

**ENVIRONMENT DIRECTORATE**

**Plastics recycled content requirements**

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# Abstract

Recycling is a key method for addressing plastics leakage and maintaining material value, but secondary plastics production is currently an order of magnitude smaller than primary production. Companies are pursuing voluntary efforts to increase their use of recycled content, but these efforts have historically failed to deliver on public ambitions. Proponents argue that implementing policies that will require the use of recycled content in products and packaging will strengthen the market for recycled plastics. There is some initial evidence that recycled content policies stimulate demand and investments to improve supply.

Businesses have experienced some challenges in their initial efforts to incorporate recycled plastics content and comply with new regulations. Businesses are facing a disharmonious range of definitions and scope. Additionally, there is insufficient volume of quality recycled content in the market at present, raising concern of price increases. Governments are facing limitations in what is feasible for monitoring and verifying compliance.

**Key words:** circular economy, resource efficiency, recycling

**JEL Codes:** L22, L23, Q53

# Résumé

Le recyclage est une méthode essentielle pour lutter contre les fuites de plastique et préserver la valeur des matériaux, mais la production secondaire de plastique est actuellement inférieure d'un ordre de grandeur à la production primaire. Les entreprises s'efforcent volontairement d'augmenter leur utilisation de matières plastiques recyclées, mais ces efforts n'ont jamais été à la hauteur des ambitions publiques. Les partisans de cette solution affirment que la mise en œuvre de politiques exigeant l'utilisation d'un contenu recyclé dans les produits et les emballages renforcera le marché des plastiques recyclés. Il existe des preuves initiales que les politiques en matière de contenu recyclé stimulent la demande et les investissements pour améliorer l'offre.

Les entreprises ont rencontré certaines difficultés dans leurs efforts initiaux pour incorporer des matières plastiques recyclées et se conformer aux nouvelles réglementations. Les entreprises sont confrontées à un éventail de définitions et de champs d'application peu harmonieux. En outre, le volume de contenu recyclé de qualité est actuellement insuffisant sur le marché, ce qui fait craindre une augmentation des prix. Les gouvernements se heurtent aux limites des possibilités de contrôle et de vérification de la conformité.

**Mot clés:** Économie circulaire, efficacité des ressources, recyclage

**Classification JEL:** L22, L23, Q53

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## Executive summary

The waste hierarchy emphasises reduction, re-use, and then recycling before other waste treatment and disposal. Recycling is not the first-best option but can help to displace primary production of plastics by substituting them with secondary ones. It also helps to maintain material value and address plastics leakage.

Secondary plastics production is currently an order of magnitude smaller than primary production. Governments are seeking policies that can change businesses' relative reliance on primary plastics as inputs for products and packaging. To date, policy has largely targeted the supply of secondary plastics, such as with collection and recycling targets. There is a growing appreciation that these policies may need complementary policies to stimulate demand for secondary plastics.

Companies are pursuing voluntary efforts to increase their use of post-consumer recycled (PCR) plastics material, but these efforts have historically failed to deliver on public ambitions. There is some evidence that recent efforts are more comprehensive. For example, the Ellen MacArthur Foundation and the United Nations Environment Program and outside partners have created the New Plastics Economy Global Commitment. It serves as a host for voluntary pledges by companies to increase their use of recycled content. The average reported share of recycled content in the products of all signatories in the New Plastics Economy Global Commitment has grown from 4.8% in 2018 to 10% in 2021.

Proponents of government policies (e.g., regulation) that would require the use of a minimum share of recycled content in products and packaging argue that these policies would strengthen secondary plastics markets by stimulating both:

1. a separate demand for post-consumer recycled (PCR) content, and
2. investment to improve quality and quantity of PCR supply.

Governments are beginning to use a myriad of policy tools that will require businesses to use a minimum share of PCR in their products and packaging. Most of these policies are forthcoming. Prominent examples include:

- **Targets:** at least twelve OECD Member Countries<sup>1</sup> have agreed to a national target for recycled content either for plastics or a relevant sector.
- **Extended Producer Responsibility (EPR) fee modulation:** at least six OECD member countries have made EPR policy that lowers producers' fees based on the share of recycled content in their product or packaging.
- **Public procurement:** several OECD member countries have requirements or incentives for governments to purchase products with a share of PCR content.

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<sup>1</sup> In 2018, Canada, France, Germany, Italy, and the United Kingdom agreed via the G7 forum to adopt a plastic charter that included the goal to increase recycled content "by at least 50%" by 2030. The Charter has since been signed by the European Union, Mexico, Norway, the Netherlands, Costa Rica, Finland, Chile, Belgium, and 15 additional non-OECD countries.



- **Taxes and penalties for non-compliance** with a regulatory requirement for a minimum share of PCR: at least 25 OECD member countries (two-thirds of total membership) will have regulatory requirements for a minimum share of plastics recycled content in targeted products or packaging in place by 2024. The severity of the financial penalty for non-compliance means that these policies can have the effect of a tax or a penalty. Most of these regulatory policies are forthcoming.

There is some initial evidence that voluntary efforts and government policies may stimulate a separate demand and investments to improve supply. For example:

- OECD country markets with impending policies have experienced some price differentiation between Polyethylene Terephthalate (PET) and recycled (r)PET from bottles. In Europe, the price of rPET flake in May 2020 was higher than the price for its primary equivalent PET, demonstrating that firms will pay a premium for secondary materials in some circumstances, a break from previous market conditions. The growth rate of the price for recovered plastics increased in the United Kingdom after the announcement of its recycled content requirement in October 2018, and then accelerated after the policy began in April 2022.
- Recycling companies have explained that record revenues in 2022 were partially due to recycled content commitments. However, high fuel prices could also be partly responsible for driving demand for secondary material. In the United States, Waste Management Inc. made a net income of USD 2.2 billion in 2022 and is planning USD 590 million in additional investments in recycling and recovery.

Monitoring and verifying compliance with regulation is proving to be a challenge. Governments are currently relying on self-reporting by regulated companies, while several are actively developing rules for how to verify these claims.

Business have experienced some challenges in their initial efforts to incorporate recycled plastics content and comply with new regulations. Challenges include:

- Harmonisation-- definitions of recycled content and methodology used in government policies differ and complicate accounting by regulated companies. There is not a universally accepted definition of PCR content and policymakers are using different definitions. Different definitions can also send mixed signals to industry on how to invest to improve supply. There is unclear signalling about investing in chemical recycling, for which there is an ongoing debate about the extent to which companies should rely on these technologies to meet their commitments and obligations for recycled content.
- Obtaining supply of quality recycled content-- Food-grade material is particularly challenging to acquire.

Early adopters have identified some good practices for overcoming the key challenges in implementing these kinds of policies. Early experience suggests the following guidance should help inform future policy development:

- Targets should be challenging, but feasible.
- Policymakers should take care that requirements do not jeopardise health or safety.
- Supply-based measures that aim primarily to increase the production and quality of secondary material, including extended producer responsibility policies, can complement demand policies and ensure price reductions in the long term.

- Exemptions from recycled content requirements can help to address sanitary or safety concerns but should be balanced against the fact that they reduce the reach and impact of the policies.
- International cooperation can promote harmonisation around best practices, identification of insights from development of definitions for recycled content, measurement and verification.

Recycled content requirements are a potentially significant policy tool. But there is a question whether regulations or alternative policy instruments throughout the lifecycle might be better or equally well suited to incentivise recycled content. For example, primary (virgin) material taxes increase the relative cost of primary material and can help stimulate reduction and the substitution of these materials with secondary equivalents. Further work will be needed to shed light on this issue.

# 1 Introduction

Once opportunities for reduction and reuse are exhausted, recycling is an integral way to increase resource productivity and circularity by maintaining the value of material inputs and minimising waste. Recycling has two principal benefits. First, it diverts material from becoming waste in landfills or incineration. This helps prevent litter from permanently leaking out of the economy, avoiding subsequent environmental and health impacts, and retains some of the material's value. Second, where secondary material replaces demand for primary material, recycling helps to ease environmental pressures from extraction and primary production. A metanalysis of lifecycle assessments comparing packaging with recycled content found that increasing recycled content results in lower environmental impacts compared with similar virgin-based plastics packaging (Vendries et al., 2020<sup>[1]</sup>).

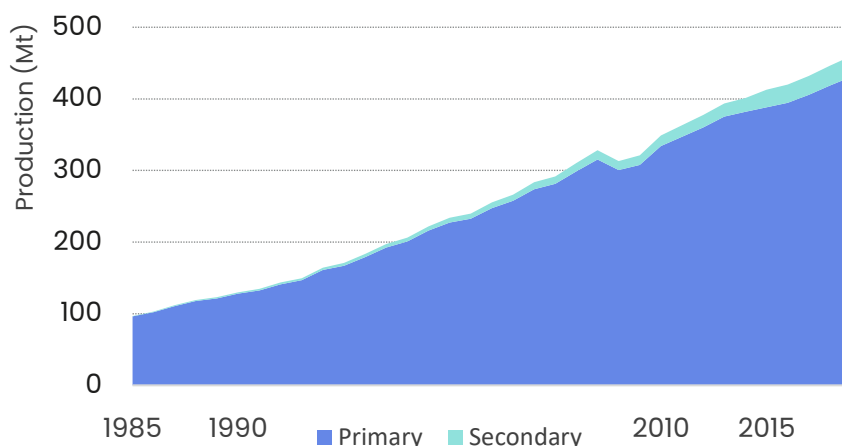
Companies are pursuing voluntary efforts to increase their use of post-consumer recycled (PCR) plastics material, but these efforts have historically failed to deliver on public ambitions. Whilst environmentally preferable to primary materials, using secondary materials is often not the preferred choice of producers, due to added costs related to adjusting production methods and barriers such as price, contamination, supply risks, and demand uncertainty (OECD, 2022<sup>[2]</sup>).

Several governments in OECD member countries have recently adopted targets or regulatory policies that will soon require a share of secondary material in the composition of new plastic products or packaging. This paper covers recycled content policy for plastics and will consider similar policies for other materials only where it can inform plastics policy development<sup>2</sup>. Plastics recycling is in most cases technically feasible, but the scale of the production of primary plastics is much larger. Global secondary plastics production quadrupled from 6.7 Mt in 2000 to 29.1 Mt in 2019 but remains minor compared to 431 Mt of primary plastics production in 2019 (Figure 1.1).

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<sup>2</sup> Similar policies have been implemented for paper products and packaging, for example in the composition of material used in production of newspapers (Madris, 1994<sup>[102]</sup>). These previous efforts can help to inform the design of recycled content policy and enforcement for plastics. However, there are some differences between the materials' physical, chemical and economic characteristics that complicate this applicability. For example, while paper can be composed of entirely recycled content, the loss in strength to weight in mechanically recycled plastic content means it is nearly always mixed with primary material. Paper recycling is also a much more advanced industry compared with plastics. For example, in 2018 an estimated 68.2% of post-consumer paper and paperboard was recycled in the United States, the highest rate for any stream measured in its municipal solid waste (U.S. EPA, 2022<sup>[103]</sup>). Comparatively lower, in 2018 the estimated recycling rate of post-consumer plastics in the United States was 8.7% (U.S. EPA, 2021<sup>[104]</sup>)

Figure 1.1. Comparison of primary and secondary plastics production



Source: (OECD, 2022<sup>[2]</sup>)

Policy instruments to enhance recycling and reduce plastic leakage to the environment can be either ‘enabling’ or ‘steering’. Steering policies, such as regulations and economic instruments seek to compel or incentivise improvements in recycling, whilst softer enabling policies such as research, communication, and voluntary commitments help to engage stakeholders and enable recycling improvements. To date, OECD countries have widely adopted enabling policies, but there is still significant scope to further strengthen the steering policies (OECD, 2022<sup>[2]</sup>).

Governments in OECD countries have made extensive use of supply “push” policies, which aim in the first instance to improve the quantity of production, but the low- quality of secondary plastics remains largely a gap. For example, Extended Producer Responsibility (EPR) policies tend to target the quantity of secondary production and not quality. Secondary plastic markets today consist of a glut of low-quality material. Production of closed loop high-quality secondary material remains stubbornly low, which may in part be due to diluted economic incentives from the collective implementation of EPR.

Regulatory policy for recycled content in the composition of products and packaging can be a potential spur to secondary plastics markets. First, policies on recycled content “pull” demand for secondary plastic. As Stephen Alexander (CEO of the Association of Plastic Recyclers) has suggested, “If you don’t have a customer for your recycled product, all we’re doing is collecting, sorting and processing trash” (Mcneese, 2022<sup>[3]</sup>). Second, there is hope that these policies may in turn stimulate investments and economies of scale to improve quality of supply of secondary material.

Verification of recycled content claims by firms will be key to ensuring that these policies do not simply instigate an exercise in ‘green washing.’ Key to this issue are the methods used to track the movement of the secondary materials through the supply chain.

The aim of this paper is to inform the development of recycled content policies for plastic by analysing the design of instruments by early adopters. In doing so, this paper will seek to answer three questions:

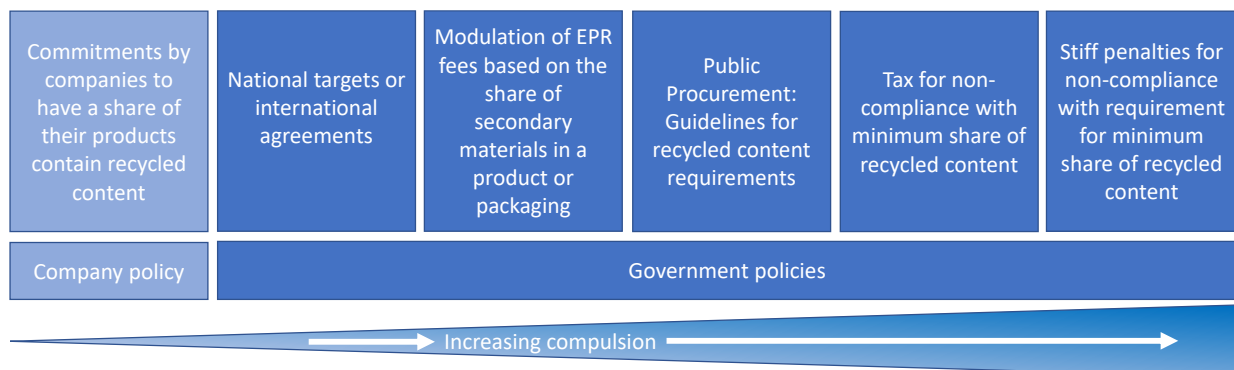
- What policies are OECD member countries adopting to require a minimum share of secondary plastics content in new plastic products and packaging?
- What is the early evidence that these policies impact secondary plastics markets?
- How are policymakers verifying producers’ claims about the share of secondary plastics in their products?

This paper provides a Stock-take of policies to require a minimum share of recycled content and methods for checking Compliance with requirements and verification of recycled content. This stocktake and evaluation of early evidence informs the Considerations for the design of recycled content policies and the Key policy insights.

## 2 Stock-take of policies to require a minimum share of recycled content

Companies and governments across the OECD are making use of a wide range of policies to require that products and packaging are made with a minimum share of recycled content, which vary by the degree to which the policy compels producers (Figure 2.1). Companies have announced commitments to increase the share of post-consumer recycled (PCR) content in their products, while several producer responsibility organisations (PROs), groups that collectively implement extended producer responsibility (EPR) obligations of companies, modulate the fees paid by individual companies based on the share of recycled content in their products or packaging. Governments have announced ambitious national targets or agreed to international commitments, set guidelines for public procurement, and set regulation with varying degrees of severity of the financial penalty for non-compliance.

**Figure 2.1. Recycled content policies vary by key actor and level of compulsion**



These policies vary in their geographic coverage, the specificity of covered products and the ambition for the minimum share of recycled content (Table 2.1). Policies with a wide product coverage tend to be ambitious but have little consequence for non-compliance. For example, national targets do not by themselves compel compliance by producers. Similarly, voluntary efforts tend to be ambitious and apply across the company's product lines, but with little consequence for non-compliance. These high-ambition, wide coverage policies also have a wide geographic coverage, including European and American countries. Policies with a narrower product coverage tend to begin with less ambitious minimums that are set to increase over time, but these tend to have stronger incentives for compliance. These are primarily in Europe, the United Kingdom, and at the sub-national level in North America.

**Table 2.1. Policies vary in geographic and product coverage and ambition within the OECD membership**

Type of Measure	Description	Product scope	Ambition	Geographic spread
Voluntary commitments:	Commitments by companies to have a share of their products contain recycled content	Typically cover packaging of products	Most commonly to reach 22% recycled content by 2025	Multinational companies present in most OECD countries
Targets and Aims	Targets announced by national governments or set by international agreement	Not typically specified	G7 target of 50% by 2030	Various specific national targets, as well as G7 target
Extended producer responsibility (EPR): fee modulation based on recycled content in products	Modulation of EPR fees based on the share of secondary materials in a product or packaging	Packaging, carpets	Minimum to trigger fee modulation ranges from 10% to 50%	Europe: Belgium, France, and Germany, N America: Quebec (Canada) and California (United States) Chile
Procurement	Guidelines for recycled content requirements on public procurement	HDPE bottles, print cartridges, textiles.	Most are low, under 50%, but can be as high as 81%	Belgium, the Netherlands, and the United States
Taxes	Financial penalty for non-compliance with requirement for minimum share of recycled content	Bags, beverage containers, general packaging (rigid)	Beverage containers: range from 30% to 50%, by 2030s, Bags 20-40%	EU member states, the United Kingdom, the United States, and Japan
Penalties for non-compliance	Regulations with stiff penalties for non-compliance with requirement for minimum share of recycled content	Plastic bags, carpets	Carpets 30% bags 40%	California and New York (United States)

## 2.1 Company Policies

### 2.1.1 Voluntary commitments:

Numerous multinational companies have announced voluntary commitments with respect to the share of recycled content in their products and packaging. One recent survey identified more than 80 global consumer-packaged-goods and retail companies that have made public commitments to reach between 15 to 50 percent recycled content in their packaging by 2025 (Peng et al., 2022<sup>[41]</sup>). The Sustainable Packaging Coalition identified 42 companies that have made voluntary commitments to meet a minimum share of recycled content in their packaging (Figure 2.2). The personal care, packaging, beverage, and food sectors have the most companies with such commitments. The mean of individual company commitments in the cleaning, EEE, personal care, and packaging product sectors are each above 50% recycled content. Several packaging companies have commitments to produce rigid PET packaging with 100% post-consumer recycled (PCR) content by 2025.

Figure 2.2. Voluntary commitments for recycled content in packaging by product sector



Source: based on data from (Sustainable Packaging Coalition, n.d.<sup>[5]</sup>)

Policymakers have identified the automotive industry as being a promising sector for increasing incorporation of recycled plastics in products. To date, only a limited number of companies in the sector have pledged to increase the share of recycled content in their vehicles. For example, Volvo has pledged to use at least 25% recycled plastics in the plastics it will use in every newly launched vehicle from 2025 (Volvo, 2018<sup>[6]</sup>). Approximately 12% by mass of current end of life vehicles (EOLV) are composed of plastics, but current frontrunners use only 2-3% recycled content in their cars and the majority of material collected from EOLV is sent to landfill or energy recovery (Maury et al., 2023<sup>[7]</sup>). The European Commission has adopted a regulation designed to enhance the circularity of the automotive sector, covering the design, production and end-of-life treatment of vehicles. This includes in particular a proposal that 25% of the plastics used to build new vehicles should come from recycling (2023<sup>[8]</sup>).

In addition to voluntary commitments by individual companies, there are several public-private, industry-wide voluntary commitments that include commitments to use recycled content in the packaging and textiles sectors (Table 2.2). These typically have two aims:

1. to increase the production of recycled material, and
2. to increase uptake of recycled material as inputs.

The ambition in the share of recycled content ranges in these commitments tend to be below one-third, from an average of 26% by 2025 in the high-profile ‘new plastics economy’<sup>3</sup> to 30% in the U.S.-based plastics pact and 30% in the European Plastics Pact. These commitments also have a wide product coverage, typically setting the commitment by material or for all single-use packaging.

Several of the commitments have a global geographic reach as they impact multinational companies. There are also regional commitments in Europe and national-level commitments in the United States. Differences in recycled content policies at the national level, especially for food contact applications, have

<sup>3</sup> The new plastics economy is an initiative led by the Ellen MacArthur Foundation and the United Nations Environment Program, comprising investors, public entities, businesses, and NGOs. The U.S. Plastics Pact is part of the EMF Plastics Pact Network.

been an obstacle to companies meeting their commitments. For example, prior to 2018, the People's Republic of China (hereafter “China”) prohibited the use of recycled materials in food packaging. Today's supply chains are frequently multinational, meaning that policy differences can mean that multinational companies design products or packaging to have the widest market compatibility. Differences between national targets within a single market, for example in the European Union, could also add complexity for governments and regulated companies.

**Table 2.2. Industry-wide voluntary commitments**

	<b>Description</b>	<b>Geographic coverage</b>	<b>Commitment</b>
<i>America Recycles Pledge</i>	380 signatories pledge to work with the United States' EPA and other signatories to address challenges facing the nation's recycling system (EPA, n.d. <sup>[9]</sup> ).	United States	
<i>ANZPAC</i>	Regional plastics pact of 60 NGOs and brand companies to implement EMF new plastics economy in the region.	Australia, New Zealand, and Pacific Islands	25% recycled content in plastics packaging. (ANZPAC, 2022 <sup>[10]</sup> )
<i>Circular Plastics Alliance</i>	To promote cooperation along the value chain of plastics.	European Union	To increase the usage of plastics in new products in the EU from 3.9 million megatonnes in 2016 to 10 megatonnes in 2025 (Circular Plastics Alliance, n.d. <sup>[11]</sup> ).
<i>Canada plastics pact</i>	Led by Natural step Canada	Canada	30% recycled content across all packaging (CPP, n.d. <sup>[12]</sup> )
<i>Chile plastics pact</i>	Led by the Ministry of the environment and fundación Chile	Chile	25% recycled content into plastic packaging (EMF, n.d. <sup>[13]</sup> )
<i>Dutch plastics pact</i>	Launched by the ministry of infrastructure and the environment	The Netherlands	At 35% recycled content by company for single use plastic packaging (EMF, n.d. <sup>[13]</sup> )
<i>European Plastics Pact.</i>	Signatories to the pact expect to focus on goals in four areas, including 'achieving the highest possible percentage of use of recycled plastics.	European Union	By 2025, reaching at least 30% average recycled content across all single-use plastics products and packaging (European Plastics Pact, 2020 <sup>[14]</sup> )
<i>Fashion Industry Charter for Climate Action</i>	A partnership between the United Nations Framework Convention on Climate Change and Textile Exchange (Worley, 2021 <sup>[15]</sup> ).	Global	to replace their use of virgin polyester with recycled polyester.
<i>France plastics pact</i>	Launched by the ministry of ecological and solidarity transition and led by Causanova	France	An average of 30% recycled plastic by 2025 (EMF, n.d. <sup>[13]</sup> )
<i>New Plastics Economy Global Commitment</i>	Led by the Ellen MacArthur Foundation and the United Nations Environment Program, the commitment comprises investors, public entities, businesses, and NGOs.	Global	To increase the average recycling content rate of plastic packaging. The average commitment is to 26% by 2025
<i>Polish plastics pact</i>	Led by Kampania 17 Celów	Poland	Average 25% recycled content across all packaging (EMF, n.d. <sup>[13]</sup> )
<i>Portuguese plastics pact</i>	Led by smart waste Portugal with support of the ministry of environment and the general directorate of economy	Portugal	Average 30% recycled plastics in new plastic packaging (EMF, n.d. <sup>[13]</sup> )
<i>The United Kingdom plastic pact</i>	A forum for NGOs, governments, and businesses to address plastic waste and create a circular economy for plastics, part of the EMF New plastics economy initiative	United Kingdom	30% average recycled content across all plastic packaging (WRAP, n.d. <sup>[16]</sup> )
<i>US Plastics Pact</i>	Founded by the Recycling Partnership and the World Wildlife Fund.	United States	30% recycled content or responsibly sourced, bio-based content in plastic packaging by 2025



It is unclear if companies have sufficient motivation to achieve these commitments in the absence of compelling government policy. Environmentally friendly actions by companies are typically motivated by demand for sustainable products, lower costs of production (e.g. waste reduction or lower costs of inputs of secondary material), and the aim to deter or lessen public perception of a need for policy interventions (Lyon and Maxwell, 2008<sup>[17]</sup>). If market conditions are unfavourable, either due to insufficient quality of supply or high relative prices (compared with primary materials) there is potentially an economic incentive to forego or delay the commitments. In their analysis of PET, Kahlert and Bening argue that pledges alone by beverage companies are unlikely to withstand increases in price due to demand by other industries raising price above their willingness to pay (2022<sup>[18]</sup>). For example, several beverage companies have previously missed their own targets or deadlines to earlier commitments. Barriers to previous commitments included difficulty in sourcing material and regulations prohibiting recycled content in food contact applications.

Pledges frequently include soft language that describe the commitment in aspirational terms such as “aims to,” which gives some flexibility in perception of their accountability. To overcome some of these accountability issues, the European Union has adopted sustainability reporting standards for listed companies to help inform the public on their sustainability performance (European Commission, 2023<sup>[19]</sup>).<sup>4</sup>

Most producers in the plastics packaging sector have yet to commit to a voluntary pledge to incorporate recycled content. For example, 20% of the sector is part of the EMF’s New Plastic Economy, but the remaining 80% is not. Government policies could be better placed to ensure sector-wide adoption of secondary material.

## 2.2 Government policies

### 2.2.1 Targets and Aims

At least twelve OECD Member Countries have set national targets for recycled content either for plastics as a material or a product sector that uses plastics (Table 2.3). In 2018, Canada, France, Germany, Italy, and the United Kingdom agreed via the G7 forum to adopt a plastic charter that included the goal to increase recycled content “by at least 50%” by 2030. This plastic charter has a wide geographic coverage because it was also agreed to by Chile, 3 additional European OECD member countries (Belgium, Finland, and the Netherlands), the EU, Mexico, Norway, and Costa Rica. Its product coverage is not specific and referred to as “where applicable.” Additionally, the target does not specify a baseline from which to compare the increase “by” 50%, which could be a barrier to measurability and accountability. At the national level, Australia has an ambitious target with an earlier time horizon—50% by 2025.

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<sup>4</sup> ESRS 5 sets requirements for reporting on resource use and circular economy. A previous draft included reporting requirements for the absolute value and percentage of reused or recycled products and material used for products and services (including packaging) (EFRAG, 2022<sup>[108]</sup>).

**Table 2.3. Examples of international and national recycled content targets**

Scale	Name	Description	Geographic coverage	Ambition
International	<i>G7 Oceans Plastic Charter of 2018</i> (Government of Canada, 2021 <sup>[20]</sup> ).	G7 pact to support secondary markets for plastics including using policy measures and developing international incentives, standards or requirements for product stewardship, design, and recycled content.	<i>signed by Canada, France, Germany, Italy, and the United Kingdom. The Charter has since been signed by the European Union, Mexico, Norway, the Netherlands, Costa Rica, Finland, Chile, Belgium, and 15 non-OECD member countries</i>	Increasing recycled content by least 50% in plastic products where applicable by 2030
National targets	<i>2025 National Packaging Targets</i> (APCO, n.d. <sup>[21]</sup> ).		Australia	30% average recycled content included in packaging by 2020 and 50% by 2025
	<i>National packaging and packaging waste regulation</i>	Applicable to packaging composed of at least 50% plastic.	Sweden	To achieve at least 30% recycled content by 2030

It is questionable if these targets truly impact decisions by companies. Internationally coordinated and national targets help to establish clear expectations for industry. On the other hand, there is not a mechanism in these targets that has economic impacts for company-level design choices.

### **2.2.2 Extended producer responsibility (EPR): fee modulation based on recycled content in products**

EPR fee modulation is usually a government induced policy that can provide economic incentives to increase the share of recycled content in products or packaging. In collective implementation of EPR, the fee schedules set by Producer Responsibility Organisations (PROs) are typically quite basic. Fee differences are set by product type or material based on easily measurable cost differences for end-of-life management. The lack of a more granular fee schedule provides little incentive for design change by producers. A more advanced fee modulation, based on detailed product design criteria, can provide producers with stronger design incentives (Laubinger et al., 2021<sup>[22]</sup>).

Modulation of EPR fees, based on the share of secondary materials is more compulsive than a voluntary commitment because it provides incentives to use secondary materials. Some PROs have started to modulate the fees paid by their producers based on the share of recycled content in their products (Table 2.4).

The required share of recycled content ranges in these PROs from 10% for carpets to 100% for one packaging EPR programme. These policies also have a wide product coverage, typically including the product type or by material the EPR programme is covering. The modulation sets the size of the economic incentive. Some PROs issue a set per weight reduction, such as Valipac in Belgium. Others give a percentage modification, such as EEQ in Canada and Re\_loop in France. PROs typically give the bonus for the entire product fee based on meeting the threshold.

PROs in Europe and North America have been early adopters of fee modulation based on recycled content. In several countries, governments set a requirement that PROs include modulation in their fee setting, such as France, Germany, California (United States), and Chile. The EU requires fee modulation in its required EPR product sectors but does not specify that recycled content is a criterion. Compared with other government policies, EPR may be more flexible to changing ambition and size of modulation, building on the specialised expertise of the producers they represent.

Table 2.4. Examples of EPR fee modulation according to recycled content criteria

Country (State/Province)	Producer Responsibility Organisation	Product or packaging	Share of recycled content	Size of modulation
Belgium	Valipac (Valipac, n.d. <sup>[23]</sup> ).	All industrial plastic packaging	30% PCR material	Bonus of EUR 50 per tonne
France	Re_loop (EY, 2016 <sup>[24]</sup> ).	textiles and shoes	15% recycled fibres/materials	50% fee reduction
France	CITEO (CITEO, 2021 <sup>[25]</sup> )	<ul style="list-style-type: none"> <li>PET (EUR 0.05 per kg and an additional EUR 0.35 if the packaging is made exclusively with PCR material).</li> <li>PE flexible (EUR 0.40 per kg and an additional EUR 0.15 if made exclusively of recycled household packaging)</li> <li>PE rigid [mainly HDPE] (EUR 0.45 per kg)</li> <li>BD (EUR 0.40 per kg and EUR.15 for PCR material).</li> <li>PP (EUR 0.45 per kg); and</li> <li>PS (EUR 0.55 per kg).</li> </ul>	No minimum requirement	Ranges from EUR 0.05 to EUR 0.55
Germany	The 2019 Packaging Ordinance requires PROs to provide incentives for sustainable packaging design and to modulate EPR fees accordingly. PROs are required to design fees that include differentiating fees along criteria of among others recyclability (given existing technologies) and recycled content and content of renewable materials (BMJV Germany, 2019 <sup>[26]</sup> ).			
Canada (Quebec)	ÉEQ (EEQ, 2020 <sup>[27]</sup> ).	Packaging and printed materials.	<ul style="list-style-type: none"> <li>100% for packaging and 50% for printed materials (e.g., magazines and other publications).</li> <li>Integration of 15% recycled content can count for 20% towards a maximum 50% bonus for eco-design incentive pilot project.</li> </ul>	<ul style="list-style-type: none"> <li>20% credit</li> </ul>
United States (California)	Carpet America Recovery (Carpet America Recovery Effort, n.d. <sup>[28]</sup> ).	carpets	10% recycled content	USD 0.02 per square yard bonus
United States (California, Colorado, Maine, and Oregon)	<ul style="list-style-type: none"> <li>California's law establishing EPR for packaging requires that fees be adjusted using malus fees or credits for the percentage of PCR content (California Legislative Information, 2022<sup>[29]</sup>).</li> <li>Colorado will require its PRO to set government-approved targets for PCR content by material type (Colorado general assembly, 2022<sup>[30]</sup>).</li> <li>Maine's Department of Environmental Protection will specify performance targets for PCR content (Maine Legislature, n.d.<sup>[31]</sup>).</li> <li>Oregon law requires that PCR content be included in consideration of fee structure (Product Stewardship Institute, 2022<sup>[32]</sup>).</li> </ul>			
Chile	Collective management systems for packaging must modulate fees with bonus or malus based on recycled content, if the secondary material is derived from waste generated in Chile (Ministerio del Medio Ambiente Chile, 2021 <sup>[33]</sup> ).			

### 2.2.3 Procurement

Governments in Europe and the United States have set public procurement requirements or guidelines for the share of recycled content (Table 2.5). Governments typically seek a public comment period and specify a specific product and a level of recycled content. The ambition in the level of recycled content is typically low, most are under 50%, and the minimum requirement for products is typically lower than for packaging.

**Table 2.5. Examples of procurement policy with recycled content requirements**

Country	Product or packaging	Requirement	Result
Flanders (Belgium)	furniture with plastic parts in public outdoor areas, plastic roadside acoustic screens, underground non-pressurised plastic pipes for rain and wastewater drainage, cover plates for cables, gas pipes and other utilities, plastic window systems, compost barrels and compost bins, garbage roll containers, growing pots, growing trays and plant trays	a proposal for regional legislation (VLAREMA) on recycled content requirements for public procurement, expected to be approved in 2023 [forthcoming]	
Ghent (Belgium):	Packaging for cleaning supplies	that they meet cradle to cradle bronze label certification	10% recycled content in PEHD plastic bottles, and 81% recycled content for PET plastic bottles (European Commission, 2017 <sup>[34]</sup> )
The Netherlands	Textile purchases by the Ministry of Defense	10% PCR cotton and laces with recycled polyester, all delivered in packaging with at least 75% (plastic) or 80% (cardboard) recycled material (Rainville, 2021 <sup>[35]</sup> ).	In 2017, the Ministry procured towels and overalls (i.e. dungarees) with at least 10% PCR content, achieving an average of 36% for the towels and 14% for the overalls (European Commission, 2017 <sup>[34]</sup> ).
California (United States)	plastic print cartridge products	Minimum of 75% postconsumer recycled content (CalRecycle, n.d. <sup>[36]</sup> ; Calrecycle, n.d. <sup>[37]</sup> )	In fiscal year 2020-2021, roughly 71% of procurement spending (roughly USD 36 million of USD 51 million) was compliant with the requirement (CalRecycle, n.d. <sup>[38]</sup> ).
United States	Including, but not limited to office, landscaping, and park and recreation products	The comprehensive procurement guideline program designates products and sets recycled content recommendations by product (U.S. EPA, n.d. <sup>[39]</sup> ).	In fiscal year 2017, just over 8% of procurement dollars contained a sustainability clause (Office of Federal Procurement Policy, 2017 <sup>[40]</sup> )

It is questionable whether procurement policy alone provides sufficient incentive for companies to change design. Positively, procurement policy increases demand for products made with secondary material, which can in turn lead to economies of scale for quality recyclers. The size of the demand is large, meaning it can create some powerful incentives. For example, public expenditure on works, goods, and services was roughly 192% of GDP across the OECD in 2022 (OECD, 2023<sup>[41]</sup>).

There is limited evidence that public procurement policies alone significantly drive demand for materials like recycled plastics (OECD, n.d.<sup>[42]</sup>). Additionally, monitoring of implementation remains a challenge, as roughly 41% of national governments have yet to publish results on their implementation of sustainable public procurement (UNEP, 2017<sup>[43]</sup>). Procurement policy may have reporting requirements, but typically do not include enforcement provisions.

Public procurement policies can increase demand for secondary material, but do not require all producers in a sector to meet this threshold for all their products. Thus, they provide economic incentives, but they are not as compulsive as regulations with financial penalties for non-compliance.

## 2.2.4 Requirements

Dozens of governments are introducing regulations for minimum recycled content requirements. At least 25 OECD member countries (two-thirds of total membership) will have some recycled content requirement in place by 2024. These typically specify covered products, a minimum share of recycled content by product type, a future date when the regulation will take effect, and reporting requirements.

Most of these policies are forthcoming (Table 2.6). In some cases, the product range is known. For example, the European Union requires its member states to set requirements for PET beverage bottles to be made with 25% secondary material by 2025. While in others the product range is to be determined. For example, Connecticut has authorised its environmental agency to set requirements by 2023. It remains unclear how these will be implemented. Additionally, the European Commission has proposed a revision to its packaging and waste legislation that would require minimum inclusion rates for recycled content in plastic packaging.

Flanders (Belgium) was an early adopter of recycled content requirements for plastic bags intended for waste collection and disposal. From 2021, the law requires 80% recycled plastics by 2021 and 100% by 2025, of which at least half must be made with post-consumer plastics.

**Table 2.6. Forthcoming recycled content requirements**

Country	Description	Product range	Timeline
The European Union	<ul style="list-style-type: none"> <li>The Single-Use Plastics Directive will require member states to set policies.</li> <li>The proposed regulation on packaging and waste legislation proposes minimum recycled content in plastics packaging.</li> </ul>	<ul style="list-style-type: none"> <li>PET beverage containers; all single-use plastic beverage bottles</li> <li>Plastics packaging</li> </ul>	<ul style="list-style-type: none"> <li>25% by 2025 in single-use PET bottles; 30% in all single-use plastic bottles by 2030 (EU Lex, 2019<sup>(44)</sup>).</li> <li>To be determined in a future implementing act, increasing until 2040 (European Commission, 2022<sup>(45)</sup>).</li> </ul>
Japan	guidelines for measures on the design of plastic-containing products, such as using recycled plastics, as part of the Act on Promotion of Resource Circulation for Plastics (METI, 2021 <sup>(46)</sup> ).		
Connecticut (United States)	the state's Commissioner of Energy and Environmental Protection will develop recycled content requirements for products sold in the state (Open States, 2021 <sup>(47)</sup> ).	To be determined	2023

Requirement policies typically apply a financial penalty to producers for non-compliance with the minimum share of recycled content. The severity of this penalty is the basis for whether the policy is effectively a tax (small penalty) or an authorisation to place the product on the market, which if violated triggers a penalty. In the forthcoming policies (Table 2.6) the financial penalty for non-compliance is yet to be determined. The remainder of this sub-chapter takes stock of existing requirement policies, organised by taxes (small penalties) and authorisation (large penalties, i.e., penalties).

### *Taxes*

Several early adopters in the United States (sub-national governments) and the United Kingdom have set a small financial penalty for non-compliance that will have a similar effect as a tax (Table 2.7). For example, California and Washington will levy an annual financial “penalty” on each beverage manufacturer that violates its requirements. In both states, governments will assess the fee (USD 0.2 per pound [USD 0.44 per kg]) against the difference between the weight of recycled content used and the required weight. The fee in the United Kingdom is equivalent to 0.3 GBP per kg of non-compliant material.

There are some differences in the product coverage of these policies. The UK law applies to all packaging, whereas the US state laws specify types, such as beverage containers, rigid packaging, and bags. The required share also varies between the policies and type.

Several governments have specified how the revenues generated by the penalties may be spent. The funds that California collects will be used for the sole purpose of supporting recycling infrastructure, collection, and processing of plastic beverage containers in the state, whereas Washington funds will be deposited into a recycling enhancement account (Legislative Counsel Bureau and State of California, 2020<sup>[48]</sup>; State of Washington, 2021<sup>[49]</sup>). Washington may require a corrective action plan from the producer in lieu of or in addition to the penalty assessment (State of Washington, 2021<sup>[49]</sup>).

**Table 2.7. Examples of recycled content requirements as taxes**

Country	Product or packaging	Minimum requirement	Financial penalty (tax)
United Kingdom	plastic packaging	30% recycled material	GBP 200 per ton [0.2 GBP per kg] (HR Revenue Customs, 2021 <sup>[50]</sup> ). The price will be adjusted for inflation to GBP 210.82 per kg.
Maine	Plastic beverage containers	25% PCR content by 2026 and 30% by 2031	USD 0.2 per pound [USD 0.44 per kg] (Doudera, 2021 <sup>[51]</sup> )
California (United States)	1. plastic beverage containers 2. trash bags.	1. a minimum share (up to 50% in 2030) 2. 10% PCR content (CalRecycle, n.d. <sup>[52]</sup> )	USD 0.2 per pound [USD 0.44 per kg]
New Jersey (United States)	1. rigid plastic containers 2. rigid plastic beverage containers 3. plastic carryout bags	1. 10% PCR content that increases by 10% every three years until reaching 50%. 2. 15% PCR content for that increases by 5% every three years until reaching 50% 3. 20% PCR content that increases to 40% after 3 years (State of New Jersey, 2022 <sup>[53]</sup> ).	A per-pound civil penalty to be established.
Washington (United States): (State of Washington, 2021 <sup>[49]</sup> ).	1. household cleaning and personal care products 2. plastic trash bags 3. certain plastic beverage containers 4. dairy milk containers	1. 15% by 2025, 25% by 2028, and 50% by 2031 2. 10% by 2023, 15% by 2025, and 20% by 2027 3. 11% by 2025, 25% by 2026, and 50% by 2031 4. 15% by 2028, 25% by 2031, and 50% by 2036	USD 0.2 per pound [USD 0.44 per kg]

Governments could also provide a positive economic incentive for the inclusion of recycled content. For example, the Czech Republic provided the European Council meeting in June 2023 with a note inviting discussion with the European Commission and member states about lowering the value added tax (VAT rate) on certain products with recycled content (Council of the European Union, 2023<sup>[54]</sup>). This would have the effect of lowering the relative cost of this material and encouraging its use as an input.

### *Penalties for non-compliance*

Some subnational governments in the United States have adopted regulations that set a large financial penalty for non-compliance (Table 2.8). For example, the New York law on carpet recycling will issue a USD 500 civil penalty for each violation and for each day the violation continues (The New York State Senate, 2022<sup>[55]</sup>). Violations of California's paper and reusable plastic bag requirements can be charged USD 1 000 per day for a first violation, USD 2 000 for a second and USD 5 000 for subsequent violations (CalRecycle, 2017<sup>[56]</sup>). With sufficient enforcement, it is likely that retailers will have strong incentives to

comply with these minimum requirements. The level of ambition for these policies is like those observed in taxes, 20-40%.

**Table 2.8. Examples of recycled content requirements as authorisation with penalties**

Country	Product or packaging	Minimum requirement	Penalty for non-compliance
New York (United States)	Carpets*	20% within four years, and 30% within five years.	USD 500 civil penalty for each violation and for each day the violation continues (The New York State Senate, 2022 <sup>[55]</sup> ).
California (United States)	reusable plastic bags	40% PCR content.	USD 1 000 per day for a first violation, USD 2 000 for a second and USD 5 000 for subsequent violations (CalRecycle, 2017 <sup>[56]</sup> ).

Note: \*Carpets are frequently made with synthetic fibres derived from polymers. The minimum requirement is not specific to synthetic fibres.

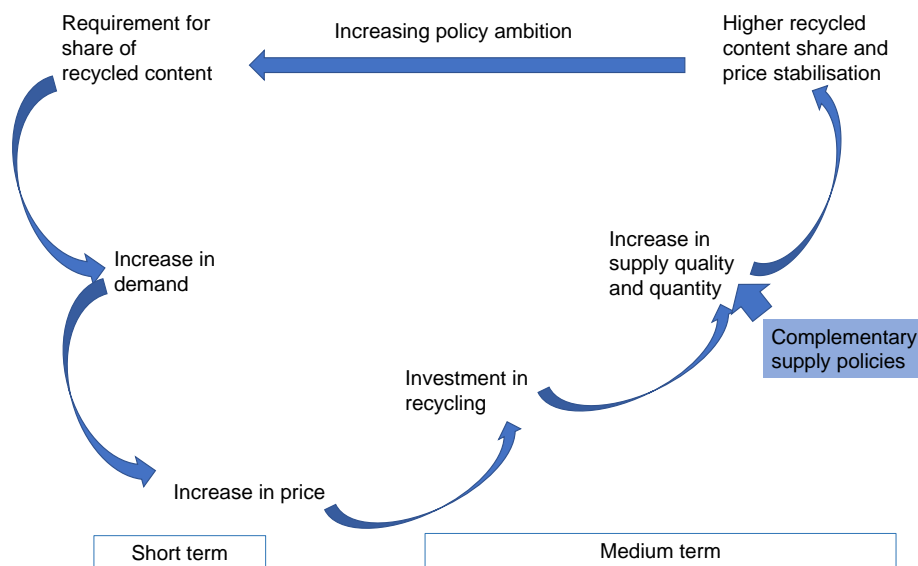


# 3 Early evidence of the effectiveness of recycled content policies

Recycled content policies seek to increase the share of recycled content in products and packaging which should ideally be the indicator for the effectiveness of these policies. Several factors confound a straightforward assessment of the impact of these policies. First, governments did not implement the policies in isolation, thus it is difficult to determine if they are the proximate cause of any changes. Second, there is limited data available for determining a baseline from which to compare. Third, sourcing of secondary materials is often via brokers and long-term contracts and not spot markets, meaning that there may be a delay in any price changes. Lastly, many of the most compelling policies are forthcoming, meaning that they both obfuscate assessment of earlier policies and cannot yet be subject to *ex-post* analysis.

Due to the limited availability of data and the forthcoming nature of the more compelling policies, a theory of change framework can help to inform expectations of impacts for policymakers (Figure 3.1). Instead of uniform and immediate impacts, there is likely to be phases in the impacts of these policies. In the short term, recycled content requirements should increase the demand for secondary materials. However, as supply is fixed in the short term, the increase in demand should increase the price of secondary materials. The aim of the more compelling policies is to maintain this demand, despite price increases, so that the high price will subsequently serve as a motivator to increase supply of secondary materials. In the medium to long term, with confidence in the resilience of this demand, there is hope of investment in recycling capacity that will enable improvements in the quality and quantity of supply, bringing down the price of secondary materials.

Figure 3.1. Theory of change



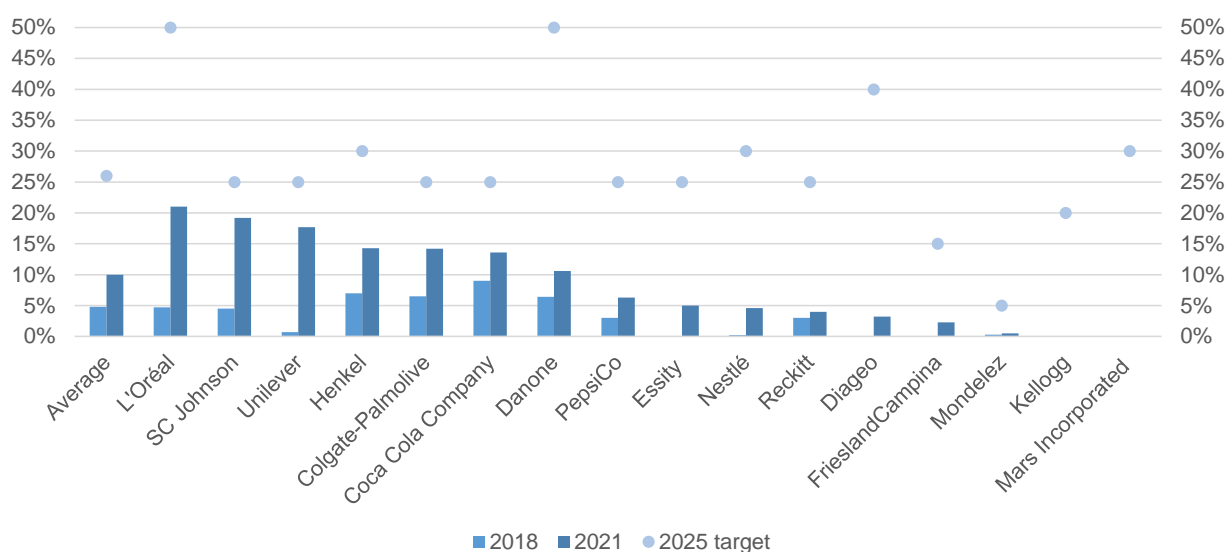


This chapter reviews the available data on the share of recycled content and the applicability of the theory of change to recent secondary plastics market trends.

### 3.1 Early evidence of an increase in the share of recycled content

Companies have had some incremental success in increasing the share of recycled content within products in the absence of more compelling policy for recycled content minimums. One-quarter of companies are ‘on track’ to meet their 2025 commitments in the New Plastics Global Commitment (Figure 3.2). As well, the average share among over 500 signatories has grown from 4.8% in 2018 to 10% in 2021. However, most signatories have yet to achieve the aggregate 26% target. However, over the same period, the use (weight) of primary plastics increased. Signatories have had a much easier time meeting commitments to increase the share of ‘recyclable’ content and have noted challenges in incorporating recycled content beyond rigid PET packaging, especially for food contact applications. Noting challenges in meeting their goals by 2025, Gartner supply chain researchers have suggested that as many as 20% of companies may seek to shift or postpone their 2025 plastic targets for recyclability or recycled content (2023<sup>[57]</sup>).

Figure 3.2. Examples of new plastics economy signatories’ performance



Note: Reporting scope limited to PET primary plastic packaging for the Coca Cola Company and FrieslandCampina.

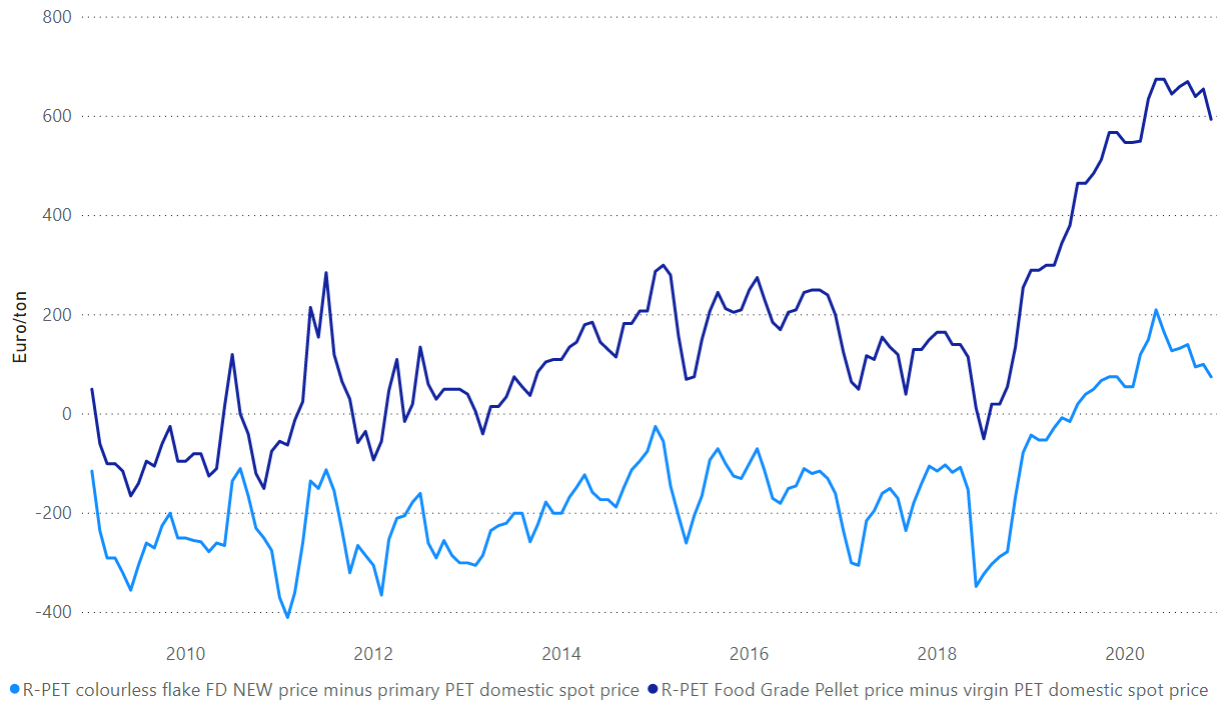
Source: (Ellen Macarthur Foundation, 2022<sup>[58]</sup>; Ellen Macarthur Foundation, 2023<sup>[59]</sup>).

### 3.2 Early evidence of price impacts in the short term

The combination of forthcoming compelling policy and private commitments can help to establish a separate demand for secondary material in some markets. For example, in Europe, the price of recycled post-consumer PET flake in May 2020 was higher than the price for its primary equivalent PET resin (Figure 3.3). The single-use plastics directive, published in 2019, set the first recycling targets at EU level and helped to impact the price of recycled PET (rPET). This price difference shows that firms will pay a premium for secondary materials in some circumstances, a break from previous market conditions in which the price for secondary material is typically lower than primary and covariates with oil and gas prices.

Indeed, in 2019 when the price of primary PET spot prices fell to under EUR 1 200 per tonne due to high stock and low feedstock prices, the equivalent price of food-grade rPET remained at roughly EUR 1 400 per tonne (Brooks and Milner, 2019<sup>[60]</sup>).

**Figure 3.3. Price difference in primary and secondary PET in Europe**

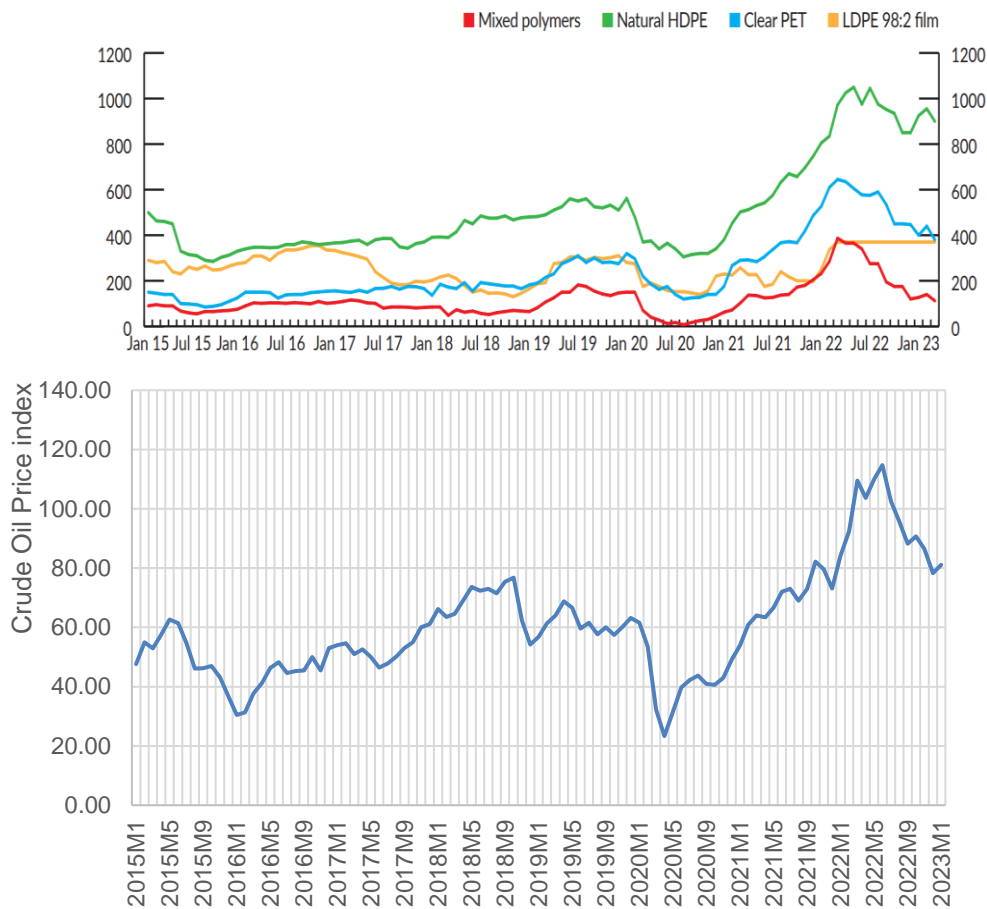


Note: Figures are the difference in price between secondary material and a primary equivalent. Figures are through May 2020.

Source: (Victory, McGeough and Tudball, 2021<sup>[61]</sup>).

There is some early evidence that the introduction of minimum content requirements in a national market correlates with increases in the price of covered secondary material. The growth in the price for recovered plastics increased in the United Kingdom after the announcement of its recycled content requirement in October 2018, and then accelerated after the policy began in April 2022. However, prices fell in the second half of 2022 (Figure 3.4). As well, there was an increase in the price of crude oil over the same period, peaking in May 2022. Historically, the price of secondary plastics is correlated with the price of primary equivalents which are in turn driven by the price of feedstock (e.g., crude oil). Therefore, the observed increase in price of recovered plastics could in part be due to rising costs of its primary equivalent.

Figure 3.4. Price evolution of recovered plastics in the United Kingdom (top) and price evolution of crude oil (bottom)

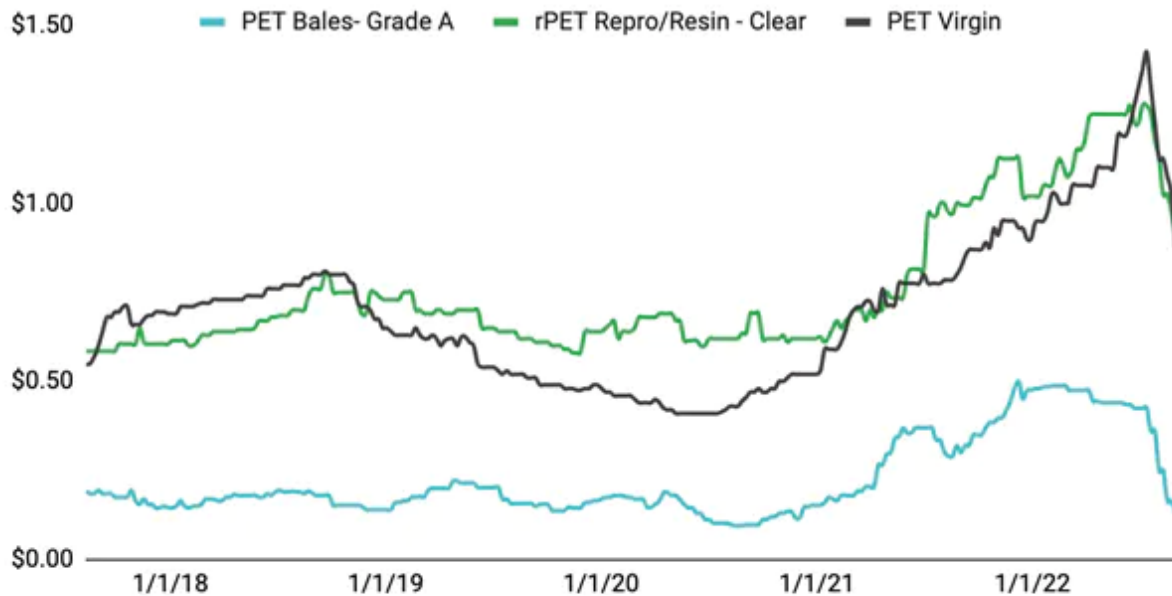


Note: top: Low density polyethylene (LDPE), High density polyethylene (HDPE), Polyethylene terephthalate (PET). The UK policy applies to all polymers. Bottom: Crude Oil (petroleum), Price index, 2016 = 100, simple average of three spot prices; Dated Brent, West Texas Intermediate, and the Dubai Fateh.

Source: top (WRAP, 2023<sup>[62]</sup>), bottom: (International Monetary Fund, 2023<sup>[63]</sup>)

In the United States, secondary or recycled PET (rPET) has been price competitive with primary PET from 2019 through 2022, and often sold at a higher price (Figure 3.5). Arthurs argues that PET market trends are likely due to increased demand for secondary materials because of high oil and gas prices, new digital marketplaces facilitating the ease of material sourcing, and improvements in supply via design change and improved collection (2022<sup>[64]</sup>). The decline in prices in the second half of 2022 could be due to a temporary oversupply of material from imports and a slowdown in overall consumer spending (Pyzyk, 2022<sup>[65]</sup>). However, the drop in price of rPET with PET in 2022 indicates that there is still a limited demand that is unique and resilient for rPET.

Figure 3.5. United States primary and secondary PET (rPET) price comparison



Source: (Arthurs, 2022<sup>[64]</sup>)

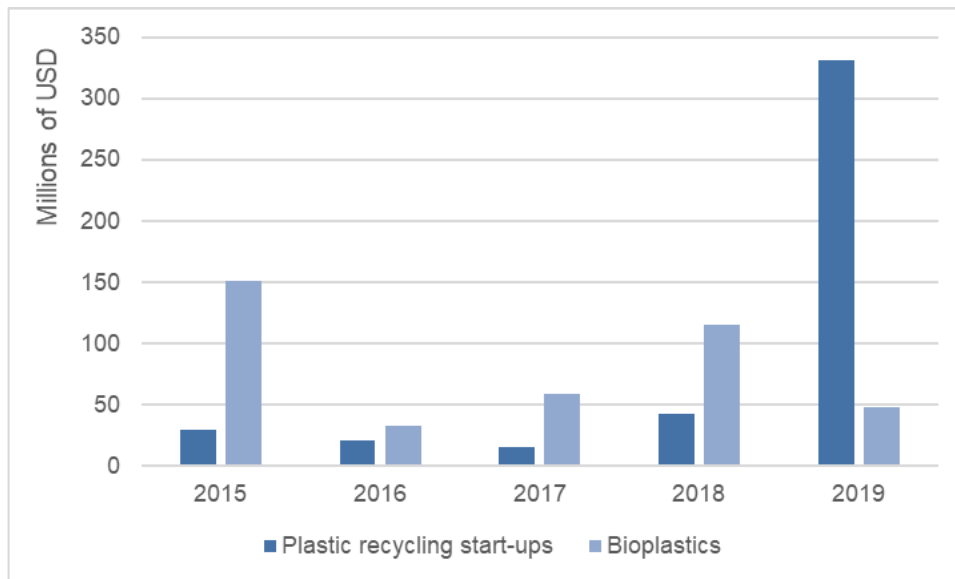
### 3.3 Early evidence of investment in recycling

In the medium to long term a resilient demand for secondary materials (despite higher prices) should stimulate investment in improving recycling supply. Private and blended finance will likely be needed to improve supply, in addition to complementary supply 'push' policies (see Recycled content requirements in the context of a policy mix

Complementary policies: ensuring sufficient supply). McKinsey estimated that a 50% plastics recovery rate would require 15 to 20 billion USD in capital investments per year from 2020 to 2030, above the 8 to 10 billion USD average annual investment observed from 2010 to 2020 (Hundertmark et al., 2018<sup>[66]</sup>). Plastics Europe announced it will increase investment from 2.6 (2025) and 7.3 billion (2030) EUR in advancing chemical recycling operations (Plastics Europe, 2021<sup>[67]</sup>).

Increased revenues for recyclers in the short term could stimulate investment in recycling. There is some early evidence that commitments to use recycled content can help to generate revenues for waste haulers and processors. In the United States, Waste Management Inc. reported that its 2022 recycling revenue increased USD 96 million (Q1) and 212 million (Q2) above 2021. In total, the company made a net income of USD 2.2 billion in 2022 and is planning USD 590 million in additional investments in recycling and recovery, of which will be USD 125 on plastic film recycling systems (Rosengren, 2023<sup>[68]</sup>). The company explained to its shareholders that the revenue increase was due to a higher market price for recycling commodities, in part driven by higher demand from e-commerce retailers and manufacturers for secondary material in 2022 to meet their recycled content commitments. Despite the price increases, the company noted that demand continued to outpace its supply capacity (Waste Management, 2022<sup>[69]</sup>).

In a global context, there is some evidence that investment in new start-up companies for plastics recycling has accelerated in recent years. The IEA estimated that in 2019 USD 332 million was invested in these companies, a twenty-two-fold increase compared with 2017 investments, and far outpacing similar investments in 'bioplastics' (Figure 3.6).

**Figure 3.6. Global Investments in alternative plastic feedstocks**

Note: Investments include grant, equity investment (at various stages), structured loan and private investment in public equity. Recycling includes both mechanical recycling (e.g., robotics to allow more efficient sorting and picking) as well as chemical recycling.

Source: (IEA, 2020<sup>[70]</sup>)

# 4 Compliance with requirements and verification of recycled content

Monitoring, compliance, and verification of recycled content in products are likely to become challenges as compelling government policies begin to take effect. This chapter will review the methods that governments have adopted for monitoring and compliance. These are reliant on self-reporting by companies, raising the issue of how to verify the self-reported data. The second half of the chapter reviews the broader literature of supply chain of custody methods and considers its applicability to plastics recycled content verification.

## 4.1 Examples of compliance requirements

Government policies often establish requirements for reporting and specify the degree of disaggregation by product for data (Table 4.1). Authorities can also specify the geographic scope of the requirements, which can be particularly important for sub-national governments in countries with a federal system and for countries in a single market. For example, Washington and New Jersey (United States) will allow submission of nationwide data by companies. This intends to ease the costs of compliance for companies, but it means that the policy is unlikely to directly impact the products sold in the state.

**Table 4.1. Recycled content/requirements reporting and scope definitions**

Country or sub-national government	Reporting	Geographic coverage	Product coverage	Citation(s)
ÉEQ (Quebec, Canada)	Producers must submit a letter of confirmation from the supplier with quantities and specifications up to ISO 14001 for recycled content	For bonus, packaging must be made in Québec	Containers and packaging	(Éco Entreprises Québec, 2017 <sup>[71]</sup> )
United Kingdom	The United Kingdom requires manufacturers and importers to register online and complete a plastic packaging tax return while maintaining relevant records and accounts			(HM Revenue & Customs, 2022 <sup>[72]</sup> )
Maine (United States)	Manufacturers will submit annual data on products sold, offered for sale, or distributed for sale in the state the previous year	Manufacturers can report Maine-specific data based on regional data with an accompanying description of methodology	Covers plastic beverage containers, requires reporting by resin type	(Doudera, 2021 <sup>[51]</sup> )
California (United States)	Provides manufacturers with a standard form for annual reporting	applies only to beverage containers subject to the states DRS, meaning only those sold in the state	requires reporting by resin type, but does not require reporting by product line	(CalRecycle, 2022 <sup>[73]</sup> )
Washington (United States)	will require manufacturers of covered products to provide the	will allow producers to submit national data	specifies that reporting is across all products in a	(Washington State Department of Ecology,

	state with an annual report	allocated on a per capita basis for Washington if state level data is shown to be infeasible or inaccessible	covered product category	n.d. <sup>[74]</sup>
New Jersey (United States)	will require each producer to register with the state and pay an annual fee to help cover costs of administration of the programme	will allow each producer to report the average amount of PCR content for its products sold nationwide.	will allow reporting across a whole product line or by sub-lines	(State of New Jersey, 2022 <sup>[53]</sup> ).

Several governments with recycled content requirements are currently developing rules and regulations for their enforcement, but monitoring and verification of self-reporting can help to check for compliance (Table 4.2). Limited resources are likely to be a barrier to monitoring and enforcement efforts. To overcome this barrier, governments can assign responsibility for monitoring to producers. For example, the New Jersey law gives the state authority to conduct a random sample each year at cost to the manufacturers (State of New Jersey, 2022<sup>[53]</sup>).

**Table 4.2. Examples of monitoring and enforcement language provisions**

U.S. state	Enforcement provision
Maine (United States)	the government may conduct audits or take other necessary actions to verify the accuracy of reported data (Doudera, 2021 <sup>[51]</sup> ).
California (United States)	EPR for packaging requires fee adjustment on the basis of the share of post-consumer recycled content states that these claims shall be validated through an independent third party that has been approved by the state's environmental department (California Legislative Information, 2022 <sup>[29]</sup> )
New Jersey (United States)	may audit or investigate a manufacturer to assess compliance (State of New Jersey, 2022 <sup>[53]</sup> ).

## 4.2 Definitions for recycled content

There is not a universally accepted definition of recycled content and policymakers are using different definitions (Table 4.3). A proliferation of different definitions could complicate accounting and verification for covered producers. The EU's implementing decision on the single-use plastics directive will help to harmonise definitions within its membership because it will set precedent for how to calculate and verify recycled content.

**Table 4.3. Examples of definitions of recycled content**

	<b>Definition of recycled material</b>
European Union	Post-consumer plastic waste generated from plastic products that have been placed on the market (European Commission, 2023 <sup>[75]</sup> ).
ISO 14021: 2016	Material that has been reprocessed from recovered [reclaimed] material by means of a manufacturing process and made into a final product or into a component for incorporation into a final product.
United Kingdom	Recycled plastic is plastic that has been reprocessed from recovered material by using a chemical or manufacturing process. This is so it can be used either for its original purpose or for other purposes. Recovered material is pre-consumer plastic or post-consumer plastic that both: <ul style="list-style-type: none"> <li>• is no longer suitable to be used in the process from which it was generated and would otherwise have been used for energy recovery (for example, by incineration) or disposed of as waste (for example, by being sent to landfill)</li> <li>• has been collected and recovered for use as a material input for a recycling or manufacturing process, instead of new primary material (HM Revenue &amp; Customs, 2021<sup>[76]</sup>)</li> </ul>
Maine	plastic produced from the recovery, separation, collection and reprocessing of plastic that was originally sold for consumption and that would otherwise be disposed of or processed as waste. It does not include post-industrial plastic or pre-consumer plastic (Doudera, 2021 <sup>[51]</sup> ).
California	any good or material that has been reused or refurbished <b>without substantial alteration</b> of its original form. Postconsumer material, as defined in PCC section 12200(e), comes from products that were bought by consumers, used, and then recycled. (CalRecycle, n.d. <sup>[77]</sup> )
Washington	Post-consumer resin (PCR) is a technical term for recycled plastic generated by the end-users of plastic products. End users include households, as well as commercial, industrial, and institutional facilities. PCR also includes returns of material from the distribution chain. (Washington State Department of Ecology, n.d. <sup>[74]</sup> )
New Jersey	Postconsumer recycled content is defined as a material or product that has completed its intended use, is at the end of its lifecycle, and which has been separated from the solid waste stream for the purposes of collection and recycling. (NJDEP, 2022 <sup>[78]</sup> )

Note: The Ellen MacArthur Foundation uses the ISO definition for recycled content.

There are key differences in whether definitions include ‘pre-consumer’ recycling. Whilst post-consumer waste (commercial and residential) is more abundant, pre-consumer waste is often of higher quality and value (OECD, 2018<sup>[79]</sup>). The ISO and the United Kingdom, allow for pre-consumer recycling in their definitions. Alternatively, the European Commission’s implementing decision, Maine and New Jersey specify that only post-consumer recycling can count in their definition.

Policies differ on whether chemical recycling is in the definition of recycled material. Currently, New Jersey and California do not allow for chemical recycling in their definitions. However, the United Kingdom, ISO, and Washington’s definitions do allow for chemical recycling.

### 4.3 Verification of recycled content

Verification of recycled content claims is necessary to ensure that these policies do not simply instigate an exercise in ‘greenwashing.’ There is a mature literature on supply ‘chain of custody’ methods, including standards and definitions by the International Standards Organisation (ISO) (Table 4.4). Chain of custody methods are processes to monitor information about material as it moves through a supply chain. They enable tracking of a special characteristic, in this case plastics recycled content.



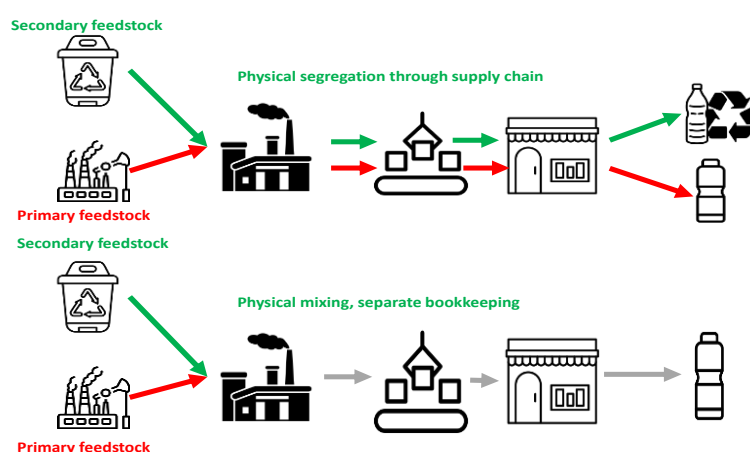
**Table 4.4. Examples of chain of custody methods**

Chain of custody method	Description
Segregation	the characteristic of the material is maintained from the initial input to the final output, meaning no mixing of material with different characteristics, but it is permissible to blend material with the same characteristic from multiple sources
Controlled blending (single percentage model)	materials or products with the characteristic is mixed according to certain criteria with materials or products without that set of characteristics resulting in a known proportion of the specified characteristics in the final output
Mass balance	materials with a specified characteristic are mixed according to defined criteria with materials or products without that set of characteristics. The proportion of the input with the specified characteristic might only match the initial proportions on average and may vary across different outputs
Book and claim (a.k.a. certificate trading model and credit trading)	the administrative record flow is not necessarily connected to the physical flow of material or product throughout the supply chain. Thus, the share of inputs in the overall supply chain are maintained as a share of output, but the claims and physical characteristics need not match (Ellen Macarthur Foundation, n.d. <sup>[80]</sup> ).

Source: (ISO, 2020<sup>[81]</sup>)

The physical characteristics of a material help determine which type of chain of custody method is best suited. For example, some products can be made entirely of secondary material, such as some paper products that can be made with 100% post-consumer recycled content. In these cases, an identity preservation or segregation model is possible. For example, paper products can follow this model for certification schemes like the Forestry Stewardship Council. However, many plastic products and packaging need to mix a share of primary and secondary material. Therefore, controlled blending, in which inputs are mixed resulting in a known per-unit output proportion and mass-balance, in which a mix of inputs results in outputs with a proportion available only on averages, may be more realistic for plastics (Figure 4.1). Controlled blending is easier than mass balance for tracing source material but could complicate supply chain logistics.

**Figure 4.1. Comparison of segregation (top) mass-balance (bottom)**

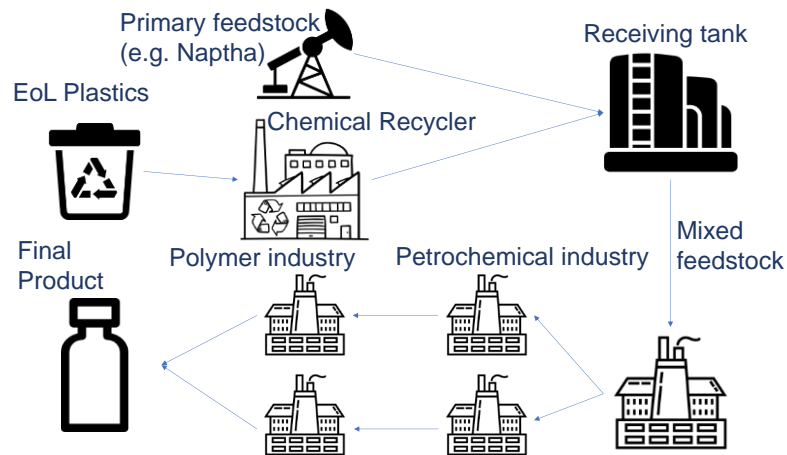


Source: Adapted from (ISCC, 2019<sup>[82]</sup>).

The recycling process itself can rule out the possibility of using the segregation method for chemical recycling. Chemical recycling of plastic waste refers to a collection of processes that apply chemical agents to break down plastic waste material into its building blocks (either polymers, monomers or fuels). These building blocks can then mix with primary equivalent for the production of new plastic for application in

products and packaging (Figure 4.2).<sup>5</sup> Compared with mechanical recycling<sup>6</sup>, there are additional challenges for developing verification methodologies for identifying and tracking chemically recycled content throughout the supply chain. Due to these complications, there is a need for further investigations into appropriate measures for measuring chemically recycled content.

**Figure 4.2. Mixing of chemically recycled material with primary equivalent**



Source: adapted from (Davidson, 2022<sub>[83]</sub>).

There is an ongoing debate about the extent of the need for chemical recycling to meet commitments. Signalling industry's perceived need for chemical recycling, twelve international corporations in the consumer goods forum issued a letter of intent in 2022 that they intend to demand at least 800 000 tonnes per annum of chemically recycled plastics (Consumer goods forum, 2022<sub>[84]</sub>). Additionally, mechanical recycling degrades material strength over time, suggesting the need for regenerative processes. However, several environmental groups and policymakers note that chemical recycling can be energy intensive, create harmful by-products, and recover less material compared with mechanical recycling.

The need for chemical recycling may also depend on the type of plastic application. Mechanical recycling of rigid plastic materials is more common than flexible polyolefins. Chemical recycling could prove more attractive to producers seeking to supply food grade flexible packaging.

There is regulatory uncertainty for chemical recycling. For example, at the sub-national level in the United States chemical recycling is subject to a range of regulatory measures from prohibition (Maryland) to classification as manufacturing (Michigan). This disharmony of regulation complicates decision-making by regulated business seeking to comply with requirements and invest in improving the supply of secondary material.

It is extremely difficult to identify and measure the share of recycled content in a finished plastic product. Mechanical recycling does leave some trace identifiers that authorities could use to test for recycled content. For chemical recycling, identifying recycled content in the final product is practically impossible because the chemically recycled molecules are not traceable or measurable (Beers et al., 2022<sub>[85]</sub>). As such, governments may need to allow for measures like mass-balance to account for what share of a product is composed of material from chemical recycling. However, there is not a standard methodology

<sup>5</sup> Some chemical recycling processes do not combine or co-process with primary material. For example, Loop Industries, Green Mantra, Polystyvert, and Pyrowave.

<sup>6</sup> in which material is processed via washing, shredding, melting, followed by re-moulding.

of how to account for the material lost in chemical recycling, such as when feedstock material companies can claim is recovered as energy to sustain a pyrolysis reaction.

The flexibility of mass-balance or book-and-claim approaches make them attractive options for tracing plastics recycled content, but this flexibility also means there is the possibility for a wide range in their application, scope, and definitions, critical to ensuring compliance and use of recycled content by companies. Governments and certifying organisations therefore need to specify guidelines for methods and definitions. Companies have voiced concerns about difficulties due to differences (dis-harmonisation) between various policies.

There are several certifying organisations that use chain of custody methods to certify plastics recycled content (Table 4.5). Several of these organisations, including International Sustainability & Carbon Certification (ISCC) have announced that they will develop standards and certification processes for chemical recycling. These organisations typically have a wide geographic coverage, often global or regional in Europe and North America.

**Table 4.5. Examples of certification schemes for recycled content**

Certification scheme	Geographic coverage	Description
EN 15343:2007 Plastics Recycling Traceability and Assessment of Conformity and Recycled Content	Europe	Describes the necessary procedures for mechanical recycling that are needed for products that have been manufactured completely or in part from recycled plastics and need proof of traceability.
International Sustainability and Carbon Certification (ISCC) Plus	Global	Certifies sustainable, deforestation-free, and traceable supply chains for materials from waste and residue raw materials.
UL 2809 Environmental Claim Validation Procedure (ECVP) for Recycled Content	Global	Authenticates the post-consumer, pre-consumer (post-industrial), closed loop or total recycled content of products, providing third party validation. Also includes Ocean Bound Plastic and Ocean Plastic in the source materials.
SCS Recycled Content Standard	Global	Evaluates products made from pre-consumer or post-consumer material, measuring the percentage of recycled content.
GreenBlue Recycled Material Standard (RMS)	North America	Labelling of products and packaging that contain or support verified recycled material, either through a certified CoC or via the Attributes of Recycled Content (ARC) certificate trading system.
EuCertPlast	World: Europe, Türkiye, and Brazil	Audit scheme that verifies the traceability of recycled material within all steps of the value chain while ensuring the origin of the material pre- and post-consumer in product claims
RecyClass	Europe	Verifies the traceability of recycled material within all steps of the value chain while ensuring the origin of the material pre- and post-consumer in product claims.
Recycled Claim Standard (RCS)	Global	Sets requirements for third-party certification of recycled input and chain of custody by verifying the presence and amount of a given raw material in a final product.
RSB Standard for Advanced Products	Global	Certification for non-energy products such as plastics, textiles, and packaging, One uniform standard for bio-based, recycled content, and attributed systems.
QA-CER Recycled Content Certification System	Global	Third-party system certification based on ISO 9001 principles including Chain of custody.

Source: adapted from (Edwards, 2021<sup>[86]</sup>)

Certification can be based on definitions and standards set by governments, which could help to ease compliance with more compelling recycled content requirements. For example, the EU Cert plus is based on European standard N15343, which defines pre- and post-consumer recycling as well as methods for determining content per recycled output. European-based PROs, such as CITEO (France, packaging) have relied on the EU Cert plus certification for verification of claims by companies seeking the premium

fee adjustment. Polycert Europe serves as a technical platform for harmonising certification schemes in the EU by facilitating verification and auditing.

Harmonisation of standards where possible is advantageous, and there is some nuanced consensus on principles for chain of custody verification for recycled plastics. For example, The American Chemistry Council argues that a mass-balance standard should not enable a market for the sale and transfer of credit certificates outside their product-value chain, while Zero Waste Europe calls for ‘batch level mass balance’ at the site level (Zero Waste Europe, 2021<sup>[87]</sup>; American Chemistry Council, 2020<sup>[88]</sup>). The Ellen MacArthur Foundation calls for a common set of rules to be agreed internationally and the ACC calls for broad global adoption of a small number of harmonised standards (Ellen MacArthur Foundation, n.d.<sup>[80]</sup>; American Chemistry Council, 2020<sup>[88]</sup>). Chemical Recycling Europe has called for an EU-wide rule on a ‘fuel-use exempt’ mass-balance approach for calculating recycled content (2023<sup>[89]</sup>). The EU’s draft implementing decision on the single use plastics directive defines content as post-consumer, establishes a reporting chain for each batch of material containing recycled content, especially obliging operators at the early stage of the manufacturing chain (European Commission, 2023<sup>[75]</sup>).

# 5 Considerations for the design of recycled content policies

Policymakers should take care when designing policy to avoid perverse incentives, unchallenging or infeasible targets, and jeopardising other objectives<sup>7</sup>. Careful design and complementary policies, especially to improve supply of secondary material, can help to mitigate some of these potential pitfalls. As this policy approach emerges and governments gain experience with compelling policies, international organisations can further analyse the design, impacts of this policy approach, and promote harmonisation around best practices.

## 5.1 Considerations for defining recycled content requirements

### 5.1.1 Target setting: challenging, but feasible

The target shares for incentives and requirements need to be both realistic and challenging to avoid futile policy efforts. For example, in the EU market, roughly 32% of PET bottles are recycled, but recycled content represents only 14% of the share of new bottles (CPME, 2021<sup>[90]</sup>). The current difference between recycled content and the recycling rate of PET bottles suggests that a share of collected material is being used in other applications, e.g., downcycling to lower value applications. The EU's SUP directive challenges producers to increase the share of recycled content by 11 percentage points (to 25%) within five years' time and 16% (to 30%) in 10 years' time, meaning that the content requirement remains below the recycling share of EoL PET bottles. Therefore, supply of feedstock material should be sufficient to meet the future demand for secondary material.

Policymakers will need to define the geographic scope for the application of chain of custody methodology. A narrow geographic scope will be costlier to comply with than a broader definition but can provide a higher confidence in product composition. Mass-balance that is both site and product specific (i.e., batch-level), or controlled-blending, means a high-level of confidence in the composition of individual products. Requirements for reporting at the product line backed by certification would mean greater confidence in the impact of requirements, but with greater administrative burden. Alternatively, a scope that is not product or geography specific means less confidence in the composition of a particular product. It may also enable the producer to meet the requirements in a cost-effective manner.

Definitions of exemptions should be given special consideration. Policy should avoid *de minimis* exceptions that could provide perverse incentives. For example, the UK recycled content tax applies to packaging (>50% weight) made with plastics. Therefore, there is a window for producers to avoid the tax by using multi-material design to ensure at least half (by weight) is made of non-plastic material. These designs may be harder to recycle, meaning the policy may in some cases negatively impact recycling and material efficiency efforts. Careful considerations of definitions for exemptions should be carefully examined by policymakers. For example, New Jersey's policy allows for an exemption for cosmetic

<sup>7</sup> Based on Albert Hirschman's framework of perversity, futility, and jeopardy.

products from its content requirements for rigid plastics. This exemption, which lawmakers had intended to be narrowly applied, has provided exemption to a wide range of products.

Government consultation with industry can help to inform target setting. In many OECD countries the rulemaking process affords stakeholders opportunities for comment on regulation. The target and definitions in the United Kingdom's tax on plastic packaging was informed by industry via the consultation process (HM Treasury, 2020<sup>[91]</sup>).

### **5.1.2 Effective fee scheduling**

For taxes and penalties, the size of the fee helps to determine incentives for producers. The motivation for these policies is to incentivise producers to use a greater share of secondary material. However, in the short term with limited supply, these policies are likely to increase the cost of secondary material. The fee for non-compliance should be large enough to at least cover the difference in costs of primary and secondary material to properly incentivise this uptake. However, there is an argument that in the absence of sufficient material, insufficient supply can be a bigger factor than price in driving non-compliance. Policy can link these considerations by using revenue generated by non-compliance fee payments to invest in improvements in supply.

### **5.1.3 Design impacts and food contact considerations**

Emphasis on recycled content may give mixed signals to producers on priorities for design. For example, inclusion of recycled content can compete with light weighting because recycled materials tend to have a higher weight-to-strength ratio than virgin materials. Recycled content can also impact the future mechanical recyclability of a product or packaging. To address this concern, some governments are specifying that the content must not disturb future recyclability. For example, the California law establishing EPR for packaging requires fee adjustment on the basis of the percentage of PCR content and specifies that the fee modification can only be applied when the recycled content does not disrupt the potential for future recycling (California Legislative Information, 2022<sup>[29]</sup>).

Integration of recycled content in food contact materials is a safety challenge, including concerns with odours and contamination due to the resin composition of the packaging. For example, some laboratory tests have identified higher migration rates of Sb (antimony) and Bisphenol A (an endocrine disruptor) in secondary PET (rPET) as compared with its primary equivalent (Gerassimidou et al., 2022<sup>[92]</sup>). A recent study commissioned by Environment and Climate Change Canada argued that most plastic produced in the United States and Canada are not suitable for making food grade post-consumer recyclates, because, among other reasons, the material was made with non-food-grade material, suggesting the presence of additives or the leaching of non-food safe contaminants (STINA, 2021<sup>[93]</sup>).

The risk of chemical migration can be partially mitigated with recycling improvements in collection, separation, and decontamination, such as when fillers wash rPET bottles before first use (Cheng et al., 2010<sup>[94]</sup>). Additional improvements in decontamination could include high-temperature treatment; vacuum or inert gas treatment; and surface treatment with non-hazardous chemicals (Welle, 2011<sup>[95]</sup>). Earlier in the lifecycle, design for recycling and monitoring at the production phase can help to improve the supply of secondary material. As such, supply-based policy improvements will be particularly pertinent where recycled content requirements are in place for food contact materials like beverage containers, which typically use rPET. EPR schemes may be particularly important as a complementary policy as a means for increasing recycling rates, funding improvements in recycling, and incentivising design for recycling.

## 5.2 Recycled content requirements in the context of a policy mix

### 5.2.1 *Complementary policies: ensuring sufficient supply*

Without complementary policies to “push” and improve the supply of secondary material, content policies that “pull” demand may only increase the price for material. For example, some re-processors in North America have expressed concern that supply will be insufficient for upcoming demand and may increase pricing in the short term (Mcneese, 2022<sup>[3]</sup>). Indeed, in the United States, for example, there was an estimated gap of 0.5 Mt between the 2019 supply of rPET and the EMF goal of 25% recycled content by weight of all PET bottles sold (The Recycling Partnership, 2019<sup>[96]</sup>). Larger corporations may also control much of the demand in a limited-supply market, having possible consequences for competition (Heffernan, 2022<sup>[97]</sup>). Sector or product requirements may also crowd out other uses for the same material. For example, a requirement for recycled content in beverage bottles could crowd out the use of secondary PET as a source for recycled fibre (Ryan, 2022<sup>[98]</sup>).

The size of a market and its place in supply chains can in part determine the impact of content requirements on local recycling efforts. Large markets with many producers, such as California may be well placed to reap the benefits, compared with smaller markets distant from recycling supply chains (Mcneese, 2022<sup>[3]</sup>). As well, California has a supply side policy in place for beverage products with its mature deposit refund system for beverage containers.

Governments can help to leverage and further stimulate private investment in improvements to recycling. For example, Flanders invested 30 EUR million adding around 300 EUR million from private funding for 14 innovative recycling projects. In this case, plastic content requirements did not directly stimulate the public investment, but these improvements will help companies to meet forthcoming requirements. In the United States, the federal (national) government plans to invest USD 275 million in grant making to its subnational governments for solid waste infrastructure to improve recycling programs (OECD, 2023<sup>[99]</sup>).

The environmental benefits of recycled content are based on the displacing primary production and should complement policies that aim to prevent material consumption and waste generation. As such, recycled content policies are not a ‘silver bullet’ for circularity. Complementary policies that encourage reduction and design for reusability and recyclability, infrastructure to collect and recycle materials, pay as you throw fees on mixed waste, informing consumers of different disposal methods and collection facilities, and even new business models for circular economy are still effective for reducing primary demand (EASAC, 2020<sup>[100]</sup>). Additionally, policymakers should consider complementary policies that encourage smart logistic solutions, sorting by companies, as well as policies to increase the recycling rate of certain waste streams including those with a nascent recycling market. Complementary policies can also drive change in design for recyclability, such as reducing use of certain colorants and specific additives for marketing or branding purposes.

### 5.2.2 *Alternative policies: other means for impacting the relative price of secondary plastics*

Another question that has appeared in the policy debate is whether regulations or alternative policy instruments throughout the lifecycle are better suited to incentivise recycled content. For example, primary (virgin) material taxes increase the relative cost of primary material and can help stimulate reduction and the substitution of these materials with secondary equivalents. The incentive from primary material taxes is also dynamic because they can encourage recycled content uptake beyond minimum thresholds. For example, the Regional Action policy scenario in the Global Plastics Outlook includes a one-third increase in the tax on plastics use, which is projected to both restrain demand and increase the global recycling rate (OECD, 2022<sup>[101]</sup>). As well, at the end-of-life stage, increases in tipping fees help to decrease the relative costs of recycling, and thus can help to increase supply. These policies may be easier to monitor and

enforce while still decreasing the relative price of secondary material. However, they may not raise the salience of recycled content for designers as effectively as minimum policies.

Minimum requirements set penalties for products that do not meet the required share, but EPR fee modulation so far has served to subsidise those products that meet thresholds for recycled content. In effect, fee modulation means low performers subsidise the EPR fees of high performers. Penalties and taxes can help to fund development of recycling, in turn helping to improve supply of secondary material which should ease future compliance, whereas EPR fees themselves can fund these efforts.



## 6 Key policy insights

Despite the potential environmental benefits of displacing primary with secondary plastics, the production of secondary plastics remains an order of magnitude below production of primary plastics. To date, policymakers have relied primarily on enabling and steering policies that focus on the supply of secondary plastics. By 2024, two-thirds of OECD countries will have introduced a regulatory requirement for the inclusion of recycled content in some products and packaging, steering policies aimed at stimulating resilient demand for secondary material.

Commitments by companies to increase the share of recycled content in their products are not particularly new. For decades, there have been company commitments that were ambitious but lacked accountability for non-compliance.

Monitoring and verification of PCR content will be a challenge. To improve private efforts, **companies could provide publicly available or open access data** to reduce a perception of 'green washing' and enable the public to participate in monitoring. However, **verification of self-reporting is a policy gap**. Several governments are using self-reporting to ensure compliance with recycled content requirements. It remains to be determined how these will be monitored and enforced.

Certification schemes may be a helpful way to ensure confidence in recycled content claims. Presently, **secondary plastics certification is immature relative to other materials**, like paper standards. As requirements proliferate, there will be calls for harmonisation. Were only a small handful of certification schemes to be recognised by most governments, concerns about competition and governance issues may arise. Instead of identifying specific certifying organisations, government could set the requirements for certification schemes to allow for competition by multiple certifiers. Particularly in markets with limited supply of secondary material, **policymakers will want to ensure fair competition for both acquisition of the material and its certification**.

There is a risk that different governments within a single market (e.g., within the European Union or the United States of America) will use different definitions of recycled content which will complicate accounting by regulated companies. Different definitions can also send mixed signals to industry on how to invest to improve supply, especially whether to invest in chemical recycling. International **cooperation can promote harmonisation around best practices**. For example, existing multilateral fora could facilitate the analysis of policy impacts and identification of insights from development of definitions for recycled content, measurement and verification.

Isolating and identifying the impact of recycled content policies **to measure their effectiveness will be a challenge**. *Ceteris paribus*, these policies should increase the demand and thus price for secondary plastics in the short term and stimulate investments in supply improvements in the long term. Supply-based measures can complement demand policies and ensure price reductions in the long term. Requirements should aim for targets that are challenging, but feasible. Food-grade material is likely to be particularly challenging to acquire, but **policymakers should take care that requirements do not jeopardise safety**. Exemptions from recycled content requirements can help to address sanitary or safety concerns but should be balanced against the fact that they reduce the reach and impact of the policies.

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