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An overview of strategies in selected countries

Milja Räisänen, Claire Mosoni and Sari Kauppi

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Abstract

How is Europe responding to the plastic challenge?
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The global plastics challenge has evoked countries to take action to reduce the environmental and health impacts of plastics. Measures are being taken both internationally and nationally to curb the harmful impacts of plastics and to create a sustainable circular economy of plastics.

The EU is steering its member states in the right direction through a number of regulatory instruments, the most recent being the SUP Directive (EU) 2019/904 on the reduction of the impact of certain plastic products on the environment, which is currently being implemented in member states. The measures and schedules for their implementation vary from country to country and include both voluntary and statutory measures.

This report presents the strategies of selected European countries to address the plastics challenge. The Nordic countries (Finland, Sweden, Norway, Denmark and Iceland), the large countries (France, Germany and United Kingdom, England and Scotland in particular) and the Netherlands, a pioneer in the circular economy, are included. Information was compiled primarily from countries' plastics strategies and other administrative documents and websites during the fall and winter of 2020 and early 2021. In addition, a short survey was carried out for supplementary information in fall 2020, directed to IG Plastics working group of the EPA Network. The survey was repeated in February 2022 to obtain updated information.

The amount of information found varied between countries. In addition, the use of available information was limited by the fact that some countries mainly produce information in their own language. The identified policy instruments can be categorized into regulatory, market-based, informative and financing measures, and voluntary agreements. In addition to these, the transition towards a sustainable circular economy of plastics is supported by research and development activities that build knowledge and bring changes to various stages of the plastics value chain. Substitutes for traditional plastics, such as bio-based and biodegradable plastics, are being developed. There is significant potential in bioplastic, but a lot of development still needs to be done and comprehensive sustainability assessments are required.

Based on the collected material, a number of measures are being taken in Europe to promote the circular economy of plastics. However, differences can be observed between countries in terms of the detail of plans and speed of action. From the point of view of the waste hierarchy, several measures focus on either waste prevention or recycling. In addition to the strategies examined, it would have been useful to have more information on the implementation schedules and effects. Such follow-up data was rarely available.

Steering towards the circular economy of plastics is continuous and fast-paced, which is why it is encouraged to look for updates to the information presented in this report. The Covid-19 pandemic may also have affected the implementation of the planned measures.

Keywords: plastic, circular economy, EU-countries, Europe, policy instruments, measures, strategies, bioplastic

Tiivistelmä

Miten Eurooppa vastaa muovihaasteeseen?
Katsaus valittujen maiden strategioihin

Globaali muovihaaste on herättänyt maat toimimaan muovien ympäristö- ja terveysvaikutusten vähentämiseksi. Toimenpiteitä tehdään sekä kansainvälisesti että kansallisesti, jotta saataisiin hillittyä muovien haitallisia vaikutuksia ja muodostettua kestävä muovien kiertotalous.

EU ohjaa jäsenmaitaan muovien kestävään kiertotalouteen useilla sääntelykeinoilla, uusimpana tiettyjen muovituotteiden ympäristövaikutusten vähentämistä koskeva SUP-Direktiivi (EU) 2019/904, jota on toimeenpantu viime vuosina kansallisesti eri jäsenmaissa. Erilaisten toimenpiteiden muodostamat kokonaisuudet sekä niiden toteutusaikataulut vaihtelevat maittain ja sisältävät sekä vapaaehtoisia että lain velvoittamia toimia.

Tämä raportti kokoaa ja esittelee valittujen Euroopan maiden suunnitelmia muovihaasteen ratkaisemiseksi. Mukana ovat pohjoismaat (Suomi, Ruotsi, Norja, Tanska ja Islanti), suuret maat (Ranska, Saksa ja Yhdistyneestä kuningaskunnasta etenkin Englanti ja Skotlanti) ja kiertotalouden edelläkävijämaa Alankomaat. Tietoa kerättiin näiden maiden muovistrategioista, muista hallinnollisista dokumenteista ja nettisivuilta vuoden 2020 lopussa ja 2021 alussa. Tiedonsaannin edistämiseksi syksyllä 2020 laadittiin EPA-verkoston IG-Plastics-työryhmälle aiheesta lyhyt kysely, johon pyydettiin päivityksiä helmikuussa 2022.

Tietoa löytyi vaihtelevasti. Lisäksi saatavilla olevan tiedon hyödyntämistä rajoitti joidenkin maiden tapa tuottaa tietoa lähinnä omalla kielellään. Toimenpidekokonaisuuksista tunnistettiin sääntelytoimenpiteitä, markkinaperusteisia toimenpiteitä, tiedotustoimenpiteitä, rahoitustoimenpiteitä ja vapaaehtoisia sopimuksia. Näiden lisäksi muutosta kohti kestävää muovien kiertotaloutta tukevat tutkimus- ja kehitystoimenpiteet, jotka tuovat tietoa ja uudistavat muovien arvoketjun eri vaiheita. Yksi kehityskohde on perinteisen muovin korvaajat, esimerkiksi biopohjaiset ja/tai biohajoavat muovit. Biopohjaisissa muoveissa on paljon potentiaalia, mutta kehitystyö on vielä alussa ja materiaalit vaativat kattavia kestävyysarvioita.

Aineiston perusteella Euroopassa on käynnissä ja suunnitteilla lukuisia toimenpiteitä muovien kiertotalouden edistämiseksi. Maiden välillä voidaan kuitenkin havaita eroja esimerkiksi suunnitelmallisuudessa ja reagointinopeudessa. Jätehierarkian näkökulmasta useat toimenpiteet keskittyvät joko jätteiden ehkäisyyn tai kierrätykseen. Tutkittujen suunnitelmien lisäksi olisi ollut hyödyllistä saada enemmän tietoa mainittujen toimenpiteiden toteutusaikatauluista ja vaikutuksista. Tällaista seurantatietoa oli harvoin saatavilla.

Ohjaus kohti muovien kiertotaloutta on jatkuvaa ja nopeatempoista, minkä vuoksi raportissa esitettyjen tietojen päivityksiä suositellaan etsimään. Covid-19-pandemia on myös osaltaan voinut vaikuttaa suunniteltujen toimenpiteiden toteuttamiseen.

Asiasanat: muovi, kiertotalous, EU-maat, Eurooppa, ohjauskeinot, toimenpiteet, strategiat, biomuovi

Sammandrag

Hur svarar Europa på plastutmaningen?
En översikt över utvalda länders strategier

Den globala plastutmaningen har väckt länderna till att arbeta för att minska miljö- och hälsopåverkan av plast. Åtgärder vidtas både nationellt och internationellt för att bekämpa plastens skadliga effekter och för att skapa en hållbar cirkulär ekonomi för plast.

EU styr sina medlemsländer till en hållbar cirkulär ekonomi med hjälp av flera regleringar varav den nyaste är SUP-direktivet (EU) 2019/904 om minskning av vissa plastprodukters inverkan på miljön som de senaste åren genomförts nationellt i de olika medlemsländerna. Helheterna som utgörs av olika åtgärder samt tidsplanerna för genomförandet av dem är olika i olika länder och omfattar både frivilliga och lagstadgade åtgärder.

Denna rapport sammanfattar och presenterar utvalda europeiska länders planer för att lösa plastutmaningen. Bland dessa utvalda länder finns de nordiska länderna (Finland, Sverige, Norge, Danmark och Island), de stora länderna (Frankrike, Tyskland och från Storbritannien i synnerhet England och Skottland) samt Nederländerna som är pionjär inom cirkulär ekonomi. Information samlades in från dessa länders plaststrategier, andra administrativa dokument och webbsidor i slutet av 2020 och i början av 2021. För att främja tillgången till information sattes hösten 2020 upp en kort enkät till EPA-nätverkets IG-Plastics-arbetsgrupp. I februari 2022 ombads respondenterna att komplettera sina svar.

Information hittades i olika omfattning. Dessutom begränsades utnyttjandet av tillgänglig information av att vissa länder främst producerar information på sitt eget språk. Bland åtgärdshelheterna kunde man identifiera regleringsåtgärder, marknadsbaserade åtgärder, kommunikativa åtgärder, finansieringsåtgärder och frivilliga avtal. Utöver dessa stöds förändringen mot en hållbar cirkulär ekonomi för plast av forsknings- och utvecklingsåtgärder som bidrar med kunskap och förnyar de olika stadierna i plastens värdekedja. Ett föremål för utveckling är ersättare för plast, till exempel biobaserad och/eller biologiskt nedbrytbar plast. Biobaserad plast har mycket potential men utvecklingsarbetet befinner sig på ett tidigt stadium och dessa material kräver omfattande hållbarhetsutvärderingar.

Utgående från materialet är åtskilliga åtgärder för att främja en cirkulär ekonomi för plast på gång eller under planering i Europa. Man kan dock upptäcka skillnader mellan länderna när det gäller planmässighet och reaktionstid till exempel. Utifrån ett avfallshierarkiperspektiv fokuserar flera åtgärder antingen på att förebygga avfall eller på återvinning. Utöver de planer som undersöktes hade det varit nyttigt att få mer information om tidsplanen för genomförandet av de nämnda åtgärderna samt om deras effekter. Den här typen av uppföljningsdata var sällan tillgänglig.

Styrningen mot en cirkulär ekonomi för plast är kontinuerlig och snabb, och därför rekommenderas det att söka uppdateringar till de uppgifter som presenterats i rapporten. Covid-19-pandemin kan för sin del också ha påverkat genomförandet av planerade åtgärder.

Nyckelord: Plast, cirkulär ekonomi, EU-länder, Europa, styrmedel, bioplast, åtgärder, strategier

Extended Summary

The challenges related to plastics, such as littering, fossil origin, harmful substances and a low level of recycling, are addressed in various ways. Solutions are developed both internationally and nationally, for example, through regulation and R&D activities targeted at different stages of the plastics value chain. The common goal is a sustainable circular economy of plastics. In the EU, several strategies (Circular Economy Action Plan, Plastics Strategy and Chemicals Strategy) and legal acts aim to promote the sustainability of plastics. The most recent legal act is the Single-Use Plastics Directive (EU) 2019/904, currently being implemented in member states. It aims to restrict the consumption of certain problematic plastic products.

To reach the EU's objectives and to respond to the global plastic challenge, European countries have implemented different policies. This study aims to shed light on the types of strategies and measures European countries have introduced, or are planning to introduce, to reach the goal of a sustainable circular economy of plastics. The focus is on Nordic countries (Finland, Sweden, Norway and Denmark), large countries (France, Germany and United Kingdom) and forerunners countries (especially Netherlands).

Information has been compiled primarily from countries' plastics strategies, other administrative documents and websites during the end of 2020, early 2021 and 2022. In addition, a short survey was carried out for supplementary information in fall 2020, directed to members of Interest Group Plastics (IG Plastics). The survey was repeated in February 2022 to obtain updated information. IG Plastics operates under The European Network of the Heads of Environmental Protection Agencies (EPA Network). In addition to the information found, more information would have been needed on the implementation of plans to assess the progress and effects. Unfortunately, monitoring data for strategies were often not available. A few examples of monitoring are presented in a separate chapter in this report for France and England.

Using the same categorization as the European Environment Agency (2019), the measures identified in this work can be summarized in the following way.

Regulatory measures were identified in the national plastic action plans of France, Sweden, Denmark, Finland, Norway, Scotland and Netherlands. Some measures show a determined effort towards single use plastics with a focus on withdrawing disposable plastics in the coming years, replacing them with reusable plastics or other materials. The ban on plastic bags is also strengthened in some countries, with measures such as prohibiting giving free plastic bags, prohibiting the use of certain single use plastic products such as straws or cotton buds, or prohibiting the importation and manufacture of single-use plastic bags in the country.

In addition. most states are introducing a ban on plastic microbeads intentionally put in cosmetics, Netherlands being the forerunner of this particular measure. Worth mentioning is also Norway's decision to revise the regulations concerning plastic waste exports to ensure the environmentally sound management of exported waste. This is based on the Basel Convention 2019 and came into force in Norway in January 2021.

Along with regulatory measures, a group of policy instruments that is used extensively is **market-based measures**, such as taxes, subsidies, and extended producer responsibility (EPR). At least Sweden, England, France, Netherlands, Scotland, Finland and Denmark have such measures, in addition to the EPR scheme for packaging, which is obligated in the Packaging and Packaging Waste Directive to all member states.

Taxing manufacturers and importers of plastic bags, as well as a tax on single-use plastics in general, are used in some of these countries instead of a ban. Financial incentives for recycled

and renewable plastics are being introduced, such as a tax on plastic packaging that contains less than a certain percentage of recycled plastic, or a reward for renewable plastics through an ECO label classification. Finally, one of the most common measures is extended producer responsibility, introducing it or reinforcing it in other products (plastic fishing nets, for example).

Informative measures can have different target groups. Through analysis of the informative action measures of Sweden, France, Iceland, Denmark, Finland and the Netherlands, we can see some measures directed to manufacturers and importers, and others directed to consumers.

The informative measures for manufacturers, importers and retailers of plastic products are often guidance documents, mandatory methodologies on the requirements of reporting, and information to provide to customers, such as the presence of endocrine disruptors.

Furthermore, informative measures for the consumers are presented, such as making sorting more efficient and with better packaging (single logo for sorting, color classification of waste bins). Finally, a lot of informative platforms have also been created through websites and social media to make the customer more aware of this issue.

Financing measures have become more numerous in recent years, with countries making more efforts to implement circular economy and manage waste. The Netherlands, in particular, in their action plan, show the money the Ministry allocates to each action and whether other parties are also concerned. Grants to municipalities and communities, environmental agencies' budgets and solidarity funds towards actors playing a role in the recycling and circular waste management of plastics are mentioned.

Finally, **voluntary agreements** bind actors at different parts of the plastics value chain. Agreements have different goals, such as:

- reducing plastic waste from agriculture or construction,
- reducing the consumption of plastic carrier bags,
- enhancing collaborations to improve circular economy: the reuse and recycling of plastics as well as developing bioplastics.

A couple of examples of voluntary agreements in Sweden, Denmark, Netherlands and Finland are mentioned. They differ in terms of objectives and the required level of commitment.

Some measures do not directly fall under the previously mentioned categories of policy instruments. Much effort is put into research, development and innovation activities. For example, collection and recycling systems are being improved, the effects and movements of plastic litter in the environment are studied, and new materials are being developed. Countries' positions on bio-based and biodegradable plastics that substitute traditional plastics are presented in a separate section at the end of the work. In short, the terminology of bio-based and biodegradable plastics is being clarified in many countries as new biomaterials are being developed. At the same time, research is needed for the evaluation of their environmental, social and economic impacts. In terms of recycling, bioplastics are considered challenging. Several countries also suspect that biodegradability might encourage littering. However, in Finland, for example, there is a lot of potential for the development of bio-based materials due to the abundance of raw materials and know-how.

When comparing the strategies of different countries, some curiosities emerge, a few of which should be mentioned here. France, for example, intends to prohibit the use of the term "biodegradable" on product packaging because it might be misleading and even encourage littering. The UK has raised the issue of tackling waste crime as a special theme and compared to others, the Dutch strategy stands out as it immediately sets precise budgets and timeframes for the implementation of actions.

Overall, from the waste hierarchy point of view (Figure ES1), many of the plastic-related measures proposed by the countries are implementing either waste prevention or recycling. A significant factor in waste and litter prevention will be the implementation of the SUP Directive, with direct bans and other restrictions on certain problematic products. Recycling, on the other hand, is promoted through, for example, product design, the expansion of collection and recycling systems and the development of technology. Besides, new categories of plastic products are being introduced to recycling, for example, through deposit schemes. In several countries, the expansion of EPR systems has been presented as a means of better management of products.

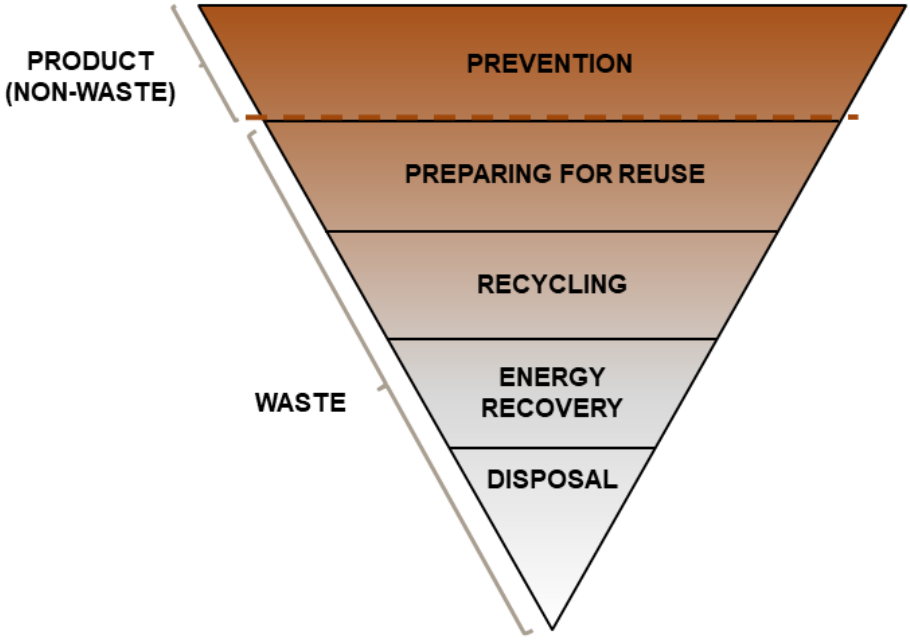


Figure ES1. Waste hierarchy. Redrawn from EC 2021a.

Preface

The governance of plastics is constantly being developed globally. To get an overview of national strategies regarding plastics in Europe, the Ministry of the Environment assigned the Finnish Environment Institute SYKE to compile this information. As a result, this report presents the national measures taken in selected European countries to tackle the harmful impacts of plastics. The work was funded by the Ministry of the Environment (2020–2021) and Business Finland (9030/31/2019, 2022). The information was mainly gathered during the end of 2020 and early 2021, with some updates added in early 2022.

The authors wish to thank Merja Saarnilehto from Ministry of the Environment and Petrus Kautto from the Finnish Environment Institute SYKE for providing valuable comments during the writing process. Thank you also to the members of the Interest Group Plastics for providing information from different countries.

The work was carried out by Researcher Milja Räisänen, Research Assistant Claire Mosoni and Senior Research Scientist Sari Kauppi.

Helsinki, May 2022

The authors

Contents

1 Introduction

Growing awareness of the harmful impacts of plastics has triggered action globally. At the same time as the understanding of the effects of plastics continues to grow, countries have adopted different strategies and measures to address the challenge. The common goal is the circular economy of plastics.

The sustainability of plastics production and the effects of plastics in the environment, humans and other organisms are major research topics at the time of writing. Subjects such as plastic litter, microplastics and the fossil origin of traditional plastics have recently been under negative spotlight, not to forget the impact of the production and waste treatment on the climate (Figure 1).

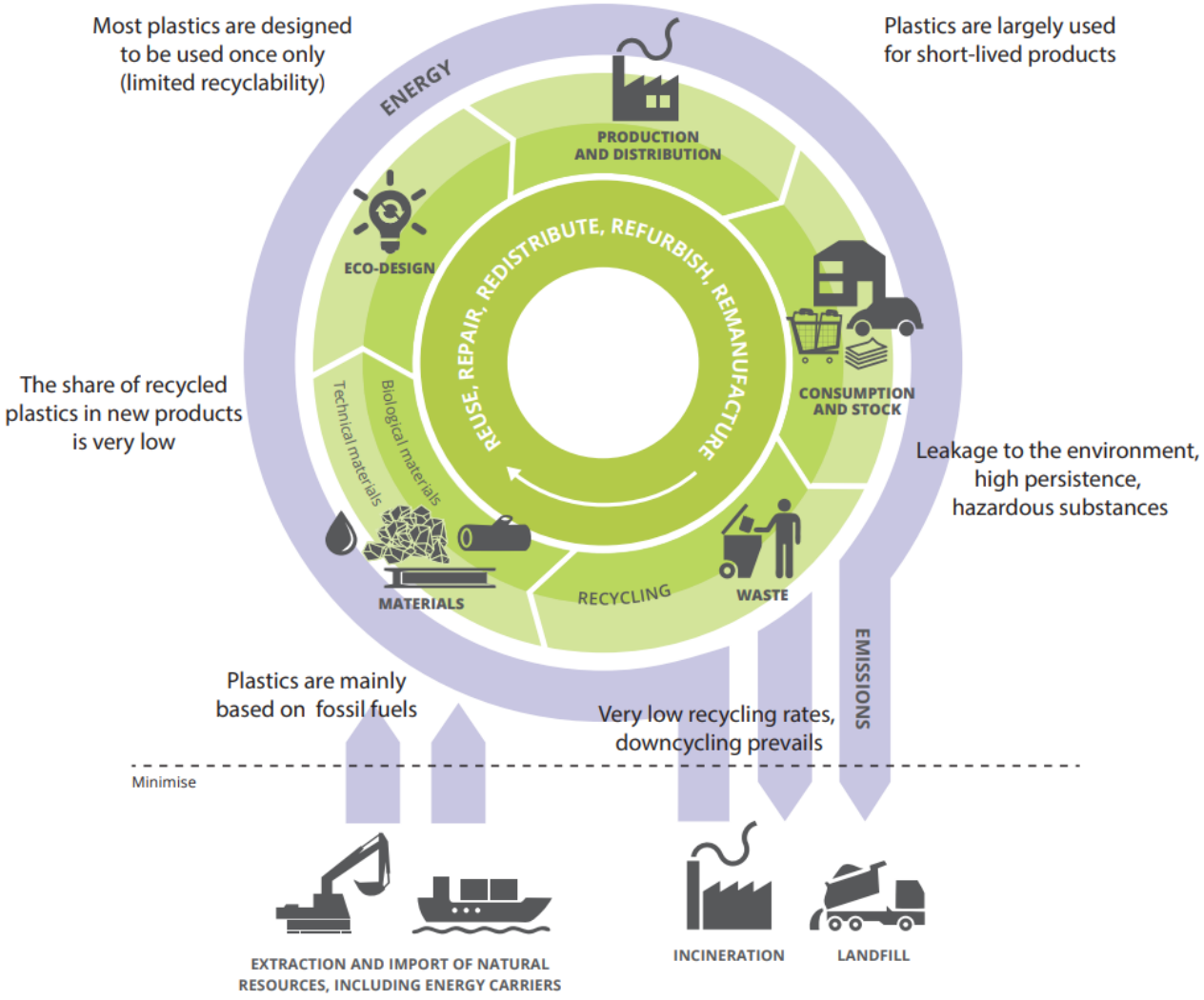


Figure 1. Challenges along plastics value chain. Figure from EEA 2019.

The development of recycling systems and techniques for plastic waste is advancing rapidly and this brings much needed options for less sustainable plastic waste treatment methods. In Europe, most of the post-consumer plastic waste is still incinerated (43%), and a considerable share is

landfilled (25%), which leaves the precious materials completely unexploited. Recycling is steadily increasing, with a share of 33% (PlasticsEurope 2020).

Globally, in the worst cases, there is no waste management at all. When released into the environment, plastic litter breaks down into smaller pieces and may travel far. Some plastics also contain hazardous substances used as additives or contaminants absorbed from the surroundings. Bits of plastic may cause serious hazards for different species (see e.g., de Souza Machado et al. 2018; Rochman et al. 2016). The World Economic Forum, the Ellen MacArthur Foundation and McKinsey & Company (2016) have predicted that the production of plastics will double by the mid-2030's and in business-as-usual scenario in 2050, there will be more plastic in the sea than fish. These alarming predictions underline the urgent need to move towards a sustainable circular economy of plastics – materials which are extremely useful when wisely used.

Global action to address plastic waste has taken place in recent years. China implemented a waste import ban in 2018, the Basel Convention obligates parties to control the transboundary movements of plastic wastes presumed to be hazardous (newest amendments effective in January 2021), and in 2021 and 2022, the possibility of initiating the negotiations of a global agreement on plastic waste is being discussed at the fifth session of the United Nations Environment Assembly (UNEA-5). The focus of the global agreement under discussion is mitigating marine plastic pollution. Exploring the advantages of a global agreement is widely supported around the world. The perspective of Nordic countries can be read in a report by Raubenheimer & Urho (2020). Over the years, a number of international agreements have come into force to control plastic waste and litter and, in particular, to protect the seas. The participation of European countries in international conventions and other agreements is presented in Appendix II.

In Europe, the EU sets the framework for safe and sustainable plastics production and use. In the European Commission's Circular Economy Action Plan (COM-2015-614), plastics were identified as one of the priority areas, which led to the development of the European Strategy for Plastics in a Circular Economy in 2018 (COM-2018-28). The new Circular Economy Action Plan was launched in March 2020 and presented new initiatives for single-use products, packaging and microplastics (COM-2020-98). Some of the most important EU legal acts addressing plastics problems are:

- Directive 2008/98/EC of the European Parliament and of the Council on waste and repealing certain Directives (*Waste Framework Directive)*
- European Parliament and Council Directive 94/62/EC on packaging and packaging waste (*Packaging and Packaging waste Directive)* and Directive (EU) 2015/720 of the European Parliament and of the Council amending Directive 94/62/EC as regards reducing the consumption of lightweight plastic carrier bags (*Plastic Bags Directive*)
- Directive (EU) 2019/904 of the European Parliament and of the Council on the reduction of the impact of certain plastic products on the environment, Single-use Plastics Directive (*SUP-Directive*)
- Regulation (EC) No 1013/2006 of the European Parliament and of the Council on shipments of waste (*Waste Shipment Regulation*) and Commission Delegated Regulation (EU) 2020/2174 amending Annexes IC, III, IIIA, IV, V, VII and VIII to Regulation (EC) No 1013/2006
- Directive 2008/56/EC of the European Parliament and of the Council establishing a framework for community action in the field of marine environmental policy (*Marine Strategy Framework Directive*).

In addition, the European Chemicals Agency, ECHA, is preparing a proposal for an EU-wide restriction on intentionally added microplastics in mixtures. The restriction is based on REACH-regulation (EC) No 1907/2006. The Commission opened a public consultation in the beginning

of 2022 and plans about the adoption in fourth quarter 2022 (ECHA 2020, 2022). Plastics are also included in the Chemical Strategy for Sustainability, Towards a Toxic-Free Environment (COM-2020-667). Innovative technologies are particularly needed to detect the presence of legacy substances in plastic waste streams to guarantee safe recycling.

To reach the EU's objectives, and to respond to a global plastic challenge, European countries have implemented different policies. This study aims to shed light on the strategies and measures European countries have introduced, or are planning to introduce, to reach the goal of a sustainable circular economy of plastics. The focus is on Nordic countries (Finland, Sweden, Norway and Denmark), large countries (France, Germany, United Kingdom, especially England and Scotland) and circular economy forerunner country Netherlands.

The purpose of this work was to gather information into an easily readable format. Plastic policies are in constant development, which should be kept in mind when reading this report; checking updates to presented measures is encouraged. The Covid-19 pandemic may also have affected the implementation of measures in different countries.

2 Materials and methods

The administrative websites were the most important sources of information for this report. However, documents written in English were not always available which limited the amount of information that could be utilized.

Information has been compiled primarily from countries' plastics strategies and other administrative documents and websites. Information was mainly collected during the end of 2020 and the beginning of 2021, with a few updates added in the early 2022. A short survey was carried out for supplementary information in fall 2020 and was repeated at the beginning of 2022. It was directed to members of Interest Group Plastics (IG Plastics), which operates under the network of the heads of the Environmental Protection Agencies (EPA Network). Information was searched for in English, French, Finnish and Swedish. Materials written in other languages could not be considered in this work. This is a limitation of this work as some countries produce information primarily in their own language.

The collected information was classified based on the type of policy instrument it represents (regulatory, market-based, informative, financing and voluntary agreements). This classification was adopted from the European Environment Agency EEA (2019) and is presented in the extended summary. Other measures that do not directly fall under these categories, such as research and innovation activities, were also identified. The actions of each country are presented in country-specific chapters. Information about the positions of the countries on bioplastics is gathered in the last chapter to provide a special focus on these traditional plastics-substituting materials.

To complement the information provided in this overview, further reading is suggested, such as:

- PlasticsEurope annually analyses European plastics production, demand and waste data.[1]
- The European Environment Agency has published a report reviewing waste prevention policies in Europe with a focus on how these policies approach the issue of plastics and plastic waste (EEA 2019).
- The European Environment Agency has also published a report about the challenges related to moving towards a circular plastics economy (EEA 2020).
- The Global Plastics Outlook introduces the challenges and solutions in the plastics value chain to make the lifecycle of plastics more circular (OECD 2022).

[1] The analysis for 2020 can be found here:
https://plasticseurope.org/knowledge-hub/plastics-the-facts-2020/

3 Finland

In 2018, a Plastics Roadmap for Finland (*Reduce and refuse, recycle and replace)* was prepared in a broad-based working group. The aim was to examine the challenges related to plastics and to find a potential solution by defining short- and long-term measures for reducing littering and unnecessary consumption, improving the recycling of plastics, and replacing plastics made from fossil-based materials with sustainable and renewable alternatives. The roadmap is updated in 2022.

3.1 The process of developing a plastics roadmap

The development of a Plastics Roadmap for Finland provided the possibility for all citizens to participate in the collection of ideas for several themes, such as global challenges and possibilities, speeding up innovations and research, diminishing environmental and health impacts, consumers, and information. After collecting ideas, the work of the working group and secretary continued. Two large stakeholder workshops were organized for even broader view on targeting the right proposals and measures and, in the second workshop, on the suggested proposals.

The finalized roadmap presented ten proposals and several actions for each proposal (Figure 2).

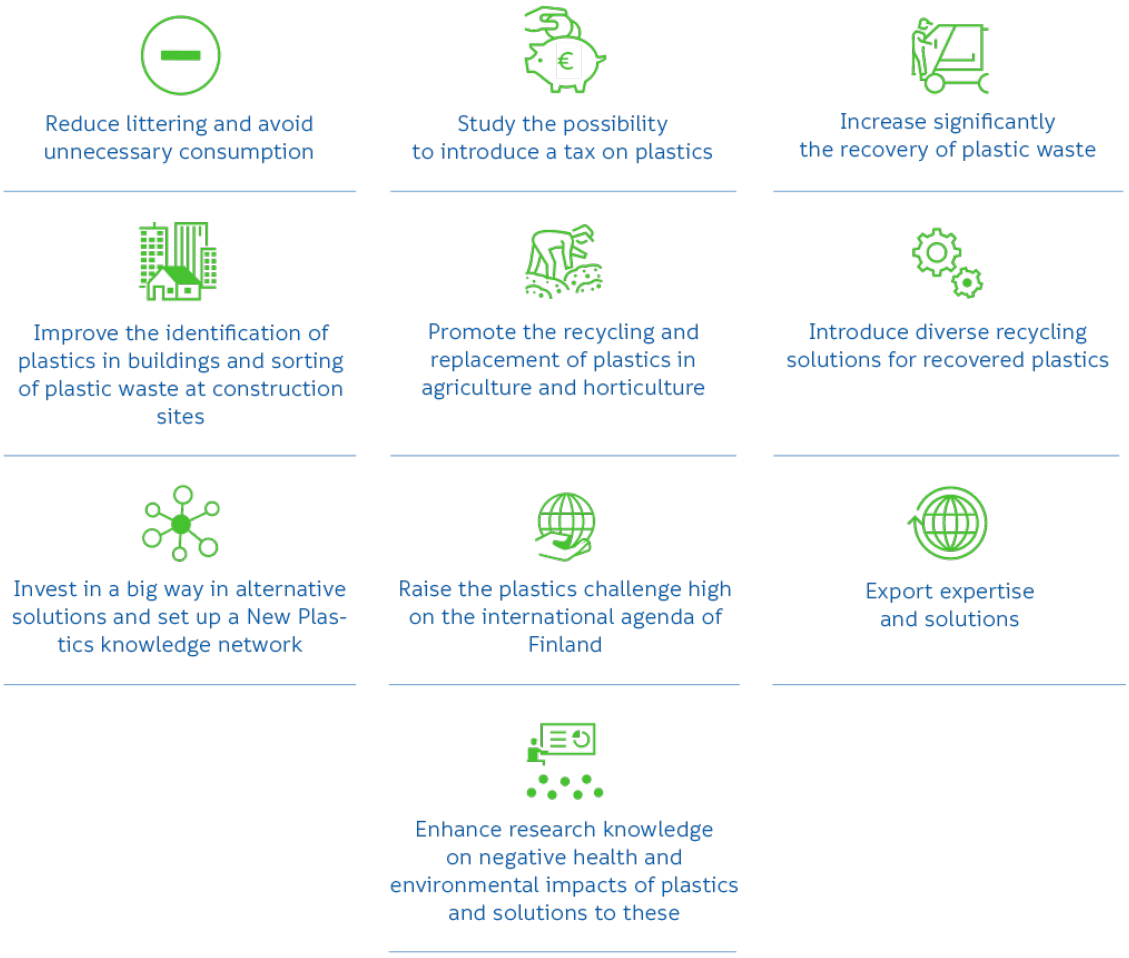


Figure 2. Ten proposals of the Plastics Roadmap for Finland. Figure from Ministry of Environment of Finland 2018.

The working group involved in the Plastics Roadmap created a networking group which continued to meet several times each year to support the implementation of the proposals. Additionally, the secretariat has had at least monthly meetings to support the actions of the proposals, the network meetings, and communication regarding plastics. A larger event, "Plastics forum," has been arranged once a year with a specific theme for each meeting (e.g., bioplastics). The Network has also served as one of the stakeholder groups in SUP-directive implementation in Finland, which was implemented (including oxodegradable plastics) under waste legislation in Finland in 2021. The new period for the network and secretariat started in June 2021 and will last until May 2023. The Plastics Roadmap was evaluated in 2021 and will be updated during spring 2022. New measures are discussed with the network members, and new indicators and targets can be set to steer the process towards sustainable circular economy of plastics.

3.2 Evaluation of plastic tax and End-of-Waste criteria

The plastics roadmap includes an assessment of options for plastic tax implementation and the impacts of this tax on the consumption of certain single-use plastic products, as well as evaluation of the relationship between taxation and the producer responsibility system and its expansion and the needs and opportunities to expand the deposit-refund system.

To promote mechanical and chemical recycling, introducing End of Waste (EoW) -criteria has also been evaluated (Teittinen et al. 2020). Communication with the wide stakeholder group began in July 2021 to prepare the EoW act for mechanical recycling.

3.3 Increasing the recovery of plastic waste

To increase the recovery of plastic waste, multiple measures are mentioned in the Plastics Roadmap for Finland. The sorting of waste is encouraged with lower prices for sorted waste compared to unsorted waste. For example, in 2020 in Helsinki, emptying a 660-liter plastic packaging waste container once a week cost EUR 7.45 (incl. VAT 24%) and emptying a mixed waste container of the same size cost EUR 11.31. The prices for 2021 were EUR 6.86 and EUR 12.44, respectively. (HSY 2020)

In addition, the recovery of plastic waste is increased by measures such as:

- amending the requirements for separate waste collection
- expanding the property-specific and regional collection systems
- organizing collection points for areas with detached or terraced houses
- better collaboration between package manufacturers, municipalities, waste management companies and other actors in the collection of plastic packaging waste. (Ministry of the Environment of Finland 2018)

Currently, the collection system is expanding and collection points are being added. Some waste stations have also established a reception for rigid plastic waste. The plastics roadmap provided financing for some testing and pilot scale projects during 2020, e.g., for pilots targeting enhancing the recovery of plastic waste.

3.4 Informative measures to raise awareness

The Plastics Roadmap for Finland proposes informative measures to reduce littering and avoid unnecessary consumption. In order to raise awareness among consumers and the general public about littering, single-use items and sustainable choices, a set of campaigns, is planned.

Since the publication of the plastics roadmap in 2018, there has been several information campaigns organized by different actors:

- I love muovi –campaign in April 2019 was organized by Finnish Broadcasting Company YLE. The campaign challenged citizens, schools and cities to accelerate plastics recycling and to avoid unnecessary consumption (YLE 2019).
- World Wildlife Fund, WWF, gathers information on measures of Finnish and EU levels, focusing on marine litter (WWF 2021a). In 2020, WWF organized three public events and one event for Finnish members of parliament to widen the knowledge of plastic pollution and solutions. Training for the press was also organized. In collaboration with SYKE and Keep the Archipelago Tidy Association, WWF has also organized beach clean-up events. The collected plastic litter has been studied in different research projects[2].
- The Martha Organization has committed to raising awareness of reducing the consumption of plastics, sorting, recycling and alternatives to products made of virgin plastics (Sitoumus2050 2019).
- The Finnish Plastics Industries Federation maintains a website muovikuuluukiertoon.fi which highlights the role of plastics in society and shares recycling tips. The Finnish Plastics Industries Federation also annually organizes a national collection campaign for plastics products.

The Ministry of Agriculture and Forestry of Finland has prepared an information package for farmers about plastic packaging used in agri- and horticulture and plastics used in production. It includes information about sorting, storing, collecting and recycling. The reports also describe who pays for the collection and processing of plastic packages and plastics from the production. (Ministry of the Environment of Finland 2021, Ministry of Agriculture and Forestry of Finland 2019a and 2019b.)

3.5 Voluntary agreements

In 2016, the Ministry of the Environment concluded a Green Deal agreement with the Federation of Finnish Commerce in order to decrease the consumption of plastic carrier bags. The Green Deal is called the 'Plastic Carrier Bag Agreement' and was introduced to implement the EU Directive on packaging and packaging waste by a voluntary agreement instead of a legal instrument.

According to the Green Deal: "The agreement is in force until the end of 2025 and the aim is to make sure that Finland reaches the reduction targets for the consumption of plastic carrier bags in the EU Directive. The aim is that by the end of 2025 no more than 40 bags per person per year are used." (Sitoumus2050 2016)

In December 2020, a Green Deal agreement on the reduction of plastic packaging in the real estate and construction sector (2020–2027) was signed. The objective was to reduce the consumption of plastic films in construction and to increase the separate collection of these plastics in construction projects, contracts and supply chains, and to enhance the recycling of plastic films and the use of recycled plastics in construction. (Sitoumus2050 2020)

A Green Deal on take-away packaging is currently under negotiations. This deal would also implement the SUP-directive Article 4 on consumption reduction.

[2] More information about projects focusing on marine litter and plastic debris found on Finnish shores: https://www.pidasaaristosiistina.fi/tietoa_meista/ymparistoprojektit/rantaroskaseuranta (in Finnish), https://www.syke.fi/fi-FI/SYKEn_meriroskahankkeet (in Finnish)

The Closed Plastic Circle -project orchestrated by the Smart & Clean Foundation aims to circulate all recyclable plastic in Helsinki metropolitan area and Lahti more efficiently. The project commits a variety of actors in both public and private sectors to the goal of maximizing the amount of plastic that can be recycled. (Helsinki Metropolitan Smart & Clean Foundation 2021)

Finnish Green Deals are binding agreements, setting targets and actions for participants.

3.6 Research and development

According to the Plastics Roadmap for Finland: "Experiments are launched to investigate the alternative ways to implement the separate collection of different types of plastic waste. To improve the quality of recycled plastic, cleaning, recycling and refining technologies for plastic waste are developed and tested, including the possibility to collect plastic packaging waste and other plastic waste in the same container. Collection systems are designed to be user-friendly and efficient" and "Means are found to ensure recyclability in designing plastic products and composites. Product groups are identified where a certain share of recycled plastic could be required."

Piloting different ways to replace, reduce and recycle plastics in construction is done in multiple projects. The uses of plastics in construction is also investigated, and in August 2020, two construction projects were launched to test a material pass application. Testing provides information and experiences on how the material data of construction products can be combined with Building Information Model and how this information can later be utilized to increase the recyclability and reuse of building materials.

In 2019, the Ministry of the Environment and Technical Research Centre of Finland VTT made an inventory of the amount and recycling potential of plastics in the built environment. The study focused on residential buildings and daycare centres (Ministry of the Environment of Finland 2019).

An investigation of microplastics in agricultural land is being conducted by SYKE, Finnish Food Authority and Natural Resources Institute Finland Luke.[3] In addition, the collecting and recycling of non-packaging agri-plastic waste has been studied by University of Turku. (Erälinna & Järvenpää 2019)

The Technical Research Centre of Finland, VTT, has launched a Circular Plastics package with the aim to provide research-based circular economy solutions for the entire value chain of plastics. The approach covers ecodesign, sorting and mechanical recycling, reducing fossil feedstock and chemical recycling.[4]

Plastic pharmaceutical packaging containers are studied in the Sustainable Drug Discovery and Development with End-of-Life Yield (SUDDEN) project, especially from the circular economy point of view and possibilities of safe recycling. A study on value chain of pharmaceutical packaging focused on plastic containers.[5]

A report on the means to reduce the consumption of single-use plastic products was published in 2021, which proposed reduction measures and observed the data available to cover the SUP-directive (EU) 2019/904 Article 4 products (Sorvari & Heinonen 2021).

From plastic waste into products, the Actors' visions of the development of the recycled plastics market -report provides an overview of the operations of plastic value networks in Finland. Data for the analyses of expert views on the development of the recycled plastics market was gathered via interviews and public statements. (Valve et al. 2022)

[3] https://www.syke.fi/en-US/Research__Development/Research_and_development_projects/Projects/Microplastics_in_Agricultural_soil_MicrAgri [Accessed 30.3.2022]
[4] https://www.vttresearch.com/en/ourservices/circular-economy-plastics [Accessed 15.3.2022]
[5] https://sudden.fi/en/ [Accessed 30.3.2022]

Different recycling techniques have been developed:

- L&T has invested in a modern recycling facility in Merikarvia
- The potential of chemical recycling in Finland has been studied (Roschier et al. 2019)
- Neste develops chemical recycling technologies and capacity.

Finland's plan is to strengthen the knowledge and know-how in solving the plastic problem and exporting the know-how abroad, for example, to countries where plastic pollution is a major challenge. This export can cover solutions for collecting, sorting, processing and cleaning technology as well as biodegradable materials and solutions for recovery of plastic litter in the oceans. In 2019, Business Finland, the government organization for innovation funding and trade, travel and investment promotion, launched a Bio and Circular Finland -programme with the aim to increase the exports of bio and circular economy solutions to be adopted in international markets. The programme focuses on plastic and packaging industries. (Ministry of the Environment of Finland 2018, Business Finland 2019.)

In spring 2022, Business Finland published their decision of a 20 million euros grant for a new project through the EU's Recovery and Resilience Facility (RRF).[6] The project will aim at the replacement of fossil feedstock by renewable feedstock, the development of plastics recycling, regarding both mechanical and chemical recycling and making production carbon -neutral through electrification and by using hydrogen and renewable electricity.

In order to increase research knowledge on the negative health and environmental impacts of plastics and on the solutions to these problems, research organizations such as SYKE, Luke, VTT and the Finnish institute for health and welfare, THL, have launched multiple projects[7].

[6] https://www.businessfinland.fi/en/whats-new/news/cision-releases/2022/towards-green-transition-with-the-new-leading-companies-borealis-and-meyer-turku [Accessed 30.3.2022]

[7] Examples of projects: https://muovitiekartta.fi/toimenpiteet/lisataan-tutkimustietoa-muovien-haitallisista-terveys-ja-ymparistovaikutuksista/ (in Finnish) [Accessed 30.3.2022]

4 Sweden

Plastics is one of the identified priority material flows in Sweden's national waste plan and waste prevention program (2018–2023) as well as in the national strategy for circular economy.

4.1 Action plan for plastics under development

Sweden does not yet have a national plastics strategy, but an action plan is currently being developed by the government and will be published in the first quarter of 2022. The Swedish Environmental Protection Agency (EPA) is responsible for the national coordination of sustainable plastic use. In 2021, the Swedish EPA published a roadmap until 2025, which identifies, for example, the most important areas of action in the plastics value chain and factors that hinder action. It also suggests indicators for measuring the improvement (Swedish Environmental Protection Agency 2021a). Below are some of the key measures Sweden has introduced so far to govern plastic.

4.2 Schemes to cover plastic packaging

In Sweden, all packaging is covered by EPR which is regulated by ordinance 2018:1462. For plastic bottles, there is a deposit refund system regulated by ordinance 2005:220. The targets for material recycling rates are 90% for plastic bottles and 50% for other plastic packaging by 2029, and beyond that at least 55%.

4.3 Ban on plastic microbeads

In July 2018, Sweden introduced a ban on selling cosmetic products that contain plastic microbeads with a cleansing, scrubbing or polishing effect. The ban covers products that are intended to be rinsed off or spit out after being used (e.g., soap with a scrubbing effect or toothpaste with a polishing effect). The ban applies to plastic particles in solid form that have any dimension smaller than 5 mm and that are insoluble in water. The ban does not cover particles that consist of naturally occurring polymers such as cellulose. (Swedish Chemicals Agency KEMI 2018)

4.4 Means to reduce the use of plastic bags and other single use products

Plastic bags and other single-use products are regulated by ordinance 2021:996, which implements the SUP Directive (EU) 2019/904 and came into force on 1 January 2022.

According to the reduction targets, the consumed amount of thin plastic bags should not exceed 40 bags per person per year by 31 December 2025.

In May 2020, Sweden introduced a tax on plastic bags. It applies to manufacturers, importers and those who receive plastic carrier bags from another country. The taxed amounts are SEK 3 for plastic bags >15µm thick and SEK 0.3 for plastic bags <15µm thick and <7 liters in volume.

The impact of the tax on the number of plastic bags used per person is evaluated each year. The first report of numbers of plastic bags per person was in 2017 and since then the number has decreased per person by nine.

The providers of plastic bags are also required to inform consumers about the environmental impact of plastic bags, the benefits of reduced plastic bag consumption and measures to reduce consumption.

For single use cups and food containers, the reduction target is 50% until 2026 compared to 2022. Some rules of the SUP Directive implementing ordinance 2021:996 will come into force later. Some examples of which are:

- From 2024 onwards, it is forbidden to place single use cups that contain more than 15% plastic on the market (14 §).
- From 30 April 2022 onwards, it is forbidden to use plastic-containing confetti outside (16 §).
- Requirements to offer reusable alternatives for single use cups and food containers in serving will come into force in 2024.

In addition, a new tax on single-use cups and food containers has been proposed, but the government has not yet made a decision. The idea behind the tax is to support a transition to a more resource-efficient and bio-based circular economy. The tax is proposed based on an investigation commissioned by the Swedish Government in 2020 (Statens Offentliga Utredningar SOU 2020).

4.5 Guidance documents to support the implementation of EU legislation

The Swedish EPA is responsible for the national coordination of sustainable plastic use and therefore, the organization has developed two guidance documents on plastic bags to support compliance to the rules on plastic bags in the EU packaging directive 94/62/EC. The documents are directed to producers (manufacturers and importers) of plastic bags and provide guidance on fulfilling the requirements for the reporting of plastic bags and for providing information to customers. In addition, the Swedish EPA has compiled a collection of arguments to support retailers in their meetings with customers.

The Swedish EPA has also complied other guidance documents to support the implementation of EU legislation on matters such as waste prevention, waste management, new extended producer responsibility (EPR) schemes in the SUP Directive and implementation of the new Packaging and Packaging Waste Directive in national law.

4.6 Grants for combatting litter and development of standards

Since March 2018, communities have been able to apply to the Swedish EPA for a grant to clean up plastic litter from their beaches. The grant may cover up to 90% of the costs. As an example, the total budget for grants in 2021 was SEK 25 million (Swedish Environmental Protection Agency 2021b).

To enforce the polluter pays principle, a new litter fee will be introduced in Sweden in 2023 and 2024 by ordinance 2021:1002. It will cover the products that most commonly end up as litter, such as candy and ice cream wrappers, cigarette butts, cups and wet wipes. The revenues (estimated to be around SEK 600 million per year) will be distributed to the municipalities for cleaning activities.

In 2019, Swedish EPA granted SEK 2.8 million to the Swedish Institute for Standards (SIS) for the development of plastic standards. The grant is divided into the following subjects:

- establishing ISO-secretariat for plastics recycling
- continuing the work with the report “ISO/NP TR 23891 Plastics – Recycling – Necessity of standards”
- amendments about decomposition to “SS-EN 13432 förpackningar – krav gällande förpackningar återvinningsbara genom kompostering och biologisk nedbrytning”
- general guidelines for recycling plastic waste
- glossary for CEN (European Committee for Standardization) or ISO (International Organization for Standardization)
- characterization of recycled plastic
- establishing a new Swedish working group for textiles focusing on environmental aspects of textiles made of plastic, with the objective to bring environmental aspects to the international standardization agenda
- proposal of new terminology for recycling textiles made of plastic
- funding of four participants from the academy for participation in textile standardization. (Swedish Environmental Protection Agency 2019)

4.7 Research

The Swedish EPA is also responsible for gathering and disseminating knowledge on microplastics. Currently, they are working on two projects on indicators related to the Convention for the Protection of the Marine Environment of the North-East Atlantic OSPAR: a project to develop indicators for monitoring microplastics in the marine environment and a project to measure and analyze microparticles in sediment.

A chemical cluster of chemical companies Adesso Bioproducts, INOVYN, Nouryon, Borealis and Perstorp in Stenungsund has launched a vision called Sustainable Chemistry 2030 (Hållbar Kemi 2030) with the aim of eliminating fossil raw materials. To achieve this vision, they have, for example, developed a chemical recycling concept called Plastic return refinery (Plastreturraffinaderi). Further development of the refinery is included in the Swedish government’s climate policy action plan which was introduced in December 2019. (Hållbar Kemi 2021)

5 Norway

Norway released a new plastic strategy in August 2021 with the main goal of following and contributing to EU plastic measures. There is also a big focus on plastics in the marine environment and the imports and exports of plastic waste. The main measures and initiatives in the strategy are presented below.

5.1 Extended Producer Responsibility

The Norwegian Environment Agency has been commissioned to review and assess EPR and include new product groups such as:

- disposable food containers (for takeaway or fast food)
- wet wipes
- balloons
- tobacco products with filters
- fisheries and aquaculture equipment containing plastic.

Furthermore, new requirements will also be considered for producer responsibility concerning the end of life and covering costs. (Klima- og miljødepartementet 2021)

5.2 Regulatory and informative measures

Regulatory measures are not as present in Norway as in other countries presented in this report, and mostly consist of introducing new requirements for plastic products and what they contain, or special requirements for specific sectors, such as agriculture or transport.

Some of these requirements are:

- introducing requirements for the proportion of secondary raw materials of plastic in plastic bottles
- introducing requirements for the sorting and material recovery of agricultural plastics
- introducing requirements for reporting lost fishing vessels
- implementing the EU's revised Ship Waste Directive and introducing a general one waste fee for fishing vessels. (Klima- og miljødepartementet 2021)

Informative measures are following a similar organizational pattern, with measures more general and others more sector specific. The main ones are:

- introduce labeling requirements to ensure correct waste management of some disposable items
- work to give consumers easier access to environmental information about plastic in products through marketing tools such as labeling schemes and digitally available product information
- promote innovation and information on measures against plastic in biological waste treatment in the agriculture sector where bio-residue or compost is used instead of fertilizer
- be a driving force and contributor to global knowledge about sea-based sources of marine litter and microplastics. (Klima- og miljødepartementet 2021)

5.3 Regulating the transboundary movements of certain types of plastic waste

A revised law came into force on 1st of January 2021 in Norway related to the 2019 amendments of the Basel Convention, on the transboundary movements of certain types of plastic waste. This revised law is the implementation of the Prior Informed Consent (PIC) procedure under the Basel Convention. This procedure relates to difficult-to-recycle plastic waste and its export. An exporter will now have to submit documentation to the national authorities which proves "the existence of a contract with a recipient in the importing country, ensuring that the waste will be subject to environmentally sound management at its destination." (Norwegian Government 2020a)

Thus, these revisions ensure more regulations on the transport of "low value" plastic waste as the authorities of the countries to which the plastic waste is sent will be aware of the transport and be able to set its own conditions on it.

Furthermore, this new law also includes restrictions similar to the revised EU regulation on transboundary transports of waste ((EU) 2020/2174). This means Norway also adopts a ban on the exports of Basel-type plastic from the EU to non-OECD countries.

5.4 Actions against marine litter and microplastics

Norway has been actively trying to reduce marine litter and microplastics through different actions. First, in 2018, the government started a programme called "The Norwegian Development Programme to Combat Marine Litter and Microplastics" (Norwegian Government 2020b). The basis of the programme is Sustainable Development Goal 14 and especially the first target which states: "By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution" (UN 2021). Approximately NOK 1.6 billion (around EUR 166 million) in funds for the period 2019–2022 will be provided by the government. (In 2019, NOK 236 million, EUR 25 million, were spent on 34 projects). These funds are generally given to multilateral organisations (UN, World Bank, NGOs, research institutes).

Second, Norway is trying to develop waste management systems on land through research since "sound waste management is the most important measure to reduce the supply of litter to the ocean" (Norwegian Government 2020b).

Finally, other actions include:

- raising awareness about marine litter (beach cleans ups are an example of activities organized in this sense)
- stronger international commitments and agreements to prevent marine litter
- research on innovation and the development of new technology and sustainable products
- outside counsels from other actors on government policies and action plans.

5.5 Voluntary agreements

A working group, Østfold Research (Norsus), was commissioned by the Ministry of Climate and the Environment to consider voluntary solutions with the business community to achieve plastic consumption reduction.

Furthermore, an initiative from a number of companies called Plastløftet has been formed to increase the use of recycled plastic and avoid unnecessary use of plastic and design for recycling. One of the tools to achieve this is the reporting of measures and results to "Grønt Punkt Norge" (Green Dot Norway).

Finally, Handelens Miljøfond (The Norwegian Retailer's Environment Fund), a collaboration between the government and business organisations, has recently adopted a new target of a 50% reduction in the use of plastic bags from 2016 to 2025. (Klima- og miljødepartementet 2021)

5.6 Research

In its new strategy, the Norwegian government set several goals concerning harmful substances in plastics. A lot of these goals are related to research; identifying the substances that need to be phased out in plastics and strengthening knowledge about their impacts on health and the environment. For this purpose, Norway intends to contribute to the work of the European Chemicals Regulations, as well as highlighting this work under the Norwegian Presidency of the Nordic Council of Ministers for environment and climate in 2022. Finally, Norway intends to set "the same requirements in connection with environmental toxins and other hazardous substances in plastic product produced from primary and secondary raw material, to increase the degree of material recovery and provide safe product." (Klima- og miljødepartementet 2021).

Research in Norway also focuses on finding alternatives to and reducing plastic packaging. Indeed, a new project called "FuturePack" project has been launched in order to develop "new expertise and technology for the production and recovery of both fossil and bio-based materials for the production of more sustainable packaging". Furthermore, there are several projects in the food industry to find alternatives to plastic for certain food product packaging ("ReducePack", "SeaPack"). (Klima- og miljødepartementet 2021)

6 Denmark

Denmark published the national plastics action plan in 2018. The plan is so far progressing as planned; the national plastic centre monitors the progress.

6.1 Establishing a national plastic centre for building knowledge and enhancing collaboration

Initiative number one in Denmark's plastics action plan (Ministry of Environment and Food of Denmark 2018) is to establish a national plastics centre that has the following responsibilities:

- Launching value chain collaboration and guiding businesses in the transition to circular plastics consumption.
- Building and communicating knowledge on plastics to citizens and businesses.
- Identifying barriers for the reuse and recycling of plastics in Denmark.
- Developing design manuals for plastics so that plastic products are designed for reuse and recycling.
- Packaging:
  - Setting up a forum for the plastic packaging value chain which will work on recommendations on the design of packaging. The aim is to reduce the number of plastic packaging types to 3–5 and to promote packaging that can be easily disassembled and recycled. Denmark will also internationally promote the agenda on reducing plastic pollution and developing a circular economy for plastics including fewer types of plastic packaging. (Miljø- og Fødevareministeriet 2019)
  - Knowledge building regarding sustainable design of plastic packaging is included in the implementation of the EPR for packaging. This is to provide a financial incentive for sustainable design and material consumption at companies covered by the producer responsibility.
- Contributing to the development and establishment of common European design manuals.
- Discuss opportunities with water companies to inform the public about water fountains in order to reduce the consumption of bottled water. Publicly available water fountains that can be used for filling water bottles are mapped and listed on an app and a website. (Miljø- og Fødevareministeriet 2019)
- A dialogue is established between plastic producers, transporters and other stakeholders in order to prevent the waste of plastic pellets during plastic production (Miljø- og Fødevareministeriet 2019).

Affiliated with the national plastics centre, a national network for research and innovation on microplastics will be established. It will cover authorities, universities, consultants, consumers and industry.

Additionally, a nationwide information campaign to prevent and reduce littering is being launched according to the action plan. The campaign will focus on single use plastics and other types of waste that are most often seen in nature.

The national plastics centre will launch several voluntary sector collaborations in selected sectors in order to increase the potential for further reuse and recycling of plastics through active collaboration in the value chain.

6.2 Standardizing recycling and controlling SUPs via bans

In the national plastics action plan, one initiative concerns the standardization of collection schemes and sorting criteria for post-consumer plastics waste. Standardization is seen to support a more proper functioning market for the recycling of plastics waste on a large scale. It will also simplify sorting.

The action plan also suggests bans on non-degradable shot wads and the intentional addition of microplastics in cosmetics. Decreasing the consumption of plastic bags is also mentioned. The aim is to decrease consumption through an amendment to the Environmental Protection Act that prohibits shops from offering free shopping bags and completely bans the use of all kinds of thin plastic bags that cannot be reused, except for those which provide hygiene purposes for food. There is an intention to fix a minimum price of DKK 4 for shopping bags. These new regulations regarding plastic bags came into force on 1 January 2021. (Ministry of Food, Agriculture and Fisheries of Denmark 2020)

In addition, options for local authorities to regulate SUPs consumption in connection with the authorization of major events will be mapped. Other measures to decrease the use of SUPs are also being considered.

6.3 Taxes and EPR to control SUPs and extending deposit schemes

The deposit-return system has been extended to include juice and fruit concentrate bottles. Since January 2020, these plastic bottles have been collected and recycled into food packaging. From January 2025, an EPR for packaging will be introduced. (Ministry of Environment and Food of Denmark 2018)

In addition, experiences will be collected from supermarkets that have tested deposit schemes for carrier bags. (Miljø- og Fødevareministeriet 2019)

According to the plastics action plan, also:

- A packaging tax on single-used tableware will be considered based on the environmental effects of different materials
- The established national plastics centre will continuously consider the need to introduce an EPR for plastic fishing nets pursuant to the SUP directive.

6.4 Allocating funds

The Danish government has allocated DKK 50 million over four years for the implementation of Denmark's plastics action plan launched in 2018.

The action plan initiates that public subsidy funds under the auspices of the Danish Eco-Innovation Program "Environmental Technology Development and Demonstration Program (MUDP)" or others must be prioritised for projects focusing on technological developments for recycling and the circular consumption of plastics.

A four-year subsidy fund has been granted for local voluntary initiatives for cleaning up Danish beaches of plastics and other wastes. In 2022, DKK 3.6 million will be allocated for voluntary initiatives (Miljøministeriet 2021).

6.5 Research

Several initiatives in Denmark's plastics action plan are related to knowledge building. The aim is to map the following:

- Plastic volumes in Denmark with an overview of different types of plastic and sectors as well as the where the waste of different types of plastics ends up.
- Abandoned fishing gear ('ghost nets') in Danish waters. The extent of ghost nets is mapped, methods for efficient cleanup are tested and guidance will be provided to fishermen about how to prevent the loss of fishing gear. The national plastic centre will gather the experiences of the existing reporting system on lost fishing nets. (Miljø- og Fødevareministeriet 2019)
- The occurrence of microplastics in sewage sludge and the environmental impacts of spreading the sludge on agricultural land. Advantages and disadvantages of other uses of sludges containing microplastics are also assessed, such as energy production and raw material extraction by thermal and biological gasification, phosphorus extraction, metal extraction, enzymatic treatment etc. (Miljø- og Fødevareministeriet 2019)
- The quantities of microplastics released from artificial turf into surrounding environments and the options for using alternative materials to rubber granulates.
- Quantities, types, and consumption of PVC on the Danish market, including the rate of recycling and options for substitution with other types of plastics.
- The environmental and socioeconomic effects from the use of bio-based plastics instead of fossil-based plastics. The biodegradability of biodegradable plastics in the Danish environment is also being investigated.
- All publicly available water fountains that can be used for filling water bottles.
- Development and business potential for Danish plastic companies. This is done by mapping Danish, European and global markets for plastics, plastic waste and recycled plastics. The mapping also includes both existing sorting, recycling and recovery technologies as well as new technologies. The use of new technologies such as pyrolysis, thermal gasification and enzymes in the processing of plastic waste that is difficult to recycle will be evaluated (Miljø- og Fødevareministeriet 2019).

According to the action plan, a number of life cycle analyses will be conducted on the tableware of different materials to find the environmental effects. The results will be considered in the analysis of packaging tax on single-use tableware.

A sector collaboration has been initiated with a focus on the restaurant industry. In this collaboration, the current consumption of disposable plastic packaging in the industry is mapped with the possibility to set reduction targets. Alternative packaging types will be assessed and proposals for return schemes are being developed and tested. The SUP directive regarding EPR for packaging and clean-up responsibility will be implemented so that financial incentives are targeted to reusable take-away cups and thereby consumption is reduced. (Miljø- og Fødevareministeriet 2019)

6.6 Other

The Danish government is committed to working towards having common European requirements for recycling design. Overall, the aim is to boost participation in regional and global forums. (Ministry of Environment and Food of Denmark 2018)

The national implementation of the SUP Directive will be conducted in such a way that the goal of reducing plastic waste in nature is achieved with a special focus on cigarette butts and fishing gear (Miljø- og Fødevareministeriet 2019).

7 Netherlands

Netherlands released their strategic plan in 2018: the Transition Agenda Circular Economy – Plastics. It was produced by a team of experts from business, knowledge institutions, non-governmental organisations, and governments. So far, the plan has been followed with a progressive implementation of the measures in the past few years.

7.1 Regulatory measures on single use plastics and harmful additives

The Netherlands have measures in their *Transition Agenda Circular Economy – Plastics* (Holland Circular Hotspot 2018) to implement a sustainable circular economy on plastics based on regulatory policy instruments:

- An overview of suitable products to transform from one-time to multiple-use (Budget: EUR 50,000 (one-off), Timeline: 2018–2019).
- Netherlands was one of the first countries to install a ban on microbeads in cosmetic products in 2014 (Watkins et al. 2019). Since then, the prevention of harmful additives and microplastics in the environment has been developed even more, as Table 1 below shows.
- A ban on free plastic bags was introduced in January 2016 (Government of the Netherlands 2016). In more recent years, Netherlands has again been active in advancing the plastic transition with a ban on single use plastics put in place in July 2021. This ban includes products made from oxo-degradable synthetics, cotton tips, straws, cutlery, plates, stirrers, polystyrene foam food and drink container and balloon rods. In addition, some products (drinking cups, packaging of some sanitary products and packaging of tobacco filter products) must be labelled to inform consumers on their disposal and the impact of litter on the environment. This ban is expected to be finalized in 2023 and 2024 with additional single use plastic packaging and products such as light carrier bags (2023), wrappers (2023), wipes (2024) or fishing gear (2024), among others. (Rijkswaterstaat 2021)
- A deposit on small plastic bottles for soft drinks and water was also introduced in July 2021, with a 15 cent deposit for each small bottle (< 1 litre) and a 25 cent deposit for larger bottles (> 1 litre). (Government of the Netherlands 2020). This deposit is expected to be expanded to beer and lower alcoholic drinks at the end of 2022. (Netherlands Enterprise Agency 2021)

Table 1. Measures to combat harmful additives and microplastics in the Netherlands (Holland Circular Hotspot 2018).

Harmful additive	Measure and intended result	Budget	Timeline
Microplastics in cosmetics added voluntarily whereas alternatives with less impacts on ecosystems are available (silicon for example).	**Ban of microplastics in cosmetics**, in line with the European Commission´s restriction intentions in 2018. (European Parliament 2018)	- (ban)	2018–2019

Microplastics from wear and tear of plastic products (car tyres and washing clothes, for example).	Innovations through the **development of a research programme** in collaboration with the industry sector (automotive, chemicals, textiles prioritised) for the prevention of wear and tear	€60,000 (one-off)	2018–2019
SVHC (Substances of very high concern) added to plastics for quality, safety and/or ease of use reasons. There are concerns about the end-of-life of these additives in the waste management process.	An **assessment framework** of risks and measures to manage these additives is developed. A programme was launched in 2018 to find natural alternatives to these additives called the "Biomimicry programme"	€100,000 (one-off) €70,000 (one-off)	2018–2020
Rubber	**New renewable raw material** for rubber from dandelions	€50,000 (one-off)	2018–2019

7.2 Obligations for manufacturers and importers (EPR)

In the Netherlands, an extended producer responsibility is visible, with manufacturers and importers responsible for everything from the packaging of the product to the waste phase. These regulations are from the "2014 Packaging Management Decree (*Besluit Beheer Verpakkingen*)" (Staatsblad 2014). The Netherlands intends to expand the EPR to more products in 2023 (tobacco products with filters, single serve food packaging, disposable cups, bags and wrappers, light plastic carrier bags, beverage containers) and 2024 (ballons, fishing gear, wet wipes).

In more detail, the extended producer responsibility in the Netherlands includes the following:

- The requirement to pay for and organise the collection and recycling of packaging.
- The recycling rate of materials used for packaging must increase each calendar year. In 2015, the weight percentage of the plastic packaging to be recycled was 45%, and 31% for wood packaging; in 2022 this should increase to 52 and 45% respectively.
- Prevention measures are required to:
  - minimise the amount of packaging material
  - facilitate the recycling of the packaging
  - maximise the amount of recycled material used in new packaging
  - minimise the amount of litter produced. (RVO 2021)

7.3 Stimulating the supply and demand of renewable plastics

Different actions are considered in the Netherlands in order to make renewable plastic more economically attractive. The different measures and actions to stimulate the supply and demand for renewable plastics are summarized in Table 2. (Holland Circular Hotspot 2018)

Table 2. Stimulating the supply and demand of renewable plastics in the Netherlands (Holland Circular Hotspot 2018).

Issue	Action	Budget	Timeline
Cost of reuse and recycling of materials. To stimulate demand, recycling materials should cost less than making virgin fossil plastics.	**Financial and/or fiscal incentives** for reducing energy consumption and stimulate the supply and demand of renewable raw plastic materials (a higher energy tax for large consumers for example),	€80,000 (one-off)	2018–2020
Ownership of virgin plastic. If the cost of virgin fossil plastic increases, investors and future markets will change.	**New strategy for investors** who invest in the ownership of plastic material which they put in the market afterwards as a "right of use" for a yearly period of time. The price of the "right of use" can then vary depending on the use of the plastic material by the industry (circular design, cost-efficient return…). Combined with the action described above, this strategy would be beneficial both for the investors and the industry.	€60,000 (one-off) Action holders: - PGGM - insurers - Ministry of Economic Affairs and Climate Policy - Ministry of Finance	Exploration (2018–2019) If positive, then a pilot (2022)
Reputation and rewards of companies producing renewable plastic products	**ECO labels and Green Deal Green Certificates** which would increase popularity (company classification on circularity) and would give "award points" to companies using renewable plastics as well as giving an incentive for consumers to purchase these products.		2018
Methods to recycle plastics are underdeveloped. New ways to recycle plastics are developed to increase the supply of recycled plastic.	**Mechanical recycling action plan, incl. hard recycling target of 50%.** **Action plan for Chemical Recycling** **Overview of producers and products suitable for use in bio-based plastics, bio-based composites.** **Exploration of possibilities for CCU (Carbon Capture and Utilization)** which would use carbon dioxide or methane as raw materials to make plastic.	€60,000 (one-off) €80,000 (one-off) €60,000 (one-off) €60,000 (one-off)	2018 2018–2019 2018 2019

7.4 Voluntary agreements of stakeholders promoted in the Netherlands

The Dutch government has proposed ways for stakeholders to cooperate in the chain management of plastic:

- funds could be given to the supply chain management if supply chain cooperation is made (voucher scheme)
- regional cooperation is also favoured with stakeholders who could invest together in labs and hubs

- at the international level, the Netherlands wants to set an example of cooperation between the government, companies and NGOs to influence European frameworks (such as EPR and Ecodesign), be the frontrunner with innovations, and provide guidance to other countries with less waste infrastructure, to ultimately create an international business community for a circular economy. (Holland Circular Hotspot 2018)

7.5 Other innovations for reducing plastic waste

Other innovative measures for reducing plastic waste and progressing towards a circular economy, presented in the Transition Agenda, are summarized below in Table 3.

Table 3. Other measures and innovations for reducing plastic waste in the Netherlands (Holland Circular Hotspot 2018).

Innovation	Budget	Timeline
Circular design Stakeholders have to reconsider the design of plastic products (among other products such as electronics, for example) to take into account their use and also their end-of-life and re-use (repair, disassembly and recycling). Examples are consumers replacing an entire product when only a small part is broken, or a part of the product preventing successful recycling because of a different material used or the way it is assembled (glue, coating). A programme has been created to help stakeholders make new design plans. This programme is called "The CIRCO circular design Programme" and will be strengthened and brought to international level. The Transition Plan for a circular economy states: "In the period 2018–2022, five to ten CIRCO tracks will be financed annually, but only if the companies in question provide co-financing, and guarantee that the findings will be implemented in the organisation and that the acquired knowledge and experience will be shared widely." A guideline for circular design will also be produced through a three-year programme.	€200,000 per year €500,000	2018–2022 2019
Chain shortening The production of plastic products can be improved by shortening the chain and logistics attached to it, and thus reduce costs. One particular way to do this that has been developed is 3D-printing. Furthermore, by shortening the chain, for example using 3D-Printing, using renewable plastic materials in the supply could be simplified. Sector plans and hotspots where chain reduction is being studied are currently in place.	€50,000 (one-off)	2018–2022
Less Plastic Litter in the Oceans A "Programme of Measures for the implementation of the Marine Strategy Framework Directive (KRM)" exists in the Netherlands with a different set of policies: one set focuses on prevention and source policy, and another set is a microplastic policy. International initiatives to clean up the oceans are supported.	-	-

7.6 Research

The Netherlands has taken a particular interest in chemical recycling and started an R&D programme on this subject in 2018 to be carried out until 2022 (five years). Indeed, chemical recycling can be a very interesting option for recycling plastics, as the Transition agenda states: "Chemical recycling potentially makes it possible to break down plastic into the smallest chemical building blocks (gasification) from which monomers and polymers can then be made, or, to a lesser extent, to molecular intermediate steps from the plastic production chain (depolymerisation, pyrolysis)."

By enabling this breaking down of plastics, the quality of plastic could be maintained through recycling and additives could be separated. Indeed, as the Transitions Plan explains: “In chemical recycling, all carbon-based contaminants and additives are broken down to the same smallest chemical building blocks as the plastic itself. Heavy metals and halogens (chlorine, bromine) are separated and these can also be reused.” Finally, another advantage of chemical recycling is that it could enable the removal of harmful additives included in old plastic products and plastic waste.

However, chemical recycling still needs to be developed as, for now, these benefits do not always balance the energy consumption and costs required. For this reason, the programme launched by the Dutch government would stimulate the implementation of chemical recycling through different actions:

- the programme would set up a classification and clear definition of chemical recycling and the processes that could be used for end-of-life plastics materials in a national innovation strategy for the long term (solvolysis, depolymerisation, catalytic pyrolysis and gasification)
- it also would include a public-private support programme for startups so that they can make the step towards upscaling and market introduction with new, promising innovative technologies
- it would be coherent with the Chemical Recycling Roadmap of the Netherlands Institute for Sustainable Packaging KIDV and its goals, maybe even making them more ambitious.

8 England

The Resources and Waste Strategy for England was published in 2018 and sets out actions and longer-term commitments in terms of circular economy and waste management. This strategy goes hand in hand with the 25 Year Environment Plan, which sets out what will happen in England in the next generation to improve the environment.

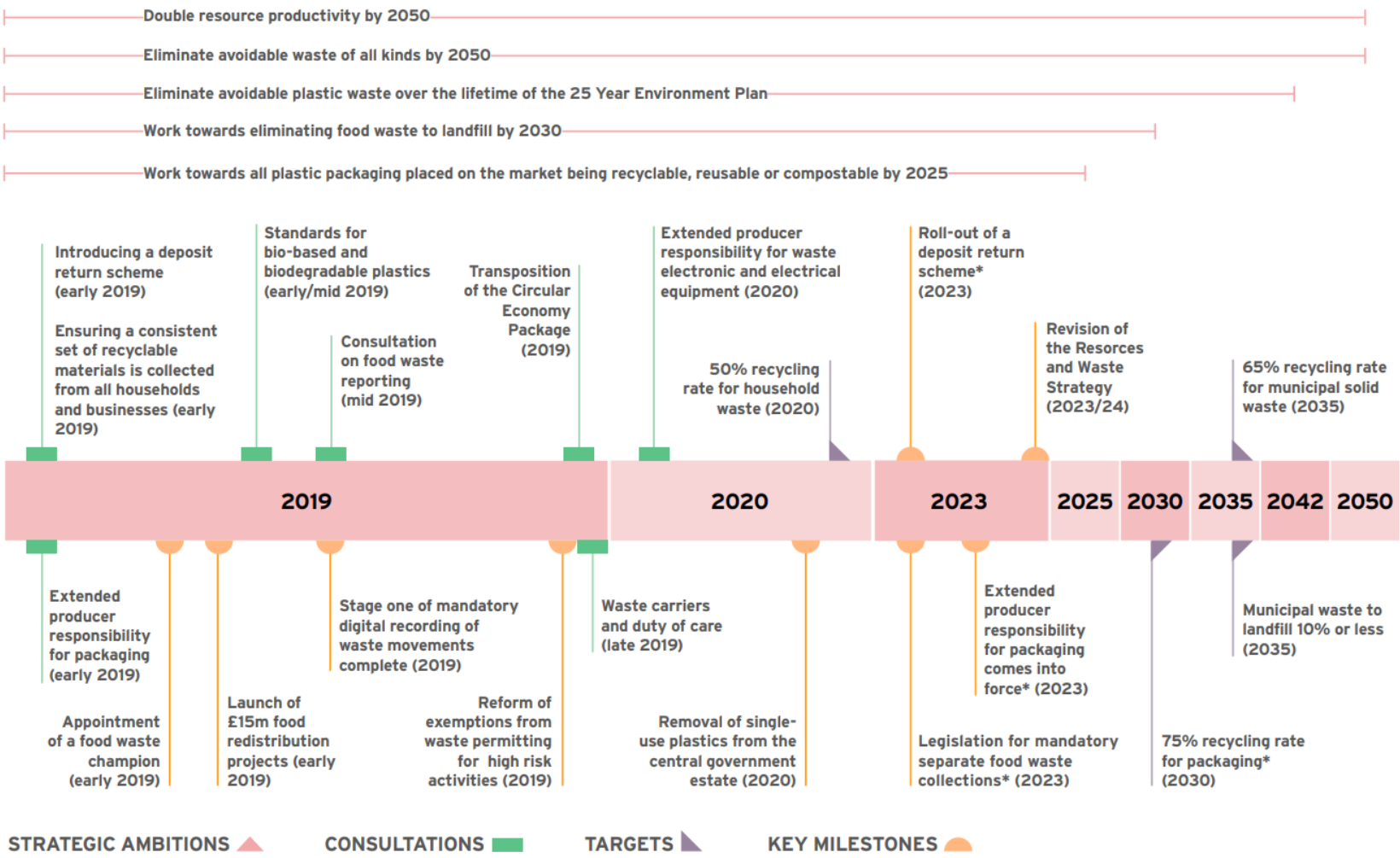
8.1 Ambitions of the Resources and Waste Strategy

Regarding plastics, the Resources and Waste Strategy of England (HM Government 2018) aims at for example eliminating avoidable plastic waste of all kinds by 2050, all plastic packaging placed on the market being recyclable, reusable or compostable by 2025, and 75% recycling rate for all packaging by 2030 (Figure 3).

8.2 Principally market-based measures to manage plastic waste

The first part of the Resources and Waste Strategy focuses on sustainable production and different methods of good production to reduce waste. The different measures mentioned in this section are principally market-based and are stated in the strategy as follows:

- "Invoke the 'polluter pays' principle and extend producer responsibility for packaging, ensuring that producers pay the full costs of disposal for packaging they place on the market (UK-wide reform).
- Stimulate demand for recycled plastic by introducing a tax on plastic packaging with less than 30% recycled plastic.
- Harness the potential of extended producer responsibility for other product types.
- Set minimum requirements of eco-design to encourage resource efficient product design.
- Develop a model for realising resource efficiency savings, working with businesses through 'resource efficiency clusters'." (Figure 4)



*subject to consultation

Figure 3. The full programme of the Resources and Waste Strategy of England for the coming years planned in 2018 (no updated version available at this time). Figure from HM Government 2018.

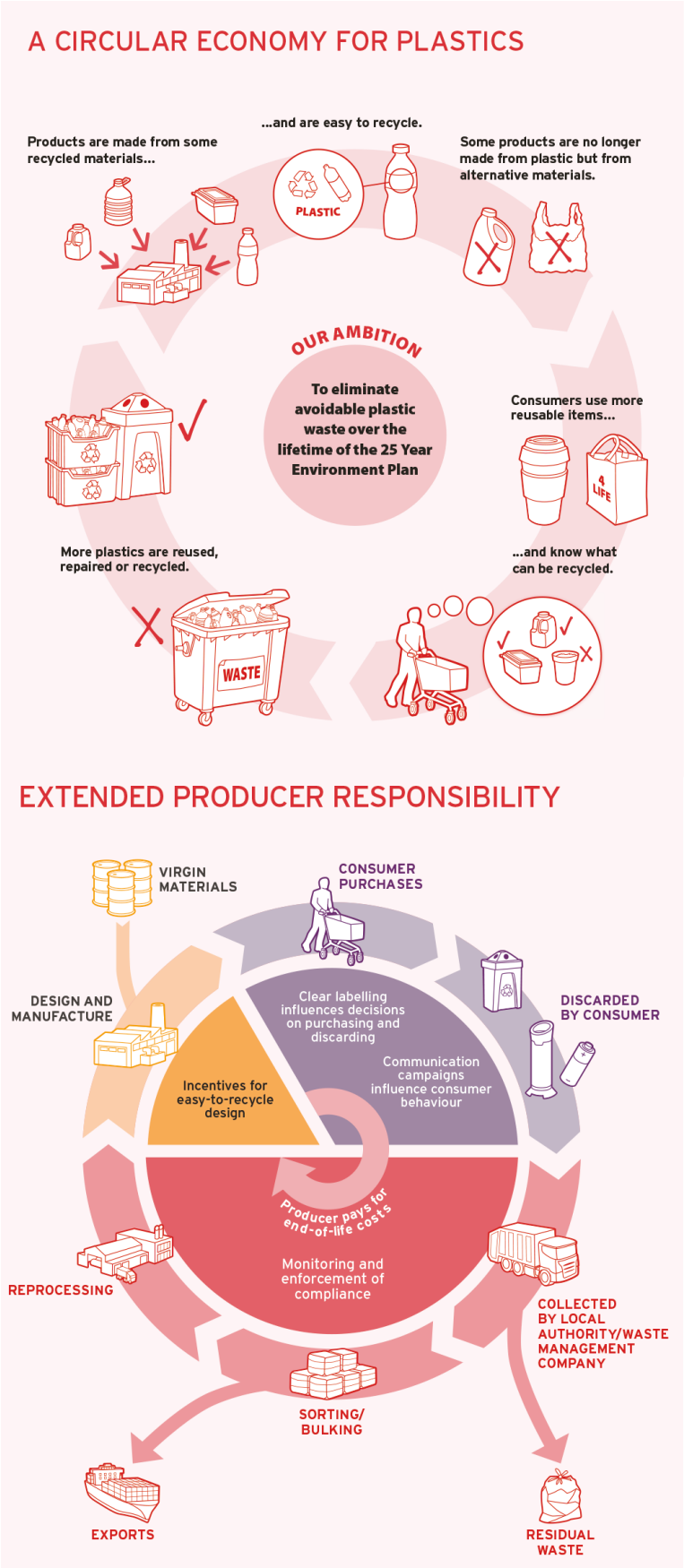


Figure 4. The goals for a circular economy for plastics and producer responsibility in the UK. Figure from HM Government 2018.

8.3 Tackling waste crime

An innovative part of strategy in England is tackling waste crime. The principles stated in the strategy are:

- "Improve the transportation, management and description of waste by reforming existing regulations.
- Strengthen intelligence sharing and engagement to tackle illegal activity.
- Prevent illegal activity being hidden through waste exemptions by reforming the existing regime.
- Mandate the digital recording of waste movements, subject to consultation.
- Create a Joint Unit for Waste Crime.
- Toughen penalties for waste criminals.
- Increase awareness of waste regulations and publicise the positive work of enforcement bodies as they tackle waste crime." (HM Government 2018)

8.4 Research

One of the research goals in the strategy from 2018 was to launch a call for evidence on the development of standards for bio-based and biodegradable plastics. This was launched in 2019 and received 85 responses. In April 2021, a summary of the responses was published and in 2022, a full report is expected to be released. An outcome of the call was a possible ban of oxo-degradable plastics in the future. (Department for Business, Energy & Industrial Strategy and Department for Environment, Food & Rural Affairs 2021)

9 France

The French plastic plan was published as the anti-waste law for a circular economy on 10th February 2020 (law n° 2020-105) and already sets implementation times for most of its measures, ensuring their realisation. Precision and supplementary measures are then set by decree. So far, no issues have been raised during the application of the law.

9.1 Regulatory measures for single use plastics

The French anti-waste law for a circular economy sets, as one of the main goals, a ban on all single used plastics by 2040 (Ministère de la transition écologique 2020). To achieve this, a 5-year-at-a-time plan has been set with a progressive withdrawal of disposable plastics, starting with the 2021–2025 period, followed by three more periods: 2025–2030, 2030–2035, and 2035–2040.

The law set most of the measures concerning single use plastics and waste, along with their date of application. It is then completed by decrees when needed. In 2021, the measures, that entered in force as of 1st of January, according to this law are the following:

- Prohibition of the importing and manufacture of single-use plastic bags for the purpose of supply on national territory. A ban on cups, glasses and disposable kitchen plates was to be applied as of January 2020 already, completed as of 1st of January 2021 by straws (with the exception of those intended for use for medical purposes), plastic confetti, steak skewers, disposable glass lids, plates other than those in the 2020 ban, cutlery, stirrer sticks for drinks, containers in expanded polystyrene, bottles in expanded polystyrene for drinks as well as support rods for balls and their mechanisms intended for distribution to consumers. Two decrees (one on January 1st 2020 and one on January 1st 2021) specified and clarified this specific article of the law and its application. (Légifrance 2019; Légifrance 2020b.)
- Prohibition of the marketing of products made from oxodegradable plastic (Ministère de la transition écologique 2022).
- A ban on the distribution of beverages in plastic bottles, when possible, in public establishments and professional premises. Furthermore, “contractual clauses imposing the supply or use of single-use plastic bottles in the context of festive, cultural or sporting events are deemed unwritten, with the exception of cases where the substitution of these bottles by reusable products is impossible.” (Légifrance 2020a)
- “By 1 January 2021 at the latest, the Government will submit to Parliament a report on the health, environmental and societal impacts of biosourced, biodegradable and compostable plastics over their entire life cycle. This report addresses in particular the risk of dispersion of microplastics in the environment linked to the composting of biobased, biodegradable and compostable plastics.” (Légifrance 2020a)

One additional decree to the regulatory measures described above was published in April 2021 (Décret n° 2021-517 du 29 avril 2021) concerning all producers, manufacturers, distributors and importers of single use plastic packaging. A target of a 20% reduction in single use packaging was set for all actors above by the end of 2025, with an additional target of having half of the single use packaging obtained by repurposing or reuse of packaging. Furthermore, at the beginning of 2023, an indicator will be put into place to monitor the number of Sale Units marketed

in single-use plastic household packaging, as well as the industrial and commercial single-use plastic packaging units. (Ministère de la transition écologique 2022)

In 2022, new measures from the law n° 2020-105 came in force on January 1st:

- The obligation to present unprocessed fresh fruit and vegetables for sale without packaging made wholly or partly of plastic was put in place. A decree in October 2021 specified the conditions of application (for example, all red berries are not subjected to this ban).
- A ban on free plastic toys in children's menus as of January 1st 2022.
- A ban on the affixing of labels directly on fruit or vegetables, with the exception of labels that can be composted.
- An obligation for establishments open to the public (stations, libraries, schools, universities, hospitals, etc.) to allow free access to one or more drinking water points.
- Prohibition of the marketing of tea and herbal tea bags made of non-biodegradable plastic. A decree specifying the conditions of application is yet to be published.
- A ban on plastic packaging for the delivery of newspapers, magazines and advertisements.
- An end to State purchases of single-use plastic products for use in workplaces or at events as of January 1st 2022. A decree was also published on January 4th 2022 to provide exceptions to this ban in case of sanitary, technologic, humanitarian or environmental crisis. (Légifrance 2022)

The other main regulatory means to eliminate single use plastics in the anti-waste law in the next 5 years are the following:

- Replace disposable tableware in fast-food restaurants with reusable tableware (to be applied in 2023 according to law n° 2020-105).
- Impose that each household or professional washing machine be equipped with a plastic microfiber filter (to be applied in 2025 according to law n° 2020-105). (Ministère de la transition écologique 2020)

9.2 EPR schemes

Producer responsibility in France extends to the end of life of the product and this is one of the main ways of managing waste used in the country. Indeed, large product families are part of this EPR: packaging, electric and electronic equipment, batteries, tires, paper, textiles and shoes, furniture, etc. (Ministère de la transition écologique 2020).

However, some products are not yet covered by EPR and a plan to change this between 2021 and 2024 is underway, as set in law n° 2020-105 of February 10, 2020. This would apply to professional packaging, construction products or materials from the building sector, toys, sports and leisure equipment, do-it-yourself (DIY) and gardening products, used oil, cigarette butts, sanitary textiles (wipes, paper towels, cotton, nappies, etc.), fishing gear, among others. When each product category reaches the date set in the law concerning its inclusion into an EPR scheme, a decree is published to specify the exact condition of the new EPR. Thus, in September 2021, a decree was released concerning toys, sports and leisure items, and DIY and garden items subjected to EPR. In December 2021, a decree also included construction products and materials for the building sector. (Ministère de la transition écologique 2022)

Furthermore, this management of products by manufacturers is mainly done through their contribution to a PRO (producer's responsibility organization) in charge of managing this waste on their behalf. However, no results targets were imposed upon them, which has changed since 2021 with PROs having to give quantifiable targets for recovery, reuse, repair, and especially

ecodesign of the products subject to these channels (depending on the channels, this measure is already in place or will be within the next 2 years). (Ministère de la transition écologique 2020)

Extended Producer Responsibility (EPR) schemes will also be asked to financially support actors involved in reuse and insertion through employment (waste sorting and recovery centres, recycling centres etc.). This financial support will be called "solidarity reuse funds" and the contribution will be 5% for several schemes, for a total of 50 million euros. (Ministère de la transition écologique 2020)

9.3 A bonus-malus system to support eco-design

A bonus-malus display favors eco-design products: with recycled materials, without useless over-packaging, or made to be repairable. Those who design their products in a more ecological way benefit from a bonus on the contribution they pay to the PRO for the management and treatment of the end-of-life of their products. On the contrary, the contribution to the PRO increases with a malus for manufacturers that do not change the production of their product to a more eco-design approach. These bonuses and maluses create financial incentives which allows waste management progress by limiting overproduction and overpackaging. Bonus-malus can be set by decree if necessary. All products that are part of an EPR scheme are covered. (Ministère de la transition écologique 2020)

9.4 Informative measures

The French anti-waste law for a circular economy also states a number of informative measures such as:

- Make sorting more efficient through a single logo (in force in 2021), sorting methods (a decree on sorting waste from products subjected to EPR was published in June 2021) and a harmonization of the colour of waste bins (in force by the end of 2022). (Ministére de la transition écologique 2020; 2022)
- Impose the provision of information to the public on products containing endocrine disruptors (a decree concerning this measure and specifying how to provide this information was published in August 2021).
- Develop a mandatory methodology for environmental labelling.
- Prohibit claims of being "biodegradable" or others such as "respects the environment" which cause confusion and bad recycling and add the message "do not throw in nature" for products domestically or industrially compostable. (Ministère de la transition écologique 2020)

10 Germany

Germany introduced a plan to reduce the use of plastic and increase recycling in 2018. The SUP Directive is being implemented through several legal acts such as German Packaging Law, Regulation on the Quality and Labelling on Certain Single-Use Plastic Products, Regulation on the Prohibition of the Placing on the Market of Certain Single-Use Plastic Products and Products made of Oxo-degradable plastic and Circular Economy Act, all responsible for certain areas of SUP Directive. Most of the new regulations came into force in July 2021, but some parts of the SUPD are still to be implemented. Below are some German efforts to fight the plastic challenge.

10.1 Reducing the use of some plastic products

The German Environment Agency has evaluated the environmental impact of take-away beverage cups and suggested measures to reduce their consumption. Voluntary measures could include deposits or levies and communication campaigns for customers and staff. Regulatory measures could be mandatory levies on lids and disposable cups and a supra-regional deposit system. Labelling requirements are also recommended. (Kauertz et al. 2019). Later on, the consumption reduction measures of the SUP Directive, including food packaging and single use beverage cups, were implemented through the German Packaging Law. According to the law, from January 2023, for goods offered in single use food containers and cups, there must be an option with reusable packaging (at the same price and quality). There are some exemptions for small businesses who, however, must be prepared to fill customers' reusable containers.

10.2 Recycling and recyclability

Ensuring the greatest possible environmental benefit is the main objective of recycling practices in Germany. The recyclability of packaging is determined with the minimum standard guidelines (Zentrale Stelle Verpackungsregister 2021) and PROs are responsible for setting incentives for recyclability. Germany has also proposed a minimum recycled content for plastic packaging from post-consumer plastic waste in a revision of the Packaging and Packaging Waste Directive (German Environment Agency 2021).

10.3 Research on recycling techniques

The German Environment Agency is conducting research to compare chemical recycling, mechanical recycling, and energy recovery. The project is called: "Assessment of the potentials and evaluation of the techniques of (thermo)chemical plastics recycling" ("Abschätzung der Potenziale und Bewertung der Techniken des (thermo)chemischen Kunststoffrecycling"). The time frame is from 2020–2023. A background paper on chemical recycling was published in December 2020 (Vogel et al. 2020).

11 Other countries

11.1 Scotland

Scotland does not have a national plastics strategy yet, but measures are being taken to better control plastics. Scotland is also committed to the Ellen MacArthur Foundation's New Plastics Economy global commitment (EMF 2021).

11.1.1 Market restrictions on SUPs

A ban on the manufacture and sale of plastic microbeads came into force on 19 June 2019. A ban on plastic-stemmed cotton buds came into force on 12 October 2019. Other single-use items, including food and drink containers made of expanded polystyrene, as well as stirrers, cutlery, plates, straws and balloon sticks, will be banned or restricted by The Environmental Protection (Single-use Plastic Products) (Scotland) Regulations SSI 2021/410 that come into force on 1 June 2022.

11.1.2 Deposit return scheme for PET bottles

The establishment of a deposit return scheme for drinks containers, including PET plastic bottles, is planned by 1 July 2022, with a 90% collection target by 2025. Requirements for businesses, public sector and non-profit organisations to present plastic (and other materials) for separate collection, as set out under the (Scotland) Waste Regulations 2012, are also in place. (The Scottish Cabinet Secretary for Environment, Climate change and Land Reform 2020).

11.1.3 Programme financed by the Scottish Government

The Scottish Government is funding Zero Waste Scotland, which is a service offering free advice and technical support to businesses on how to cut their waste. (Zero Waste Scotland 2021)

11.2 Iceland

The waste reduction policy of Iceland implements circular economy principles and aims at reducing the use of virgin natural resources. The policy program is divided into six two-year sections, each focusing on different priority areas (food, plastic, textiles, electronics, buildings and paper). Additionally, three categories are included in the entire duration of the program (meat and fish by-products, beverage packaging and heavy industry). The Environmental Agency of Iceland oversees the implementation of the program.

Following the publication of waste prevention policy that focused on plastic in 2018–2019, the Environmental Agency of Iceland launched a website (samangegnsoun.is), Instagram-account and Facebook-page under the name 'Together against waste' (Saman gegn sóun). (The Environmental Agency of Iceland 2021)

Currently, hay roll plastic waste is cleaned and processed into pellets using geothermal energy in Iceland by Pure North Recycling. It is the first company that recycles plastic in Iceland. In the future, Pure North Recycling intends to also process hard plastic and plastic packaging. (Pure North Recycling 2021)

12 Examples of monitoring and analysis for implementing plastic policies

In this chapter, examples of the analysis of France, in order to implement the new anti-waste law for a circular economy, is presented using a classification of plastics by function and what would be necessary to achieve the objectives of the law. Monitoring actions in England are also presented, where a new strategy was introduced with new indicators to monitor their progress.

12.1 France

This section is based on a document released in November 2020 called 'What 3R Potential by 2025? (Reduce, Re-use, Recycling) for plastic packaging' (Poivert & Hestin 2020).

To identify existing or potential alternatives to single-use plastic packaging, it is first necessary to analyse the expected functionalities and constraints linked to these plastics. The potential for deploying alternatives to plastics depends on their ability to fulfill the initial functions, in terms of health and product protection and conservation in particular. As Poivert and Hestin (2020) point out: "Developing packaging for fresh food products (meat, fish, dairy products), do not present at all the same constraints as for dry food products (pulses, rice, pasta), drinks (milk, water, fruit juice) or non-food products (hygiene, maintenance, etc.). Consequently, the alternatives available, their adequacy with the expected functionalities, their level of maturity, and therefore their potential for deployment, are very different. The products are not equal in front of the 3R (reduction, reuse, recycle) potentials."

In order to identify and assess potential alternatives to plastic packaging for single use, a list of product / packaging pairs, grouped into four large families, was created. This organization by product families provides a more global vision of the issues of packaging (functionality, "machinability", supply chain, marketing, usage) than the standard organization by packaging type. (Poivert & Hestin 2020)

This organization makes it possible to cover about 90% of the amount of household plastic packaging, and 70% of the amount of industrial and commercial plastic packaging. In the table below, the four different plastic packaging families and their products are shown, along with the main type of plastics and their quantity. The potential for reducing plastics can also be seen, considering that all plastics are 100% recyclable in 2025. (Table 4 and Poivert & Hestin 2020.)

Table 4. Four different plastic packaging families with their products, the main type of plastic, quantity and potential for reduction as estimated by Poivert and Hestin (2020).

Family	Including	Type of plastics	Plastic packaging quantities put on the market (in 1000 t)	Reduction potential	Reuse potential (as part of reduction)
Food - Fresh	Meat, fish	Container (PP, PE, PET, PS, PSE, PVC,Complex)	65	Low	Low
	Dairy products	Jars (PS, PET, PP or PE) Container (PP or PE)	130	Uncertain	10% of the market

		Flexible bags (PP or complex)			
	Prepared meals (fresh,frozen, commissary)	Container (PP, PE, PET, PS, PSE, PVC,Complex) Flexible bags (PP or complex)	90	40%	50%
	Fruits and vegetables	Flexible bags (PP)	20	40%	Low
Total for the family “food – fresh”			305	15%	25%
Food - Other	Milk	Bottles (HDPE or opaque PET)	50	8%	100%
	Still and sparkling water	Bottles (transparent or colored PET)	220	20%	75%
	Soft drinks, fruit juices	Bottles (transparent or colored PET)	120	20%	75%
	Oils, vinegars, condiments	PET bottles (transparent or colored) Bottles (PE or PP)	25	10%	75%
	Sweet groceries (biscuits…)	Soft bags (PE, PP, complexes) Jars and containers (PE or PP)	75	15%	33%
	Savory groceries (pasta…)	Soft bags (PP or complex)	25	20%	50%
Total for the family “food – other”			515	18%	70%
Non-Food	Hygiene / beauty / cosmetics	Bottles and flasks (PET, PE or PP) Jars and tubes (PE, PP or complex)	55	25%	60%
	Home maintenance	Bottles and vials (PET, PE or PP)	70	25%	60%
	Professional liquid containers	Buckets, cans, barrels (PE or PP)	320	20%	50%
	Miscellaneous (toys, crafts, electronics, etc.)	Blisters and shells (PVC, PET, PETG) Soft bags (PE)	60	50%	0%
Total for the family “non-food”			505	36% (not incl. professional liquid)	33% (not incl. professional liquid)
Logistics	Secondary packaging	Films grouping batches of products (bottles, cans, paper hygienic, etc.), PE	30 (household) 120 (professional)	20%	0%
	E-commerce packaging	PE or complex bags	20	75%	67%
	Rigid transport packaging	Pallets, boxes	110	80%	100%
	Flexible transport packaging	Palletizing films	190	10%	10%

Total for the family “logistics”	450	20% (not incl. products for professional use) For products for professional use: 21%	46% (not incl. products for professional use) For products for professional use: 71%

The details of the alternatives considered, and the deployment hypotheses by 2025, are presented below, as found in the document.

1. “A consensus is emerging around the ambition to achieve 100% plastic packaging recyclable by 2025. This implies, in particular:
   - To abandon single-use plastic packaging which does not have recycling channels, and who do not have short-term prospects. These are mainly complex plastic packaging, that is to say composed of different plastic resins not separable, household packaging in EPS, and non-recyclable resins (PVC, PETG, ABS, etc.).
   - Rapidly develop recycling channels for certain packaging that does not have one today, but for which work is in progress. It's mainly the case for PS jars (yoghurt jars) and flexible PP packaging. If these sectors do not develop, the players agree that a decision should be taken and a time horizon should be set.
   - The players agree on concerted approaches and consumption standards (choice of recyclable resins and joint development of treatment infrastructure at support).
   - This orientation represents an important lever for increasing the effective recycling rate, itself conditioned by other parameters, such as the efficiency of the sorting process and separate collection, sorting and recycling systems.

2. A potential for reducing the quantities of plastic in single-use packaging from 20% on average, variable according to the product categories:
   - For products which require high barrier properties (in particular meat, self-service cold cuts, fish, milk, dairy products), the potential is limited.
   - For food products that are less fragile or do not require long periods of preservation, and for non-food products, the potential is greater.
   - Overall, at least half of the reduction can be obtained by reuse devices (bulk, deposit, refills), the rest being obtained by reductions in unit weight, the substitution by other materials, or the elimination of certain packaging or packaging elements that are not necessary, or particularly likely to be abandoned.

Achieving this reduction potential requires substantial investment.” (Poivert & Hestin 2020)

12.2 England

England is, in its strategy, setting up a plan to monitor progress on plastic waste and management based on three main objectives: collecting data, monitoring progress and evaluation.

Collecting data

The first objective, collecting data, relies on the professionals involved in the use of plastic materials and production of plastic waste, as well as the organisations providing services to them which have to collect and report data on the implementation of the strategy. Defra (Department for Environment Food & Rural Affairs) will be responsible of the coordination of all actors: Devolved Administrations, Office for National Statistics, environment agencies such as WRAP, local authorities, the resources and waste sector and new partners. (HM Government 2018).

Moving away from weight-based targets towards impact-based targets and reporting (focusing initially on carbon and natural capital accounting) is the main goal of the collection of data, as well as the development of new indicators for the strategy by "working with tech firms to develop innovative digital solutions for tracking waste and consulting on options to mandate the digital recording and sharing of waste movement data." (HM Government 2018).

Monitoring progress

Figure 5 below shows the indicators related to the Waste strategy already developed or under development as of 2018 to measure progress on the strategy (HM Government 2018). In the monitoring progress report from November 2021, new indicators were also added and under development such as: avoidable waste and avoidable plastic waste, percentage of municipal waste landfilled, food waste landfilled. (Department for Environment, food and rural affairs, 2021)

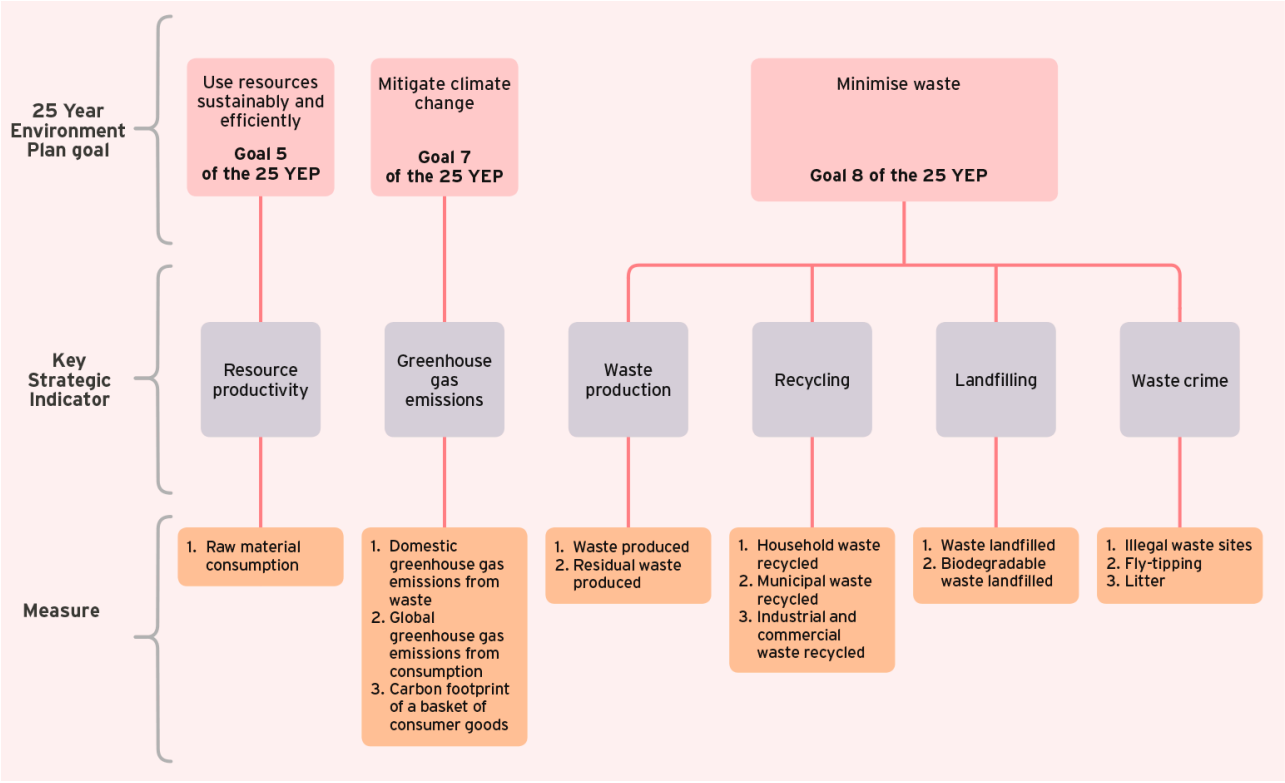


Figure 5. Indicators considered in 2018 to monitor Waste Strategy for England. Figure from HM Government 2018.

Evaluation

For policies that concern new provisions for EPR on packaging waste or on a deposit return scheme, a multi-method approach is used for evaluation, and will also be part of the required post-implementation review. This approach includes a process and impact evaluation. For more general evaluation of the effectiveness and contribution of the waste strategy, as well as the effectiveness of the requirements for consistent collections, a theory-based impact evaluation deploying both qualitative (for the analysis of the contribution and effectiveness) and quantitative (for the analysis of effectiveness) methods is used. For the effectiveness of the strategy, looking across the Government at actions targeting plastics will be used to draw conclusions about successes. Dates for realization of the evaluation are given for each policy. (HM Government 2018)

13 National plastic pacts: examples of parties and objectives

Some examples of the stakeholders involved in plastic pacts, as well as their objectives, are described for the Netherlands and UK below. The objectives are similar, as in the national action plans, but aim at the companies, as such, focusing more on the redesigning and recycling efforts that need to be done.

13.1 Netherlands: Plastics Pact NL 2019–2025

The parties involved in the Plastics Pact NL 2019–2025 are:

- **Ministry of Infrastructure and Water Management.**
- **Plastics-using companies**: corresponding to companies using plastics as a material in goods or packaging for consumers (producers and retailers).
- **Plastics-producing companies**: corresponding to all producers of plastics of any type (virgin, biobased and recycled).
- **Other Parties**: corresponding to other organisations which can play a significant role in the Plastic Pact network.

The objectives are:

- The pact aims to make the plastic supply chain more circular by marketing products and packaging with reusable plastic when possible, and recyclable plastic in every case. To achieve this objective, the parties rely on simplification of the plastic supply chain as well as the use of plastic (no more than necessary), recycling more and developing biobased plastics.
- The goals set for the year 2025 are the following:
  - "All single-use plastic products and packaging that the Plastics-Using Companies place on the Dutch market are reusable where possible and appropriate, and are in any case 100% recyclable.
  - Each of the Plastics-Using Companies avoids unnecessary use of plastic materials through reduced use, more reuse and/or use of alternative, more sustainable materials, resulting in a 20% reduction in the amount of plastics (in kg) relative to the total amount of single-use products and packaging placed on the market, compared to the reference year (2017). This will in any case reduce the total amount of single use plastic products and packaging of the Plastics-Using Companies combined.
  - The Plastics-Producing Companies will have created sufficient sorting and recycling capacity in the Netherlands so that at least 70% of all single-use plastic products and packaging (measured by weight) that reach the disposal stage in the Netherlands are recycled to a high standard.
  - All single-use plastic products and packaging marketed by Plastic-Using Companies will contain the highest possible percentage of recycled plastics (in kg), with each company achieving an average of at least 35%. Moreover, the plastics used will as much as possible be sustainably produced biobased plastics, in order to reduce the use of virgin fossil-based plastics."

For each objective, measures and actions of each actor (plastic-using and plastic-producing companies, Ministry) are also described in the Pact. (Government of the Netherlands 2019)

13.2 The United Kingdom Plastics Pact

The UK Plastics Pact has approximately 100 business members in 2020, from the entire plastic market chain (retail, manufacturing, hospitality, the plastic supply sector, plastic recycling and resource management). It states that these businesses are responsible for "50% of plastic packaging place on the UK market and are responsible for over 90% of grocery retailers and the majority of brands sold through them." (Waste and Resource Action Programme WRAP 2020)

The goals of the pact for 2025 are the following:

1. Eliminate problematic or unnecessary single-use packaging through redesign, innovation or alternative (reuse) delivery models.
2. 100% of plastics packaging to be reusable, recyclable or compostable.
3. 70% of plastics packaging effectively recycled or composted.
4. 30% average recycled content across all plastic packaging. (WRAP 2020)

14 Bioplastics

The development and assessment of bio-based and biodegradable plastics to replace traditional plastics is underway in several countries in Europe. This chapter presents the views of different states on the opportunities and challenges of these new materials.

14.1 Definitions

The definition of bioplastics is not yet concrete. Bioplastics are either biobased (i.e., made of renewable biomass), biodegradable (i.e., degradable by microbes) or may be both. Biobased plastics are made of agro-based feedstock (e.g., corn or sugarcane), ligno-cellulosic feedstocks (plants that are non-eligible for food, such as cellulose and flax), or organic waste feedstocks. The biodegradation process demands suitable physical conditions for microbial degradation, including temperature and moisture. Often, biodegradable plastics are degradable only in conditions at biowaste treatment facilities where high temperatures are possible (European Bioplastics 2022).

Since the use of these terms and their definitions is not yet well established, many countries are working towards clarifying the terminology. This is usually done along with a more profound knowledge building on bioplastics. For example, in February 2020, The Danish Environmental Protection Agency published a comprehensive report to build knowledge of bio-based and biodegradable plastics, as required in their plastics action plan. The report also clarifies some terms. (The Danish Environmental Protection Agency 2020)

In Finland, the New Plastics Center (NPC) was established in 2019 to strengthen the knowledge network around substitutes for traditional plastics. In 2020, the NPC published a guide to bioplastics to share information on the current state and prospects of bioplastics and to clarify the terminology related to bioplastics. (NPC 2020)

14.2 Biomaterial innovations

One of the ten measures in the Plastics Roadmap for Finland is to majorly invest in alternative solutions for traditional plastics and set up a New Plastics knowledge network. To further this goal, in 2019, Muovipoli Ltd together with the Finnish Plastics Industries Federation established the previously mentioned New Plastics Center, which is a business-oriented knowledge network. The NPC focuses on promoting biomaterial innovations and product development in Finland and strengthening the co-operation and networking necessary for the development and introduction of new materials.

Another measure in the Plastics Roadmap for Finland is to launch a national programme and allocate funding to the development of new value networks for the solutions, materials and technologies to replace plastics, as well as to business models jointly developed by various stakeholders.

The need to develop recycling and new material solutions is also mentioned regarding plastics in agriculture and horticulture. According to the Plastics Roadmap for Finland: “Investments are made in the development and introduction of new, bio-based and fully biodegradable mulch materials, including the verification of their biodegradability and testing different solutions in different application areas. Replacing fossil-based plastics with bio-based alternatives, e.g., in the mulch for perennial plants, is also encouraged by further expanding the scope and developing the environment payment scheme of the Rural Development Programme.”

In order to replace traditional plastic in Finland, development projects will focus on boosting wood-based products and products based on agriculture and side-streams. (Ministry of the Environment of Finland 2018.) A study on materials and solutions for replacing traditional plastics was presented in January 2022 and the report will be published later in 2022. (Leinonen et al. manuscript)

14.3 Sustainability of biodegradable and bio-based plastics

In addition to the evolving vocabulary on bioplastics and innovating new materials, effort is put into better understanding the environmental effects of biodegradable plastics. It is understood that when evaluating biodegradability in nature, standard test conditions differ due to each country's natural conditions. The Danish government's plastics action plan thus suggests that to what extent biodegradable plastics can biodegrade in the Danish environment is investigated, and based on that, the performance requirements for biodegradability under Danish natural conditions will be drawn up. (Ministry of Environment and Food of Denmark 2018.) The importance of understanding the true natural conditions is also highlighted in the Danish Environmental Protection Agency's report on bio-based and biodegradable plastics. (The Danish Environmental Protection Agency 2020). The biodegradability investigation relates to the initiative to ban non-degradable shot wads in Denmark.

Moving towards using more bio-based feedstock instead of fossil-based feedstock (whether the produced plastic is biodegradable or not) also has environmental effects. The German Environment Agency (2017) concluded that the sustainability of bio-based plastics is dependent on the crop and the land used: "On the one hand, undemanding plants and such grown-on land unsuitable for the production of food crops could be an alternative to fossil sources. On the other hand, materials based on sugar cane, for example, would constitute a direct conflict of use with food crop production. Comparative life cycle assessments of selected bio-based and fossil plastics come to the conclusion that the production of plastics from fossil raw materials usually produces more CO_2, however, renewable raw materials bear a high eutrophication potential. The few comparing studies of the two models directly suggest that the ecological effects may shift, but no clear ecological advantageousness can be assessed."

Mapping the environmental effects as well as the socio-economic effects of using more bio-based feedstock for producing plastics has also been suggested in The Danish government's plastics action plan. (Ministry of Environment and Food of Denmark 2018)

14.4 Problems in waste treatment

It has also been noted that mixing biodegradable plastics with other types of plastics may prevent recycling (Ministry of Environment and Food of Denmark 2018). Consumers are confused by different types of plastics, which leads to confusion when sorting. As new substitutes are developed, both fossil and bio-based, biodegradable and non-biodegradable and even compostable, the spectrum of material types increases and it becomes even more difficult for the consumer to understand how these materials should be treated.

England's waste strategy raises concern that mixing, for example, biodegradable and non-biodegradable waste streams increases contamination rates and costs (HM Government 2018). The German Environment Agency points out that "existing recycling facilities are not aimed at high-quality recycling of biologically degradable plastics. This lack could be solved via additional investments in sorting technologies. However, it has been noticed that a number of biologically degradable plastics do not sustain the established washing procedures and transform to a gooey material, which negatively influences the recycling of recyclable plastics. In addition,

biologically degradable plastics are often per se only recyclable to a limited extend." (The German Environment Agency 2017)

England's waste strategy also raises questions about the risks and impact of degradable plastics appearing in new products that include recycled plastic. (HM Government 2018)

14.5 Positions

There is a lot of uncertainty related to bioplastics and this shows in countries' positions. Since the biodegradability of certain plastics is yet to be examined, in Denmark, it has been suggested that focus should be on incentivising appropriate behaviour where plastics can be easily recovered, and littering prevented. (The Danish Environmental Protection Agency 2020)

The same objective has been set in Germany, where The German Environment Agency especially advises "against concepts which foresee a disposal of biodegradable plastics into the environment in competition with ordered collection, capture and recycling of waste. The problem of littering cannot be solved through biodegradable plastics. To the contrary, the characteristics of biodegradability can be misunderstood by the consumer and encourage littering, which would lead to increased environmental pollution through waste." (The German Environment Agency 2017)

In the UK, HM Government (2018) stated that according to Defra's own research, as well as a number of international studies, there is currently insufficient evidence to support claims that the widespread uptake of biodegradable plastics will increase resource efficiency or reduce waste. If littered, or otherwise released into the environment in an uncontrolled way, plastics which are claimed to be biodegradable may not degrade quickly or at all and can only be composted if they meet relevant standards. (HM Government 2018.) They continued: "Innovative new packaging types could help reduce the environmental impact of plastic, if disposed of in the right way. We want to make this easy for people. One potential solution could be to introduce new standards for them. We will work with UK Research and Innovation, and industry, to examine the demand, benefits and implications, starting in 2019 with the launch of a call for evidence." (HM Government 2018)

The Danish growth strategies do not contain any binding targets for growth in the biodegradable or biobased plastic markets, so there are no policy instruments that would significantly promote such growth. One key conclusion in The Danish Environmental Protection Agency's report (2020) is that there will be huge efficiency improvements in the production process of bio-based feedstock. Hence, a forward-thinking perspective is necessary when evaluating these materials with LCA. (The Danish Environmental Protection Agency 2020)

In general, the German Environment Agency perceives concepts promoting biologically degradable plastics critically. Exceptions are niche applications such as mulch foils, which remain on land used for agriculture, or applications in the medical sector. The same criticism relates to bio-based plastics with no proven ecological advantage. (The German Environment Agency 2017)

In France, due to the lack of clear definition of what biodegradable is by the scientific community, and confusion of consumers who might then consider it appropriate to dispose of these products in the natural environment, it has been prohibited to display claims of 'biodegradable' on plastic products in order to avoid plastic pollution. The only exception is tea bags, in which plastic synthetic material will be prohibited in 2022 in order to avoid the release of harmful components in hot water. (Ministère de la Transition écologique 2020.) Apart from mentioning biodegradable plastics from the perspectives of sorting and health concerns, the French anti-waste law does not mention developing the production of biodegradable plastic materials.

In Finland, the development of bio-based materials is seen as a great opportunity because the expertise in biomaterials is strong and there are plenty of raw materials. (Ministry of the Environment of Finland 2018)

15 Conclusions

Numerous measures are being taken in Europe to curb the harmful impacts of plastics. In addition to the actions decided in the EU, member states have developed national action plans, roadmaps, and strategies. However, there is a lot of variation in the level and detail of national plans. From a waste hierarchy point of view, most measures aim at the prevention or recycling of waste, to reduce littering and promote resource efficiency.

The scope and targeting of national measures are affected by many factors, such as countries' starting points for the development of a circular economy of plastics, financial resources, geographical location (whether coastal or not), the most problematic types of litter in the country, level of expertise, technology and other developments, and availability of raw material to develop substitutes for traditional plastics. Based on conditions resulting from these factors, member states have adopted different combinations of policy measures (regulatory, financial, market-based, informative, and voluntary agreements). In addition to the information on the content of strategies and single measures, it would have been useful to learn more about the implementation schedules and effects. Such follow-up data was rarely available.

When developing national strategies, countries can support and learn from each other. The most visible of the harmful impacts of plastics is littering, and as the transport of litter in the environment is universal, the importance of international cooperation is clear. This is where effective collective measures such as the implementation of EU's Single-Use Plastics Directive and the global UN Treaty on plastics, currently under negotiation, are needed.

Appendices

Appendix I: National strategies and commitments

The table below (Table 5) summarizes the identified national action plans, plastic pacts and other commitments in European countries. Some of the most important international pacts and conventions are presented in Appendix II.

Table 5. Examples of national plastic strategies and commitments.

Country	National plastics action plans	National Plastic Pacts and Green Deals	Other commitments
Finland	The Plastics Roadmap for Finland / Kansallinen muovitiekartta (2018, update in 2022) https://muovitiekartta.fi/in-brief/	Plastic Carrier Bag Agreement (Green Deal) 2016–2025: Ministry of the Environment (YM) and the Federation of Finnish Commerce https://sitoumus2050.fi/en_US/muovikassisopimus#/ Material Efficiency Commitment 2019–2021: Food and packaging industries & retail, TEM, MMM, YM https://www.motiva.fi/en/solutions/material_efficiency/material_efficiency_commitment_for_industry Sustainable Demolition Green Deal 2020–2025: Ministry of Environment and Rakli ry. https://sitoumus2050.fi/en_US/kestavapurkaminen#/ (in Finnish) Green Deal agreement on plastics in construction 2020-2027 https://sitoumus2050.fi/en_US/rakentamisen-muovit#/ [In Finnish] Green Deal agreement on the reduction of packaging plastics in the real estate and construction sector (2020–2027) https://sitoumus2050.fi/en_US/rakentamisen-muovit#/ [In Finnish] Green Deal Agreement on take-away packaging (under development)	Ban plastic microbeads in cosmetics (2017–2020) (partner) https://oceanconference.un.org/commitments/?id=18818 International activities are listed in Plastics Roadmap for Finland -website HELCOM – e.g. updated regional action plan on marine litter in 2021 https://helcom.fi/action-areas/marine-litter-and-noise/marine-litter/

Sweden	Sweden does not yet have a national plastics strategy, but an action plan is currently being developed by the government and will be published in the first quarter of 2022. The Swedish EPA published a roadmap towards sustainable plastic use in 2021 (Swedish Environmental Protection Agency 2021a).		Ban plastic microbeads in cosmetics (2017–2020) https://oceanconference.un.org/commitments/?id=18818 Responsible plastic management (2017–2020) https://oceanconference.un.org/commitments/?id=20448 Desktop Study on Marine Litter including Microplastics in the Arctic (Phase I) https://oceanconference.un.org/commitments/?id=18373 Development projects for sustainable plastic use - Swedish Environmental Protection Agency (swedishepa.se)
Norway	Norwegian waste measures (2017) The Norwegian Government steps up the efforts to turn waste into resources and reduce marine litter - regjeringen.no Basel Convention and implementation to Norwegian law: Norway implements the 2019 "Basel amendments" on plastic waste - regjeringen.no The Norwegian Development Program to Combat Marine Litter and Microplastics (Norwegian Government 2020b) The Norwegian Development Program to Combat Marine Litter and Microplastics - regjeringen.no Norway is currently updating their national plastics strategy and working on an action plan for circular economy. Both were scheduled to be completed during the first half of 2021.		Partner in: Ban plastic microbeads in cosmetics (2017–2020) https://oceanconference.un.org/commitments/?id=18818 Desktop Study on Marine Litter including Microplastics in the Arctic (Phase I) https://oceanconference.un.org/commitments/?id=18373
Iceland	Action plan on plastic / Úr viðjum plastsins - Aðgerðaáætlun í plastmálefnum https://www.stjornarradid.is/library/03-Verkefni/Umhverfi-og-natturuvernd/Loftslagsmal/%c3%9ar%20vi%c3%b0jum%20plastsins%20-		Partner in: Ban plastic microbeads in cosmetics (2017–2020) https://oceanconference.un.org/commitments/?id=18818

	%20A%c3%b0ger%c3%b0a%c3%a1%c3%a6tlun%20%c3%ad%20plastm%c3%a1lefnum%20september%202020%20.pdf Website for the waste prevention program: https://samangegnsoun.is/plast/		Desktop Study on Marine Litter including Microplastics in the Arctic (Phase I) https://oceanconference.un.org/commitments/?id=18373
Denmark	Plastics without waste – The Danish government's plastics action plan / Plastik uden spild – Regeringens plastikhandlingsplan (Ministry of Environment and Food of Denmark 2018) https://en.mfvm.dk/fileadmin/user_upload/ENGLISH_FVM.DK/Regeringens_plastikhandlingsplan_UK.pdf	According to the plastics action plan, there will be a voluntary agreement between the Minister of Environment and Food, the Danish Chamber of Commerce, COOP and other relevant chain stores to halve the consumption of carrier bags by 2023.	
Belgium	Plastics Implementation Plan 2020–2025 (Flanders) / Uitvoeringsplan Kunststoffen https://www.ovam.be/sites/default/files/atoms/files/Uitvoeringsplan%20Kunststoffen%202020-2025.pdf		
Germany	5-Punkte-Plan für weniger Plastik und mehr Recycling https://www.bmu.de/pressemitteilung/bundesumweltministerin-schulze-legt-5-punkte-plan-fuer-weniger-plastik-und-mehr-recycling-vor/		
France	The anti-waste law in the daily lives of the French people – What does it mean in practice https://www.ecologie.gouv.fr/sites/default/files/en_DP%20PJL.pdf	The French National Pact on Plastic Packaging / Pacte National sur les emballages plastiques https://www.ecologie.gouv.fr/sites/default/files/2019.02.21_Pacte_National_emballages_plastiques.pdf	Partner in: Ban plastic microbeads in cosmetics (2017–2020) https://oceanconference.un.org/commitments/?id=18818
England	Our waste, our resources: a strategy for England https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/765914/resources-waste-strategy-dec-2018.pdf		
United Kingdom		The UK Plastics Pact brings together governments, businesses, local authorities, citizens and NGOs behind a common vision and commitment to a set of ambitious targets. https://wrap.org.uk/sites/files/wrap/The-UK-Plastics-Pact-Roadmap-2020_0.pdf	

Netherlands	Transition Agenda Circular Economy-Plastics (2018) TRANSITION-AGENDA-PLASTICS_EN.pdf (hollandcircularhotspot.nl)	Plastics Pact NL 2019-2025 https://www.circulairondernemen.nl/uploads/0e657a0084a4f18d2ff61335794ea3c7.pdf	Combatting litter (2017–) https://oceanconference.un.org/commitments/?id=18046
Portugal		Portuguese Pact for Plastics / Pacto Português para os Plásticos https://www.pactoplasticos.pt/	
Poland		The Polish Plastics Pact / Polski Pakt Plastokowy https://paktplastikowy.pl/	
Austria	Government site: Plastics (bmk.gv.at)		
Ireland			Partner in: Ban plastic microbeads in cosmetics (2017–2020) https://oceanconference.un.org/commitments/?id=18818
Luxembourg			Partner in: Ban plastic microbeads in cosmetics (2017–2020) https://oceanconference.un.org/commitments/?id=18818
Scotland	Current and planned actions of the Scottish government concerning plastic (dated 12 October 2020) Single-use plastic items - market restrictions: consultation - gov.scot (www.gov.scot) Zero Waste Scotland programme funded by the Scottish Government and the European Regional Development Fund About us | Energy Efficiency Business Support (zerowastescotland.org.uk)	The UK Plastic Pact http://www.wrap.org.uk/sites/files/wrap/The-UK-Plastics-Pact-Roadmap-v3.pdf	
Switzerland	Federal Office for the Environment FOEN: Plastics in the environment -website https://www.bafu.admin.ch/bafu/en/home/topics/waste/info-specialists/waste-policy-and-measures/plastics-in-the-environment.html		

Appendix II: International conventions and pacts

International pacts and regional conventions have a major role in environmental protection by controlling plastic waste and litter. Many of the international agreements are legally binding. The government participation of EU countries (+ UK, Norway, Iceland, Switzerland and Russia) in some of the most important conventions and pacts are shown in Table 6.

Table 6. Parties of different international and regional conventions and pacts. Table includes EU Member States and UK, Norway, Switzerland, Iceland, and Russia. Some agreements have other European countries participating as well, though not mentioned here. Participation is marked with "X". Information retrieved from convention and pact websites.

	European Plastics Pact	G20 Marine Litter Action Plan	HELCOM	OSPAR	Barcelona Convention	Bucharest Convention
Austria	X					
Belgium	X			X		
Bulgaria						X
Croatia					X	
Cyprus					X	
Czechia						
Denmark	X		X	X		
Estonia			X			
Finland	X	X	X	X		
France	X	X		X	X	
Germany	X	X	X	X		
Greece	X				X	
Hungary	**					
Ireland	**			X		
Italy	X	X			X	
Latvia	X		X			
Lithuania	X		X			
Luxembourg	*			X		
Malta					X	
Netherlands	X	X		X		
Poland			X			
Portugal	X			X		
Romania						X
Slovakia						
Slovenia	X				X	
Spain	X	X		X	X	
Sweden	X		X	X		
UK	**	X		X		
Norway	* **	X		X		
Switzerland	**			X		
Iceland				X		
EU		X	X	X	X	
Russia		X	X			X

*The governments of Luxemburg and Norway have indicated that they sympathise with the Pact and are favourably considering signing it.

** Business or other signatory (other than national government signatory)

Descriptions of conventions and agreements:

European Plastics Pact (EPP), established in 2020, is a public-private pact that involves states, companies, NGOs and other organizations and focuses on single-use plastics and packaging. The pact has four main objectives linked to the plastics value chain:

- Design all plastic packaging and single-use plastic products placed on the market to be reusable where possible and in any case recyclable by 2025.
- Move towards a more responsible use of plastic packaging and single-use plastic products, aiming to reduce virgin plastic products and packaging by at least 20% by weight by 2025, with half of this reduction coming from an absolute reduction in plastics.
- Increase the collection, sorting and recycling capacity by at least 25 percentage points by 2025 and reach a level that corresponds to market demand for recycled plastics.
- Increase the use of recycled plastics in new products and packaging by 2025, with plastics user companies achieving an average of at least 30% recycled plastics by weight in their product and packaging range.

The objectives set in the pact are voluntary. 15 governments in Europe have signed the pact (by September 2021). (EPP 2021)

G20 Marine Litter Action Plan (G20 2017) and **G20 Implementation Framework for Actions on Marine Plastic Litter** (G20 2019). Where the G20 Action Plan on Marine Litter (adopted at the G20 Hamburg Summit in 2017) laid the foundation for the G20 members to address marine litter, the G20 Implementation Framework for Actions on Marine Plastics Litter facilitates further concrete actions on marine litter. It focuses especially on marine plastic litter and microplastics, and considers e.g., members' national circumstances, policies and approaches on a voluntary basis. The framework complements the work of the UNEP.

HELCOM, established in 1974 is the Baltic Marine Environment Protection Commission. It is an intergovernmental organization that has 10 contracting parties with Baltic Sea shoreline: Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, Russia, Sweden, and the EU. HELCOM supervises, develops and coordinates environmental protection actions in the Baltic Sea area. It also provides information and is an environmental policy maker. (HELCOM 2021)

OSPAR Convention, established in 1992 brings together 15 governments and the EU to protect and conserve the North-East Atlantic and its resources. The contracting parties are legally bind by the convention decisions. Recommendations and agreements are also introduced. Concerning plastic, OSPAR monitors the marine litter, develops indicators and has developed a Marine Litter Regional Action Plan. (OSPAR 2021)

The Barcelona Convention, established in 1995 is legally binding regional plan of the Mediterranean area that focuses e.g., on marine pollution management and the protection of natural resources. It has 22 contracting parties: countries with a Mediterranean shoreline and the European Union. (EC 2021b)

The Bucharest Convention, established in 1992 was set to protect the Black Sea against pollution. It is a legal framework that has 6 contracting parties with Black Sea shoreline: Russia, Turkey, Ukraine, Georgia, Bulgaria and Romania. (EC 2021c)

The Basel Convention controls the transboundary movements of hazardous wastes and their disposal. In 2019, three amendments were made to clarify the types of plastic wastes covered by the Basel Convention and to better control the transboundary movements of plastic wastes considered hazardous. The amendments came into force as of January 2021. The Basel Convention is legally binding for all EU countries through EU legislation. (Basel Convention 2021)

In addition to these, the **UN Global treaty on plastics** is under discussion. An agreement similar to the Paris Agreement is already supported by 68 countries worldwide (WWF 2021b). The UN will decide on the treaty at the fifth session of the UN Environment Assembly (UNEA-5) in 2021/2022.

Organizations in plastics value chains in the EU can e.g., join the European Plastics Pact or **Circular Plastics Alliance**: https://ec.europa.eu/growth/industry/policy/circular-plastics-alliance_en and submit **voluntary pledges** to use or produce recycled plastics: https://circulareconomy.europa.eu/platform/en/commitments/pledges.

Lexicon

Term	Definition
Bio-based plastic	Bio-based plastics are made wholly or partly from renewable biological resources such as sugarcane or cellulose. They are not necessarily biodegradable or compostable. Examples of bio-based plastics are bio-PET and PLA.
Biodegradable plastic	Biodegradable plastics are plastics degraded by micro-organisms into water, carbon dioxide (or methane) and biomass under specified conditions.
Bioplastic	Definitions of bioplastics are not yet concrete. Bioplastics are either biobased (i.e., made of renewable biomass) or biodegradable (i.e., degradable by microbes) or may cover both.
Chemical recycling	In chemical recycling, plastic waste is chemically broken down into monomers which can then be processed to polymers again. Chemical recycling technologies include e.g., pyrolysis, gasification, hydro-cracking and depolymerization.
EPR	Extended producer responsibility
LCA	Life cycle assessment
PRO	Producer responsibility organization
Single-use plastic (SUP) or disposable plastic	A single-use plastic product means a product that is made wholly or partly from plastic and that is not conceived, designed or placed on the market to accomplish, within its lifespan, multiple trips or rotations by being returned to a producer for refill or re-used for the same purpose for which it was conceived (Directive (EU) 2019/904). Single-use plastics are most commonly used for packaging and food service ware, such as bottles, wrappers, cutlery, straws, and bags.

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