling companies, municipal government waste management programs, material recovery facilities, a statewide retailers association, a community-based organization or minority group, a privately owned transfer station or drop off-center, and a public transfer station or drop off-center (Concerning the Management...2020). The purpose of these councils is to help to implement the producer responsibility plans, advise plans, and amend them. They should help PROs and producers with the development of their plans and ensure they are meeting all the EPR regulations outlined in the legislation (Concerning the Management...2020). Connecticut is an example of one state that has a Product Stewardship Council to oversee their EPR programs. The council is within the state's Department of Energy and Environmental Protection. It helps advise EPR programs that focus on batteries, carpet, electronics, mattresses plastic bags, mercury thermostats, and paint (What is Product Stewardship).

*Annual Report*

PROs or producers complying with EPR policies independently must file a report each year detailing their compliance to EPR standards set by the legislation. The annual reports typically must include a list of materials that can be collected, a summary of the implementation of the program means of collection, the type and weight of materials collected, an estimate of the materials available for collection, the method used to develop it the plan, the recycling rates by material and how it compares to performance standards, a sample of educational materials, the costs of the program, and a plan audit (Concerning the Management….2020). Most pieces of

policy require plans to be published on the organization's website and available for the public to view. An example of an annual report that focuses on EPR for PPP from British Columbia can be found here.

*Penalty Structure*

EPR policies impose a penalty structure on producers who violate the law's requirements. Fines typically start at five hundred dollars for the first violation and can go up to ten thousand dollars based on how many times a company violates the legislation (An Act to Save Recycling Costs…2021).

*Overview*

EPR systems are complex systems that transition the responsibility of recycling from municipalities and governments to product producers. EPR policies require producers to meet a variety of requirements including taking responsibility for the end-of-life product collection, recycling, performance standards, education programs, annual reports, and advisory councils. To help assist in reaching the measures set by EPR policies many industries have turned to and recognized PROs to assist in the process. These are NGOs that help facilitate the collection and recycling process for consumers. They can also assist in the production of educational materials and completing the annual report.

EPR policies have been in the U.S. since the late 1990s for hard to recycle materials such as textiles, tires, mattresses, light bulbs, and batteries  However, there is currently a more expansive push for EPR for a broader range of materials products like plastics and packaging products. Maine and Oregon have become the first states to pass EPR targeting plastic and PPP products with several other states introducing similar legislation in the past two legislative sessions.

# Chapter 4

*Case Study EPR for Rechargeable Batteries in the U.S.*

One of the largest EPR programs in the U.S. is rechargeable batteries. There are 21 states in the United States that have battery recycling requirements and 8 states where producers are required to fund or offer battery recycling programs. The first rechargeable battery focused EPR legislation was passed in 1991 by New Jersey and Minnesota, with New York being the most recent in 2010 (Nash and Bosso 2013).

The industry has an established PRO, Call2Recycle, formerly referred to as the Rechargeable Battery Recycling Corporation (RBRC). The non-governmental organization (NGO) has been recycling batteries for the industry since 1994 (History 2017). Call2Recycle provides collection and is responsible for the recycling of batteries for companies that pay to join the organization. The organization collects a variety of types of dry cell recyclable batteries up to 11lbs, other single-use batteries up to 11lbs, as well as damaged and recalled batteries (Program Overview 2019).

Call2Recycle has over 30,000 collection sites in the United States and Canada, with sites consisting of public locations like retailers, municipalities, and private locations such as hospitals, military bases, businesses, and government agencies. Individuals can drop off any qualifying battery at a collection site (Program Overview 2019). The drop-off locations are then responsible for shipping the batteries. They can ship the batteries in the Call2recycle paper collection kit with a prepaid shipping label for shipments of up to 66lb or less in weight. For high-volume collection sites that ship batteries of 500lb or more, they may use their own large containers, drums, or Call2recycle's boxes flat on a pallet to ship back collected materials. For high-volume shipping, collection centers must use Call2recycle's Bill of Lading (BOL) Wizard

(Program Overview 2019). This is a tool that allows high-volume collection sites to fill out the information regarding the materials they have, and it generates a paid shipping label for them to ship their products. The batteries are then shipped to their processing facility which processes the batteries and breaks them down to be used in new materials. Call2recycles processing facilities include Battery Solutions, Wistron GreenTech, Inmetco, Glencore, Umicore, Gopher Resource, Terrapure, Retriev, and Recycling Coordinators. These processes are located across the U.S. in states like NY, PA, IN, MN, and NV as well as globally in countries like France, Germany and Japan (Program Overview 2019). After these facilities process the batteries, they are then resold to be used in the development of new products (Program Overview 2019).

*Post-Consumer Content Technologies*

Call2Recycle has a well-developed recycle and post-consumer content creation process. Once materials are collected and delivered to the recycling facility, they are then sorted by type and chemistry so they can be broken down to be reused into different post-consumer products. Each material is recycled in a different way (Explore the Secret Life of Batteries 2021). Rechargeable batteries, such as nickel-cadmium, nickel-metal hydride, and lithium-ion batteries) have plastics separated from the battery. The remaining metals then go through a high-temperature metal reclamation (HTMR) process (Jacoby 2019). The low-melt metals (zinc, lithium, and cadmium) separate during the process and are collected as metal oxide. They are then reused to make new products like golf clubs, silverware, steel, stainless steel, pots, and pans (Jacoby 2019). Lead batteries go through a separate process. Once melted and impurities are removed, they are sent to battery manufacturers where they are remelted and used in the production of new batteries (Beale 2021). The final type of batteries Call2Recycle recycles for post-consumer content is single-use batteries. Recycling for single-use batteries is done in two

different ways depending on the material. Alkaline single-use batteries are recycled using a steel-making process. Lithium single-use batteries go through a process to neutralize the electrolytes and are then used as clean scrap metal (Jacoby 2019. Figure 4 illustrates how each type of battery is reused and incorporated into new materials.

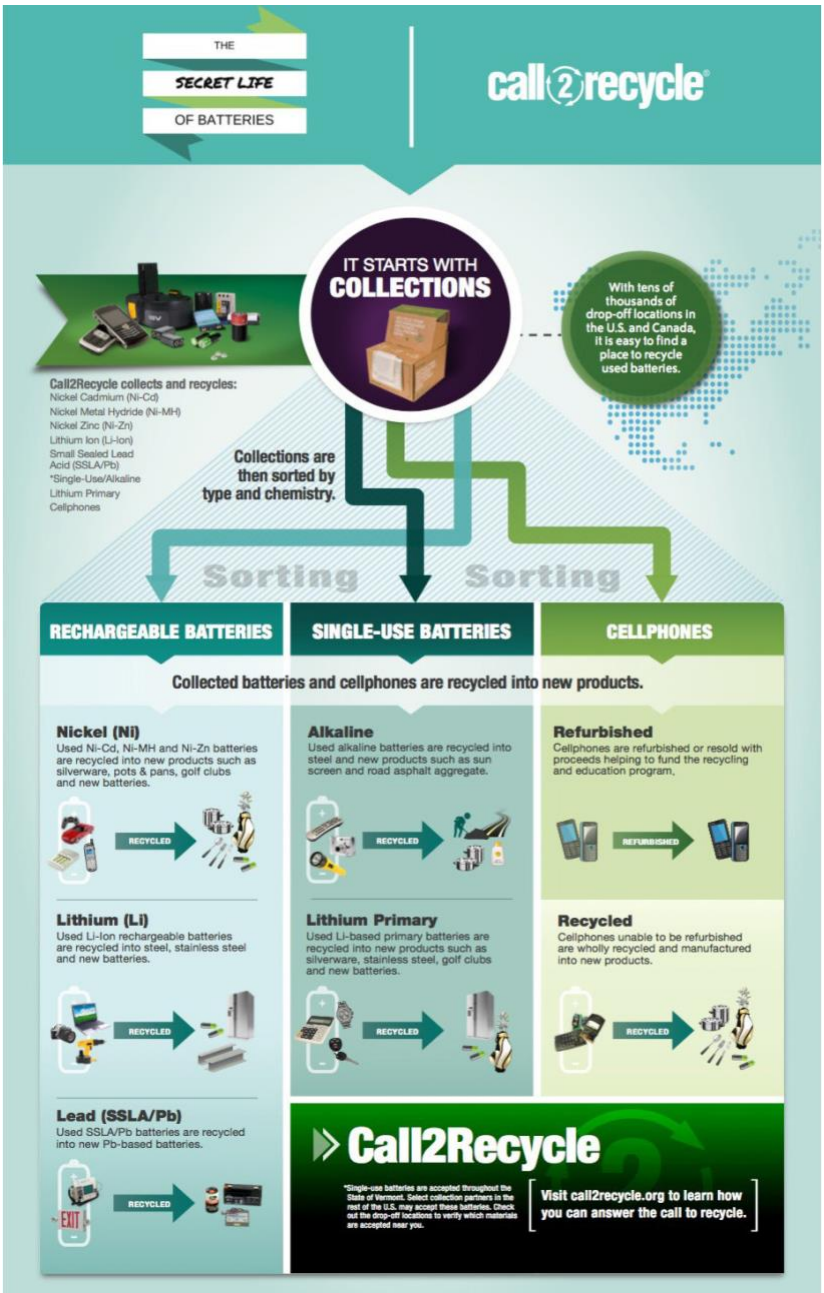



Figure 3: Call2Recycle Battery Recycling, (Explore the Secret Life of Batteries 2021).

*Education Programs*

Like many other recycling programs, the rechargeable battery producers are required to provide educational materials. The Call2Recycle Website provides several consumer resources that cover a wide variety of information, including what type of batteries can be recycled, the recycling process, as well as instructions for collection sites and consumers (Program Resources 2016). The website also provides a list of all the organizations' collection sites, a list of the materials collected, contact information for the producers, a description of the shipping, collection, and processing processes, and each organization's annual report detailing progress and a program description (Program Resources 2016).

*Payment Structure*

Call2Recycle has a fee structure set in place and charges members based on the type and amount in weight of materials recycled. The organization also offers recycling credits for producers who are complying with the requirements (Fee Schedule 2021). The credits awarded are based on the amount of weight the members recycle in proportion to the total amount of goods produced. The tables below explain Call2Recycle's fee structure and recycling credit system.

| 2021 STEWARDSHIP FEES (USD) | | |
|---|---|---|
| **Battery Type** | **USA** | **Canada (Except BC, MB, QC, ON, SK& PEI)** |
| **Rechargeable Batteries ($ / 100 grams)** | | |
| Ni-MH | $0.0075 | $0.0110 |
| Ni-Cd | $0.0250 | $0.0360 |
| Li-Ion (>5% Cobalt/Nickel Content) | $0.0075 | $0.0110 |
| Li-Ion (<5% Cobalt/Nickel Content) | $0.0150 | $0.0220 |
| SSLA | $0.0027 | $0.0038 |
| **Primary Batteries ($ / gram)** | | |
| **Battery Type** | **Vermont** | |
| Alkaline | $0.00132 | |
| Lithium Primary | $0.01056 | |

Figure 6: Call2Recycle Payment Table, (Fees Schedule 2021)

**Rechargeable Battery Recycling Credit**

The recycling credit is offered as a benefit to Call2Recycle's stewards to help offset costs associated with managing battery take-back. The credit program is tiered to reward the stewards for their commitment to help keep batteries out of landfills.

| Credit Status | Pounds Recycled / Quarter (US only) | % of Credit |
|---|---|---|
| Bronze | 5,000 – 24,999 lbs | 5% |
| Silver | 25,000 – 49,999 lbs | 10% |
| Gold | 50,000 – 74,999 lbs | 15% |
| Platinum | 75,000+ lbs | 25% |

Figure 7: Call2Recycle Credit Structure (Fees Schedule 2021)

# Chapter 5

*European Union Comparative Analysis*

The EPR policy framework in the European Union (EU) provides one example of policy structure that the U.S. can examine to help with the development of its own EPR policies at the state and federal level. The EU takes a harmonized national approach to EPR policies, creating standardized legislation for all EU members to meet regarding recycling, recovery, and reuse standards. This is recommended for the U.S., as currently there are only a patchwork of policies determined by state legislatures. The EU was one of the first supranational entities to introduce the concept of EPR in 1994 and has continually worked to update their legislative requirements (Extended Producer Responsibility 2017). Almost all EU states have EPR policies and by 2024 every state within the EU is set to have an EPR program put in place for Paper and Packaging

Products (PPP) (Extended Producer Responsibility 2017), showing that this could become a possibility for the U.S.

*The Directive on Paper and Packaging Waste*

France, Germany, and Sweden were among the leaders in establishing the first EPR systems for the European Union (EU), and the EU has played a large role in the implementation of these systems. In 1994 the European Union passed its first EPR centered initiative, 94/62/EC, The Directive on Packaging and Paper Waste (Factsheet...2015). The main purpose of this directive was to work to create a unified standard for packaging waste reduction to limit future environmental impact (Factsheet...2015). The bill emphasizes the reuse and reduction of packaging to minimize waste. By doing so it can create a more energy-efficient system while limiting further environmental impact (Factsheet...2015). The EU has proved successful at creating a more efficient energy system while minimizing their environmental impact. From 1990 to 2019 the EU has reduced GHG emissions by twenty four percent while seeing a sixty percent increase in economic growth during the same time period (Progress made in Cutting Emissions).

The directive also introduces two core components of EPR systems for member countries to follow. First, Article 6 creates target recycling and recovery rates for member states, making it one of the first pieces of legislation to introduce harmonized recycling and recovery rates for such a large geographic entity. Although targets were lowered for some so-called "developing" such as Greece and Portugal. For countries or those facing economic barriers, basic targets included that, by the year 2000 states must recover 50 to 65% of packaging waste and 25% to 45% of packaging material should be recycled (Directive on...1994). The article also

requires states to submit a report documenting their progress towards these targets each year (Directive on...1994).

Another key EPR component, Article 7 encourages countries to set up return, collection, and recovery systems. This means that states must provide several collection opportunities for consumers to dispose of their waste (Directive on...1994). This can include curbside collection and/or drop-off locations. This directive sets up the proper framework for states to develop their own EPR legislation and program structure. The act proved to be successful according to the EU's 2014 Waste Review (Fitness Check), which deemed the act to still be fit to for its purpose. The review concluded that the act contributed to better environmental conditions and an increase in paper and packaging recycling for member states (Implementation of the Packaging Directive). Between 2005 and 2011 there waste a 15% increase in recycling across all product categories covered (Fitness Check).

After the passage of 94/62/EC, the EU has continued to define its EPR agenda and waste management policies over time to work towards a circular economy. The Waste Framework Directive in 2008 as well as the 2015, 2019, and 2020 Circular Economy Action Plans have become the core pieces of legislation that have come to shape EU EPR policies in recent years.

*The Waste Framework Directive*

The Waste Framework Directive was first established in 2008, and it has most recently been revised in 2018, with the next set of revisions to be released in 2023 (Waste Framework Directive). The original document, The Waste Framework Directive, 2008/98/EC, has two specific components that set the foundation for circular economy and waste management in the EU, which include the establishment of the Waste Hierarchy, the formal framework of EU waste policy, and an official introduction to EPR waste prevention programs.

The Waste Hierarchy is established in Chapter 1, Article 4, and creates a targeted order that European waste policy should follow. The list prioritizes what types of policies should be created for waste prevention in the EU to be the most economically efficient while minimizing future environmental costs (The Waste Framework Directive 2008). The waste hierarchy prioritizes waste management policies starting with prevention followed by preparing for reuse, recycling, energy recovery and other recovery methods, and lastly disposal (The Waste Framework Directive 2008). This hierarchy serves as a national framework that all states must work to follow in the creation of waste reduction policies within the EU. Chapter 1, Article 4 also requires that states provide transparency through the creation of their policies to demonstrate adherence to the hierarchy (The Waste Framework Directive 2008). The goal is to increase reuse and recycling methods before having to rely on a regret's solution such as energy recovery and landfill disposal.

The implementation of the Waste Hierarchy has played a significant role in the EU's work toward a circular economy and waste management. It provides a national framework that all states within the EU are set to follow unless they demonstrate clear boundaries (The Waste Framework Directive 2008). The hierarchy provides EU members with several policy options to work towards waste reduction before having to resort to product disposal. It instills a policy structure for a circular economy and a way for countries to improve their recycling and reusability policies, as depicted in Figure 6 (Waste Framework Directive).


Figure 7, Waste Hierarchy, (Waste Framework Directive)

Another important piece of the 2008 Waste Framework Directive is the first formal request for EPR programs for EU member states. Although EPR concepts have been introduced in former EU legislation, such as the 1994 Directive on Packaging and Paper Waste, this was the first time the term Extended Producer Responsibility and all of the system components were formally introduced. Chapter 2, Article 8, outlines the purpose and the potential EPR have to help EU states manage their waste (The Waste Framework Directive 2008). It also requires all EU member states to have EPR programs for PPP established by July 4, 2018 and be in compliance with the article by 5 January 2023 (The Waste Framework Directive 2008). Under this article, it lays out the general structure of EPR programs for states to take guidance in the creation of their EPR systems and policies. One of the most important is keeping the programs in line with the Waste Hierarchy. Besides that, it highlights the key components of all EPR structures including producers taking on the responsibility of end-of-life management, an established waste collection system run by producers, performance rates, and yearly reports detailing the progress of states' programs each year (The Waste Framework Directive 2008). EU states were highly successful in meeting the requirements associated with the act by 2017

twenty-six out of twenty-eight member states had EPR for PPP programs established. The EU also reached the goal of recycling more than fifty percent of municipal waste by 2020.

Since 2008, the original framework has been amended with the most recent changes being implemented in 2018. Through the amendment, the core of the document remains intact but there are a few important changes, such as binding waste reduction targets, a hierarchy for waste processing, improvements for EU recycling systems, and ways to improve waste reduction through decontamination (What Is the Waste Framework Directive? 2022). Reuse and recycling standards set under this act include that the preparing for reuse and recycling of all municipal waste be increased to fifty-five percent by 2025, sixty percent by 2030 and sixty-five by 2035. This is significant because it demonstrates the commitment the EU has worked to continually provide member states with new ways to follow the Waste Hierarchy and improve their waste management strategies (What Is the Waste Framework Directive? 2022).

*The Circular Economy Action Plan*

Another way that the EU has proved to be a leader in EPR implementation is through the development of The Circular Economy Action Plan. The first plan was released in 2015, with the latest edition in 2020 (The EU's Circular Economy Action Plan). The original plan specifically introduced the concept of circular economy in the EU for the first time. The plan lays out developments to help EU countries improve their reuse and recycling processes to reduce waste management. It outlines a list of actions for the EU to strive for to reach a circular economy, from production and consumption, waste management, and the market for secondary raw materials (The EU's Circular Economy Action Plan). It also set specific recycling targets for product areas like plastics. The plan also highlighted the need for technology and innovation to help transform the recycling industry. The plan's goals work towards building the EU to a

sustainable circular economy that fosters economic success and the creation of new jobs. The plan sets out fifty-four objectives all of which have been met by EU member states since 2019 (The EU's Circular Economy Action Plan).

Since 2015, the plan has been updated several times with the most recent being in 2020. The 2020 action plan is significant because it is one of the pieces of the European Green New Deal. The plan will serve Europe's new agenda for sustainable growth. It lists 35 actions for member states to achieve (European Commission Adopts Circular Economy Action Plan 2020). Several of these actions focus on ensuring less waste, creating sustainable products, an emphasis on implementing recycling and reusability programs for highly circular product categories such as packaging, textiles, food, water, and electronics, as well as leading efforts toward a circular economy at the global level (European Commission Adopts Circular Economy Action Plan 2020). This new plan works to implement circular economy measures across the entire lifecycle to increase economic growth and the creation of new green jobs, as well as sustainability norms (European Commission Adopts Circular Economy Action Plan 2020).

*Effect of these Policies*

As a result of these policies, it has led twenty-six out of the twenty-eight member states to implement EPR for packaging programs (Watkins et al 2017). These programs have led the EU to see increases in recycling rates for all product categories including paper, plastic, and packaging products. All product categories have met the recycling rate of twenty-five percent set by the 1994 Directive on Packaging and Packaging Waste (Factsheet...2015). As of 2020, the total recycling rate for municipal recycling in the EU is forty-eight percent, packaging products at sixty-six, plastic products at forty-five point one percent,, and paper products at seventy-two percent (Waste Recycling in Europe 2021). These numbers show that European recycling

programs are seeing great success overall, and in specific product categories, putting them on the path toward a circular economy.

*Comparison to the U.S.*

Overall, the U.S. lacks to have a comprehensive EPR system like the EU. Although aligned under a different government structure than the EU, the U.S. has no national legislation in place on EPR for packaging products. It has been left to state legislatures to construct policies on the implementation of EPR programs for all product categories. Currently, there are only two states in the U.S. that have plastic and packaging EPR pieces of legislation in place: Maine and Oregon. Maine became the first state to sign a packaging EPR policy into law on July 3, 2021, with Oregon following a week later (Gleason 2021). There is hope for more programs to pass EPR for packaging within the coming years as New York, California, Maryland, and Washington are all states that have introduced EPR for PPP policies (Quinn 2021). However, the idea of this EPR for PPP policies and the implementation of the EPR programs is a new concept still being navigated by businesses and potential PROs. In the U.S, there currently are more established EPR programs for other product categories such as mattresses, tires, and batteries, but there are still no pieces of national legislation to exist (Quinn 2021).

Due to the limited number of EPR programs and underdeveloped recycling programs across the country, it has caused U.S. recycling rates to suffer across all product categories compared to the EU. In total, only 30% of all municipal waste is recycled as of 2018 (National Overview... 2020). In addition to that, only 8.7% of plastics are recycled (Plastics: Material-Specific Data), 53.8% of packaging products, and 68.2% of paper products (Paper and Paperboard: Material-Specific Data). Overall, the U.S. comes in lower compared to the EU in overall, paper, plastic, and packaging recycling percentage rates. It is evident that the lack of

uniform recycling policies potentially plays a role in the lower recycling rates across the U.S. The U.S. is struggling with the current recycling system and examine the strategies used in the EU for guidance in development of its own EPR programs.

# Chapter 6

*Benefits of EPR and the Circular Economy*

Extended producer Responsibility (EPR) is one policy mechanism that can be implemented to help set economies on the path to reaching circularity. EPR helps close economic loops by enforcing producer take-back initiatives, specific recycling rates, and post-consumer recycled content rates. By setting standards for recycling and post-consumer content the goal is to force producers to work towards creating products with high levels of recyclability and reusability, minimizing packaging waste. It helps minimize the introduction of new materials into the economy and focuses on reusing and refurbishing current products. Because of this EPR and its ability to foster a CE can have many benefits.

When examining the EPR system, many large-scale benefits can occur. One benefit is it encourages producers to design eco-friendly packaging products (Rogoff and Clark 2013). By creating eco-friendly packaging, it will make it easier for producers to comply to EPR polices and meet performance standards. This can be done by creating products that use less material or are made from more recyclable material. Doing this has the potential to reduce waste. Another important benefit of EPR programs is they have the potential to increase recycling rates. We are seeing this shift specifically by producers in the EU to help comply to EPR legislation and help work towards the EU become carbon neutral by 2050 which is set by the latest Circular Economy Action Plan (Will the EU be Ready...2020).

Having producers take over the responsibilities of recycling through legislative requirements rather than it being done by a large-scale municipality or government system can lead to more efficient recycling systems (Rogoff and Clark 2013). There is potential for more funding to become available for recycling programs through the establishment of EPR for PPP. This is because funds are raised specifically for the program by the producers. Under this system, this would typically come through the costs consumers would be paying for the products. Consumers would take on part of the costs through purchasing the products rather than paying for government taxes that go to a wide variety of government-funded projects (Rogoff and Clark 2013). This can increase finances and create a way for direct funding to be generated for recycling programs. By placing the weight of responsibility on the producer and generating a larger availability of funding, these actions have the potential to create a more efficient and well-rounded recycling program.

The larger benefits from EPR can also come through its connection to a circular economy. EPR provides one pathway for diverting waste, minimizing resource use, and increasing the reusability of materials, all key components of a CE. When implemented properly EPR programs and the transition to the CE can work to reach triple bottom line of sustainable development. It should reach the 3Ps and strike a balance of what is beneficial for people, the planet, and profit (Simone 2022). This can lead towards long term economic success, provide consumers with what they want and minimize the impact on the environment (Simone 2022). CE can provide benefits in the three key pillars of sustainability: economic, social, and environmental leading the U.S. towards the triple bottom line of success (Korhonen et al. 2018).

Creating a CE can lead to many economic benefits for producers and consumers alike. One of the key economic benefits is that goods maintain their value along the supply chain rather

than going to waste. By creating products that can be reused and recycled they can stay in the economy longer and be resold up to two or more times for businesses, which increases profits for producers. (Mapping the Benefits of...2017).

The reuse and recycling of products also save businesses costs in the production process. When businesses can reuse and refurbish materials it saves them the time, energy, and production costs. Through CE, businesses can save money through extraction costs. Fewer raw materials need to be extracted in a CE since products in the supply chain are already reused. When less materials are extracted, it saves money on extraction costs, labor costs, energy costs, since less equipment is needed to be utilized, as well as transportation because they will no longer have to transport such a significant number of raw materials to the manufacture. (Wijkman and Skanberg 2017). Limiting extracting will also help business move away from having to rely on highly demanded materials and high-cost non-renewable materials (Korhonen et al. 2018). Beside from the extraction process businesses are also able to save costs in the production process when using recycled materials in the creation of new products. The energy and the number of resources need to transform raw materials into new products is significantly higher than refurbishing old products (Wijkman and Skanberg 2017). Producers have proven that this is possible and can be done. Evian water bottles is one example of a product that has been able to create new products made completely out of recycled plastics (Holbrook 2020). Right now, fourty percent of the company's products are completely made from recyclable materials with a goal from having all their products being made of one hundred percent recycled materials by 2025 to reach their goal of become a circular business (Holbrook 2020).

Another economic benefit that CEs can lead to is the limitation in price fluctuations related to supply and demand. As described earlier, price volatility is the increase and decrease in

raw material prices associated with their supply and demand. Raw materials affected by this are often common ones, like metals, which are often used in the development of new products (Towards a Circular Economy 2013). Because of this, when the prices of raw materials fluctuate it affects the price of the product it is being used to make, increasing overall costs for consumers. This problem is only expected to be exacerbated with the growing levels of the global middle class, which is expected to reach five billion by 2030 (Towards a Circular Economy 2013). Because of the large increase of the consumer population and decrease in resource pools of non-renewable resources and valuable metals, extraction costs are only expected to continue rising increasing the value of consumer products (Towards a Circular Economy 2013). Under a CE, price volatility and fluctuations are decreased. CE can minimize the demand level for raw materials and increase the supply level for non-renewable resources because materials are being reused rather than going to waste, decreasing the extraction of new raw materials (Towards a Circular Economy 2013). When the supply and demand levels of resources used to create new products and packaging are stabilized it makes it cheaper for producers to develop new products, minimizing the overall costs to consumers (Towards a Circular Economy 2013). Resources that can benefit from this include natural gas, oil, steel, aluminum, copper, nickel (Eisner and Weintraub 2012).

CEs can also lead to the development of new products and industries. One example of this is in technology. With the development of CEs and the implementation of policies such as EPR, there needs to be proper technology developed to help increase recycling rates, reusability, and achieve post-consumer required content rates (Stahel 2016). Because of this, it has led to the development of new technology companies and equipment. One example of this is the post-consumer content technology company EREMA which was highlighted earlier in the thesis.

However, CE does not just help lead to the development of companies in the technology sector. It can help lead to the development of businesses focused on upscaling and refurbishment in every commercial sector. One example of a new industry that the CE system has created is sustainable fashion. Sustainable fashion can be seen as an alternative to the fast fashion industry, which is cheap and quickly produced clothing to keep up with consumers overconsumption habits. Fast fashion creates several issues through the high amounts or resources used in production process, large amounts of energy expanded, and quick turnaround and disposal of products due to poor quality (Crumbie 2021). Sustainable fashion is the idea of creating new clothing from previously used articles of clothing (Mapping the Benefits of...2017). This not only helps limit the environmental effects of clothing production but, also helps producers save money on production costs. Creating clothing takes a large amount of energy, fiber, water, and electrical costs. Reusing previously created clothes in the development of new ones limits the costs associated with production and offsets some of the harmful environmental effects created throughout the production process, like greenhouse gas emissions (Mapping the Benefits of...2017). Sustainable fashion provides one example of CE can create new business opportunities.

Aside from the economic benefits, instilling a CE can also create several social benefits. One of the social benefits that a transition to a CE can bring is the potential for new jobs (Stahel 2016). As described, CE has the potential to lead to several new types of businesses focused on refurbishment. When new businesses are created it helps lead to the development of new jobs. One example of an area where new jobs could be created is engineering. Engineers can help design new technologies that can increase recycling rates and make product reuse possible (Korhonen et al. 2018).

However, with CE and the potential development of new businesses in all types of commercial sectors comes a potential for new jobs in every part of the production and sales process. There will need to be designers to design new products, individuals to help in the manufacturing process, and those in sales to be able to help sell the products. There also can potentially be jobs created in transportation to help transfer the new goods produced, as well as marketing to help market the product and educate producers as well as consumers on the benefits of recycled goods. There is a supply chain effect for new jobs when one industry or business is created (Wijkman and Skanberg 2017). The ILO predicts that twenty-four million new jobs could be created internationally by 2030 through implementing green economy practices (24 Million Jobs...2018). The ILO also highlights that this large increase in jobs should be able to outnumber potential loses seen from the transition. It is estimated that there will be three million net jobs created in the Americas and two million in Europe (24 Million Jobs...2018). The ILO also predicts that only two regions will receive net loses, Africa, and the Middle East, respectively at .04% and .48%. Overall, there is a large potential for job growth by 2030 through a transition to a green economy (24 Million Jobs...2018).

When new job opportunities are created it can have a positive impact on society. It can play a role in decreasing unemployment and providing people with more disposable income. When this occurs, it allows individuals to provide for themselves, take part in the community, and spend money on the economy. It can help lead to financial dependence for individuals. This can particularly be seen in the U.S. through a transition to a CE as the ILO predicts a net gain of three million jobs in the Americas (24 Million Jobs...2018).

Transitioning towards a CE also has the potential to create a stronger sense of a shared community and better care of products. With individuals knowing that products will be used

again it is the hope that it establishes a norm for better care of products (The Circular Economy in Detail). This helps extend the lifetime of a product while building a sense of a shared community among others because people are ultimately using goods that have been used by one another (The Circular Economy in Detail). One example of this in CEs is rental systems or pay-by-use systems (Stahel 2016). Under these systems, items or products are constantly being used by different people. People do not own the item itself, minimizing the sense of ownership and increasing the responsibility to take care of the item. Individuals know someone else will be using the good and therefore, it is the hope they will take good care and responsibility for the product (The Circular Economy in Detail). This places the responsibility on the individual and instill the concept of CE as a social norm. Adidas is also an example of a company that highlights this notion in their sneaker return program by saying no one will ever own a pair of their shoes again (Fleming 2020)

A final social benefit that CEs offer is cleaner ecosystems. Under circular economies, less waste is produced, limiting the amount of pollution in ecosystems (McGinty 2021). This helps create a healthier environment for people to enjoy. Producing less pollution and waste can also help improve human health conditions (McGinty 2021). CEs can help limit the amount of particulate matter in the atmosphere minimizing the risk of cardiovascular and respiratory diseases associated with poor air quality. Reducing waste can also help reduce the risk of illnesses from water and ecosystem contamination (McGinty 2021). Therefore, this can potentially help individuals live healthy, longer, and more enjoyable lives.

Apart from the economic and social benefits, many environmental benefits can occur through transitioning to a CE. A majority of these benefits come from less waste being developed and the focus on reusability in the production process. One environmental benefit that

a CE can provide is the reduction in the use of natural and non-renewable resources (The Circular Economy in Detail). This is because goods are made to be recycled and reused, leading to fewer raw materials needing to be used in the production process. CEs can help expand the resource pool and limit low supply levels of resources (The Circular Economy in Detail). This is important because it can help prevent issues like the tragedy of the commons. The tragedy of the commons is an issue related to resource availability, introduced by William Forester Lloyd in 1883 (Spiliakos 2019). It demonstrates how unmonitored resource extraction between a group of people can lead to the complete depletion of the resource pool. The concept is used a lesson to demonstrate that if businesses fail to monitor their resource extraction in the future, they will eventually not be able to use the good for production in the long run preventing the business from creating profit long term (Spiliakos 2019). Common examples of industries that have been susceptible to the tragedy of the commons is fast fashion, fishing, and coffee bean production (Spiliakos 2019).

Another environmental benefit that can occur through the transition to a CE is a decrease in greenhouse gas levels (McGinty 2021). When fewer products are produced due to reusability, there is less work done in the extraction and production process, reducing the amount of energy and emissions created in the development of new goods. When recyclability is increased it also reduces the amount of overall waste produced. Producing less waste also helps minimize the number of materials that are incinerated or placed in landfills, which are two common sources of greenhouse gases related to product disposal. Overall, when fewer greenhouse gases are emitted it mitigates the effects of the greenhouse gas effect and climate change (The Greenhouse Gas Effect). This can include unstable temperatures, poor farming conditions, an increase in severe weather events, and flooding (The Greenhouse Gas Effect).

A decrease in extraction, incineration, and landfill disposal of products can also help minimize other pollutants emitted, such as smog and particulate matter. This is significant because these pollutants often contribute to poor air quality and can affect human health (McGinty 2021). When decreased, it can help minimize the risk of respiratory and cardiovascular diseases associated with poor air quality (McGinty 2021).

Minimizing smog and particulate matter can also help create healthier ecosystems. The chemicals in smog and particulate matter, such as sulfur dioxide have the potential to create acid rain (Effects of Acid Rain). When they are reduced, they can limit acidity levels in rain and ecosystems. This can create more stable pH levels for aquatic ecosystems allowing organisms to thrive and minimize the threat of invasive species which are harmful non-native organisms which can outcompete native ones when tolerance levels are exceeded due to acidity. ((Effects of Acid Rain). Land ecosystems can often benefit when there are lower acidity levels in rain and runoff. It allows certain plants to gain access to necessary nutrients for plant growth which acid rain often prevents. This can help prevent premature death and provide a healthy source of food for several types of organisms (Effects of Acid Rain).

Overall, EPR systems and the CE system can potentially lead to several positive benefits. Through instilling EPR policies it can help reduce waste through eco-friendly product design, increase recycling rates, increase post-consumer required content rates of new products, and help generate more funding for recycling programs. The transition to a CE, which can be assisted through the implementation of EPR policies can also potentially provide benefits in all three pillars of sustainability: economic, social, and environmental. Economically, CE systems can help increase goods' values along the supply chain, saves costs in the extraction and production process, increase the development of new goods as well as technologies, and provide

opportunities for new companies to emerge. Socially, CE can help potentially provide new jobs, increase levels of disposable income, and create better care of goods as well as a shared sense of community. Lastly, CE can also create several environmental benefits, such as a reduction in the use of natural and non-renewable resources, a decrease in the level of greenhouse gas emissions, lower levels of particulate matter, and healthier ecosystems through lower levels of acid rain and contamination.

# Chapter 7

*Current Policy Status*

The push for EPR policies for plastics as well as packaging and paper products (PPP) is at an all-time high. States like NY, CA, NJ, MA, and MD have all pushed to have EPR policy passed last year (Stern et al. 2021). Chances are high for new legislation as EPR programs appear to become a high priority on the state legislative agenda due to environmental concerns related to waste management (Stern, et al. 2021). For example, on July 13, 2021, Maine Governor Janet Mills signed into law LD 1541, making Maine the first state to pass legislation enforcing EPR programs for plastic and packaging products (Stern et al. 2021). The legislation will establish a stewardship organization in the state with an approved stewardship program. The organization chosen to take on the responsibilities will be through a competitive bidding process (Extended Producer Responsibility Program for Packaging). Producers who sell products within the state will be required to join this organization or create an alternative collection program. Producers must pay membership fees to the stewardship organization or alternative collection program to have them take on the responsibility of EPR program requirements, including creating a

collection process, establishing drop-off locations, recycling, and providing educational materials (Extended Producer Responsibility Program for Packaging).

Oregon became the second state to pass an EPR policy on plastics and packaging products on August 6, 2021, when Governor Brown signed S.B. 582, The Plastic Pollution and Recycling Modernization Act into law (Stern et al. 2021). This bill requires producers who sell their products in the state to register with a PRO that approved has a stewardship plan for packaging products. The PRO will be responsible; for establishing a list of recyclable materials, providing consumer drop-off locations, the recycling process, creation of post-consumer content, creating a website that is easy to access, and ensuring members comply with the program (Stern et al 2021). This bill will also establish post-consumer recycled content and recycling rates that producers must meet. It will also establish an Oregon Recycling Advisory Council made of industry representatives, which will advise PROs and the Department of Environmental Quality on stewardship plans and EPR goals (Stern et al 2021).

*Recommendations*

Currently, most EPR policies are being created at the state level or sells goods within the state. Because of this, the primary recommendation that can be put forth is the creation of a national EPR policy, like the Break Free from Plastic Pollution Act (Break Free From...2021). The Break Free from Plastic Pollution Act is a federal bill that outlines plastic reduction strategies to a more sustainable future. EPR is recognized as one of the potential solutions to reduce plastic within the act (Break Free From...2021). Creating a national policy would keep policy standards harmonized and minimize the patchwork of different policies that are being created at the state level. Developing a national policy would put all companies and producers on a fair playing field and prevent some companies from being impacted more than others. It would

create a standardized system for performance standards, put pressure on producers to adhere the policy, and help develop strong enforcement mechanisms.

However, due to minimal support from Congress for a national policy, the best companies can do is prepare for the passage of a state policy. The first step PPP producers and businesses can take is to establish or recognize a non-governmental organization (NGO) that can serve as an industry PRO or establish individual business mechanism to meet EPR policies. By having an organization or business structure already in place it can facilitate a base for membership and create a strong organizational structure if legislation were to be passed. If companies chose to forgo involvement in a PRO, it would be beneficial for them to begin to outline their plans for how they would operate their collection and recycling processes. U.S. companies such as Adidas (Mazzoni 2020), Nike (Mazzoni 2020), Burger King (Mazzoni 2020), and Lululemon (Introducing Lululemon Like New 2021) are all examples of companies that have started to develop these structures on their own, demonstrating that it is possible to establish take back and recycling programs.

A further step plastic and PPP industries could take is developing a stewardship plan through the NGO. This is similar to an EPR program, but it is entirely voluntary, meaning it is optional for companies to join. The program would help run members' run end-of-life collection, recycling processes, and the development of educational materials. This would be the best option if producers would like to be fully prepared for the passage of EPR policies. It would allow them to begin to build their programs so they can be implemented on time if a policy is passed. This would prevent businesses from having to pay any fines for requirements not being met on time.

Another important step producers can take to prepare for the passage of EPR policies is to examine MRFs and technologies available to help businesses reach recycling and post-

consumer content policies set under EPR policies. Having the knowledge of these technologies and companies can provide producers and NGOs with a potential list of businesses with which they can set up contracts in the future to ensure recycling responsibilities and performance standards are fulfilled.

# Chapter 8

*Conclusion*

This thesis was created to dive deeper into an analysis of EPR policies and their connection to the Circular Economy (CE). It began with work that started through a policy briefing created during my internship at RISE, a standing committee of CropLife America. It starts with an examination of the CE and how it can provide a more sustainable economy than the current linear economy the U.S. operates under. The linear economy is unsustainable in the following ways: it creates price volatility, high energy costs, and increased greenhouse gas emissions. It generates high levels of waste and relies on single-stream recycling systems, which require a time-consuming and expensive process for MRFs to sort the products (Leblanc 2020). However, producers continue to rely on the linear economy through the large amounts of profit it generates. Through the single-stream collection process, all types of recyclables are collected in the same bin and sorted later once they reach material recycling facilities (MRFs). Although simple for consumers, this leads to a time-consuming and expensive process for MRFs to sort the products (Leblanc 2020). This leads to a backup of materials at recycling facilities making it difficult for products to be recycled. High levels of contamination are also common through this process contributing to dismal recycling rates (Leblanc 2020). In addition to the difficulties associated with single-stream recycling, it has become even harder for the U.S. to increase

recycling through international measures due to the China Sword Policy passed in 2018, which prevents nations from sending China their recyclables that are lower than 99.5 purity standard (Cho 2021). Due to the high levels of overconsumption, waste generation, and contamination associated with single-stream recycling, it has made it impossible for most U.S recyclables to reach that standard. Overall, this has led to low recycling levels and increased landfill and incineration rates in the U.S. It has become too difficult for MRFs to process such a large influx of materials (Cho 2021). It has led to severe environmental impacts which can be supported through LCAs. These developments show that the linear economy has seen its time and there must be a shift in the management and development of products if the U.S. hopes to see long term economic success.

Due to these hardships, it is evident that the shift to a circular economy can help improve recycling and decrease waste within the U.S. CE is the concept of implementing an economic model that emphasizes the recycling, reuse, and refurbishment of products rather than disposing of waste, and creating new goods (Stahel 2016). CE minimizes the extraction of raw materials and focuses on extending the life of products, growing their value over time (Stahel 2016). CE is a systematic change the has potential to create sustainable economic growth for the U.S. while minimizing producers and consumer's environmental impact.

One policy that paves the way toward a CE is Extended Producer Responsibility (EPR) for plastic, packaging, and paper products (PPP). EPR is a system that requires producers to bear the responsibility for the end-of-life management of their products. They must take responsibility for the collection, recycling of their goods, reuse of products, and creation of educational materials on recycling (Extended Producer Responsibility for Packaging and Paper, 2020). The By putting the weight of post-consumption management on producers through legislation it

increases recycling rates. It creates more efficient recycling systems because legislation requires producers to reach specific recycling standards. EPR paves the way to make the transition to a CE as works to increase recycling levels and post-consumer content in products minizine the extraction of raw materials (Extended Producer Responsibility… 2020). It assists the in the systematic change the U.S. need to work towards to see sustainable growth. The system has been successful for other industries in the U.S., like the rechargeable batteries industry. EPR policies have also been utilized nationally in the EU and have played a large role in their transition towards a CE. EPR in the EU has helped increase recycling rates among all products specifically PPP (Extended Producer Responsibility… 2020). The EU has proved through the implementation of EPR and CE policies it is possible to minimize environmental impacts through emissions reductions while still achieving high levels of economic growth. The EU is a prime example of how EPR for PPP policies can be effective (Extended Producer Responsibility… 2020). They are something the U.S. should learn from and use as guidance towards the implementation of their own policies.

EPR and its connection to CE can also provide several benefits. It can lead to the development of eco-friendly product design, create more funding for efficient recycling programs, and reduce waste (Rogoff and Clark 2017). The CE is also a key to creating a sustainable future as it provides benefits across the three pillars of sustainability. Economically it can increase profits for producers, decrease production costs, reduce price volatility, and lead to the development of new industries. Socially a CE can help create new jobs, increase disposable income, and develops a sense of shared community leading to better care for products. Environmentally CE can limit GHG emission, reduce secondary pollutants, minimize acid rains

levels and their effects on ecosystems, and reduce the total level of waste polluting environments.

Right now, there are currently no national policies EPR policies for PPP in the U.S., due to minimal support from congress due to the comprehensive nature of the legislation, but there has been a rise in the last year for state policies. Maine and Oregon became the first two states to establish EPR for PPP pieces of legislation. Within the past year, legislation has also been introduced in states such as PA, NY, NJ, and WA (Stern 2021). It is only expected that more EPR policies similar to Maine and Oregon will be passed soon. Policymakers are seeing EPR as one way to reduce waste and help reap the potential benefits that a transition to a circular economy can provide.

Overall, it is evident that there needs to be a systematic change in the U.S. economic system and post consumption management of goods. It is clear the linear economy single stream recycling system has been flawed from the start and we are finally beginning to see the effects of these poor decisions today. Consumers are driven by patterns of overconsumption which has led to high levels of waste generation. Due to a poor end of life management system associated with single stream recycling it has made it hard for MRFs to keep up with municipal waste generation and management of recyclables. The large influx of products from single stream collection also leads to high levels of contamination minimizing the U. S's ability to recycle even more (Katz 2019). The U.S. needs to create a systematic change to be able to continue to see long term growth economically, socially, and environmentally (Korhonen 2018). This can be achieved through the CE and the establishment of EPR policies. The enactment of EPR policies can force a systematic change within the recycling system through the requirements established under the policy which producers are subject to follow. EPR has proven to be successful for other products

and other countries globally and can be the key towards leading the U.S to a CE and the enjoyment of its several benefits.

# Appendix

**Extended Producer Responsibility**
**Briefing Report**
June 2021

## Index

## Executive Summary

This is an in-depth report that provides the pesticide and fertilizer industry with the necessary information to understand Extended Producer Responsibility (EPR) policies and their impact on container recycling in the industry. The report is broken up into three main sections: Pesticide Industry Report, Case Studies, and a Legislative Index. Each one of these sections is broken down into further components covering all areas of EPR from defining what is, evaluating existing organizations in the United States, examples of EPR for other products in the United States and internationally, and a list of the primary pieces of state and federal policy that would impact the pesticide and fertilizer industry.

The first section, The Pesticide Industry Report, covers all of the basics of EPR. It defines EPR and discusses the history of EPR policies. It explains how EPR policies have become much broader in the past few years and will require producers to take over the recycling of their plastic containers in addition to meeting specific recycling and post-consumer content rates. This section also explains how producers can comply with EPR policy. It can be done individually or through a non-profit organization called a Producer Responsibility Organization (PRO). It explains what a PRO is and how they can manage the pesticide and fertilizer industry's recycling process and EPR standards.

The Pesticide Industry Report section also discusses what is specifically being done for pesticide packaging and EPR in the United States. This section features a list of organizations that represents the industry or support EPR policies in the United States. The organizations discussed are AMERIPEN, The Recycling Partnership, The Product Stewardship Institute, and The Ag Container Recycling Council (ACRC). This section also includes a comparison of the structure of a PRO and the ACRC, which is a trade association that provides recycling for the pesticide and fertilizer manufacturers. Lastly, this section also includes a description of the current industry status, highlighting the passage of Maine's EPR bill L.D 1541, as well as a list of the recommendations the industry should consider implementing.

The second section, Case Studies, provides several different examples of EPR programs already in place. It evaluates EPR for batteries in the United States and the industry's leading PRO, Call2Recycle. It looks at all of the aspects of Call2Recycle, as a PRO, and how they are meeting the battery industry's EPR standards. This section also provides an evaluation of several international case studies. It discusses the European Union and the success it has seen with recycling and the post-consumer recycled content they have implemented. Canada's EPR system is also evaluated and the type of post-consumer content technology they use. This section also specifically focuses on Clean Farms which is a non-profit in Canada responsible for the recycling of pesticides and agricultural Products. Lastly, this section looks at Brazil and inpEV which is the non-profit organization that manages recycling for pesticide and fertilizer manufactures. inPEV is responsible for the country's Clean Fields System. The Clean Field system provides recycling for pesticide and fertilizer industry. It is one of the most successful in the world reaching a recycling rate of 94%.

The last section is the Legislative Index. This section lists all of the important pieces of EPR legislation that would affect the industry by state and on the federal level. It includes the introduction date for each bill, its current status, and primary sponsors. Each bill also has a bill summary and a full bill description attached with all of the information regarding the piece of legislation.

# Pesticide Industry Report

Extender producer responsibility (EPR) is a policy approach that helps reduce waste and create a circular economy. It can also be referred to as product stewardship. EPR policy shifts the post-consumption management of goods and packing from local governments to manufacturers and producers. EPR programs can cover several types of material/packaging or a specific area like food and beverage containers. By giving producers a stake in the recycling processes, the goal of these programs is to increase recycling and product reuse. It is also expected that, by giving producers responsibility for their packaging, they will provide greater access to recycling resources and drop off sites to ease the burden on consumers.

Many EPR programs also establish recycling and post-consumer recycled content rates. Post-consumer recycled content is the amount of recycled material used within a new product. Therefore, moving forward, the hope is to implement new technologies to create post-consumer recycled materials and minimize the use of virgin materials like plastic in the development of new products. Producers can work to reach these standards independently or join a Producer Responsibility Organization (PRO), which will set up a plan for producers to meet the targets and legislative requirements.

**Why EPR Programs?**

The push for EPR policies has become much more relevant within the past few years, especially on the state level. EPR policies are becoming more relevant due to society's increasing consumption rates and generation of waste, which can create negative environmental and human health impacts.

Implementing EPR policy would also take the costs of recycling a way from local governments and taxpayers. Recycling is currently run by municipalities and paid for by taxpayers. Through EPR municipalities would be reimbursed for their services and taxpayers would no longer have to bear the costs. Producers would have to cover that through their program fees. By having producers take on this responsibility it also expected that a more efficient recycling system will be put in place that can control the excess of recycled materials at MRFs.

There are several other reasons the support for EPR has also grown within the last few years. One reason is the implementation of the China National Sword Policy in 2018, which bans other countries from importing plastics and other materials to the country to be processed by their recycling industries. This has led to a significant backlog of recyclables in the United States, as the country has been shipping recyclables to China for over a quarter century. United States' Material Recovery Facilities (MRF) are now struggling to keep up with amount of material received and more recyclables are heading into landfills more than ever before.

The National Caucus of Environmental Legislatures (NCEL) has a played a large role in bringing EPR policy to the surface. The NCEL is a bipartisan organization that invites representatives from across the country to join who have an interest in the environmental legislation. NCEL's goal is to unite legislators to protect and conserve the environment. NCEL has been a strong supporter of the advancement of EPR policies. Although the caucus does not have lobbying abilities, it has addressed support for the positive environmental impact EPR programs could make. Many of the organizations legislatures are also the leading voices behind several EPR policies introduced this year such as California State Senator Ben Allen and Maryland State Delegate Brooke Lierman. In 2021 alone there were 32 EPR bill introduced across the US. The full list can be found under the NCEL's website here.

EPR is seen as a potential solution to these problems and as a sustainable policy that can help reduce litter and environmental impact. The overall goal of EPR programs is to reduce waste and encourage producers to reuse packaging to create a higher level of post-consumer recycled content in their product packaging for the future. In addition, EPR supporters hope to rebuild recycling markets and create a circular economy with the creation of secondary and end of life markets. Expanding the recycling industry could also the create new "green" jobs in recycling and in the creation of post-consumer recycled materials.

**Legislative History of Recycling and EPR**

The concept of extended producer responsibility emerged in the United States in the early 2000s. As of 2021, there are a total of 119 EPR programs in the United States, spanning across 33 different that cover 14 different materials. Most programs primarily deal with heavy and high-cost recyclable materials such as paint, carpet, mattresses, fluorescent lighting, pharmaceuticals, and electronics. However, the goal is to begin to have EPR programs cover a broader range of materials. In 2021 there have been a total of 32 pieces of EPR focused legislation introduced with a majority focused on paper and plastics packaging. California, Hawaii, New York, Oregon, and Washington have been some of the states most focused on trying to pass EPR legislation that covers plastic and paper. There has also been a piece of federal legislation introduced, The Break Free from Plastic Pollution Act, that specifically focuses on plastic waste reduction, extended producer responsibility, and increasing post-consumer recycled content in new materials. (See the Appendix for a more detailed summary of key state and federal bills, including bill numbers, sponsors, actions, and summaries.)

In addition, the National Caucus of Environmental Legislators (NCEL) has identified "plastic pollution" as a priority issue area for the organization. They highlight how there are over 9 million tons of plastic pollution end up in the world's oceans each year and that by 2050 there will be more plastic weight in the ocean then fish. Because of the threats they see with plastic they have highlighted that EPR programs as one of the better policy strategies to deal with plastic pollution. The caucus feels that putting the costs on the producers will keep them profiting off of pollution and reducing the amount of waste they produce. Legislators also feel it would increase recycling and reduce that amount of plastic waste that end up in landfills or incinerators.

<u>EPR Program Structure</u>

A majority of the EPR bill that have been introduced in legislators across the United States follow a similar framework and requirements that producers must abide by. The key component is being enlisted in an approved producer responsibility plan, which can also be referred to as stewardship plan. Producers can create these plans individual, join a Producer Responsibility Organization (PRO), or stewardship organization with an approved plan by one of the state's departments. If a Producer joins a PRO or stewardship organization, they will have to pay fees to cover the costs of the program. This can either be a standard, based on the costs of materials collected, or a combination of both. Producer responsibility plans have many requirements they must meet including a description of how the recycling process will be run, the development of educational resources, the creation of a website with the materials the producer or PRO will accept, a list of consumers drop off locations, a description of a PROs fee structure to cover the costs of the program, and the plans for end-of-life product management. Performance standards for post-consumer content and recycling rates that producers must work to meet by a given date are typically also established under the plan.

Most legislation also requires producers and PROs to submit an annual report. The reports typically include the amount of material by type collected, the total amount of material collected for the calendar year, a financial audit from an independent contractor, a sample of the educational materials, a list of producers and their contact information a part of a PRO, a list of the collection facilities, and list of the materials being collected.

In addition to these two components some pieces of legislation establish other requirements or avenues to comply. One requirement that is common in EPR legislation is the establish of Producer Responsibility Council or Stewardship Council. This is a group of industry stakeholders chosen to help review and advise government departments and PROs on producer responsibility requirements. They also often give feedback and provide advice for producer responsibility plans. A few pieces have also allowed for producers to comply for legislation without being registered though a PRO, but through an alternative collection program. This is a group of producers who create their own plan to meet the bills recycling and producer responsibility plan requirements. These producers are then no longer responsibility for adhering to a fee structure of a PRO for the material they recycle because they take on the costs themselves. One piece of legislation that has included is Maine bill L.D. 1541, which was recently passed.

Lastly, all pieces of legislation have in place a system of penalty fees for producers who do not meet the legislations requirements. This varies per legislation but fines typically increase with the number of violations are producer commits. However, legislation also endorses PROs to provide subsidies or fee credits to producers who meet at their requirements and to serve as an incentive for producers to increase their recycling rates.

*Producer Responsibility Organizations:*
Producer Responsibility Organizations (PROs) are non-profit organizations (501c(3)) that serve specific industries and take responsibility of their recycling and waste managements. PROs can be industry specific or cover a wide variety of materials. Joining a PRO also referred to as a Product Stewardship Organization is one-way producers can meet recycling requirements established under EPR legislation. PROs do this by creating producer responsibility plans that they run for their members which meet all of the necessary EPR requirements. Plans typically include the creation of collection facilities for consumer to drop off producers packaging, transportation of materials, processing of materials, development of post-consumer recycled materials, the development of performance standards for post-consumer recycled content and recycling rates, and educational material for consumers about the program and what materials can be recycled. In order to join a PRO producers must pay a fee. This fee can either be a base fee or based on the amount of materials collected from the producers. PROs also typically have violations in place if producer do not comply. Some also offer incentives to reduce the costs for those who do or exceed postconsumer content and recycling rates.

**Pesticide Packaging and EPR**
The way current and trending EPR legislation is structured, it is likely to target the pesticide, fertilizer, and agriculture industries. These new EPR bills are quite broad and contain restrictions for almost all types of covered products. The most common type of material that the industry will be required to recycle is high density polypropylene (HDPE) plastic containers. Manufacturers and producers will be responsible for ensuring that they reach the responsible recycling rates and post-consumer content rates for this type of packaging in the future.

Under current legislative proposals, it is likely that the pesticide industry could play a role on a Producer Responsibility Council. A Producer Responsibility Council is a board composed of different representatives for PROs that are from all areas of the industry impacted by EPR legislation. The Council's main responsibility is to provide feedback and insights for PRO stewardship plans.

AMERIPEN

AMERIPEN is a trade association for the packaging and packaged product industry. It is a US based organization that represent their members on the federal and state levels. They serve in the economic interest of the industry and represent the opinion of the packaging value chain on packaging and environmental issues. According to their mission statement the organizations goal is to use facts and science to develop a position on environmental issues related to packaging for their members. They focus on all areas of packaging from production, sourcing, and end of life management. AMERIPEN works to take a material-neutral stance and advocates for the interest of the industry. The organization works to represent their members through by engaging and informing legislatures, promoting sound science, endorsing the creation of independent research related to packaging and the environment, and working with other trade association with common interests.

Recycling Partnership

The Recycling Partnership is a nonprofit organization with a goal to create more efficient and sustainable recycling systems across the United States. They utilize their corporate partnership funding from businesses like Coca-Cola, PepsiCo, DOW, and several others to transform recycling programs in communities, cities, and states in the United States. It is one of the only organizations to engage in the full recycling supply chain from producers, collectors, converters, and end markets. The Recycling Partnership works to help improve recycling across the country by providing grants, educational resources, research, and public policy advocacy. The organization has a handful of recycling coordinators and initiatives all geared towards improving the recycling industry.

The Recycling Partnership's recycling coordinators is broken down into three components, they offer programs, resources, and material decision tools. There programs include, fighting contamination, recycle with carts, engage with residents, and grants. Their fight contamination program provides information for MRF on how to fight contamination. The organization has anti-contamination curbside and drop off kits that it provides communities with to prevent single stream recycling and a more organized system. The recycle with carts program provides a guide for local governments on how to implement and move towards a cart-based recycling stem, a list of the benefits that carts offer, and a grant system to help governments implement new cart recycling systems. The engage with their residents' program offers educational materials for municipalities and local governments to provide their residents with information about recycling. The grants program provides grants to different local governments to improve any aspect of their recycling program. The recycling coordinators resources include DIY signs which help governments creates their own recycling signs, a campaign builder which allows communities to receive recycling campaign materials, a map Material Recycling Facilities (MRF) in the United States, and a Green House Gas calculator that which allows to determine their greenhouse gas emission through answering a series of questions. The last accept of the recycling Coordinators that the organization offers is Material Decision Tool kits. Currently they offer a tool kit on the recyclability of pizza boxes which includes research on how they should be accepted into the recycling stream.

The Recycling Partnerships initiatives are the Pathway to Circularity, Film & Flexibles Coalition, Plastic IQ, Polypropylene Recycling Coalition, and the Circular Economy Accelerator. The Pathway to circularity is framework for producers to guide them through the challenges of the recycling industry to make a circular economy possible. It is made of five key building blocks to help producers to ensure their products are recyclable and truly gets recyclable. The building blocks are packaging fate, capture journey, design for circularity, package prevalence, and MRF and community adoption. The organization also has a Pathway to Circularity Industry Council which consists industry leaders representing various material types, brands, governments, Materials Recovery Facilities (MRFs), NGOs, retailers, and trade associations. The group works to address different strategies for recycling circularity and create national engagement towards the issue. The Film and Flexibles Coalition is working to advance the recycling of film and flexibles through three steps; gather reteach on the impacts of current collection methods, assess the most effective technology and pilot new technology, and implement national interventions to increase the recycling of film and flexible. The Plastic IQ is a digital tool companies can use that can help them reduce their plastic packaging and plastic waste. Companies can input industry information into the tool and answer a series of questions. Once that is completed it helps companies structure their own plan and strategies as well as compare them with other businesses who have utilizes the Plastic IQ. The Polypropylene Recycling Coalition initiative is working to increase recycling for polypropylene (PP). The coalition is trying to ensure more people have access to curbside recycling of the material, MRFs can sort the material, and high-quality recycled polypropylene can be made and reused in new materials. The coalition is strong advocate for education and providing communities with the necessary resources they need to implement PP recycling programs. The last initiative is the Circular Economy Accelerator. The Circular Economy Accelerator is the organizations policy initiative. It advocates for national recycling policies in the United States. The organization has created their own policy proposal, advocating for a public-private recycling partnership to improve recycling and circularity. The proposal has two primary components and funding mechanisms: The Packaging and Printed Paper Fee and the Disposal Surcharge. The Packaging and Printed Paper Fee would be paid by producers through a non-governmental organization that would serve as Packaging and Printed Paper Stewardship Organization (PSO). The fee would cover the cost of capital and educational materials created by the PSO. The Disposal Surcharge would be covered by the public sector and would cover operational expenditures. This model would be the first of its kind and would be unique to the US if implemented. The full policy report can be found here.

Product Stewardship Institute

The Product Stewardship Institute (PSI) is a non-profit organization that advocates for producer responsibility and the passage of EPR legislation. PSI believes that if producer take responsibility for their products it will lead to a more sustainable and environmentally friendly recycling system. PSI assists producer, recyclers, governments, and consumers in the understanding of EPR and its benefits. Their services include research, pilot projects, education, empowerment, consensus building and legislative support. The organization also provides membership for government agencies. They currently have 47 members. Membership benefits includes discounts on EPR consulting projects, access to EPR news and information, legislative support, and networking. PSI is most well known for their assistance and advocacy for EPR legislation. The organization has worked to educate legislatures and highlight the importance of EPR legislation. The organization has conducted research studies and pushed for EPR policies for several products like carpet, paint, light bulbs, solar panels, and pesticides. The organization also provides educational resources on their website to educate their members and the public on EPR.

*PSI's Pesticide Stewardship Briefing Document:* In 2017 PSI created a Pesticide Stewardship Briefing Document. The document outlines what pesticides are and outlines different setbacks the industry is facing in disposing of unwanted pesticides and recycling pesticide containers. The document highlights a list of key issues in the industry the effect implementation of EPR policies, which includes toxicity, lack of awareness and education, uncontrolled stockpiles of pesticides on farms, cost to government, lack of sustainable financing, data gaps, convenience, level playing field, volume/wasted resources, regulatory barriers, lack of collection opportunities, and product revisions and cancellations. It also discusses the current sales and disposal in the industry. The briefing then evaluates what other nations have done for pesticide disposal and container recycling such as Clean Farms in Canada. The document closes by discussing a list of strategies the industry should work to implement to create a better recycling system. The strategies the document lists are to conduct research to determine gaps in collection infrastructure for households, agricultural, and industrial/commercial/government; to increase collection convenience through collection events and drop-off locations; increase education on the location of collection sites; and increase education on the benefits of limiting pesticide purchases, using pesticide alternatives, and applying different approaches to pest management. The whole document can be found here.

Ag Container Recycling Council

The Ag Container Recycling Council (ACRC) is an industry-funded not-for-profit trade association for pesticide, fertilizer, and agriculture industries that provides voluntary recycling services for their members. ACRC operates in 47 states across the United States (excluding Alaska, New Jersey, and Pennsylvania, with the latter two run state-sponsored programs) where they provide collection location for consumers to have their products recycled.

ACRC safely collects and recycles agricultural crop protection, animal health, and specialty pest control product containers, focusing on rigid high-density polyethylene (HDPE) containers that are 55 gallons and smaller. ACRC recycling programs cover plastic containers that were previously used for crop protection; containers that held EPA-registered crop protection products labeled for agricultural uses; non-registered products such as adjuvants, crop oils, and surfactants; and containers that held EPA-registered specialty pesticides and fertilizers containers, including those labeled for professional structural pest control, animal health, turf and ornamental, vegetation management, nursery, greenhouses, forestry, aquatics, and public health uses. ACRC does not collect any container constructed of anything other than HDPE, including rotationally molded containers, mini-bulk, intermediate bulk containers (IBC), totes, or any container that previously held products utilized in consumer home and garden, pest control and swimming pool maintenance. All materials are recycled through the triple rinse ANSI/ASABE standard established under the Federal Insecticide, Fungicide & Rodenticide Act (FIFRA).

ACRC has been an important industry stewardship investment. With ACRC's support of the collection and recycling of containers through the promotion of cost-effective recycling and waste programs, the pesticide industry voluntarily recycles approximately 30-35% of its plastic containers each year. Of the remaining plastic, roughly 60% goes into landfills and 10% is burned.

ACRC is industry funded, with their own formalized dues structure. ACRC regular member (basic manufacturers and registrants) dues are based on the pounds of plastic each member sells into the marketplace in the prior year. ACRC determines this via self-reporting from members. In the survey, members must report package size and how many HDPE containers (55 gal and smaller) they sold into the market in the prior year, which is converted into pounds of plastic. The minimum dues paid by any regular member is $5,000 per year. Affiliate members (packaging manufacturers) dues are a flat fee, which are currently $3,500 per year, increasing to $5,000 per year in 2022.

ACRC versus a PRO

Based on their program structure, ACRC has a strong foundation of creating a PRO for the pesticide and fertilizer industry. However, the ACRC does not currently meet all the qualifications of a PRO. The ACRC is currently a voluntary organization that producers have the option to join. Therefore, they are currently not operating under any legislative requirements such as creating a producer responsibility plan that includes an annual report, the creation of extensive education materials, and performance goals for postconsumer recycled content and recycling rates. The biggest difference between the ACRC and a PRO is the ACRC is registered as trade associations, a 501c(6) while a PRO must be registered 501c(3), a non-profit.

The ACRC's fee structure is also different than what a PRO's would be. The ACRC currently offers two different types of memberships: regular members who pay based off of the amount plastic they sold into the market the prior calendar year and affiliate members who pay a flat rate. The regular members are primarily chemical registrants while the regular members are packaging manufactures. A PROs fees would different. They would only have one type of fee structure for their members. All members would likely have to pay a flat fee and then would pay additional charges based off of the amount of plastic they recycle or sell into the market each prior year. The fees would cover the complete costs of the recycling program and the expenses of running the PRO.

The staffing and administration of the program is also different between the two entities. The ACRC and PRO are similar because they both have committees and a governing board for the organization. However, a PRO for the industry would have to have a much larger staff then the ACRC. A PRO would need to hire a whole team including an executive director or president, a CFO, Operation Directors for different states, a government affairs director, a technical director, a communications manager, a human relations manager and an office administrator. A PRO would also likely have to operate in different states requiring each subsidiary to register as limited liability company (LLC) with the sole member being the PRO allowing them to be disregarded for taxes.

**Current Industry Status**

The push for EPR policy is at an all-time high. States like NY, CA, NJ, MA, and MD are all pushing to have EPR policy passed this year. Chances are low for new legislation in most of these states, with legislatures adjourning for the year, but appears to be a very high priority going into next year.

*Maine:* Governor Janet Mills signed into law LD 1541, which established extended producer responsibility requirements in the state. The legislation will establish a stewardship organization in the state with an approved stewardship through a competitive bidding process. Producers will be required to join this organization or create an alternative collection program for specific materials or an industry. Producers must pay into the stewardship organization or alternative collection program to take on the responsibility of recycling their plastics as well as meet other requirements such as providing education resources, a list of the materials collected, management several drop off locations to make it easy for consumers to recycle their products, transportation, and the recycling process.

*Oregon:* S.B 582 is currently in Governor Kate Brown's office waiting to be signed. If signed into law, it would force producer to register with a PRO with an approved stewardship plan. The PRO will be responsible; for establishing a list of recyclable materials, providing consumer drop off locations, the recycling process, creation of postconsumer content, creating a website that is easy to access, and ensuring members comply to the program. This bill will also establish postconsumer recycled content

and recycling rates producers must meet. It will also establish an Oregon Recycling Advisory Council made of industry representatives, which will advise PROs and the Department of Environmental Quality on stewardship plans and EPR goals.

**Recommendations**

Based off the of the current state of this policy issue, there are a few options that RISE can take. One option is to continue lobby each state for possible amendments and exemptions for the fertilizer and pesticide industry in the bills. Part of this could also involve the legal counsel However, this may not be the best long-term option considering the direction in the industry is heading in with Maine and Oregon. Another option would be to lobby for federal legislation. This could create a more coherent policy would easier to comply to rather than a patchwork of different state policies. If legislation on the federal level gets pushed forward, there is always the option to push for exemptions or amendments within the bill. The best next option the industry should take would be to create a Producer Responsibility Organization to represent manufacturers. This could come through ACRC or a completely independent organization could be developed. This would prepare the industry to prepare for any EPR pieces of legislation that apply to the pesticide and fertilizer space. In addition, the industry should also begin to look into post-consumer content technologies. Based off of the variety of international technology available this should become much easier if more legislation is passed. It would be likely an industry producer would emerge, or an international business would expand into the US and could be contracted by PROs to create new material from recycling.

## Case Studies

As of 2021, there were a total of 119 EPR programs in the United States. Most programs primarily deal with heavy and high-cost recyclable materials such as paint, carpet, mattresses, fluorescent lighting, pharmaceuticals, and electronics. In addition, there are numerous EPR programs, focusing on plastic, in other countries around the world.  Here

**EPR for Batteries**

In the United States, there are several other products that are currently subjected to EPR policies. One of the most common is batteries. There are 21 states in the United States that have battery recycling requirements and 8 states where producers are required to fund or offer battery recycling programs.

The industry has an established PRO, Call2Recycle, formerly referred to as the Rechargeable Battery Recycling Corporation (RBRC) and has been recycling batteries for the industry since 1994. Call2Recycle provides collection and responsible recycling of batteries for companies who pay to join the organization. The organization collects a variety of types of dry cell recyclable batteries up to 11lbs, other single use batteries up to 11lbs, and damaged and recalled batteries.

Call2Recycle has over 30,000 collection sites in the United States and Canada, with sites consisting of public locations like retailers, municipalities, and private locations such as hospitals, military bases, businesses and government agencies. Individuals can drop off any qualifying battery at a collection site. The drop off locations are then responsible for shipping the batteries. They can ship the batteries in the Call2reclycle paper collection kit with a prepaid shipping label for collection of up to 66lb or less in weight. For high volume collection sites that ship batteries of 500lb and more they may use their own large containers, drums or Call2recycle's boxes flat on a pallet to ship back collected materials. Call2recycle has a Bill of Lading (BOL) Wizard which is tool collection sites high volume collection sites can fill out that generates the proper shipping documents. The batteries are then shipped to their

process which process the batteries and break them down into to be used in new materials. Call2recycles processing facilities include Battery Solutions, Wistron GreenTech, Inmetco, Glencore, Umicore, Gopher Resource, Terrapure, Retreiv, and Recycling Coordinators.

Post-Consumer Content Technologies

Call2Recycle has a well-developed recycle and post-consumer content creation process. Once materials are collected and delivered to the recycling facility, they are then sorted by type and chemistry so they can be broken down to be reused into different post-consumer products. Each material is recycled in a different way. Rechargeable batteries (such as nickel cadmium, nickel metal hydride, and lithium-ion batteries) have the plastic separated from the battery. The remaining metals then go through high temperature metal reclamation (HTMR) process. The low-melt metals (zinc, lithium, and cadmium) separate during the process and are collected as a metal-oxide. They are then reused to make new products like golf clubs, silverware, steel, stainless steel, pots, and pans.

Lead batteries go through a separate process. Once melted and impurities are removed, they are sent to battery manufacturers where they are remelted and used in the production of new batteries.

The final type of batteries Call2Recycle recycles for post-consumer content is single use batteries. Recycling for single use batteries is done two different ways dependent on the material. Alkaline single use batteries are recycled using a steel-making process. Lithium single use batteries go through a process to neutralize the electrolytes and are then used as clean scrap metal.

Education Programs

Like many other recycling programs, the battery PROs are required to provide educational materials. These can all be found on Call2Recylces Website. On their website they provide several different pamphlets and handouts for consumers. They cover a wide variety of information including what type of batteries can be recycled, the recycling process, as well as informational instructions for collection sites and consumers. The website also provides a list of the of all the organizations collection sites, a list of the materials collected, the contact information of the producers apart of the organization, a description of the shipping, collection, and processing processes, and the organization's annual report detailing their progress and a program description. There 2020 annual report can be found here.

Payment Structure

Call2Recycle also has a fee structure set in place. They charge their members based on the amount in weight of materials recycled. The organization also offers recycling credits for producers who are complying to the requirements to help offset the costs. The credits awarded are based off of the amount of weight the members recycle. Below are pictures describing Call2Recycle's fee structure and recycling credits.

| 2021 STEWARDSHIP FEES (USD) | | |
|---|---|---|
| Battery Type | USA | Canada (Except BC, MB, QC, ON, SK& PEI) |
| Rechargeable Batteries ($ / 100 grams) | | |
| Ni-MH | $0.0075 | $0.0110 |
| Ni-Cd | $0.0250 | $0.0360 |
| Li-Ion (>5% Cobalt/Nickel Content) | $0.0075 | $0.0110 |
| Li-Ion (<5% Cobalt/Nickel Content) | $0.0150 | $0.0220 |
| SSLA | $0.0027 | $0.0038 |
| Primary Batteries ($ / gram) | | |
| Battery Type | Vermont | |
| Alkaline | $0.00132 | |
| Lithium Primary | $0.01056 | |

**Rechargeable Battery Recycling Credit**

The recycling credit is offered as a benefit to Call2Recycle's stewards to help offset costs associated with managing battery take-back. The credit program is tiered to reward the stewards for their commitment to help keep batteries out of landfills.

| Credit Status | Pounds Recycled / Quarter (US only) | % of Credit |
|---|---|---|
| Bronze | 5,000 – 24,999 lbs | 5% |
| Silver | 25,000 – 49,999 lbs | 10% |
| Gold | 50,000 – 74,999 lbs | 15% |
| Platinum | 75,000+ lbs | 25% |

**EPR in the European Union**

EPR programs have also had success internationally and can serve as crucial examples of ways that EPR can be successful in the United States. The European Union (EU) is one example. The concept of EPR was developed in Sweden during the 1990s and EPR programs are now required by every state in the EU. Germany was the first country to implement EPR legislation in 1991, which played a significant role in the creation of the EU's Directive on Packaging and Packaging Waste, also referred to as the Packaging Directive of 1994. This directive established the first recycling requirement in the union and has been updated several times to encourage continuing improvement of the recycling process. The latest update was in 2018 and set a recycling goal of 65% of all household, industrial, and commercial packaging by weight recycled by the end of 2025, increasing to 75% by the end of 2030. The update also requires all EU members to adopt EPR programs for all types of packaging by December 31, 2024.

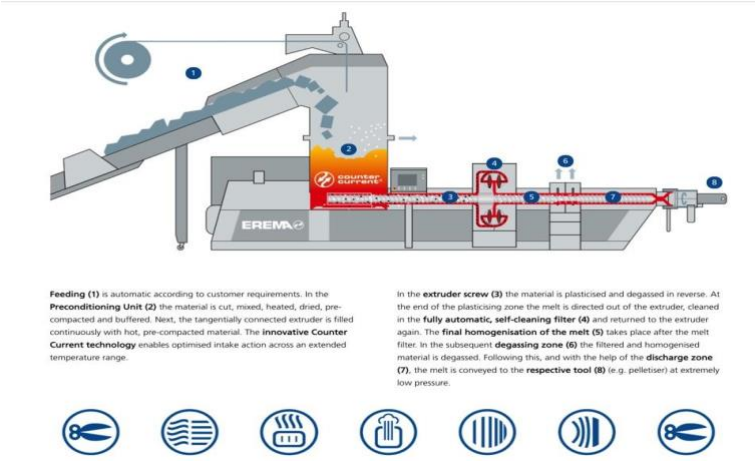
European countries have seen significant success through the implementation of their EPR programs. From 2000 to 2017, Ireland's recycling rates for Plastic and Paper Products (PPP) jumped from 19% in 2000 to 65% in 2017, Spain's increased from 40% to 68%, and Italy's increased from 38% to 67%. Nearly all participating EU countries have achieved PPP recycling rates of at least 60%, with many reaching 70% to 80%.

<u>Post-Consumer Content Technologies</u>

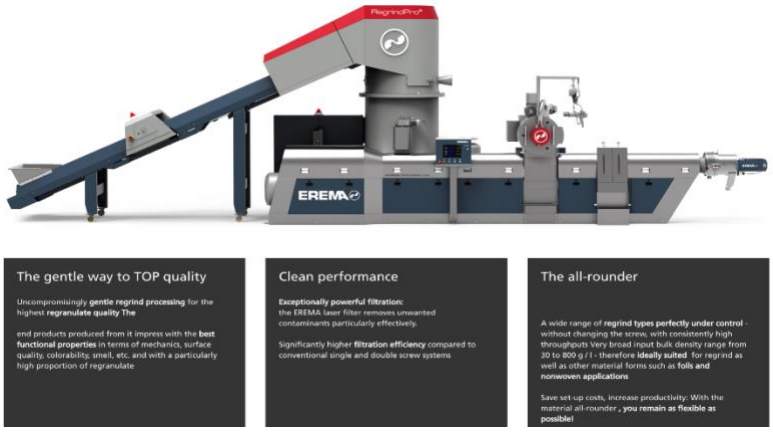
The EU has also been one of the leaders in the development of new technologies to increase the development of post-consumer recycled content. One of the most successful contractors in Europe for the development of post-consumer recycled content that can serve as a lesson for EPR development in the United States is EREMA. ERMA collects the following materials: Polyethylene (PE) washed shreds, agriculture sheeting, PE film with paper labels, Polypropylene (PP) film/non-woven fleece with solid content, thick regrinded material, thin regirded material, regrinded High Density Polyethylene (HDPE) material; and breaks them down into their raw form to be used into new materials. EREMA products are specifically used for thermoplastic household and agricultural waste. They take broken down plastics from these industries and turn them into pellets to be sold in end markets. There technologies are capable of handling, thin, thick, contaminated and mixed materials.

EREMA uses two different technologies that each break down different types of material. The first is the INTAREMA® TVEplus®, which can break down; lightly printed films, PE washed cuttings, PE film with paper content, metallized BOPP film, washed PE film flakes, agriculture film, PE film with paper labels, and PP film with solid contamination.

The process starts for the creation of new material through the INTAREMA® TVEplus® by first feeding the material onto the machine's conveyor belt, which takes it to the preconditioning unit. Once in the preconditioning unit the material is cut, mixed, heated, dried, pre-compacted and buffered through innovative counter current technology. It is then moved to the extruder screw where it is plasticized and degassed in reverse. Next, the material is then filtered and cleaned after being fully plasticized, where it is then sent back to the extruder for a second time. After being degassed for a second time it goes through homogenization. After homogenization the material is sent to the degassing zone to be degassed for the third time. Finally, it goes to the discharge zone where it is pelletized at a very low pressure. The pellets are then sold to end markets to be reused in the production of new materials. Below is an image and a description of the INTAREMA® TVEplus® technology.




The other technology EREMA utilizes is the INTAREMA® Regrind Pro®. The INTAREMA® Regrind Pro® is similar to the INTAREMA® TVEplus® except it breaks down different materials. The INTAREMA® Regrind Pro® breaks down thick walled regrind particles, high bulk density, and HDPE rigid materials. The process for the creation of new material begins on the INTAREMA® Regrind Pro® once the materials are placed on a conveyor belt and taken to the preconditioning unit where they are warmed homogeneously and degassed for the first time. The materials are then sent to the extruder screw where they are melted and degassed for the second time. Next, they are then sent to a laser filter where all contaminants are removed. The materials are then homogenized again and moved to a double venting chamber. In the venting chamber they are degassed for the third time and pelletized. Below is a picture of the INTAREMA® Regrind Pro® and more information describing the technology process.



**EPR in Canada**

Canada has also seen success with EPR. Canada has implemented some national EPR initiatives such as the 2009 Action Plan for Producer Responsibility, and the Zero Waste Project in 2018, however much of the success has come through policies implemented by individual provinces. Four provinces that have seen the most success are Ontario, Quebec Manitoba, and British Columbia.

*Ontario:* Ontario developed their first recycling system in 1994, requiring municipalities to provide curbside recycling through the Blue Box Program. The province then established their first EPR system for packaging and paper products (PPP) in 2002 under the Waste Diversion Act. This led to the establishment of Stewardship Ontario, the province's PRO, which would take on the responsibilities of the Blue Box Program. Under the act producers were required to cover 50% of the costs of the Blue Box Program through payments to Stewardship Ontario. Stewardship Ontario sets material fees for producers based on the recycling rate and net cost to manage each material. The EPR for PPP program in Ontario is set to transition from a shared cost model (50/50) to full producer responsibility in the coming years. The program has increased the recycling level since its implementation and has a current recycling rate of around 60% for all materials.

*Quebec:* Quebec established their first EPR system for PPP in 2005. The program started as a shared 50/50 cost model and transitioned to full cost by 2013. There are two PRO's that run recycling operations for produces; Recycle Medias, which is responsible for newspaper recycling, and Éco Enterprises Québec (ÉEQ) which recycles all other materials. Both PRO's run on a fee structure based on the weight of material recycled. Fees are modulated, accounting for weight, collection rates, and the net costs of managing each material in the system. The average fee is $220 USD per metric ton put onto the market. Current recycling rate is just above 60% and is working towards the goal of 70%.

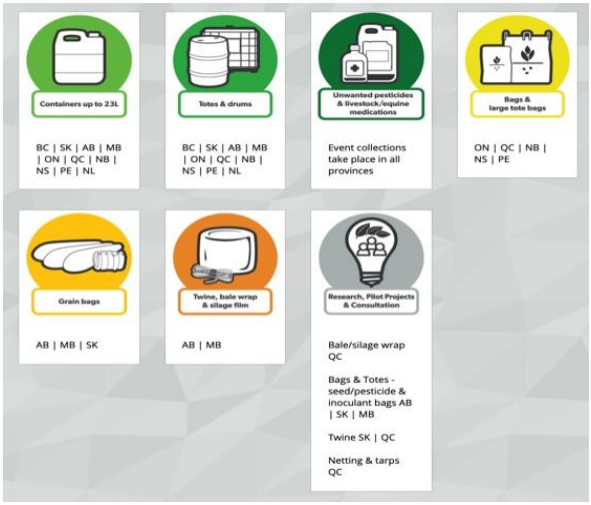
*Manitoba:* Manitoba's EPR for PPP program was established in 2010 by the Waste Reduction and Prevention (WRAP) Act. Manitoba has two PRO's that take on recycling responsibilities for producers; Multi-Material Stewardship Manitoba (MMSM), which recycles almost all materials, and The Canadian Beverage Container Recycling Association (CBCRA), which is responsible for recycling beverage containers. MMSM charges their producers a set fee for their recycling and collection services. However, producers with difficult-to-recycle materials face higher cost for investment in new options of end-of-life management. MMSM also reimburses municipalities for 80% of their net reasonable recycling costs. Manitoba's current recycling rate is 84.3%.

*British Columbia:* British Columbia also has a notable recycling system set in place. In 1997, producers in B.C. began the Beverage Container Stewardship Program and in 2003, B.C. adopted the Environmental Management Act (EMA) to streamline EPR and expand producer responsibility to more product categories. EMA required producers to submit stewardship plans to the B.C. Ministry of the Environment and obligated them to achieve target material recovery rates of at least 75%. In 2011 B.C. implemented their EPR for PPP and the province's first PRO, Multi-Material BC, was established in 2014. In 2017 Multi-Material BC, was rebranded to Recycle BC. Since then, there have been two other PROs' created for the province, B.C.: Brewers Recycled Container Collection Council, and New Media Canada (NMC). Under the Recycled BC framework local governments have the option to become full members, partial members or fully opt out of joining the pro and meeting EPR requirements individually. The producer's fee for the PRO's is based on the weight of the material collected. B. C's current recycling rate is over 80%.

Clean Farms

Clean Farms is a PRO in Canada the represents the agriculture and fertilizer industry. The organizations goal is to help farmers manage their waste and create a sustainable agriculture industry. Clean Farm include developers, manufacturers, distributors and retailers of pest control products, fertilizers, seed, as well as equine and livestock medications. The organization has several programs established to help improve industry recycling and the development of post-consumer recycled content.

Clean farms programs are broken up by Province and the type of materials collected by the organization differs by province as well. A general list of the materials the organizations accepts across Canada includes containers up to 23L, drums and totes, unwanted pesticide containers, unwanted equine/livestock medication containers, pesticide and seed bags/totes, grain bags, and bale wrap. They also offer recycle research products in certain provinces. Below is a graphic detailing which material are recycled and collected in each province.




Before dropping off materials at collection sites consumers must follow the proper recycling standards for each material such as the triple rise standard for pesticide containers, which can be found by clicking on each material on the website. Once that is completed consumers may drop off that containers one of the collection sites listed on the website. After materials are collected, collection sites must fill out a form to have the material collected to be taken to a facility to be broken down for new products or be reused in the industry.

Clean Farms also provides all other standards of a PRO on their website. On their website they provide the necessary educational materials on industry recycling, a list of their programs, a list of a member and their products, and their annual report. Clean farm could serve as the model of an Ag PRO in the US.

Post-Consumer Content Technologies

Canada has also become a leader in the development of post-consumer content technologies. Most of the PRO's and provinces in Canada have contracts with post-consumer content companies that take the recycled goods and break them down into raw materials that can be used in new products. One notable company that provides post-consumer content services in Canada is Lavergne. Lavergne creates different types of 100% post-consumer recycled thermoplastic resins (VYPET, VYTEEN, VYSTYRNE, and custom resins) that can be sold to end markets to be made into new products. VPET is made from Polyethylene Terephthalate (PET) and is sold to create new products in the automotive and electoral industries. VYTEEN is made of Acrylonitrile-Butadiene-Styrene (ABS) and Polycarbonate (PC), and is

utilized to make new electrons, automotive parts, and electrical components. VYSTYRENE is made of High-Impact Polystyrene (HIPS) and can be used to create low-strength structural components, electronic housings, cases and covers, as well as housing appliances. Lastly the custom resin is made with client specific materials. Lavergne has one standardized technology process that they use to create all of their materials. All of the recycle material they receive go directly to the Plastic Care Center. At the Plastic Care Center, the plastics are shredded into smaller flakes, separated by type and color, cleaned to remove contaminants, deep washed, and lastly sorted and homogenized into 16 silos. After those steps are completed the plastics are moved to the mixing additives center. There, scientists develop an additive formulation, which includes a recycled base polymer and additives specifically tailored for each type of plastic or client's application. Scientists also ensure that the resin meets new resin specifications and color matching. Once that is completed the materials go to the Reactive Compounding Center. At the Reactive Compacting Center, the base polymers and additives are melted and blended together, and the resulting compound then undergoes extrusion and is cut into pellets After that every batch then goes to the certified testing lab before being sold to new markets.

Another company that has also created efficient postconsumer content technologies in Canada is Pyrowave. Pyrowave uses their patented microwave catalytic depolymerization technology to break down used polystyrene into new materials. Pyrowave does this by first mixing the plastic in a preparation tank, which removes contaminants like labels and films as well as other impurities. This makes it easier to inject the plastic into the reactor. The conditioned polystyrene is then introduced into the reactor where it is mixed with patented silicon carbide particles which interact with a high energy microwave field. This breaks the chains of polymers into liquid rich in monomers which are then purified to reach the same specifications as the monomers used by industry. These purified and recycled monomers are then taken back by a manufacturer and transformed again into virgin resin, in order to manufacture a whole range of products such as polystyrene, synthetic rubber, latex and plastics for electronic products.

**EPR in Brazil**

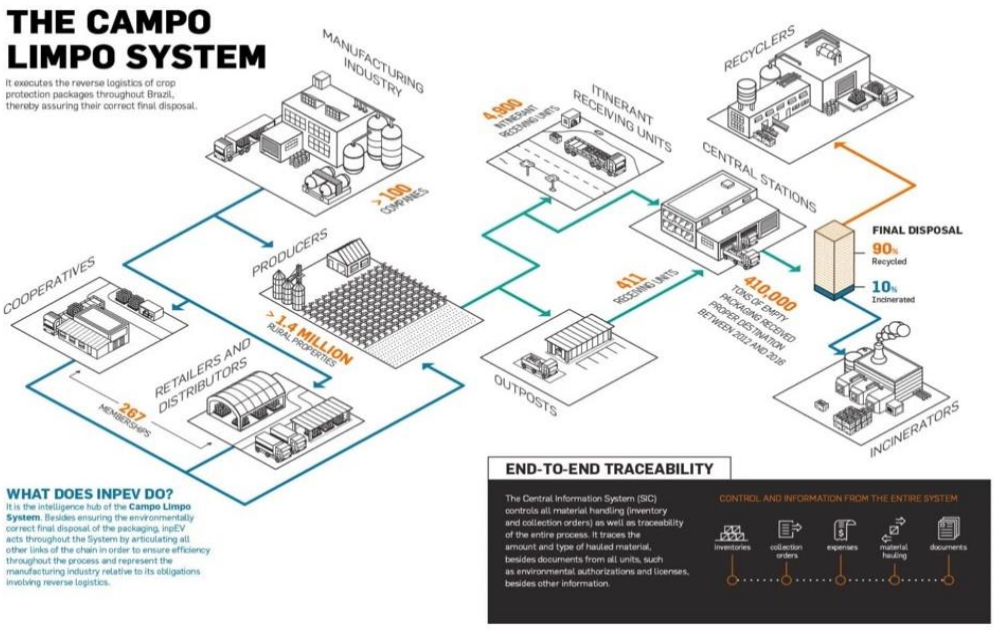
<u>inPEV (The National Institute for the Processing of Empty Packing)</u>
InpEV is a non-profit organization in Brazil that was created by pesticide manufactures. It is responsible for the collection and recycling of the industries plastics. The organization was formed in December 2001 and began operating in March 2002 to help manufactures in the pesticide industry comply with Federal law 9,974/00 which established reverse logistics recycling and environmental standards for the handling and disposal of pesticide containers from all areas of agriculture production (farmers, distribution channels and cooperatives, industry and public authorities). inpEV companies share responsibility in the costs of handling, collection, and recycling for the pesticide industry. inpEV ensures member companies meet all the proper recycling standards through the Clean Fields System. inpEV runs the reverse logistics for the Clean Fields System. inpEV currently has over 100 members they work with to create sustainable recycling system for the countries pesticide industry.

*Clean Field System and Reverse Logistics:*
The Clean Fields System is Brazils cooperative for recycling in the pesticide industry and is primarily run by inpEV. The system is structured to ensure producers in the industry meet the federal regulations regarding plastic packaging. InpEV is primarily responsible for the collection of material from the consumers and making sure they end up at the final dispatcher; recycling centers for recyclable and incinerators for non-recyclables.

The Clean Fields System is very structured. It begins with consumers and puts the weight back on the producer to ensure the goods meet their final end markets. The Clean Fields system accepts two broad types of packaging washable and non-washable. Washable packaging includes High Density Polyethylene (HDPE), Coex, and Polypropylene (PP). Non-washable plastics include Bags made of plastic, paper, metallized, mixed or made with another flexible material, packaging of seed treatment products, cardboard boxes, cardboard cartridges, and Fibrolats. Consumers are then responsible for separating their products and properly washing their washable containers. Consumers with washable containers must triple rinse of pressure wash their containers in suit with federal regulations. Triple rinsing is washing the container out three times. Pressure washing is when the containers are sprayed with a water jet for 30 seconds filling all sides of the container. After producer's triple rinse or pressure wash the containers, they must poke a hole in the bottom to signify that they have been previously used and are cleaned. After that farmers must store the containers in plastic rescue bags provided by the Clean Fields System.

Once containers are stored, farmers and consumers must use inpEV's online scheduling tool to have their packages picked up and shipped to the proper receiving unit, which is provided to the consumer on a receipt when they purchase the product. Brazil has over 400 receiving units across the country. Receiving units are either one of two types: central or post. Post receiving units are smaller and are managed by a distributor association or cooperative. Post units separate washed and unwashed materials, confirm receipt of the packages to the consumers, and ship the goods to proper receiving center. Central receiving units are larger facilities and often take on more responsibilities. Central units, sort the material based off whether they are washed or unwashed and then material type, confirm the receipt of the packages with the consumers, and issue a collection order to inPEV to deliver the products to their final destination (recycling center or incinerator). Products that are recyclable are sent to one of inpEV's 10 recycling partners and are broken down based off of material type to reused into new industrial materials such as corrugated pipes, sewage pipes, battery boxes, railway sleepers, signposts, pole crosses, cardboard molds for industrial and furniture protection, and new packaging and lids for pesticides.

Below is a flow chart of the Clean Fields system and a link to their website can be found here.



inpEV also meets several qualities similar to what a PRO would have to in the United States. They have extensive education resources on their website which can be found here. They have educational materials and programs for all types of groups including farmers, students, and the public to help them learn about the Clean Fields System and its importance. inPEV has also established National Clean Fields, which is celebrates on August 18th, since 2008. It serves as an outreach event for the organization to educate the public and create more community awareness of the Clean Fields System. inpEV also has a fee structure that similar of a PRO. Members pay an annual fee based off of the volume of material collected. The money collected by inPEV is then used to help fund the Clean Fields system. Lastly, inPEV also provides a list of all of their member companies and entities on their website.

## Legislative Summary

1. **California**
    a. **SB-54: Plastic Pollution Producer Responsibility Act**
    Introduction: 12/07/2020
    Latest Action: Ordered to inactive file on request of Senator Allen on 5/20/2021
    Primary Sponsors: Ben Allen, Henry Stern, Scott Wiener, Lorena Gonzalez, Lena Gonzalez, Al Muratsuchi, Phil Ting
    Bill Summary: This bill would establish the Plastic Pollution Producer Responsibility Act, which will build off of existing legislation, specifically The California Integrated Waste Management Act of 1989, administered by the Department of Resources Recycling and Recovery, and The Sustainable Packaging for the State of California Act of 2018. The California Integrated Waste Management Act regulates the recycling, disposal, and management of solid waste, like single-use plastic straws. The Sustainable Packaging for the State of California Act of 2018 focuses on the food service industry requiring that a food service facility operating at a state facility, under a state contract or under contract from a state food distributor, are prohibited from using packaging that is not recyclable or compostable. Current California law states that it is the goal of the state that no less than 75% of solid waste be compostable, recyclable, or source reduced. Under this bill, producers of single use package or food service ware products would be prohibited from selling, importing, or distributing these products in the state or into the state from where they are manufactured by January 1, 2032, unless they are recyclable.
    Full Bill Description

2. **Hawaii**
    a. **HB 1316: Relating to Packaging Waste**
    Introduction: 01/27/2021
    Latest action: Passed second reading as amended in HD 1 and referred to the committee(s) on Consumer Protection and Commerce Committee with none voting “aye with reservations”
    Bill Summary: The bill will require the state to provide funds to the Department of Health to conduct a study on the costs and benefits of implementing an extended producer responsibility program in the state. It will prohibit restaurants from using single use plastic ware to consumers, unless requested by the consumer, starting January 1, 2022. It will also require beverage manufacturers to sell, offer, or distribute beverages in plastic containers to

help reach Hawaii's minimum post-consumer recycled content requirements, beginning January 1, 2023.
Full Bill Description

b. **SB 719: Relating to Pesticides**
Introduction: 01/22/2021
Latest Action: Report adopted; passed second reading, as amended (SD 1) and referred to Way and Means Committee/Judiciary Committee on 02/10/2021
Primary Sponsors: English, Chang, Fevella, Gabbard, Kanuha, Keith-agaran, Misalucha, Kim, Shimabukuro
Bill Summary: The bill will provide funding and require the Department of Agriculture, in partnership with the Department of Health, to develop and implement a one-time pesticide disposal program. Program duration will be determined by the Department of Agriculture. The department will be required to create a steering committee to monitor the pesticide disposal collection program. The bill will also increase penalties for violating the Hawaii pesticide law.
Full Bill Description

c. **SB 1419: Relating to Product Stewardship Programs**
Introduction: 01/27/2021
Latest Action: Re-referred to the Joint Distribution Committee on 02/16/2021
Primary Sponsors: Acasio
Bill Summary: Shifts the responsibility of recycling from the government to producers through the establishment of a Municipal Product Stewardship Program. Producers will cover the costs of the program through funding local governments, municipalities, towns, and cities. The goal of the program is to increase and expand recycling services across the state.
Full Bill description

**3. Maine**

a. **L.D 1541: An Act to Support and Improve Municipal Recycling Programs and Save Taxpayer Money**
Introduction: 05/10/2021
Latest Action: Passed on 06/18/2021
Primary Sponsors: Grohoski
Bill Summary: This bill establishes a stewardship program in the State for packaging material, to be operated by a stewardship organization contracted by the Department of Environmental Protection following a competitive bidding process. Under the program, producers of products contained, protected, delivered, presented, or distributed in or using packaging material pay into a fund based on the amount by weight of packaging material associated with the products they sell, offer for sale, or distribute for sale in or into the State. Producers can wholly or partially offset this payment obligation by implementing independent programs to recycle packaging of the same material type for which they have a payment obligation and can further reduce their payment obligation by reducing the amount of packaging associated with the products they sell, offer for sale, or distribute for sale in or into the State or by meeting other program incentives. Producer payments received by the stewardship organization are used to reimburse 34 eligible municipalities for certain recycling and waste management costs. In addition to the payment of municipal reimbursements, the

stewardship organization is authorized to use producer payments to cover the operational costs for the program, to pay department fees, and to make investments in education and infrastructure aimed at reducing packaging waste and improving recycling outcomes in the State.
Full Bill Description

4. **Maryland**
    a. **HB 36: Environment – Packaging, Containers, and Paper Products – Producer Responsibility**
    Introduced: 01/26/2021
    Latest Action: Died in Committee on 02/09/2021
    Primary Sponsors: Liernman
    Bill Summary: This bill requires producers that sell in or distribute goods into Maryland to comply with a producer responsibility plan. This will shift the recycling responsibilities away from local governments to producers. Producers will be responsible for covering the costs of the plan. Plans must also include specific post-consumer content and recycling rates. The Department of the Environment will be responsible for approving and monitoring the plans.
    Full Bill Description

5. **Massachusetts**
    a. **HB 878 (HD 1553): An Act to Save Recycling Costs In The Commonwealth**
    Introduction: 03/29/2021
    Latest Action: Hearing scheduled for 06/22/2021 from 01:00 PM-05:00 PM in Virtual Hearing
    Primary Sponsors: Day
    Bill Summary: A bill that sets standards to cut down on recycling costs and increases the rate of recycling and products made from post-consumer content.
    Full Bill Description

6. **New Jersey**
    a. **SB 3853: Requires producers of packaging products sold in New Jersey to adopt and implement packaging product stewardship plans**
    Introduced: 06/01/2021
    Latest Action: Assigned to Senate Environment and Energy Committee on 06/01/2021
    Primary Sponsors: Smith
    Bill Summary: The bill requires producers of packaging products sold in New Jersey to adopt and implement packaging product stewardship plans, while supplementing Title 13 of the Revised Statutes.
    Full Bill Description

7. **New York**
    a. **AB 3580: Requires manufacturers of consumer goods to accept for collection, handling and recycling or reuse, consumer goods waste for which it is the manufacturer**
    Introduction: 12/27/2020
    Latest action: Referred to Environmental Conservation Committee on 01/27/2021
    Primary Sponsors: Hunter
    Bill Summary: The bill requires manufacturers to establish consumer waste programs and be responsible to bear the costs of the program. Through the program, manufactures of

consumer goods must accept the handling, collection, recycling, or reuse of goods of which it is the manufacturer.
Full Bill Description

b. **AB 4071: Requires manufacturers to meet certain standards with their packaging in New York state to reduce waste**
Introduction: 02/01/2021
Latest action: Referred to Environmental Conservation Committee on 02/01/2021
Primary Sponsors: Englebright, Abinanti
Bill Summary: The bill requires manufacturers in New York to adhere to packing requirements to reduce waste and provides a timeframe and guidelines the manufacturers must comply with.
Full Bill Description

c. **AB 5801: Establishes the extended producer responsibility act**
Introduced: 02/25/2021
Latest Action: Bill was recommitted to the Codes Committee in anticipation of further consideration in 2022
Primary Sponsor: Englebright
Bill Summary: The act will amend the environmental conservation law. It will establish an extended producer responsibility program that will require producers of covered materials and packaging to impose strategies that promote recycling, reuse, and recovery of plastic and paper products.
Full Bill Description

**8. Oregon**

a. **SB 582 Requires producers of covered products to join producer responsibility organization unless exempt**
Introduced: 01/11/2021
Latest Action: Waiting for Governor to sign
Primary Sponsors: Dembrow, Sollman
Bill Summary: The bill required manufacturers of covered products to join a producer responsibility organization unless they meet the exemptions. The producer responsibility organization is responsible for submitting a program plan.
Full Bill Description

b. **SB 14: Relating to plastics; prescribing an effective date**
Introduced: 01/11/2021
Latest Action: In Senate Committee on Energy and Environment upon adjournment on 06/226/2021
Primary Sponsor: Beyer
Bill Summary: Producers may no longer sell covered products in or into the state unless they are primarily composed of the Department of Environmental Qualities approved list of plastics or a member of a stewardship organization with a plastics program approved by the department.
Bill description

**9. Vermont**

a. **H. 142: An act relating to extended producer responsibility for packaging and paper products**
Introduced: 01/27/2021
Latest Action: Referred to the Committee on Natural Resources, Fish, and Wildlife on 01/27/2021
Primary Sponsors: Sheldon
Bill Summary: This bill proposes to require parties responsible for the production or distribution of packaging and paper products to implement or participate in a plan for the collection and management of recyclable packaging and paper products.
Full Bill Description

**10. Washington**

a. **SB 5022: Concerning the management of certain materials to support recycling and waste and litter reduction**
Introduction: 12/17/2021
Latest action: Passed into law on 05/18/2021
Primary Sponsors: Das, Rolfes, Carlyle, Dhingra, Keiser, Kuderer, Liias, Lovelett, Nobles, Nguyen, Pedersen, Saldaña, Salomon, Stanford, Wellman, Wilson, C.
Bill Summary: The bill establishes a minimum recycled content requirement and establishes regulation for solid waste management by prohibiting expanded polystyrene, providing for food service ware upon customer request, and addressing plastic packaging. The bill will establish new expiration dates and penalties for those who fail to comply.
Full Bill Description

b. **SB 5219: Concerning the management of plastic packaging materials**
Introduction: 01/14/2021
Latest Action: Public hearing in the Senate Committee on Environment, Energy & Technology on TBD 01/28/2021
Primary Sponsors: Stanford, Liias, Conway, Hunt, Keiser, Kuderer, Nguyen, Wilson
Bill Summary: This bill sets standards for the management of plastic packaging materials.
Full Bill Description
Fiscal Note Summary

**11. Federal Legislation**

a. **S. 984: Break Free from Plastic Pollution Act 2021**
Introduced: 03/25/2021
Latest action: Read twice and referred to the Senate Finance Committee on 03/25/2021
Primary Sponsors: Udall, Lowenthal
Bill Summary: The bill amends the Solid Waste Disposal Act to reduce the production and use of certain single-use plastic products and packaging, to improve the responsibility of producers in the design, collection, reuse, recycling, and disposal of their consumer products and packaging, to prevent pollution from consumer products and packaging from entering into animal and human food chains and waterways, and for other purposes.
Full Bill Description

b. **HR 1512: Clean Future Act- Title IX Waste Reduction- Subtitle B: Product Standards and Producer Responsibility**
Introduced: 03/02/2021

Latest Action: Referred to the Committee on Energy and Commerce, Subcommittee on Environment and Climate Change on 03/03/2021
Primary Sponsors: Pallone
Bill Summary: The bill amends the Solid Waste Disposal Act and creates recycling and producer responsibility standards for beverage and covered product producers.
Full Bill Description

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