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POLICY APPROACHES TO INCENTIVISE SUSTAINABLE PLASTIC DESIGN- ENVIRONMENT WORKING PAPER N°149

By Emma Watkins (1), Jean-Pierre Schweitzer (1), Eeva Leinala (2), Peter Börkey (2)

(1) IEEP (Institute for European Environmental Policy)

(2) OECD Environment Directorate

Authorised for publication by Rodolfo Lacy, Director, Environment Directorate.

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Abstract

POLICY APPROACHES TO INCENTIVISE SUSTAINABLE PLASTIC DESIGN

Plastics are an important material in the economy but present a challenge for waste management, resource efficiency and the environment. Low rates of recycling and high rates of environmental leakage represent key sustainability challenges for plastics as well as product designers and producers. The chemical composition of plastics, including their additives, create physical and toxicological barriers to 'closing the loop' on the material, and creates risks such as low quality secondary materials or ecological exposure to hazardous chemicals. A range of policy instruments can be applied to improve the sustainability of plastics, including regulations, market-based instruments, information and voluntary tools. The report reviews the current use of instruments in each of these categories, provides a number of good practice examples, such as product taxes and charges, eco-design standards, extended producer responsibility and environmental product labels, as well as discussing opportunities for their future applications.

JEL classification*:* Q55, Q58
Keywords*:* Plastics, Policy Instruments, circular economy, resource efficiency.

Résumé

APPROCHES POLITIQUES VISANT À ENCOURAGER LA CONCEPTION DE PLASTIQUES DURABLES

Les matières plastiques sont un matériau important dans l’économie mais ils représentent un défi pour la gestion des déchets, l’utilisation efficace des ressources et l’environnement. Les faibles taux de recyclage et les taux élevés de plastiques dans l’environnement représentent les principaux défis en matière de durabilité pour ce type de matière ainsi que pour les concepteurs et les producteurs de produits. La composition chimique des plastiques, y compris leurs additifs, crée des barrières physiques et toxicologiques à la création de boucles de matière, et crée des risques tels que des matériaux secondaires de qualité médiocre ou une exposition écologique à des produits chimiques dangereux. Une série d'instruments politiques peuvent être appliqués pour améliorer la durabilité des plastiques, y compris des réglementations, des instruments économiques, des outils d’information et des approches volontaires. Le rapport examine l'utilisation actuelle des instruments dans chacune de ces catégories, fournit un certain nombre d'exemples de bonnes pratiques, comme les taxes produit, les normes d’écoconception, la responsabilité élargie des producteurs et les labels environnementaux, ainsi que des opportunités pour de futures applications.

Codes JEL: Q55, Q58

Mots clés: Plastiques, Instruments politiques, économie circulaire, utilisation efficace des ressources.

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List of acronyms and Abbreviations

ABS	Acrylonitrile butadiene styrene
ASA	Acrylonitrile styrene acrylate
AUD	Australian dollar
BBI JU	Bio-based Industries Joint Undertaking
bn	Billion
BOS	Board of Supervisors (San Francisco)
BPA	Bisphenol A
BPI	Biodegradable Products Institute
CIEN	Chemical Information Exchange Network
CITEO	French PRO for packaging and paper waste
CLP	Classification, Labelling and Packaging of Substances and mixtures
CONAI	Consorzio Nazionale Imballaggi (Italian PRO for packaging waste)
CRV	California Redemption Value
CSR	Corporate social responsibility
DG	Directorate-General (European Commission department)
DIN CERTCO	German certification scheme
DKK	Danish krone
DRS	Deposit refund scheme
EKO-KOM	Czech PRO for packaging waste
EMAS	EU Eco-Management and Audit Scheme
EPD	Environmental Product Declarations
EPR	Extended producer responsibility
EPS	Expanded Polystyrene
EU	European Union
EuPC	European Plastics Converters
EUR	Euro
FCMs	Food contact materials
G20	Group of Twenty countries
G7	Group of Seven countries
GBP	British pound
GPP	Green public procurement

HDPE	High-density polyethylene
ILS	Israeli shekel
IOs	International organisations
ISO	International Organization for Standardization
kg	kilogram
LDPE/LLDPE	Low-density polyethylene/Linear Low Density Polyethylene
ME	Maine
MFDS	Ministry of Food and Drug Safety (Korea)
MIWA	Minimum Waste (Czech app supported grocery shopping system)
MSW	Municipal solid waste
NGO	Non-governmental organisation
NY	New York
OECD	Organisation for Economic Co-operation and Development
PA	Polyamide
PC	Polycarbonate
PCEP	Polyolefin Circular Economy Platform
PET	Polyethylene terephthalate
PP	Polypropylene
PRE	Plastics Recyclers Europe
PRO	Producer responsibility organisation
PS	Polystyrene
PUR	Polyurethane
PVC	Polyvinyl Chloride
REACH	Registration, Evaluation, Authorisation and Restriction of chemicals (EU Regulation)
SAN	Styrene acrylonitrile
SDGs	Sustainable development goals
SEK	Swedish krona
SIN	Substitute It Now
TÜV	Austrian certification scheme
UK	United Kingdom
UN	United Nations
UNEA	United Nations Environment Assembly
UNEP	United Nations Environment Programme

US/USA	United States of America
USD	US dollar
VAT	Value added tax
WHO	World Health Organization
ZAR	South African rand

Executive summary

Plastics are an important material in the economy but present a challenge for waste management, resource efficiency and the environment. Since 1950, approximately 8,300 million tonnes of plastic have been produced and 6,300 million tonnes of plastic waste have been generated, around 9% of which has been recycled, 12% incinerated, and 79% accumulated in landfills or leaked to the environment. Plastics are commonly made of fossil based feedstocks, but most plastics also contain additives which help to give them specific qualities or material properties. The average plastic contains 93% polymer resin and 7% additives. Low rates of recycling and high rates of environmental leakage represent key sustainability challenges for plastics as well as product designers and producers. The chemical composition of plastics, including their additives, create physical and toxicological barriers to 'closing the loop' on the material, and creates risks such as low quality secondary materials or ecological exposure to hazardous chemicals. A range of policy instruments can be applied to improve the sustainability of plastics, including:

Regulations, which can be used to develop frameworks for managing chemicals in plastic products, including bans or threshold concentration limits for toxins. Additionally, upstream measures (e.g. eco-design measures and requirements for recycled content) alongside waste treatment regulations (e.g. recycling targets and landfill bans) can provide demand/supply measures to increase the uptake of secondary plastics. Challenges exist in harmonizing chemicals, product and waste legislation to facilitate the use of secondary materials.

Market based instruments, which can incentivise changes in the plastics value chain that support sustainability. Taxes can be applied to penalise specific products (or chemical additives) and less preferable waste treatment practices (i.e. landfilling or incineration). Well-designed deposit refund schemes (DRS) and extended producer responsibility (EPR) policies can recover the costs of waste management, and help to create a market for products which prevent waste, or are easy to re-use or recycle.

Financing and investment, which can support the development of both up- and down-stream measures to support the sustainability of plastics. This includes the development of waste management infrastructure, and funding for research and development (R&D) in areas such as designing products for reuse and novel polymers (including bio-plastics). Green public procurement (GPP) provides a powerful measure reduce the environmental impact of public services and to leverage investment in green products. Challenges for investors include identifying knowledge gaps for plastics and avoiding infrastructural lock-in to inefficient and unsustainable practices such as landfilling and incineration. Development cooperation can also be used as a tool to support sustainable plastics in non-OECD countries.

Information and voluntary tools, such as certification and labelling, which can enable information exchange on plastics – particularly on material composition. Voluntary actions from industry including participation in information exchange, or increasing re-use or the recycled content in products, can accelerate sustainability of plastics. Technology can aid information flow, for example through app-based platforms for consumers including wider access to Environmental Product Declarations (EPD) for plastic products.

Many aspects related to plastics will likely require more horizontal and systemic policy making in the future. Key challenges include: the close coupling of plastics to fossil based feedstocks (reflected in the low price of virgin plastics), the potential for trade-offs between convenience and resource use if single-use products are avoided, and the risks of substituting plastics for alternative materials (e.g. resulting in increased emissions due to product weights, or biodiversity and land use impacts related to bio-based materials).

The design and implementation of policies to address the barriers to sustainability for plastics will demand a mix of instruments and measures at different governance levels. It will also require the engagement of all stakeholders, including national decision makers, those at regional, municipal and intergovernmental levels, as well as the private sector, civil society and consumers.

1. Aims, objectives and context

1.1. Aims and objectives

This document supported the OECD workshop *Design of 'Sustainable Plastics' From a Chemical Perspective*, held from 29-31 May 2018 in Copenhagen. The objective is to develop a better understanding of how policies can be used to improve the sustainability of different types and applications of plastics from a design perspective. This includes developing a clearer understanding of the typology of instruments which are relevant to plastics, providing examples of existing measures from across the OECD member countries, detecting gaps and opportunities for developing policies in the future, and identifying key stakeholders who are necessary to support the implementation of future policies.

This document is based on a literature review as well as informal discussions with several stakeholders, and was revised following the workshop in Copenhagen. In practice, a range of policies are necessary to address the sustainability of plastics, particularly because of the fundamental role the material plays in the economy and the challenges it presents for waste management. Rather than attempting to be exhaustive in reviewing existing practice or providing prescriptive policy recommendations, this document aims primarily to provide an overview of the types of policy instruments, and existing examples from OECD countries, that can be used to promote sustainable plastics.

1.2. Structure of this document

Chapters 2-5 introduce different types of policy measures which can be used to address the sustainability of plastics, including regulations, market based instruments, financing and investment, and information tools and voluntary approaches. For each chapter, an overview of the measures is followed by selected specific examples of instruments currently in place in OECD member countries.

Chapter 6 identifies gaps and opportunities for policy making on plastics and the final chapter suggests a roadmap for action, highlighting key stakeholders for different instruments and measures.

1.3. Context

Plastics are an important material in the economy. However, at the same time, plastics drive a range of negative environmental impacts through the use of materials and energy, as well as the generation of waste and emissions. Global policy makers have identified the need to improve the sustainability of plastics, yet a number of factors currently hinder 'closing the loop'[1] on the material.

[1] In contrast to a linear economy, a closed loop economy aims to minimise the input of virgin materials and use reduce waste through measures such as sharing, leasing, reuse, repair, refurbishment and recycling.

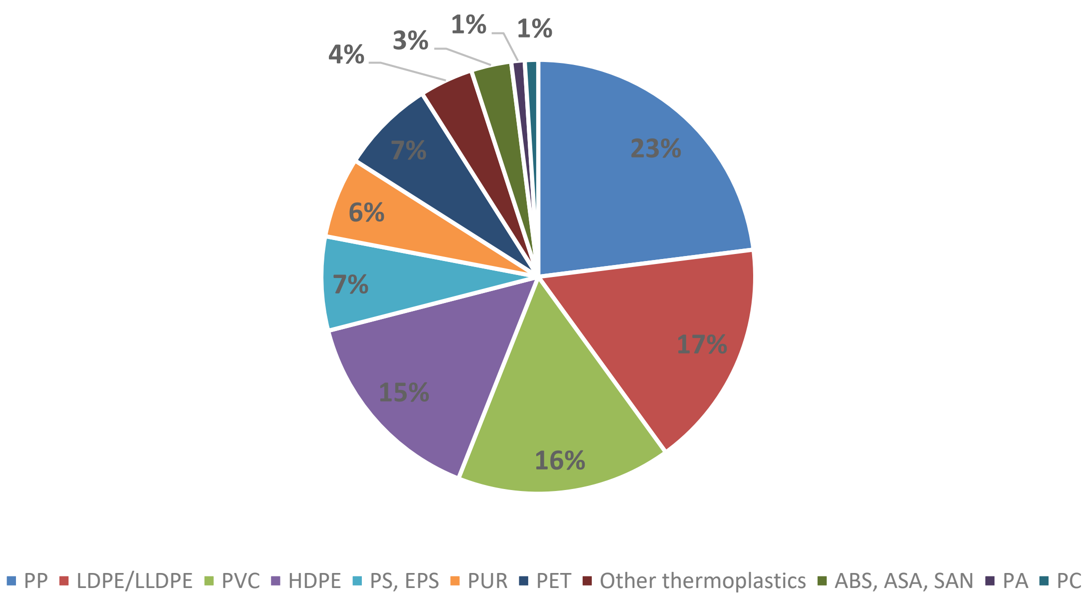
1.3.1. Plastic design, production and additives

Rapid growth in the manufacture and application of plastics has taken place over the course of the last half century, notably for packaging and other single use plastics which account for most plastics applications. Cumulatively, approximately 42% of all non-fibre plastics have been used for packaging (Geyer, R., Jambeck, J. R. and Law, K. L., 2017[1]). Global plastics production reached 322 million tonnes in 2015 (PlasticsEurope, 2018[2])

Production is closely coupled to fossil fuels which provide the sector's main feedstock – at least 90% of plastics produced globally are derived from fossil fuels (Bourguignon, 2017[3]). Meanwhile, plastics production accounts for approximately 4% of all fossil fuels extracted. In 2012, the CO_2 emissions generated from plastics production amounted to 390 million tonnes (Hopewell, J., Dvorak, R. and Kosior, E., 2009[4]; WEF, EMF and McKinsey&Company, 2016[5])

In addition to its fossil-based input, the plastics sector is also dependent on a range of chemical additives to sustain a wide range of products with highly diverse properties. The average (non-fibre) plastic contains 93% polymer resin and 7% additives. The most common additives (accounting for more than 75%) are plasticizers, fillers and flame retardants (Geyer, R., Jambeck, J. R. and Law, K. L., 2017[1]). The main types of plastics are shown in Figure 1.

Figure 1. Global demand for plastics by plastic type - % (of 269 million tonnes) (Plastics Europe, 2016)



The design of plastics plays an important role in determining the end-of life and potential secondary use of a product. For example, thermoset plastics (unlike many thermoplastics) are not recyclable using conventional mechanical recycling methods. This means some products are destined to be unrecyclable. Having said this, properties from that material, e.g. hardness and strength, might make it highly suitable for specific applications, including re-usable functions. In general, plastic product designers are tasked with overcoming complex trade-offs between the sustainability of a product, and other necessary functions, including product safety and economic costs. In many cases, determinants of sustainability including feedstocks, emissions, toxicity, and end-of-life will differ between materials and different plastics.

This document is focused on exploring policies which support the development of plastic products which are sustainable by design. Box 1.1 below introduces the topic of material substitution. Whilst this is not a key focus of this paper, policies should nevertheless be developed carefully in order to avoid unintended consequences from material substitutions.

Box 1.1 Material substitution and life cycle assessment

For many products, designers have a choice between using plastics or other materials (e.g. wood, glass and metal), and indeed combining several materials (as is often the case for multi-layered packaging). Substituting plastics for alternative materials could present an option for addressing sustainability issues, however it can also pose a risk to sustainability if alternative materials themselves have greater environmental impacts. A range of tools have been developed to carry out product environmental impact assessments such as input output models, and perhaps most notably Life Cycle Assessment (LCA). LCA are often used to identify potential trade-offs when developing products and policies.

A wealth of research now exists on the environmental performance of different products based on LCA analysis – see for example UNEP/SETAC[2]. Some research, including a report by the American Chemicals Council, suggests that substituting plastics for alternative materials in consumer goods may result in a net increase in environmental costs (Trucost, 2016[6]). However, other analysis is critical of an over reliance on LCA data to define product policy (for packaging in particular), as end-of life issues are potentially poorly integrated into methodologies (MacKerron, 2015[7]; Schweitzer, J.-P., Petsinaris, F. and Gionfra, S., 2018[8])

In practice, the suitability of a given material to a specific application is highly context dependent and takes into account many factors including functionality, convenience and safety, as well as environmental impacts. It is therefore not possible to make broad generalisations about material choice and sustainability. Furthermore, the environmental impacts of products may also be defined by factors outside the material and product design, including but not limited to feedstock choice, supply chain configurations and transport modes. This is well illustrated by research comparing reusable or single-use packaging options (WRAP, 2010[9]). Optimising product sustainability often therefore requires systemic thinking about a range of factors and their interrelations.

In 2018, the European Commission conducted research on single use plastic products which are commonly found as marine litter on beaches. This research includes examining the potential for product substitution – legislative proposals were published in May 2018 alongside an impact assessment of substitute products (EuropeanCommission, 2018a[10]).

[2] There is a joint life cycle initiative by the United Nations Environment Programme (UNEP) and the Society of Environmental Toxicology and Chemistry (SETAC) which provides information and resources on Life Cycle Assessment.

1.3.2. Plastic waste and environmental leakage

Compared to other materials, plastics tends to have low rates of re-use and recycling of plastic waste, additionally plastic products (particularly packaging and other single-use plastics) have short lifetimes (see Box 1.2.)

While the handling of plastic waste varies significantly between countries, negative externalities imposed by plastics have been experienced across the globe. A combination of factors have resulted in high rates of leakage of plastics into the terrestrial and marine environment, including poor waste management, perception of a low economic value of plastics, and technical challenges in recycling the material (WEF, EMF and McKinsey&Company, 2016[5]). It is estimated that approximately 8 million tonnes of plastics are released each year into the world's oceans (Jambeck, J. R., Geyer, R., Wilcox, C., Siegler, T. R., Perryman, M., Andrady, A., Narayan, R. and Law, K. L., 2015[11]; UNEP/MAP, 2015[12]), with 10 rivers in Asia and Africa[3] estimated to transport 88-95% of the global load of marine plastic debris from land-based sources to the sea (Schmidt, C., Krauth, T. and Wagner, S., 2017[13]). Recent estimates suggest there are currently around 150 million tonnes of plastics in the ocean (WEF, EMF and McKinsey&Company, 2016[5]). Once in the environment, plastics result in a range of ecological and socio-economic impacts (UNEP, 2014[14]).

Although evidence suggests that OECD countries are not the largest direct contributors to the leakage of plastics into the marine environment, it should be noted that:

- Global level data on sources, pathways and sinks of marine litter is still in its infancy and includes a high degree of uncertainty;
- OECD member countries are major producers, as well as exporters of plastics and of plastic waste, which may indirectly result in litter elsewhere; and
- As developed nations, OECD members have the potential to provide leadership on sustainable plastics through domestic policy and via development cooperation.

Box 1.2. "Production, use, and fate of all plastics ever made"

A recent study, combining present and historical data on plastics, including product, use, and end-of-life, has developed the first comprehensive global material flow for mass produced plastics. The analysis reveals that around 8,300 million tonnes of virgin plastics were produced between 1950 and 2015. Of this total, approximately 6,300 million tonnes of plastic waste was generated, around 9% of which was recycled, 12% incinerated and 79% accumulated in landfills or leaked to the environment. The study authors estimate that if current waste management trends continue, 12,000 million tonnes of plastic will be in landfills or the natural environment by 2050 (Geyer, R., Jambeck, J. R. and Law, K. L., 2017[1]).

[3] This comprises eight rivers in Asia (the Yangtze, Indus, Yellow, Hai, Meghna/Brahmaputra/Ganges, Pearl, Amur and Mekong) and two in Africa (the Nile and Niger).

1.3.3. Closing the loop on plastics

The international community is increasingly aware of these end-of-life impacts of plastics and the need to improve the sustainability of plastics has been acknowledged in a range of international and intergovernmental agreements, such as UNEA-2, the G7, G20, and the United Nations Sustainable Development Goals (SDGs) (ten Brink, P., Schweitzer, J.-P., Watkins, E. and Howe, M., 2016[15])

Considering the low rates of re-use and recycling of plastics, as well as the high rate of environmental leakage, key objectives to improve the sustainability of the material are to improve waste management globally and increase the uptake of plastics for secondary uses. This reflects broader resource efficiency objectives which are already established in many countries for a range of materials. It also recognises the overall need to reduce the material and carbon intensity of the economy as a whole and its associated environmental impacts.

As well as reducing negative environmental externalities from plastic waste, closing the loop on plastics has the potential to deliver a range of direct and indirect socio-economic benefits, including generating jobs in re-use and recycling industries, improving tourism amenities in coastal zones, and supporting fish stocks by reducing ghost fishing (Watkins, E., ten Brink, P., Mutafoglu, K., Withana, S., Schweitzer, J.-P., Russi, D., Kettunen, M. and Gitti, G., 2016[16]). There are also knowledge gaps about the potential environmental health impacts associated with microplastics, particularly in relation to their observation in a range of foods and bottled as well as tap water (TheLancetPlanetaryHealth, 2017[17]).

Many countries, including OECD member countries, have already developed policies to address the problematic aspects of plastics. However, efforts to close the loop on plastics face a number of barriers. Many of these barriers relate to the chemical nature of plastic products and their additives, notably:

- The potential risks posed by chemical additives in plastics to human health and to the environment;
- The information gap between waste and recycled plastics; and
- The quality of secondary plastics.

Some of these barriers are explained in more detail below.

Risks from chemical additive in plastics

As stated above, a range of different chemicals are commonly added to plastics to achieve certain qualities and material properties. Some of these additives may be hazardous to the environment and/or to human health, either directly or after reaching a certain threshold concentration. From a chemicals perspective, some plastic applications may therefore be particularly problematic, including plastics in contact with food (see Box 2.5. for more information), children's toys, or pipes used for public utilities (such as water supply and sewerage). For these applications, there may be a higher risk of chemical exposure. For example, chemicals may in some instances migrate from packaging to food and be ingested by consumers (Muncke, 2009[18]), with endocrine disrupting chemicals[4] of particular concern (SafeFoodAdvocacyEurope, 2015[19]).

Hazardous chemicals may also be persistent and remain in the environment for a long time without breaking down, and can bio-accumulate in animal tissue thereby increasing in concentration through the food chain. Persistent organic pollutants (POPs) are a group of chemical substances that are both persistent and bioaccumulative.

Studies have also found that plastic debris may adsorb POPs in seawater, and thereby serve as a mechanism to transport POPs from plastic marine litter into the food web (see e.g., (Teuten et al, 2009[20]; Wardrop, P., Shimeta, J., Nugegoda, D., Morrison, P. D., Miranda, A., Tang, M. and Clarke, B. O., 2016[21]). However, other analysis suggests the risks from absorbed POPs may be overstated (Lohmann, 2017[22]).

The presence of persistent, bioaccumulative and/or hazardous substances in plastics may drive environmental contamination caused by plastics as well as risks to human health, as they are released during plastic degradation (EuropeanCommission, 2016a[23]; Lithner, D., Larsson, Å. and Dave, G., 2011[24]) . For example, ecotoxicological analysis of three additives commonly used in plastics and other household products (bisphenol A (BPA), triclosan (TCS) and 4-nonylphenol (4-NP)), displayed toxicity for several common marine species. Toxicity thresholds tested at recorded environmental concentrations for coastal waters ranged between very low to high depending on the additive (Tato, T; Salgueiro-Gonzalez, N; Leon, V; Gonzalez, S; Beiras, R, 2018[25]).

1.3.4. Information on chemicals in recycled waste streams

As new information about plastics emerge and best practice on their use becomes available, their application and the nature of the plastics industry changes. New chemicals are developed and some existing ones are withdrawn, in particular if they are found to be hazardous to human health or to the environment. This means that by the end of a product's lifetime, when it becomes waste, it may contain chemicals that are now considered hazardous, sometimes referred to as 'legacy substances' (EuropeanCommission, 2018e[26]). In many cases, it is not obvious that such substances are contained in products, for example if products are not labelled, or information on chemical content is not traceable through the value chain. In such cases, where these products are recovered and the material recycled, the hazardous substance may enter the material recycling stream undiscovered. This has clear potential health, safety and environmental risks and can hamper the development of sustainable plastics.

1.3.5. The quality of secondary materials

The quality of secondary materials is one determinant of whether recyclates are a suitable substitute for virgin inputs for a given product. The chemical composition of a plastic, including factors such as the length of polymers and types of additives it contains, are key determinants of its material properties. Similar to other non-permanent materials, plastics cannot be recycled indefinitely and the material degrades with subsequent cycles (Conte,

[4] The World Health Organisation (WHO) defines an endocrine disruptor as "an exogenous substance or mixture that alters function(s) of the endocrine system and consequently causes adverse health effects in an intact organism, or its progeny, or (sub)populations" (Bergman, Å., Heindel, J. J., Jobling, S., Kidd, K. A. and Zoeller, T., 2013[117])

F; Dinkel, F; Kagi, T; Heim, T, 2014[27]). This results in recycling often in fact being 'downcycling', i.e. the use of material for gradually lower value uses.

Additives in plastics (either toxic or non-toxic) can also disrupt the recycling process by contaminating the material stream, making recycling and the production of high quality secondary material either difficult or impossible (Watkins, E., Gionfra, S., Schweitzer, J.-P., Pantzar, M., Janssens, C. and ten Brink, P., 2017[28]). One example is the use of opaque PET in plastic packaging. This causes problems for recyclers since it is difficult for recycling plants to distinguish from other materials such as (transparent) PET and HDPE, yet unlike those materials it is poorly recyclable due to its opacifier coating. Rapid growth in the use of opaque PET (up 45% since 2014 in France, for example), such as for cosmetic and dairy packaging, has caused a degradation of the quality of recyclates (ZeroWasteFrance, 2017[29]). Ensuring the quality of recycled plastics is a key challenge to ensure the sustainability of the material from a chemicals perspective.

2. Regulations

2.1. Overview of practice

The chemical industry is subject to regulations, due to the safety risks and environmental impacts associated with both the derived products and the manufacturing processes. Plastics represent one of the main materials produced from the industry. Reducing the use of substances of concern and substituting them with less harmful alternatives may contribute to the first step of the waste hierarchy: prevention. Synergies between waste and chemicals policy objectives are being explored and are giving rise to a policy mix among governments, industries, local authorities and international organizations aimed at minimising the negative impacts of the chemicals industry and its products (OECD, 2001[30]; EuropeanCommission, 2018c[31])

Instruments of regulatory nature have been adopted in OECD countries and beyond and applied to the chemicals industry's products, such as plastic items, or to specific chemicals or uses (OECD, 2001[30]). Regulatory measures include:

- **UN and other conventions** – Conventions represent agreements among countries through which regulations are then formulated. Three UN conventions on chemicals and waste have been agreed on until now (see Box 2.1. below), presenting some aspects of relevance for the design of more sustainable plastics.
- **National and EU-wide regulations** – The objectives of such regulations include minimising the risks posed by chemicals to humans and the environment, regulating the placement of products containing exceeding levels of allowed chemicals on the market, setting rules over migration limits and authorised substances in plastics in contact with food.
- **Product bans** – Banning specific products (e.g. single-use plastic bags in France[5]) can lead to technological changes and product substitution.
- **Chemicals bans** – Banning specific chemicals such as BPA can incentivise green chemical innovation.
- **Products standards and specifications** – Standards and specifications are applied to specific products or applications (e.g. food contact materials) and determine requirements and restrictions on hazardous substances.

[5] The ban is applied to single-use plastics bags of less than 50 microns

Box 2.1. Examples of regulatory actions on plastics and chemicals

1989 UN Basel Convention on the control of transboundary movements of hazardous wastes and their disposal[6]

1998 UN Rotterdam Convention on the prior informed consent procedure for certain hazardous chemicals and pesticides in international trade[7]

2001 UN Stockholm Convention on Persistent Organic Pollutants[8]

2003 EU Restriction of the Use of Certain Hazardous Substances (RoHS I)

2007 EU regulation for the Registration, Evaluation, Authorisation and Restriction of chemicals (REACH)

2011 EU Regulation on plastic materials and articles intended to come into contact with food

2011 EU ban on BPA in products that come into direct contact with food for babies and young children

2011 EU Restriction of the Use of Certain Hazardous Substances (RoHS II)

2011 Korean Food Sanitation Act (Article 8)

2016 Washington D.C ban on extended polystyrene food service products

2017 France's ban on single-sue plastic bags (less than 50 microns)[9]

2018 Italy's regulations on the commercialisation of non-biodegradable non-compostable plastic bags[10]

2018 China's restrictions on certain plastic waste imports

2.2. Examples of existing practice

Regulations: Regulations can be used to set specific standards on the use of chemicals, such measures can support a shift to safer alternatives and stimulate innovation. An example is given by the EU Regulation (EC 1907/2006) for the Registration, Evaluation, Authorisation and Restriction of chemicals (REACH), adopted in 2007, which is the most comprehensive regulation on chemicals, generating an impact on most industrial sectors and industries in the EU. REACH is complemented by the regulation (EC 1272/2008) for

[6] http://www.basel.int/Portals/4/Basel%20Convention/docs/text/BaselConventionText-e.pdf

[7] https://treaties.un.org/pages/ViewDetails.aspx?src=IND&mtdsg_no=XXVII-14&chapter=27&lang=en

[8] http://chm.pops.int/Portals/0/Repository/convention_text/UNEP-POPS-COP-CONVTEXT-FULL.English.PDF

[9] https://www.planete-energies.com/en/medias/close/france-s-single-use-plastic-bag-regulation

[10] From 1st January 2018, plastic bags allowed for commercialisation (intended as free of charge or with a fee applied) are biodegradable, compostable or lightweight bags with a minimum of 40% renewable raw materials (percentage to be increased in following years). See: http://www.minambiente.it/comunicati/shopper-ecco-la-circolare-ministeriale-intepretativa

the Classification, Labelling and Packaging of Substances and mixtures (CPL), which ensures transparency over the hazards associated with chemicals (EuropeanChemicalsAgency, 2015[32]).

In addition, regulations are applied as a way to restrict the production and commercialization of specific products, such as food contact materials, that contain harmful substances (e.g. Article 8 of the Korean Food Sanitation Act, see Box 2.2. below). Another example is Regulation (EU) No 10/2011 on Plastic Materials and Articles which sets out rules on the substances allowed in the manufacturing of plastics food contact materials, as well as specific concentration limits and requirements for a declaration of compliance. The Regulation does not cover varnishes and coatings, metals and alloys, printing inks and adhesives (EuropeanCommission, 2011b[33]; SafeFoodAdvocacyEurope, 2016[34]).

Bans and phase-outs: Bans and phase-outs on specific chemicals or products have been introduced in several OECD countries, as well as regulatory measures applying to specific uses (e.g. cosmetics) (see Box 2.3. below). These are generally the result of growing concerns and evidence over health and/or environmental impacts, and aim at stimulating technological and behavioural changes. For example, bans on single-use plastic bags bans have been adopted in several countries and municipalities, including: 132 cities in the US, the city of São Paulo in Brazil (2007), the city of Paris (2007), France (2017) and Australia. In addition, regulations on non-biodegradable plastics items have been applied or approved in several OECD countries (e.g. non-biodegradable plastic bags and cotton bud stick in Italy[11]).

Standards: Standards applied to plastic products are instrumental in ensuring the quality, reliability and safe utilization for both manufacturers and end-users. Given plastics' variety of applications, standards tend to cover a wide range of products or different properties of the material (e.g. biodegradability) (ASTMInternational, 2018[35]). Several standards addressing the plastics industry have been developed (e.g. ISO 83.080.01 on Plastics[12]). Country-specific standards in the OECD countries have also been adopted, such as the Australian standard on biodegradable plastics (see Box 2.4. below).

Box 2.2. Regulations: Korea Food Sanitation Act – Article 8

Article 8 of the Korean Food Sanitation Act prohibits the manufacture, sale and import of food contact materials (apparatus, containers or packages) that contain poisonous or harmful materials. The Act also authorizes the Ministry of Food and Drug Safety (MFDS) to enforce the law and establish regulations, standards and specifications for food-related products such as food additives, food packaging materials and food containers (Korean Ministry of Government Legislation, 2011).

[11] From January 1st 2019, Italian Law n. 205 approved on 27 December 2017 forbid to market and produce on the national territory the sticks for cleaning the ears that have the support in plastic or in non-biodegradable and compostable material according to UNI EN 13432: 2002 (See: http://www.repubblica.it/ambiente/2017/12/19/news/in_legge_di_bilancio_stop_a_cotton_fioc_non_biodegradabili_e_microplastiche_nei_cosmetici-184587060/)

[12] https://www.iso.org/ics/83.080.01/x/

Box 2.3. Bans and phase-outs

Ban on BPA in food contact materials

Bisphenol A (BPA) is used in the manufacturing of polycarbonate plastics materials, such as baby bottles. National regulations on the use of this organic molecule were first introduced by France and Denmark in 2010, following discussions on the potential health risks of BPA intake through releases in food. France prohibited the manufacturing of baby bottles containing BPA, while Denmark addressed the ban to all food packaging containing BPA.

In 2011, Directive 2011/8/EU was adopted by the European Commission, banning the manufacturing, the placing on the market and the import of baby bottles containing BPA in the EU.

In 2015, France's ban on BPA entered a second phase, extending the ban to all packaging intended to come into contact with food (EuropeanCommission, 2011a[36]; Geuke, 2015[37]).

In 2012, the US FDA had amended its regulations to no longer provide for the use of BPA-based polycarbonate resins in baby bottles and sippy cups, and the following year for the use of BPA-based epoxy resins as coatings in packaging for infant formula[13]. In February 2018, the US FDA reaffirmed the safety of existing food contact applications of BPA[14].

Ban on microbeads in cosmetics

Microbeads are small pieces of plastics (less than 5mm in diameter) which are often used in cosmetics. The increasing presence of these tiny plastics particles in the ocean, harming marine life and ecosystems, has given rise to a set of national regulations. The Netherlands were the first country to introduce a ban on microbeads in cosmetic products in 2014. Several countries followed suit, with a ban currently in place in the US, Canada, Australia, and most recently in the UK.

A ban on the sale of cosmetics containing microbeads has also been announced in Ireland, New Zealand and Italy and expected to become effective in 2018/2019 (BeattheMicrobead, 2018b[38]).

[13] https://www.fda.gov/newsevents/publichealthfocus/ucm064437.htm

[14] https://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm598100.htm

Box 2.4. Standard – Australian standard on biodegradable plastics

The Standard on biodegradable plastics AS5810 was prepared by the Standard Australia Committee EV-017 and adopted in 2010, following the Australian Standard AS4736 for biodegradable plastics suitable for composting and other microbial treatment (in commercial systems). The standards ensure the quality of plastic products entering the Australian market, based on toxicity claims and biodegradability. The aim of introducing such standards is to convey confidence in consumers and retailers over products defined as "biodegradable", as well as to support State-wide regulations on non-biodegradable single-use plastic bags (StandardsAustralia, 2010[39]; ParliamentofAustralia, 2016[40]). It is not clear whether or not these bags would biodegrade in the marine environment.

2.3. Potential opportunities for regulatory actions

Although a range of regulations have already been adopted to try to ensure the safety of plastics and minimise the risks posed by chemicals, there is scope for better alignment and harmonisation of such regulations within and across countries, as well as for additional regulatory measures to address current gaps (e.g. supporting the disclosure of information on substances contained in products, or preventing disruptive substances from entering product and waste streams, etc.) The European Commission has recently proposed options to address the interface between chemical, product and waste legislation. As the issues arising from such interfaces go beyond the EU Member States, exploring opportunities for regulatory actions in this field warrants priority.

Harmonising chemicals and food contact materials legislation - Plastics are extensively used in the food industry, during preparation, processing, packaging, and transportation. Box 2.5. summarises the challenges in integrating food contact regulations with recycling objectives. Current legislation applied to food contact materials often lacks harmonization with wider regulations applied to harmful substances, including those classified as substances of concern or of very high concern (SafeFoodAdvocacyEurope, 2016[34]). For instance, the plasticiser substance DEHP contained in flexible PVC is subject to use restrictions and authorisation in the EU under REACH. However, this is often managed as non-hazardous waste (EuropeanCommission, 2018c[31]) and the use of DEHP has been authorised in plastic FCMs (EuropeanFoodSafetyAuthority, 2018[41]). Human exposure to DEHP is still largely attributed to food contact materials (EuropeanChemicalsAgency, 2010[42]). Better coordination between chemicals regulations and FCM legislation should be achieved within and across countries – in the EU and elsewhere – aiming at a more coherent approach so that substances phased out under the former are also phased out under the latter. This could contribute to consolidating the market for secondary plastics materials.

Box 2.5. Closing the loop on food contact materials

Food grade plastics and other applications (such as medical grade plastics) requiring a certain quality or purity represent a specific challenge for recycling. Food packaging is highly relevant to discussions on sustainable plastics because it makes up a significant proportion of demand. In the EU, for instance, best available data suggests that at least 16% of all plastic demand, or 8 million tonnes, goes towards food packaging each year (Schweitzer et al, 2018).

Plastics intended to be used as food contact materials (FCMs), including in food packaging or utensils, are often subject to more stringent restrictions on substances which may be harmful to the consumer of food. Examples of such regulations exist across the OECD, e.g.:

- USA FDA Regulations on Packaging & Food Contact Substances (FCS)[15]
- Japan Ministry of Health, Labour and Welfare (MHLW) Regulation on Utensils, Containers, Packaging, Toys[16]
- Health Canada Food and Drugs Act and Regulations, Section B.23.001[17]
- Korea Ministry of Food and Drug Safety Standards and Specifications for Food Utensils, Containers and Packages[18]

Whilst these regulations correctly safeguard consumer health, they also represent a barrier to using recycled content in food contact materials. For example, the FDA note safety concerns with the use of recycled plastic materials in FCMs as follows: "1) that contaminants from the post-consumer material may appear in the final food-contact product made from the recycled material, 2) that recycled post-consumer material not regulated for food-contact use may be incorporated into food-contact packaging, and 3) that adjuvants in the recycled plastic may not comply with the regulations for food-contact use" (USFDA, 2017[43]). Different jurisdictions have developed different tools to manage the use of recycled materials in FCMs. For example, the FDA reviews the use of recycled content on a case by case basis (USFDA, 2018[44]). Though overall, it is unclear the extent to which existing legislation on FCMs is fit for purpose to close to the loop on food grade plastics. Noting the growing use of plastics in the food system, key challenges for the designers and producers of food grade materials as well as policy makers will be to integrate resource efficiency objectives while preserving consumer protection.

[15] https://www.fda.gov/Food/IngredientsPackagingLabeling/PackagingFCS/default.htm

[16] http://www.mhlw.go.jp/english/topics/foodsafety/containers/index.html

[17] https://www.canada.ca/en/health-canada/services/food-nutrition/food-safety/packaging-materials.html

[18] http://www.mfds.go.kr/eng/eng/index.do?nMenuCode=120&page=1&mode=view&boardSeq=70089

Alignment of rules on hazard classification of chemicals and waste – Inconsistent waste classification methodologies inevitably lead to waste being classified in different ways across or even within countries. This can generate uncertainty over the management of waste containing substances of concern. This calls for the alignment of the rules for classification of chemicals and waste (EuropeanCommission, 2018c[31]).

Introducing eco-design products standardisation – The design stage of a product determines 80% of its environmental impact. It is at this stage that decisions are made which directly influence the end-of-life management of products (their level of durability, recyclability, reusability and reparability) as well as the avoided or limited use of substance of concerns, and the use of secondary raw materials (EuropeanCommission, 2018c[31]). By introducing eco-design products standardisations, these decisions can be regulated and the management of a product once it reaches the stage of waste can be pre-determined. Actions to introduce new eco-design measures on plastics products are ongoing in the EU, with the aim of setting minimum requirements that take account of circular economy aspects incentivising the recyclability and reusability of plastics, in line with the objective of ensuring all plastic packaging placed on the EU market to be easily recycled or reusable by 2030 (EuropeanCommission, 2018a[10]).

Supporting recycling and the uptake of secondary raw materials – The uptake of secondary raw materials is often determined, among other factors, by the perceived lower quality and performance of recyclates compared to virgin materials. This partly concerns the possibility to remove substances of concern. An alignment of rules between virgin and secondary materials can promote non-toxic material cycles and support the uptake of secondary raw materials (EuropeanCommission, 2018c[31]).

Potential new regulations triggered by China's restrictions on the import of certain wastes – The recent Chinese restrictions on waste imports have already started to have an effect on the waste industry in major waste exporting countries. In particular, trade restrictions on waste provide an additional pressure for countries to find alternative solutions for the post-consumer plastics which are no longer accepted by China (Tamma, 2018[45]). In 2016, China imported 7.3 million metric tonnes of plastics waste from developed countries, including South Korea, the EU, the US and Japan. The ban can drive improvements in the quality of post-consumer recovered materials, triggering innovation in design as well as encourage investments in recycling, therefore potentially leading to improved quality and reduced quantity of plastic waste produced (Cole, 2017[46]).

3. Market based instruments

3.1. Overview of practice

Market-based instruments (MBIs) are an increasingly popular approach with policy-makers to address environmental issues and achieve environmental objectives by encouraging targeted changes in business practices and consumer behaviour. Well-designed environmental MBIs can also make a contribution to revenues to support national budgets, and in some cases can act as a means of reducing the reliance on labour-related taxes.

Whilst MBIs in the area of chemicals policy related to plastics are unlikely to be very significant in terms of national revenues and offering an opportunity to reduce labour taxes, when implemented well and as part of a coherent package of measures, they can be used to achieve the more sustainable use of chemicals in plastics, amongst target groups including producers and consumers. In essence, MBIs in this area should be designed to internalise the external costs of plastics and the use of chemicals within them, including taking into account the potential environmental and health impacts. In this way they should give the correct market signals to decrease the use of unsustainable plastics and promote the more sustainable use of chemicals within plastics. Careful design and coherence with other policies can also ensure that MBIs do not create perverse incentives to use alternative materials with greater external costs (e.g. greater natural capital, environmental, life cycle or health impacts).

The range of MBIs that are relevant in this area includes taxes and fees (e.g. applied to specific products, chemicals, materials or certain uses of chemicals or materials), subsidies (e.g. to support certain products/desirable alternatives, production processes, or research & development), extended producer responsibility (EPR) schemes (in particular those that include an element of fee modulation based on materials and/or their chemical content) and deposit refund schemes (DRS).

The following sections explain a little more about some of these instrument types, and provides some existing examples of their use within OECD countries, including examples demonstrating how they can be successful in reducing single use plastics, encouraging recycling, and collecting revenues to support the development of infrastructures for the collection and recycling of plastics.

3.2. Examples of existing practice

3.2.1. Taxes and fees

Taxes and fees can be used as a market signal to reduce the use of certain products, materials or chemicals, or certain applications of materials or chemicals. Typically, a tax increases the price of a good or activity, encouraging an associated reduction in the use of that good or activity. In the case of promoting more sustainable plastics design from a chemicals perspective, taxes can be applied to discourage the use of certain chemicals in plastics by increasing the price if the taxed chemicals are used. For example, since 2017 Sweden has applied a tax on certain chemicals used as flame retardants in electronic goods (see Box 3.1. below), providing a fiscal incentive for producers not to add specific substances to their electronic products.

Denmark applies a tax to certain soft PVC items, with rates varying according to whether phthalates or other substances are used as softeners (see Box 3.2. below).

Box 3.1. Swedish tax on chemicals used as flame retardants in certain electronics

Since 1 July 2017 Sweden has applied a tax on certain chemicals that are used as additives in flame retardants and reactive flame retardants in electronic goods (AAM-AKI-Collectivo-consortium, 2016[47]). The aim is to reduce the public's exposure to hazardous substances contained in consumer electronics, and to reduce the incidence of such substances when these items are discarded as electric/electronic waste (SGS, 2017[48]). It is planned that the scope will gradually be widened to include a broader range of both electronic products and hazardous substances (SGS, 2017[48]). The tax for 'white goods'[19] will typically be SEK 8 per kg of the net weight of the taxable good, up to a maximum of SEK 320 per good, whilst the tax for other consumer electronics[20] will be SEK 120 per kg, again up to a maximum of SEK 320 per good. The tax may be reduced by 50% for goods that do not contain more than 0.1% by weight of added bromine or chlorine compounds in any printed circuit board or plastic part weighing over 25 g. The tax may be reduced by 90% for goods that additionally do not contain more than 0.1% by weight of added phosphorus, reactive bromine or reactive chlorine compounds in any printed circuit board or plastic part weighing over 25 g (AAM-AKI-Collectivo-consortium, 2016[47]).

Box 3.2. Danish PVC tax

Denmark applies a tax to certain soft PVC products. A tax of DKK 0.25- 3.60 per kg is applied to a wide range of PVC products that contain phthalates (e.g. pipes/tubes, floor/wall coverings, tape/self-adhesive foils, roofing foils/sheets, skylights, gloves/aprons/protective suits, rainwear, curtains/blinds/table linens, cables/wires, and gutters/drainpipes). A tax of DKK 1.70 per m2 is applied to tarpaulins, and a tax of between DKK 0.05-0.33 per item to plastic sleeves/folders and binders. A reduced tax rate is applied to products in these categories that contain a softener other than phthalates (DKK 0.10-2.00 per kg of most products; DKK 0.42 per m2 for tarpaulins; DKK 0.02-0.13 per item for sleeves/folders and binders). The tax therefore provides a fiscal incentive for producers of these products to use softeners other than phthalates. (EuropeanCommission, 2017[49])

[19] Including e.g. fridges, freezers, dishwashers, washing machines, tumble dryers, vacuum cleaners, microwaves

[20] Including e.g. computers, telephones, some radios, monitors, TVs and video game consoles

Box 3.3. Unforeseen consequences – South Africa and calcium carbonate fillers

In 2004, South Africa introduced a ZAR 0.03 levy on plastic bags with a density of less than 24 microns, with the intention that thicker bags are more easily recyclable or more durable. In 2017, the Department of Environmental Affairs (DEA) were investigating claims that thicker bags branded as recyclable were not. This was because manufacturer were adding a calcium carbonate filler to bags to increase their density, and consequently avoid the levy. Bags with a calcium carbonate filler are difficult to separate in waste management systems using a sink-float process (Gordon, 2018[50]).

Revenues from the measure were to be directed to the National Treasury and the Revenue Fund. Although the funds are not ring-fenced a contribution of ZAR 22.4 million has been committed to the National Regulator for Compulsory Specifications (NRCS) until 2020 for research into plastics. The DEA has established a Waste Bureau in order to monitor the implementation of different measures to divert waste from landfill (InfrastructureNews, 2017[51]).

Taxes on plastics, certain types of plastics or certain uses of plastics can also help to reduce unsustainable consumption of plastic materials more generally. Several EU Member States, including the OECD members Belgium, Denmark, Estonia, Finland, Latvia, Netherlands and Slovenia, apply taxes to plastic packaging (Eunomia and IEEP et al., 2017[52]), with some applying higher rates to specific types of plastics and/or to single-use plastic items. The application of taxes to single-use plastic items can help to increase the price of such items, and therefore drive demand away from such items and result in substitution. Well-designed taxes (i.e. taking care not to actually incentivise the use of less sustainable alternatives) should lead to the use of more durable and/or more sustainable alternatives. Such alternatives could include redesigned plastic options (e.g. more readily recyclable, compostable or conversely more durable plastic) or non-plastic alternatives (e.g. manufactured from wood, metal or glass).

For example, the Belgian packaging tax applies EUR 3.6 per kg of disposable cutlery placed on the market, and EUR 3 per kg of single use plastic bags. Other OECD countries with single-use plastic bag taxes or charges include France (EUR 10 per kg, approx. EUR 0.06 per bag), Ireland (EUR 0.22 per bag), Portugal (EUR 0.08 per bag plus VAT), the UK (GBP 0.05 per bag) (Eunomia and IEEP et al., 2017[52]), and several US cities (including New York NY, Portland ME and Washington D.C.) (National Conference of State Legislatures, 2017[53]).

In 1993, Italy introduced a tax on plastic bags that were not biologically decomposable, but this tax is no longer in place (OECD, 2018[54]). The Irish plastic bag levy is often cited as a successful example of driving behavioural change; discarded plastic bags amounted to 0.13% of litter pollution in 2015 compared to an estimated 5% in 2001 (Litter Monitoring Body, 2015). In addition, it also generated EUR 200 million of revenue between 2002-2013 (Hogan, 2013[55]) which has been used for both administration and environmental projects. Since the UK plastic bag charge was introduced, major retailers have distributed 9 billion fewer single use bags, a reduction of 83% (Defra, 2017[56]).

The lowest rate for plastics within Denmark's weight-based packaging tax is DKK 7.75 per kg for recycled plastics and plastics substituted with other materials, and the highest DKK 12.95 for primary plastics, thereby encouraging the use of recycled/substituted plastics. In addition, EPS and PVC incur a higher tax rate of DKK 20.35 per kg (Eunomia and IEEP et al., 2017[52]). The Latvian natural resource tax varies the tax on plastic packaging according to material, with the aims of promoting economically efficient use of natural resources, restricting pollution, reducing the manufacture and sale of polluting substances, and promoting the implementation of new environmentally-friendly technologies. Polystyrene source materials are charged at EUR 1.56 per kg, most plastic EUR 1.22 per kg, single-use plastic bags weighing more than 0.3 g EUR 1.14 per kg (lighter bags are charged at EUR 3.70 per kg) and oxy-degradable plastic EUR 0.70 per kg (Eunomia and IEEP et al., 2017[52]).

Taxes on landfilling and incineration are also relevant to the overall sustainable use of plastics, since placing a tax on waste disposal acts as a driver to instead recycle waste that can be recycled. Poland, for example, applies a charge specifically to the landfilling of selectively collected plastics waste[21] (OECD, 2018[54]). However these taxes are not further discussed in this paper, as they are more concerned with final disposal than sustainable plastic design.

3.2.2. Subsidies

Subsidies can be used to promote more sustainable behaviours, for example in support of certain products or desirable alternatives, production processes, or research & development.

One example is the Plastic Recycling Investment Tax Credit in Colorado (USA). The credit is available to Colorado resident individuals, and is equal to 20% of the first USD 10,000 of net expenditures to third parties (e.g. rent, wages, supplies, consumable tools, equipment and utilities) made for new plastic recycling technology in Colorado (ColoradoDepartmentofRevenue, 2016[57]).

3.2.3. EPR and deposit refund schemes

Extended producer responsibility (EPR) schemes are a means of ensuring that those who place products on the market (i.e. producers) are made at least partly responsible – financially and/or logistically – for their products when they become waste at the end of their useful life. Producer responsibility organisation (PRO)-based EPR schemes for packaging typically apply variable fees based on the type of packaging material placed on the market (e.g. glass, paper/card, metals, plastic). Fees for plastic and for composite packaging materials tend to be significantly higher than fees for other packaging materials (Pro-Europe, 2017[58]); for example plastic is charged at EUR 188 per tonne in the Italian CONAI scheme, compared with EUR 45 for aluminium, EUR 16 for glass, EUR 13 for steel and EUR 4 for paper/card (CONAI, 2017[59]).

In several EPR schemes in EU countries that are OECD members, fees are varied for different types of plastics, such as PET/HDPE, expanded polystyrene, bio-plastics/bio-degradable plastics and plastic bags. Schemes in Austria, Germany, Latvia and the Netherlands have lower fees for bio-plastic or biodegradable plastic than other plastics. Hungary has a higher fee for plastic bags than for other plastic packaging, and an extremely high fee if the plastic bag features advertising. Many EPR schemes also have specific fees for beverage cartons (which tend to be composite paper/card, plastic and/or aluminium foil) and other composite materials. The Czech Republic's EK-KOM scheme applies no fee to

[21] NB The revised EU Landfill Directive, when it enters into force, will prohibit the landfilling of selectively collected waste.

reusable packaging, only to one-way/single-use packaging. (Watkins, E., Gionfra, S., Schweitzer, J.-P., Pantzar, M., Janssens, C. and ten Brink, P., 2017[28])

The Korean Waste Charge System applies a charge to producers and importers per plastic container for pesticides/toxic products, and per kg of synthetic resin contained within plastic products for general or construction use (KoreaEnvironmentCorporation, 2017[60]).

Some additives that are introduced to plastic packaging are not hazardous but may be disruptive in other ways, e.g. by making items difficult to separate at the sorting stage, and/or contaminating the material stream, making recycling and the production of high quality secondary material either difficult or impossible (Watkins, E., Gionfra, S., Schweitzer, J.-P., Pantzar, M., Janssens, C. and ten Brink, P., 2017[28]). Fees within EPR schemes could be made higher for such materials, ideally with periodic review to take into account best available technologies (Watkins, E., Gionfra, S., Schweitzer, J.-P., Pantzar, M., Janssens, C. and ten Brink, P., 2017[28]). The French CITEO scheme is particularly advanced in its attempts to use eco-modulation, applying a bonus-malus system of increased fees ('malus') for undesirable packaging and reduced fees ('bonus') for packaging with a lower environmental impact. This includes in relation to the use of certain additives in plastic packaging (see Box 3.4. below).

Deposit refund schemes, which have been used for many years for glass bottles, are also sometimes applied to plastic beverage bottles. A deposit fee is charged at the point of purchase, and refunded to the purchaser when the bottle is returned via a specifically-designed system. Although such schemes do not typically have a specific chemical-related aspect in their design, they nevertheless help to capture a specific type of material for recycling, thereby facilitating effective and efficient collection, reducing littering/material leakage and enabling reuse or recycling, which in turn encourages higher quality, purer secondary material that is not contaminated with other material or chemical additives. In the case of material that can be reused (e.g. refillable glass or PET bottles) or reprocessed multiple times into the same product, DRS can create closed material loops, whilst in other cases it can facilitate the capture of material for recycling into other products (e.g. PET bottles into man-made textile fibres). OECD countries that have at least one DRS for plastic bottles include Australia (Northern Territory, South Australia, New South Wales and Australian Capital Territory), Canada (most provinces/territories), Chile, Denmark, Estonia, Germany, Hungary, Iceland, Israel, Italy (Piemonte region), Latvia, Mexico, Netherlands, Norway, Poland, Slovenia, Spain, Sweden, Turkey and the United States (OECD, 2018[54]). Some examples are outlined Box 3.5. below.

Box 3.4. Eco-modulation in the French CITEO packaging EPR scheme

The CITEO EPR scheme applies a 100% increase ('malus') in the fee charged to producers for rigid PET packaging with more than 4% mineral opacifier content (CITEO, 2017[61]). The CITEO scheme also applies a 50% increase to the fee for bottles for which the majority material is PET but that also contain aluminium, PVC or silicone to a density greater than 1 (PET bottles with lids made from other materials but which can be completely removed/separated from the bottle are not subject to the increased fee). In addition, a 100% increase to the fee is applied to plastic bottles/flasks for which there is currently no recycling channel (e.g. plastics other than PET, HDPE or PP) (CITEO, 2017[61]).

Box 3.5. Examples of DRS and their impacts

A container deposit scheme in South Australia which applies an AUD 0.10 refundable deposit to beverage containers has led to a three-fold reduction in the number of beverage containers becoming litter on beaches (Hardesty, B., Wilcox, C., Lawson, T., Lansdell, M. and van der Velde, T., 2014[62]).

In 2001, Israel introduced a deposit refund law that applies a deposit of ILS 0.25 to glass and plastic containers smaller than 1.5 litres. A cost-benefit analysis in 2010 (Lavee, 2010[63]) concluded that the law had had a positive impact, with total benefits exceeding total costs by around 35%, and potentially greater benefits if the scheme were also applied to larger bottles.

In Ecuador, a refundable USD 0.02 deposit paid per PET beverage bottle (in 2011) led to a significant increase in PET bottle recycling, increasing from 30% in 2011 to 80% in 2012, when 1.13 million of the 1.4 million PET bottles produced were recycled (MinistryofEnvironmentofEcuador, 2012[64]).

The USA has no federal legislation on bottle refund schemes, but several States have introduced ‘bottle bills’. The California Redemption Value (CRV) is USD 0.05 for containers smaller than 0.7 litres and USD 0.10 for larger containers. Since its introduction in 1987 it is estimated that 300 billion aluminium, glass and plastic beverage containers have been recycled (CalRecycle, 2015[65]).

3.3. Potential opportunities for market based instruments

In the European Strategy for Plastics in a Circular Economy (EuropeanCommission, 2018d[66]), the Commission announced its intention to explore the feasibility of introducing EU level fiscal measures related to plastics. This idea of a ‘plastics tax’ is yet to be further explored, so it is not yet clear whether there would be any specific design or chemical-related element to the tax; it would perhaps be more likely to take the form of a tax on virgin resin, to promote increased use of recycled plastic. Careful design of such taxes, and coherence with other policies, can ensure they do no incentivise the use of materials with greater environmental impacts. It is also worth pointing out that it may be difficult, or at least take some time, for Member States to reach the level of agreement required to introduce such an EU-wide fiscal measure.

Wider use of eco-modulation within EPR schemes, in particular based on the material and/or chemical content of plastic products, has the potential to make a significant contribution to encouraging producers to use more sustainable types of plastic in their products, thereby acting as a driver for sustainable plastic design. A similar approach can also be effective within taxation, such as packaging taxes. Consideration could also be given to the use of carbon-related taxes, for example offering a tax reduction for certain products containing recycled plastic, to incentivise the use of secondary plastic material in appropriate applications. Consideration could therefore be given to applying such approaches within EPR schemes and taxes in a greater number of OECD countries.

4. Financing and investment

4.1. Overview of practice

Public and private investments are key measures for ensuring the sustainability of plastics, supporting the implementation of regulative instruments and/or development and uptake of market based instruments. Different forms of investment can be applied throughout the product life cycle of plastics, helping to reduce waste and other environmental impacts. Examples of ways in which investments can support the sustainability of plastics include:

- the development of infrastructure for plastic waste prevention and management
- the provision of funding for research and development as well as new businesses
- the development of green public procurement guidelines and rules for plastic products

Some investments can directly result in the development of sustainable plastics, such as direct support for research and development in plastic design. While other, more systemic changes, might indirectly influence product design. OECD members may also support all these actions in other countries via development cooperation.

The following section describes these examples of investment in more detail and provides examples from the OECD member countries.

4.1.1. Infrastructure for plastic waste

Public investments in infrastructure are particularly important for waste management, including recycling centres and waste water treatment plants. Waste management services are often subcontracted by regional and municipal authorities. In these cases, investments will blend public and private funding. Plastics account for a significant share of municipal solid waste (MSW) – 13% in the USA (TheRecyclingPartnership, 2017[67]). Overall, well executed MSW management is a key driver of preventing the environmental leakage of plastics. One study estimated that in 2010, up to 12.7 million metric tonnes of plastic waste entered oceans primarily as a result of poor waste management at coastlines (Jambeck, J. R., Geyer, R., Wilcox, C., Siegler, T. R., Perryman, M., Andrady, A., Narayan, R. and Law, K. L., 2015[11]).

Waste management practices help to define the end of life for plastics, as well as helping to prevent waste altogether. This also means the configuration of waste management infrastructure can indirectly influence the design of plastic products. For instance, a waste management system which focuses on incineration is less likely to place an emphasis on the potential for a product to be separated into its component materials (Sora, M; Ventosa, I, 2013[68]).

Conversely, waste management can facilitate the recovery of waste plastics for recycling. And well-functioning recycling systems can result in the design of plastic products which make use of recycled material. While other factors such as pricing may play a role, investment in waste infrastructure is an essential tool for establishing markets for secondary plastics, helping to close the loop on the material.

OECD countries demonstrate significant variability in the development of their waste infrastructure for plastics. This is, in part, visible in the difference in municipal waste treatment in OECD countries, see Table 4.1. Improving recycling rates will require investments in infrastructure and services, different measures can be used to leverage investments – see example of plastics recycling subsidy scheme in Box 4.1.

Table 4.1. 2015 Municipal waste treatment for selected OECD countries: Recycling (%)

Country	Recycling %
Germany	48
Slovenia	48
Switzerland	32
Italy	29
Finland	28
United Kingdom	27
OECD - Europe	27
Norway	26
Czech Republic	25
OECD - Total	25
Netherlands	25
Spain	17
Israel	16
Slovak Republic	8

Box 4.1. USA – Plastic recycling subsidy scheme

In order to support private investments in plastic recycling facilities the State of Colorado initiated a "plastic recycling investment tax credit". The scheme gives a tax credit of 20% of the first USD 10,000 invested in new plastic recycling in Colorado. It covers any expenses to third parties such as rent, wages, supplies, consumable tools, equipment, test inventory and utilities (ColoradoDepartmentofRevenue, 2016[57]).

Waste management systems for product streams which place a greater emphasis on re-use will require investment in specific infrastructure (such as reverse logistics systems, collection facilities, reverse vending machines and cleaning facilities) as well as switching to the design of more durable products. This can be seen in countries which operate deposit refund systems (DRS) for bottles. One cost benefit analysis looking at the introduction of a DRS system in Auckland, New Zealand, suggested that capital costs for collection infrastructure were greater than the operating costs of such a scheme, but the overall benefits outweighed the costs (Davies, 2017[69]).

Lastly, and with respect to the waste hierarchy, policies which avoid and reduce waste at source should be given the highest priority[22]. Preventing waste in the first place can be addressed via upstream measures addressing both the design of products (i.e. for longevity), but also consumer focused measures, including those which discourage unnecessary consumption (EuropeanCommission, 2016b[70]). For example, the PRE-Waste project completed in 2013, was funded by the European Regional Development Fund with support of nearly EUR 1.5 million. It aimed to improve the effectiveness of waste prevention policies in EU territories, involving 10 partners and nine countries (INTERREG_IVC, 2013[71]).

Combining different instruments can be used to support particular waste management practices. For example, regulations such as standardisation and minimum requirements

[22] See explanation form the New South Wales EPA (2017) https://www.epa.nsw.gov.au/your-environment/recycling-and-reuse/warr-strategy/the-waste-hierarchy

may support re-use or recycling. Similarly, market based instruments, such as modulated EPR schemes may favour product designs which can readily integrated into local waste management facilities (Watkins, E., Gionfra, S., Schweitzer, J.-P., Pantzar, M., Janssens, C. and ten Brink, P., 2017[28]).

Materials within some specific products may only be recovered using more advanced waste management technology – this reflects increasingly complex product designs. This is the case for multi-layered and multi-material packaging, which are generally problematic to recycle (EMF, 2017[72]) – see example of disposable coffee cups in the UK in Box 4.2. In these cases, investors must make decisions about the cost effectiveness of investing in infrastructure to separate waste compared to upstream measures focusing on changing the design of a product or substituting for a different material. Social entrepreneurs may find opportunities to invest in developing re-use and recycling systems where these are not supported by municipal waste management through investment and collaboration with local businesses.

Box 4.2. UK – challenges recycling disposable coffee cups

Growth in the market for "on-the-go" coffee has resulted in a growing consumption of disposable cups. Disposable coffee cups are predominantly made from paper, but an interior lining - commonly made of polyethylene - make these cups very difficult to recycle.

In the UK, the Environment Audit Committee assessed the sustainability challenges of this product. It showed that 2.5 billion disposable cups are used each year, of which less than 0.25% are recycled, while 4% are littered (representing 500,000 cups littered daily). While both the paper and plastic components of the cups are recyclable, the production process which heats and binds the materials, renders them difficult to separate. Some paper mills and recycling facilities (with advanced technologies) are able to separate the materials, but only when the cups are provided as a separate waste stream. Only three such recycling plants currently exist in the UK. It estimated that the central tax revenues were covering 90% of the burden of collecting, sorting and disposing of the cups. The study concluded that the Government should introduce a 25 p (GBP) levy on disposable cups, earmarking revenues to investment in reprocessing facilities and litter prevention infrastructure (House_of_Commons_Environmental_Audit_Committee, 2017[73]).

Recently established "CupClub" is a London based start-up which is attempting to overcome the coffee cup challenge. The business offers consumers a plastic coffee cup designed for reuse, which can be returned at collection points in collaborating retailers. A rewards based system incentivises consumers and coffee retailers to engage in the scheme as well as covering the costs of reverse logistics (EMF, 2018[74]).

4.1.2. Research and development for plastics

Funding for research and development can directly support innovation throughout the plastics supply chain including the design stage. Public grants can be used to identify knowledge gaps and technology needs for the sector. Funding might also be made available to support SMEs which develop products or services in the field of sustainable plastics, as well as helping to leverage private investments.

Key challenges might include:

- Developing methodologies for identifying and removing contaminants in plastic waste streams, and developing products suitable for re-use and recycling.
- Developing and scaling up technologies for reducing the flow or cleaning up plastics (including micro-plastics) in the marine environment (e.g. via waste water treatment)
- Developing novel materials, including bio-based and biodegradable plastics, as well as substitute re-usable and recyclable products.
- Developing safer alternative for additives used in plastics, or developing the evidence base to better understand the risks of those currently in use.

As outlined in the previous section, the design of products influences waste management practices and vice versa. Multi-material products, or those containing a high number of additives, are likely to be difficult to recycle. Likewise products which are not designed to be durable are less likely to be reused. Policy makers can develop mechanisms to support R&D investments in these areas. This can include opening calls for research funding in areas of relevance to plastics, investing in research infrastructure in relevant fields, and providing support to scale up or develop existing research into marketable products. Box 4.3. provides an example of a recent design competition aimed at improving the sustainability of plastics, in this case financed by the private sector.

Novel materials, notably bio-based and biodegradable plastics present both challenges and opportunities for the sustainability of plastics. Bio-based plastics provide an alternative feedstock to fossil fuels for producing plastics with comparable material properties, however the social and ecological impacts of bio-based feedstocks must be considered.

Although most materials biodegrade in the natural environments over sufficient timescales (i.e. several hundred years or more), in the context of sustainability biodegradation means to avoid pollution. Consequently biodegradation should take place in a sufficiently short time period under specific settings, controlled or natural conditions (i.e. the marine and terrestrial environment). Plastics currently marketed as "biodegradable" only biodegrade under certain conditions, typically industrial composting[23] - and do not biodegrade in the natural environment, as they require conditions very rarely met in the marine environment (sustained temperatures in excess of 50°C) (UNEP, 2015[75]). The quality of biodegradation is not dependent on the feedstock of the plastic: which can be fossil or bio-based (EuropeanCommission, 2018b[76]).

Further research into better understanding how the sustainability risks associated with bio-based and biodegradable materials can be managed is needed, though an initial analysis by UNEP concluded that "adoption of plastic products labelled as 'biodegradable' will not bring about a significant decrease either in the quantity of plastic entering the ocean or the risk of physical and chemical impacts on the marine environment, on the balance of current scientific evidence" (UNEP, 2015[75]).

[23] Composting is accelerated biodegradation, typically using aeration and natural heat from the biological decomposition of the material, under conditions which are managed

Box 4.3. New Plastics Economy Innovation Prize

The New Plastics Economy, is an initiative led by the Ellen MacArthur Foundation which aims to apply the circular economy principles to “rethink and redesign the future of plastics”. The Innovation Prize, held in 2017, offered USD 2 million in prizes to suggests for new materials, designs and business models relevant to plastics.

Examples of the winners included:

- Evoware (Indonesia) – seaweed based packaging to replace small format single-use plastics
- Aronax Technologies (Spain) – recyclable magnetic coatings to replace multi-layered packaging
- University of Pittsburgh (USA) – development of recyclable and durable packaging utilising nano-engineering
- MIWA (Czech-Republic) – app supported grocery shopping to facilitate the use of reusable packaging

The winners joined a 12 month accelerator programme in order to upscale and market their products (EMF, 2018[74]).

4.1.3. Green public procurement for plastics

Public procurement can be used to support the sustainability of plastics. Green public procurement (GPP) guidelines or criteria can be developed, at different governance levels (from national budgeting to local authorities), to include environmental criteria when allocating contracts or purchasing products from private suppliers. Well-designed GPP criteria can help to reduce the environmental impact of services or products throughout their lifecycle, including those with relevance to plastics. Public contracts can leverage significant funds, helping to create a market for “green” products and incentivise industry to improve the environmental performance of their products. For example in the EU, public authorities spend EUR 2 trillion each year, equivalent to 19% of its GDP (EC, 2016). On average OECD countries spend 12% of their GDP on procurement (OECD, 2016[77]). GPP practices which replicate environmental as well as wider policy objectives, also have political value as they demonstrate decision makers are leading by example.

In the context of plastics, procurement criteria can address different aspects of the plastics value chain. For instance, avoiding the consumption of particularly wasteful or polluting plastic products (e.g. single use straws), or promoting good practice in waste management (e.g. separate collection of waste streams), as well as favouring products which are well designed (i.e. for re-use and recycling).

With respect to chemicals, procurement criteria might prohibit the purchase of products containing chemicals known to be problematic due to their sustainability impacts (e.g. BPA, carbon black dye). Procurement criteria may also be linked with other environmental policy instruments, such as extended producer responsibility schemes or product labels. For example, the Chinese GPP policy, which covers “plastic products” amongst more than 60 product categories, is linked to the Chinese “Environmental Labelling” initiative (OECD, 2015[78]). Many municipal authorities have started to develop specific measures to reduce the use of single-use plastics in particular – see Box 4.4. These measures demonstrate opportunities for leading local authorities to strengthen national level policies.

Box 4.4. Municipal GPP criteria for plastics

Hamburg – In 2016, the City of Hamburg introduced Green Public Procurement (GPP) rules banning municipal use of coffee capsules, single use bottles and utensils (Hamburg, 2016[79]).

Turin – GPP criteria introduced for school catering contracts in the Italian city emphasise the need to use reusable and refillable packaging as well as the separate collection of waste. A shift to reusable plates by the city was estimated to save 157 tonnes of plastic per year alone (EuropeanCommission, 2014[80]).

San Francisco – Since January 2017, the San Francisco Board of Supervisors (BOS) and the Mayor passed Ordinance No. 009-17 to restrict the sale or procurement of packaged water on City property. This also covers any events in the city with more than 100 people in attendance (SF_Environment, 2017[81]).

4.2. Potential opportunities for financing and investment

Though many existing public and private financing and investments already demonstrate support for sustainable plastics, there are opportunities to explore by policy and decision makers. For plastic waste management, meeting minimum standards for waste management, and moving away from landfilling and incineration towards waste prevention, re-use and recycling should be primary objectives for investors. In several emerging or innovative areas, there are knowledge gaps which need to be addressed before investments can be made. This is notable in the field of bio-based and bio-degradable plastics, where the costs and benefits of these products in terms of their feedstocks and end-of-life, should be appropriately assessed (UNEP, 2015[75]; van den Oever, M; Molenveld, K; van der Zee, M; Bos, H, 2017[82]).

Future funding investment (both public and private) should be used to support eco-design for plastic products, providing support to innovators and designers who target inefficiencies in the plastics sector upstream (ten Brink, P.; Schweitzer, J.-P.; Watkins, E.; De Smet, M.; Leslie, H.; Galgani, F., 2017[83]). Subsidies and incentives are important measures for ensuring the sustainability of plastic – see Section 3.2.2 on Subsidies. Improvements in the sustainability of plastics may be leveraged by targeting specific problematic products, or through systemic changes to the plastics sector as a whole.

OECD members also have a role to play in providing access to finance and investing in the promotion of sustainable plastics in developing countries across the globe. Investments could for example help to address inequities and gaps in waste management infrastructure between countries, and the associated risks of plastic waste leaking into the environment (Jambeck, J. R., Geyer, R., Wilcox, C., Siegler, T. R., Perryman, M., Andrady, A., Narayan, R. and Law, K. L., 2015[11]). Member countries and organisations within the OECD Development Assistance Committee might explore how funds and investments can better support sustainable plastics. In 2018, the UK Government pledged GBP 61.4 million to support initiatives to address plastics. This includes GBP 25 million to support research on marine plastic waste, GBP 20 million for waste management in developing countries, and an additional GBP 16.4 million specifically for the Commonwealth Clean Oceans Alliance

(CCOA). The CCOA will work with several NGOs and businesses to reduce marine litter in the Commonwealth (Defra, 2018[84]).

Likewise, initiatives which engage the private sector in supporting investments should also be explored. Closed Loop Partners is one example of such an initiative, the fund is supported by a number of large corporations. It includes the Closed Loop Fund, which aims to invest USD 100 million in supporting recycling infrastructure and manufacturing technology, as well as Closed Loop Oceans which aims to invest USD 150 million in waste management and preventing marine litter in South East Asia (ClosedLoopPartners, 2018[85]).

5. Information tools and voluntary approaches

5.1. Overview of practice

In the context of this report, information tools can be classified as interventions that seek to encourage the design of more sustainable plastics by facilitating communication up and down product value chains. Examples include labels, voluntary standards and certification, product declarations, ratings, marketing claims, foot printing or life-cycle assessments (UNEP, 2017[86]). Information tools may be of voluntary or compulsory nature and are often applied in a wider mix of regulatory and market-based interventions. Enabling information exchange throughout value chains is important to developing more sustainable plastics, in particular in relation to their chemical composition. This is due to the complexity of chemical additives and their interaction with nature and health (as described in Chapter 1), the difficulty of gathering and processing all the relevant information and the lack of standardised systems and defined responsibilities.

In the last few years, an increasing number of firms and industries around the world have made voluntary commitments related to reducing the environmental and health impacts of plastics and plastic products, for instance by setting strategic targets for material substitution. These initiatives might reflect both reactive and proactive commercial strategies. Over time, product supply chains and the relationships between business and external interests have become increasingly complex, and civil society is today well-informed and quick to respond to new information about products' and companies' environmental and social impacts. As a consequence, businesses are facing more tangible responsibility for their products, services and actions today than perhaps ever before. Firm commitments may also reflect proactive strategies aiming to tap into new business potential driven by societal trends and consumer preferences.

The following section describes examples of information tool and voluntary approaches in a bit more detail and provides examples from the OECD member countries.

5.2. Examples of existing practice

5.2.1. Voluntary certification and environmental labelling

Firms can voluntarily choose to comply with certain criteria in an environmental certification scheme in order to reduce any negative externalities imposed by their production processes or products. Such schemes and the product labels verifying them ultimately aim to reward firms for these commitments and generate a demand for such alternatives by providing information to customers. Importantly, any certification scheme to verify environmental or health claims should be based on recognised standards to be credible and ensure consistency across sectors (UNEP, 2017[86]; OECD, 2014[87]).

Several Type I labels[24] are applicable to polymers and various additives. One example is the voluntary Safer Choice scheme established by the US Environment Protection Agency

[24] The International Organization for Standardization (ISO) has classified labels into Type I (claims verified by an independent body), Type II (self-proclaimed labels) and Type III (environmental product declarations licenced by an independent body) ISO (2012) *Environmental*

to help consumers and commercial buyers identify products with safer ingredients, including various polymers and plasticisers (US Environmental Protection Agency, 2015). Multinational examples include the Nordic Swan Ecolabel scheme in the Nordic countries where several of the product groups apply to plastics (including Toys and Office and hobby supplies, etc.). The requirements for toys include, for instance, a number of additives that Swan labelled toys cannot contain due to their potentially harmful impacts (Nordic Ecolabelling, 2011). Applicable across the EU, several product groups of the EU Ecolabel scheme also apply to plastics (including Personal computers and Furniture products), restricting, for instance, a number of plastic additives (DG_Environment, 2017[88]). Box 5.1 below includes some examples of environmental labelling of bioplastics.

Environmental Product Declarations (EPD) (ISO type III labels) provide information about product composition and content and intend to enable the consumer to assess any potential environmental or health impacts of the product. EPD programmes are still rarely applied in practice, although some schemes exist in OECD member countries, including at national level in Sweden, Italy, South Korea and Japan.

Box 5.1. Environmental labelling of bioplastics

Substituting parts or all petroleum-based polymers in plastics with renewable, bio-based and even compostable alternatives is one potential avenue to make plastics more sustainable. However, such approaches need to consider full life-cycle impacts and not adversely impact food stocks or contaminate recycling. Most current environmental labels for bioplastics only refer to presence of bio-based content or biodegradability but do not assess overall environmental performance and impacts. Bio-based materials are still a niche sector and their continued development is closely linked to being able to build and maintain sufficient demand at a competitive price point. Communicating their characteristics and potential benefits to downstream users through labelling and certification is therefore a key element for the viability of these alternatives (CommissionExpertGrouponBio-basedProducts, 2017[89]). While the environmental advantages of different bioplastics are still being discussed, a number of schemes already exist in OECD countries to substantiate industry claims about e.g. biodegradability. It should be noted that biodegradable/compostable plastics can be made from both fossil and bio-based feedstocks. The Biodegradable Products Institute (BPI) label certifies products that will compost in large scale composting facilities by meeting strict ASTM or ISO standards (BPI, 2018[90]). European certifiers such as TÜV Austria and German DIN CERTCO substantiate industry claims about compostable materials by verifying and certifying conformity to the European standards 13432 and 14995 (TUV_Austria, 2018[91]; DIN_CERTCO, 2018[92]). Biobased carbon content in plastics can be certified according to the European technical standards 16137 or 16295 (CEN, 2014[93]).

5.2.2. App-based platforms

Various existing and emerging digital solutions, such as smartphone apps, can help facilitate information flows throughout the plastics supply chain. In principle, these tools

labels and declarations How ISO standards help, Genève: ISO Central Secretariat. Available at: https://www.iso.org/files/live/sites/isoorg/files/archive/pdf/en/environmental-labelling.pdf.

intend to enable end consumers to make better informed purchasing decisions, thereby potentially favouring alternatives with less health and environmental impacts on the market and send a market signal to producers and designers about consumer preferences.

One example is the *Beat the Microbead* app, through which consumers can verify whether a product contains plastic microbeads by scanning the barcode with their smartphone camera. The app was initiated by the world-wide campaign with the same name, launched in 2012 by the Amsterdam-based NGO Plastic Soup Foundation, sponsored by the UN (BeattheMicrobead, 2018a[94]). In late 2017, the Foundation also launched the *My Little Plastic Footprint* app, intended to help consumers reduce their personal plastic footprint by, for instance, providing information about the issue of plastic waste and encourage consumers to join pledges related to their plastics consumption (PlasticSoupFoundation, 2018[95]). Other examples include the GoodGuide apps, rating products according to their health impacts and enabling consumers to make more informed decisions (GoodGuide, 2018[96]). ToxFox, developed by Friends of the Earth Germany, is available in some European countries and intends to help consumers identify hazardous substances in products (BUND, 2018[97]). The European AskREACH app enables consumers to send requests to suppliers about Substances of Very High Concern (SVHC), facilitating the "right to know" provision included in Article 33 of the EU REACH regulation (Becker, 2018[98]).

A potential limitation of this type of measures is their uptake, including the participation of producers. In order to achieve their objectives, these apps rely to a large degree on the comparability of product information which may require the existence of a centralised, harmonised system of disclosing product information. Such a system would optimally need to apply the same to all relevant products, or at least ensure sufficient market coverage.

5.2.3. Voluntary commitments

Industry-wide and collective initiatives

In January 2018, the trade association Plastics Europe announced that, by 2020, the plastics industry will "have finalised the on-going development of ecodesign guidelines for plastics packaging and design for recycling to maximise re-use and recycling of plastic packaging". The industry aims to, from 2018 onwards, use its expertise and resources to advance the standardisation of plastics within the context of the Circular Economy, through a multi-stakeholder dialogue, including in the ISO (TC 61) subcommittee on "Environment" (PlasticsEurope, 2018[2]).

In another example, over 40 industrial firms have endorsed an action plan set up by the World Economic Forum and the Ellen MacArthur Foundation in 2017 to tackle plastics issues. The plan includes, for instance, building a set of global common standards (a 'Global Plastics Protocol') for packaging design (EMF, 2017[72]). In a 2017 R&D partnership, Nestlé and rival Danone have teamed up with a material start-up to develop a 100% bio-based plastic bottle, made from waste such as sawdust or cardboard. The process and its results will be openly accessible for the rest of the beverage industry (NestléGroup, 2017[99]). One of Danone's water brands, Evian, pledged in January 2018 to produce all its bottles from recycled plastic by 2025 (Vidalon, 2018[100]).

A number of international firms have joined the Chemical Secretariat's Business Group, working together to inspire concrete progress on toxic use reduction, such as Adidas, Apple and Skanska (ChemSec, 2018a[101]).

Commitments by individual firms

Some product groups are highly regulated for health and safety reasons, such as toys, which may restrict for example the use of recycled plastic materials for risks of contamination. Toy manufacturer the LEGO Group has, for instance, committed to invest 1 Billion DKK (€130M) in research, development and implementation of new, sustainable, raw materials. It aims to use only sustainable materials in its products by 2030 and in March 2018, LEGO announced that production has begun on a first line of pieces made entirely from plant-based (derived from sugar cane) plastics (Trangbaek, 2015[102]; Gherasim, 2018[103]). Individual movements by large multinationals like LEGO can generate shifts throughout the industry and among upstream suppliers. Other examples include IKEA, who in their sustainability strategy has committed to, for instance, ensure all plastics used in their products are 100% renewable and/or recyclable by August 2020 (IKEA, 2014[104]). Unilever has committed to "ensure all of its plastic packaging is designed to be reusable, recyclable or compostable by 2025" in their Plastics Commitment (Boin, 2017[105]). Similar commitments have been made by many other consumer product companies. McDonald's aims to source 100% of its packaging from renewable, recycled or certified sources by 2025 (Altmin, 2018[106]).

Some companies are taking pre-emptive action in relation to substances or groups of chemicals "of concern", i.e. that are not yet categorised as hazardous but might have been identified as potentially harmful and likely to be subject to future restrictions (see Section 5.2.5 below). One example is retailer COOP Denmark who has banned the use of twelve substances of concern ("the dirty dozen") from its own-brand products and product packaging. One example of these substances if Bisphenol A. COOP has since launched a public campaign urging Danish politicians to vote for a ban of these chemicals from all consumer goods[25].

While the plastics supply chain can generate effective changes to production processes and material choice, regulators have an important role in incentivising voluntary commitments and sufficient industry ambition. For instance, to encourages this type of commitments and boost the uptake of recycled plastics, the European Commission recently called on companies and industry associations to put forward voluntary pledges (the "Pledging Campaign"). The overall objective is to ensure that 10 million tonnes of recycled plastics are used in new products on the EU market by 2025 (EuropeanCommission, 2018a[10]).

5.2.4. Public-private collaborations and partnerships

Collaboration and voluntary agreements between industry and the regulator are common in relation to chemicals and plastics, in particular plastic packaging. The Australian Packaging Covenant is one example, established in 1999 as a public-private agreement to reduce the environmental impacts of consumer packaging in Australia (AustralianGovernmentDepartmentoftheEnvironmentandEnergy, 2017[107]). In a similar agreement, the Bio-based Industries Joint Undertaking (BBI JU) aims to increase investment in the development of a sustainable bio-based industry sector in Europe (BBI_JU, 2014[108]).

[25] www.nykemilov.nu

5.2.5. Information exchange: guidelines, databases and other tools

Gathering and processing comprehensive information can be difficult and costly. Public or private bodies may produce guidelines, training, online databases or other services to assist companies in interpreting and evaluating different substances regarding their environmental and health compatibility. This type of information might for instance promote substance substitution for more sustainable plastics. One example is the UNEP-led Chemical Information Exchange Network (CIEN). Since 2000, the CIEN project has provided training and electronic equipment to facilitate access and exchange of chemicals information in about 50 countries worldwide[26]. Other examples have been implemented at the state level in the US, including the Michigan Green Chemistry Clearinghouse, aiming to accelerate green chemistry awareness, innovation and investment, and the California's Green Chemistry Initiative. The latter includes a focus on identifying and prioritizing chemicals of concern in consumer products and evaluating safer alternatives to toxic chemicals. The Initiative has for instance led to the establishment of an online Toxics Information Clearinghouse (MichiganGreenChemistry, 2016[109]; CaliforniaDepartmentofToxicSubstancesControl, 2010[110]). The American organisation BizNGO has similarly developed principles for safer chemicals, webinars and benchmarking tools for industry explicitly to help generate more sustainable plastics, including Guidelines for Sustainable Bioplastics (BizNGO, 2018[111]). The Swedish Chemicals Agency – a supervisory authority under the Government – provides a database ('*PRIO'*) to help manufacturers identify more benign chemical alternatives and thereby reduce health and environmental risks of their products (Kemikalieinspektionen, 2018[112]). Finally, the OECD Substitution and Alternatives Assessment Toolbox (SAAT) is an example of an online information platform to support the design on more sustainable plastics. A first version has been published online, intending to support decision-making by providing examples of chemical hazard assessment tools, frameworks to assess alternatives and a list of relevant regulations and restrictions adopted in OECD countries. It also provides case studies and other resources. The SAAT will be enriched and updated on a regular basis (OECD, 2014[87]).

The Polyolefin Circular Economy Platform (PCEP) is an example of industry establishing its own platform for collaboration and knowledge-sharing (founded by three plastics industry associations: EuPC, PlasticsEurope and PRE). Its aim is to advance the circular economy by increasing the reuse and recycling of polyolefin-based products and the use of recyclates as raw material (PCEP, 2018[113]).

Other examples of information exchange to support the development of more benign plastics include "grey or black lists" of substances that are likely to be subject to regulation in the near future, established to help firms reduce their use of these substance in advance and thereby speed up change to more sustainable alternatives. One example is the Substitute It Now (SIN) list established by ChemSec, a globally used database of chemicals identified by ChemSec as fulfilling the EU REACH criteria for Substances of Very High Concern (SVHC) (although not yet placed on the REACH Candidate List), and therefore likely to be banned or restricted in a near future (ChemSec, 2018b[114]).

[26] For more information, see http://chm.pops.int/Portals/0/download.aspx?d=UNEP-POPS-PAWA-CASES-ChemicalInformationExchangeNetwork.En.pdf.

5.3. Potential opportunities for information tools and voluntary approaches

There is a wide range of information tools and different voluntary approaches adopted throughout the OECD member countries with relevance to sustainable plastics – only some have been mentioned here. That said, important knowledge gaps remain and there are opportunities to explore in particular in terms of harmonising the various information tools and standards with relation to plastic additives, further improving our understanding of so-called bioplastics and how they would fit into the existing waste management systems and coordinating policy approaches to support a more effective circular approach to plastics.

Facilitating information exchange throughout product value chains is essential for ensuring the sustainability of plastics. There is currently a lack of internationally harmonised databases and information systems to ensure disclosure of chemicals contents in plastic materials and provide accessible information along the value chain. Providing such information in so-called product passports is one possibility, similar to the already existing EPDs. EPDs are still rarely applied, however, exploring alternative methods of providing this information might be appropriate. Ensuring sufficient and transparent flow of information throughout the value chain also has important bearing for when new materials or products are placed on the market. For instance, mandatory or voluntary technology assessments prior to market launch could avoid issues at end of life by ensuring that the necessary waste management is available. Ultimately, also policy instruments adopted to address challenges throughout the plastic value chain rely on availability and comparability of data. Further, combining different instruments in more holistic policy approaches and strategies creates a necessity for consistency between instruments, thereby accentuating the need for systematic and reliable information.

6. Gaps and opportunities for policy

6.1. Current practice and gaps

The previous sections provide an overview of the types of policy measures that can be used to address the sustainability of plastics, illustrated by existing examples from OECD member countries. Available data on waste management and environmental leakage, however, suggest that major challenges still remain in addressing the sustainability of plastics.

Regulatory measures have been widely applied with the aim of regulating the placing on the market of harmful substances and therefore minimising the associated risks. However, lack of harmonization across countries and non-aligned rules has translated into a diverse yet flawed policy mix. Furthermore, plastics remain one of the more problematic materials in waste management systems.

Market based instruments have been adopted targeting both producers and consumers and aiming to drive substantial changes in both product design and actors' behaviour (e.g. in terms of purchasing, use and waste management). While such measures have in many cases been successful, there is still scope for improvement in instruments that can drive more sustainable plastics design and use, including measures such as modulated EPR fees to encourage more sustainable design, taxes on the use of hazardous additives, certain types of polymers or even plastics in general, and instruments in support of improved waste management.

Investments have been made throughout the life cycle of plastics products, aiming at reducing the environmental and health impacts at each stage, whether by providing funding for research and development to support innovation, developing green public procurement rules for plastics, or improving waste management infrastructure. Regarding public procurement, general barriers relate to a lack of political focus, knowledge and awareness, as well as a general division between government departments responsible for procurement and for environmental matters. Further challenges are found in the lack of tools and standardised procedures to document the plastic waste prevention possibilities within public procurement (Plastic Zero, 2014). Knowledge gaps are also an issue in several innovative and emerging areas (e.g. biodegradable and bio-based plastics), which can hold back investments. In addition, current long-term investments in waste management strategies can lead to lock-in to sub-optimal technologies if the knowledge gaps remain unaddressed.

Finally, the complexity of chemical additives has resulted in the need for **information tools** to facilitate communication throughout the value chain of products, thereby supporting the sustainable design of plastics. Private firms have made voluntary commitments on the use of more sustainable materials, which have the potential to provide leadership for sector wide action. Nevertheless, important knowledge gaps remain which challenge the coordination of policy approaches to more sustainable uses of plastics and the possibility to combine information tools with other policy measures to improve effectiveness.

6.2. Remaining and additional challenges

Existing measures applied to the plastics and chemicals industry cannot deliver the necessary changes to support the shift to sustainable plastics on their own. Additional overarching challenges within plastics production and consumption trends remain:

- With 90% of plastics globally derived from fossil fuels, the plastics industry is still very resource-intensive. Even though alternative feedstocks exist, the extent to which they can be up-scaled sustainably (e.g. with respect to land use for bio based plastics) remains unclear. Moreover, primary/virgin feedstocks continue to be favoured in markets, especially when oil prices are low, making unsustainable applications of plastics more financially viable than alternatives (ten Brink, P.; Schweitzer, J.-P.; Watkins, E.; De Smet, M.; Leslie, H.; Galgani, F., 2017[83]).
- Substituting plastics for other materials (either single-use or reusable) may drive other environmental impacts, for example transport based emissions from increases in packaging weight (UNEP, 2014[14]). A switch to reusable products may require systemic changes necessitating a change in business practices such as supply chain lengths and access over ownership business models (Schweitzer, J.-P., Petsinaris, F. and Gionfra, S., 2018[8]).
- The technical and economic value of secondary plastics is lowered when there is contamination by other materials or additives, as is often the case with plastic products (Geyer, R., Jambeck, J. R. and Law, K. L., 2017[1]). While just a few resins make up a considerable share of the plastics market, as a result of the addition of additives and combinations with different materials, products and waste streams are nevertheless diverse. In general, plastics are recycled into lower value applications (e.g. textiles) through mechanical open-loop recycling (WEF, EMF and McKinsey&Company, 2016[5]).
- The recent global shift to single-use plastic products, as a result of social and cultural trends, has led to plastics being associated with a throw-away society and therefore high levels of waste.
- At the purchasing stage aesthetics, convenience and design are among the primary factors that influence consumers' choices and can therefore drive change in consumption trends. A growing preference for more sustainable, ethical products has been observed. However, a behaviour-attitude gap still persists, which calls for measures addressing both production (design) and consumption (Rokka, J. and Uusitalo, L., 2008[115]).
- There remain significant challenges regarding data related to the sustainable use of plastics. This includes lack of comparable data/methodologies on recycling figures (e.g. some countries include energy recovery in their definition of recycling for statistical data), lack of clear/traceable information on the material composition of plastic products (which can be a particular issue for legacy products when they reach the end of their life), and lack of information on the health impacts of some chemical additives.
- In a related point to the one above on data, both existing and new policies must be applied in a coherent manner and also be carefully and continually monitored to ensure that they are having the desired impact (i.e. the more sustainable use of plastics) and not creating unintended impacts (e.g. damaging local economies).

6.3. Opportunities for more effective policies

More than 80% of products' environmental impacts are determined at the design stage. It is at this stage that decisions on the use of polymers, materials and additives are made to ensure the development of functional, attractive, consumer-friendly design, and these decisions have a crucial impact on the sustainability of plastic products, including their end-of-life phase. The development of more sustainable plastic use therefore requires better and more sustainable design choices (EuropeanCommission, 2018c[31]).

It should be noted that design efforts should not necessarily be primarily directed at material design to increase the recyclability of plastic products. It is important to take into account much wider ambitions for sustainable plastic use, including design that can increase the durability, reparability and potential for renovation/updating of plastic products, in order to enable longer lifetimes for plastic products and thereby contributing to the objective of preventing plastic waste.

While specific standards and requirements can be applied to guide the sustainable design of plastics products, and regulations can be imposed on the use of additives, harmonisation across countries may be required to achieve effective implementation. In particular, the alignment of waste, product, and chemicals legislation plays a crucial role in ensuring cross-border compliance and in regulating the use of substances of concern, including legacy substances.

Further, existing measures need to be better coupled with those addressing all stages of the plastics value chain. For instance, market based instruments which target not only producers but also consumers can stimulate action, driving change from the bottom up. Improvements of relevant instruments include the application of fee modulation to EPR schemes based on the material and/or chemical content of plastics products, stimulating change in plastics design.

Although plastic packaging has the highest rate of recycling among plastics applications (39.5% in 2014) (PlasticsEurope, 2016[116]), most plastics items are not collected for recycling, illustrating a significant untapped recycling potential (WEF, EMF and McKinsey&Company, 2016[5]). This lack of action translates into a missed opportunity and a loss of economic value to the economy. Investments in waste management, such as recycling infrastructure, and the development of rules for green public procurement can provide an incentive to develop the management of plastics at the disposal stage, while also encouraging research and innovation. This can also contribute to ensuring that secondary plastic materials have a market value. As regards waste management infrastructure, the investment focus should be directed away from landfilling, energy recovery and incineration and towards the more preferable waste management options of recycling and re-use – with the highest priority going towards preventing waste in the first place. At the same time, funding should be directed towards the promotion of plastics eco-design, encouraging upstream measures which address the sector's inefficiencies while contributing to reducing the environmental impacts. But the effectiveness of such investments is ensured only when coupled with other effective measures. In general, measures to address sustainable plastics should be developed as part of a policy mix, rather than single instruments.

Currently, information tools on the substances used in plastics products exist but lack harmonization. Methods of providing information on products' components and materials, such as 'product passports', should be promoted and further expanded to facilitate information exchange along the value chain and further effort is needed to coordinate these tools in line with other instruments.

7. Towards a road map of action

7.1. Actors who can make changes

Different stakeholders throughout the international plastics value chain have various roles to play in incentivising more sustainable plastics design.

National regulators need to make sure that the most harmful chemical components of plastics are not allowed to enter, or are phased out of, the market, and that unnecessary and damaging products and activities are discouraged where viable alternatives exist. National regulators also have an important role in setting ambitious plastic recycling targets, and in terms of developing and adopting standards and schemes for product standards, labelling and substance declarations to support design shifts as well as comparability and fairness in the international market.

Regional and city authorities can, for instance, provide an important steer and support for more sustainable plastic design by adopting 'green' procurement strategies. They are also key actors in waste management, agreeing contracts with utility services and communicating with citizens. A central aspect in achieving more sustainable plastics is the extent to which plastics can be recycled and ensuring the quality and safety of secondary raw material plastic streams. By investing in appropriate waste collection and recycling infrastructure, authorities may thereby help improve the circularity of plastics.

The **private sector** has an important part to play, in particular in terms of investing in eco-design measures, assessing the sustainability of their products and materials (e.g. through LCAs) and supporting transparency of relevant information all along the value chain. Voluntary phase-outs and material substitution by producers and multinationals or procurement choices by retailers can meanwhile provide important upstream signals in support of more benign chemical additives and sustainable resins.

As demand ultimately determines the materials and products placed on the market, **consumer** preference and choices will largely impact the future of plastics and could incentivise producers towards more sustainable plastics design. This requires the availability of reliable, comparable and comprehensive information about plastic products and their chemical composition, as well as any relevant information about the properties of those chemicals. Consumers are also key in ensuring the appropriate disposal of many plastic products, including waste separation and reducing littering.

Retailers can influence upstream demand as well as provide transparency to consumers. Procurement choices by retailers can provide signals to the sustainable design of plastics. As well, retail marketing of more sustainable products can increase consumer demand and awareness of these types of products. At the same time, retailers play an important role in ensuring that comprehensive information about plastic products is accessible to consumers.

Importantly, there is a need to ensure a more transparent flow of information among and between all stakeholders and to raise awareness about the sustainability of existing and emerging plastics. This may help incentivise design changes and ensure that new solutions are firmly established. This in turn depends on further improving our understanding of plastics' impacts on human health and the environment (including plastic additives, other chemical components, marine litter, etc.), giving **academia and research institutions** an important role. Further research and development opportunities exist in the development of new technologies and innovation.

International organisations, such as the OECD, can use their resources, networks and geographic overview to support the design of more sustainable plastics, for instance by helping to improve our understanding of the costs and benefits of different types of plastics. They may also facilitate knowledge exchange and integration by identifying good practice, developing guidance and establishing forums and other opportunities for plastic value chain stakeholders to collaborate. Finally, international organisations can exert important pressure on national governments and multinationals to take timely and ambitious action in pursuit of more sustainable plastics.

7.2. Instruments: from precedent to widespread practice

There are several pathways and opportunities through which conventional plastics can become more sustainable. This background report has identified a number of interesting examples applied in OECD member countries, many of which have the potential to be scaled up and applied also elsewhere.

Engaging and providing opportunities for consumers to change their purchasing behaviour is key. This includes providing sufficient and reliable information and, importantly, combining information with awareness raising and tools to enable better informed sourcing and consumption, such as online databases and consumer smartphone apps. Meanwhile, collecting and analysing data on chemicals and plastic additives can be very costly and time-consuming for individual manufacturers. Transparency, knowledge exchange and collaboration are therefore important components to obtain comprehensive and lasting design shifts throughout the industry. Similarly, harmonisation of eco-design and product standards may support fair competition between firms and create economies of scale for the wider use of more sustainable alternative materials.

A central component of sustainable plastics design is the circularity of plastics – both to have access to a clean and safe supply of secondary plastic raw materials but also to encourage design of products that are easily disassembled and recycled at end of life. Common quality standards for secondary plastic raw materials might be one solution, in combination with investments in appropriate collection and waste management infrastructure.

7.3. Windows of opportunity

OECD member countries have an opportunity to take the lead in achieving a transition towards more sustainable plastics, including supporting and scaling up existing and new alternatives and solutions.

This leadership requires action from a range of stakeholders, as outlined above, utilising their respective strengths and leverage points. The following table, which illustrates a selection of potential actions, could form the basis for a road map for the development of future policies to encourage sustainable plastics design and use.

Table 6.1. A roadmap for design of 'sustainable plastics' from a chemicals perspective

	Knowledge – understanding the problem and solutions	Awareness and integration of knowledge	Policy, objectives, strategies and plans	Instruments, measures and legislation	Financing and investment
OECD	Research into investment needs, knowledge gaps and innovation needs; explore impacts on health and environment (e.g. OECD Chemicals Committee).	Facilitate knowledge-exchange among sectors; Data collection and distribution (e.g. OECD Chemicals Committee).	Develop fora and a database of best practice for policy to encourage sustainable plastics	Develop fora and a database of best practice for instruments to encourage sustainable plastics; (Harmonised) standards for chemicals and plastics.	
Other IOs	Explore best practices; explore impacts on health and environment	Consultation; Data collection and distribution; Facilitate knowledge-exchange among sectors	New Plastics Economy initiative; Guidance on policy tools to encourage sustainable plastics	(Harmonised) standards for chemicals and plastics/ packaging/ products; Legislative and market-based tools if there is competence in these areas	Fund studies into sustainable plastics design and use
National	Assess health and environmental risks/impacts of plastics	Stakeholder engagement; Awareness raising initiatives for business, retailers and consumers	Green public procurement; Moving away from landfilling; Product policies; Encouraging/coordinating voluntary agreements by retailers/producers/industry	Implement EPD schemes; Bans on hazardous substances/ products (e.g. bio-accumulating substances, microbeads); Product/material standards and labelling; Alignment of rules to support uptake of secondary raw materials (also internationally); Eco-design product standardisation; Explore potential for plastics taxes	Waste collection and recycling infrastructure and services; Research funding; Monitoring schemes
Regions & cities	Assess costs of plastics to health and environment	Share data and experiences; Develop local innovation clusters to foster R&D from universities	GPP within municipal buildings and waste management; Reducing consumption of single use plastics	Awareness-raising; Alignment of rules for classifying chemicals and waste (also internationally); Fines for improper waste disposal/ littering	End-of-life infrastructure; Waste collection infrastructure
Private sector	R&D into designing more sustainable plastics; conducting LCAs	Support transparency through increased information on plastic chemical components ; Implementing EMAS	Commit to material substitution according to e.g. SINlist; CSR commitments; Sourcing of sustainable plastics; Look for industrial symbiosis opportunities	Voluntary phase-outs; implementing EPDs and certification/ labelling	Invest in recycling facilities; closed-loop systems; eco-design of plastics
Civil society & citizens	Knowledge of health and environmental impacts of plastics	Moving from knowledge to changing purchasing behaviour	Develop citizen initiatives to improve waste management, and reduce wasteful practices from the private sector	Careful adherence to local waste management practices to support separate collection and recycling	Buying sustainable plastics and labelled products; Reducing consumption of single-use plastics
Research	Improve knowledge about bio-based plastics, including their ability to biodegrade and their various costs and benefits; Research substitutes to single use products; use of secondary raw materials & depollution techniques	Collaborate with industry to identify solutions; Communicate research to policy makers; Contribute to understanding best practice	R&D on sustainable plastics; Innovation in waste management systems to increase plastics recycling and secondary raw materials use	Analysis on the costs of action and inaction with respect to the sustainability of plastics, can support policy makers.	Investment/research grants in plastics challenges; Develop positions (e.g. PhDs) focusing on plastics challenges

7.4. Conclusions and next steps

A mix of policy instruments and approaches will be required to incentivise design of more sustainable plastics. This report identifies a number of interesting examples applied throughout OECD member countries to contribute to future reflection about potential opportunities for further action and how successful existing examples might be scaled up or applied in other countries.

Improvements to the design stage of plastics can help to reduce risks imposed by plastics to human health and to the environment and support the circularity of plastics. Different stakeholders throughout the plastics value chain have different roles to play to incentivise design changes. Meanwhile, knowledge exchange and collaboration between stakeholders is key to align and harmonise approaches and to find lasting solutions for the benefit of industry, civil society and the environment.

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