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PLASTICS AND SUSTAINABLE INVESTMENTS

An information brief for investors

Tobias D Nielsen, IVL Swedish Environmental Research Institute
Fredric Bauer, Lund University



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Swedish Environmental
Research Institute

Mistra Investor brief nr 1 (2019):

Plastics and Sustainable Investments – an information brief for investors

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MISTRA INVESTOR BRIEFS

Mistra, the Swedish Foundation for Strategic Environmental Research, funds academic and multi-stakeholder research with the purpose of solving important environmental problems and contributing to a sustainable development.

The determination to drive positive change is key to Mistra also in our role as an asset owner. Assets are entirely invested according to sustainability criteria and with a long-term perspective.

These dual roles as research funder and asset owner give Mistra the unique opportunity to provide a bridge between the finance sector and researchers that can provide for increased knowledge regarding asset management for sustainable development. The 2019 initiative Mistra Dialogue emphasises the ambition to refine and adapt ideas, knowledge and results from Mistra funded programmes to reach different target groups, with asset managers and investors as a key actor.

The idea of "Investor briefs" came up after a meeting between two of Mistra's external asset managers and researchers from the Mistra funded programme **STEPS – Sustainable Plastics and Transition Pathways**. The aim of the investor brief is to provide a comprehensive, yet easily accessible, report on trends and key aspects as well as a tool kit that is useful for supporting sustainable investments and engagement. We envisage that this Investor brief is the first in a series where Mistra Dialogue will contribute to connecting investors and researchers and catalysing the implementation of the knowledge produced in the research programmes.

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PREFACE

This information brief for investors aims to present research based information about a complex and heterogeneous industrial sector and the role for investors to support a sustainable development for plastics. It provides plenty of examples of firms and actors active within the sector, but any mentions of individual actors should not be understood as direct support for these actors nor as an investment recommendation. None of the actors mentioned have had any opportunity to directly influence the information presented.

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INTRODUCTION

Since the invention of the first synthetic plastic materials in the first half of the 20th century plastics have become ubiquitous in our society.

Plastics are integral for many important societal functions, e.g. as packaging to protect food, as insulation in buildings, and as a structural material in vehicles. The technical development of plastics has been rapid, and the expansion of demand even more so. Global production of plastics has thus grown at a speed more than double that of global GDP since 1950 – from a production of around 2 Mton to almost 400 Mton today.¹

However, plastics are also associated with three significant problems that need to be tackled by innovative actors and through responsible investments:

- A dependence on fossil raw materials and

energy (mainly petroleum naphtha and natural gas liquids) which contributes to global climate change.

- Dysfunctional management of plastic waste and recycling of plastics which leads to a low efficiency in resource use.
- Littering and pollution of terrestrial and aquatic environments.

The brief report will address each of these problems, with a focus on the first two, to discuss emerging development pathways that have the potential to mitigate the negative effects. It also presents reasons for why the financial sector should look carefully at investments related to plastics.

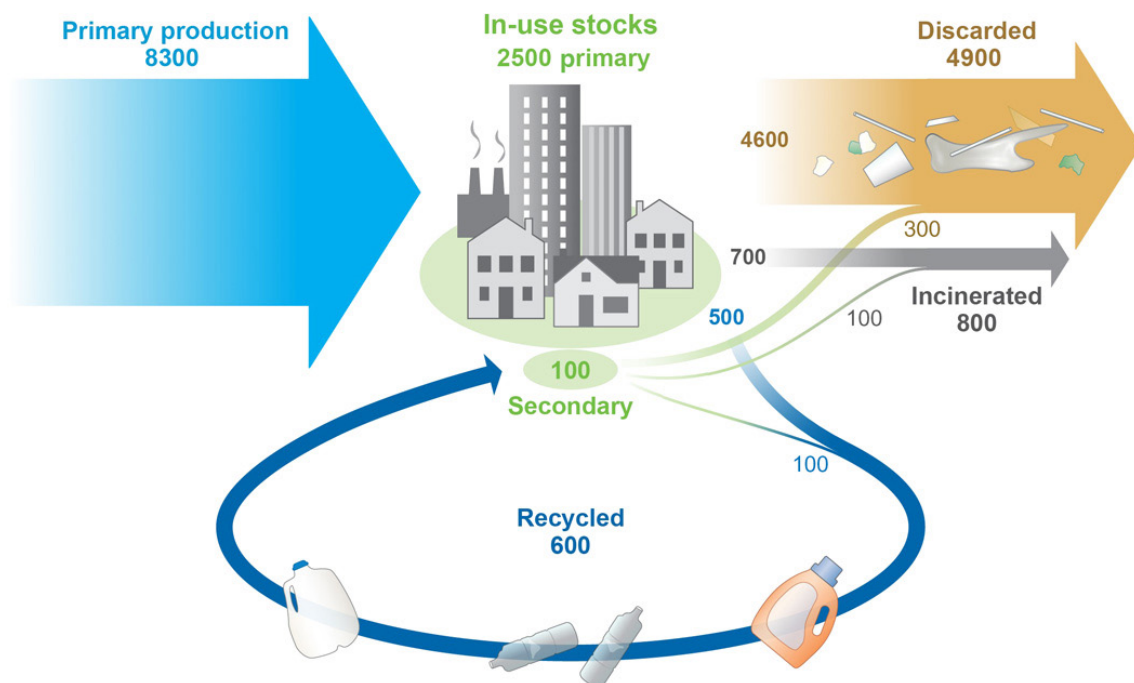


Figure 1. Global production, use, and fate of polymer resins, synthetic fibers, and additives (1950 to 2015; in million metric tons). Image by Geyer et al. 2017 (Distributed under a CC-BY-NC 4.0 license).

1. Geyer, R., Jambeck, J. and Law, K. (2017) Production, use, and fate of all plastics ever made. Science Advances. Vol. 3(7): 1-5.

ROLE OF FINANCIAL INVESTORS IN FACILITATING A TRANSITION TOWARDS SUSTAINABLE PLASTICS

The potential of the financial sector to contribute to a sustainable development has been highlighted in recent years, by actors from both the political sphere and within the financial sector. Decarbonizing the economy will on the one hand require massive investments in new green infrastructure, and on the other massive divestments from assets related to fossil fuel extraction that promote a fossil lock-in.

The role of the financial sector to support and drive the transition towards a sustainable economy was for a long time overlooked but has in recent years been emphasized by international actors and organizations.

The Paris Agreement on climate change stipulates the need for finance flows to become consistent with a pathway towards low greenhouse gas emissions, the World Economic Forum has articulated the great need for investments in renewable energy and green infrastructure to enable the transition away from global dependence on fossil energy, and the EU Sustainable Finance Action Plan emphasizes the need to reorient capital flows towards sustainable investments.

The proposed EU taxonomy for sustainable economic activities gives directionality for environmentally friendly investments. The proposed standards for the growing market for green bonds provide stability for a new instrument that is gaining interest in the financial sector and can support real investments in sustainable plastics.

Furthermore, the notion that traditional metrics used within the financial sector for evaluating activities and investments are insufficient to deal with new risks posed by climate change and long-term political goals for climate change mitigation and adaptation has spread. New types of risks are

becoming apparent, from the physical risks caused by climate change such as flooding, to risks of being left with stranded assets as stricter policies aiming to phase out industries heavily dependent on fossil resources are implemented. A better understanding and inclusion of these risks are also highlighted in the EU Sustainable Finance Action Plan as a means of minimizing financial risks stemming from climate change and environmental degradation.

The new role and societal context for the financial sector emphasizes the need for new and developed analytical tools, metrics, and information

The new role and societal context for the financial sector emphasizes the need for new and developed analytical tools, metrics, and information. Approaches focusing on environmental, social and corporate governance (ESG) have become widely accepted but likely need further development to include relevant information on the actual environmental impact of complex value chains and responsibilities as well as opportunities for individual firms to contribute to these. This has become evident in recent critique against ESG approaches which has concluded that it has not led to major change to capital flows or pushed a greening of industries and business from a macro perspective.

In parallel with the Paris Agreement the Task Force on Climate-Related Financial Disclosures (TCFD) was launched under the Financial Stability Board (FSB), aiming to provide better

information for financial actors on this matter, and EU is implementing new guidelines on corporate climate-related information reporting following the TCFD.

Plastics is a sector and value-chain which ought to generate interest from investors, equity managers, and other actors from the financial sector aiming to support and promote sustainability. The use of plastics has grown rapidly over the past decades and enables energy efficiency in many domains of society, yet it struggles with an almost complete dependency on fossil resources and is connected to significant problems around the world regarding improper waste management and marine pollution.

Solutions such as biobased plastics, improved collection and sorting of plastic waste from packaging, transportation, and construction, as well as mechanical and chemical recycling of plastics will require investments by both small and large firms around the world. Understanding the sector, its challenges, and the important trends that are shaping its future is thus key for supporting the development towards a more sustainable production, use, and management of plastics through different instruments available for actors in the financial sector.

List of abbreviations

CE	Circular economy
EPR	Extended Producer Responsibility
(E)PS	(Expanded) polystyrene
ESG	Environmental, social, and corporate governance
FSB	Financial Stability Board
GPP	Green public procurement
HDPE	High-density polyethylene
LDPE	Low-density polyethylene
MBI	Market-based policy instruments
PE	Polyethylene
PET	Polyethylene terephthalate
PP	Polypropylene
PU(R)	Polyurethane
PVC	Polyvinyl chloride
TCFD	Task Force on Climate-Related Financial Disclosures

THE PLASTIC INDUSTRY AND VALUE CHAIN STRUCTURE

The production of plastics mainly uses fossil feedstock in the form of light hydrocarbons such as ethane or propane, commonly called natural gas liquids, from natural gas processing or naphtha from oil refineries.

The hydrocarbons are then **cracked** to produce monomers such as ethylene and propylene that in subsequent process stages are **polymerised**. The virgin polymers typically come in granulates which are then **compounded**, i.e. the main polymer is mixed with different additives to achieve the desired properties for the intended application. These additives can be fillers, heat and light stabilisers, antioxidants, flame retardants, plasticisers, blowing agents, or others.

The compounding process produces a mixed plastic with the desired properties for specific applications. This mixture is then used in the subsequent **converting** processes where the plastic is converted into products through molding, extrusion or blowing. These products can either be products directly for end consumers, or used as components by other industries such as water pipes used in the construction industry or interior panels used in the automotive sectors. Key stages of the value

chain (processes and materials) for plastics are shown in figure 2.

According to the business association Plastics Europe the industry gives direct employment to 1.5 million people, in close to 60 000 companies (mostly small and medium sized enterprises) with a total turnover of 350 billion EUR in Europe. The plastics manufacturers which run the cracking and polymerisation plants are generally large, international corporations with close connections to the petroleum and energy sectors, such as Dow Chemical, BASF, Braskem, Sinopec and SABIC to name a few.² Economies of scale are important and have led to very large factories for manufacturing plastics and petrochemicals, creating barriers for new entrants and small scale production by innovative firms. Compounders and converters are commonly small or medium sized enterprises and make up the largest share of firms in the industry. Recyclers which are the actors at the very end of

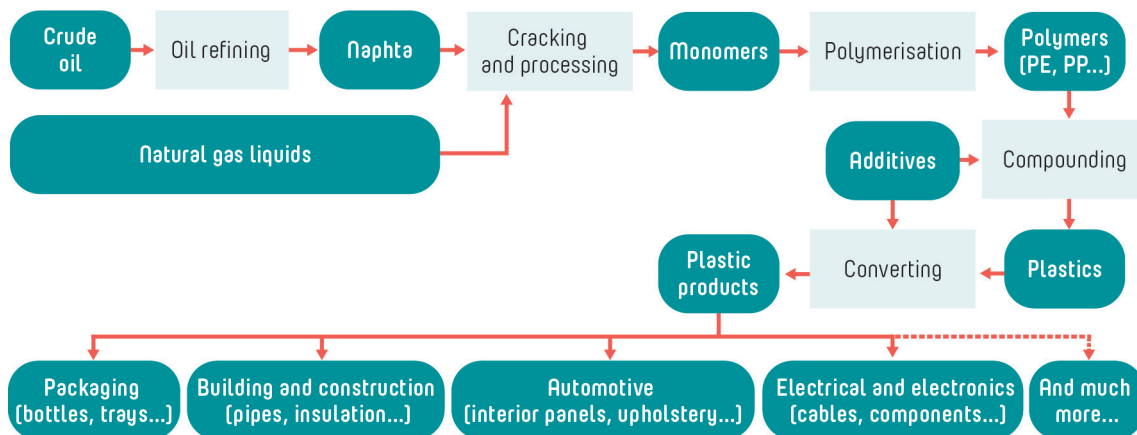


Figure 2. Overview of the plastic value chain. Dark green bubbles represent products/materials and light green boxes shows processes.

2. Tullio, A.H. (2017) C&EN's Global Top 50. *Chemical & Engineering News*, vol 95(30):30-35.

	Companies		Turnover		Employees	
	Count	%	Value	%	Count	%
Manufacturers	2 000	3.8 %	100 BEUR	27.6 %	140 000	7.9 %
Converters	50 000	94.3 %	260 BEUR	71.8 %	1 600 000	90.4 %
Recyclers	1 000	1.9 %	2 BEUR	0.5 %	30 000	1.7 %
Total	53 000	100 %	362 BEUR	100 %	1 770 000	100 %

Table 1. Turnover and employment in the European plastic industry. Data from European Plastics Converters.

the value chain make up the smallest part of both employees, companies, and turnover, as can be seen in table 1.

The term plastics obscures the high diversity and complexity of the range of products it describes. Five types of polymers do however constitute over 90 percent (by weight) of all plastics produced: polyethylene (HDPE and (L)LDPE), polypropylene (PP), polyvinyl chloride (PVC), polyethylene terephthalate (PET), and polystyrene (PS). The basic polymers take different forms and are modified in different ways for different applications (expanded PS, rigid and flexible PVC).

The main market sectors using plastics are packaging, building and construction, transportation (automotive), and electronics.³ As these application domains use plastics for different purposes, they have highly differentiated requirements on

the material which is reflected in the use of different types of plastics in each domain. Packaging is dominated by simple polyolefins such as PE and PP together with PET, while plastic products in buildings, such as floors and window frames, which have a long lifetime to a large degree uses PVC.

Not only the main polymer types vary across the sectors but also the use of additives which modify the plastic in different ways, e.g. flame retardants are commonly added to plastics used in electronics and cars but not in packaging. Although there are as few as five basic polymers these can in different ways be modified to create thousands of varieties with different properties – some of which are wanted in some applications but prohibited in others, which complicates the recycling of plastics across sectors.

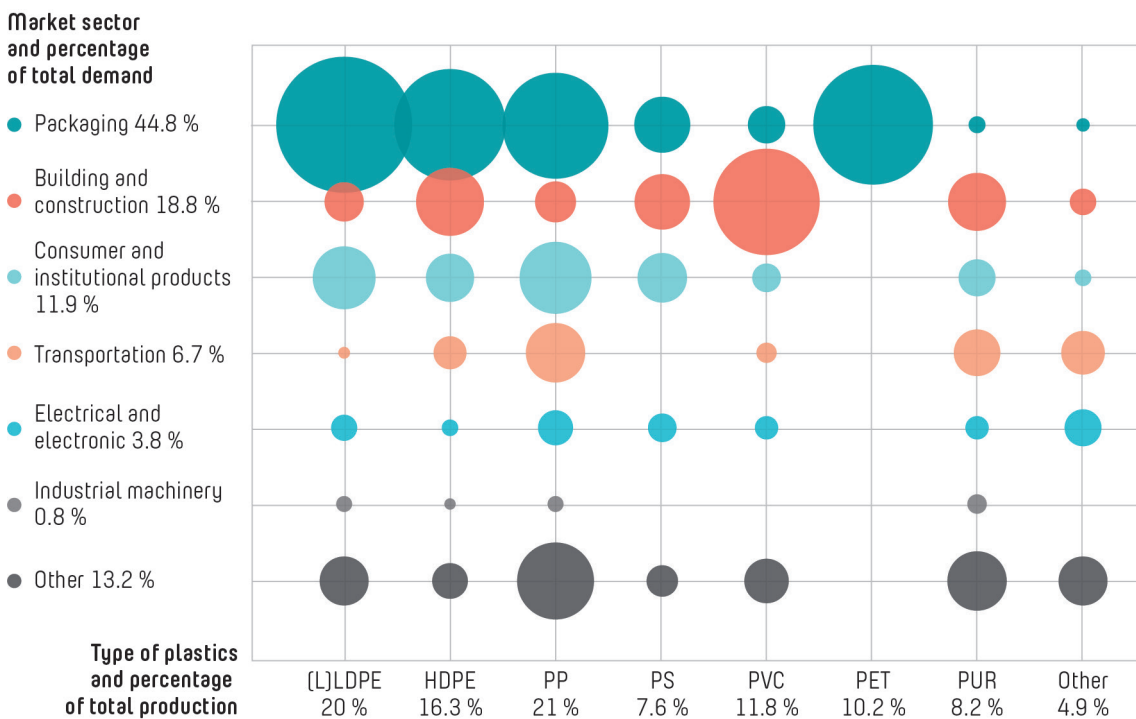


Figure 3. Demand for different types of plastics in important sectors. Data from Geyer et al. 2017.

3. Plastics Europe (2018) *Plastics – The Facts 2018*.



LEGISLATIVE TRENDS

This section provides an overview of legislation and instruments regulating the plastic sector and an outline of current trends and focal areas for policies to come. In general, legislation on plastic is still at a relatively early stage with several countries in the process of developing their governance strategies. An introduction to the most common types of instruments used to govern the sector is provided first. This is followed by an overview of legislative trends globally, in the EU and some examples of new initiatives in the Nordic countries.

Policy instruments used in relation to plastics

There are a range of policy instruments, which can be used to govern plastics. These can be categorised as regulation, market-based, finance and investment, information and voluntary. Table 2 provides a summary of the wide range of public policy instruments that are used on plastics, including the opportunities and challenges they face.

Regulation

Regulations can be used to set specific standards to ensure quality, reliability and safe utilization for both manufacturers and end-users. Given the variety of applications of plastics, standards tend to cover a wide range of products or different properties of the material, e.g. biodegradability. Several standards addressing the plastic industry have been developed.⁴

Regulation is used to restrict the production and commercialization of specific products, such as food contact materials and potentially harmful substances, such as flame retardants.⁵ Regulation is also used to set targets on for example plastic recycling rates as the EU plastic strategy

(COM/2018/028) and promote demand measures to increase the uptake of recycled/reused plastics. Regulation also includes bans on individual plastic items, e.g. single-use plastic products (Directive 2019/904), microbeads in rinse-off cosmetics (France, Italy, Sweden, UK)⁶, and bans on additives such as BPA in baby bottles (Directive 2011/8), or bans on landfilling of plastics (COM/2018/028). Beyond Europe's borders there exists numerous bans related to plastics, such as bans on thin plastic carrier bags⁷ and the Chinese import ban on certain types of plastic waste – which is likely to spread to other countries in the region.

Opportunities for regulation include harmonising and aligning policies on plastics. For example, the different waste management practices across (or within) EU member states. Another key potential is to introduce eco-design product standardization. More than 80 percent of products' environmental impacts are determined at the design stage.⁸ Having minimum requirements for recyclability and reusability already at the design stage could have a profound impact further down the life-cycle and also aid designers in making more sustainable choices.

4. <https://www.iso.org/ics/83.080.01/x/>

5. European Commission (2011b) COMMISSION REGULATION (EU) No 10/2011 on plastic materials and articles intended to come into contact with food, Brussels: European Commission.

6. <https://www.beatthemicrobead.org/>

7. Nielsen, T.D., Holmberg, K. and J. Stripple (2019) Need a bag? A review of public policies on plastic carrier bags – Where, how and to what effect? *Waste Management*. Vol. 87: 428-440.

8. OECD (2018) Policy approaches to incentivise sustainable plastic design: Background paper 3.

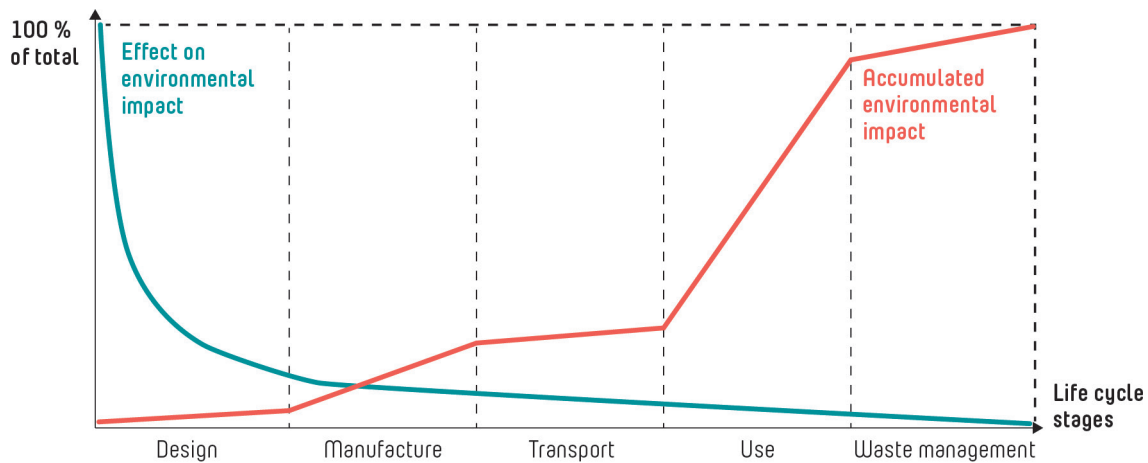


Figure 4. The possibilities to affect the environmental impact of a product, and its cumulative environmental impact throughout the life cycle.

Market-based instruments

Market-based instruments (MBIs) are an increasingly popular approach used by policy-makers to address environmental issues and achieve environmental objectives by encouraging targeted changes in business practices and consumer behaviour, often through creating economic incentives. Environmental MBIs are an often well-liked option for policymakers as revenues from MBIs such as taxes can support national budgets and act as a means of reducing the reliance on income taxes. Important MBIs related to plastics include extended producer responsibility (EPR), deposit-refund systems, and taxes or fees on specific categories of plastic products.

Several countries have introduced EPR in the form of modulated fees on plastic packaging that are differentiated for different types of plastics or uses. The EU directive on plastic bags (Directive 2015/720) aims to reduce consumption of plastic bags by either fixed targets or otherwise mandating a fee on them. Eco-modulated fees on plastic packaging has been introduced in countries such as France (by Citeo) and Sweden (by FTI). It increases fees for undesirable packaging and reduced fees for packaging with a lower environmental impact. Introducing or expanding existing deposit-refund systems have been discussed extensively in the EU as they generally result in high collection rates (>90 percent in Scandinavia). European countries with deposit return schemes on PET bottles include: Denmark, Estonia, Hungary, Norway, Finland, Lithuania, and Sweden. Taxes have been used on plastic additives, including toxic flame retardants in electronics (Sweden) and on plasticizers (phthalates) used for PVC products (Denmark).

Deposit refund systems and eco-modulation on plastic packaging are policies which are likely to expand into more countries and more applications in the future. One opportunity for MBI being discussed is the idea of a tax on virgin fossil-based plastics to encourage more recycled content and bio-based plastics. The European Commission has announced its intention to explore the feasibility of introducing EU level fiscal measures related to plastics, and Sweden (amongst others) are looking into the possibility of a climate compensation fee on virgin fossil-based plastics.

Finance and investment

As argued in previous sections finance and investment tools are generally underdeveloped. Yet there are key opportunities when it comes to investments in promoting sustainable plastics, including:

- Development of infrastructure for plastic waste prevention and management
- Provision of funding for research and development as well as new businesses
- Pressure companies on sustainable policies including product design, waste prevention, and developing take-back schemes
- Scaling up of new technologies for sustainable plastics
- Address inequities and gaps in waste management infrastructure between countries, and the associated risks of plastic waste leaking into the environment
- Research into developing standards for comparing environmental footprints of different materials

One financial policy instrument which has been

gaining considerable attention is green public procurement (GPP). Public contracts can leverage significant funds, helping to create a market for "green" products and incentivise industry to improve the environmental performance of their products. For example, in the EU, public authorities spend EUR 2 trillion each year, equivalent to 19 percent of its GDP.⁹ GPP policies can be developed at different governance levels – from local authorities to national budgeting.

Attempts have been made to procure biobased plastics for specific purposes such as disposable aprons for hospital use, but more GPP initiatives related to plastics are expected.

However, key challenges to overcome include knowledge and awareness gaps in the public sector, guidelines or standardized criteria for green procurement, and evaluation of the effect of GPP initiatives. Legislation and directives to public financial institutions such as the European Investment Bank promoting green investments through lower interest rates or larger deductibles is another way to support necessary investments.

Information and voluntary agreements

Information tools can be classified as interventions that seek to encourage the design of more sustainable plastics by facilitating communication up and down product value chains. Examples of information instruments include: product labeling, voluntary commitments, traceability, and life-cycle assessments.

Several product labels include plastics to help consumers and commercial buyers identify safer plastics, such as the Nordic Swan label which for example is used to label toys without certain harmful additives, and the EU Ecolabel scheme which restricts a number of plastic additives for computers and furniture products.¹⁰ A certification scheme, which is gaining increasing interest is "mass balance". This is essentially an accounting methodology that allows producers to state that a certain percentage of a product originating

from a facility using mixed feedstocks is derived from renewable or recycled raw materials. Similar schemes exist for electricity and biofuels.

Voluntary commitments can both be on a collective or individual basis. Collective commitments include the trade association Plastics Europe¹¹, 250+ major companies that have signed up to Ellen MacArthur's global commitment to reduce plastic pollution¹², as well as number of civil society-led commitments. On an individual basis, brand owners such as Lego, Ikea, and Volvo have committed to targets on using renewable or recyclable plastics in their products.

Facilitating information exchange throughout product value chains is essential for ensuring the sustainability of plastics. The limited traceability makes recycling and reuse more difficult and lowers the quality and faith in recycled material and their use in new products (COM(2018) 32). Today's text-based marking system is not sufficient, and chemical and digital watermarking systems are being developed – not only for the type(s) of polymers but also the additives. These include: Polymark (chemical marker), FiliGrade (2D and 3D marking), WRAP (UV-pigment), SCANNECT (digital marking) and companies working on laser marking, DNA-tagging, and readable micro-structures.

Challenges

However, there are several challenges on governing a sustainable plastic transition. These include:

- Risks of unfavourable substituting of plastics for alternative materials, e.g. resulting in increased emissions due to production and product weights, or biodiversity and land use impacts related to bio-based materials.
- Lack of harmonization across countries and non-aligned rules have translated into a patchwork of different practices on for example waste management plastics (even within countries).

A certification scheme, which is gaining increasing interest is "mass balance" – a methodology to state that a certain percentage of a product is derived from renewable or recycled raw materials

9. European Commission (2016) Green public procurement: a method to implement environmental policy. Science for Environment Policy.

10. DG Environment (2017) EU Ecolabel Electronic Equipment / Personal Computers. Brussels: European Commission.

11. Plastics 2030 – Voluntary Commitment, available at <https://www.plasticseurope.org/en/newsroom/press-releases/archive-press-releases-2018/plastics-2030-voluntary-commitment>

12. <https://www.ellenmacarthurfoundation.org/news/spring-2019-report>

- Lack of knowledge, awareness, guidelines, and division between governmental bodies, as well as between public and private actors when implementing policies on plastics such as GPP.
- Overcoming infrastructural/investment lock-in e.g. incineration, petrochemical sector.
- Knowledge gaps on plastic flows.¹³
- Risk of greenwashing.
- Lack of evaluation of measure implemented and targets agreed, which prevents conclusions on the effectiveness of measures and the ambition of targets.¹⁴

The design and implementation of policies to address the barriers towards sustainability for

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

Global trends in plastics governance

Two trends that are shaping the plastic agenda on a global scale are circular economy and (marine) plastic pollution. They often include specific targets that are monitored by internal or external parties.

Policy instrument	Opportunities	Challenges	Examples [Europe]
Regulation	<ul style="list-style-type: none"> • Bans • Eco-design measures • Targets • Standards 	<ul style="list-style-type: none"> • Unfavourable material substitution • Lack of harmonization • Rebound effect • Knowledge gaps • Measurement incompatibility 	<ul style="list-style-type: none"> • EU directive on single-use plastics. • Bans on microbeads in rinse-off cosmetics (e.g. France, Italy, Sweden). • Bans on specific additives such as BPA in baby bottles (Directive 2011/8/EU). • EU plastic strategy targets for plastic recycling. • Plastic landfilling bans.
Marketbased	<ul style="list-style-type: none"> • Tax/levies • Deposit refund systems • Extended producer responsibility (EPP) 	<ul style="list-style-type: none"> • Getting the price right • Extra costs of a deposit system • Rebound effect • Civil disobedience • Unintended negative effects 	<ul style="list-style-type: none"> • Levies on plastic carrier bags (in most EU member states) • Deposit-refund scheme for PET bottles (e.g. Nordic countries) • EPR on plastic packaging (e.g. France, Germany, UK)
Financing and investment	<ul style="list-style-type: none"> • Support sustainable transition of plastics • Investment in innovative solutions • Funding for R&D • Green public procurement • Technology transfer 	<ul style="list-style-type: none"> • Identifying knowledge gaps. • Overcoming infrastructural lock-in • Unclear cost and benefits for investors 	<ul style="list-style-type: none"> • GPP of bio-based plastics • Research on sustainable plastics (e.g. EU strategy) • Examples of private investment in waste management sector
Information and voluntary tools	<ul style="list-style-type: none"> • Certification and labelling • Chemical/digital watermarking • Voluntary industry action 	<ul style="list-style-type: none"> • Getting companies to share information • Complying with voluntary agreements • Risk of greenwashing 	<ul style="list-style-type: none"> • Labels (Nordic Swan; EU Ecolabel) • Green mass balance (BASF, Perstorp) • Environmental product declaration

Table 2. Illustrative examples of policy instruments.

Sources: OECD (2018) *Policy approaches to incentivise sustainable plastic design: Background paper 3*; EEA (2019) *Preventing plastic waste in Europe*; European Commission (2019) *A circular economy for plastics – Insights from research and innovation to inform policy and funding decisions*.

13. SMED (2019) Kartläggning av plastflöden i Sverige: Råvara, produkter, avfall och nedskräpning.

14. EEA (2019) Preventing plastic waste in Europe. EEA report: 02/2019.

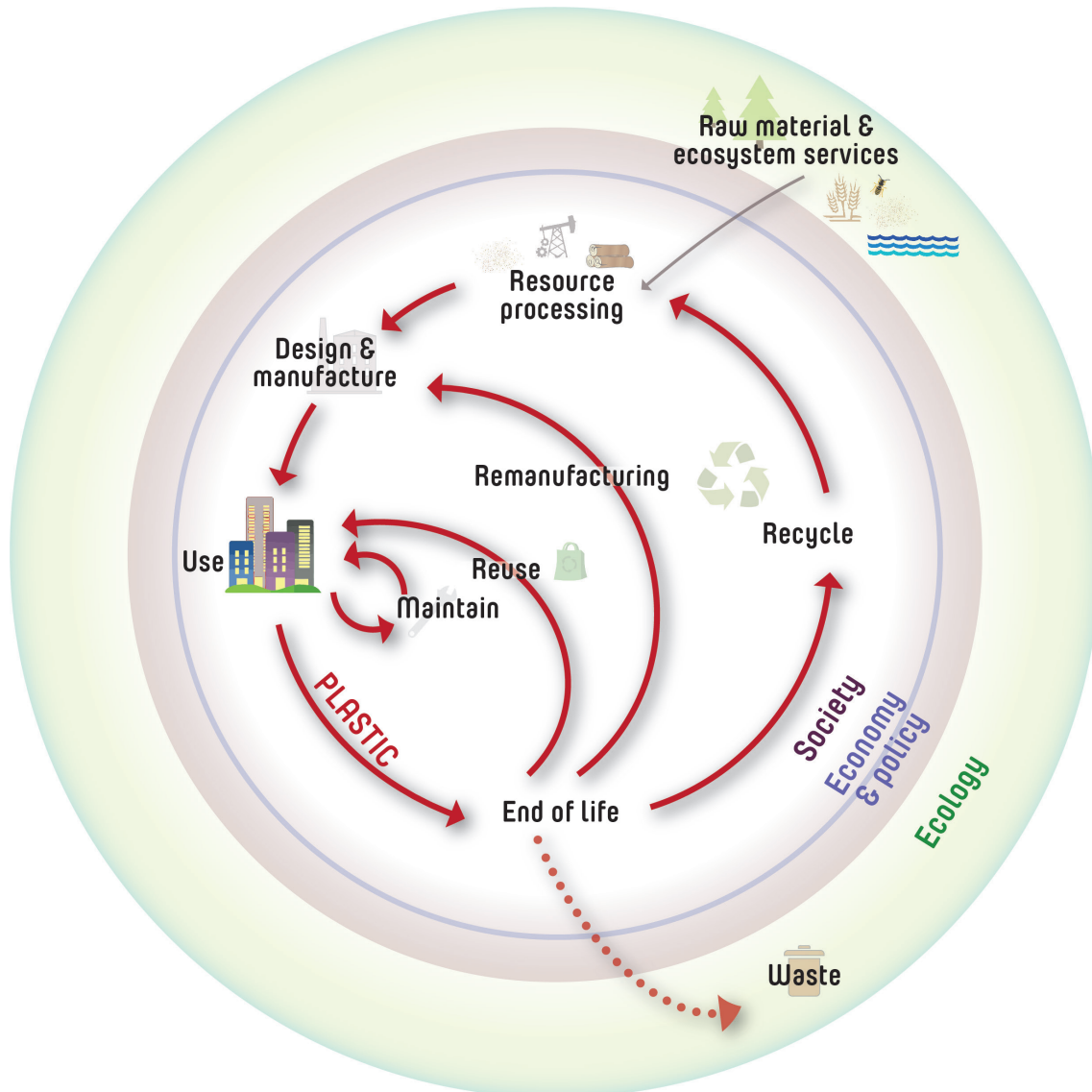


Figure 5. A circular economy for plastics reuses, remanufactures, and recycles plastics to minimise the production of virgin plastics which will come from sustainable sources. Picture source: IVL

Circular Economy – Closing the Plastic Loop

Circular economy (CE) has become a key pillar in the European Commission work on sustainability, but also elsewhere most noticeably China, which has been pursuing a national strategy on CE since 2013 (first country to do so). The rapid rise to prominence of the CE approach to plastics owes much to the publication of the Ellen MacArthur Foundation report *The New Plastics Economy*.¹⁵ Moreover, the restrictions of plastic waste imports to China have also forced countries to come up with new strategies to handle their plastic waste.

Its strict import regulations from 2018 on plastics for recycling is now expected to divert some 111 million metric tons of waste to lower-income neighbouring countries¹⁶, some of which have now reacted and started implementing stricter policies on imports of plastic waste. It has also led to the revision of the *Basel convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal* to include also trade in plastics. All in all, this puts further pressure on developed countries to improve domestic waste management systems.

15. World Economic Forum, Ellen MacArthur Foundation and McKinsey & Co (2016). *The new plastics economy: rethinking the future of plastics*.

16. Brooks, A.L., Wang, S. and J. R. Jambeck (2018) The Chinese import ban and its impact on global plastic waste trade. *Science Advances*. Vol. 4(6):1-7.



The main **promise of the CE** is to move from a linear “take-make-consume-discard” pattern to a closed loop in which materials are continually reused and recycled. Transitioning to a circular economy requires the integration of different stages in the life cycle. One example would be designing products from the outset for easy recyclability. The expectations are that CE will entail fundamental rethink to current business and industry operations with stronger inter-linkages within the value chain and products that are designed for reuse/recyclability. The result is a circular plastic system where plastic material is circulated for longer time, which consequently leads to lower virgin material demand, more effective use of materials, and lower levels of leakage (and arguably also emissions from plastic production).

The **challenges of CE** are whether it can live up to its name and be a panacea to every facet of the plastic crisis. From a critical perspective, CE might provide an excuse for polluters to introduce low-effort recycling programmes that meet a conservative minimum standard, and present these as systemic changes (i.e. green-washing). There are also a number of obstacles specific to plastics in the CE, such as toxic elements in recycling streams, quality loss in the recycling process, lack of transparency regarding polymers and additives in plastic products, complexity of collecting and sorting, and current low-market demand for recycled plastics.

Table 3 provides an overview of key policy initiatives on a transnational or global scale relating to a circular economy of plastics. The table is not exhaustive, rather it illustrates some of the most important initiatives and the range of actions being taken by multiple actors across the public and private sectors.

Marine plastic pollution – topic for a new global plastic convention?

In response to the increasing awareness of marine plastic pollution there has been a growing momentum calling for a global plastic convention to organise international efforts to combat the issue, following the examples of the conventions on climate change and ozone depletion.

The **opportunities** with a global convention is that it can more adequately deal with the international dimension of marine plastic pollution. The current policies to reduce marine plastic pollution are too fragmented and weak, allow for too many loopholes for industry actors wanting to deflect responsibility, and are unable to keep pace with the exponential increase in plastic waste on the global level. In response, an increasing momentum is building around calls for stronger and more coordinated action on plastics through global agreements, conventions, or treaties.

The **challenges** to a global convention include: possible limited effectiveness and the tendency

Name	Lead organization	Year	Scope
Global Plastics Platform	UNEP	2018	Supports countries and cities to set plastic reduction targets; explores ways to change the design, production, consumption, and disposal of plastics in line with a transition to a more circular economy.
New Plastics Economy Global Commitment	Ellen MacArthur Foundation	2018	A commitment signed by more than 250 organizations, representing more than 20 percent of all plastic packaging produced globally, to eliminate plastic waste and pollution at the source.
Platform for Accelerating the Circular Economy	World Economic Forum	2018	Develops public-private partnerships in support of CE; lends policy advice and support to address barriers; scales up and accelerates CE projects by partners (over 50 members from the public and private sectors).
Circular Plastics Alliance	European Commission	2019	Gathers 30 stakeholder organizations along the plastics value chain to promote voluntary action on the circular economy; aims to provide 10 million tons of recycled plastics to the EU by 2025.

Table 3. An overview of key transnational circular economy policy initiatives in the area of plastics. Source: Nielsen, T.D., Hasselbalch, J., Holmberg, K. and Strippel, J. (2019). *Politics and the plastic crisis: A review throughout the plastic life cycle.* Wiley Interdisciplinary Reviews: Energy and Environment, e360.

Name	Lead organization	Year	Scope
UNEP Clean Seas campaign	UNEP	2017	Campaigns governments, the general public, and the private sector to fight marine plastic pollution.
The United Nations Environment Assembly Resolutions on Marine Litter and Microplastics	UNEA	2016/ 2017/ 2019	A commitment signed by more than 250 organizations, representing more than 20 percent of all plastic packaging produced globally, to eliminate plastic waste and pollution at the source.
Plastic Leak Project	Quantis International & Shaping Environmental Action	2019	A multi-stakeholder initiative including 18 major companies together with UNEP and other international organizations to map plastic and microplastic pollution and develop circular economy initiatives.

Table 4. An overview of recent global agreements concerning marine plastic pollution.

of a drawn-out procedure around global environmental negotiations, push-back from industry and countries, and the prevalent knowledge gaps concerning the causes, effects, and solutions to marine plastic pollution.

European Union

The EU provides an important benchmark in understanding current legislative trends on plastics. It is a key driver of policy change on plastics and a global front-runner on regulating the plastic sector at large - as opposed to individual plastic objects. It is likely that successful EU initiatives on plastics will be replicated elsewhere. At the center of EU governance on plastics lies the EU plastic strategy.

EU Plastic Strategy

On January 16, 2018, the European Commission presented their new "Strategy for Plastics in the Circular Economy" (COM/2018/028). The aim of the strategy is to "protect the environment from plastic pollution whilst fostering growth and innovation, turning a challenge into a positive agenda for the Future of Europe". Emphasizing that there is a strong business case for European industries to take the lead in transforming the way plastic products are produced, designed, recycled, and used, the strategy introduces the five overarching aims of the initiative:

- To make **recycling more profitable** for business (by developing new rules on packaging and standardizing the collection and sorting of waste).
- To **curb plastic waste** (targeting especially single-use plastics, fishing gear, and microplastics).

- To **stop littering at sea** (by introducing new rules on port reception facilities).
- To **drive investment and innovation** (with €100 million support for the development of smarter and more recyclable plastics materials).
- To **spur change across the world** (by developing international standards and liaising with partners around the globe).

The EU plastic strategy is not a legal document, but a Communication from the European Commission. It is, nevertheless, important as it identifies the direction the European Commission is promoting to address the challenges of plastics and what kinds of solutions it deems relevant. The strategy will lead to both new directives e.g. Single-Use Plastics Directive and the modification of existing directives e.g. waste management, REACH, and eco-design directives.

Single-Use Plastics Directive

On March 27, 2019 the EU reached agreement on the Single-Use Plastics directive (2019/904), aimed at reducing marine plastic pollution. The directive targets ten single-use plastic items and fishing gear that together account for 70 percent of marine pollution in Europe. The directive includes the following measures:

- **Bans** on the use of plastics in items including: food and drink containers, straws, drink stirrers, cutlery, plates, cotton buds, sticks for balloons.
- **Consumption reduction targets** for food and drink containers.
- **Extended producer responsibility** to help cover the costs of waste management and clean-up.
- **Collection targets** (90 percent collection rate for drinks bottles by 2025).
- **Labelling standards.**

Upcoming EU measures on plastics

At this stage, it is not clear how the new European Commission will act regarding plastics. However, developing a circular economy for plastics and reducing marine plastic pollution will likely continue to be focus areas. Research and innovation efforts on improved recyclability and recycling of plastics will likely be prioritised together with activities promoting bio-based plastics. The policy framework for promoting the circular economy will be further developed over the coming years.

In January 2019, the European Chemical Agency (ECHA) submitted a restriction proposal for **microplastic particles** (below 5 mm) that are intentionally added to products. The **Ecodesign directive** has hitherto focused on energy efficiency but is likely to be expanded to introduce requirements on material labelling and design to simplify reuse and recycling. It is also likely that **textiles, additives, recycling targets on plastic waste** beyond packaging, and the **coordination of policies across different sectors**¹⁷ using plastics will be areas that the European Commission are going to address in the near future.

In addition, waste legislation will be simplified, and co-operation between the Commission and the Member States will be stepped up. Minimum operating conditions for extended producer responsibility schemes will be laid down. Tailor-made approaches will be implemented for specific waste streams, such as marine litter, phosphorus, construction and demolition, food, hazardous and plastic wastes.¹⁸

Examples of new initiatives in the Nordic countries

Danish Action Plan

In December 2018 the Danish government launched its **national action plan: Plastik uden spild**¹⁹ ("Plastic without waste"). It contains **27 initiatives on plastic**, including the establishment of a **national knowledge centre on plastic**, a **ban** on thin plastic bags, and harmonisation of plastic sorting systems in Denmark. Overall the EU's

plastic strategy is used as a key benchmark with several initiatives that fall in line with the EU's strategy; it also focuses on building up knowledge on plastic and quantifying the flows of plastic in Denmark, working across the value chain, and promoting public/private initiatives. Key policy tools include: targets, harmonisation, and economic incentives. However, the limited budget of DKK 50 million over 4 years challenges the level of ambition of this action plan.

Finnish Roadmap

In October 2018, the plastics roadmap for Finland *Vähennä, Ja Vältä, Kierrätä, Ja Korvaa*²⁰ ("Reduce and refuse, recycle, and replace") was submitted to the Finnish Minister of Environment. It contains 10 proposals for measures including a study on the possibility for introducing a **tax on plastics**, improvements to local waste management systems, a **chemical recycling** facility, and specifies the need for investments in alternative solutions and the establishment of a New Plastics knowledge network. The Plastics Roadmap presents specific actions for two sectors that represent a significant volume of plastic waste and must improve its management of plastics, agriculture and construction.

Swedish Public Inquiry

In December 2018, the Swedish Government published a public inquiry on plastics: *Det går om vi vill*²¹ ("Yes, it is possible, if we want it to be!"). The comprehensive report covers a broad range of challenges for plastics, including: toxic additives, municipal waste strategies, feedstock recycling, use of disposable products, biobased plastics, policy making capability. The main message is that plastics can be managed, but it requires **policy coordination** across many areas and also in new areas. Policy suggestions include: institutional capacity building on plastics, public procurement measures, expanding the Ecodesign directive, **climate compensation fee** on plastics, and support for a **chemical recycling** facility.

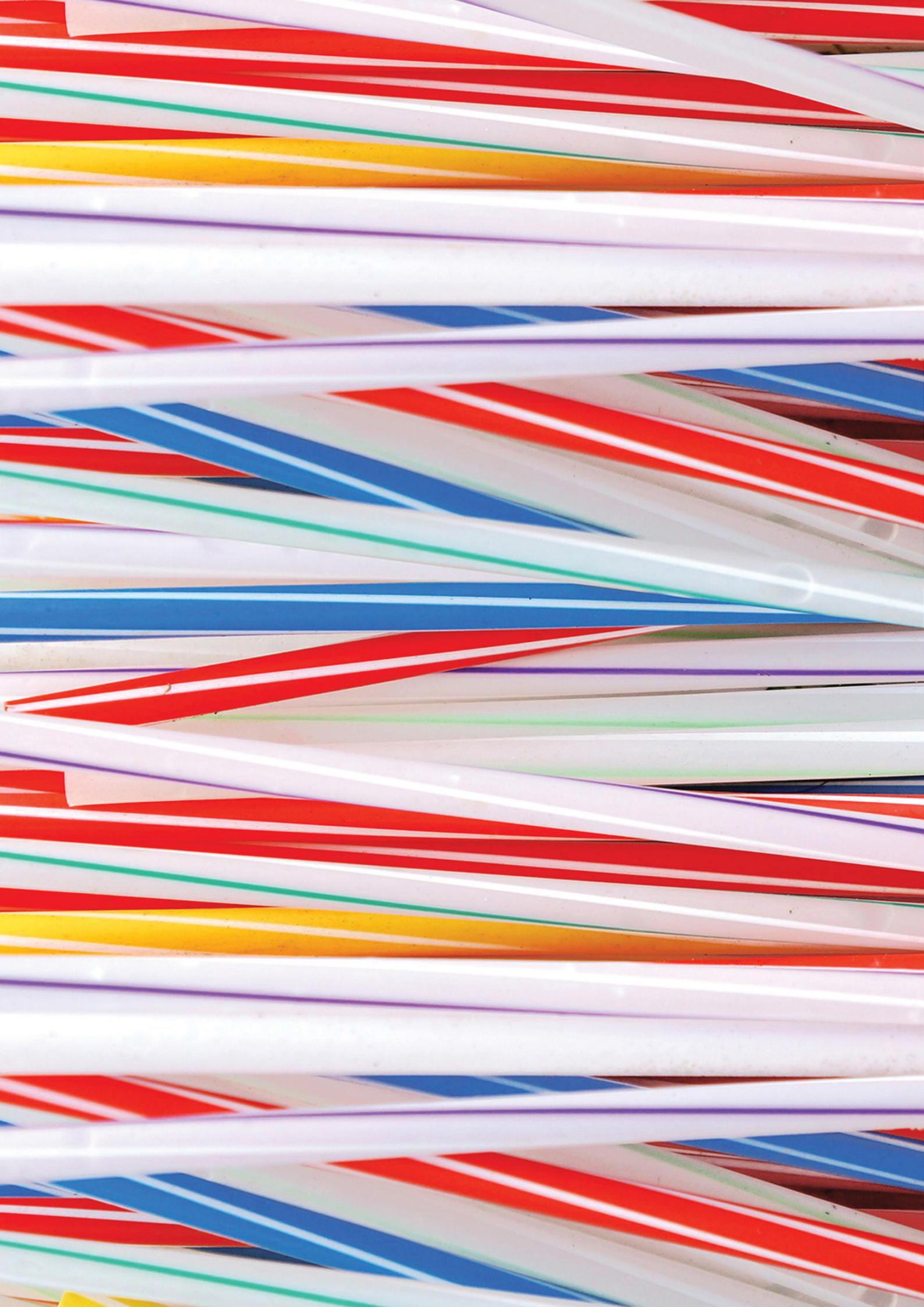
17. European Commission, Communication on options to address the interface between chemical, product and waste legislation, COM(2018) 32.

18. http://europa.eu/rapid/press-release_IP-14-763_en.htm

19. *Plastik uden spild – Regeringens plastikhandlingsplan* is available (in Danish) at <https://mfvm.dk/miljoe/plastikhandlingsplan/>

20. *Reduce and Refuse, Recycle and Replace – the Plastics Roadmap for Finland* is available at <https://muovitiekartta.fi/in-brief/>

21. *Det går om vi vill – förslag till en hållbar plastanvändning* is available (in Swedish) at <https://www.regeringen.se/rattsliga-dokument/statens-offentliga-utredningar/2018/12/sou-201884/>. A summary in English will be published late 2019 under the title *Yes, it is possible, if we want it to be! – Proposal for a sustainable use of plastic in Sweden Executive summary*



SECTORS EXPOSED TO LEGISLATIVE TRENDS

To illustrate the risk of exposure to current legislative trends, we provide examples of sectors that are exposed to recent or likely regulations in different degrees: single-use plastics, plastic packaging, and microbeads are examples of sectors that are negatively exposed to plastic legislation while waste management, and eco-design are areas that could benefit from current legislative trends.

Single-use plastic items

EU, India and Canada, amongst others, have already implemented or are planning to implement bans on specific single-use plastic items, although the term "single-use plastics" remains contentious and vaguely defined. Moreover, several NGO campaigns are targeting specific plastic single-use items from straws ("Strawless in Seattle" in the US), to coffee cups ("The Freiburg Cup" in Germany) and plastic bags (Bye Bye Plastic Bags in Indonesia). Given the pressure from legislature, consumers, and civil society producers of single-use plastic products are **highly exposed**. In the future it is likely that disposable items such as plates, cutlery, and cotton buds will have to be produced from paper or other bio-based materials.

Opportunities lie in companies developing alternative materials for single use products. Many small firms and start-ups (from potato-to-plastic cutlery in Sweden to banana-leaf plates in India) are active in developing these materials and products around the world and these actors will most likely need to make significant investments to scale up production. In addition, investors can play an important supportive role for clean-up campaigns and in the development of effective monitoring efforts on plastic waste, e.g. the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP).

Packaging

The report *The New Plastics Economy: Rethinking the future of plastics* estimated the share of plastic packaging as a share of global packaging volumes to have increased from 17 percent in the year 2000 to 25 percent in 2015 driven by a strong growth in

the global plastic packaging market of 5 percent annually. In 2013, the industry put 78 million tonnes of plastic packaging on the market, with a total value of \$260 billion. However, after a first short use cycle, 95 percent of plastic packaging material value, or \$80–120 billion annually, is lost to the economy. Almost three quarters of the used plastic packaging is not recovered and plastic packaging accounts for the largest amount of marine plastic pollution found on beaches.

As with single-use plastics, plastic packaging is **exposed** to legislative and consumer pressure. The drink bottle industry and food packaging (in general) have been heavily criticized in recent years because of heightened awareness of marine plastic pollution. In response, the industry has promised to: provide more transparency on their plastic use and waste e.g. the Sustainable Packaging Coalition Goals Database, focusing more sustainable product development, partnerships across the value chain e.g. Nestlé and Veolia and sponsored clean-up and plastic pollution monitoring programmes. Pressure is also mounting from retailers, with an increasing number, e.g. Marks and Spencer, Lidl, Sainsbury's and COOP, developing internal targets for plastic packaging which often focus on using less plastic packaging and/or more recycled materials. Plastic and/or packaging free supermarkets have been introduced in several European and American countries, e.g. Germany, Italy, Canada, and Brazil, but are currently a small niche.

Given the current pressure on packaging from consumers, retailers, and policymakers it may well be a **make or break situation**, where companies that best respond to the sustainability challenges will have a significant competitive advantage.

Reusable packaging is being introduced by some firms to alleviate the problem with plastic packaging. Requirements on all packaging being recyclable are likely to be put in place following the EU Plastic Strategy and will thus be crucial for packaging manufacturers to develop. Already a range of policy measures in the Single-Use Plastics Directive will significantly affect the industry, e.g. bottle caps need to be attached to the bottle, extended producer responsibility for clean-up costs. Nevertheless, the market for plastic packaging is projected to continue its strong growth to double volumes in 2030. By 2050 the use of plastic packaging is expected to reach 318 million tonnes – almost as much as all plastics today.

Opportunities exist for companies that are involved in developing **novel packaging materials, improved (eco)designs for recyclability, and better waste management.** New business models are also appearing including leasing of packaging and **reusable packaging solutions.**

Textiles

The global clothing market is estimated to be worth around USD 1.3 trillion and to employ more than 300 million people.²² The annual production of clothes is 53 million tonnes with a growth projection to 160 million tonnes in 2050. The average number of times a garment is worn during its lifetime has decreased by 36 percent compared to 15 years ago – while global production has doubled during the same period. An estimated 60 percent of clothing is made from plastic – mainly polyester (PET), but also acryl (polyacrylonitrile) and nylon (polyamide) fibres are used. Washed away fibres are a key global source of microplastics. It has been estimated that around half a million tonnes of plastic microfibers are shed during the washing of plastic-based textiles and ends up in the ocean annually. Concern is also growing around the use of fluoropolymers (a special category of modified plastics) used for improved water-resistance and the effects that these have on the environment as they are shed from garments.

Currently, there are few policies specifically on plastic in textiles, however it is likely that the EU

and Member states will enact catchment policies (standards for wastewater treatment plants), implement EPR policies on textiles, or introduce recycling targets for textiles. Textiles are rarely reused or recycled, for many different reasons, e.g. only about 5 percent of the over 120 000 tonnes of new textiles put on the market in Sweden every year is recycled. Several different actors and projects are developing technologies for automatic sorting of collected textiles, as well as for recycling textile fibres in garments that cannot be reused.

Given the public concern about microplastics and the general pressure on the textile industry to become more sustainable the textile sector is likely to become **exposed** towards future legislation on for example **microplastic shedding and leakage of specialties** as well as public pressure to reduce the use of plastic fibres that cannot be recycled. There is however, **significant opportunities** for technologies that improves recycling rates of textiles, as well as for initiatives upstream at the design state, e.g. making products more recyclable and include more recycled plastic in their textiles.

Waste management and recycling

Global waste management of plastic has come under pressure both because of the noticeable lack of plastic recycling and from the ban of low-quality plastic waste imports to China. However, the current discussion on plastic pollution presents opportunities for waste management sectors. There are significant challenges when it comes to recycling and reuse of plastics, including collection, sorting, quality, and low market demand. However, companies that provide viable solutions to these challenges have a very positive outlook due to the increased focus on recycling. Waste management and recycling are sectors which have previously been targets for dishonest actors and the increasing interest in investing in these sectors may attract increasing attention from such actors again, underlining the need for careful analysis of investment opportunities.

Solutions that may become attractive could be in new systems for tracing (watermarking), optical

An estimated 60 percent of clothing is made from plastic – mainly polyester, but also acryl and nylon. Washed away fibres are a key global source of microplastics.

22. Ellen MacArthur Foundation, A new textiles economy: Redesigning fashion's future

sensors (near infrared spectroscopy), collection schemes (producer take-back schemes), colouring (new pigments which are easier to sort), and recycling (chemical or mechanical) different types of materials and products. In general, the waste management sector has a comprehensive challenge when it comes to addressing plastic waste, but with the current focus on increasing plastic recycling and minimizing waste, the sector stands to **benefit considerably** from upcoming plastic-related legislation. A recent, McKinsey report sees significant opportunities in developing waste management industry for recycled plastics, representing a profit pool of nearly 50 billion Euros per year worldwide by 2030.²³

In Europe an estimated 30 percent of plastics is collected for recycling, however less than that is actually recycled. The EU Plastic Strategy promotes the following targets:

- By 2030, all plastics packaging placed on the EU market is either reusable or can be recycled in a cost-effective manner.
- By 2030, more than half of plastics waste generated in Europe is recycled.
- By 2030, sorting and recycling capacity has increased fourfold since 2015,
- EUR 100 million up to 2020 to finance priority measures such as developing smarter and more recyclable plastics material, making recycling more efficient and tracing and removing hazardous substances.

Achieving these targets will require massive investments and innovation in the waste management system.

Other sectors

As legislation on plastics expands also other sectors are likely to be affected, e.g. **automotive**, **agriculture**, **construction**, and **consumer electronics**. Probable measures in the short to medium term are recycling and waste sorting targets, product design requirements following an expansion of the Ecodesign directive, or stricter EPR and GPP schemes, i.e. the expansion to new sectors of instruments that have already been tried in other domains. When it comes to recycling of waste in these sectors there are some advantages compared to household waste and packaging. Actors in these sectors will thus most likely have to build internal capacity to manage their use of plastics in a coherent manner, if they have not already.

23. McKinsey & Company (2018) No time to waste: What plastics recycling could offer.





TECHNOLOGICAL OPPORTUNITIES

Several technologies are promoted as offering key solutions to the plastic problems. They all offer at least partial solutions to persistent problems in the current plastics system, yet also have drawbacks. This section provides a brief introduction to the opportunities and challenges of two key technological opportunities currently being highlighted in the international debate: chemical recycling of plastics and bio-based plastics.

Chemical recycling

Chemical recycling offers solutions to those segments of plastics that conventional mechanical recycling typically cannot manage. This includes certain polymers which are difficult to recycle (e.g. PVC), certain types of applications, e.g. textiles, laminates (more than one polymer or plastics in combination with other materials), and thermoset plastics which cannot be melted and remolded into new products (e.g. epoxy resins used for windmills). In addition, chemical recycling offers solutions to avoiding the risk bringing toxic/unwanted additives and unknown substances into new plastic applications, ensures high quality and pure (recycled) plastics that could be approved for food contact on par with virgin plastic and the potential for endless cycles of plastic recycling. Hence, chemical recycling offers solutions to some of the most permanent problems related to plastics recycling. Given its technological promises and the continued low mechanical recycling rates, chemical recycling has been gaining increasing traction over the past few years. A recent study put the market opportunity at \$120 billion annually in North America alone.²⁴

Chemical recycling is an umbrella term that covers a range of different types of processes. The main categories are:

- **Solvent-based purification** is a process where plastic is dissolved in chemicals allowing for removal of additives and contaminants. It does,

however, not change the constitution of the polymer itself.

- **Decomposition or selective depolymerisation or solvolysis** is a process that involves breaking down (mono) plastics into its building blocks (single monomer molecules) or shorter fragments (oligomers), both of which can be re-polymerised into pure polymers.
- **Feedstock recycling or conversion** is similar to decomposition in that it involves breaking the molecular bonds of plastics. A key difference is that the output products from conversion processes are often liquid (pyrolysis) or gaseous hydrocarbon (syngas) similar to the products derived from petroleum refining. These raw materials can be used to make fuels for combustion (plastic-to-fuels), and/or petrochemicals (e.g. naphtha) that can be made into new plastics (plastic-to-plastic). This means that, in theory, almost all types of plastic waste can be converted into the same quality standards as virgin plastics.
- **Gasification** is a process that produces a gas that can be used for energy production or chemical conversion, one possible product category of which could be plastics. The process can be less sensitive to the input quality than pyrolysis but is more energy intensive. Gasification of mixed plastic waste and pyrolysis of sorted plastics yield superior CO₂ reduction scores compared to incineration with energy recovery.²⁵

24. Closed Loop Partners (2019) Accelerating circular supply chains for plastics: a landscape of transformational technologies that stop plastic waste, keep materials in play and grow markets. Available at http://www.closedlooppartners.com/wp-content/uploads/2019/04/CLP_Circular_Supply_Chains_for_Plastics.pdf

25. Broeren, M., Roos Lindgreen, E. and Bergsma, G. (2019) *Verkenning chemische recycling – update 2019. Hoe groot zijn – en worden – de kansen voor klimaatbeleid?* Delft: CE Delft.

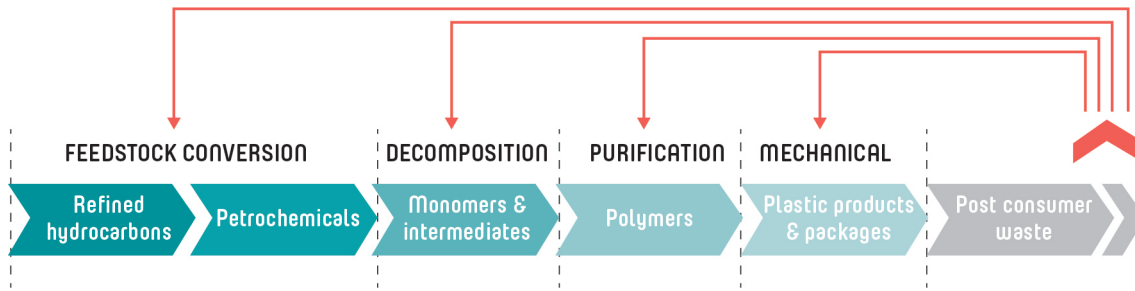


Figure 4. Chemical recycling of plastics.

However, there are several challenges to chemical recycling. These include:

- Technical, it is a very energy intensive process (especially feedstock recycling).
- Economic, it is more expensive than virgin plastic or mechanical recycling.
- Environmental, hazards related to treatment of byproducts.
- Regulatory, standards for assessing and measuring the recycled content such as the mass balance principle are still being developed.
- Consumer perception, how will consumers react to it?
- Lock-in, it might strengthen a "linear lock-in" for plastics as feedstock recycling arguably falls out of the circular plastics economy if the feedstock is instead used for fuels.

There are an increasing number of companies getting involved in chemical recycling. Major plastics and petrochemicals manufacturers such as Indorama, SABIC²⁶, BASF²⁷, and LyondellBasell²⁸ are making strategic investments in chemical recycling solutions and a European industry association for chemical recycling has recently been formed.²⁹ Consumer brand owners such as Adidas, Coca-Cola, and P&G are also involved in projects related to chemical recycling.³⁰ There are also a number of financial actors involved in financing chemical recycling facilities, including Blackrock, Breakthrough Energy Ventures, Closed Loop Partners, Cycle Capital Management, Kleiner Perkins, Rabobank, and Royal Bank of Canada.³¹

Bio-based plastics

Bio-based plastics are plastics produced using biomass as feedstock, in contrast to conventional fossil-based ones. The term bioplastics is often used to describe both biodegradable plastics (which may or may not be produced from renewable feedstocks) and bio-based plastics (which may or may not be biodegradable), see figure 7.

Bio-based plastics have received significant attention but few are commercialised as of today. Bio-based plastics available on the market today are commonly produced from sugar (sugarcane or sugarbeet), starch (corn or wheat) or vegetable oil (rapeseed or castor bean) and are thus **exposed** to critique against using arable land for non-food crop production.

The largest commercial actor is Braskem, producing biobased PE from sugarcane, which has identical material characteristics to conventional PE. It is mainly used in packaging applications where it can directly substitute for conventional PE. Biobased PA (nylon) is also commercially available, although in smaller volumes, from actors such as DSM and Arkema.

Poly-lactic acid (PLA) is the second largest bio-based plastic, and the market is dominated by the American firm NatureWorks, but Total-Corbion inaugurated a new full scale production facility in 2019 and other actors producing PLA are for example Hycail and Purac. PLA has mainly been used for packaging and in 3D-printing, but can

26. Uses decomposition technology to turn PET (bottles) to PBT (used in consumer electronics, automotive, etc.). It is developing a new feedstock recycling plant in the Netherlands with Plastic Energy which is expected to be operational in 2021.

27. ChemCycling project uses feedstock recycling technology to convert plastic waste to syngas or oils. It partners with pyrolysis technology provider Recenso GmbH.

28. Investments in Karlsruhe Institute of Technology (KIT) and Quality Circular Polymers (QCP).

29. Chemical Recycling Europe. For more info see www.chemicalrecyclingeurope.eu

30. For example, Loop Industries that uses depolymerize technology to turn PET and polyester fiber waste into PET plastic used in consumer products.

31. Closed Loop Partners (2019) Accelerating circular supply chains for plastics: a landscape of transformational technologies that stop plastic waste, keep materials in play and grow markets. Available at http://www.closedlooppartners.com/wp-content/uploads/2019/04/CLP_Circular_Supply_Chains_for_Plastics.pdf

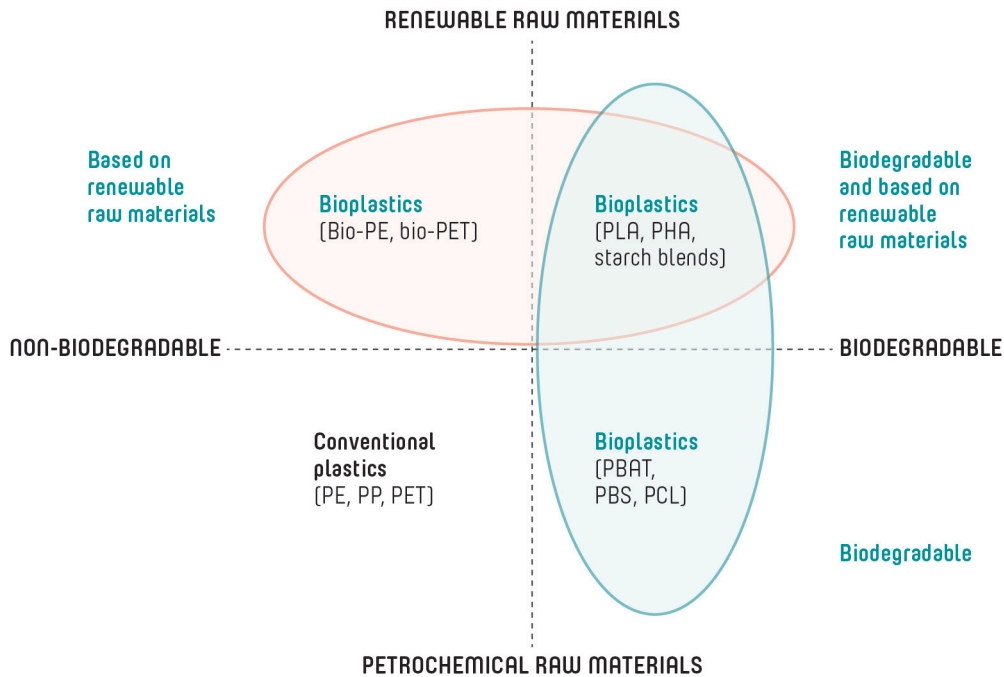


Figure 7. Bioplastics, bio-based plastics, and biodegradable plastics.

also be used as a fiber for textiles and medical applications.

Polyhydroxyalkanoates (PHA) is another type of biobased plastic that is reaching commercial production in 2019 through the upscaling of the production facility of Danimer Scientific in USA.

Several other types of biobased polymers are being developed by different actors around the world, as well as processes for producing bio-based plastics from non-food sources. Most likely bio-based plastics has a large market potential in a wide range of applications and will continue to grow, but thus far growth has been fairly slow. The use of different types of renewable resources will continue to be a contentious issue, connected to complex patterns of agricultural policies in the EU and abroad.

Connected to bio-based plastics, biocomposites are another group of plastic materials that are also gaining interest. Composite materials consist of a strong material (e.g. plant fibers) embedded in a matrix of a softer material (plastic), giving the composite material properties unlike those of the individual components. Biocomposites are composite materials consisting of one or more materials derived from a biological origin. Although the

polymers used for wood-plastic composites are still usually conventional fossil-based plastics, it is also possible to use recycled or bio-based plastics for the production of biocomposites and this is increasing. Biocomposites are already used in a range of applications, such as automotive panels and upholstery, noise insulating panels, and indoor furniture.

The global demand for wood-plastic composites was estimated to be around 900 000 tonnes per annum in 2008 with around 70 percent of demand in North America and 20 percent in Europe. Recent estimates for Europe are that more than 30 compounders are active in the area of biocomposites and together produced more than 100 000 tonnes in 2018.³² Biocomposites is an area which has attracted the attention from the forestry and paper industry such as Södra and Stora Enso as it allows for expanding into new markets for wood fibers. Furthermore, there are many small firms developing and marketing new types of biocomposites for new applications, some of which may need to invest in larger production facilities if the interest for this type of material continues to grow at current rates. **Challenges remain around the recyclability** of these materials if mixed with regular plastics.

32. Holmes, M (2019) The Natural Alternative. *Compounding World*, March: p 29-38.



ΚΟΥΠΙΝΑΚΕ
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WRAPPING UP

Plastics have become ubiquitous in modern society. It is a group of materials that is versatile and useful in many types of applications and have thus become extremely popular. Plastics are thus important for many industries and value chains as well as for everyday practices of most individuals – and should thus be also for investors and financial actors.

A transition to sustainable plastics will require investments in production, management, and recycling – and investments need to transition towards sustainable practices as argued by many international organisations and governments. A transition towards a sustainable production and use of plastics must deal with several important sustainability issues related to plastics: the complete dependency on fossil resources and energy for their production; low rates of recycling – also of material that is collected for recycling; unsustainable waste management which contributes to plastic pollution of terrestrial and aquatic environments. To this list could also be added health concerns related primarily to the use of different types of additives.

Societal pressure – currently primarily driven by the concern for marine plastics – will necessitate legislative action which will impact the sector in the next five to ten years.

Plastics are thus becoming a key concern for global policy making for several different reasons.

Historically the sector has not been subject to strict and specific governance, but that is likely to change as it is becoming scrutinized both in the EU and globally. Legislation is thus likely to affect the sector in many different ways, as shown in this report. Recycling is the domain where pressure is likely to develop most rapidly, both from new and stricter policy instruments and civil society. This will affect not only plastic waste management but all producers of plastic products who likely will have to ensure recyclability of their products. Bio-based feedstocks for conventional plastics as well as new biobased plastics and materials are likely to grow as pressure also regarding the climate impact of the sector increases.

Investments in plastics and related sectors must acknowledge the risks associated with the industry and consider how to evaluate and mitigate them. Plastics will remain important for many years to come, and investments to make the sector more sustainable are thus crucial.



INVESTOR TOOLKIT

Here we aim to present key issues to consider for investors looking into investments in firms producing or using plastics as an important material in their business. The list is not exhaustive but can serve as an entry-point for discussions on the sustainability of plastic-related business.

Primary production of plastics

- What is the plan for ensuring sustainable production of plastics?
 - What types of raw materials will be used in the coming 5, 10, 20 years?
- If biomass is used as raw material, does it comply with the criteria set by the EU TEG taxonomy? How will this be ensured over time? What is the scalability of the supply?
- How does increased plastic recycling affect the business opportunities of the firm? Can recycling (mechanical and/or chemical) be incorporated as part of the business to reduce the use of fossil raw materials?
- What measures are being taken to reduce the leakage of plastic pellets and waste from production sites?

Product design

- Do the products contribute to sustainability?
- How is the use of sustainable plastics being considered in the design stage?
 - Are the plastics used recycled/recyclable?
 - Are there deposit-refund schemes or other voluntary closed loop recycling schemes available for products?
- What types of additives are used in the products?
 - Are any of them at risk of being restricted on some markets, e.g. due to adverse health effects?
 - Do any of the additives limit the recyclability of the material?
 - Are any problematic additives substitutable?
- What measures are being taken to substitute plastic products affected by current regulation, e.g. the EU single-use directive and plastic bag restrictions?

- What measures does the company take to increase traceability (e.g. share list of additives/polymers used)?

Packaging

- What types of plastics are used for packaging of products used or produced by the firm?
- Is there a functional recycling scheme for the type of plastic used for packaging?
- Can recycled plastics be used instead of virgin materials?
- Can standardized reusable packaging be used instead of a single-use plastic package?

Collaboration

- What global networks or voluntary commitments are the company active in?
- How is the company collaborating along the value chain to reduce adverse environmental impact of plastics?

Information/labelling

- How does the company provide information about the plastics they use to their customers, e.g. regarding how to reuse or recycle the plastics?
- Are they involved in a certification/labeling scheme?

Waste

- What measures are the company doing to minimise waste (in productions and inhouse)?
- Does the company know what happens to its post-consumer waste (recycled, shipped to other countries)?
- Does the company have take-back schemes?
- What measures are the company doing to increase recyclability/reuse of products?

SOURCES FOR FURTHER READING

Academic papers

- Brooks, A.L., Wang, S. and J. R. Jambeck (2018) The Chinese import ban and its impact on global plastic waste trade. *Science Advances*. Vol. 4(6):1-7.
- Geyer R., Jambeck, J.R., and Law, K.L. (2017) Production, use, and fate of all plastics ever made. *Science Advances*. Vol. 3(7): 1-5.
- Hatti-Kaul, R., Nilsson, L.J., Zhang, B., Rehnberg, N. and Lundmark, S. (2019) Designing Biobased Recyclable Polymers for Plastics. *Trends in Biotechnology*.
- Nielsen, T.D., Hasselbalch, J., Holmberg, K. and Stripple, J. (2019). Politics and the plastic crisis: A review throughout the plastic life cycle. *Wiley Interdisciplinary Reviews: Energy and Environment*, e360.

Reports

- Ellen MacArthur Foundation reports: <https://www.ellenmacarthurfoundation.org/>
- STEPS publication "Pathways to sustainable plastics – A discussion brief": http://steps-mistra.se/wp-content/uploads/2018/09/STEPS_Pathway-Discussion-Brief_DIGITAL.pdf
- Center for International Environmental Law (CIEL) reports "Plastic & Climate: The Hidden Costs of a Plastic Planet" and "Plastic & Health: The Hidden Costs of a Plastic Planet": <https://www.ciel.org/research-publications/>
- SMED "Kartläggning av plastflöden i Sverige": <https://www.naturvardsverket.se/upload/miljoarbete-i-samhallet/miljoarbete-i-sverige/plast/smed-rapport-2019-kartlaggning-plastavfallsfloden.pdf>
- McKinsey & Co "No time to waste: What plastics recycling could offer": <https://www.mckinsey.com/industries/chemicals/our-insights/no-time-to-waste-what-plastics-recycling-could-offer>
- European Commission "A circular economy for plastics – Insights from research and innovation to inform policy and funding decisions": <https://publications.europa.eu/en/publication-detail/-/publication/33251cf9-3b0b-11e9-8d04-01aa75ed71a1/language-en/format-PDF/source-87705298>
- United Nations Environment Programme "Legal Limits on Single-Use Plastics and Microplastics: A Global Review of National Laws and Regulations": https://wedocs.unep.org/bitstream/handle/20.500.11822/27113/plastics_limits.pdf

Key news streams

- Sweden:
 - General news on sustainability: www.aktuellhallbarhet.se
 - Svensk plastindustri (industry group): <https://www.svenskplast.org/nyheter/>
- Europe:
 - ENDS Europe (EU policy): <https://www.endsreport.com/>
 - EurActiv (EU policy): <https://www.euractiv.com/>
 - European Bioplastics (industry group): <https://www.european-bioplastics.org/>
 - Plastics Europe (industry group): <https://www.plasticseurope.org/en>
 - European Plastics Converters (industry group) <https://www.plasticsconverters.eu/>
 - Plastics Recyclers Europe (industry group) <https://www.plasticsrecyclers.eu/>
- International
 - Plastics News (industry news): <http://www.plasticsnews.com>
 - Guardian (newspaper): <https://www.theguardian.com/environment/plastic>
 - Plastic Pollution Coalition (NGO): <https://www.plasticpollutioncoalition.org/>



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