Assessment of options for reinforcing the Packaging and Packaging Waste Directive's essential requirements and other measures to reduce the generation of packaging waste

Final Report

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Directorate-General for Environment

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LIST OF ABBREVIATIONS

Abbreviation	Description
AD	Anaerobic Digestion
AdCo	Administrative Cooperation Groups
AQ	Air Quality
B2B	Business to Business
B2C	Business to Consumer
BRG	Better Regulation Guidelines
CBA	Cost-benefit Analysis
CBI	Confidential Business Information
CEA	Cost-effectiveness Analysis
CEN	European Committee for Standardization
CLP	Classification, Labelling and Packaging
CMR	Carcinogenic, Mutagenic or Reprotoxic
CPA	Circular Plastics Alliance
CPPdb	Chemicals associated with Plastic Packaging database
CPV	Common Procurement Vocabulary
Downcycling	Recycling of waste in cases where the recycled material is of a lower quality and functionality than the original material
DRS	Deposit Return Scheme
ECHA	European Chemicals Agency
EN	European Standard
EoW	End of Waste
EPR	Extended Producer Responsibility
ETS	Emissions Trading Scheme
FCM(R)	Food Contact Material (Rules)

Abbreviation	Description
FTE	Full Time Equivalent
GDP	Gross Domestic Product
GHG	Greenhouse Gas (emissions)
GPP	Green Public Procurement
HORECA	Hotels, restaurants and catering
ICT	Information and Communication Technologies
IVC	In-Vessel Composting
JRC	Joint Research Centre
LCA	Life Cycle Analysis
MCA	Multi-criteria Analysis
MS	Member State
nCEAP	new Circular Economy Action Plan
NIAS	Non Intentionally Added Substances
OPC	Online Public Consultation
OPRL	On-Pack Recycling Label
PBT	Persistent Bioaccumalative Toxic
PEF	Product Environmental Footprint
POM	Placed on the Market
PPWD	Packaging and Packaging Waste Directive
PRO	Producer Responsibility Organisation
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
RTP	Returnable Transport Packaging
SHVC	Substances of Very High Concern
SKU	Stock Keeping Unit
SME	Small and Medium Enterprises
SUP(D)	Single Use Plastic (Directive)
TED	Tenders Electronic Daily
vPvB	Very Persistent and Very Bioaccumalative (substances)
WFD	Waste Framework Directive

Abstract

The European Commission commissioned a study to develop and assess a set of options to reinforce the Packaging and Packaging Waste Directive's essential requirements and achieve an absolute reduction in packaging waste generation.

The work included six main components: (1) problem definition, including problem drivers and consequences, (2) objectives to be achieved to address the problems and need for EU intervention, (3) baseline scenario on how the situation will evolve in the absence of policy intervention, (4) presentation of policy measures in eight intervention areas, (5) grouping of the measures into policy options, and description of the impacts of the preferred option, (6) extensive stakeholder consultation throughout the process.

Based on the above a preferred policy option was identified, consisting of twenty-three policy measures. The monitoring and evaluation framework was also described.

Résumé

La Commission européenne a commandé une étude pour élaborer et évaluer une série d'options visant à renforcer les exigences essentielles de la directive relative aux emballages et aux déchets d'emballages, et à obtenir une réduction absolue de la production de déchets d'emballages.

Le travail comprenait six éléments principaux : (1) définition du problème, y compris les moteurs et les conséquences du problème, (2) objectifs à atteindre pour résoudre les problèmes et nécessité d'une intervention de l'UE, (3) scénario de base sur l'évolution de la situation en l'absence d'intervention politique, (4) présentation des mesures politiques dans huit domaines d'intervention, (5) regroupement des mesures en options politiques et description des impacts de l'option préférée, (6) consultation approfondie des parties prenantes tout au long du processus.

Sur la base des éléments ci-dessus, une option préférée a été identifiée, composée de vingt-trois mesures. Le cadre de suivi et d'évaluation a également été décrit.

Executive Summary

Background and Objectives

The Essential Requirements, which all packaging placed on the EU market needs to comply with, were first introduced in the Packaging and Packaging Waste Directive (PPWD – Directive 94/62/EC), as defined in Article 9 and Annex II. These requirements, and the associated harmonised standards, have not changed substantially since their introduction, and previous studies have identified the Essential Requirements as potentially requiring further attention to improve packaging design, particularly in relation to the lack of recyclability of many packaging formats. In addition, the policy landscape has evolved significantly since the PPWD first established the Requirements; the 2018 revision of the PPWD included, in addition to a revision of the recycling targets for packaging waste, a mandate for the Commission to examine "*the feasibility of reinforcing the essential requirements with a view to, inter alia, improving design for reuse and promoting high quality recycling, as well as strengthening their enforcement.*"

This study carried out an impact assessment of different options available to reinforce the Packaging and Packaging Waste Directive's Essential Requirements, and other measures to reduce the generation of packaging waste to transition to a low-carbon and circular economy.

Problems, Consequences and EU intervention

The generation of packaging waste can be attributed to various problematic trends. Packaging waste in the EU is seeing a general upward trend in both absolute terms and per capita since the introduction of the PPWD in 1994. High levels of avoidable packaging are also being used, which has not been reduced by increased light-weighting efforts. Country specific trends also show a reduction in reusable primary and tertiary packaging. The reuse of consumer (primary) packaging is increasingly uncommon and is limited primarily to beverage packaging at a national scale. This has been accompanied by a significant rise in the use of one-way packaging, especially single-use plastic.

Another attributive factor are the barriers to circularity which provide challenges for the recycling of packaging. There has been an increased use of packaging design characteristics that may inhibit recycling. The demand for bio-based and compostable plastics has led to consumer confusion leading to cross-contamination of conventional and compostable recycling streams. Circularity is impacted by a lack of legal certainty in the Essential Requirements, and little information on the use of chemicals, potentially hazardous, in packaging and packaging components. Furthermore, the labelling of recyclable packaging increases consumer confusion leading to used packaging being discarded in a way that does not maximise recyclability. In addition, currently the recycling of materials does not produce outputs of a high enough quality to be recycled back into packaging.

These problems generate negative social impacts, such as air pollution from the incineration of waste packaging and litter, which causes severe consequences in how citizens feel about their local environment. Environmental impacts include increased greenhouse gas emissions, air and water pollution from the use of hazardous substances, and litter impacting ecosystems and

affecting biodiversity, including through the soil and marine life. The move towards a circular economy is affected by the heightened demand for packaging, combined with low recyclability and low levels of recycled content, leading to an increased use of a range of non-renewable resources.

These problems could also threaten the integrity of the EU internal market as individual Member States seek to take action on packaging unilaterally due factors such as the vague nature of the Essential Requirements. The need for EU action to address these packaging problems is clear. In the absence of EU-level intervention, such divergence across Member States to address packaging could be expected. This lack of harmonisation could not only affect the integrity of the internal market but impede the move to circular economy. Consistent approaches across the EU to packaging design would also provide clear signals to packaging designers and investors, reduce confusion and achieve efficient harmonisation to promote the move to a low-carbon and circular economy.

Objectives and Baseline

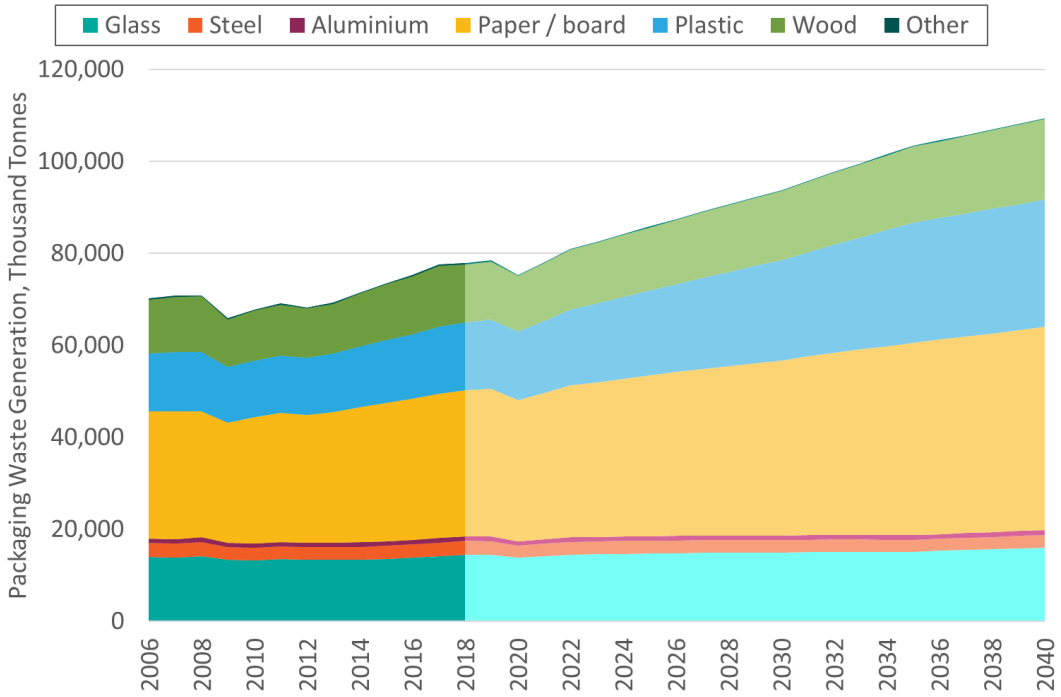
Based on the above problems (and their drivers and consequences), a series of inter-related objectives were defined, as show in Table E-1 below.

Table E-1 General, specific and operational objectives.

General	A well-functioning internal market	Tackling negative impacts from packaging on environment	Promoting a circular economy
Specific	Ensuring a level playing field through a common set of rules	Reducing environmental and social impact throughout all stages of the packaging life cycle	Increasing the circularity of packaging and reducing packaging waste
Operational	› To ensure that enforcement mechanisms and associated data gathering are effective whilst minimising administrative burden › To ensure that labelling for consumers is relevant and clear	› To limit and/or reduce the amount of packaging waste generated › To more fully understand and then minimize the presence of hazardous substances within packaging › Ensuring functioning markets for secondary raw materials and related industrial processes	› To increase the uptake of reusable packaging › To increase the recyclability of packaging › To increase the level of recycled content in packaging › To set conditions for the use of compostable packaging in order to help reduce cross-contamination in the recycling stream

To carry out the impact assessment of different measures available to meet the objectives of this study, the baseline scenario was established, projecting current trends into 2040 and beyond. This scenario is based on no additional policy interventions. Figure E-1 shows the evolution of packaging waste generation.

Figure E-1 Generation of packaging waste, thousand tonnes



Policy Measures and Options

Once the baseline was established, a selection process was carried out the determine and select policy measures to meet the objectives and address the problems, including the root causes. This process consisted of:

- A longlist of 115 measures, which were screened against seven criteria;
- A shortlist of 45 measures, which were reviewed for feasibility, coherence and effectiveness;
- A selection of 27 measures which were impact assessed; and
- A final selection of 25 measures which were grouped in three policy options (see Table E-2, next page)

Table E-2 Policy options determined by the measures selection process. The Options included in the Preferred Option have been highlighted in green.

	Option 2	Option 3	Option 4	Option 5	Option 6
Prevention and reuse	M1 Over-arching changes to limiting criteria approach M10 Standardisation of reusable packaging and effective reuse systems M11 Business advisory body M12 Harmonised labelling for reusable packaging	M2b Mandatory Member States reduction targets – low M8b Member States level sector by sector reuse targets - low	M2b Mandatory Member States reduction targets – high M8c Member States level sector by sector reuse targets - high	M5 Void space threshold limits M7 Phase out avoidable / unnecessary packaging M19 Harmonisation of when reusable packaging (including RTP) is classified as waste	M3 Best-in-class weight limits
Recyclable and compostable	M21 Updates to the Essential Requirements M22a – Defining recyclable packaging - qualitatively M28 Updates to EN 13432	M22b – Defining recyclable packaging – DfR M29d Criteria for compostable Packaging – mix of 29a and 29b	M22c – Defining recyclable packaging - quantitatively M29c Criteria for compostable Packaging – ban on compostables	M23 Harmonisation of EPR fee modulation criteria in an implementing act	
Recycled Content	M34a Introducing a mandatory reporting requirement for recycled content in all packaging M37 Harmonised definition and measurement method	M35c Recycled content targets for plastic packaging – Targets based on contact sensitivity / broad application			
Enabling measures	M31 Update 'hazardousness' in PPWD M33 Restriction of hazardous substances M42b EPR reporting harmonisation with de minimis threshold alongside Member State reporting of EPR data into the Commission	M40b Mandatory minimum GPP packaging criteria for priority product and service areas	M40c Mandatory minimum GPP packaging criteria for all products and service areas	M27c Harmonised standards for labelling of recyclable packaging – to include information on material components	M41 Environmental award criteria M32 Expanding the information base on hazardous substances

The Preferred Option was defined as a combination of Options 2, 3 and 5. Table E-3 describes the economic, environmental and social impacts of the Preferred Option as well as the impacts on mass material flows (all quantified as the net difference in 2030 relative to the baseline).

Table E-3 The impacts of the Preferred Option

Type	Impact	Net difference in 2030 vs baseline
Mass flow impacts	Packaging waste generation	-21.6 million tonnes
	Recycling rates	+3.6pp
Economic Impacts	Waste management costs	-€5.5 billion
	Annualised capital and operational costs of running reuse schemes	+€4.9 billion
	Contamination costs	-€118 billion
	Turnover for packaging producers	-€57 billion
	Material Costs	-€8.4 billion
Environmental Impacts	Carbon emissions	-21.5 million tonnes CO_2e
	Water use	-756 thousand m^3
Social impacts	Job creation	additional 1.3 million full-time equivalent jobs

Synthèse

Contexte et objectifs

Les exigences essentielles, auxquelles tous les emballages mis sur le marché de l'UE doivent être conformes, ont été introduites pour la première fois dans la directive relative aux emballages et aux déchets d'emballages (directive 94/62/CE), telles que définies par l'article 9 et par l'annexe II. Ces exigences, et les normes harmonisées associées, n'ont pas changé de manière considérable depuis leur introduction, et des études précédentes ont identifié les Exigences Essentielles comme nécessitant potentiellement une attention supplémentaire pour améliorer la conception des emballages, en particulier en ce qui concerne le manque de recyclabilité de nombreux formats d'emballages. De plus, le paysage politique a considérablement évolué depuis que la DPP a établi les exigences pour la première fois ; la révision de 2018 de la DPP comprenait, outre une révision des objectifs de recyclage des déchets d'emballages, un mandat pour que la Commission examine "*la faisabilité du renforcement des exigences essentielles en vue, notamment, d'améliorer la conception en vue de la réutilisation et de promouvoir un recyclage de haute qualité, ainsi que de renforcer leur application.*"

Cette étude a réalisé une analyse d'impact des différentes options disponibles pour renforcer les exigences essentielles de la directive sur les emballages et les déchets d'emballages, ainsi que d'autres mesures visant à réduire la production de déchets d'emballages pour assurer la transition vers une économie circulaire et à faible production de carbone.

Problèmes, conséquences et intervention de l'UE

La production de déchets d'emballages peut être attribuée à diverses tendances problématiques. Dans l'UE, les déchets d'emballages suivent une tendance générale à la hausse, tant en termes absolus que par habitant, depuis l'introduction de la directive PPWD en 1994. Des niveaux élevés d'emballages évitables sont également utilisés, ce qui n'a pas été réduit par des efforts accrus en matière d'allègement. Les tendances spécifiques à chaque pays montrent également une réduction des emballages primaires et tertiaires réutilisables. La réutilisation des emballages de consommation (primaires) est de moins en moins courante et se limite principalement aux emballages de boissons à l'échelle nationale. Cette évolution s'est accompagnée d'une augmentation significative de l'utilisation d'emballages à usage unique, notamment le plastique à usage unique.

Les obstacles à la circularité, qui constituent des défis pour le recyclage des emballages, sont un autre facteur d'explication. On constate une utilisation accrue des caractéristiques de conception des emballages qui peuvent entraver le recyclage. La demande de plastiques biosourcés et compostables a entraîné une confusion chez les consommateurs, ce qui a conduit à une contamination croisée des flux de recyclage conventionnels et compostables. La circularité est affectée par un manque de sécurité juridique dans les exigences essentielles et par le peu d'informations sur l'utilisation de produits chimiques, potentiellement dangereux, dans les emballages et leurs composants. En outre, l'étiquetage des emballages recyclables accroît la confusion des consommateurs, ce qui conduit au jet des emballages usagés d'une manière qui

ne maximise pas leur recyclabilité. De plus, à l'heure actuelle, le recyclage des matériaux ne permet pas d'obtenir des produits d'une qualité suffisante pour être recyclés en emballages.

Ces problèmes génèrent des impacts sociaux négatifs, tels que la pollution de l'air due à l'incinération des déchets d'emballage et les détritus, qui ont de graves conséquences sur la façon dont les citoyens perçoivent leur environnement local. Les impacts environnementaux comprennent l'augmentation des émissions de gaz à effet de serre, la pollution de l'air et de l'eau due à l'utilisation de substances dangereuses, et les déchets qui ont un impact sur les écosystèmes et affectent la biodiversité, notamment le sol et la vie marine. L'évolution vers une économie circulaire est affectée par la demande accrue d'emballages, associée à une faible recyclabilité et à de faibles niveaux de contenu recyclé, ce qui entraîne une utilisation accrue d'une série de ressources non renouvelables.

Ces problèmes pourraient également menacer l'intégrité du marché intérieur de l'UE, les États Membres cherchant à prendre des mesures unilatérales en matière d'emballages en raison de facteurs tels que le caractère imprécis des exigences essentielles. La nécessité d'une action communautaire pour résoudre ces problèmes d'emballage est évidente. En l'absence d'une intervention au niveau de l'UE, on pourrait s'attendre à de telles divergences entre les États Membres en matière d'emballage. Ce manque d'harmonisation pourrait non seulement affecter l'intégrité du marché intérieur mais aussi entraver le passage à l'économie circulaire. Des approches cohérentes à travers l'UE en matière de conception d'emballages fourniraient également des signaux clairs aux concepteurs d'emballages et aux investisseurs, réduiraient la confusion et permettraient une harmonisation efficace pour promouvoir le passage à une économie circulaire et à faible émission de carbone.

Objectifs et scénario de base

Sur la base des problèmes ci-dessus (et de leurs moteurs et conséquences), une série d'objectifs interdépendants ont été définis, comme le montre la table E-1 ci-dessous.

Table E-1 Objectifs généraux, spécifiques et opérationnels.

Généraux	Un marché intérieur performant	Aborder les effets négatifs des emballages sur l'environnement	Promouvoir une économie circulaire
Spécifiques	Garantir des conditions de concurrence équitables grâce à un ensemble de règles communes	Réduire l'impact environnemental et social à toutes les étapes du cycle de vie de l'emballage	Accroître la circularité des emballages et réduire les déchets d'emballage

Opérationnels	› Garantir que les mécanismes d'application et la collecte de données associée sont efficaces tout en minimisant la charge administrative. › Veiller à ce que l'étiquetage destiné aux consommateurs soit pertinent et clair	› Limiter et/ou réduire la quantité de déchets d'emballages générés › Mieux comprendre puis minimiser la présence de substances dangereuses dans les emballages › Assurer le fonctionnement des marchés pour les matières premières secondaires et les processus industriels associés	› Augmenter l'adoption d'emballages réutilisables › Augmenter la recyclabilité des emballages › Augmenter le niveau de contenu recyclé dans les emballages. › Fixer des conditions pour l'utilisation d'emballages compostables afin de contribuer à la réduction de la contamination croisée dans le flux de recyclage

Mesures et options politiques

Une fois la base de référence établie, un processus de sélection a été mis en œuvre pour déterminer et sélectionner les mesures politiques permettant d'atteindre les objectifs et de traiter les problèmes, y compris leurs causes profondes. Ce processus a consisté en :

- Une liste longue de 115 mesures, qui ont été examinées en fonction de sept critères;
- Une liste courte de 45 mesures, dont la faisabilité, la cohérence et l'efficacité ont été examinées;
- Une sélection de 27 mesures qui ont fait l'objet d'une évaluation d'impact; et
- Une sélection finale de 25 mesures qui ont été regroupées en trois options politiques (voir table E-2, page suivante).

Table E-2 Options déterminées par le processus de sélection des mesures. Les options incluses dans l'option préférée ont été surlignées en vert.

	Option 2	Option 3	Option 4	Option 5	Option 6
Prévention et réutilisation	M1 Modifications générales de l'approche des critères limitatifs M10 Normalisation des emballages réutilisables et des systèmes de réutilisation efficaces M11 Organisme de conseil aux entreprises M12 Étiquetage harmonisé pour les emballages réutilisables	M2b Objectifs obligatoires de réduction des États Membres - bas M8b Objectifs de réutilisation secteur par secteur au niveau des États Membres – bas	M2b Objectifs obligatoires de réduction des États Membres - haut M8b Objectifs de réutilisation par secteur au niveau des États Membres - haut	M5 Seuils limites de l'espace vide M7 Suppression progressive des emballages évitables / inutiles M19 Harmonisation de la classification des emballages réutilisables (y compris les RTP) en tant que déchets.	M3 Limites de poids *best-in-class*
Recyclable and compostable	M21 Mises à jour des exigences essentielles M22a - Définition des emballages recyclables - sur le plan qualitatif M28 Mises à jour de la norme EN 13432	M22b - Définition des emballages recyclables - DfR M29d Critères pour les emballages compostables - mélange de 29a et 29b	M22c - Définition des emballages recyclables - de manière quantitative M29c - Critères pour les emballages compostables - interdiction des compostables	M23 Harmonisation des critères de modulation de la redevance REP dans un acte d'exécution	
Contenu recycle	M34a Introduction d'une obligation de déclaration du contenu recyclé de tous les emballages M37 Définition et méthode de mesure harmonisées	M35c Objectifs de contenu recyclé pour les emballages plastiques - Objectifs basés sur la sensibilité au contact / application			

Mesures d'accompag-nement	M31 Mise à jour de la notion de "dangerosité" dans le PPWD M33 Restriction des substances dangereuses M42b Harmonisation des rapports sur les REP avec le seuil de minimis, parallèlement à la communication par les États membres des données sur les REP à la Commission	M40b Critères minimaux obligatoires pour les emballages de marchés publics écologiques pour les produits et services prioritaires	M40c Critères minimaux obligatoires d'emballage de marchés publics écologiques pour tous les produits et services	M27c Normes harmonisées pour l'étiquetage des emballages recyclables - inclure des informations sur les composants des matériaux	M41 Critères d'attribution environnementale M32 Élargissement de la base d'informations sur les substances dangereuses

L'option préférée a été définie comme un regroupement des options 2, 3 et 5. La table E-3 décrit les impacts économiques, environnementaux et sociaux de l'option préférée ainsi que les impacts sur les flux massiques de matières (tous quantifiés comme la différence nette en 2030 par rapport au scénario de référence).

Table E-3 Les impacts de l'option préférée

Type	Impact	Différence nette en 2030 par rapport au scénario de base
Impacts sur flux massiques	Production de déchets d'emballages	-21,6 millions de tonnes
	Taux de recyclage	+3,6pp
Impacts économiques	Coûts de gestion des déchets	-5,5 milliards d'euros
	Coûts d'investissement et d'exploitation annualisés des systèmes de réutilisation	+4,9 milliards d'euros
	Coûts de contamination	-118 milliards d'euros
	Chiffre d'affaires des producteurs d'emballages	-57 milliards d'euros
	Coûts des matériaux	-8,4 milliards d'euros
Impacts environnemen-taux	Émissions de carbone	-21,5 millions de tonnes de CO2e
	Consommation d'eau	-756 000 m3
Impacts sociaux	Création d'emplois	1,3 million d'emplois équivalents à temps plein

1 Introduction

Eunomia Research & Consulting Ltd, along with COWI, Arcadis and Milieu, is pleased to present this Draft Report (under the Framework Contract ENV.F.1.FRA/2019/0001) under study request No07.0201/2020/824634/SFRA/ENV.B.3 concerning the *Assessment of options for reinforcing the Packaging and Packaging Waste Directive's essential requirements and other measures to reduce the generation of packaging waste* and develop and assess measures on recycled content in packaging and green public procurement for packaging.

1.1 Political and legal context

Article 1 of Directive 94/62/EC on Packaging and Packaging Waste (PPWD) states that:[1]

> *"This Directive aims to harmonize national measures concerning the management of packaging and packaging waste in order, on the one hand, to prevent any impact here of on the environment of all Member States as well as of third countries or to reduce such impact, thus providing a high level of environmental protection, and, on the other hand, to ensure the functioning of the internal market and to avoid obstacles to trade and distortion and restriction of competition within the Community."*

In line with the waste hierarchy, the seventh recital notes that:

> *"the management of packaging and packaging waste should include as a first priority, prevention of packaging waste and, as additional fundamental principles, reuse of packaging, recycling and other forms of recovering packaging waste and, hence, reduction of the final disposal of such waste"*

The Directive covers all packaging placed on the European market and all packaging waste, whether it is generated at industrial, commercial, office, shop, service, household or any other level, regardless of the material used.

According to Article 9 of the PPWD, EU Member States must ensure that all packaging placed on the EU market meets the Essential Requirements defined in Annex II of the Directive, which relate to:

a. the manufacturing and composition of packaging;
b. the reusable nature of packaging; and
c. the recoverable nature of packaging (through material recycling, energy recovery, composting or biodegradation).

Enforced by Member States, compliance with the Requirements is presumed in case of compliance with the harmonised European standards for packaging, the reference numbers of which have been published in the Official Journal of the European Communities. Primary, secondary and tertiary packaging is all within scope – comprising all containers, outer wrapping and storage material used in the production of a product. Those entities placing any packaging on the market must be able to demonstrate compliance with these requirements.

[1] https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31994L0062:EN:HTML

In 2009, the EC surveyed Member States to assess compliance with the Essential Requirements[2]. The results showed limited progress in the monitoring and enforcement of the Essential Requirements in Member States. This is confirmed by statistical data, as despite the Directive's provisions on waste prevention and minimization of environmental impacts of packaging, waste arisings have increased for plastic and paper/board streams. According to Eurostat, around 69 million tonnes of packaging waste were generated in 2005, and an estimated 77.7 million tonnes in 2018 – representing a 13% growth in tonnage of packaging waste generated in the EU in this period, largely driven by increases in the use of plastic and paper/board packaging.[3]

In 2014 a Fitness Check[4] took place of five Waste Stream directives, including the PPWD, that assessed the effectiveness, efficiency, relevance and coherence of the directives. This study identified several weaknesses in the Essential Requirements, and recommended to make them "more concrete and easily enforceable" and "to strengthen Essential Requirements as a key tool to achieve better environmental performance of packaging".

In 2018, the PPWD was amended by Directive (EU) 2018/852 which entailed measures designed to reinforce prevention and to promote reuse and recycling of packaging waste. The PPWD revision consisted primarily in setting the new 2025 and 2030 recycling targets (as shown in Table 1-1) and rules for their calculation.

Table 1-1 Recycling rates targets prior to and following the 2018 revision of the PPWD

	Targets prior to the revision	Revised target for 2025	Revised target for 2030
All packaging	55%	65%	70%
Plastic	25%	50%	55%
Wood	15%	25%	30%
Ferrous metals	50% (incl. Al)	70%	80%
Aluminium	-	50%	60%
Glass	60%	70%	75%
Paper and cardboard	60%	75%	85%

A number of key weaknesses that had been identified in the 2014 Fitness Check were only addressed in the revised Directive through "hooks" tasking the Commission with the preparation of further measures in the near future. While the PPWD's emphasis on packaging waste prevention was reinforced through still relatively 'soft' requirements upon Member States, no

[2] European Commission – DG Environment (2009) A *Survey on compliance with the Essential Requirements in the Member States (ENV.G.4/ETU/2008/0088r) Final report.* https://ec.europa.eu/environment/waste/packaging/pdf/report_essential_requirements.pdf

[3] Eurostat *Eurostat - Data Explorer - Packaging waste by waste management operations and waste flow*, http://appsso.eurostat.ec.europa.eu/nui/show.do?lang=en&dataset=env_waspac

[4] SWD(2014) 209 final, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014SC0209&from=EN

new EU level measures were included in response to what the evaluation had identified as a persistent weakness in relation to this point. Similarly, while the evaluation had concluded on the need to strengthen the PPWD's Essential Requirements for packaging to be placed on the EU market, these were only very marginally touched upon in the 2018 revision. However, the co-legislators in the 2018 revision of the PPWD tasked the Commission with follow-up work linked to both aspects, more specifically with regard to:

- The PPWD's Essential Requirements (Art 9(5)) – "by 31 December 2020, the Commission shall examine the feasibility of reinforcing the Essential Requirements with a view to, inter alia, improving design for reuse and promoting high quality recycling as well as strengthening their enforcement. To that end, the Commission shall submit a report to the EP and to the Council, accompanied if appropriate, by a legislative proposal."
- Reuse (PPWD Art 5(5)) – The Commission is to examine data on reusable packaging with a view to considering the feasibility of setting quantitative targets on reuse of packaging (…) and any further measures to promote reuse of packaging (and submit a report and, if appropriate, a legislative proposal by 31 Dec 2024).

The vague formulation of the requirements, in combination with a general trend towards lightweighting of packaging, has led to a shift to less recyclable packaging formats, particularly for plastics. This challenge was recognised in the European Strategy for Plastics in a Circular Economy (January 2018) in which the Commission set out to "initiate work on new harmonised rules to ensure that by 2030 all plastics packaging placed on the market can be reused or recycled" in a cost-effective manner".[5] Furthermore, the European Council meeting of 17-21 July 2020 introduced an own resource based on plastic packaging waste that is not recycled to finance the EU budget over the 2021-2027 period. Member States will provide a contribution which is proportional to the quantity of plastic packaging waste in their respective territory, with a correction mechanism in support of low-income countries.[6] This will incentivise Member States to increase recycling of plastic packaging.

In December 2019, the Commission adopted the European Green Deal[7], setting out an ambitious new growth strategy for the EU on a climate-neutral, resource-efficient and circular economy trajectory. A key component to deliver on the objectives of the Green Deal is the new Circular Economy Action Plan (nCEAP) adopted in March 2020. The nCEAP reinforces the Green Deal's call for further action relating to waste prevention and to ensure that all packaging on the EU market is reusable or recyclable in an economically viable way by 2030. Notably, the European Green Deal emphasizes the need to avoid waste generation and recognises that this requires new legislation, including targets and measures for tackling over-packaging and waste

[5] European Commission - DG Environment (2018) Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions A European Strategy for Plastics in a Circular Economy COM/2018/028, Annex I. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2018:28:FIN

[6] European Council (2020) Special meeting of the European Council (17, 18, 19, 20 and 21 July 2020) – Conclusions, available at https://www.consilium.europa.eu/media/45109/210720-euco-final-conclusions-en.pdf

[7] European Commission, Communication From The Commission, The European Green Deal, Secretariat-General (2019) https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52019DC0640

generation. The nCEAP also indicates that there is "a mismatch between supply and demand of secondary raw materials" thereby justifying the need for the Commission to "take further targeted measures to address the sustainability challenges posed by [plastics] and… continue to promote a concerted approach to tackle plastics pollution at global level". In relation to packaging this calls for investigating the possibility of mandatory requirements for recycled content in packaging to drive the demand for recycled materials, and in particular plastics. The new CEAP also announced that the "Commission will propose minimum mandatory green public procurement (GPP) criteria and targets in sectoral legislation", which includes packaging.

Ultimately, this updated policy landscape, together with the identified problems as described in section 2.2, highlight a need for the revision of the PPWD, which is the subject of this study. The problems this study aims to tackle are therefore closely linked to reduction of negative environmental impacts, including GHG emissions, associated with the production and transport of increasing quantities of packaging (with continued reliance on resource extraction) and its end of life management – particularly for plastics.

As outlined in the Terms of Reference:

> *"The overall purpose of this study is to assist the Commission in developing and assessing a set of options to:*
> - *reinforce the Packaging and Packaging Waste Directive's essential requirements;*
> - *achieve an absolute reduction in packaging waste generation."*

While improvements to the Essential Requirements are therefore an integral and key part of this study, it will also consider the need for and appropriateness of additional regulatory and other measures to deliver on the main objectives of the PPWD and recent political commitments, in particular: (1) Ensure free movement of packaging and packaged goods; (2) Ensure a well-functioning market for secondary raw materials and support compliance with recycling targets for packaging; (3) Ensure reduction in packaging waste generation, including by reducing (over)packaging. The review will not cover lightweight plastic carrier bags or aspects of the Single use Plastics (SUP) Directive; however, both are important aspects to consider in the baseline definition.

1.2 Report overview

This report is set out in line with the Commission's requirements for the structure of the impact assessment report. The main sections are:

- Section 2: Problem definition
- Section 3: Why should the EU act?
- Section 4: Objectives
- Section 5: Baseline
- Section 6: Measures
- Section 7: Policy Options
- Section 8: Recommended option

There are a number of appendices accompanying this report:

- Appendix A: Problem Definition
- Appendix B: Baseline Methodology
- Appendix C: Longlist of Measures

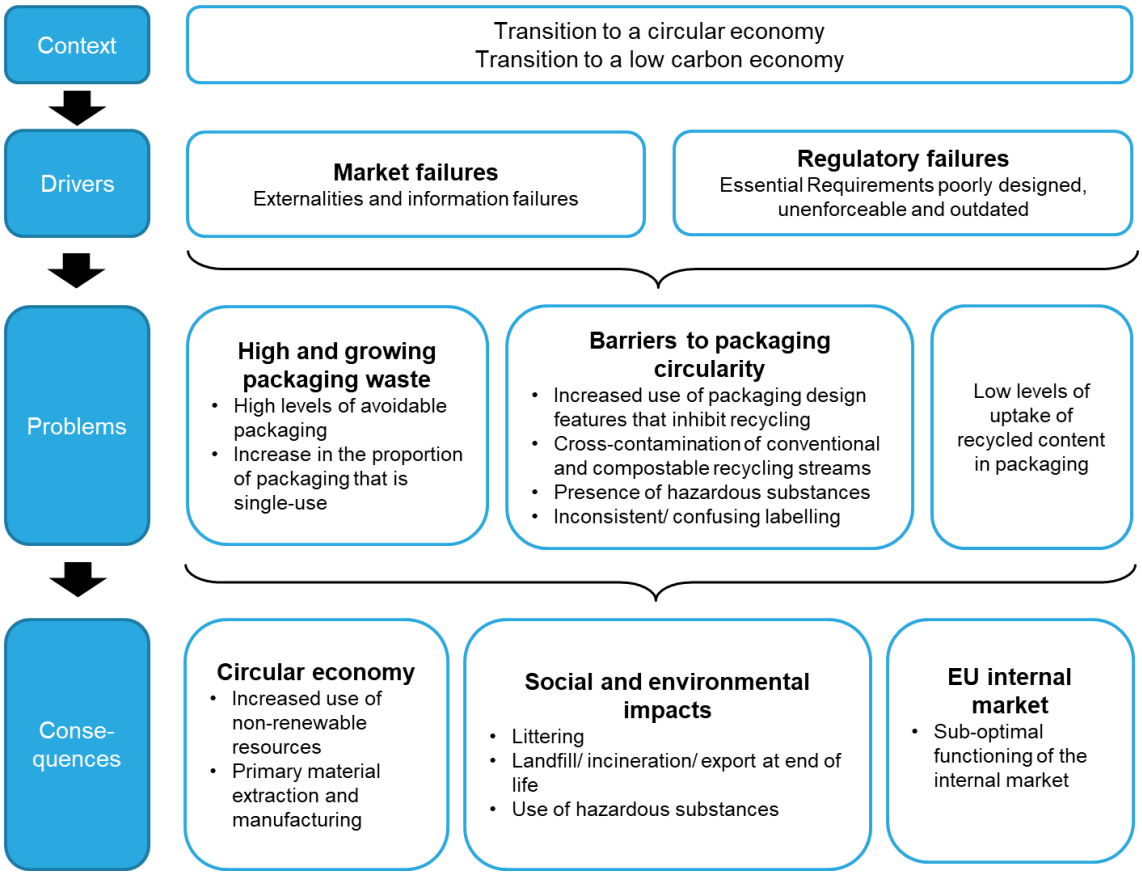
- Appendix D: Impact Modelling Methodology
- Appendix E: Stakeholder synopsis report
- Appendix F: Online Public Consultation report
- Appendix G: Green Public Procurement Packaging Criteria Research
- Appendix H: Impact assessments for intervention area Waste Prevention
- Appendix I: Impact assessments for intervention area Reuse
- Appendix J: Impact assessments for intervention area Recyclability
- Appendix K: Impact assessments for intervention area Compostable Packaging
- Appendix L: Impact assessments for intervention area Hazardous substances
- Appendix M: Impact assessments for intervention area Recycled Content
- Appendix N: Impact assessments for intervention area Green Public Procurement
- Appendix O: Impact assessments for intervention area Data & Reporting
- Appendix P: Impacts per Member States

2 Problem definition

In line with the Better Regulation Guidelines on Impact Assessment[8], this section further defines the problems that are being addressed by this review of the Directive (as touched upon in Section 1.2 above). The main focus is on the scale of these problems, their consequences and underlying drivers, as outlined in Tool #14 How to Analyse Problems.

The aim of this initiative is to tackle **three groups of highly interlinked problems** related to packaging waste (Figure 2-1).

Figure 2-1 Overall problem tree



The current scale and trends associated with each problem are discussed first[9], based on an assessment of the available data on packaging waste and packaging markets. This is accompanied by an overview of the current consequences of each problem. The problem drivers are presented in section 2.2, grouped in three categories. Next, in section 2.4 we discuss how the problems are likely to evolve in the absence of further intervention and finally, in section 2.5 we present an overview of the affected stakeholders.

[8] https://ec.europa.eu/info/sites/info/files/better-regulation-toolbox_2.pdf

[9] This is a summarized version of the problems, which has been designed for readability and clarity. Appendix A contains the complete description of the problems with figures, charts and references: macro trends, examples, consequences, detailed problem drivers and problem trees.

2.1 What are the problems?

2.1.1 High and growing levels of packaging waste

The Circular Economy Action Plan (CEAP) notes that:[10]

> *The amount of materials used for packaging is growing continuously and in 2017 packaging waste in Europe reached a record – 173 kg per inhabitant, the highest level ever.*

Accordingly, the CEAP states that the Commission will consider measures with a focus on:

> *reducing (over)packaging and packaging waste, including by setting targets and other waste prevention measures;*
> *driving design for re-use […] of packaging, including considering restrictions on the use of some packaging materials for certain applications, in particular where alternative reusable products or systems are possible or consumer goods can be handled safely without packaging;*

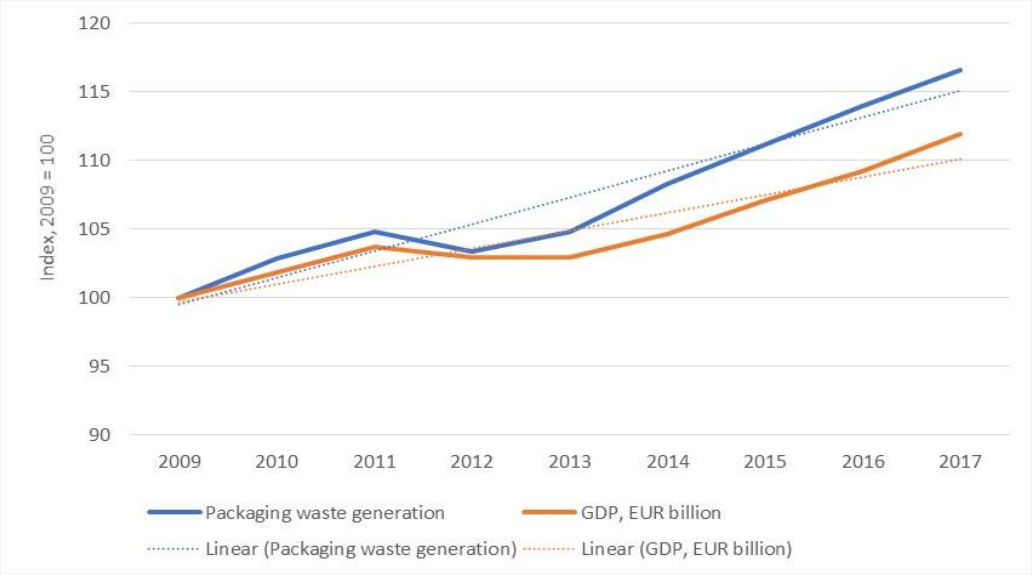
The quantity of packaging generated within the EU has seen a **general upward trend** both in absolute terms and in terms of packaging waste generated per capita since the introduction of the PPWD in 1994.

According to Eurostat, around 69 million tonnes of packaging waste were generated in 2005, and an estimated 77.7 million tonnes in 2018 – representing a **13% growth in tonnage of packaging waste** generated in the EU in this period[11]. Whilst there has been significant economic growth in this period, packaging waste generation is still increasing faster than GDP, as shown in Figure 2-2. This suggests that there are other drivers of packaging waste growth asides from GDP.

[10] European Commission (2020) A new Circular Economy Action Plan for a Cleaner and more Competitive Europe, COM(2020) 98, 11th March 2020, available at https://eur-lex.europa.eu/resource.html?uri=cellar:9903b325-6388-11ea-b735-01aa75ed71a1.0017.02/DOC_1&format=PDF

[11] Eurostat *Eurostat - Data Explorer - Packaging waste by waste management operations and waste flow*, accessed 25 April 2019, http://appsso.eurostat.ec.europa.eu/nui/show.do?lang=en&dataset=env_waspac

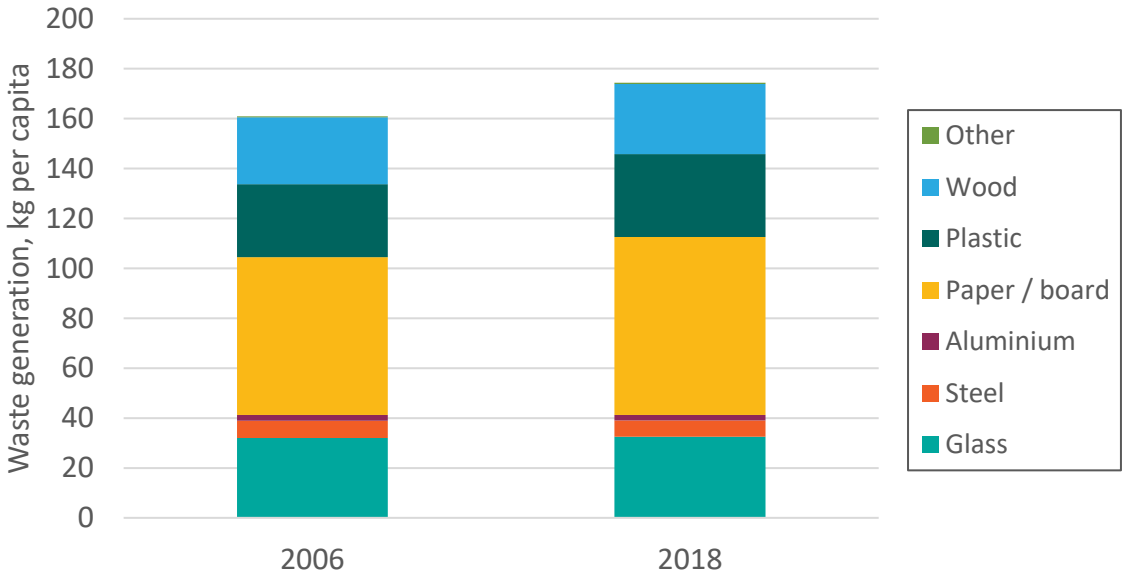
Figure 2-2 Trends in Packaging Waste Generation and GDP adjusted by PPP, EU (27 countries - from 2020)



Source: Eunomia baseline report, Eurostat data

Even when accounting for population growth within the EU, **packaging waste generated per capita** increased from 158 kg per person in 2005 to 174kg per person in 2017, as shown in Figure 2-3, representing a 10% increase over the period.

Figure 2-3 Trend in Packaging Waste Generation per capita (EU-27 countries)

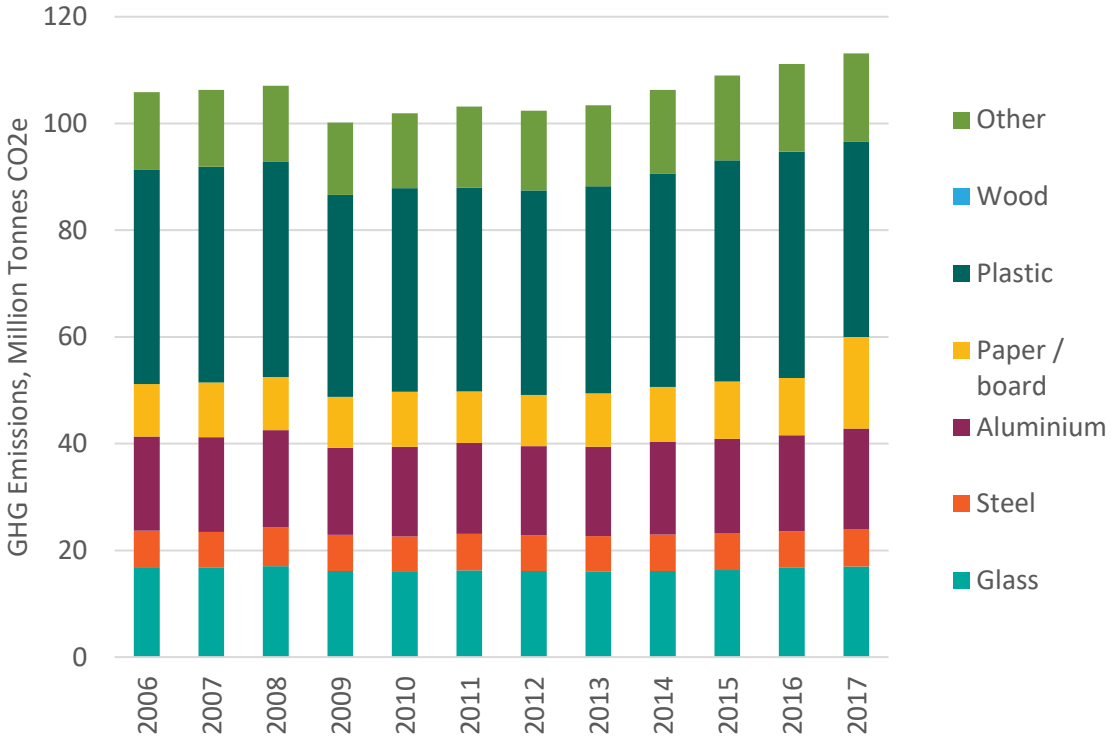


Source: Eunomia baseline report (see section 5 for details), Eurostat data

The manufacture of packaging, accounting for both resource extraction and subsequent production processes has a significant impact in terms of carbon emissions, as displayed in

Figure 2-4 below.

Figure 2-4 GHG emissions from manufacturing for the packaging materials



Source: Eunomia baseline report

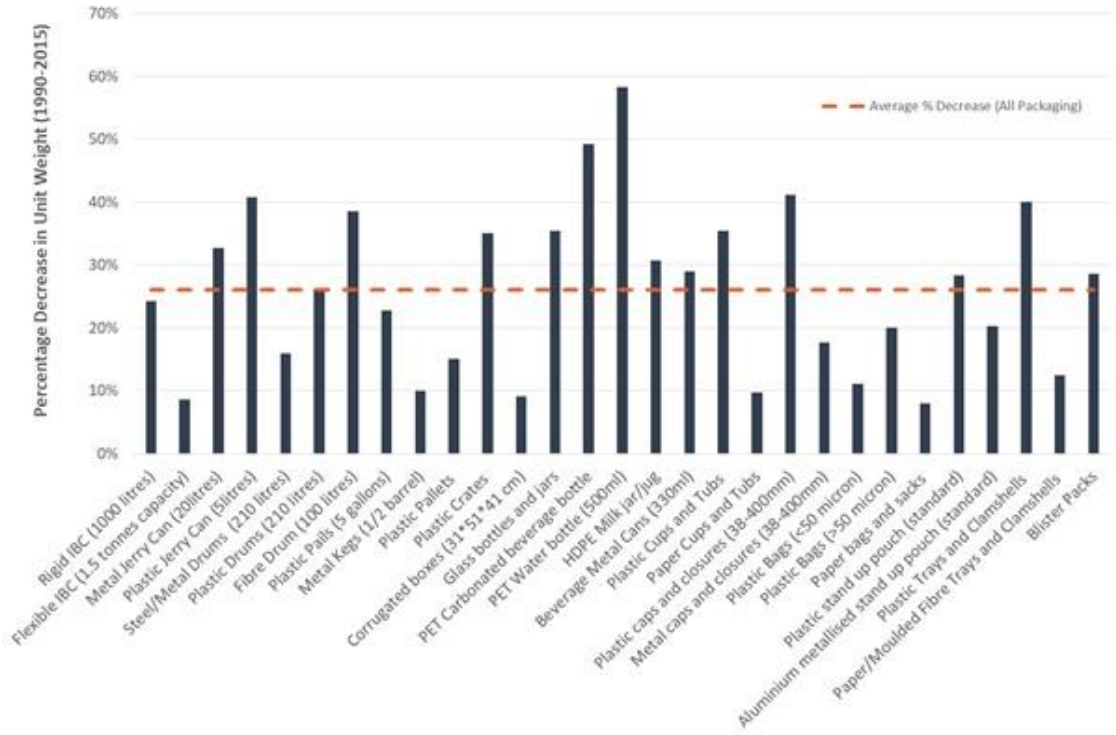
Two key elements of this problem are:

- high levels of avoidable packaging (see Section 2.1.1.1); and
- an increase in the proportion of packaging that is single-use (see Section 2.1.1.2)

2.1.1.1 High levels of avoidable packaging

Light-weighting efforts within material categories have led to a relative increase in packaging material efficiency (i.e. the amount of packaging by weight used for a certain application) (see Figure 2-5) on a per unit basis, and this has helped, to an extent, to stem the increase in overall packaging use.

Figure 2-5 Percentage decrease in unit weight by product and material categories from 1990 to 2015



Source: Eunomia baseline report

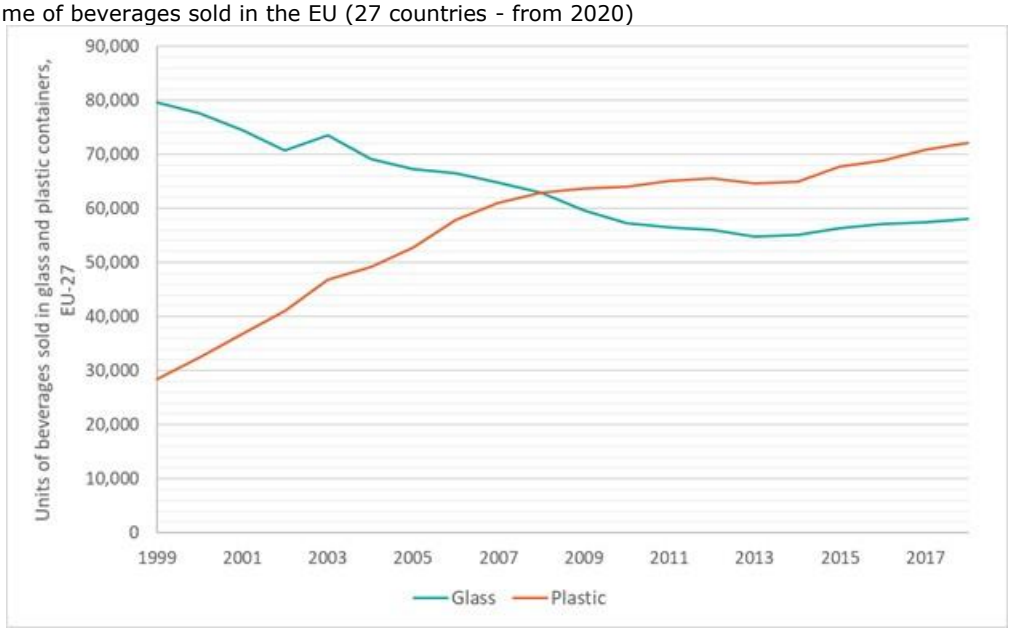
However, the examples shown in Figure 2-5 represent averages, and there can be significant variations from the mean in terms of the weight of packaging of a specific material for a certain product type. A good example, but by no means the only case of this is glass wine bottles. The range of bottle weights available from one of the leading global glass packaging manufacturers Owens-Illinois (OI) is shown in Figure 2-6. While this does not show levels of consumption for each weight class, indications from stakeholders suggests that there more packaging is being used than is strictly necessary for the purposes of product protection.

Figure 2-6 Variation in Packaging Weights of Still Wine Bottles

Source: OI Glass Catalogue

Light-weighting of packaging has been accompanied by a **shift in material use**, particularly from glass to plastic (see Figure 2-7), particularly for beverages, but these factors together have not led to an overall reduction in the weight of packaging used.

Figure 2-7 Volume of beverages sold in the EU (27 countries - from 2020)



Source: Global Data

Accordingly, there are still many examples of **packaging that remains heavier and larger than might be considered strictly necessary** for the purpose of protecting the product it contains, as often evidenced by comparison with the same products from other brands where less packaging is used, and from the extra outer packaging and void space evident in most e-commerce packaging. There remains **significant potential for further reductions**, but in the absence of further interventions this potential seems unlikely to be realised.

2.1.1.2 Increase in the proportion of packaging that is single-use

Data on packaging reuse across Europe is limited. However, overall country specific trends indicate a **reduction in reusable** primary and tertiary packaging (no data are available for secondary packaging) over the past two decades. The reuse of consumer (primary) packaging is increasingly uncommon, and is limited primarily to beverage packaging at a national scale. Even within beverage packaging, a steep decline in reusables has been recorded, with some exceptions in the hospitality sector. Table 2-1 shows the Member States which have experienced the greatest market share decreases for refillable beverages over the last two decades, the highest being Denmark with a 76% reduction in market share of refillables.

Table 2-1 Change in Refillables' Market Share for Beverages, 1999-2018

Country	Market Share refillables 1999	Market Share refillables 2018	% difference
Denmark	91%	15%	**-76%**
Finland	79%	5%	**-74%**
Norway	77%	8%	**-69%**
Romania	70%	15%	**-55%**
Bulgaria	74%	22%	**-52%**
Hungary	63%	15%	**-48%**

Source: Reloop, GlobalData (2019)

The tertiary sector remains the strongest in terms of reuse practices. The use of reusable transport packaging has remained relatively stable, although there are some material and sector-specific challenges, which contribute to a mixed picture. Some reusable packaging such as crates, kegs, drums and pallets show an increase in use while others show a decline.[12] There is an ongoing shift from corrugated single-use packaging towards reusable plastic RTPs (Returnable Transport Packaging), such as pallets and crates for fresh products including eggs, fruit and vegetables, meat and fish.[13] The consumption of reusable wooden pallets has also risen in the past decade, but the reuse/reconditioning of steel drums has fallen. This is partly due to switches to plastic drums and Intermediate Bulk Containers (IBCs).

As products, materials and consumption patterns have evolved, there has been a **significant rise in the use of one-way packaging, especially single-use plastic**. The evolving retail landscape, with larger distribution networks, produced and packed on high-speed packaging lines, have combined to exert a downward pressure on reuse.

This is a trend which looks set to continue despite the introduction of the SUP Directive, which requires Member States to implement certain consumption reduction measures for some forms of plastic packaging, along with product bans; however, this may well lead to a straight switch

[12] Deutsche Umwelthilfe (DUH) (2019) *Aufkommen und Verwertung von Verpackungsabfällen in Deutschland im Jahr 2017*, accessed 5 May 2020, https://www.umweltbundesamt.de/publikationen/aufkommen-verwertung-von-verpackungsabfaellen-in-12

[13] ibid.

to non-plastic[14] single use items for convenience rather than a wholesale shift to reusable solutions.

There have been recent signals, albeit on a small scale, that this decline in reusable primary packaging may be slowing in some areas and for some consumer packaging types. There is significant opportunity in this sector to build upon a rise in consumer awareness, and the growing popularity in some EU cities of packaging free/zero waste shops. Also, as previously mentioned, reuse in the tertiary sector is a well-established practice and could be expanded.

In addition, at the national level, some Member States are taking action to encourage reuse, through for example: binding and non-binding reuse targets, use of Green Public Procurement and/or use of EPR funds to promote reuse. While potentially welcome, such initiatives at the Member State level may lead to challenges to the integrity of the internal market.

2.1.2 Barriers to packaging circularity

The European Green Deal states that:[15]

> *The Commission will develop requirements to ensure that all packaging in the EU market is reusable or recyclable in an economically viable manner by 2030*

The nCEAP reiterates the commitment made in the Green Deal, and notes that to ensure this is achieved, the Commission will review Directive 94/62/EC to reinforce the mandatory Essential Requirements for packaging and consider other measures, with a focus on:[16]

> *driving design for re-use and recyclability of packaging;*
> *considering reducing the complexity of packaging materials, including the number of materials and polymers used.*

The nCEAP further notes that the Commission will address emerging sustainability challenges by developing a policy framework on:

> *use of biodegradable or compostable plastics, based on an assessment of the applications where such use can be beneficial to the environment, and of the criteria for such applications. It will aim to ensure that labelling a product as 'biodegradable' or 'compostable' does not mislead consumers to dispose of it in a way that causes plastic littering or pollution due to unsuitable environmental conditions or insufficient time for degradation.*

At present, however, there are a number of related challenges in respect of the recyclability of packaging. Environmentally, this has negative consequences, since the landfilling/ incineration of recyclable materials not only results in increased GHG emissions, but also supports continued reliance on virgin materials rather than recycled ones. Figure 2-8 displays the same chart as in

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[14] Alternative materials for disposable packaging, such as bamboo, composite materials, aluminium, paper, coated paper and glass.

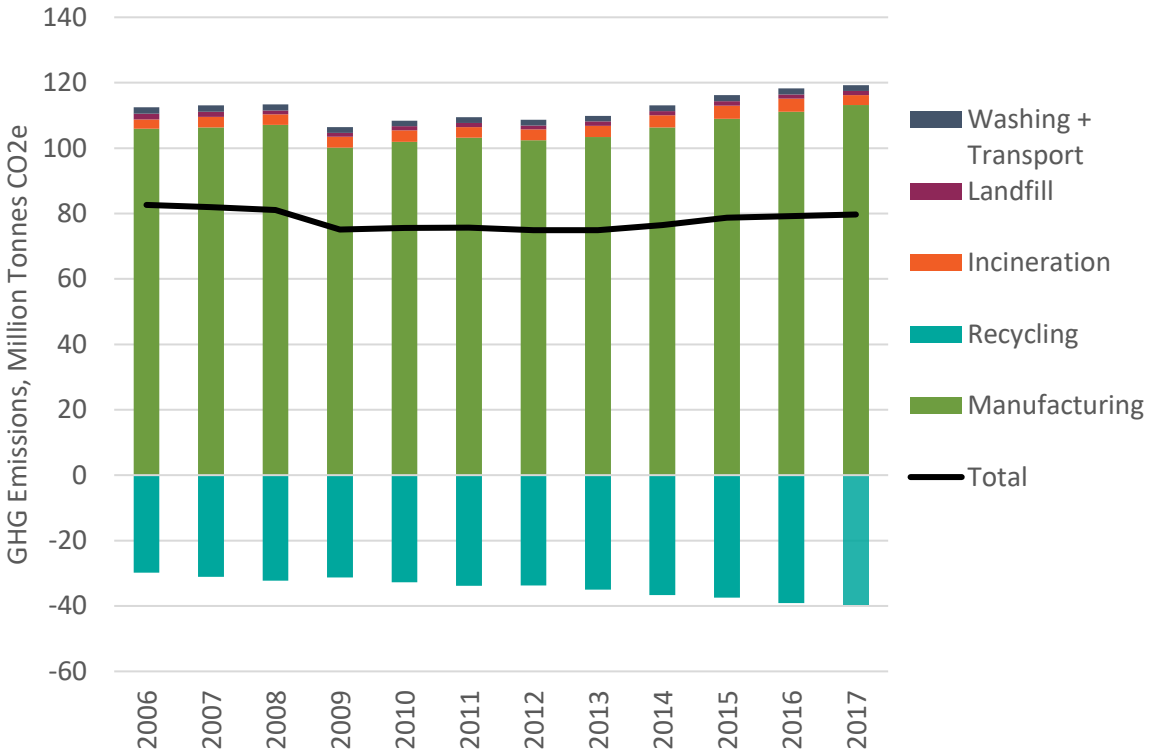
[15] European Commission (2019) The European Green Deal, COM(2019) 640, 11th December 2019, available at https://eur-lex.europa.eu/resource.html?uri=cellar:b828d165-1c22-11ea-8c1f-01aa75ed71a1.0002.02/DOC_1&format=PDF

[16] European Commission (2020) A new Circular Economy Action Plan for a Cleaner and more Competitive Europe, COM(2020) 98, 11th March 2020, available at https://eur-lex.europa.eu/resource.html?uri=cellar:9903b325-6388-11ea-b735-01aa75ed71a1.0017.02/DOC_1&format=PDF

Figure 2-4, but including the GHG emissions of the different end of life options for packaging, namely landfill, incineration and recycling. The chart shows how recycling contributes to lowering the net GHG emissions associated with packaging. However, as discussed in the following sections, there are challenges in respect of the recyclability of packaging, notably:

- Increased use of packaging design features that inhibit recycling
- Increased use of compostable plastic packaging that can cause contamination
- A lack of information about substances in packaging that may be hazardous
- Inconsistent and confusing labelling of recyclable packaging

Figure 2-8 GHG emissions for the packaging manufacturing and end of life management routes



Source: Eunomia baseline report

2.1.2.1 Increased use of packaging design features that inhibit recycling

Data from both Eurostat and market data reports[17] shows increased use of packaging design characteristics that may inhibit recycling.

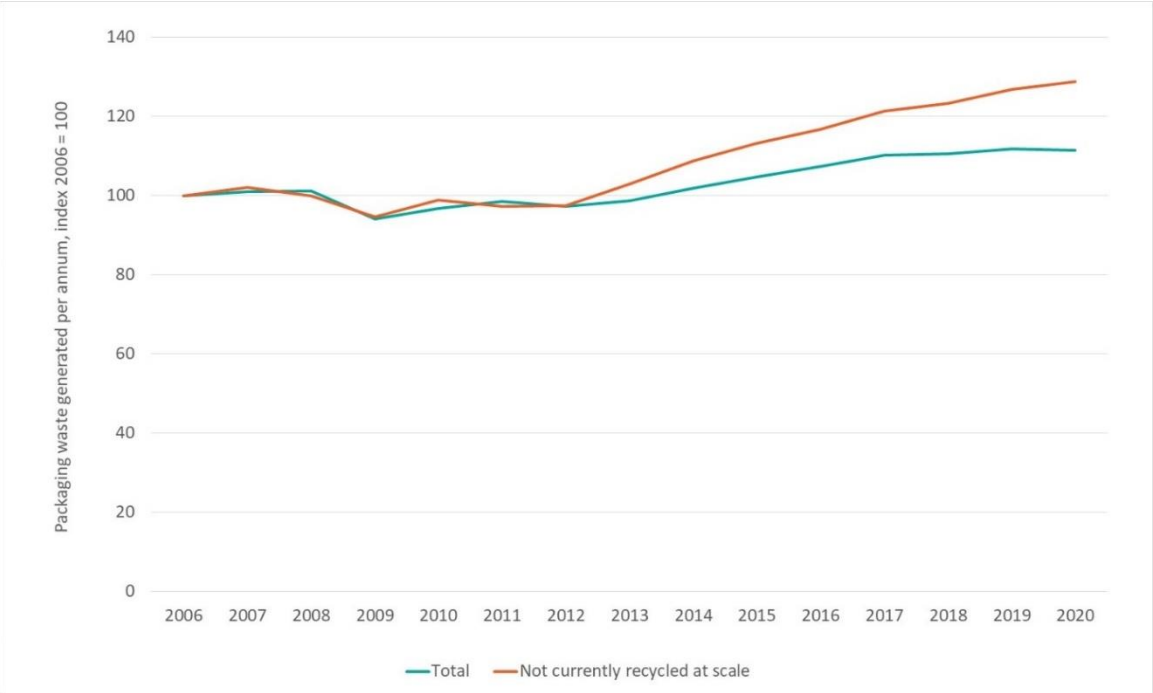
A comprehensive list of materials deemed 'unrecyclable' can be found in Appendix A – Problem Definition, but in general 'unrecyclable' packaging types are those which:

- Are less likely to be collected by streams being subjected to sorting for recycling;
- Pose challenges to the majority of sorting systems; and/or
- Pose challenges to recycling operations.

[17] Transparency Market Research (2018) *Packaging Market - Europe Industry Analysis, Size, Share, Growth, Trends and Forecast, 2018 – 2026*, December 2018

For around the last decade, the amount of packaging that inhibits recycling has been increasing at a greater rate than total packaging waste generated, showing that the problem has been increasing, as show in Figure 2-9.

Figure 2-9 Change in total and packaging that inhibits recycling, index 2006 = 100



Source: Eunomia baseline model

Many of these packaging types are *technically* recyclable, though the processes associated with their collection and sorting (including washing and decontamination) can be costly and inefficient, associated with relatively low quality/ quantity of useful output and, historically, a lack of sufficient demand in end markets.

In some cases, the switch to high barrier (designed to extend the shelf life of products), lightweight, and low-cost packaging design can also result in an increase in the generation, distribution and persistence of litter in the natural environment. These packaging types pose greater requirements on reprocessors, who must either increase their sorting and recycling capabilities, or, as is more likely in the short term, reject these types.

It is noted also that while packaging recycling rates have steadily improved since the 1990s, this trend has historically been attributed to the targets established by the Waste Framework and Packaging Waste Directives. Moving forward, increasing targets, accompanied by a new recycling calculation methodology, is likely to make it more challenging, and thus more costly, for Member States to meet these requirements in the absence of further regulatory and economic incentives for producers to make packaging more recyclable.

2.1.2.2 Cross-contamination of conventional and compostable recycling streams

The demand for bio-based and compostable plastics has grown substantially over the past 15 years, a trend which is expected to continue going forwards as they are used in new applications, in many of which fossil-based plastics are already ubiquitous. In Europe, such packaging has grown from 48,700 tonnes placed on the market in 2003, to 283,000 tonnes in

2018.[18] This represents an almost five-fold increase over the fifteen year period, although their total share of the plastic packaging market remains small at 1%.

This application of compostable plastic materials alongside more conventional plastics in consumer packaging has led to confusion about the correct end of life management of such packaging, exacerbated by the fact that in most cases, the compostable plastic alternatives are, in appearance, very similar to their conventional counterparts.[19] Consequently, waste operators have reported an increase in instances of non-compostable plastic packaging being disposed of in food waste, and, conversely, of compostable plastic packaging being separated for recycling alongside other plastic packaging. In both cases, the result has been an increase in the contamination levels in both these streams, resulting in a lower quantity and quality of material recycled.[20] These also include the risks of more plastics in compost and ultimately in soils.

While the range of packaging placed on the EU market is largely consistent across all Member States, the systems for packaging waste collection and treatment at the end of life differ widely. This is true of systems for the end-of-life management of compostable/ bio-based packaging as well, and includes not only the scope of targeted materials and the systems for their collection (kerbside, door-to-door, bring, etc.), but also the infrastructure and technology used for composting, including both home composting and industrial composting. These differences can result in the situation in which a particular item of compostable packaging may be correctly separated and subsequently composted in an industrial facility in one Member State, but identified as contamination and disposed of as a part of residual waste from composting in another. In many cases, these variations in collection systems exist even within Member States, with different systems adopted in different municipalities or regions.

Inconsistent labelling practices across the EU, and in many cases, within Member States, causes consumer confusion regarding the correct disposal options for compostable packaging at the end of life, making their correct sorting challenging, and increasing cross-contamination between packaging streams. This inconsistency in part reflects the lack of harmonised/ consistent collection practices between municipalities and across Member States, and further exacerbates the problem.

Continued use of compostable plastics will, in the absence of dedicated collection and treatment infrastructure, continue to negatively affect the efficiencies of operating recycling services and ultimately negatively impact recycling rates.

In addition, consumers might confuse compostable packaging (which needs to be collected in order to biodegrade) with biodegradable plastics in the open environment, with a risk for

[18] Transparency Market Research (2018) *Packaging Market - Europe Industry Analysis, Size, Share, Growth, Trends and Forecast, 2018 – 2026*, December 2018

[19] Eunomia & Mepex (2018) Bio-Based and Biodegradable Plastics. An Assessment of the Value Chain for Bio-Based and Biodegradable Plastics in Norway. Report for the Norwegian Environment Agency. 30th November 2018. https://www.miljodirektoratet.no/Documents/publikasjoner/M1206/M1206.pdf

[20] European Commission (2018), *Behavioural Study on Consumers' Engagement in the Circular Economy*, October 2018, https://ec.europa.eu/info/sites/info/files/ec_circular_economy_final_report_0.pdf

increased littering, as consumer expect these compostables to biodegrade in the open environment[21].

At present, food packaging, disposable tableware and bags are the largest end use segment for such materials at present, and the major growth driver for biodegradable and compostable polymer consumption.[22] Some countries encourage the use of compostable single-use carrier bags and smaller bags used in shops for fruit and vegetables in bio-waste collections. The aim here is to reduce the amount of contamination in these collections that would otherwise arise from the inappropriate use of conventional plastic carrier bags. In this way, compostable plastics may also play a potential role in reducing contamination levels in bio-waste collection and treatment systems.

Appendix A contains a case study about Italy, which collects significantly more food waste than any other European country. Through a series of policy measures, quantities of conventional plastic contamination have been reducing annually in recent years, whilst the amount of compostable plastic has significantly increased – quantities of the latter entering composting plant tripled from between 2016 and 2019. The most recent data indicates that Italy is on track to meet its target of 50% of compostable plastic bags being treated via the biowaste collection system. Contamination levels of compostable plastic in conventional plastic remain relatively low, at an estimated 6,000 tonnes per annum in 2019.

2.1.2.3 Lack of mechanism in Essential Requirements for addressing changes in use of chemicals in packaging

In the Chemicals Strategy for Sustainability[23] the Commission recently committed to

> *"minimise the presence of substances of concern in products by introducing requirements, also as part of the Sustainable Product Policy Initiative, giving priority to those product categories that affect vulnerable populations as well as those with the highest potential for circularity, such as textiles, packaging including food packaging, furniture, electronics and ICT, construction and buildings."*[24]

Additionally, it committed to:

> "*ensure availability of **information on chemical content and safe use**, by introducing information requirements in the context of the Sustainable Product Policy Initiative and*

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[21] European Commission (202), *Relevance of biodegradable and compostable consumer plastic products and packaging in a circular economy*, https://op.europa.eu/en/publication-detail/-/publication/3fde3279-77af-11ea-a07e-01aa75ed71a1/language-en/format-PDF

[22] *Demand For Biodegradable Plastics Expected To Surge | CleanTechnica*, accessed 26 February 2019, https://cleantechnica.com/2018/07/31/demand-for-biodegradable-plastics-expected-to-surge/

[23] European Commission, Chemicals Strategy for Sustainability Towards a Toxic-Free Environment, COM(2020) https://ec.europa.eu/environment/pdf/chemicals/2020/10/Strategy.pdf

[24] ibid.p.6. According to footnote 16, 'substances of concern' include "primarily those related to circular economy, substances having a chronic effect for human health or the environment (Candidate list in REACH and Annex VI to the CLP Regulation) but also those which hamper recycling for safe and high quality secondary raw materials. "

tracking the presence of substances of concern through the life cycle of materials and products"[25].

The PPWD restricts the use of four heavy metals in packaging, but it does not provide for any further specific restrictions on the use of chemicals. Pursuant to Article 11 of the PPWD, the sum of concentration levels of lead, cadmium, mercury and hexavalent chromium present in packaging or packaging components must not exceed certain thresholds.

In addition, Annex II laying down Essential Requirements on the composition of packaging requires the following:

> *"Packaging shall be so manufactured that the presence of noxious and other hazardous substances and materials as constituents of the packaging material or of any of the packaging components is minimized with regard to their presence in emissions, ash or leachate when packaging or residues from management operations or packaging waste are incinerated or landfilled."* (Annex II, Section 1, 3rd indent)

This raises two issues:

- First, the term 'noxious and other hazardous substances and materials' is not defined and therefore open for interpretation.
- Second, the minimisation is not required per se but only "with regard to their presence in emissions, ash or leachate when packaging or residues from management operations or packaging waste are incinerated or landfilled".

The first point causes a lack of legal certainty. The term 'noxious' is neither used in the REACH Regulation nor in the CLP Regulation which can be considered as the two central building blocks of EU chemicals legislation. Rather than referring to 'materials' REACH and CLP refer to 'substances' and 'mixtures'. The REACH Regulation refers to the classification as hazardous under the CLP Regulation. If a substances or mixture fulfils certain criteria laid out in the CLP Regulation, it is considered as hazardous. As a rule, manufacturers, importers or downstream users have to self-classify (and label) such hazardous substances.

On the second point, by only requiring manufacturers to minimise hazardous substances with regard to their presence in emissions, ash etc. when incinerated or landfilled the Directive does not address the handling by humans during the lifetime of the packaging or at the recycling stage and the resulting potential exposure of humans to hazardous substances contained in the packaging, where applicable.

It is worth noting that packaging that comes into contact with food (food contact material, FCM) is subject to regulation (EC) No 1935/2004[26] which requires *"not to transfer their constituents to food in quantities which could: (a) endanger human health; or (b) bring about un unacceptable change in the composition of food; or (c) bring about a deterioration in the organoleptic characteristics thereof"*.

The Directive, drafted long before the Circular Economy Action Plan and the Plastics Strategy were adopted falls short of requiring packaging to be kept free from hazardous substances to ensure hazardous substances are not kept in the loop through recycling.

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[25] Ibid. p.6.

[26] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02004R1935-20210327

The lack of legal certainty in relation to the wording of Annex II, Section 1, 3rd indent PPWD is problematic. Addressees of EU legislation must be able to understand what is required from them to be compliant.

Furthermore, the question whether the content of hazardous substances in packaging (waste) is problematic and what the scale of the problem is, based on the currently available data, not easy to assess. There is little information on the use of hazardous substances in packaging and packaging components.

Recent research has identified a significant lack of information on the use of chemicals in plastics manufacturing (i.e., which substances are used in which application and in what quantities, and at which level they are present in final products).[27] The researchers identified the lack of publicly accessible comprehensive registries for chemicals used in plastic packaging as a major challenge hampering the identification of chemicals associated with plastic packaging. While a problem in terms of 'recyclability' the uncertainty in relation to the presence of hazardous substances also poses concerns in respect of the uptake of recycled content.

2.1.2.4 Inconsistent/ confusing labelling of recyclable packaging

A number of studies[28] point to consumer confusion around labelling as a primary factor for used packaging not being discarded in a way that maximises its chances of being recycled. This issue is particularly pronounced for plastic packaging, given the wide range of polymers and components in such packaging. Consumers are confronted with a large amount of information on their packaging, some of which is targeted at non-consumers (e.g., packaging materials, production/ stock barcodes/ serial numbers), some of which relates to their consumption of the product in question (particularly around nutritional/ health and safety information), and some of which conveys information regarding recyclability, end of life disposal routes, EPR membership, and other environmental claims. This information can be confusing, and contradictory, especially in the absence of further guidance around the meaning of specific symbols and scope for verification of claims. Sources of confusion include both the number of labels, some of which look similar but do not mean the same thing, and symbols providing potentially misleading information. Some of the most commonly confused symbols are:

[27] Groh KJ, Backhaus T, Carney-Almroth B, Geueke B, Inostroza PA, Lennquist A, Maffini M, Leslie HA, Slunge D, Trasande L, Warhurst M, Muncke J. 2018. *Chemicals associated with plastic packaging: Inventory and hazards.* PeerJ Preprints

[28] More details in Appendix A – Problem Definition, as an example: RECOUP (2017) *Plastics Recycling Consumer Insight Research, An International Comparison*, November 2017, http://www.recoup.org/p/275/publications

Figure 2-10 Common symbols on plastic food and drink packaging

Symbol	Meaning
	The On-Pack Recycling Labels (OPRL) tell you whether you can recycle packaging in the UK. They are based on local councils' recycling collections and services.
	The Mobius Loop is an international symbol that simply tells you that somewhere in the world it is possible to recycle the packaging material. If there's a number in the centre this gives the recycled content of the packaging.
	The Green Dot is not a recycling symbol. It's used in some European countries to show that the producer has paid a tax towards recovering and recycling packaging.
	The 'Seedling' is a European-wide label which tells consumers that the material is a bio-plastic which can be composted by industrial processors.

Source: OPRL

The non-harmonised and misleading labelling practices across the EU, and in many cases, within Member States, causes consumer confusion regarding the correct disposal options for packaging waste at the end of life, making their correct sorting challenging and increasing cross-contamination between packaging streams. Unclear and non-harmonised labelling can result in reduced capture of recyclable materials as well as increased contamination of, and increased costs. In some cases, this has resulted in entire loads of recyclables being discarded, which further undermines consumer confidence in source segregation efforts and those perceived to be responsible for recycling.[29, 30]

The problem results in waste operators ultimately bearing the costs associated with additional sorting, washing and disposal requirements, as well as lower prices and fewer end markets for the resulting low quality of recyclates. Although the revised EPR rules in the WFD will reduce this cost burden on public authorities, environmentally, this still has negative consequences.

[29] Viridor (2018), *UK Recycling Index 2018*, https://www.viridor.co.uk/siteassets/document-repository/recycling-index/viridor-uk-recycling-index-2018.pdf

[30] European Commission (2018), *Behavioural Study on Consumers' Engagement in the Circular Economy*, October 2018, https://ec.europa.eu/info/sites/info/files/ec_circular_economy_final_report_0.pdf

2.1.3 Low levels of uptake of recycled content in packaging

The CEAP states that:[31]

> *To increase uptake of recycled plastics and contribute to the more sustainable use of plastics, the Commission will propose mandatory requirements for recycled content and waste reduction measures for key products such as packaging, construction materials and vehicles, also taking into account the activities of the Circular Plastics Alliance.*

The CEAP also notes that the Commission will, for the first time, develop rules on measuring recycled content in products.

The environmental impacts associated with the extraction of virgin materials is much greater than those associated with using secondary materials. Therefore, ensuring that production processes make greater use of recycled materials (with a lower embodied energy content than virgin material) will support efforts to reduce emissions of GHGs. Switching to recycled steel, for example, has been shown to reduce the impact on climate change by around 80%, whilst CO_2 reductions for aluminium and PET from using recycled rather than virgin content are around 95% and 85%, respectively[32].

Rates of uptake of recycled content in packaging vary significantly across different materials. Broader categories of paper and cardboard, aluminium, steel, and glass generally show higher levels of uptake than for plastics. Within these categories, however, rates of uptake vary further still depending on the packaging application; in the paper and cardboard category, for example, the average level of recycled content in corrugated cardboard is 89%, whilst for beverage cartons it is 0%. Table 2-2 provides a comparison of recycling rates and recycled content by packaging materials. However, it is important to note that there is **no standardised approach to measuring recycled content in packaging**, nor any agreed definition as to what can be counted. The uptake of recycled content in packaging is therefore framed by a considerable lack of data.

Table 2-2 Comparison of Recycling Rate and Recycled Content by Packaging Material (Europe)

Packaging Material	Application	Recycling Rate - 2017	Average Recycled Content
Metals	**All metal packaging**	79.2% (Eurostat)	-
	Steel packaging	80.5% (APEAL)	58% (APEAL)
	Aluminium packaging	Aluminium cans: 74.5% (European Aluminium)	*No data*

[31] European Commission (2020) A new Circular Economy Action Plan for a Cleaner and more Competitive Europe, COM(2020) 98, 11th March 2020, available at https://eur-lex.europa.eu/resource.html?uri=cellar:9903b325-6388-11ea-b735-01aa75ed71a1.0017.02/DOC_1&format=PDF

[32] European Commission (2020) *Effectiveness of the essential requirements for packaging and packaging waste and proposals for reinforcement : final report and appendices.*, accessed 16 September 2020, http://op.europa.eu/en/publication-detail/-/publication/05a3dace-8378-11ea-bf12-01aa75ed71a1

Packaging Material	Application	Recycling Rate - 2017	Average Recycled Content
Paper/ Cardboard	**All paper and cardboard packaging**	84.6% (Eurostat)	-
	Corrugated Cardboard	-	89% (FEFCO)
	Carton board		50% (CEPI)
Glass	**All glass packaging**	74.7% (Eurostat)	55.5% (average of all colours, FEVE)
Plastic	**All plastic packaging**	41.9% (Eurostat)	-
	PET	56.3% (Petcore)	*No data*
	PET beverage bottle	58.2% (EPBP)	11.7% (EuPC)

At the moment materials are not being recycled to a quality that allows them to be recycled back into packaging, exacerbated by a lack of quality standards (particularly for recycled plastics). For example, PET bottles make up the majority of the input into Europe's PET reprocessing facilities, but less than a fifth of PET is used to manufacture new bottles; most PET is used in other applications such as trays and sheets, fibre and strapping[33].

Accordingly, for producers there is a **quality risk** associated with the use of recycled content. Where virgin materials are readily available, not significantly more expensive than secondary materials, relatively cost-effective, and of guaranteed quality, incorporating recycled content into packaging materials can be considered somewhat risky. For some packaging materials, such as plastics and some paper applications, the perception that quality of packaging material produced from recycled content is poor is considered a key factor in the lack of demand in the sector.

In addition to this quality risk, the relative environmental impacts associated with the production of virgin materials and secondary materials are not reflected in the market prices of those materials, thus **external costs are not incorporated into the price paid by producers**.

The potential for use of recycled content in different applications, and the associated perception of risk described above, is, in some cases, compounded by the lack of clear and accurate information regarding quality. Would-be users of recycled content may be risk-averse and might not be in possession of all the facts regarding the quality of, and hence the potential to make use of, recycled content. As a result, due to this **information failure** they may also be unaware of the extent to which they could integrate recycled content into their production processes, or need to invest in costly sampling/ testing/ pre-processing strategies to mitigate against this risk.

[33] EFBW, Petcore Europe and Plastics Recyclers Europe (2020) *PET Market in Europe - State of Play: Production, Collection and Recycling Data*, 2020

In some material markets, the suppliers of virgin materials are well known. Indeed, there may be global exchanges which allow for widespread trading of primary materials. Although there are some exchanges in which recycled content is traded, they are less well-known, and the companies involved may also be relatively poorly known. This means that there are **high transaction and search costs** for producers seeking to incorporate recycled content.

2.2 What are the problem drivers?

At the root of the issues described above are two key problem drivers, market failures and regulatory failures.

The first problem driver is **market failure**, i.e. where markets fail to deliver an efficient outcome from a societal perspective. In respect of packaging, market failure takes a number of forms:

- **Externalities** – where market prices do not internalise the full costs to society associated with an activity – for example the relative environmental impacts of virgin and recycled content are not internalised in the costs faced by producers of packaging, meaning that overall levels of consumption of packaging are higher than they otherwise would be, with lower levels of use of recycled content than would be optimal from a societal perspective;
- **Split markets** – whereby a misalignment of incentives exists, meaning that socially desirable actions are not undertaken because market actors have different objectives that are not aligned. To date this has been an issue in that producers have not been faced with the full costs of end-of-life management of their packaging. Under Article 8a of the revised Waste Framework Directive the general minimum requirements for extended producer responsibility schemes should go some way towards addressing this, albeit the way in which Member States seek to implement these requirements will not necessarily provide consistent incentives to producers;
- **Imperfect information** – information is needed for markets to operate efficiently, and where market information is imperfect, or not equally available to all market participants, sub-optimal decisions can lead to sub-optimal societal outcomes. One area where this applies is the lack of clear and accurate information for producers on the quality of recycled content available to them. More broadly, regulators do not yet have adequate information about the nature of packaging placed on the market that would enable them to make better informed regulatory decisions in respect of what might be considered to be 'excessive' packaging, or where further restrictions on hazardous substances might be required.

The second problem driver is **regulatory failure**, i.e. where intervention by public authorities fails to achieve an efficient allocation of resources. This can be due to poor design, poor implementation and /or enforcement, and/or simply becoming out of date. In the case of the Essential Requirements it is clear that they:

- Fail to reflect the waste hierarchy, as there is not sufficient recognition that reuse takes precedence over recovery, or that recycling is preferable to energy recovery; and

- Are unenforceable in practice, as their formulation is too imprecise for Member States to enforce them – a situation compounded by the lack of requirements on producers to report on conformity.

As a consequence, there is very little enforcement activity in the Member States and surveys suggest that the Essential Requirements have had little influence on packaging design. The Essential Requirements Scoping Study noted that:[34]

> *"There is little guidance for producers, fillers and regulators as to what constitutes the 'minimum adequate amount' and the evaluation of the Essential Requirements concluded that the inherent subjectivity inhibits compliance and enforcement".*

The 2014 Fitness Check[35] also noted the difficulty in enforcement:

> *"[The Essential Requirements] are formulated in a very general manner and judged as difficult to implement. Implementation measures are scarce and guidance given to industry is mostly lacking."*

2.3 Summary of consequences

The problems described in Section 2.1 lead to three main groups of consequences, as set out in the problem tree. These inter-connected consequences **impede the move towards a circular economy**, generating **negative social and environmental impacts**, and **threaten the integrity of the EU internal market**.

Circular Economy. The heightened demand for packaging, combined with low recyclability and low levels of recycled content would mean increased use of a range of non-renewable resources. This would require the continued extraction and use of high levels of virgin resources, with the extraction processes being associated with a number of significant negative environmental impacts including localised impacts on biodiversity, air and water quality, and in respect of greenhouse gas emissions.

Social and environmental impacts. Increased generation of packaging waste within the EU, particularly where it is not readily recyclable, poses challenges to Member States in terms of waste management, and will lead to higher levels of landfilling and (increasingly) incineration than would otherwise be the case. This threatens union objectives in respect of achieving climate neutrality by 2050, and along with objectives to reduce pollution to air and water as well as commitment to tackle the pressures that contribute to the decline of biodiversity. Hazardous substances within packaging may compound the air pollution issue during end of life management, but may also have negative impacts during the use phase, albeit the understanding of this is as yet incomplete.

The increased incidence of litter from packaging, often from on-the-go consumption, is expensive to clean up, and has been shown to have severe consequences in terms of the way

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[34] Eunomia, "Effectiveness of the Essential Requirements for Packaging and Packaging Waste and proposals for reinforcement", February 2020, p.82.

[35] SWD(2014) 209 final, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014SC0209&from=EN

citizens feel about their local environment. In addition, plastic packaging can have specific impacts on ecosystems, including on marine life.[36]

Packaging waste is a notable soil and land pollutant[37]. Soils are a globally important reservoir for biodiversity, hosting at least one quarter of all living organisms on the planet.[38] Soil provides a variety of functions and services supporting life on the planet. However, the ability of soils to provide these services is highly dependent on their biodiversity. Soils biota has its own unique capacity to recover form change and is considered a key attribute of biodiversity. Soils with a higher biodiversity are thought to have an innate resistance and resilience to change. A loss in this biodiversity can lead to soil with resistance and a reduced capacity to recover.

Packaging sent to landfills, especially when made from plastics, does not degrade quickly or, in some cases, at all, and chemicals from the packaging materials, including inks and dyes from labelling, **can leach into groundwater and soil**[39]. Chemicals can affect soil organisms directly, with toxic effects on their reproductive ability and survival, or indirectly, by contaminating their food supply or habitat. Their effects may be short lived or long term and impact some, or all soil organisms.[40] Pollution is likely to affect and potentially threaten soil biodiversity and functioning of the entire soil community. Some of these changes may turn out to be irreversible or associated with efforts and costs to maintain soil biodiversity and ecosystem functioning[41].

EU internal market. Lack of coordination in the regulatory efforts presents an importance risk of regulatory divergence, which could result in a **sub-optimal functioning of the EU internal market** as individual Member States seek to take action unilaterally. This has been mentioned in previous sections but some notable examples include:

- The vague nature of the Essential Requirements could potentially mean they pose a barrier to the functioning of the internal market, as interpretations could differ between Member States. There is, however, little evidence to suggest this is a problem because there is so little enforcement activity.
- With regards to food-contact material, Belgium and the Netherlands have set a total migration limit for regulated substances commonly found in recycled paper and board fibres, whereas restrictions for the total dry residue in hot and/or cold-water extracts for paper and fibres have been set by others, including Czech Republic,

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[36] ICF and Eunomia Research & Consulting (2018) *Plastics: Reuse, recycling and marine litter – Impact assessment of measures to reduce litter from single use plastics*, Report for DG Environment, 2018, http://ec.europa.eu/environment/waste/pdf/Study_sups.pdf

[37] Ncube LK, Ude AU, Ogunmuyiwa EN, Zulkifli R, Beas IN. *Environmental Impact of Food Packaging Materials: A Review of Contemporary Development from Conventional Plastics to Polylactic Acid Based Materials*. Materials. 2020; 13(21)

[38] Tibbett M, Fraser TD, Duddigan S. 2020. *Identifying potential threats to soil biodiversity*.

[39] US Environmental Protection Agency. "Getting Up to Speed: Ground Water Contamination." EPA, August 2015. Retrieved March 7, 2019

[40] ENV-09-038_soil-biodiversity-brochure-EN.indd (europa.eu)

[41] Stefan Geisen, Diana H. Wall, Wim H. van der Putten, Challenges and Opportunities for Soil Biodiversity in the Anthropocene, Current Biology, Volume 29, Issue 19, 2019

Germany, France and Slovakia. The only legislation requiring producers to declare compliance with migration levels from paper/board fibres is in Italy[42].

- With regards to the consideration of 'waste', Germany is the only country which does not treat industrial packaging as waste when it is sent to reconditioning;

Different labelling requirements, with a most notorious example of the Green Dot (see Figure 2-10) being penalised in France and at the same time being mandated in other countries (e.g. Spain)[43].

This presents **challenges to the free circulations of packaged goods** – what is valid in one Member States may not be valid in another, and it results in additional costs for producers to have to adapt to divergent legislations. Stakeholders from the industry have stressed the downside of the current situations and additional risks in the absence of intervention (see Appendix E – Stakeholder Synopsis Report).

Furthermore, while it doesn't threaten the integrity of the internal market, differences in the criteria used for fee modulation in EPR schemes can reduce the effectiveness and efficiency of efforts to improve the design of packaging.

2.4 How will the problem evolve?

Packaging waste generation in the EU is at its highest level ever. Projected figures (see section 5 Baseline) suggest that this problem will increase further as both population and GDP continue to grow. This will likely translate to greater consumption of goods and therefore additional generation of packaging waste across the EU. Although legislation and initiatives aiming to combat this increase have been introduced at both EU and Member State level, there are areas of the packaging lifecycle that remain insufficiently addressed. **Without revision of the Packaging and Packaging Waste Directive, the scale and complexity of the problem will continue to grow.**

As has been outlined in Section 2.1, the problems addressed within the review of the Packaging and Packaging Waste Directive can be largely split into three:

1. High and growing levels of packaging waste;
2. Low levels of packaging recyclability; and
3. Low levels of uptake of recycled content

Although inherently interlinked, the evolution of these problems should be considered distinct and have therefore been addressed here as such.

High and growing levels of packaging waste includes both overpackaging and instances where alternatives to single use packaging could be implemented but currently are not. It is widely recognised that there are instances of packaging which are heavier and larger than necessary. Evidence suggests that the use of excessive packaging is not simply a function of safety. In some applications (for example, wine bottles), thicker and heavier packaging is

[42] Joint Research Centre. (2016) *Non-Harmonised Food Contact Materials in the EU: Regulatory and Market Situation, Baseline Study: Final Report.*, Report for LU, 2016, https://data.europa.eu/doi/10.2788/234276

[43] https://www.europen-packaging.eu/news/no-rest-for-the-eu-single-market-frances-green-dot-case/

perceived to be indicative of a higher quality product. In others (for example, children's toys), packaging size is driven by the desire to occupy maximum shelf space to increase the likelihood of a sale. While these perceptions remain, in the absence of regulatory intervention, problems associated with intentional overpackaging are unlikely to change. While requirements for increased cost coverage under EPR for packaging (required under Article 8a of the Waste Framework Directive) will mean greater attention is paid by producers to reducing the amount of packaging used, this effect is likely to be strongest where, all else being equal, the cost of the packaging is high relative to the value of the product. By contrast, where the value of the *product* is high relative to the cost of the packaging, and especially where the appearance of the packaging is important to the marketing the product, the incentive provided by EPR alone to reduce packaging will be weaker.

Some recent signals suggest the decline in reusable primary packaging may be slowing in some areas and for some consumer applications, so there is significant opportunity in this sector to build upon a rise in consumer awareness. However, without widespread education and supporting policy, these small shifts are unlikely to have anything but minimal effect.

Overall, the anticipated continued GDP growth in the EU will - to the extent that this is translated in a higher goods consumption - add further to the generation of packaging waste.

Barriers to packaging circularity. Over the past decade, the amount of difficult to recycle packaging has increased at a greater rate than the total packaging waste generated (as shown in section 2.1.2.1). New packaging formats and complex combinations of materials are introduced at such a rate that local recycling infrastructure is unable to adapt to meet demands. This trend is likely to continue unless action is taken. Increased cost coverage under EPR for packaging, as well as modulation of fees (as required under Article 8a of the Waste Framework Directive) may well mean greater attention is paid by producers to the recyclability of packaging used. This will, however, depend upon the extent to which Member States focus on incentivising recyclability through fee modulation, and whether they do so in a way that applies harmonised criteria. However, even in the case where there is full harmonisation of criteria to incentivise recyclability, the effect will likely be strongest where the cost of the packaging is high relative to the value of the product, and weakest where the value of the *product* is high relative to the cost of the packaging, and especially where the appearance of the packaging is important to the marketing the product.

Additionally, as compostable plastics grow in popularity and reach end of life, we can expect an increase in contamination of both organic waste streams and recyclable plastic streams leading, in turn, to a reduction in the quality and quantity of recycled materials. This problem is also fuelled by the rapid growth in this sector and the increasing number of applications to which compostable packaging are being applied, as well as outdated/ insufficient collection/ sorting infrastructure or related funding. This situation may be improved by EPR system requirements and ongoing trials to introduce "smart" sorting infrastructure on the other (e.g. digital watermarking/ trackers/ tracers/ product passports, etc.). The latter, in particular, would support increased accuracy in the identification and subsequent separation of compostables in the plastic packaging stream, or vice versa, allowing for their removal in a more efficient manner to prevent contamination.

In addition, without correct labelling of, and education around, these materials, this increased use will cause more disruption to supply chains, further limiting packaging circularity.

Various regulatory and industry-led initiatives have been launched to address issues relating to labelling more broadly, including the Commission's Green Claims initiative. However, it is noted that while the green claims initiative may prevent "greenwashing" (inaccurate claims regarding a packaging item's environmental credentials), it will not necessarily tackle the proliferation of inconsistent/ unclear labelling and the underlying lack of consistent collections for recycling. In addition, the scope of the revised EPR requirements, including the modulation of fees on the basis of whether packaging is recyclable or not has potential to address this issue but to what extend is currently unclear. Industry action via the Circular Plastics Alliance (CPA), includes the development of a range of polymer and packaging format specific standards to improve collection, sorting, recycling and the uptake of recycled material. These initiatives are likely to have some impact in terms of removing some forms of packaging that inhibits recycling from the market and reducing the cost burden associated with sorting, cleaning and decontamination.

Some improvements in labelling have already been seen. The use of QR codes to allow consumers to access additional information, and the development of smart technologies like digital watermarking may suggest the potential for further improvements in the streamlining of packaging labelling more widely.

However, the objectives of the proposed revisions to the PPWD and Essential Requirements to make all packaging placed on the market recyclable or reusable by 2030 would, in principle, eliminate the confusion regarding packaging recyclability.

Until recently there have been no targets designed to stimulate the **uptake of recycled materials in packaging** and as such, demand for recyclate has been low, particularly for plastics. Though the Council and the European Parliament have introduced legislation specifically related to recycled content in packaging (i.e. the SUP beverage container targets), it is unlikely to stimulate an increase in recycled content uptake across packaging beyond PET bottles (see Appendix A Problem Definition). It is also important to note that all legislation related to recycled content focuses on plastics.

In its Plastics Strategy the European Commission called on industry to submit voluntary pledges to ensure that by 2025 10 million tonnes of recycled plastics are used in new products (compared to <4 million tonnes in 2016). In order to facilitate this, the Commission launched the Circular Plastics Alliance in December 2018. Other voluntary initiatives include the European Plastics Pact, a public-private coalition of companies, organisations and governments focused on solving issues around single use plastics products and packaging. A key objective of the pact is to increase the use of recycled plastics in new products and packaging by 2025, with plastics user companies achieving an average of at least 30% recycled plastics (by weight) in their product and packaging range. As of September 2021, there were 149 signatories from 21 countries in Europe. It remains to be seen whether global brands will adhere to the goals they have set themselves (whether they do or not is likely to be linked to the economics of doing so).

Finally, in the future, new technologies such as chemical recycling may enable plastic packaging that is currently difficult to recycle mechanically (e.g. multi-layer, contaminated) to be recycled, increasing the supply of secondary material (albeit in the form of monomers) for uptake in

packaging, overcoming the quality/ health and safety issues currently associated with mechanically recycled secondary plastics. The development of blockchain technology to enable the tracking and tracing of recycled content in products may provide a solution to the issues associated with verifying recycled content claims (of any material) made by producers. Digital watermarking, chemical marking and other tracking and tracing technologies may allow not only better identification and sorting of packaging materials to improve the quality of secondary materials available, but may also support improved consumer awareness of the environmental claims made by packaging producers. However, the commercial viability and success of these technologies are still uncertain and unreliable.

Given the various challenges faced in respect of the use of recycled content as described in Section 2.1.3, in the absence of targeted intervention it is unlikely that uptake of recycled content within packaging will increase significantly.

2.5 Who is affected and how?

This section describes who affects, or is affected by, the problems outlined above. A selection of the key stakeholders has been outlined below alongside a top-level overview of how they are affected by the described problems.

- **Society and the general public.** Packaging and packaging waste represent a huge potential burden to society if issues associated with their manufacture, use, and disposal are not sufficiently addressed. Potential adverse impacts include, but are not limited to, environmental pollution, depletion of finite resources, unnecessary emissions, economic loss, and damage to public health.
- **EU consumers**. EU consumers lack access to clear, harmonised, and reliable information concerning packaging. This lack of information prevents them from making well-informed decisions regarding the most appropriate packaging options for a particular product they are looking to purchase. It also reduces the likelihood of consumers effectively and consistently engaging in the correct end-of-life strategy for the packaging waste they generate.
- **Brands.** Brands are consistently subjected to scrutiny over the packaging they use. The quality of a product's packaging is often taken to be indicative of the quality of the product within. As a result, many brands are constantly innovating and redesigning their packaging to maintain competitiveness. However, they are doing this against a backdrop of a regulatory landscape that is not fully harmonised across EU Member States, with uncertainties, for example, in the way in which EPR schemes might choose to revise their fee structures and reporting requirements, along with the way in which modulation might be implemented. Brands would therefore benefit from far greater harmonisation of requirements across the EU as a whole.
- **Packaging manufacturers.** Packaging manufacturers are required to meet the demands of the brands they service. Therefore, many of the ways in which brands are affected by the problems associated with current packaging are also relevant to the packaging manufacturers themselves. As a result, they must be able to adapt their manufacturing capability to maintain their position in the supply chain.

- **Waste management companies and recyclers.** Innovation and developments in technology have thus far resulted in significant changes to the designs and materials used for modern packaging. The waste management industry would benefit from increased clarity and harmonisation in terms of the future regulatory requirements, with recyclers in particular better able to co-ordinate investment with a clear view as to future developments in recyclability across the packaging mark.

3 Why should the EU act?

This section provides an overview of the basis for EU intervention to address the problems highlighted in Section 2. This includes consideration of the legal basis for the EU to act under the Treaty, as well as the applicability of the subsidiarity principle.

3.1 Legal basis and Treaty relevance

The intention is for the proposal to be adopted on the basis of Article 114 of the Treaty on the Functioning of the European Union (TFEU), which is used for measures that aim to establish or ensure the functioning of the internal market.

> ***Article 114 of the Treaty on the Functioning of the European Union (TFEU)**:*
>
> *It is necessary to strive for full harmonisation of rules on packaging across the internal market to preserve its integrity and allow for a smooth free movement of packaging and packaged goods. Uncoordinated national measures to address sustainability aspects of packaging result in obstacles to the free movement of goods and hinder the development of markets for secondary raw materials.*

The packaging market is one that is characterised by high-levels of cross-border trade between Member States, with many producers placing packaging on the market in multiple Member States. Cross-border movements have further increased with the rise in the use of the internet for distance sales of packaged goods. Against a background of significantly increased ambition in respect of packaging recycling targets, accompanied by a more stringent approach to the measurement of what is counted as recycled, Member States are unilaterally taking a number of initiatives in respect of extended producer responsibility for packaging. This is leading to divergent approaches which increase the administrative complexity for producers, particularly those selling across multiple markets. Furthermore, in response to the minimum requirements under Article 8a of the WFD, EPR schemes are exhibiting divergent approaches to fee modulation, including the use of divergent criteria. Accordingly, producers increasingly face the risk of contradictory incentives for similar packaging items across different Member States. This hampers progress at the EU-level towards greater design for recyclability. A related divergence can also be seen in a number of Member State level initiatives relating to labelling.

In addition there are already examples of national level legislation, such as in France and Spain, designed to tackle negative environmental impacts associated with packaging, that restricts the free movement of packaging across the EU (see Section 2.3).

In the absence of EU-level intervention, such divergence could reasonably be expected to increase in future years as recycling targets become more stringent, and Member States seek unilateral approaches to issues such as reusable packaging.

In order to achieve a circular economy for packaging in a cost-effective way, it is essential to harness the strength of the internal market. This therefore requires harmonisation to preserve the integrity of the internal market.

3.2 Subsidiarity: The need for EU Action

The issues described above are not confined to one or two Member States, but widespread, affecting all Member States, with key underlying causes being common across all Member

States. If action is left only to Member States alone, the scale of the problems associated with the divergent approaches will increase in future years. If left to Member States to take action, the strength of the internal market will not be brought to bear on the challenge of achieving a circular economy for packaging, meaning the targets will be more difficult, and thus more expensive to reach. Accordingly, the increased difficulty and expense associated with leaving it to Member States to address these challenges means that the achievement of the targets could also be threatened, thus reducing environmental and social benefits.

3.3 Subsidiarity: Added value of EU Action

There are clear benefits from EU level action given that the EU packaging market is in many respects one large market, rather than 27 individual markets. Maintaining the integrity of the internal market, and harnessing its strength to support the move towards a circular economy for packaging will support the achievement of targets in a more cost-effective way. Economies of scale will be achieved through consistent approaches to, for example influencing packaging design in such a way that packaging can be more cost-effectively recycled. Certainty and consistency of factors such as criteria for fee modulation will provide a clear signal to packaging designers to design for recyclability, and provide confidence to investors in recycling facilities as to the nature of feedstock they will receive. Economies of scale can also be achieved through consistent approaches to reusable packaging across all Member States. Member State action alone could not achieve such harmonisation and thus economies of scale. l

4 Objectives

Based on the problem definition and considerations of the legal basis for EU action set out in the preceding sections, this section links the problems identified for action under this initiative to the potential policy responses through identification of objectives. Links and trade-offs between the objectives are identified and discussed. The overall intervention logic is then presented.

The general, specific and operational objectives are as shown in Table 4-1.

Table 4-1 General, specific and operational objectives

General	A well-functioning internal market	Tackling negative impacts from packaging on environment	Promoting a circular economy
Specific	Ensuring a level playing field through a common set of rules	Reducing environmental and social impact throughout all stages of the packaging life cycle	Increasing the circularity of packaging and reducing packaging waste
Operational	› To ensure that enforcement mechanisms and associated data gathering are effective whilst minimising administrative burden › To ensure that labelling for consumers is relevant and clear	› To limit and/or reduce the amount of packaging waste generated › To more fully understand and then minimize the presence of hazardous substances within packaging › Ensuring functioning markets for secondary raw materials and related industrial processes	› To increase the uptake of reusable packaging › To increase the recyclability of packaging › To increase the level of recycled content in packaging › To set conditions for the use of compostable packaging in order to help reduce cross-contamination in the recycling stream

4.1 Links between objectives

Some of the operational objectives are linked between each other and/or to more than one general objective, such as:

- "To more fully understand and then minimize the presence of hazardous substances within packaging" also contributes to "Promoting a circular economy";
- "Ensuring functioning markets for secondary raw materials and related industrial processes" contributes to "Promoting a circular economy";
- "To increase the uptake of reusable packaging" contributes to "To limit and/or reduce the amount of packaging waste generated";
- Both "To increase the recyclability of packaging" and "To increase the level of recycled content in packaging" indirectly contribute to "Tacking negative impacts from packaging on environment", as less virgin resources will be consumed.

4.2 Trade–offs between objectives

The objective **"To limit and/or reduce the amount of packaging waste generated"** faces possible trade-offs with the following objectives:

- To increase the recyclability of packaging

One of the major potential trade-offs with packaging design is between lightweighting and recyclability; or between the manufacturing and logistics impacts, and end of life impacts.

As packaging becomes increasingly lightweight, it can also become less recyclable at the end of life. This is because to achieve the same functional properties with a lighter weight more complex materials are required, including use of multi-layer and/or additives.

- To increase the uptake of reusable packaging

Reusable packaging is intended to be used multiple times, however, reusable packaging items can often be heavier than their single-use counterparts The impact on overall packaging waste generation/prevention would depend on the number of reuse cycles achieved.

- To increase the level of recycled content in packaging

The use of recycled content in some materials and applications can reduce the tensile strength of the packaging, such as fibre aggregate bags and beverage cartons. In this case more material is required to meet the technical specifications relating to strength and durability. In some cases there is a trade-off between the weight of a packaging item, and the level to which recycled content can be increased.

- To ensure labelling for consumers is relevant and clear

When packaging is minimised the surface area of the packaging may also reduce. However, for labelling to confer all the necessary information to consumers in a clear manner a larger surface area may be required. Therefore, there could be a trade-off between lightweighting and ensuring the labelling is clear enough for consumers.

The objective **"To increase the uptake of reusable packaging"** faces the following potential objectives:

- To increase the recyclability of packaging

This would only be the case, given the intention for all packaging to be recyclable, (even where reusable) where it could be demonstrated that a non-recyclable reusable packaging item were preferable to a recyclable alternative

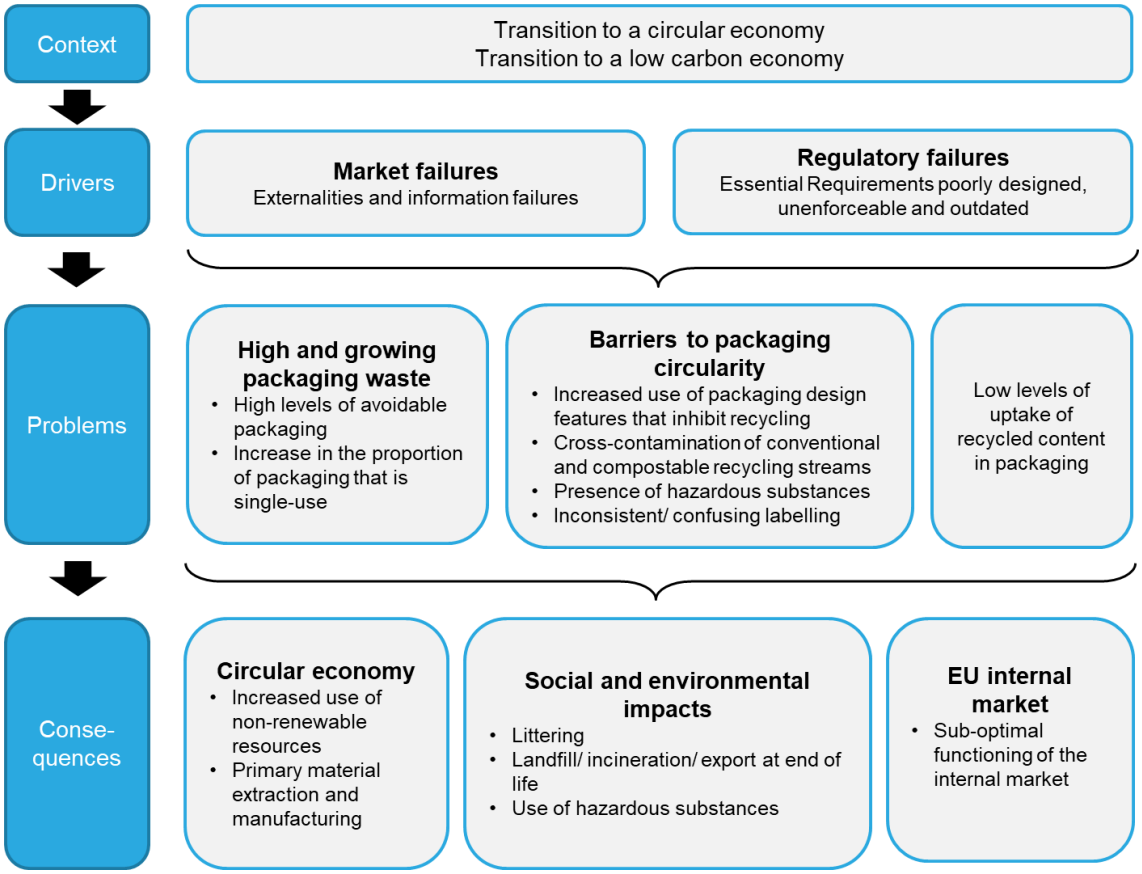
The objective **"To ensure enforcement mechanisms and associated data gathering are effective whilst minimising administrative burden"** does not necessarily present trade-offs with other objectives – indeed it should be supportive of them – but there is an inherent trade-off within the objective itself. There is a need, therefore, to strike the correct balance between the need for high quality data (which itself should make enforcement processes more straightforward) and the administrative burden of providing and managing such data. Furthermore, enforcement mechanisms themselves should be efficient and actions well targeted.

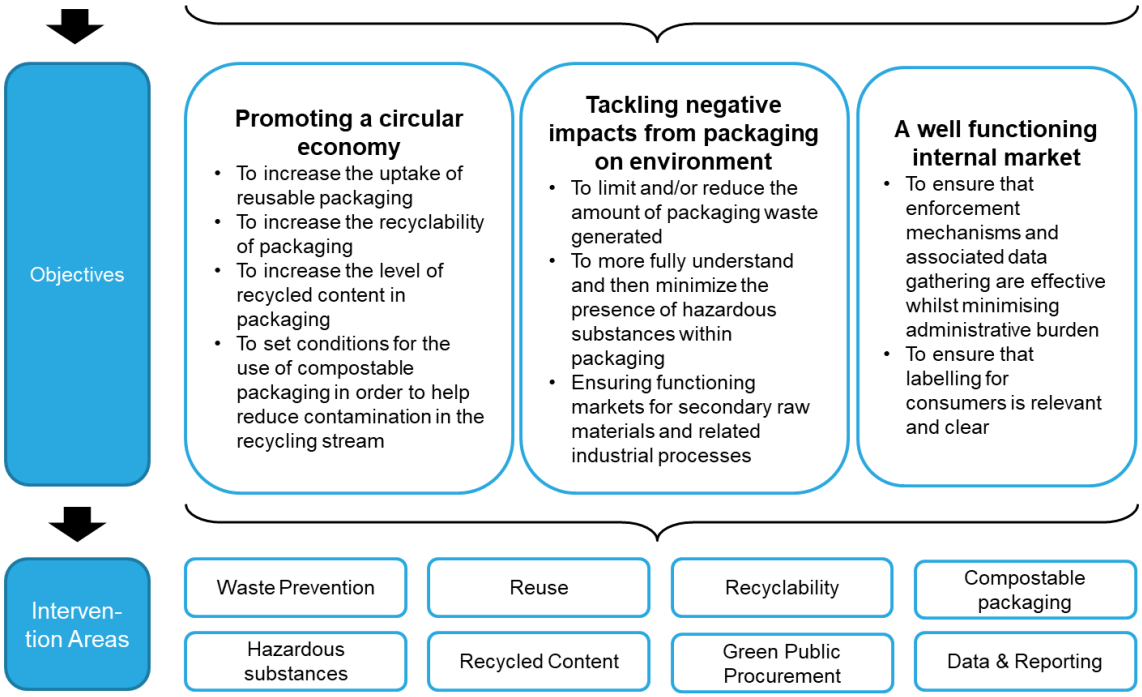
4.3 Intervention logic

In section 2.0 the overall problem tree was shown in Figure 2-1, linking the context, the drivers, the problems and the consequences. Figure 4-1 below adds the objectives previously described and introduces eight different intervention areas:

- Waste Prevention;
- Reusability;
- Recyclability;
- Compostable Packaging;
- Hazardousness;
- Recycled Content;
- Green Public Procurement (GPP); and
- Data & Reporting.

Figure 4-1 Overall problem tree as shown in section 2, adding Objectives and Intervention Areas





The following table illustrates the link between each intervention area and the objectives.

Table 4-2 Relationship between the objectives and the eight intervention areas

Objectives	Waste Prevention	Reuse	Recyclability	Compostability	Hazardousness	Recycled Content	GPP	Data & Reporting
A well functioning internal market								
To ensure that enforcement mechanisms and associated data gathering are effective whilst minimising administrative burden	X	X	X	X	X	X	X	X
To ensure that labelling for consumers is relevant and clear		X	X	X		X		
Promoting a circular economy								
To increase the amounts of reusable packaging		X						

Objectives	Waste Prevention	Reuse	Recyclability	Compostability	Hazardousness	Recycled Content	GPP	Data & Reporting
To increase the recyclability of packaging			X	X				
To increase the level of recycled content in packaging					X	X		
To set conditions for the use of compostable packaging in order to help reduce cross-contamination in the recycling streams				X				
Tackling negative impacts from packaging on environment								
To limit and/or reduce the increasing amount of packaging waste generated	X	X	X	X		X	X	X
To more fully understand and then minimize the presence of hazardous substances within packaging			X		X			
Ensuring functioning markets for secondary raw materials and related industrial processes			X		X	X		X

5 Baseline

The baseline model provides a complete picture of packaging consumption, waste generation and management for the EU-27[44], against which the impacts of policy options will be assessed. It includes both historic trends based on existing data and future projections out to 2050.

The model uses historical data for the period from 2006 to 2018 with projections for the years 2018 to 2050. 2006 is chosen as the first year of modelling as this is the first year in which detailed market data is available, which is used in our methodology to supplement Eurostat statistics. Projections are generally reported out to 2040 only, as beyond this date the modelled trends are particularly speculative. Projections to 2050 are only used for the purposes of understanding potential contributions towards 2050 net zero greenhouse gas emission targets.

Modelling of future trends includes all relevant EU-level and national policies and measures which are assumed to continue in force. Future trends also include the modelled impact of socio-economic developments (population growth, GDP growth etc.). The methodology used for modelling the baseline is described in full in Appendix B. Unless otherwise indicated, the data sources for all this section are the baseline model.

The scope of the baseline and the data, assumptions and processes used to produce the baseline are first set out in Section 5.1 below. The projections of the baseline model regarding packaging waste, waste destinations and GHGs are described in sections 5.2, 5.3 and 5.4. The significance of the baseline results are discussed in section 5.5.

5.1 Scope/data used

The preparation of a baseline of historic and projected packaging flows in Europe required the design of an appropriate method to compile and cross-compare data from existing datasets on packaging consumption and waste management.

Projections forward are based on a "no policy change" scenario, i.e. modelling of future trends will include all relevant EU-level and national policies and measures which are assumed to continue in force. Future trends also include the modelled impact of socio-economic developments (population growth, GDP growth etc.).

- The scope of this analysis includes all major packaging types, that is: household, commercial and industrial;
- Primary, secondary and tertiary;
- All major packaging materials – glass, steel, aluminium, plastic, paper/board, wood and material designated as 'other' (in Eurostat);
- Single-use and multi-use (reusable) packaging.

Regarding the terms used here, packaging waste *generation* refers to the number of units/tonnage of packaging at the end-of-life i.e. when the packaging becomes waste. Packaging *consumption* relates to the number of units/tonnage of packaging placed on the market i.e. the number used by the user. For single-use packaging, packaging consumption is in nearly all cases equivalent to waste generation. For example, a single use beverage bottle is bought, used and then discarded. The situation is different for multi-use packaging, in this case

[44] The United Kingdom is not included in this study, and has been excluded from all datasets used in the model.

a single unit of packaging is used/consumed multiple times (and, in the case of open-loop reuse, also placed on the market multiple times, see Appendix B). The number of uses of packaging before it becomes waste is therefore an important variable to understand in determining the relationship between consumption and waste.

Primary, secondary and tertiary packaging refers to the terms as defined in the PPWD:

- **Primary Packaging** (or sales packaging) - packaging conceived so as to constitute a sales unit to the final user or consumer at the point of purchase;
- **Secondary Packaging** (or grouped packaging) - packaging conceived so as to constitute at the point of purchase a grouping of a certain number of sales units whether the latter is sold as such to the final user or consumer or whether it serves only as a means to replenish the shelves at the point of sale; it can be removed from the product without affecting its characteristics;
  - As discussed in Appendix B, it was not possible to clearly delineate secondary packaging from primary packaging, and therefore secondary packaging is included in primary packaging in the baseline.
- **Tertiary Packaging (**or transport packaging) - packaging conceived so as to facilitate handling and transport of a number of sales units or grouped packaging in order to prevent physical handling and transport damage. Transport packaging does not include road, rail, ship and air containers;

Packaging waste management refers to the final destination of packaging waste: recycling, incineration, landfill, and litter left in the terrestrial and marine environment (i.e. that is not collected). Reuse is not included as a waste destination, and the impact of reuse in the model is to decrease the quantity of new packaging that is placed on the market (and that subsequently becomes waste). The nuances of this definition in relation to Eurostat reporting definitions and open/closed loop reuse are discussed in Appendix B.

Specific terminology is used throughout depending on the level of aggregation of the data described: *material* refers to e.g. plastic, glass etc., whilst *packaging type* refers to the specific packaging types e.g. glass beverage bottles etc.

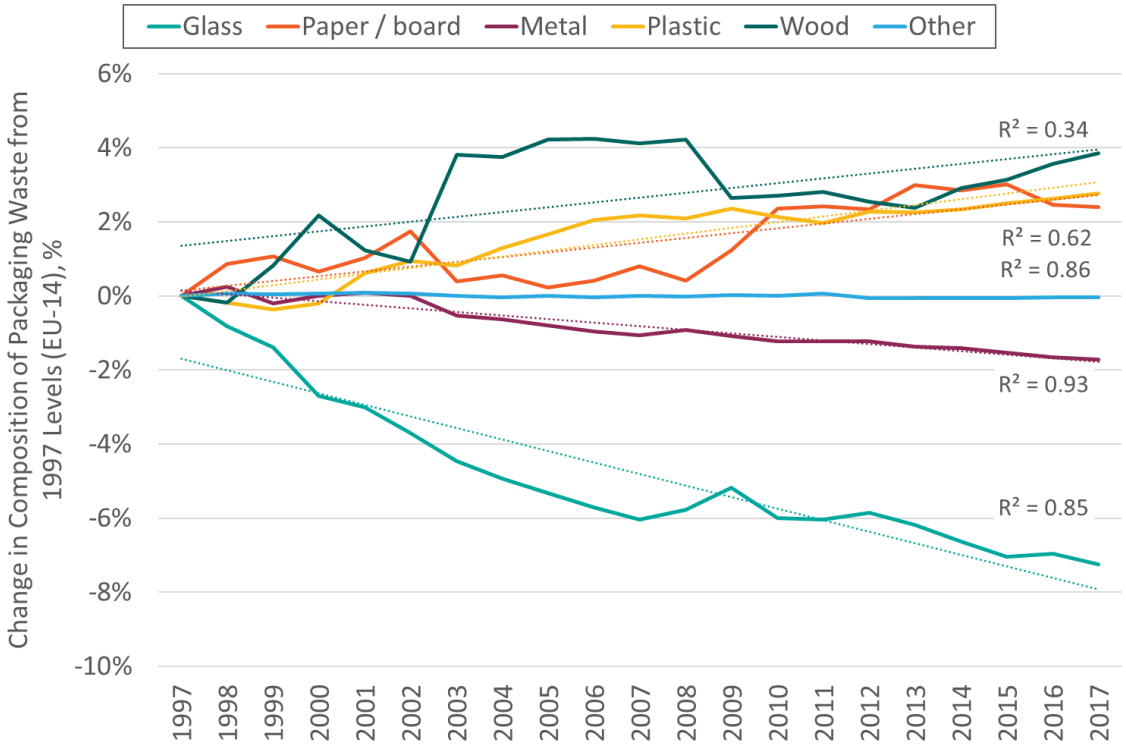
As noted in Appendix B, this output of waste generated by packaging type is the result of the merger, collation and cross-comparison of multiple datasets/sources with varying degrees of accuracy and significant data gaps and tuned to high-level packaging waste statistics as reported to Eurostat. These tonnages (and any data presented at the packaging type level) are a 'model' of the real-world, which we believe provides the best-possible representation of packaging flows in Europe within the constraints of the data and resources available to this study. The results presented below are for the EU27 and are the aggregation of underlying data which is calculated separately for each Member State.

5.2 Packaging waste

5.2.1 Historic Change in Composition

According to Eurostat data, the composition of packaging waste has evolved over time (see Figure 5-1). The proportion of packaging waste made up of paper and board, plastic and wood has increased, whilst glass and (to a lesser extent) metal are now less prevalent in the waste stream.

Figure 5-1 % Change in Packaging Waste Generation Composition over Time from 1997 Levels (EU-14) [R^2 is the coefficient of determination]



A breakdown of the latest Eurostat data shows the result of these trends. Packaging waste generated in the EU27 is now almost half paper/board by weight. The remaining waste is made up of similar proportions of plastic, glass and wood (in order of highest to lowest quantity), and a minor (approx. 5%) component of metals. The packaging waste composition by weight in the EU27 in 2018 by % of materials is:

- 40.9% paper/board;
- 19.0% plastic;
- 18.6% glass;
- 16.2% wood;
- 3.8% steel[45];
- 1.2% aluminium; and
- 0.3% other.

5.2.2 Future Projections

The baseline model projects that change in packaging composition, observed in the Eurostat data up to 2018, will continue out to 2035. These trends are based on a combination of Eurostat data (for analysis of trends at the material level) and more detailed market datasets. This data is presented below in terms of the projected total number of uses by material[46].

[45] This includes estimates of steel / aluminium packaging for countries which chose to report only metal packaging in 2018. See Appendix B – Baseline Methodology for further details.

[46] Please note that the previous section presented data by weight, not by uses

Table 5-1 Packaging Use by Material (2006, 2018, 2030, 2040), Billion Uses

	2006	2018	2030	2040
Glass	104	107	95	96
Steel	44	50	49	51
Aluminium	33	43	50	55
Paper / board	565	645	690	759
Plastic	660	979	1,407	1,758
Wood	1.4	1.5	1.8	2.1
Other	4.0	4.4	4.1	4.2

These data show that use of plastic packaging, already making up almost a half (47%) of all packaging used in 2006, has increased significantly historically, and is projected to increase further still, accounting for almost two thirds (65%) of packaging used by 2040. This is equivalent to **almost a doubling in consumption/use of plastic packaging between 2018 and 2040**.

Usage of glass packaging is assumed to decline moving forward, despite the general increase in waste generation/consumption assumed due to growing GDP and population. Although consumption increased marginally between 2006 and 2018 (from approximately 104 to 107 billion uses), it will still decrease in the future due to Member States with greater projected increases in population/GDP also having greater historical decrease in glass consumption.

Consumption all other packaging types are assumed to increase, primarily due to general increases in consumption driven by GDP and population growth. However, the proportion of packaging consumption made up of all non-plastic materials is declining. This is most significant for glass packaging, usage of which is projected to almost half from 2018 to 2040, from 5.9% to 3.5% of all packaging consumption. Usage of metal packaging is also declining, particularly for steel packaging - only 1.9% of packaging used is projected to be composed of steel by 2040, down from 2.7% in 2018. The proportion of all packaging consumption that is paper / board packaging consumption is also projected to decrease.

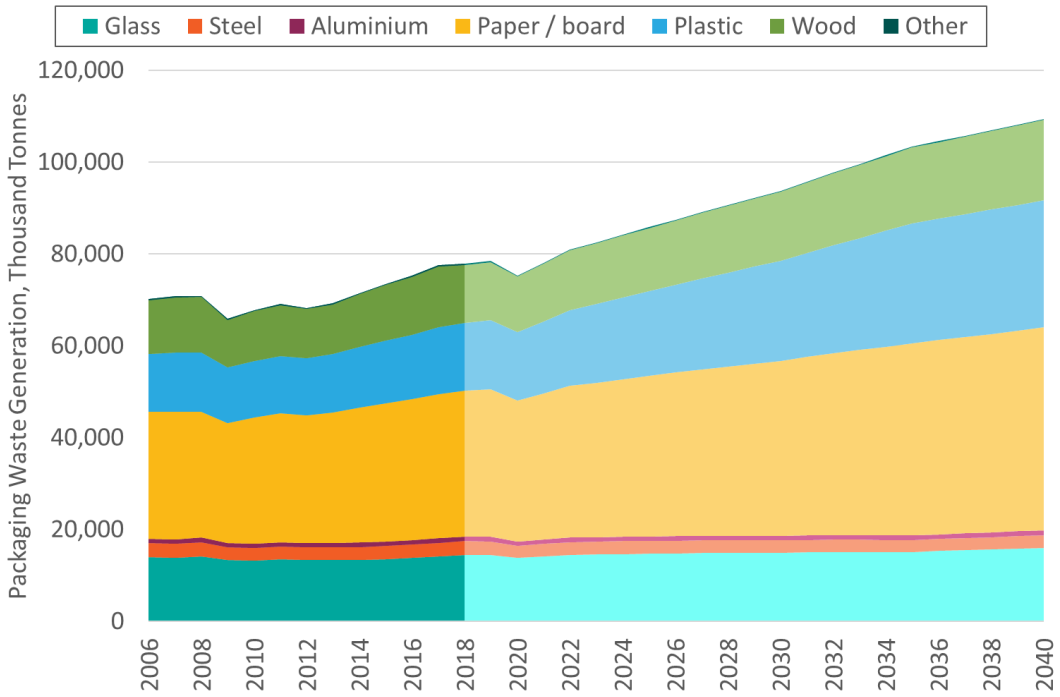
The overall story is clear, **plastic packaging consumption is on the rise**, and consumption of packaging made from other materials is declining relative to plastic consumption.

The net impact of these assumptions on modelled waste generation is shown in Figure 5-1. Total packaging waste generated is assumed to **increase from 77.8 million tonnes in 2018, to 92.4 million tonnes in 2030, and 106.6 million tonnes in 2040**.

As **the projected packaging waste generated is correlated with GDP**, we see a significant dip in waste generation coinciding with decreased GDP for Member States resulting from the economic impacts of COVID-19. This is despite estimates that the global packaging market is

expected to grow from USD 909.2 billion in 2019 to 1,012.6 billion by 2021[47], driven by a demand for pharmaceutical and e-commerce packaging[48]. While there was a growth in the global size of the packaging market, actual estimates of packaging POM show the opposite trend, one of COVID-19 induced declines in packaging.[49] For the UK, a country similarly affected by COVID-19 as Europe, and likely to be much more representative of trends in packaging waste to Europe than trends in the global packaging market, packaging POM declined from 2019 to 2020.[50] This was driven by a fall in paper, card, plastic and glass POM. Ultimately COVID-19 increases in E-commerce and pharmaceutical packaging were not enough to offset significant decreases in non-consumer packaging, non-grocery retail packaging, hospitality packaging and C&I packaging.[51] Overall packaging POM demonstrated a 'small dip' from 2019 to 2020, in line with our model's predictions of packaging waste.

Figure 5-2 Generation of Packaging Waste, Thousand Tonnes



The overall tonnage of waste by packaging type in the latest year of historic data (2018) is shown in Figure 5-3 (next page).

[47] Accumulation of plastic waste during COVID-19, Science 11 Sep 2020: Vol. 369, Issue 6509, pp. 1314-1315 DOI: 10.1126/science.abd9925, available at: https://science.sciencemag.org/content/369/6509/1314

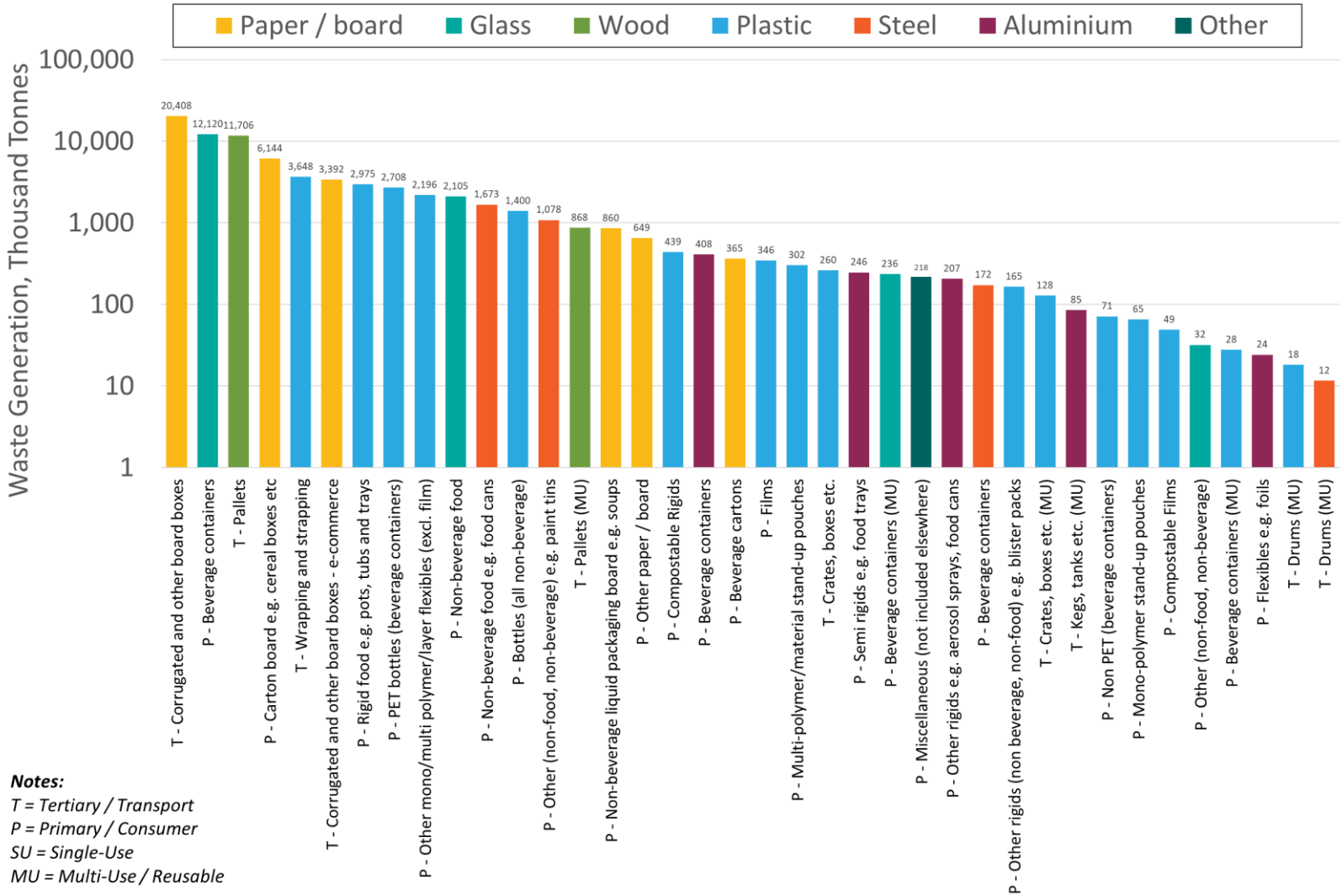
[48] "COVID-19 impact on packaging market by material type, application and region—global forecast to 2021," Business Insider (2020)

[49] PackFlow Covid-19 Phase II, The impact on the compliance landscape for UK packaging recycling 2020-2022, available at: https://wrap.org.uk/resources/report/packflow-covid-19-reports

[50] ibid.

[51] ibid.

Figure 5-3 Waste Generation by Packaging Type (2018)



Notes:
T = Tertiary / Transport
P = Primary / Consumer
SU = Single-Use
MU = Multi-Use / Reusable

Corrugated board boxes account for the greatest tonnage of packaging – 20.4 million tonnes – with significant volumes of other paper / board packaging, particularly carton board (6.1 million tonnes).

Glass beverage containers and wooden pallets each account for approximately 12 million tonnes of packaging waste. Whilst, major plastic packaging types – other flexibles (primary and tertiary), PET beverage containers, pots tubs and trays – each account for between 2 and 4 million tonnes of packaging.

Moving to packaging types with lower tonnages (between 0.3 and 1.7 million tonnes per packaging type), we see mainly the major steel packaging types (e.g. 1.6 million tonnes of food cans) and other plastic and paper / board packaging types. Rigid compostable packaging falls in this weight range at 0.44 million tonnes in weight. This is similar in quantity to aluminium beverage containers which are the major type of aluminium packaging (0.41 million tonnes).

Packaging types with lower weights are mainly minor plastic packaging types such as mono-layer pouches (65 thousand tonnes) and compostable films (49 thousand tonnes). Reusable packaging types also commonly have lower weights (all are lower than 130 thousand tonnes in weight, with the exception of glass beverage containers and wooden pallets). This is somewhat expected as reusable packaging can be used multiple times and so a lower tonnage (relative to single use packaging) is placed on the market / becomes waste. A breakdown of packaging waste is also shown in Table 5-2.

Table 5-2 Packaging Waste Composition (2018) by weight, % [T = Tertiary/Transport, P = Primary/Consumer, SU = Single-Use, MU = Multiple Use]

Material	Packaging Type	Waste Composition by Weight	
		By Material	By Type
Glass	P - Beverage containers	18.6%	15.6%
	P - Non-beverage food		2.7%
	P - Other (non-food, non-beverage)		0.04%
	P - Beverage containers (MU)		0.30%
Steel	P - Beverage containers	3.8%	0.22%
	P - Non-beverage food e.g. food cans		2.2%
	P - Other (non-food, non-beverage) e.g. paint tins		1.4%
	P - Food refill scheme boxes e.g. Loop (MU)		-
	T - Drums (MU)		0.01%
Aluminium	P - Beverage containers	1.2%	0.52%
	P - Other rigids e.g. aerosol sprays, food cans		0.27%
	P - Semi rigids e.g. food trays		0.32%
	P - Flexibles e.g. foils		0.03%
	T - Kegs, tanks etc. (MU)		0.11%
Plastic	P - PET bottles (beverage containers)	19.0%	3.5%
	P - Non PET (beverage containers)		0.09%
	P - Bottles (all non-beverage)		1.8%
	P - Rigid food e.g. pots, tubs and trays		3.8%

Material	Packaging Type	Waste Composition by Weight	
		By Material	By Type
	P - Other rigids (non beverage, non-food) e.g. blister packs		0.21%
	P - Mono-polymer stand-up pouches		0.08%
	P - Multi-polymer/material stand-up pouches		0.39%
	P - Other mono/multi polymer/layer flexibles (excl. film)		2.8%
	P - Films		0.44%
	P - Beverage containers (MU)		0.04%
	P - Bottles (all non-beverage) (MU)		-
	P - Food refill scheme boxes e.g. Loop (MU)		-
	P - Compostable Rigids		0.56%
	P - Compostable Films		0.06%
	T - Film and bubble pouches - e-commerce		-
	T - Wrapping and strapping		4.7%
	T - Crates, boxes etc.		0.33%
	T - Boxes and pouches - e-commerce (MU)		-
	T - Wrapping and strapping (MU)		-
	T - Crates, boxes etc. (MU)		0.16%
	T - Drums (MU)		0.02%
Paper / board	P - Carton board e.g. cereal boxes etc	40.9%	7.9%
	P - Beverage cartons		0.47%
	P - Non-beverage liquid packaging board e.g. soups		1.1%
	P - Other paper / board		0.83%
	T - Corrugated and other board boxes		26.2%
	T - Corrugated and other board boxes - e-commerce		4.4%
Wood	T - Pallets	16.2%	15.0%
	T - Pallets (MU)		1.1%
Other	P - Miscellaneous (not included elsewhere)	0.28%	0.28%

Together with Figure 5-3 the following can be observed for 2018:

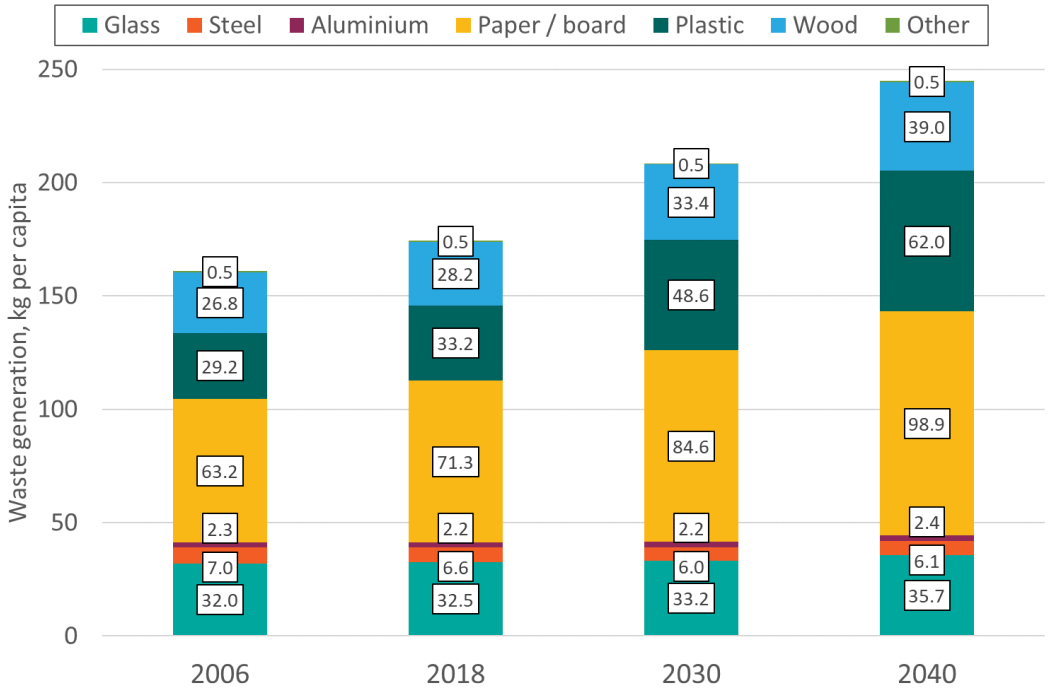
- Glass accounts for the highest tonnage of single use beverage containers (15.6% of all packaging waste vs. 3.6% for plastic), although baseline data also shows that twice as many single use plastic beverage bottles are consumed compared to glass beverage containers (100 million vs. 50 million). Multi-use glass beverage bottles account for a much lower proportion of packaging waste, although usage is similar to single-use containers;
- Steel packaging waste is mainly comprised of non-beverage food containers (e.g. food cans);

- Aluminium packaging waste is roughly half beverage containers with the remaining waste mainly other and semi rigids;
- Tertiary plastic films are the most prevalent type of packaging waste, making up 4.7% of all packaging waste (25% of all plastic packaging by weight);
- Primary rigid plastics are roughly 2.5x more prevalent in the waste composition than primary flexibles (9.4% vs. 3.7%). PET beverage bottles and pots, tubs and trays are the major components of primary rigid plastics, accounting for 3.5% and 3.8% of packaging waste respectively.
- Compostable plastics make up only 0.7% of packaging waste (3.3% of all plastic packaging waste).
- Altogether, tertiary packaging makes up just over half of all packaging waste (52%). Of this the major component is corrugated cardboard, which accounts for over half of all tertiary packaging, and almost a third (30.6%) of all packaging waste.
- Wooden packaging is the other significant tertiary packaging component, making up 16% of all packaging waste.
- Approximately 14% of corrugated cardboard (4.4% of all packaging waste) is used for e-commerce.
- Carton board is also a major component of packaging waste (8%).

As noted in Appendix B, this output of waste generated by packaging type is the result of the merger, collation and cross-comparison of multiple datasets/sources with varying degrees of accuracy and significant data gaps, and tuned to high-level packaging waste statistics as reported to Eurostat. These tonnages (and any data presented at the packaging type level) are a 'model' of the real-world, which we believe provides the best-possible representation of packaging flows within the constraints of the data and resources available to this study.

Alongside the increase in overall packaging waste shown above the model shows an increase in packaging waste generated per capita. Historically, packaging waste generated per person has increased from 161 kg (in 2006), to 174 kg (in 2018). This is projected **to increase to 209 kg per capita by 2030, and 245 kg per capita by 2040**, with plastic packaging waste accounting for just under half of this increase (41% of the increase between 2018 and 2040).

Figure 5-4 Waste Generation, Kg per Capita

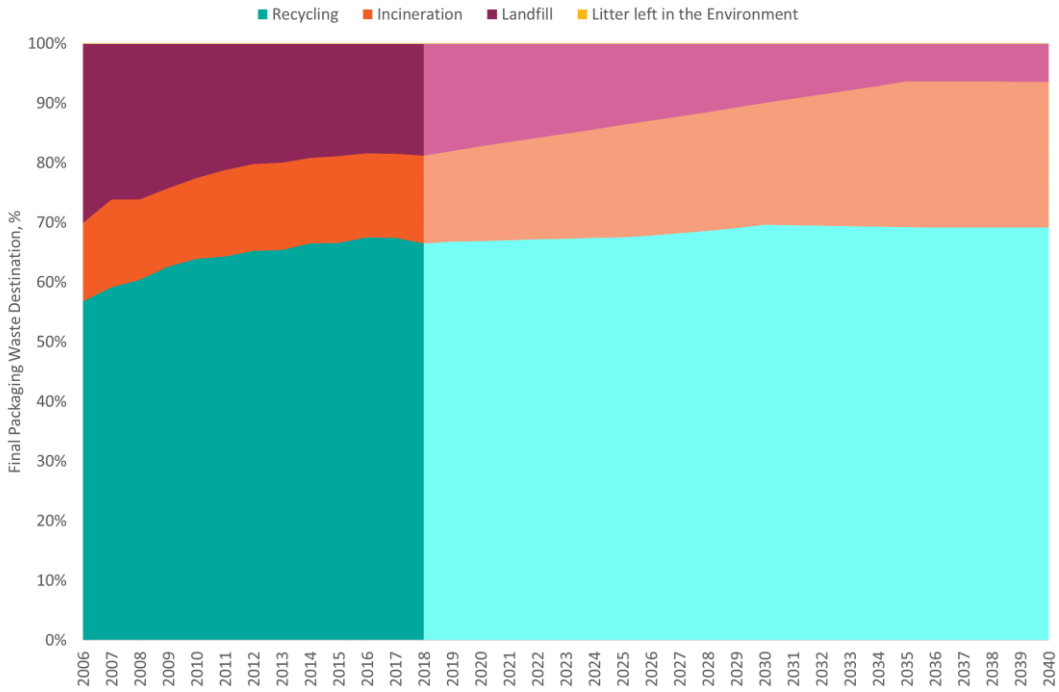


The baseline model indicates **an absolute increase in the use of most plastic packaging, and a decrease in the use of most other packaging types in the period up to 2040**. There are some exceptions to this trend, notably corrugated and other board boxes used for e-commerce which show significant growth of over 7% per annum over this period. Increases in the use of plastic packaging are concentrated in rigid, non-beverage packaging (pots, tubs, trays and other types), pouches and films. Reusable primary packaging (plastic and glass beverage bottles) is shown to continue the historic downward trend in the use of this these packaging types (see Section 2.1.1.2).

5.3 Recycling Rates, Residual Treatment and Litter

Waste destinations for all packaging waste are shown in Figure 5-5. **The overall recycling rate is projected to increase from 66.5% in 2018, to 69.6% in 2030**, as Member States meet the or miss the recycling targets set out in the PPWD. **The proportion of waste sent to landfill is projected to decrease from 18.7% in 2018 to 9.9% in 2030, and 6.3% in 2035**. This is a result of progress towards the Landfill Directive (as amended) target of no more than 10% of the total amount of municipal waste sent to landfill by 2035. A minor reduction in litter left in the environment from 2018 to 2030 (0.13% to 0.08%) is also modelled (which is too small a quantity to be visible on the chart). The remaining waste fraction is sent to incineration, which is projected to increase from 14.7% of total packaging waste in 2018, to 20.4% in 2030, and 24.4% in 2035. This increase is a consequence of the modelled interaction of packaging waste recycling targets and landfill targets for municipal waste. The proportion of waste sent to landfill reduces at a greater rate that than the increase in recycling rate, and so there is increasingly more 'spare' residual waste (i.e. not landfilled) which can only go to incineration.

Figure 5-5 Packaging Waste Final Destinations, %

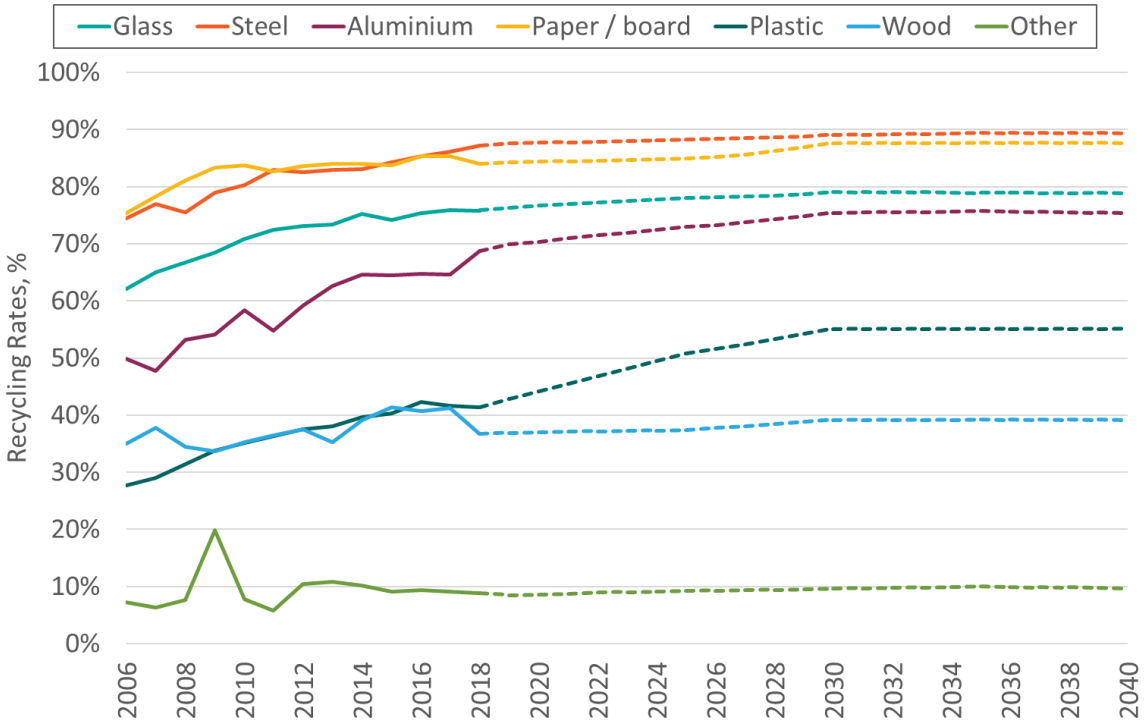


Historic and projected recycling rates by material are shown in Figure 5-6. As discussed in Appendix B, from 2020 onwards, rates reported to Eurostat may reduce relative to recycling rates reported in previous years, due to the potential impacts of the new calculation rules mandated for packaging waste reporting for the 2020 reporting year and thereafter.[52]

As this figure demonstrates, by far **the greatest projected increase in recycling rates between 2018 and 2030 is for plastics**. The highest plastic packaging recycling rate reported for the last complete year of data (2017) is 74.2% (reduced to 69.3% in 2018) whilst the average across the EU27 (as shown) is 41.7%. Thus on average a 13% increase in recycling rates is required to meet the 55% target set for 2030 in the Packaging and Packaging Waste Directive (with an interim target of 50% by 2025), notwithstanding any additional increase required due to the impact of the new calculation rules on reported tonnages. Modelled increases over the projection period for other packaging materials are lower in magnitude. Moderate increases in recycling rate (2-3%) are required from 2017 to 2030 for glass, steel and paper / board, with a greater increase required for aluminium (estimated at 11% - actual recycling rates are not well understood as Member States are not yet required to disaggregate steel and aluminium tonnages in reporting). These are the average 'distance to targets' across the EU27, and it is important to note that recycling rates modelled at the Member State level vary considerably.

[52] European Commission (2019) *Commission Decision 2005/270/EC as amended by Implementing Decision (EU) 2019/665*, https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1583325017136&uri=CELEX:02005D0270-20190426

Figure 5-6 Recycling Rates by Material, %

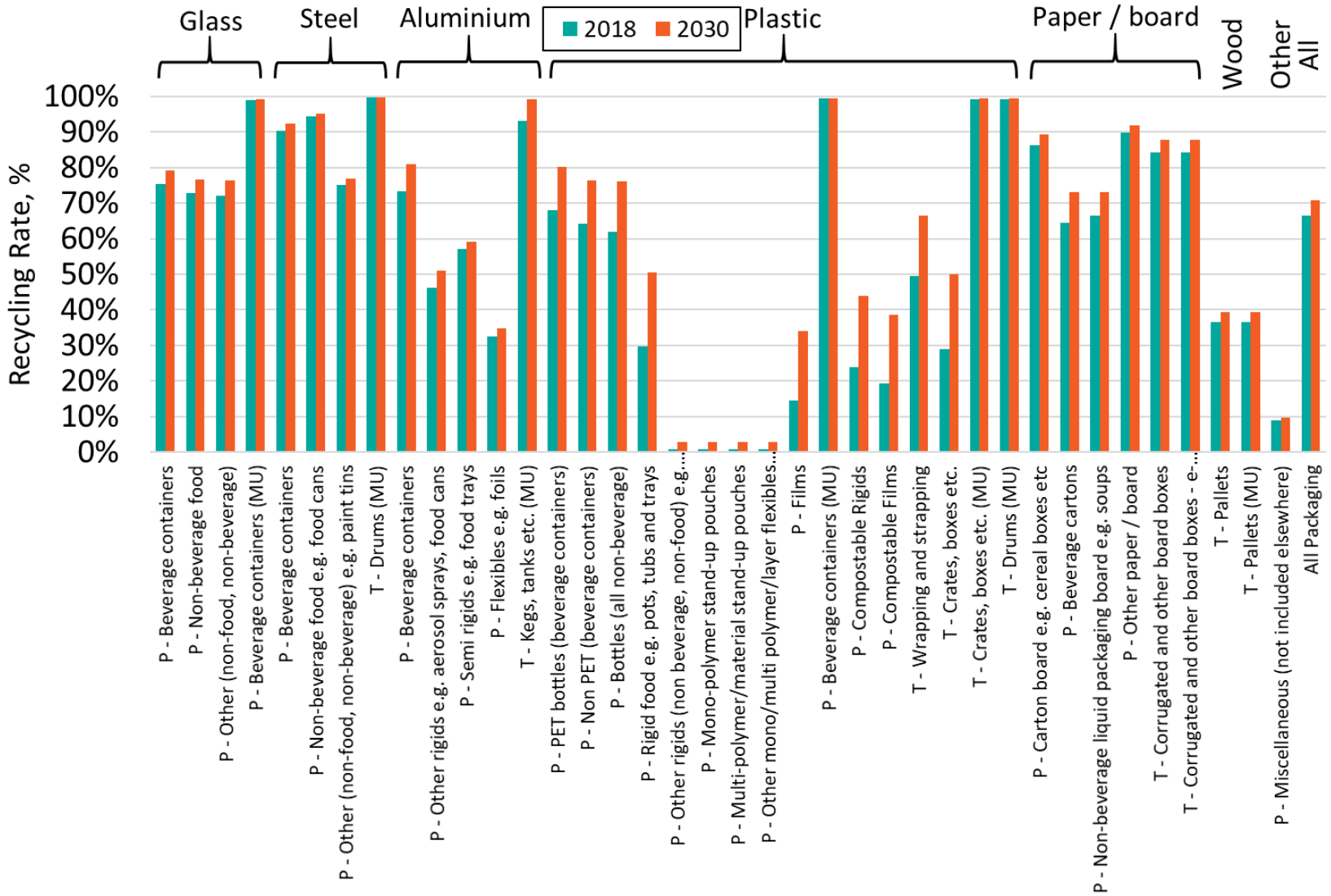


Recycling rates for each packaging type modelled for 2018 and 2030 are shown in Figure 5-7, which demonstrates the scale of change required at the packaging type level to meet the PPWD targets, particularly for plastic packaging types with moderate to low recycling rates in 2018. Whether this increased recycling is technically and/or economically practical will therefore be a key consideration in any policies which aim to shift consumption from one packaging type to another. In other words, there are two main approaches to increasing recycling rate at the material level: (1) increase recycling rates of the packaging types made up of that material, and; (2) shift consumption away from packaging types with lower recycling rates, therefore improving the overall average recycling rate at the material level.

As defined by the scaling function methodology (see Appendix B), packaging types with high recycling rates show a lower increase in recycling rate relative to packaging types with more moderate recycling rates. The rational for this is that, in general, high recycling rates demonstrate that waste management systems are already optimised and therefore further gains in recycling are more difficult to achieve and therefore lower in magnitude. This can be seen, for example, for paper/board, where packaging types with moderate (e.g. approximately 60%) recycling rates in 2018 are modelled to increase more than packaging types with recycling rates closer to 80/90%.

Conversely, our methodology also assumes that packaging types with very low (<10%) recycling rates in 2018, will show a lower increase in recycling rate relative to those with more moderate rates (i.e. for any given change in the overall – material level – recycling rate). Packaging types at these recycling rates are commonly not recyclable, or only using very specialised technologies. It is often the case that even with advances in investment in recycling technologies that recycling of such packaging remains very niche, given economic and technological constraints. This can be seen, for example, in the difference in greater change in recycling rate for pots, tubs, and trays relative to plastic pouches.

Figure 5-7 Recycling Rates by Packaging Type, %



Close to 100% recycling is observed only for multi-use packaging, which is virtually all recycled at end of life (after multiple cycles of reuse), based on discussions with stakeholders.

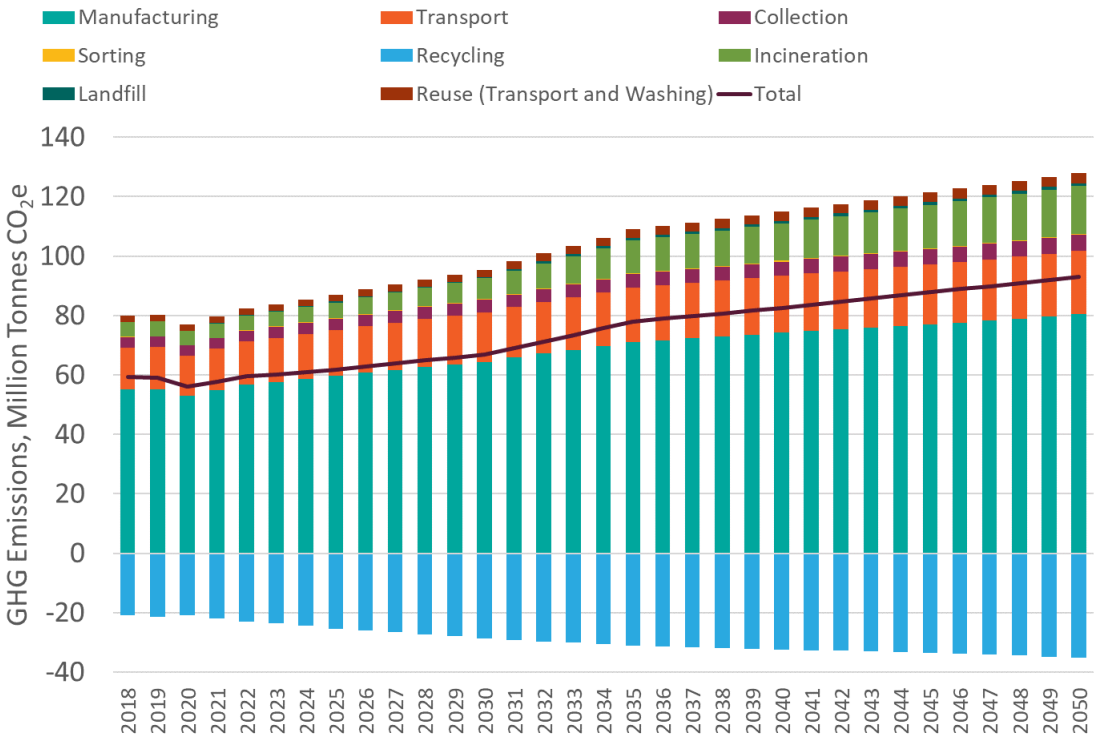
5.4 Environmental impacts

5.4.1 Greenhouse Gas Emissions

Greenhouse gas (GHG) emissions, in terms of tonnes of CO2 equivalent, are modelled by packaging type based on unit factors for manufacturing, waste management (recycling, incineration and landfill), and emissions from the washing and transport of reusable packaging.

The overall modelled change in GHG emissions over time are presented in Figure 5-8. Manufacturing emissions account for the largest proportion of GHG emissions, and so emissions are modelled to increase over time due to predicted future growth in packaging placed on the market. An increase in material placed on the market also requires more transport of material, more waste collection and more sorting, all of which leads to an increase in emissions from these sources.

Figure 5-8 Greenhouse Gas Emissions, million tonnes CO2e



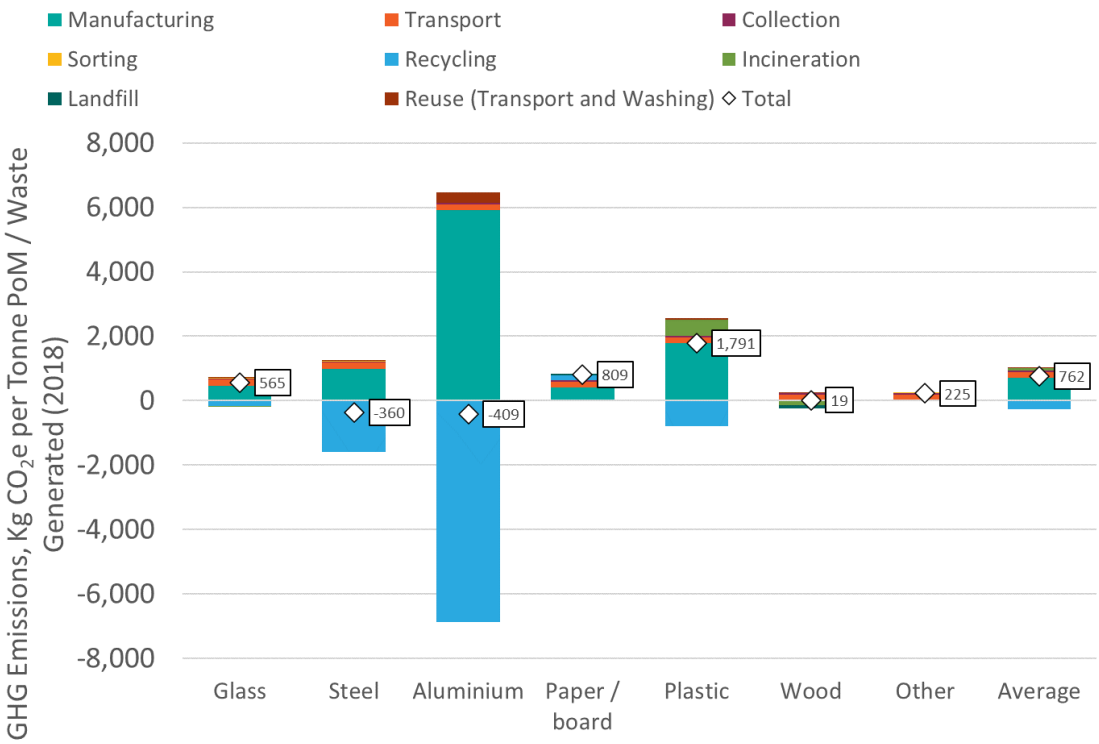
Overall emissions **increase from 59 million tonnes CO_2e per annum in 2018 to 66 million tonnes CO_2e in 2030** (after a dip in 2020 due to a projected decrease in packaging placed on the market during the pandemic). Emissions are projected to increase further to 93 million tonnes CO_2e per annum by 2050. This means that whilst emissions from packaging use only

account for 2% of total CO_2 emissions in 2018 (total CO_2 emissions of approximately 2.5 billion tonnes)[53], they could claim a significant part of the EU carbon budget by 2050.

The GHG impact of recycling is negative because it avoids emissions associated with extraction/processing to produce primary material. The emissions from recycling are calculated as the difference between the emissions from reprocessing waste into secondary material and the emissions from primary extraction/processing. The former value is almost universally lower than the latter, meaning the GHG impact comes out as negative. Recycling does increase over time, both due to more material being placed on the market, and a greater proportion of collected waste being sent for recycling (driven primarily by the requirement to meet PPWD recycling rate targets). However, these 'negative' emissions from increased recycling are not sufficient to offset the larger increase in GHG emissions from manufacturing and other sources described above.

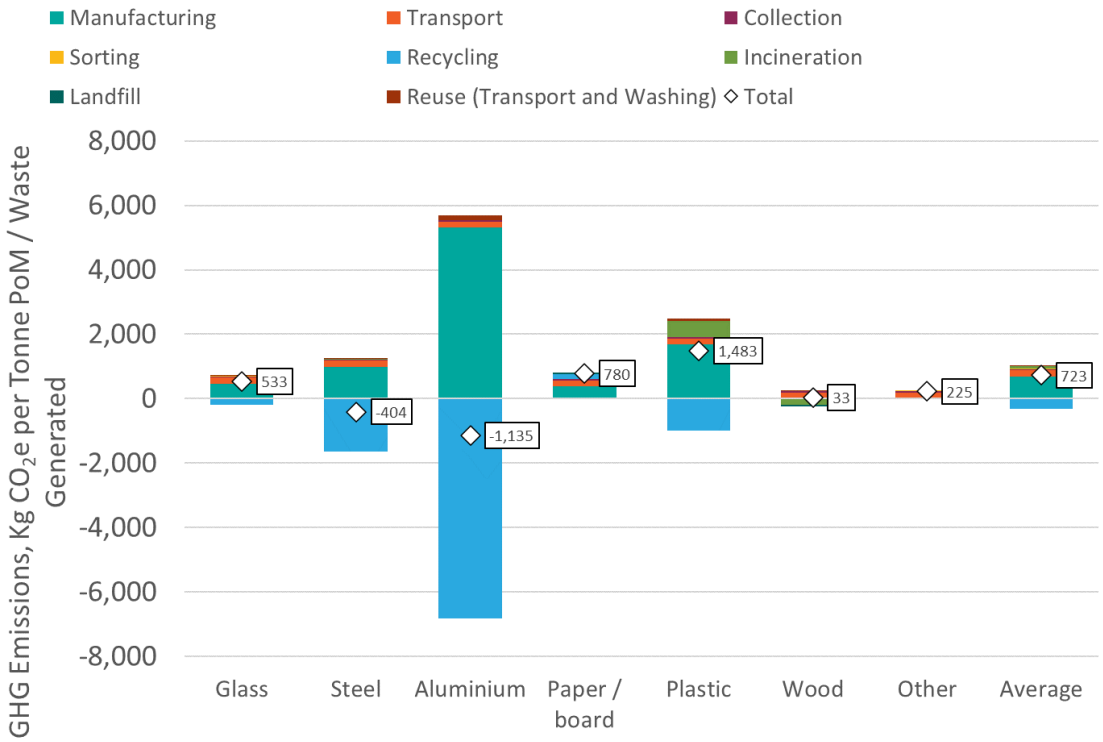
Figure 5-9 and Figure 5-10 show GHG emissions, in units of kg CO2 equivalent per tonne placed on the market (equivalent to waste generated) by material for 2018 and 2030.

Figure 5-9 Greenhouse Gas Emissions, Kg CO_2e per tonne PoM / waste generated (2018)



[53] Eurostat (2020) *Air emissions accounts by NACE Rev. 2 activity [env_ac_ainah_r2]*, Accessed 30th June 2021, https://ec.europa.eu/eurostat/databrowser/view/env_ac_ainah_r2/default/table?lang=en

Figure 5-10 Greenhouse Gas Emissions, Kg CO_2e per tonne PoM / waste generated (2030)



This shows that **plastic packaging is the most carbon intensive**, at a total of 1.8 tonnes of CO_2 emitted for the lifecycle of one tonne of plastic packaging placed on the market in 2018. This reduces to 1.5 tonnes by 2030, due to greater avoided emissions from recycling and a small reduction in manufacturing emissions per tonne due to the increase of recycled content in plastic beverage bottles to 30%, as stipulated in the SUP Directive. However, even with this increase in recycling rate (which is a greater relative upward shift in recycling rate than for other packaging types), plastic packaging is still more carbon intensive than other packaging types. There are various reasons for this:

- GHG emissions from manufacturing are significant and higher than all materials apart from aluminium, which is a very energy intensive material to extract.
- Plastic is composed of fossil carbon, and so leads to significant GHG emissions when incinerated.
- Avoided emissions from recycling are not sufficient to offset these positive emissions, even at higher recycling rates (55% average recycling rate in 2030).

The next most carbon-intensive types of packaging are paper / board and glass, which have emissions of 809 and 565 kg CO_2e per tonne packaging. Wood packaging has very low net emissions – 19 kg CO_2e per tonne packaging. This is due to avoided emissions from recycling and incineration. Net emissions from incineration of wood are negative (avoided) because energy is generated, thus offsetting generation from other sources on the grid and CO_2 emissions from incineration of wood are biogenic carbon and therefore not counted (only fossil CO_2 is in scope). Finally, net emissions from steel and aluminium are negative i.e. there is a net carbon benefit from usage of these materials. This is because of the significant level of recycling of these materials (87% recycling of steel, and 69% of aluminium in the EU27 in 2018), and the

relatively high carbon benefits that this leads to as increased recycling avoids the need for relatively energy intensive material extraction processes and manufacturing of metal packaging.

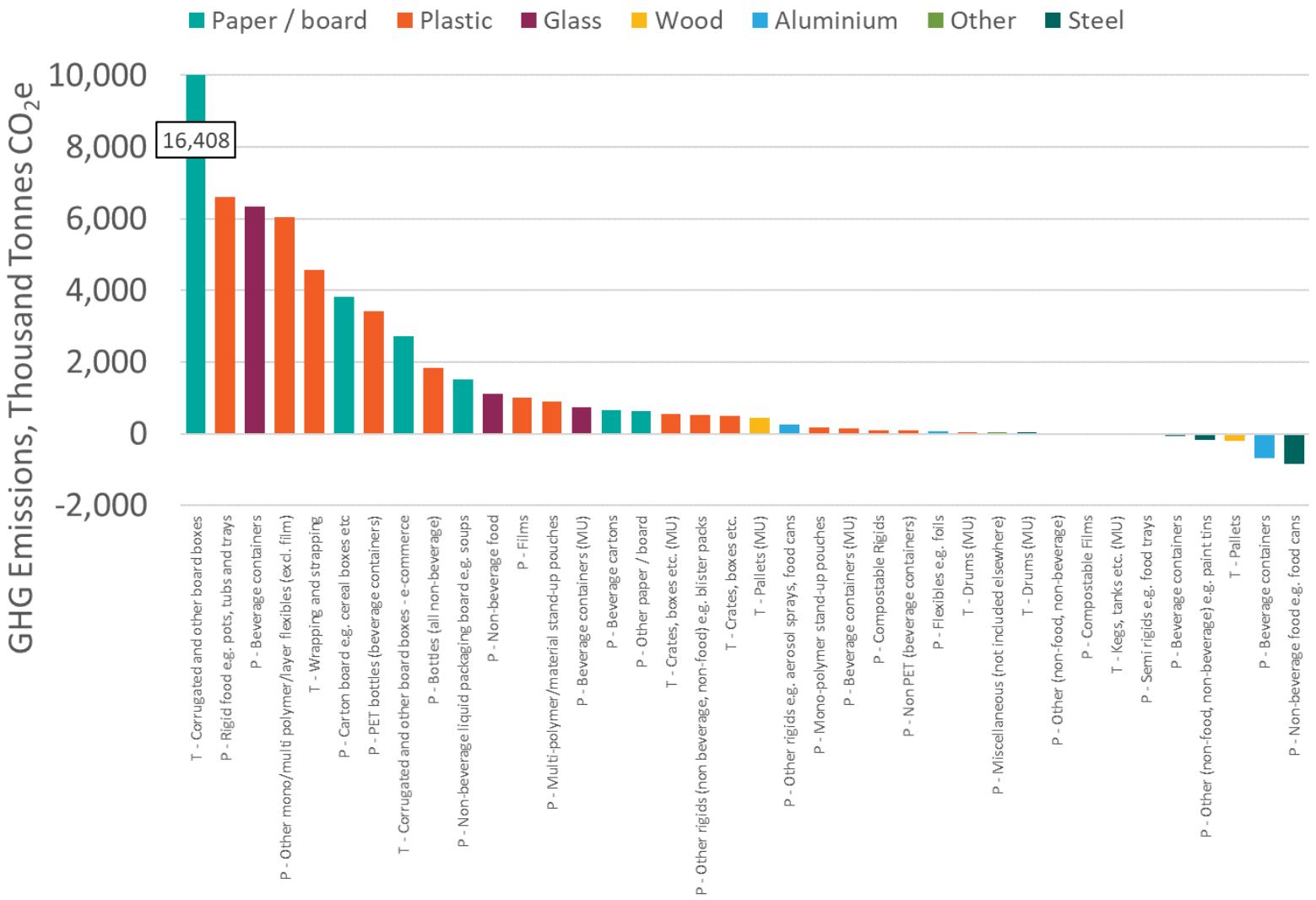
GHG emissions by packaging type are presented in Figure 5-11 for 2018. As can be seen the highest emissions are associated with corrugated cardboard (note actual value of 16,408 thousand tonnes CO_2e is off the scale of chart). This is unsurprising considering that the tonnage of corrugated cardboard is almost double any other packaging type (see Figure 5-3). The major types (pots, tubs and trays, films, PET bottles etc.) of plastic packaging also account for relatively high GHG emissions – whilst tonnages are significant (approx. 2-4 million tonnes placed on market), the ranked position of these types relative to other packaging types is mainly due to the higher relative emissions from plastic on a per tonne basis (Figure 5-9). Other packaging types with large PoM volumes, such as glass beverage bottles and carton board, also show high GHG emissions.

The model also enables the comparison of the GHG emissions per use.

- For single-use (SU) items, every use means that one unit of packaging is manufactured, used and subsequently disposed.
- For multi-use (MU) (reusable) packaging, one unit of packaging can be used multiple times, and thus impacts from manufacture and waste management per unit are apportioned to each use according to the estimated number of uses before waste. Additional emissions for multi-use packaging from transport during reuse cycles and washing are also accounted for.

In nearly all cases, the use of multi-use packaging leads to lower GHG emissions over the lifecycle of the product. For multi-use, whilst manufacturing impacts are greater at first (due to more weight/volume of material used per unit compared to single use), once apportioned on a per use basis they are much lower than for single use packaging. Washing and transport emissions are not insignificant, however, these emissions are significantly outweighed in most cases by the greater per use emissions from manufacturing and waste management for single use items.

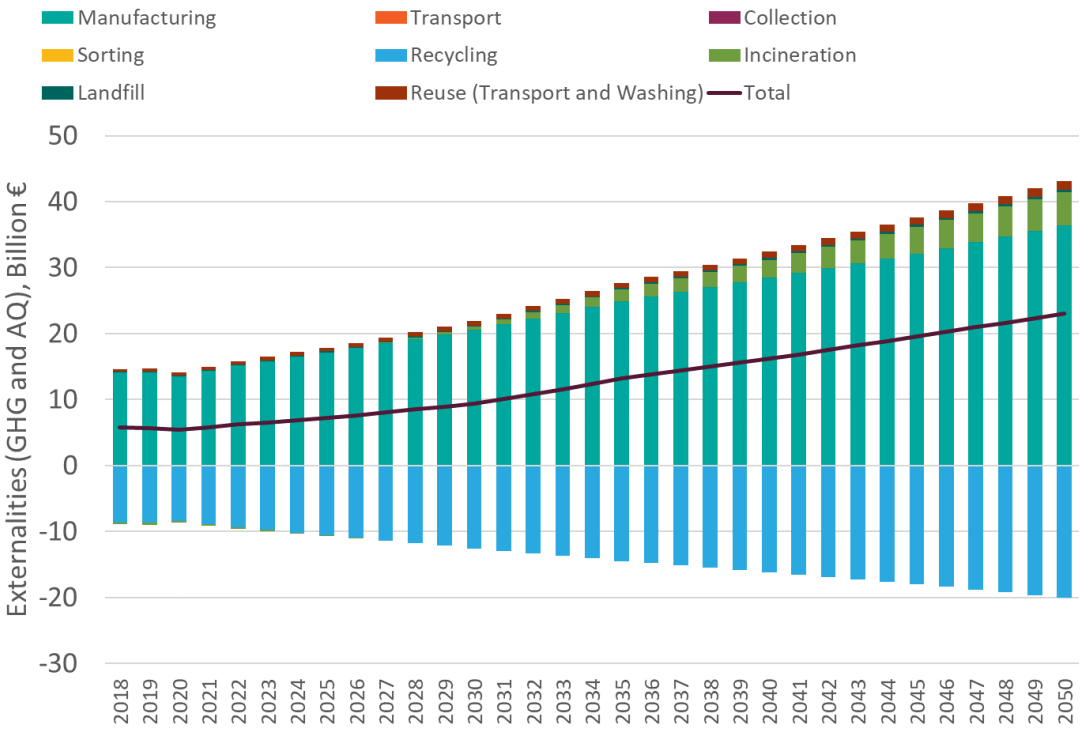
Figure 5-11 Greenhouse Gas Emissions, Thousand Tonnes CO_2e (2018)



5.4.2 Externalities

Environmental externalities include the combined damage costs of emissions from greenhouse gases and other air emissions, including substances such as NOx, SOx and particular matter. Externalities for the baseline over time are shown in Figure 5-12, which demonstrates similar trends in externalities as observed for GHG emissions (Figure 5-8). **Environmental externalities are projected to increase, from €5.8 billion in 2018 to €9.4 billion in 2030**, and potentially €23.1 billion by 2050 under business as usual.

Figure 5-12 Environmental Externalities (GHG and AQ), Billion €



5.4.3 Litter

Environmental benefits from the reduced disamenity of litter have been modelled in previous work, for example the recent impact assessment by ICF and Eunomia in support of the Single Use Plastics Directive.[54] These **have not been modelled in this study for various reasons**.

Firstly, none of the policies modelled directly target any reduction in the rate of littering. This is in contrast to policies such as DRS and Extended Producer Responsibility schemes for litter (as modelled in the SUP work) which do have a direct impact, that is, by reducing littering rates and increasing collection rates respectively.

Some reduction in littering is likely for many of the measures modelled in this study (see [reference to Synthesis report]. For example, waste prevention measures will lead to a lower

[54] ICF and Eunomia Research and Consulting Ltd (2018) *Plastics: Reuse, recycling and marine litter – Impact assessment of measures to reduce litter from single use plastics*, May 2018

tonnage of material placed on the market, and so, even if the littering rate – that is, the proportion of waste generated that is littered - remains unchanged, the tonnage of litter dropped will be lower. A similar outcome is likely for reusable packaging measures – with less single use packaging on the market there will be less potential for littering, even if consumer behaviour is largely unchanged (e.g. the rate of littering remains similar). Any reduction in littering, where it is likely to occur, is therefore more of a beneficial 'by-product' of the measures proposed, rather than a direct outcome.

Secondly, many of the measures proposed in this study lead to significant environmental benefits (prior to accounting for any benefit from reduced littering), for example, through a reduction in manufacturing, or increase in recycling. Any modelling of the reduction in litter disamenity would be in addition to these benefits, which already clearly demonstrate the benefit of many of the proposed measures quantified in this study. There is still a high degree of uncertainty on the precise value of the unit disamenity of litter, given the relatively few studies conducted on this to date. Due to these reasons, it was considered that the inclusion of littering in our environmental modelling would not improve the robustness of this study.

5.5 Implications

The baseline model provides a clear indication of how packaging and packaging are likely to develop up to 2050 based on current trends and if policy action is not taken. **The projected increase in packaging waste, both in absolute terms and per capita, suggests that the ambitions of the Commission for climate-neutral, resource-efficient economic growth with an increasingly circular economy set out in the European Green Deal are not compatible with a "no policy change" scenario**. Similarly a "no policy change" scenario will not achieve the objectives of reducing overpackaging and ensuring that all packaging on the EU market is reusable or recyclable in an economically viable way by 2030 as set out in the nCEAP and adopted in March 2020. The baseline model also indicates that **the packaging waste and packaging sector will continue to contribute substantially to GHG emissions through to 2030, inconsistent with climate change obligations**.

The baseline model is only one possible scenario, assuming that no new policies are put in place to achieve the climate-neutral, resource-efficient economic growth with an increasingly circular economy put forward in the European Green Deal. A range of measures to address the impacts of packaging and packaging waste and to facilitate reduction in packaging waste, reuse of packaging, recycling and reduce GHGs can be put in place, as shown in section 6.0.

5.6 Baseline Model Methodology

This section comprises an outline of the methodology used by the baseline model. A comprehensive explanation of the methodology is available in the Appendix B. The baseline model is informed by historic waste data and recycling rates. This data is used to make projections up to 2050, although where appropriate projections are limited to 2035 or 2040. Packaging waste projections are primarily informed by this historical data, whereas projections of future recycling rates take a range of drivers into account and the baseline model was informed by an assessment of the extent to which the selected drivers would influence recycling rates.

- Packaging Waste Generation/Consumption

Baseline model projections of packaging waste generation / consumption are based almost entirely on historic data. Overall waste generation projections were modelled using the historical relationship between waste generation, GDP and population using a linear mixed effects model[55] up to 2050. Before modelling the trends were further adjusted to properly account for the impact of lightweighting on waste generation. It was assumed that lightweighting trends would not continue, as in the past, and that unit weights for packaging would not change in the future.

- Packaging Waste Composition

Projections of packaging waste composition were made again using historical data from the EU-14. Only data from the EU-14 was used as this allowed the analysis to use time-series data going back to 1997. Compositional trends were only projected forward only to 2035, as it would not be feasible to reliably project packaging composition trends beyond this point. Therefore, as a conservative assumption, we have assumed that compositional trends remain flat - i.e. there is no change year on year in composition - from 2035 onwards.

- Methodology for Future Projections

The baseline model relies on historical market trends for packaging waste materials rather than predicting the growth of any particular material at above market trends for two main reasons. Firstly, the existing literature contains a range of reports with different views on how the use of different materials will grow in the packaging market. We do not view it appropriate for this report to take a view on whether one industry body report is more reliable than another. Relying on historic trends, rather opinion, ensures a degree of 'fair treatment' between producers of different packaging materials/types.

Secondly, in most cases, there is no compelling evidence that existing trends will significantly change in the future. Under a 'no change' policy scenario, we suggest that significant deviations from past trends in consumption are likely only for a limited range of packaging types. Overall, we believe this methodology provides a well-reasoned and conservative approach to projections of consumption / waste generation, and is the most sensible methodology to apply given the highly speculative nature of future predictions.
The exception to the above approach was compostable packaging which involves a relatively new packaging type and there is insufficient historic data to project a future trend. In the case of compostable packaging the model utilises projections from European Bioplastics.[56]

- Packaging Material and Packaging Type Level Recycling Rates

Historical packaging material recycling rates from Eurostat were used up to 2017/2018. The PPWD stipulates that Member States must meet recycling rate targets for packaging waste in 2025 and 2030. The 2018 Eurostat release of packaging waste by waste management operations suggests that 15 countries have already met their 2025 packaging waste recycling obligations. However, once Member States are obliged to report under the new calculation rules (for the 2020 reporting year onwards), this is likely to lead to a negative correction in recycling rates relative to those reported to date (under the old calculation rules). After accounting for new rules, loss rates and overreporting of PoM, there is a significant risk that some member states will not meet the 2025/30 packaging waste targets set out under the PPWD. Indeed,

[55] In R, using the R package LME4. https://cran.r-project.org/web/packages/lme4/lme4.pdf
[56] European Bioplastics (2019) Bioplastics Market Data 2019, *https://docs.european-bioplastics.org/publications/market_data/Report_Bioplastics_Market_Data_2019.pdf*

preliminary results from an EEA assessment identified 13 out of 19 assessed countries at medium or high risk of not meeting 2025 recycling targets for plastic packaging.

Given these risk assessments, it may be unrealistic to assume that member states will meet corresponding 2025/30 packaging waste recycling targets in the baseline model. In response, we have developed a methodology that adjusts when member states meet recycling targets to increase the accuracy of the tonnages predicted in the baseline model. The detailed methodology used to estimate actual member states recycling rates in 2025 and 2030 can be found in Appendix B – Baseline Methodology.

There was limited data available on the recycling rates of specific packaging types throughout the EU27. A 'synthetic' set of recycling rates were created based on a detailed review and analysis of UK packaging waste compositions and recycling tonnages recently conducted by Eunomia, which provides the most comprehensive set of packaging waste recycling rate data we are aware of for any European country.[57] The 'synthetic' recycling rate approach is used to provide a breakdown of recycling rates by packaging type (within each material category) and the overall material rate is determined by Eurostat and future PPWD targets. These were adjusted where appropriate to suit a Europe-wide waste management context. This 'synthetic' set of packaging recycling rates was internally consistent and illustrated the general stratification of recycling rates by packaging type. These recycling rates were then scaled to estimated recycling rates for each packaging type for every required data point in the model i.e. for all Member States and for all the model years (2006 to 2030).

5.7 Drivers of Recycling Rates

Alongside the PPWD targets a further eleven drivers of change in recycling behaviour were considered (see Table 5-3) in the determination of the baseline recycling rates. The impact of each driver was considered in a "low" and "high" impact scenario, and the baseline modelling team decided whether to apply the "low" or "high" impact scenario to the model, or to not incorporate the driver into the model at all.

Table 5-3 Drivers considered for baseline model

Driver	Impact	Rationale
PPWD targets	High	The targets will drive changes but will not be met.
Waste Framework Directive – Compostables	High	There is a significant possibility that the market for bioplastics will increase in future years.
Single Use Plastics Directive	Low	The method that Member States will choose to achieve the SUPD targets is not clear, and it is not apparent if this will shift behaviour to reusable alternatives.

[57] Derived by Eunomia from the most recent synthesis of waste composition data available

Driver	Impact	Rationale
Modulated EPR Fees	Low	Modulated fees are still in their infancy and the relative fees are not yet known for most Member States. A conservative assumption has been made that significant switches between packaging types will not occur.
Deposit Refund Schemes	Low	We have assumed that DRS schemes are implemented for plastic bottes only, driven by the collection targets set out in the SUPD. Whilst, in reality, other materials are likely to be included in any DRSs implemented, there is no explicit policy driver for this to take place.
EU Budget Contribution	Low	Member States do not choose to share the burden of the contribution with industry through taxation on virgin materials/ unrecycled packaging, or choose to do so, but to a limited extent that is insufficient to incentivise switches to recyclable packaging design/ types – minimal impact on recycling rates.
Landfill Directive Waste Framework Directive – Incineration of Recyclables Green Claims Food Contact Material Rules Circular Plastics Alliance Sustainable Products Initiative	Not Included	These changes are not defined in the model – as the model is calibrated based on the overall assumption of meeting recycling targets.

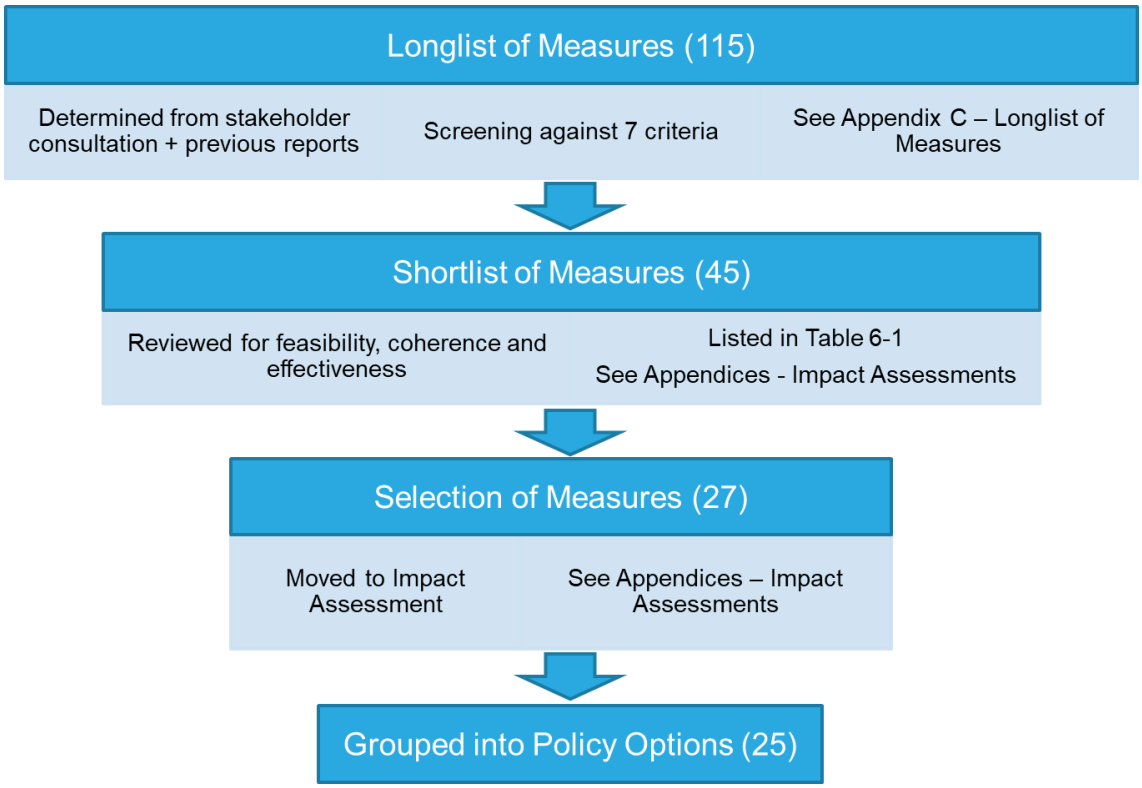
6 Measures

This section describes the intervention measures that were considered during the impact assessment stage of the project. The logic that underpins the interventions being considered was previously set out in Section 4.3. The eight intervention areas defined will be used as to group the measures: Waste Prevention, Reuse, Recyclability, Compostable Packaging, Hazardous substances, Recycled Content, Green Public Procurement (GPP) and Data & Reporting.

6.1 Measures selection process

Figure 6-1 shows the process for the determination and selection of measures:

Figure 6-1 Process for selecting measures



Firstly, a set of **longlist measures** were identified from the following sources:

- through reference to the Essential Requirements scoping study;
- stakeholder engagement, such as the Online Public Consultation, several workshops and dedicated interviews[58]; and
- stated objectives and measures in the Green Deal and nCEAP (e.g. implementation of recycled content targets).

This longlist with 115 proposals was screened against seven criteria, to determine if the proposal could be considered a "measure"; the seven criteria are:

[58] See Appendices F – Online Public Consultation and E – Stakeholder Synopsis Report

- The measure cannot be phrased as 'a measure' and/or at EU level;
- The measure does not treat Member States of different types / income levels fairly
- The measure does not treat different packaging materials fairly;
- The measure constrains the potential for innovation;
- The measure may lead to a further fragmentation of packaging across the single market;
- The measure is unfeasible to monitor and enforce; and
- The measure does not relate specifically to waste prevention and/or is already implemented.

If a longlisted measure met any of the seven limiting criteria, it was screened out from the process. Appendix C 'Longlist of measures' provides the long list of measures, and identifies those which have been screened out and why.

After the screening, 45 **shortlisted measures** remained, some with different variants (identified with a letter next the number of measure, e.g. measure 8a, measure 8b, etc.). The merits and drawbacks of each proposal were discussed with the Commission, and the measures that did not make sense (lack of coherence or appropriateness) were discarded.

After this elimination process, the 27 **selected measures** were taken forward to the impact assessment process described in section 6.4. The results of the impact assessment for each intervention area can be found in the technical appendices:

- Appendix H: Impact assessments for intervention area Waste Prevention
- Appendix I: Impact assessments for intervention area Reuse
- Appendix J: Impact assessments for intervention area Recyclability
- Appendix K: Impact assessments for intervention area Compostable Packaging
- Appendix L: Impact assessments for intervention area Hazardous substances
- Appendix M: Impact assessments for intervention area Recycled Content
- Appendix N: Impact assessments for intervention area Green Public Procurement
- Appendix O: Impact assessments for intervention area Data & Reporting

Finally, section 7.0 will propose **Policy Options**, which outline how the various measures are grouped together into coherent packages.

6.2 Shortlisted Measures

Table 6-1 shows the shortlisted measures by intervention area and columns represent different variants of the measures. In most cases the variants are alternative (either/or) with some exception where these can be implemented together (e.g. 21a and 21b). The combinations of measures into policy options will be further explored in section 7.0.

The measures in red and italics have not been selected for the impact assessment. In some cases the entire measure has not been selected while in other cases only certain variants have been taken forward. Further explanations for the reasons for being discarded can be found in the corresponding impact assessment annex for the intervention area.

Table 6-1 Shortlisted Measures

Intervention Area	#	Measure	Variant a	Variant b	Variant c
Waste Prevention	1	Over-arching changes to limiting criteria approach	/	/	/
Waste Prevention	2	Mandatory Member State reduction targets	Unit weight reduction	Kg per capita reduction – low	Kg per capita reduction - high
Waste Prevention	3	Best-in-Class weight limits	/	/	/
Waste Prevention	*4*	*Pack-to-product weight ratio limits*	*/*	*/*	*/*
Waste Prevention	5	Void space threshold limit	/	/	/
Waste Prevention	*6*	*Eco-modulation to incentivise light-weighting*	*/*	*/*	*/*
Waste Prevention	7	Phase out Avoidable / Unnecessary Packaging	/	/	/
Reuse	8	MS level sector by sector reuse targets	Voluntary targets (a)	Mandatory for selected groups – low level (b)	Mandatory for selected groups – high level (c)
			Requirement is that voluntary targets must be set (d)	*Mandate reuse of some tertiary packaging (e)*	*Target for reuse of some e-commerce packaging (f)*
			Mandating reuse of tertiary packaging (g)	*Targets for reuse within supply chains or within a specific sector (h)*	*/*
Reuse	9	Mandatory MS level overarching cross-sectoral reduction targets	*Target as % reduction of single-use items*	5% reduction to be met by reuse	10% reduction to be met by reuse
Reuse	10	Standardisation of reusable packaging and effective reuse systems	Commission to issue standardisation request to CEN (a)	Reusable packaging formats - mandatory and specified in legislation (b)	Reuse system - mandatory and specified in legislation (c)

Intervention Area	#	Measure	Variant a	Variant b	Variant c
			Guidance on best practise for reusable packaging (d)	/	/
Reuse	11	Business advisory body	Mandated formally at EU or national level	*Forum: informal EU or national level groups*	/
Reuse	12	Harmonised labelling for reusable packaging	/	/	/
Reuse	*13*	*Create a single market for reusable packaging*	*/*	*/*	*/*
Reuse	*14*	*Updates to the Essential Requirements and EPR considerations for reuse*	*Updating the Essential Requirements to better align with the waste hierarchy*	*EPR fee modulation for reusable packaging*	*Reusable packaging exempt from licensing obligations/EPR fees*
Reuse	*15*	*Reuse reporting in selected product/packaging groups*	*/*	*/*	*/*
Reuse	*16*	*Incentives for reusable models*	*Taxes on single use items*	*Levies on packaging for specific formats*	*Reduced VAT on refillable / reusable items*
Reuse	*17*	*Provision of funding for research and development*	*/*	*/*	*/*
Reuse	*18*	*Information campaigns on reuse*	*Promotion of reusable beverage cups*	*Promotion of marketability of reusable packaging*	*Promotion of environmental benefits of reuse and how to reduce packaging consumption*
Reuse	19	Harmonisation of when reusable packaging (including RTP) is classified as waste	/	/	/
Reuse	*20*	*Reusable tableware mandated in HORECA sector*	*/*	*/*	*/*
Recyclability	21	Updates to the Essential Requirements	All packaging shall be reusable or recyclable by 2030	All reusable packaging must be recyclable, (unless exemption)	/

Intervention Area	#	Measure	Variant a	Variant b	Variant c
Recyclability	22	Defining recyclable packaging	Qualitative definition in PPWD text (a)	Defined by use of design for recycling (DfR) methodologies (b)	Defined quantitatively by minimum recycling rate thresholds (c)
			Industry led voluntary DfR approach (d)	*/*	*/*
Recyclability	23	Harmonisation of EPR fee modulation criteria in an implementing act	/	/	/
Recyclability	*24*	*Defining high quality recycling*			
Recyclability	*25*	*Reducing packaging material complexity*	*restrict use of multiple materials/ polymers in a single item*	*restrict use of particular materials/polymers in packaging*	*ringfence use of particular materials for particular applications*
Recyclability	*26*	*Targets for separate collection/ recycling of packaging*	*separate collection targets for specific packaging types (a)*	*increase existing 2030 recycling targets for aluminium, plastic (b)*	*disaggregate existing 2030 recycling targets for some materials (c)*
			increased/disaggregated recycling targets by 2035 (d)		
Recyclability	27	Harmonised standards for labelling of recyclable packaging	*to include information on whether it is "recyclable" or not (a)*	*to include information on disposal instructions (b)*	to include information on material components (c)
			to include restrictions on use of particular confusing labels (d)	*to incentivise digital watermarking/ other traceability technologies (e)*	
Compostable Packaging	28	Updates to EN 13432	/	/	/
Compostable Packaging	29	Criteria prioritising applications for compostable plastics	Both compostable and conventional plastics can be placed on the market (a)	Mandating compostable packaging for specific applications (b)	Ban on compostable plastic for the applications under consideration (c)
			Mixed group of 29a and 29b (d)	/	/

Intervention Area	#	Measure	Variant a	Variant b	Variant c
Compostable Packaging	30	Harmonised labelling for compostable plastics	/	/	/
Hazardous Substances	31	Update 'hazardousness' in PPWD	/	/	/
Hazardous Substances	32	Expanding the information base on substances	Assessment of the information provided through SCIP notification	Assessment of substances with harmonised classification under CLP	Assessment of all substances used/present
Hazardous Substances	33	Restriction of hazardous substances	Under a new dedicated process under PPWD	/	/
Recycled Content	34	Requirements for recycled content in all packaging	*Updates to Essential Requirements operationalised through harmonised standards*	Introducing a mandatory reporting requirement for recycled content in all packaging	*/*
Recycled Content	35	Recycled content targets for plastic packaging	Material-specific target (a)	Product-specific targets (b)	Targets based on contact-sensitivity / broad application (c)
			Mandatory Recycled Content Targets for All Packaging (d)	/	/
Recycled Content	*36*	*Polymer substitution quotas*	*Resin manufacturers required to meet polymer based quotas + quality standards*	*Carbon border adjustment + ETS reform for plastics produced in primary forms*	
Recycled Content	37	Harmonised definition and measurement method	/	/	/
Recycled Content	*38*	*Harmonised standards for labelling of recycled content*	*pertaining to % of recycled content in packaging*	*RAG/ traffic light labelling*	*using QR codes (for further information only)*
Recycled Content	*39*	*Harmonisation of EPR fee modulation criteria for recycled content*	*/*	*/*	*/*
Green Public Procurement	40	Packaging criteria in GPP	Additional criteria on packaging added to the current (voluntary) GPP measures	Mandatory minimum packaging criteria for priority product and service areas	Mandatory minimum packaging criteria for all products and service areas

Intervention Area	#	Measure	Variant a	Variant b	Variant c
Green Public Procurement	41	Environmental award criteria	/	/	/
Data & Reporting	42	EPR reporting harmonisation and consolidation	EPR reporting harmonisation with de minimis threshold	[…] alongside Member State reporting of EPR data into the Commission	*[…] alongside PRO reporting of EPR data into the Commission*
Data & Reporting	*43*	*EU packaging compliance data portal*	*/*	*/*	*/*
Data & Reporting	*44*	*Member State enforcement reporting*	*/*	*/*	*/*
Data & Reporting	*45*	*Reinforcement of the Market Surveillance Authorities*	/	/	/

Looking at the selected measures, we can classify them according to the type of measures, as shown in Table 6-2 below.

Table 6-2 Classification of selected measures per type of measure

Intervention Area	A. Definition / Clarification / Standardisation	B. Criteria for market restrictions / Targets	C. Information (guidance, reporting)
Waste Prevention	M1 Over-arching changes to limiting criteria approach	M2 Mandatory MS reduction targets M3 Best-in-Class weight limits M4 Void space threshold limit M7 Phase out avoidable / unnecessary packaging	
Reuse	M10 Standardisation of reusable packaging and effective reuse systems M19 Harmonisation of when reusable packaging (including RTP) is classified as waste	M8 MS level sector-by-sector reuse targets M9 MS overarching cross-sectoral reduction targets	M11 Business advisory body M12 Requirement for all reusable packaging to be labelled as reusable using a harmonised European approach / logo

Intervention Area	A. Definition / Clarification / Standardisation	B. Criteria for market restrictions / Targets	C. Information (guidance, reporting)
Recyclability	M21 Updates to the Essential Requirements M23 Harmonisation of EPR fee modulation criteria in an implementing act	M22 Defining recyclable packaging	M27 Harmonised standards for labelling of recyclable packaging
Compostable Packaging	M28 Updates to EN 13432	M29 Criteria for compostable packaging	M30 Harmonised labelling
Hazardous Substances	M31 Update 'hazardousness' in PPWD	M33 Restriction of substances in packaging under the PPWD	M32 Reporting of hazardous substances in packaging
Recycled Content	M34 Requirements for recycled content in all packaging M37 Harmonised definition and measurement method	M35 Recycled content targets for packaging	
GPP		M40 Packaging criteria in GPP M41 Environmental award criteria	
Data & Reporting			M42 EPR reporting harmonisation and consolidation

In most intervention areas, we see that a combination of different types of measures has been proposed:

- Definitions (type A) are usually a pre-requisite for market restrictions (type B);
- Labelling requirements (type C) are closely linked with standardisation (type A);
- Reporting (type C) is needed to set and monitor targets (type B).

The interactions between the measures will be further explored in Section 7.0, where the measures will be grouped into Policy Options.

6.3 Selected measures

This section provides an overview of the selected measures per intervention area, along with the potential variants in how the measures are applied. Variants of measures are described as variant a, b and c. Interactions between measures in their intervention areas are also briefly discussed.

6.3.1 Waste Prevention

Table 6-3 Selected measures for intervention area Waste Prevention

#	Measure	Variant a	Variant b	Variant c
1	Over-arching changes to limiting criteria approach	/	/	/
2	Mandatory Member State reduction targets	Unit weight reduction	Kg per capita reduction – low	Kg per capita reduction - high
3	Best-in-Class weight limits	/	/	/
5	Void space threshold limit	/	/	/
7	Phase out avoidable / unnecessary packaging			

Waste prevention measures are intended to deal with the high levels of avoidable packaging identified in Section 2. Measure 1 **"Over-arching changes to limiting criteria approach"** would provide an enforceable definition of overpackaging, in contrast to the current requirement to minimise packaging. Marketing of products and standardisation in e-commerce packaging encourages larger than necessary packaging. Measure 2 **"Mandatory Member State reduction targets"** would apply across the single market equally in each member state, with achievable reductions to the average unit weight of packaging set for each material type. Measure 3 **"Best-in-Class weight limits (bottles and jars)"** would require packaging not weigh any more than the lowest weight with the product category, with a reasonable percentage extra weight allowed as not all manufacturers will be able to meet the absolute minimum. This would remove the most significant cases of overpackaging from the market over time. Measure 5 **"Void space threshold limit for selected sectors"** is intended to address instances where packaging contains significant void space, usually motivated by perceived marketing benefits of oversized packaging or economies of scale in e-commerce, where fewer box selections and the requirement to package product at high speed disincentivises time spend

optimally packaging products. The measure would set a maximum allowed void space ratio for product categories and would lead to the removal the most significant instances of void space on the market. Finally measure 7 "**Phase out avoidable / unnecessary packaging**" would effectively restrict certain packaging items from being placed on the market.

Measure 1, defining overpackaging clearly, is a prerequisite to the other measures. Measures 3 and 5 complement each other closely, both intended to eliminate the most egregious examples of overpackaging from the market. Measures 3, 5 and 7 can contribute to meeting the targets defined under Measure 2.

6.3.2 Reuse

Table 6-4 Selected measures for intervention area Reuse

#	Measure	Variant a	Variant b	Variant c
8	MS level sector by sector reuse targets	Voluntary targets	Mandatory for selected groups – low level	Mandatory for selected groups – high level
9	MS overarching cross-sectoral reduction targets	*Not assessed*	5% reduction to be met by reuse	10% reduction to be met by reuse
10	Standardisation of reusable packaging and effective reuse systems	Commission to issue standardisation request to CEN	Reusable packaging formats - mandatory and specified in legislation	Reuse system - mandatory and specified in legislation
11	Business advisory body	Mandated formally at EU or national level	*Not assessed*	/
12	Harmonised labelling for reusable packaging	/	/	/
19	Harmonisation of when reusable packaging (including RTP) is classified as waste	/	/	/

The reuse measures address the increase in single-use packaging and decline of reusable packaging identified in Section 2. Measure 8 **"MS level sector by sector reuse targets"** would require Member States set targets for a percentage of product sales/trips within a product category. Variant a would make these voluntary, while variant b would mandate targets and sanctions for not meeting these targets. Variant c would increase the ambition of the mandatory targets. Measure 9 **"MS overarching cross-sectoral reduction targets"** would mandate absolute reductions in packaging waste per capita with a proportion of this reduction achieved through reuse, with MS 'top down' reduction, again with variant c, more ambitious that variant b. Measure 10 is intended to support the development and optimisation of reusable packaging by the **"standardisation of reusable packaging and effective reuse systems"** either by issuing guidance on minimum standard (variant a), legislating requirement for reusable packaging (variant b) or going further and legislation for incentives, infrastructure and more

(variant c). The **"implementation of a business advisory body for reusable products and packaging" (measure 11)** would provide a means to monitor re-use levels, support the development and optimisation of re-use systems their adoption by industry and consumers. The measure of **"harmonised labelling for reusable packaging" (measure 12)** would both inform consumers and provide a mechanism which could help enforce re-use standards. Finally measure 19 "**Harmonisation of when reusable packaging (including RTP) is classified as waste**" seeks to eliminate barriers for reuse, and address inconsistencies across Member States.

All measures in this impact areas have a common objective of transitioning packaging away from single use solutions to reusable solutions. Measures 10, 11, 12 and 19 all support the development of reusable packaging to meet the targets set in measures 8 and 9.

6.3.3 Recyclability

Table 6-5 Selected measures for intervention area Recyclability

#	Measure	Variant a	Variant b	Variant c
21	Updates to the Essential Requirements	All packaging shall be reusable or recyclable by 2030	All reusable packaging must be recyclable, (unless exemption)	/
22	Defining recyclable packaging	Qualitative definition in PPWD text	Defined by use of design for recycling methodologies	Defined quantitatively by minimum recycling rate thresholds
23	Harmonisation of EPR fee modulation criteria in an implementing act	/	/	/
27	Harmonised standards for labelling of recyclable packaging	*Not assessed*	*Not assessed*	To include information on material components

The trend for increased use of packaging design features that inhibit recycling (see Section 2) is a risk to meeting recycling objectives. Measures in this impact area are intended to improve the recyclability of packaging.

Measure 21 **"All packaging shall be reusable or recyclable by 2030" (variant a)** is an upstream intervention to address a recycling barrier at source and ensure that packaging is fully recyclable. In addition energy recovery from incineration of non-recycled materials would no longer count towards recycling rates. Measure 21 **"All reusable packaging must be recyclable, unless there is a robust demonstrable case for exemption" (variant b)** would ensure that reusable packaging is also fully recyclable. Measure 22 takes the step of **"defining recyclable packaging"**. The recyclability of packaging is not just the type of material that packaging is made from, but also the economic, social and technical systems that collect, recover and constitute a market for the recovered material. Variant a would be to incorporate a qualitative definition of recyclable packaging, variant b would incorporate design for recycling (DfR) criteria into this definition while variant c would mandate a quantitative definition of recycling, where packaging is defined as recyclable if it is recycled over a defined

threshold in the EU. **"Harmonisation of EPR fee modulation criteria"** across the EU (measure 23) is intended to send clear and consistent price signals on packaging material and design for recyclability. The above measures are supported by measure 27c "harmonised standards for labelling of recyclable packaging", which provides transparency on producer actions and informs consumers.

Recyclability measures are closely linked, with an updated definitions of recyclability and recyclable material enabling the implementation of harmonised modulation fees and labelling. These measures work together to support a circular economy approach to packaging and packaging waste.

6.3.4 Compostable Packaging

Table 6-6 Selected measures for intervention area Compostable Packaging

#	Measure	Variant a	Variant b	Variant c
28	Updates to EN 13432	/	/	/
29	Criteria prioritising applications for compostable plastics	Both compostable and conventional plastics can be placed on the market (a)	Mandating compostable packaging for specific applications (b)	Ban on compostable plastic for the applications under consideration (c)
		Mixed group of 29a and 29b (d)	/	/
30	Harmonised labelling for compostable plastics	/	/	/

Section 2 identified the contamination of the recycling streams caused by compostable plastic packaging as a barrier to packaging circularity. The divergence of conditions required for the composting of packaging also present a risk to contamination of food waste treatment facilities. Measure 28 **"Updates to Standard EN 13432"** will further specify the concepts of biodegradability and compostability, and ensure actual composting conditions currently occurring within European biowaste treatment facilities are taken into account.

Three variants of measure 29 **"Criteria prioritising applications for compostable plastics"** are proposed, which include allowing both compostable and conventional plastics to be used in all applications, to require the use of compostable plastics in applications where they add value (assessment of this detailed in Appendix [Impact Assessment on compostable packaging], to ban compostable packaging in all applications or a combination of the first two variants. Finally, measure 30 **"Harmonised labelling for compostable plastics"** requires that compostable plastics are clearly labelled with guidance on proper disposal. It is likely that measure 30 would support the other measures through enabling compostable packaging to be disposed of correctly and mitigating risks of contamination.

6.3.5 Hazardous substances

Table 6-7 Selected measures for intervention area Hazardous substances

#	Measure	Variant a	Variant b	Variant c
31	Update 'hazardousness' in PPWD	/	/	/
32	Expanding the information base on substances	Assessment of the information provided through SCIP notification	Assessment of substances with harmonised classification under CLP	Assessment of all substances used/present
33	Restriction of hazardous substances	Under a new dedicated process under PPWD	/	/

Measures in this intervention area are intended to remove barriers to packaging recyclability by ensuring that hazardous substances are not present in packaging and to benefit health reducing the exposure of consumers and workers to hazardous substances in packaging. Measure 31 updates **"'hazardousness' in PPWD"** to include protection of human health and to consider the whole life-cycle of packaging, not just at end of life. The definition of hazardous substances would be updated to refer to substance lists from EU legislation and those that hamper recycling for safe and high-quality raw materials. At present there is little available information on chemicals within plastic packaging and it is suspected that the use of hazardous chemicals is extensive[59]. Measure 32 addresses this by **"expanding the information base on substances"** used in packaging. Variant a would require that chemicals in the SCIP database were analysed, variant b a larger group of chemicals with harmonised classification for chronic toxicity in the CLP regulation and variant c analysis of all substances used or contained in the packaging. The final measure in this impact area would address hazardous substances in packaging through **"Restriction of hazardous substances"** through a new dedicated process under PPWD.

The above measures work closely together, with measure 31 accurately defining the substances in scope and the impacts to be considered, measure 32 enabling hazardous substances in packaging to be identified and measure 33 restricting the use of these identified substances.

[59] Groh KJ, Backhaus T, Carney-Almroth B, Geueke B, Inostroza PA, Lennquist A, Maffini M, Leslie HA, Slunge D, Trasande L, Warhurst M, Muncke J. 2018. Chemicals associated with plastic packaging: Inventory and hazards. PeerJ Preprints

6.3.6 Recycled Content

Table 6-8 Selected measures for intervention area Recycled Content

#	Measure	Variant a	Variant b	Variant c
34	Requirements for recycled content in all packaging	*Not assessed*	Introducing a mandatory reporting requirement for recycled content in all packaging	/
35	Recycled content targets for plastic packaging	Material-specific target	Product-specific targets	Targets based on contact-sensitivity / broad application
37	Harmonised definition and measurement method	/	/	/

The problem definition carried out in section 2 identified low levels of uptake of recycled content in packaging. Measure 34 requires "**updates to the Essential Requirements**" for packaging to include recycled content (variant a) and for brands to report on the levels of recycled content in their packaging (variant b). Setting "**recycled content targets for packaging**" (measure 35) is intended to increase the utilisation of recycled materials and reduce the use of virgin materials as well as stimulating the market for recycled plastic. Variant a involves material-specific average targets and variant b product-specific targets for specific plastic packaging categories. A third variant (c) was defined via a combination of contact-sensitivity and broad application type. A "**harmonised definition and measurement method**" (measure 37) support measures 34 and 35 by ensuring the PPWD has a harmonised methodology for the calculation, reporting and verification of recycled content levels in packaging, as well as clarifying the definition of the term recycled content in the context of the packaging sector.

6.3.7 Green Public Procurement

Table 6-9 Selected measures for intervention area Green Public Procurement

#	Measure	Variant a	Variant b	Variant c
40	Packaging criteria in GPP	Additional criteria on packaging added to the current (voluntary) GPP measures	Mandatory minimum packaging criteria for priority product and service areas	Mandatory minimum packaging criteria for all products and service areas
41	Environmental award criteria	/	/	/

EU public expenditure on works, goods, and services is currently approximately €1.8 trillion per annum[60]. GPP therefore has the potential to contribute significantly to reduce environmental impacts, and contribute to local, regional, national, and international sustainability goals.

[60] European Commission (2016) *Buying green: A handbook on green public procurement, 3rd Edition*, 2016, http://ec.europa.eu/environment/gpp/pdf/Buying-Green-Handbook-3rd-Edition.pdf

Measure 40 to include **"Packaging criteria in GPP"** would add additional criteria to GPP measures to take into account the environmental impacts of packaging. This measure is presented with three levels of ambition. Variant 40a would add these criteria to existing voluntary GPP, variant 40b would require a mandatory minimum packaging criteria for high impact products and services and variant 40c would make minimum packaging criteria mandatory across public sector procurement (where packaging is used).

Measure 41 of introducing voluntary **"Environmental Award Criteria"** in public procurement is intended to encourage innovation and for suppliers to be rewarded for exceeding minimum standards. This would enable all suppliers to tender for a project where they meet the minimum standards, but for procurement processes incentivise innovation. Measure 41 would work alongside variants 40b and 40c, ensuring a minimum standard while encouraging suppliers to go beyond this minimum standard.

6.3.8 Data & Reporting

Table 6-10 Selected measures for intervention area Data & Reporting

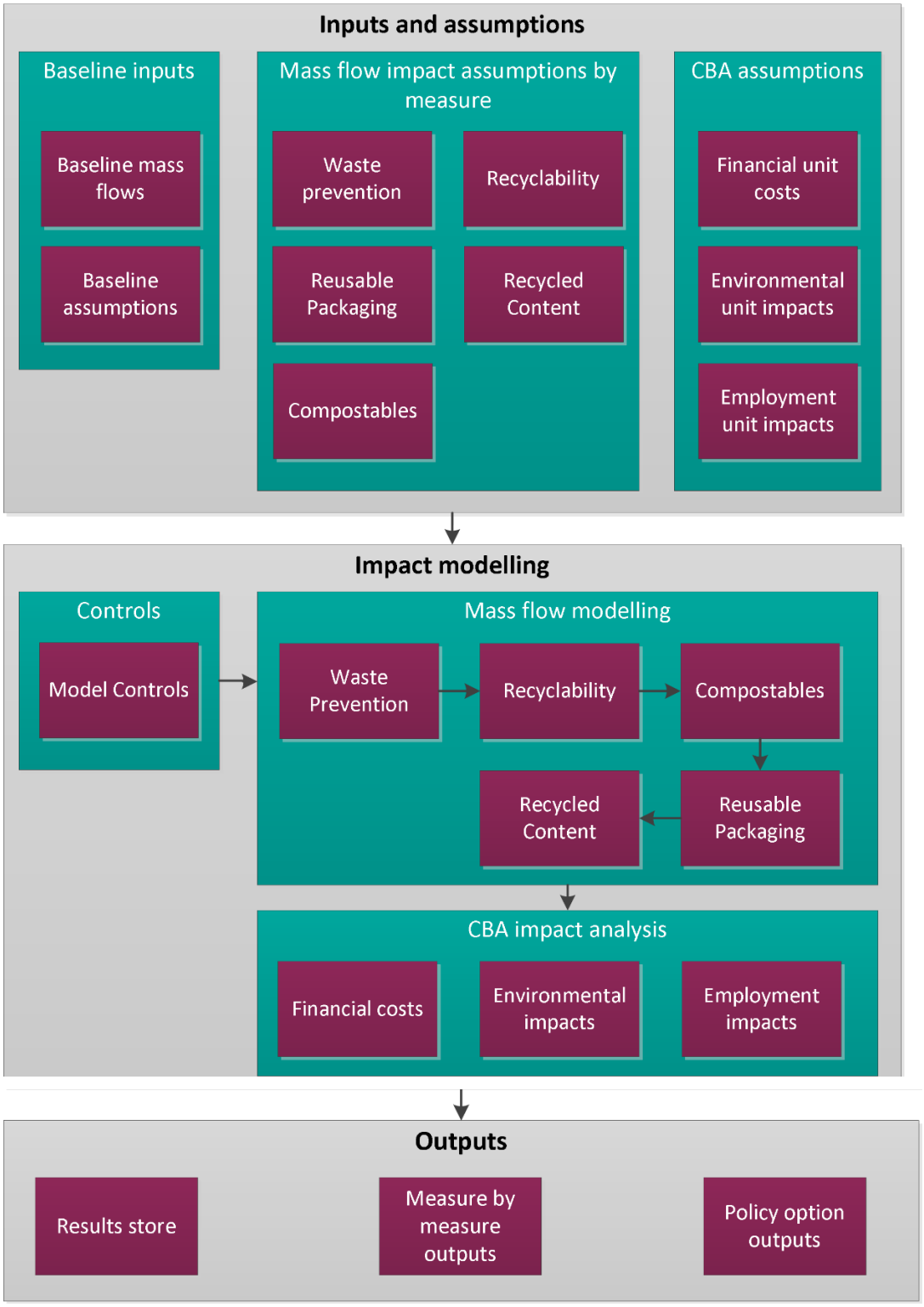
#	Measure	Variant a	Variant b	Variant c
42	EPR reporting harmonisation and consolidation	EPR reporting harmonisation with de minimis threshold	[…] alongside Member State reporting of EPR data into the Commission	*Not assessed*

Measures in the data and reporting impact area contribute to addressing all the problems identified in Section 2 and help ensure the functioning of the EU internal market. Measure 42 compels the **"EPR reporting harmonisation and consideration of packaging registries"**, streamlining the reporting process for producers operating across Member States. The granularity of data reported would be increased. Variant a would require data to be s passed directly to an EU level database, while variant b aggregates data at the Member State level before passing on to an EU database.

6.4 Impact assessment methodology

A cost-benefit analysis (CBA) model has been built to quantify the impacts of the measures relative to the baseline; see summary flow diagram in Figure 6-2 below. A full description of the impact modelling methodology and assumptions is available in Appendix D.

Figure 6-2 Flow diagram of CBA model



Specific modules have been designed for each of the intervention areas, each with the calculations required to model the specific processes that are modified by the measures. The impacts of the measures / combinations of measures for each of the measures have been modelled in a two-stage process.

- Firstly, the impacts on **mass flows** of the measures have been modelled, including the consumption, waste generation, and waste management routes for each packaging type, as well as additional data such as recycled content.
- The second modelling stage is to calculate the impacts, including **financial, environmental and social impacts**. Impacts are calculated by applying unit impact factors. These factors are defined in terms of the impacts per tonne, both in financial terms (€ per tonne), or impacts related to other environmental and social factors (e.g. greenhouse gas emissions, or employment impacts). These are calculated either within the model or sourced from existing data. A program of research will be required to obtain the parameters we need for these unit factors, including literature reviews and surveys with relevant stakeholders.

All impacts show the change driven by the measures relative to the baseline scenario (as described in Section 5) i.e**. impacts relate to the marginal chang**e in GHG emissions, financial costs etc. Where relevant, a selection of outputs is also reported in absolute terms (e.g. the recycling rate before and after the implementation of the measure) in addition to reporting the 'marginal' impact (e.g. the change in recycling rate).

The impact modelling is conducted over the relevant time period for each measure – most measures are assumed to be implemented in 2023, and for the magnitude of impacts to incrementally increase until the policy reaches its 'maximum' level of impact (generally in 2030). Where different timescales are specified in the measure, these timeframes are included in the modelling. In general, 2030 is the most relevant year for comparison with the baseline, with 2040 also providing a useful reference point.

Many of the policy measures proposed by this study have the potential for far-reaching and relatively complex impacts (e.g. across thousands of different packaging types). Furthermore, there are significant data gaps in many of the areas covered by this study, for example the commercially confidential nature of much of the cost data required for modelling, and the lack of cost data on emerging technologies. Impacts have therefore been quantified in this study only where there is data available to do so and a suitable methodology can be designed which is consistent with a 'proportionate evaluation'.[61] Where impacts are not quantified, a qualitative approach has been applied to include these in the analysis.

6.4.1 Waste Prevention and reuse

There is a strong link between the waste prevention and reuse measures, and this is most evident for measure 2 "Mandatory MS level reduction targets". Table 6-11 sets out the general specification of this measure, and the 'measures' modelled to achieve reduction targets. As can be seen, it is assumed that each intervention area – waste prevention and reuse – provides an equal (50/50) contribution to achieve the targets.

[61] See Better Regulation Toolbox #45: https://ec.europa.eu/info/sites/default/files/file_import/better-regulation-toolbox-45_en_0.pdf

Table 6-11 Modelling Specification for Measure 2

	Waste Prevention	Reuse
Overall reduction target (waste generation per capita by 2030 as a % of 2018 levels)	Measure 2b – 5% Measure 2c – 10%	
Contribution from each intervention area to meeting target	50%	50%
'Measures' modelled to achieve reduction targets	Measure 7 – phase out of unavoidable unnecessary packaging (and subsequent switch to reuse Measure 5 – Void space limit thresholds Also includes more general reductions in unit weight	Assumes the distribution of increases in reusable packaging is similar to that determined by Measure 8 (reuse targets)

Switches to reuse are modelled using predetermined magnitudes of switches from single-use to multi-use packaging / product types. As an example, it has been assumed that single-use primary plastic rigid food packaging (e.g. pots, tubs and trays) would switch to multi-use plastic packaging food refill scheme boxes (e.g. Loop): 50% plastic packaging and 50% steel packaging. The complete list of assumptions can be found in Appendix D – Impact modelling methodology. The model assumes that the types of changes that will take place (i.e. which packaging / product types are switched to reusable alternatives more) are broadly similar for both the sector by sector (M8) and cross-sectoral (M9) targets.

6.4.2 Recyclability

An initial review was conducted to determine, for each packaging type, the extent to which:

- The packaging is currently recycled at scale; and
- The packaging could be recycled at scale in the future using existing recycling technology

The impact modelling focuses on items types which cannot be recycled using current technology. To achieve 'recyclability' will require redesign/switching to more 'recyclable' packaging types and/or improvement in recycling technology – primarily chemical recycling as well as other innovative technologies. These packaging types are:

- Aluminium (Primary / consumer)
  - Flexibles e.g. foils
- Paper / board (Primary / consumer)
  - Beverage cartons
  - Non-beverage liquid packaging board e.g. soups
  - Other paper / board
- Plastic (Primary / consumer)
  - Rigid food e.g. pots, tubs and trays
  - Other rigids (non-beverage, non-food) e.g. blister packs
  - Multi-polymer/material stand-up pouches
  - Other mono/multi polymer/layer flexibles (excl. film)

- Films
- Other (Primary / consumer)
  - Miscellaneous (not included elsewhere)
- Plastic (Tertiary / transport)
  - Film and bubble pouches - e-commerce

The modelling methodology, including the implicit logic modelled for the baseline, is set out in Table 6-12 below.

Table 6-12 'Recyclability' Modelling Methodology

	Baseline	Scenario
Improved recycling collection / treatment based on existing waste management practises	Achieves recycling at scale (and therefore meets recyclability criteria) for packaging types that can be recycled using existing technology.	
Redesign – Including switches to more recyclable packaging types	Increases overall recycling rate sufficient to achieve 55% recycling by 2030	Further switching above and beyond the baseline, driven by requirement for 'recyclability'
Chemical recycling + other advanced recycling technologies	Some rollout, supports attainment of recycling rate targets	Further rollout to improve recycling rates of packaging and meet recycling rate threshold for quantitative definition of recyclability

6.4.3 Recycled Content

For this intervention are, measure 35 'Recycled Content targets for plastic packaging' was modelled in the CBA; however, only the first two variants were quantitatively assessed, which were later discarded.

6.4.4 Compostable Packaging

The CBA considered the proportion of material that would be switched from conventional packaging to compostable packaging under Measure 29. The food waste and the compostable plastics were assumed to be treated by a mix of composting and AD facilities, the proportion of which varies across Member States. The starting point for developing these assumptions was the European Reference Model on Municipal Solid Waste Management which sought data from Member States on their future waste treatment infrastructure; proportions were updated based on more recent knowledge of the market (tested with stakeholders) where appropriate.[62]

A key factor driving scenario impacts in the model is the level of contamination in food waste, measured as a percentage of the amount of plastic in the collected food waste. Assumptions in this respect are shown in

[62] Eunomia / CRI (2014) Development of a modelling tool on waste generation and management: Appendix 6 Environmental Modelling, Report for DG Environment

Table 6-13.

Table 6-13 Conventional Plastic contamination of food waste

	Business as Usual	Mandate Compost.	Ban Compost.	Both Allowed	Partial Mandate Compost.
Carrier bags	3.50%	0.20%	7.00%	2.80%	0.20%
Fruit / veg bags	0.70%	0.10%	1.00%	0.56%	0.10%
Fast food trays unsuitable for re-use	0.10%		0.10%	0.08%	0.08%
Tea bags			0.00%	0.00%	0.00%
Fruit labels	0.01%		0.01%	0.01%	0.00%
Coffee capsules / pods	0.10%		0.10%	0.08%	0.08%
Plastic film for perishables	0.20%	0.20%	0.20%	0.16%	0.16%
Films for food trays	0.20%	0.20%	0.20%	0.16%	0.16%
Trays for fruit	0.20%	0.20%	0.20%	0.16%	0.16%

6.4.5 Financial costs model

The financial impacts were modelled across the packaging lifecycle as follows:

- Changes in overall **waste management** costs were calculated by combining separate costs for recycling and residual waste management.
  - **Residual waste management** costs for incineration and landfill were obtained from the European Reference Model on Waste Management. [63]
  - For **recycling**, we assumed that the most realistic costs were likely to be those from an existing well-functioning EPR scheme, in this case, Fostplus in Belgium[64].
- For **reuse**, five schemes were considered and a methodology was designed to estimate the annualised capital and operational costs of reuse schemes, with cost assumptions derived on a per use basis.

6.4.6 Environmental impacts

One of the key assessed impacts is greenhouse gas emissions (GHG), which have been considered throughout the packaging lifecycle:

- **Impacts of manufacturing** comprise both primary energy-related emissions (e.g. from natural gas use) and electricity-related GHG emissions.

[63] Eunomia Research & Consulting (2015) *Further Development of the European Reference Model on Waste Generation and Management,* Report for European Commission Directorate-General for the Environment, May 2015, https://publications.europa.eu/en/publication-detail/-/publication/d188ce6e-9cac-11e5-b792-01aa75ed71a1/language-en

[64] https://www.fostplus.be/en/enterprises/your-declaration/rates

- **The benefits of recycling** were calculated by subtracting the GHG emissions of primary production from those of reprocessing. Reprocessing impacts are a function of the primary energy demand and electricity demand of the processes
- The emissions resulting from the **incineration and landfilling** were modelled using Eunomia's in-house waste treatment models[65], which calculate total process emissions (i.e. direct emissions arising at the facility), indirect energy-consumption related emissions, and energy generation (which displaces generation that would have produced GHG emissions).
- The emissions from **transport, collection and sorting** were calculated based on our experience of waste collection logistics modelling.

Emissions from air pollutants are included in the calculation of total externalities arising from product the product lifecycle. The pollutants accounted for in the modelling are:

- Ammonia (NH3);
- Nitrogen oxides (NOx);
- Particulates (PM2.5 and PM10);
- Sulfur dioxide (SO2), and;
- Volatile organic compounds (VOCs).

Also included in the externalities calculation are the damage costs associated with the GHG emissions, which use the per-tonne emissions costs provided by DG ENV (see Table 6-14).

Table 6-14 Climate Change Avoidance Cost of GHGs

Year	EUROS/tonne CO_2e	Year	EUROS/tonne CO_2e	Year	EUROS/tonne CO_2e
2020	€ 100.00	**2030**	€ 170.42	**2040**	€ 240.83
2021	€ 107.04	**2031**	€ 177.46	**2041**	€ 247.88
2022	€ 114.08	**2032**	€ 184.50	**2042**	€ 254.92
2023	€ 121.13	**2033**	€ 191.54	**2043**	€ 261.96
2024	€ 128.17	**2034**	€ 198.58	**2044**	€ 269.00
2025	€ 135.21	**2035**	€ 205.63	**2045**	€ 276.04
2026	€ 142.25	**2036**	€ 212.67	**2046**	€ 283.08
2027	€ 149.29	**2037**	€ 219.71	**2047**	€ 290.13
2028	€ 156.33	**2038**	€ 226.75	**2048**	€ 297.17
2029	€ 163.38	**2039**	€ 233.79	**2049**	€ 304.21

[65] These models are also the source of the data used to develop the European Reference Model on waste, which was used in the impact assessment of the Circular Economy Package for DG Environment.

Year	EUROS/tonne CO_2e	Year	EUROS/tonne CO_2e	Year	EUROS/tonne CO_2e
				2050	€ 311.25

Finally **water consumption** impacts were also modelled in a similar way as for the GHG emissions, by looking at the impacts per each phase of the lifecycle per material.

6.4.7 Social impacts

The modelled social impacts refer to **employment gain/loss** for each stage of the packaging lifecycle.

- Manufacturing jobs were calculated using an approximate methodology, based on a comparison of date relating to the value added per worker for each material type to producer turnover.
- The employment figures for various treatment and disposal options were sourced from previous Eunomia research conducted for the European Reference Model on Municipal Waste Management.
- The figures for reuse were calculated using the same approach to derive reuse costs, which is based on the five types of reuse schemes.

7 Options assessment

This section describes the possible regulatory and non-regulatory options for meeting the objectives set out in section 4.1, and thereby tackling the problems described in section 2.1. The logic that underpins the interventions being considered was previously set out in Section 4.3.

After the review of the impact assessments and consideration of stakeholder feedback, some measures were excluded from the options table, as described below:

Table 7-1 List of measures excluded from options table and reasons for exclusion

Intervention area	Measure excluded from options table	Reason for exclusion
Waste prevention	M2a Mandatory MS reduction targets - unit weight reduction	Per capita targets (M2b and M2c) are preferrable
Reuse	M8a MS level sector by sector reuse targets – Voluntary targets	Voluntary targets lacking effectiveness
Reuse	M9 Member States overarching cross-sectoral reduction targets	M9 has been included as part of M2b and M2c – a combined Member States waste prevention target that includes reuse
Compostable packaging	Criteria prioritising applications for compostable plastics: M29a Both compostable and conventional plastics can be placed on the market & M29b Mandating compostable packaging for specific applications	M29d has been defined as a combination of M29a and M29b, so these two are not included in the options table
Recycled Content	Recycled content targets for plastic packaging: M35a Material-specific target & M35b Product-specific targets	M35a and M35b were discarded after the impact assessment and the new variant M35c is added to the options table
Data & Reporting	M42a EPR reporting harmonisation with de minimis threshold	M42b is preferred since it provides visibility at EU-level

7.1 Description of options

This section describes how the selected measures (briefly described in section 6.2, and in more detail in Appendices H to O) have been grouped into different policy options, in increasing in ambition and difficulty of implementation, from option 1 to 6.

Table 7-2 Description of the 6 policy options

Option	Description
1	As described in section 5, the baseline scenario reflects the anticipated situation out to 2035 based on a **"no policy change" scenario**, i.e. it includes all relevant EU-level and national policies and measures which are assumed to continue in force, and reflects possible developments of these in the absence of new EU-level action.
2	Option 2 contains the measures related to the Essential Requirements, definitions and standards. These measures tend to be pre-requisites for measures in other groups, so they don't have much impact in isolation.
3 – low	Options 3 and 4 contain **measures of wide application** across packaging. Generally, we can find the lower ambition variants under Option 3 and their higher ambition counterpart under Option 4.
4 – high	
5 – low	Options 5 and 6 contain the **more targeted measures** (applying only to certain sectors or products), with low and high levels of ambition.
6 -high	

There is a **general trade-off between the impacts and the level of ambition**, as seen in the impact assessment annexes. Measures under options 4 and 6 are expected to have higher levels of positive impacts (environmental and social) but they are also expected to be more difficult to implement and/or may result in higher administrative burden or economic costs.

The measures and variants described in section 6, with the exclusions listed earlier in Table 7-1, have been assigned to each of the policy options 2 to 6, as shown in

Table 7-3 below. There is no duplication in the assignments, so each measure/variant is only present in one of the options. Therefore the preferred option has been built as a combination of some of the five options (excluding baseline). All of the measures can be considered complementary to each other with the exception of the following variants, which are exclusive:

- **M2 Mandatory MS reduction targets** – M2b low & M2c high;
- **M8 MS level sector by sector reuse targets** – M8b low & M8c high;
- **M29 Criteria for compostable Packaging** – M29c ban on compostables is exclusive to the other 3 variants (M29a, M29b and M29d) which allow compostables to be placed on the market;
- **M40 Mandatory minimum GPP packaging criteria** – M40b for priority product and service areas & M40c for all products.

The eight intervention areas have been simplified into four groups; under 'enabling measures' we can find those related to Green Public Procurement (GPP), hazardous substances, labelling and data & reporting.

Table 7-3 Policy options table [the preferred options are highlighted in green, described in section 7.2 below]

	Option 2	Option 3	Option 4	Option 5	Option 6
Prevention and reuse	M1 Over-arching changes to limiting criteria approach M10 Standardisation of reusable packaging and effective reuse systems M11 Business advisory body M12 Harmonised labelling for reusable packaging	M2b Mandatory MS reduction targets – low M8b MS level sector by sector reuse targets - low	M2b Mandatory MS reduction targets – high M8c MS level sector by sector reuse targets - high	M5 Void space threshold limits M7 Phase out avoidable / unnecessary packaging M19 Harmonisation of when reusable packaging (including RTP) is classified as waste	M3 Best-in-class weight limits
Recyclable and compostable	M21 Updates to the Essential Requirements M22a – Defining recyclable packaging - qualitatively M28 Updates to EN 13432	M22b – Defining recyclable packaging – DfR M29d Criteria for compostable Packaging – mix of 29a and 29b	M22c – Defining recyclable packaging - quantitatively M29c Criteria for compostable Packaging – ban on compostables	M23 Harmonisation of EPR fee modulation criteria in an implementing act	
Recycled Content	M34a Introducing a mandatory reporting requirement for recycled content in all packaging M37 Harmonised definition and measurement method	M35c Recycled content targets for plastic packaging – Targets based on contact sensitivity / broad application			
Enabling measures	M31 Update 'hazardousness' in PPWD M33 Restriction of hazardous substances M42b EPR reporting harmonisation with de minimis threshold alongside Member State reporting of EPR data into the Commission	M40b Mandatory minimum GPP packaging criteria for priority product and service areas	M40c Mandatory minimum GPP packaging criteria for all products and service areas	M27c Harmonised standards for labelling of recyclable packaging – to include information on material components	M41 Environmental award criteria M32 Expanding the information base on hazardous substances

7.2 Preferred option and impacts

The preferred option has been set as the combination of Options 2, 3 and 5.

- Measures under **Option 2** are pre-requisites for the rest of the measures since they clarify, align and update standards and definitions.
- **Options 3 and 5** contain the measures with lower level of ambition, which are considered to be proportionate in terms of balancing the trade-offs.

The preferred option has been modelled via the CBA (cost-benefit analysis) where the interplay between measures has been considered. Unless otherwise indicated, all figures shown in this section are the result of the CBA. Appendix P shows the impacts by Member State.

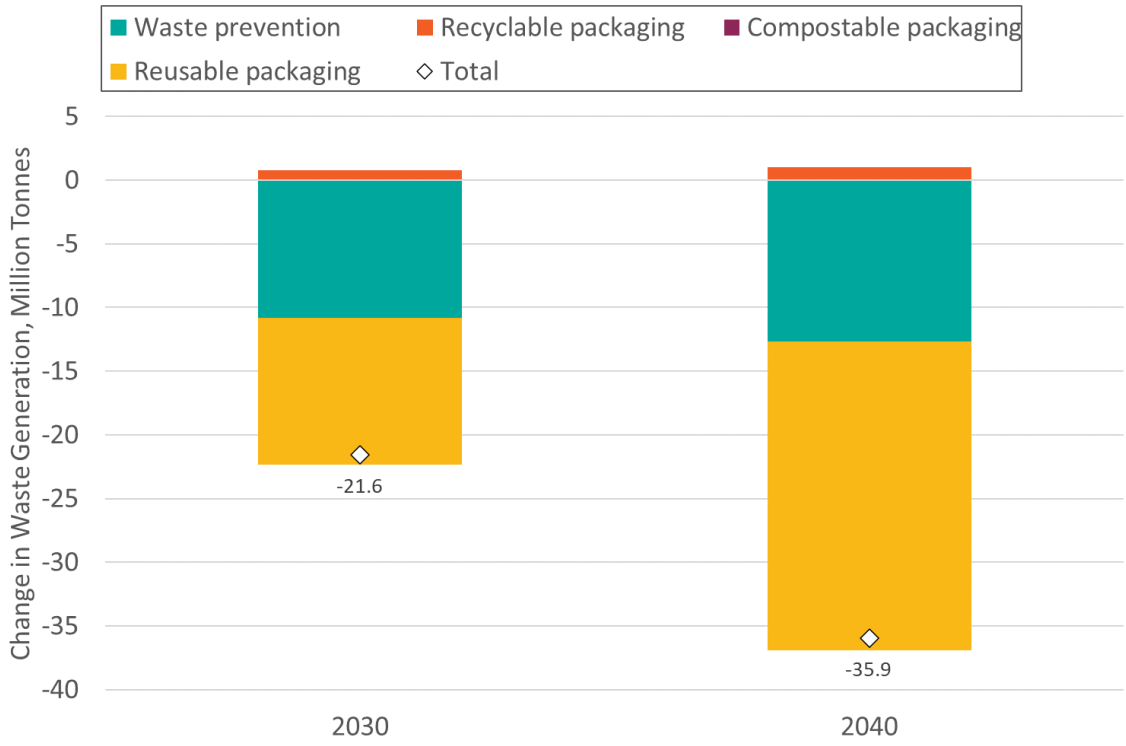
7.2.1 Mass flow impacts

Firstly, we discuss the impacts of the preferred option on the mass flows of packaging in the EU. These impacts relate to changes in overall waste generation, consumption and waste generation by packaging type, and the final destinations of packaging waste – recycling, landfill and incineration.

7.2.1.1 Waste Generation

The impacts of the preferred option on waste generation are shown in Figure 7-1.

Figure 7-1 Change in Waste Generation in Preferred Option Relative to Baseline, Million Tonnes



This demonstrates that the preferred option could lead to a **reduction in packaging waste generation, relative to the baseline, of 21.6 million tonnes by 2030, and 35.9 million tonnes in 2040**. In absolute terms, packaging waste generation in the preferred option is assumed to decrease from 77.8 million tonnes in 2018, to 70.8 million tonnes by 2030, and

then stay relatively constant from then onwards (70.6 million tonnes in 2040), as shown in Table 7-4.

Table 7-4 Packaging Waste Generation, Million Tonnes

	Baseline	Preferred Option	Change
2018	77.8	-	**-**
2030	92.4	70.8	**-21.6**
2040	106.6	70.7	**-35.9**

These changes are driven by the Member State reduction targets measure (M2b), which mandates a 10% reduction in waste generation per capita relative to 2018 levels by 2030. This is equivalent to an average reduction in packaging waste generation across the EU-27 from 174 kg per capita in 2018, to 158 kg per capita in 2030.[66] It is useful to note that, in the baseline, packaging waste generation is projected to increase to 206 kg per capita by 2030 (packaging consumption, and therefore waste generation, is strongly correlated with GDP growth). Therefore, there is a **net reduction in packaging waste generation of 48 kg per capita** in the preferred option relative to the baseline by 2030 - a percentage change of -23%. By 2040 there is a greater reduction of 81kg per capita (34% lower than the baseline in 2040).

As Figure 7-1 demonstrates (and as the measure specifies), half of this reduction is driven by 'waste prevention' measures i.e. phasing out of unavoidable/unnecessary packaging (bans), unit weight reductions and void space measures, and the remaining half from increased reuse (notwithstanding switches to reuse as a result of bans, which are categorised as a 'waste prevention' measure).

After the waste generation target is reached in 2030, it is assumed that waste generation per capita will remain constant thereafter. From 2030 onwards, GDP continues to increase, which, as discussed, drives further increases in the consumption of packaging (in both the baseline and preferred option). Within the baseline this drives a continued upward trend in packaging waste generation, thus further waste prevention is required to maintain waste generation at 2030 levels (in per capita terms). As 'waste prevention' measures are effectively 'fully' implemented by 2030 (i.e. bans have taken full effect, void space measures are implemented, and feasible unit weight reductions have been reached), further reductions in waste generation from 2030 onwards are achieved through further increases in reuse (i.e. the % of sales that are reused), as shown in Figure 7-1.

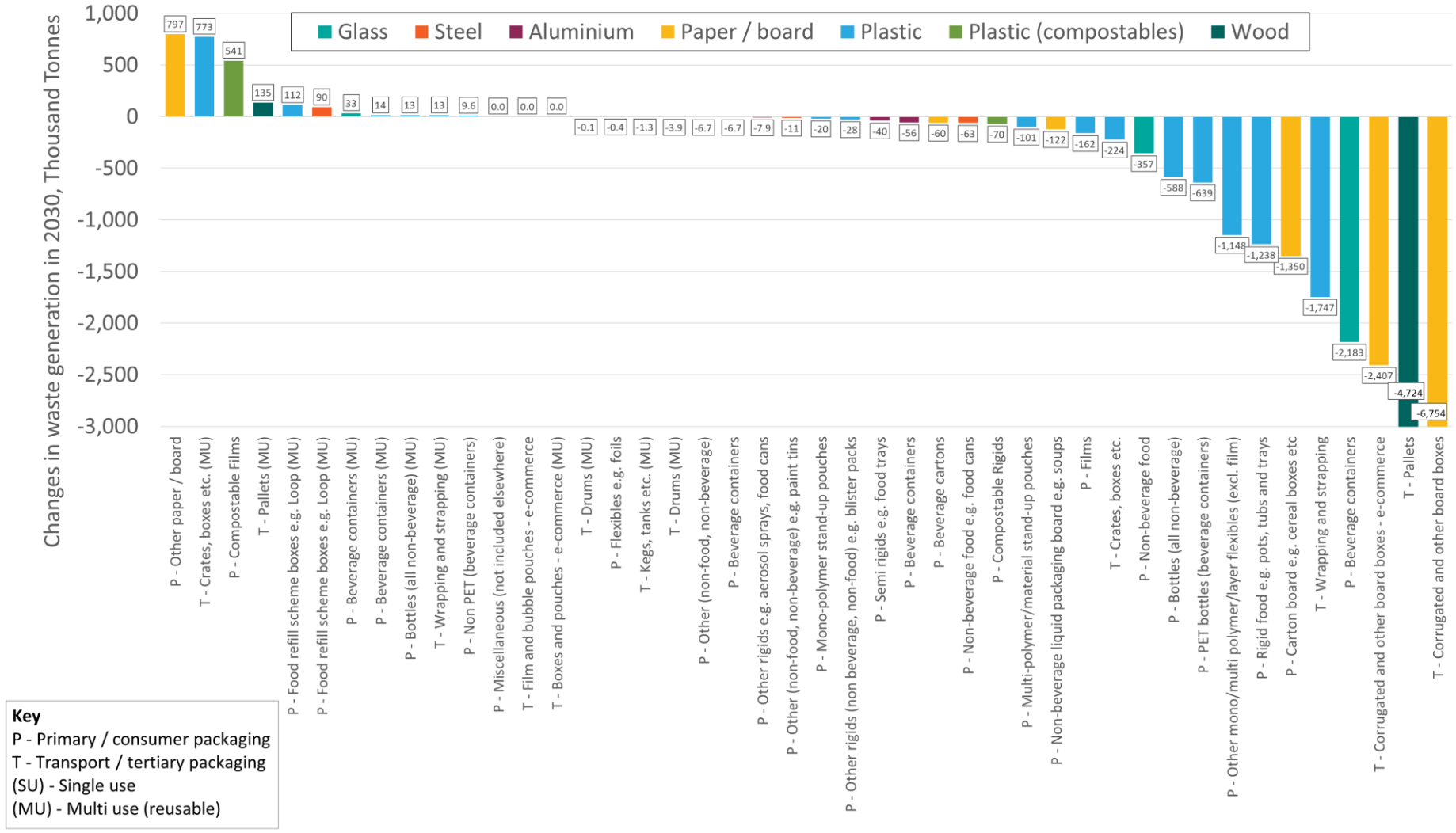
Finally, it should be noted that recyclability measures lead to a minor increase in waste generation. This is due to switches to more recyclable types, which are generally heavier than less recyclable packaging (e.g. rigid plastics are more recyclable but heavier than less recyclable alternatives, such as pouches).

7.2.1.2 Consumption by Packaging Type

Impacts of the preferred option on consumption patterns (i.e. switches from one packaging type to another) are shown in Figure 7-2.

[66] This is an average value – 2030 generation targets are calculated separately for each Member State based on 2018 generation data.

Figure 7-2 Change in Waste Generation in Preferred Option Relative to Baseline (2030), Thousand Tonnes



This chart shows the impact of measures from all the intervention areas included in the quantitative CBA (waste prevention, reuse, recyclability and compostable packaging) on packaging waste generation (which provides a proxy for consumption of packaging).

By far the most significant changes shown are switches from single use to multi-use packaging, i.e. reusable packaging that can be used multiple times prior to disposal. These impacts are a result of switches to reuse driven by the MS 'top down' reduction targets (measures 2b), which includes switches to reuse as a result of phasing out unavoidable/unnecessary packaging (measure 7).

The largest reductions in single use packaging are observed for wooden pallets and corrugated and other board boxes, due to increased reuse of tertiary packaging. As can be expected, the modelled increase in multi-use packaging waste (which is used multiple times before become waste, and so less units of packaging are required) is significantly lower than the reduction in single use packaging waste.

This chart also shows the specific impacts of other measures. These include switches driven by recyclability measures (21, 22a, 22b, 23), for example, from plastic flexibles and films to paper/board alternatives. The impact of the partial ban on conventional plastics specified by Measure 29d is also shown – driving an increase in consumption and waste generation of compostable films. In general, changes in waste generation of metal packaging is minimal, both as metals are a relatively minor component of packaging waste, and as there is already considerable reuse of tertiary metal packaging (such as steel drums etc.).

7.2.1.3 Recycling Rates

Final destinations of packaging waste are presented in Table 7-5.

Table 7-5 Final Destinations of Packaging Waste, %

	2018	2030			2040		
		Baseline	Preferred Option	Change	Baseline	Preferred Option	Change
Recycling	66.5%	69.6%	73.3%	+3.6pp	69.1%	74.9%	+5.7pp
Incineration	14.7%	20.4%	17.6%	-2.9pp	24.5%	19.3%	-5.1pp
Landfill	18.7%	9.9%	9.1%	-0.8pp	6.3%	5.7%	-0.6pp
Litter	0.1%	0.1%	0.1%	-	0.1%	0.1%	-

This table shows that recycling rates will increase by 3.6pp in 2030 for the preferred option relative to the baseline, and by 5.7pp in 2040. These changes results from the following measures:

- **Recyclability measures (21, 22a, 22b, 23)** - these measures increase recyclability for specific packaging types hence leading to increase in recycling rates. Switches from 'less' recyclable to 'more' recyclable packaging types are also

modelled – the latter having higher recycling rates and so leading to a net increase in overall rates.

- **Member State reduction targets (2b)** - as a results of bans, and the contribution to this target from increased reuse, packaging is switched from single use to multi use. Whilst the most significant impact of this is a reduction in waste generation, it also leads to improved recycling rates as when, after multiple uses, multi-use packaging becomes waste, it is generally recycled.

The individual recyclability measures operate over different timescales, and recyclability measures which take effect later (e.g. after 2030) contribute to the further increase in recycling rates from 2030 to 2040. This continued uplift in recycling rates is also a result of further increases in reuse from 2030 to 2040, as discussed in Section 7.2.1.2.

7.2.2 Economic impacts

Economic impacts of the preferred option are summarised in Table 7-6, which shows the contribution from measures from each intervention area. Cost impacts are borne by various types of economic actors, and impacts passed on indirectly via supply chains. Furthermore, economic impacts are relative to the position of each actor within the market i.e. a cost to one actor is a revenue to another. The actor to which impacts are measured relative to is indicated in brackets in the table below, using the following nomenclature: producers (P); various actors (V).

Table 7-6 Economic Impacts by Intervention Area in Preferred Option Relative to Baseline (2030), Million €

		Waste Prevention	Recyclable packaging	Compostable packaging	Reusable packaging	Total
Waste Management Costs (P)	Recycling	-2,742	870	-67	-2,388	**-4,327**
	Incineration	-227	-163	-6	-238	**-634**
	Landfill	-43	-14	0	-46	**-103**
Food waste treatment and contamination removal (P)		-	-	-118	-	**-118**
Avoided cost of one-way DRS schemes (P)		0	23	0	-377	**-353**
Direct Producer Costs (P)	Reduction in Sales /Turnover	15,380	-1,545	-2,279	45,905	**57,461**
	Material Costs	-4,329	21	0	-4,083	**-8,392**
Capital and operational costs of reuse schemes (V)		852	0	0	4,037	**4,889**

	Waste Prevention	Recyclable packaging	Compostable packaging	Reusable packaging	Total
Note: Negative values indicate a reduction in costs (i.e. a saving) relative to the baseline.					

The costs are described below for each cost category.

Waste management. As discussed in Section 7.2.1.1, a reduction in the growth of waste packaging is driven by the Member State reduction targets (2b), mainly through switches to reusable packaging. This leads to significant savings on EPR fees and one-way DRS, calculated to be -€5.5 billion by 2030 (across all measures), relative to the baseline. These savings accrue to producers, via reduced EPR fees and producer fees for one-way DRSs, however these are potentially passed on down the supply chain (i.e. to wholesalers, fillers, retailers, and finally consumers) through a reduction in the selling price of packaging.

For the reusable packaging that replaces single-use packaging, the annualised capital and operational costs of running reuse schemes are calculated at €4.9 billion in 2030, relative to the baseline. Ultimately, whether these costs are paid directly by retailers or producers, these are also likely to be passed on to consumers. These costs however may also be viewed as the basis of revenue for reusable packaging operators and reconditioners, as this amount represents a service sold.

It is also useful to note, that within the €5.5 billion net savings discussed above, the implementation of recyclability measures under the preferred option drives an increase in recycling rates, which leads to an increase in waste management costs of €716 million, due to increased costs of recycling via EPR schemes, and DRS producer fees.

Finally, implementation of the compostability measure 29d leads to a reduction in contamination from food waste in the conventional plastic recycling stream, giving rise to a saving of -€118 billion by 2030 relative to the baseline.

Turnover for packaging producers. The net change is calculated to be -€57 billion in 2030. This takes into account a decrease in the sales of single-use packaging and a smaller increase in sales for reusable packaging (the first time it is placed on the market, and not for subsequent rotations). This is a large sum, but it must be noted that this is turnover, rather than profit. To place this amount in context, a recent market report estimates the current size of the European packaging market to be €195 billion, so this represents approximately a quarter of total revenue (although this proportion will have reduced by 2030 as the packaging market grows over time)

This reduction in turnover also represents, to an extent, the cost saving to reusable packaging users from not having to buy single use packaging on an ongoing basis. This net reduction in turnover includes minor gains in turnover under the recyclable packaging and compostable packaging theme. Increased turnover is due to switches to packaging with a higher sales price, which is the general trend observed from modelled switches to more recyclable packaging types (under the recyclability measures) and from specific conventional packaging types to compostables.

Material Costs. These are calculated to be -€8.4 billion in 2030 (i.e. a saving) and represent the value of raw material that is no longer utilized as a result of reduction in packaging manufacture. For measures where packaging is light-weighted (i.e. void space threshold limits under measure 5, and general unit weight reductions under measure 2b) this is a saving that accrues to packaging producers. However for switches to reuse under measure 2b, the benefit

of this avoided cost is not captured by packaging producers, but instead is countered by the value that reusable packaging owners can generate from selling packaging multiple times as a service (accruing to reuse system operators), or the cost saving from not having to buy single use packaging on an ongoing basis (which accrues to reuse system users such as packer-fillers or consumers, depending on the reuse system in question). In both cases, material savings represent a loss to economic actors who produce and trade primary materials.

7.2.3 Environmental impacts

Modelling of environmental impacts includes the following types of emissions:

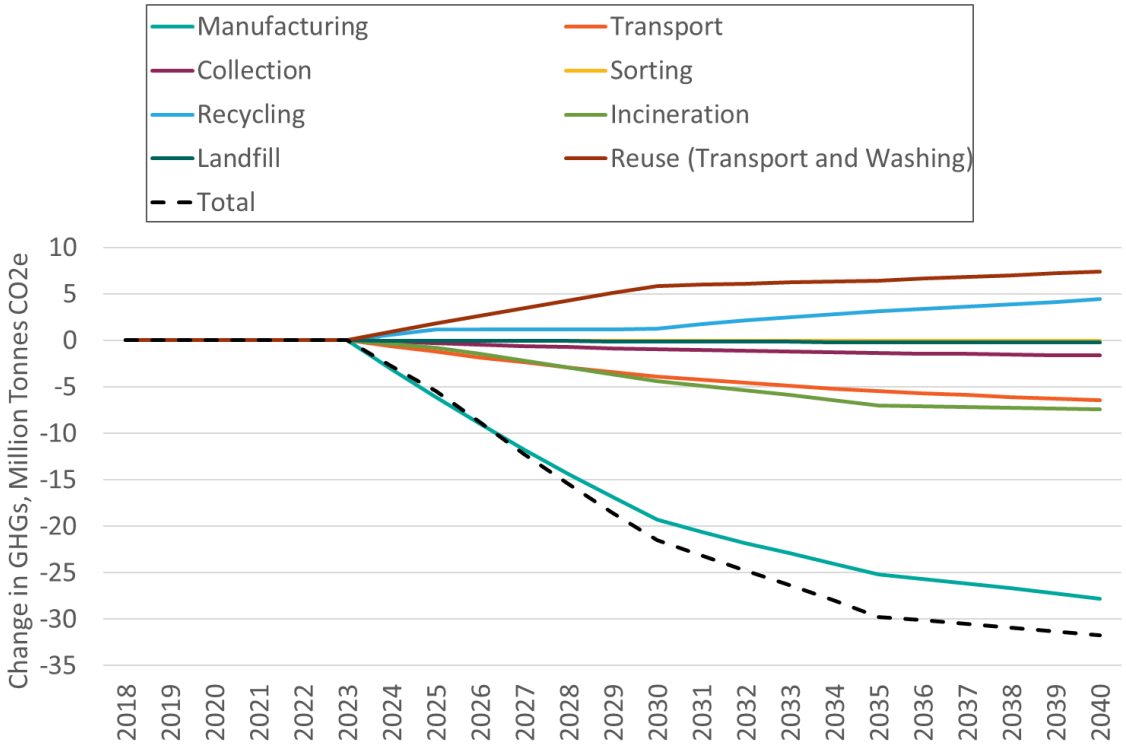
- **Manufacturing** – direct emissions and energy use from manufacturing. The model also accounts for reduced emissions when using manufacturing with a higher recycled (secondary) material content
- **Transport** – transport emissions from manufacture to retailer, and from waste collection depot to final waste destinations
- **Collection** – transport emissions from waste collection activities
- **Sorting** – emissions produced by mixed waste sorting processes
- **Recycling** – direct emissions from recycling process, and avoided GHG emissions through reduced use of raw materials in subsequent manufacturing
- **Incineration** – direct emissions and GHG avoided through energy generation
- **Landfill** – direct emissions and GHGs avoided through energy generation
- **Reuse** – emissions from transport and washing in reuse schemes

Greenhouse gas (GHG) impacts over time for the preferred option relative to the baseline are presented in Figure 7-3. This figure demonstrates modelled **savings of 21.5 million tonnes CO_2e in 2030 relative to the baseline, and 31.8 million tonnes CO_2e by 2040**. These GHG savings are equivalent to 0.7% and 1% of all greenhouse gas emissions in the EU-27.[67] As can be seen the bulk of these savings are from reduced emissions during manufacturing, resulting from the decrease in packaging placed on the market driven by switches to reusable packaging. Reductions are also achieved through a decrease in the transportation of packaging throughout the supply chain, including waste collection - with the exception of transport associated with reuse schemes, which are discussed further below.

The net impact of the preferred option is to decrease tonnages of waste going to all final destinations (driven by the overall reduction in waste generation). This includes recycling tonnages, which decrease in the preferred option despite gains in recycling rates. Reductions in residual disposal (landfill and incineration) lead to GHG savings (as these activities are net emitters of GHGs). The reduction in recycling has the opposite impact – resulting in a net gain in GHG emissions, as reduced recycling leads to a decrease in avoided GHG emissions (i.e., recycling activities would have led to negative emissions had they taken place, via the reduced use of raw materials in subsequent manufacturing). An increased rollout of reuse schemes also leads to an increase in GHG emissions, primarily from transportation of reusable packaging.

[67] Eurostat (2019) *Air emissions accounts by NACE Rev. 2 activity [env_ac_ainah_r2]*, Accessed 19th October 2021, http://appsso.eurostat.ec.europa.eu/nui/show.do?lang=en&dataset=env_ac_ainah_r2

Figure 7-3 Greenhouse Gas Impacts in Preferred Option Relative to Baseline, Million Tonnes CO_2e



GHG impacts in 2030 are also presented by intervention area in Table 7-7. As can be seen, **waste prevention and reusable packaging measures both lead to significant GHG savings**. Impacts through switches to reusable packaging result in significant savings associated with the manufacturing of packaging, although overall GHG savings are reduced by emissions associated with transport and washing activities for reusable schemes. Alongside this, reductions in unit weight driven by void space threshold limits (measure 5) and unit weight reductions - driven by MS reduction targets (measure 2b) - lead to further waste prevention, and thus a further decrease in manufacturing emissions for the waste prevention intervention area.

Although, the net impact of the preferred option, as discussed, is to reduce recycling tonnages, this impact is due mainly to the MS reduction targets (2b) under the waste prevention measures, which drive a reduction in waste generation. However, the marginal impact of the recyclability measures is to increase recycling tonnages through increased recycling rates (as well as, less significantly, a switch to heavier – more recyclable – packaging). This increased recycling activity leads to GHG savings under the recyclability measures. This same switch (to more recyclable, yet heavier packaging) is responsible for the increase in manufacturing emissions under the recyclability intervention area.

GHG savings are also achieved through the compostability measures, mainly as a result of increased manufacturing of compostable packaging rather than (fossil) plastic alternatives. Similar reasons lead to GHG savings from recycled content targets (measure 35a) – as these lead to increased use of secondary plastic during manufacturing, and reduced use of virgin plastic.

Table 7-7 Greenhouse Gas Impacts by Intervention Area in Preferred Option Relative to Baseline (2030), Thousand Tonnes CO_2e

	Waste prevention	Recyclable packaging	Compostable packaging[1]	Reusable packaging	Recycled content	Total
Manufacturing	-8,857	448	-1,069	-6,189	-3,593	**-19,260**
Transport	-1,943	140	0	-2,083	-	**-3,886**
Collection	-485	34	0	-520	-	**-971**
Sorting	-29	11	0	-31	-	**-49**
Recycling	3,316	-4,100	475	1,598	-	**+1,289**
Incineration	-1,309	-2,654	-374	-70	-	**-4,406**
Landfill	-74	13	0	-52	-	**-112**
Reuse[2]	1,456	0	0	4,413	-	**+5,869**
Total	**-7,925**	**-6,108**	**-967**	**-2,933**	**-3,593**	**-21,526**

Notes:

1. *The measure results in avoided food waste disposal – associated with food waste removed from source segregated organic treatment systems alongside conventional plastic removed as contamination. Where compostable packaging is used, this food waste is instead treated via AD or composting. These impacts are not included in the environmental modelling.*
2. *This relates to transport and washing emissions in reusable packaging schemes*

The change in externalities (GHG and air quality) associated with manufacturing, recycling, incineration and landfill are shown in Table 7-8. The values estimated by the CBA model do not include transport (from manufacturer to packaging user), collection and sorting, or reuse-associated activities (logistics and reconditioning), but the scope of the GHG emissions reported in Table 7-8 do include these impacts.

For these waste management and manufacturing activities, it is interesting to note that the **changes seen in GHG/AQ externalities are within the same order of magnitude as the reduction in the financial costs of waste management** (see Section 7.2.2).

Table 7-8 Change in Externalities (GHG and AQ) in Preferred Option Relative to Baseline, Million €

	2030	2040
Manufacturing	-5,579	-10,152
Recycling	1,106	2,719
Incineration	-561	-1,735
Landfill	-42	-80
Total	**-5,076**	**-9,248**

Change in water use is calculated at **-756 thousand m³ relative to the baseline by 2030, and -1,122 by 2040**. This is predominantly a result of the decreased weight of packaging placed on the market, associated with a decrease in water requirements during manufacture.

7.2.4 Social impacts

The impact of the preferred measure on employment is shown in Table 7-9. Overall, it can be seen, **an additional 1.3 million FTE jobs could be created by 2030** through the introduction of this package of measures. These impacts are largely due to the Member State waste prevention targets (M2b). This change in jobs arises from:

- Creation of 1.7 million jobs in the reuse sector
- Loss of 504k jobs in manufacturing, recycling and waste treatment industries, due to the reduced generation of packaging

This increase in employment would be equivalent to an increase in employment of approximately 0.7% across the EU, based on 2020 data.[68]

Table 7-9 Employment Impacts by Intervention Area in Preferred Option Relative to Baseline (2030), Thousand FTEs

	Waste prevention	Recyclable packaging	Compostable packaging	Reusable packaging	Total
Manufacturing	-125	13	13	-380	**-478**
Recycling (incl. collection)	-23	20	0.7	-18	**-20**

[68] Eurostat (2020) *Employment and activity by sex and age - annual data [lfsi_emp_a]*, Accessed 19th October 2021, https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=lfsi_emp_a&lang=en
This data relates to total employment (not FTEs), so in practice the increase in FTEs is likely to be greater given that some employment is part-time.

	Waste prevention	Recyclable packaging	Compostable packaging	Reusable packaging	Total
Residual Treatment (incl. collection)	-2.4	-1.4	0	-2.5	**-6.4**
Reuse Schemes	387	0	0	1,404	**1,791**
Total	**237**	**31**	**14**	**1,004**	**1,287**

7.3 Monitoring and evaluation framework

Effective monitoring and evaluation of many of the objectives associated with the revision of the Packaging and Packaging Waste Directive rely on harmonised and more detailed reporting of packaging placed on the market and the collection and recycling rates of different packaging materials. If implemented, measure 42 (EPR reporting harmonisation) should be able to provide much of the reporting framework needed to monitor many of the objectives identified. This harmonisation will directly support efforts to **ensure that enforcement mechanisms are effective whilst minimising administrative burden.** Additionally, market surveillance authorities should be empowered to support monitoring and evaluation activities at the level of obligated economic operators.

Monitoring any **increase in the uptake of reusable packaging** could be achieved through several avenues. First, through the existing reporting requirements as set out under point (a) of Article 12(3) of the PPWD. Under this Article, Member States are already obligated to report data on reusable packaging. Second, monitoring could happen on a system-by-system basis. Uptake of reusable packaging requires implementation of full reuse systems (e.g., refill on the go, return at home, etc.). These are often first introduced as discrete pilot studies and so monitoring and evaluation of performance will occur naturally. The information obtained through this channel could be used as an indication of uptake (although the findings will likely be localised and may not be representative of the wider EU context). Finally, as suggested under Measure 11a (business advisory body for reusable products and packaging: advisory bodies mandated formally at EU or national level), advisory bodies at either Member State or EU level could take a role in monitoring and evaluation uptake of reusable packaging. This role would require further definition.

Monitoring the objective of **increasing the level of recycled content** would require the introduction of mandatory reporting requirements for recycled content in all packaging. There is not yet an established reporting mechanism in place. However, measure 34b (introducing a mandatory reporting requirement for recycled content in all packaging) would require all economic operators to report data to Member States on the levels of recycled content in their packaging by 2025. This data would then be reported by Member States to the Commission, thus providing a suitable reporting mechanism for harvesting data that can be used to monitor and evaluate the level of recycled content in packaging. It is recommended that authorised bodies are used to certify the recycled content of packaging formats. These certification bodies

would provide evidence to economic operators which will then form part of their reporting obligations to the relevant Member States (who will then aggregate the data and pass it to the Commission). This would minimise the administrative burden on the Commission. Furthermore, under measure 35 (mandatory recycled content targets), a clear regulatory requirement for increased uptake of recycled plastic in plastic packaging would be defined. The level at which these targets would be set has not yet been specified. The detail of the proposed measure includes a provision that allows the Commission to revise the targets prior to 2030 (therefore likely before 2028) to ensure that they are suitably ambitious and technically relevant. This would provide a suitable method for evaluating performance and progress over time.

Evaluating efforts to **increase the recyclability of packaging** requires a standard approach to assessing recyclability and a reporting framework to enable gathering of the relevant data. Measure 22 of the Recyclability intervention area proposes methods for defining "recyclable packaging". One proposed approach is to use design for recycling (DfR) criteria to determine whether or not packaging is recyclable. This would create a standard approach to assessing recyclability which would then need to be accompanied by an appropriate reporting mechanism. Measure 42 (EPR reporting harmonisation) could provide the necessary reporting mechanism, including recyclability as a required data point.

In order to monitor efforts to **limit and/or reduce the amount of packaging waste generated**, Member States must report tonnages of packaging waste generated within their country. Furthermore, given parallel objectives designed to limit the amount of packaging that is placed on the market (e.g., through efforts to increase reuse etc.), Member States must also report tonnages of packaging that is placed on the market. The Commission already requires this data to be passed onto Eurostat under Annex III of the PPWD. Therefore, monitoring efforts to limit and/or reduce the amount of packaging waste generated would not require any additional reporting.

To understand the efficacy of activities designed to **reduce cross-contamination of compostable packaging in the recycling stream**, current levels of cross-contamination must first be understood and then progress against the baseline monitored. Existing studies investigating solely the contamination of conventional plastic recycling by compostable plastics are limited. Many Member States lack the market penetration of compostable plastics to justify such investigation. However, some quantification of the current status of the market in Italy has been conducted through survey data (although it is unclear if this is carried out regularly). Other surveys of contamination of plastic streams have been undertaken more generally, and whilst the contamination is sometimes broken down into streams, such reviews are reasonably limited in their granularity. Therefore, to enable monitoring, Member States should regularly undertake thorough surveying of waste streams to obtain the required data. This would then need to be reported to the Commission to allow evaluation of the performance and progress against the objective to occur. This could form part of the dataset that the Commission requires to be sent to Eurostat, as outlined in Annex III of the PPWD.

As described in section 2.1.2.3, lack of data on hazardous substances is a problem. Measure 32 "Expanding the information base on substances" was proposed with the aim to **more fully understand and then minimize the presence of hazardous substances within packaging.** However, this measure was not selected in the preferred options so the existing

mechanisms (SCIP notification, described in Impact Assessment for Hazardousness measures) will continue being used to monitor SVHCs.

Finally, monitoring the success of the objective **to ensure that labelling for consumers is relevant and clear** could be conducted through targeted consumer focus groups. These focus groups would be repeated with consumers across a number of Member States to verify if the findings are consistent across the EU.

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