THE ECONOMIC ROLE OF PLASTIC

A NORWEGIAN PERSPECTIVE

PLASTICENE

The role of humans in the life of plastic

PROJECT REPORT

PLASTICENE – THE ECONOMIC ROLE OF PLASTIC IN NORWAY

Results from building knowledge about the current uses of plastics in Norway

PROJECT NO. : NRF 318730
DATE : 2024-06-06

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Suggested Citation: Nygaard M., Skogseth J., Adielsson S., Mehta, S. (2024). PLASTICENE: The Economic Role of Plastic in Norway.

CLIENT(S) : The Research Council of Norway
PROJECT NO. : 318730
CLASSIFICATION : Internal

ABSTRACT

The aim of this report is to synthesize and build knowledge on the current uses of plastic, and the economic role of this ubiquitous material. Knowledge on the current uses of plastic and its necessity can contribute to a better understanding of possible alternative materials, and opportunities for increased circularity, thereby reducing the adverse effects of plastic use on the environment.

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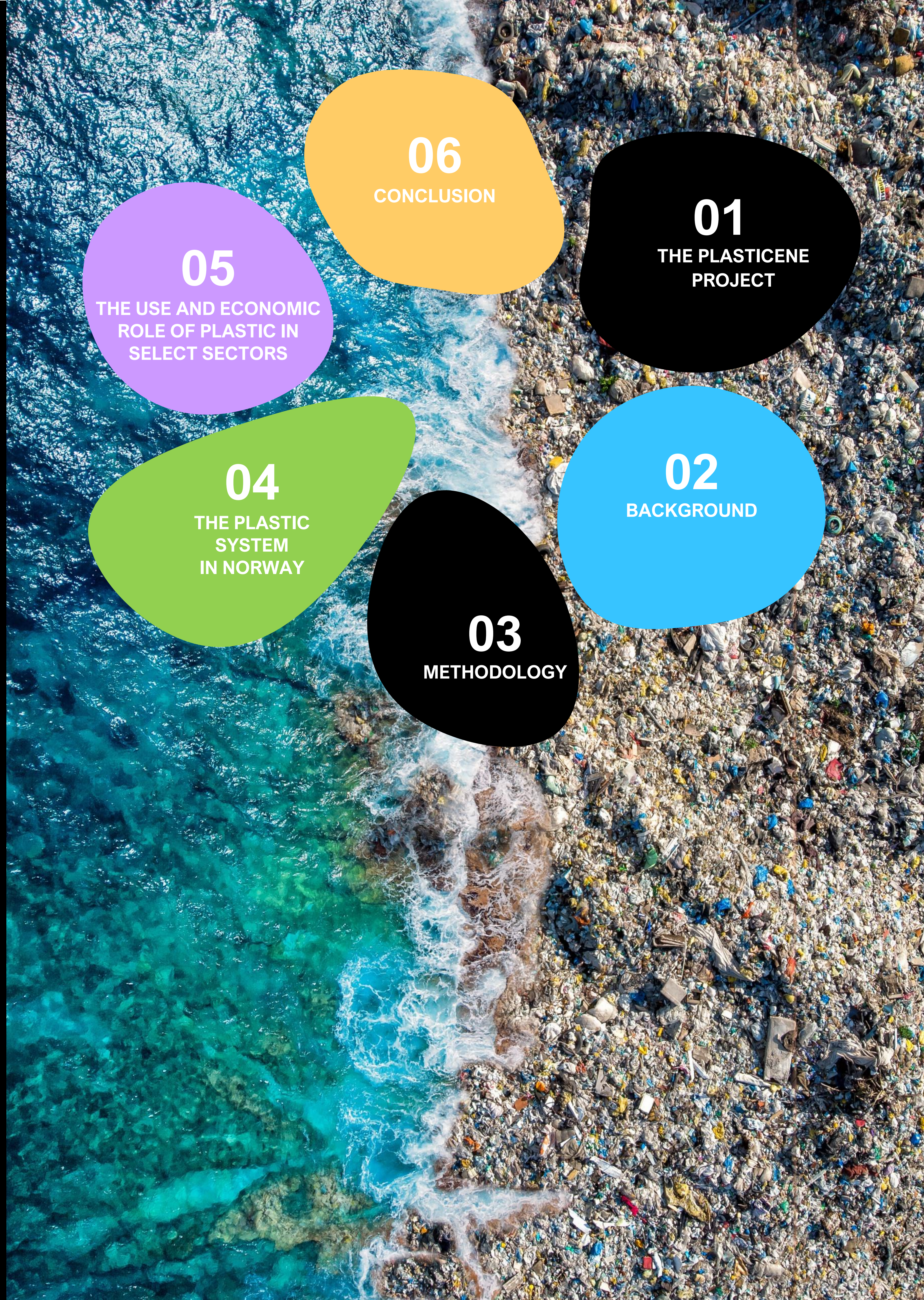

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THE PLASTICENE PROJECT

PLASTICENE is a project funded by the Norwegian Research Council. It consists of four partners – SINTEF (represented by SINTEF Ocean, SINTEF Industry, SINTEF Community and SINTEF Helgeland), Deloitte, WWF Norway, and House of Knowledge – and is coordinated by SINTEF Ocean. The project takes a full life-cycle approach to building new knowledge and addressing important processes for increased plastic circularity and effective plastic waste management, with the aim of supporting improved plastic material utilization and protecting the environment from plastic pollution.

This is critical, as more than 460 million tons of plastic are produced globally every year as of 2019[1]. Plastic waste and emissions of plastic to nature represent significant societal challenges, and increased knowledge of the plastic resource flow is essential. The regulatory landscape for plastics governance in Norway and abroad is fragmented though, and nested within multiple layers of overlapping global, regional, local and industry-focused initiatives aimed at curbing the flow of plastics to the environment and ensuring circularity.

PLASTICENE

The role of humans in the life of plastic

The Research Council of Norway · SINTEF · Deloitte. · WWF · HOUSE OF KNOWLEDGE

[1] OECD. 2023. Global plastic waste set to almost triple by 2060. Available at: https://www.oecd.org/environment/global-plastic-waste-set-to-almost- triple-by-2060.htm

BACKGROUND & METHOLOGY

2. BACKGROUND

Plastic is a versatile and durable group of materials that has a multitude of uses, and that currently plays an important role in all modern economies. The material is noted for its plasticity – from which the name of the material is also derived, i.e., its ability to be shaped and adapted to its desired use. This quality has made plastics ubiquitous and a material that is used in practically all aspects of economic life – with the World Economic Forum referring to it as the "workhorse material of the modern economy", being "virtually unrivalled in terms of great performance at low cost". The adoption and use of plastics has been near exponential – from a total of 2 million tonnes produced in 1950, to 459.75 million tonnes produced in 2019. Production and demand for plastic is closely linked to economic growth, and economic activity – the only two periods of time where global plastic production was reduced was in the aftermath of the 1973 Oil Crisis, and the 2007-2008 financial crisis.

Despite its many advantages, the use of plastics currently also has significant externalities. Plastic pollution has a significant negative impact on the environment and ecosystems, and incineration of plastics at end of life leads to considerable greenhouse gas emissions. The ubiquity of plastics means that plastic pollution can be found from the deepest depths of the ocean all the way up to space - and even in the human body, with some estimates saying humans are consuming approximately 5 grams of plastics every week. These negative externalities are not currently reflected in the relatively low price of virgin plastics.

The purpose of this report is to provide insight into the use and role of plastic in the Norwegian economy, through a detailed look at three economically important sectors with widespread use of plastics – fisheries and aquaculture, construction, and food and beverage. Knowledge on the economic uses of plastic, and economic dependencies on plastic is important to develop strategies for reduction in the use of plastic, to help improve systems for circularity, and to reduce negative externalities from the use of plastics and harm to the environment.

3. METHODOLOGY

The three sectors studied in this report have been selected according to their relative importance in the Norwegian economy, the volume of plastic streams and demand within each respective sector, the relative threat that plastic use in the sector poses to the environment, and the potential for circularity.

To gather data on the use of plastics with the three sectors, 7 interviews have been conducted with industry experts with substantive knowledge on the use of plastics in their respective sectors. Extensive desk research on the use of plastics in the Norwegian economy, and in the selected sectors has also been carried out. An overview of the interviews that have been conducted is provided in Table 1.

Sector	Organization	Interviewee
Fishery and aquaculture	Listed seafood company	Sustainability Advisor
Fishery and aquaculture	Business cluster/Centre of Expertise	Project manager
Construction	Listed construction company	Project manager
Construction	Innovation program, public-private partnership	Specialist advisor
Food and beverage	Organization representing users of plastic packaging/Listed food company	Leader/Executive Vice President for Sustainability and Innovation
Food and beverage	Listed recycling company	Vice President of Public Affairs
Food and beverage	Listed food and beverage company	Director, Product and sustainability

3.1 PLASTIC TYPES AND THE ECONOMIC BENEFITS OF PLASTIC

Plastics are a group of materials, either synthetic or naturally occurring, that can be moulded and shaped when soft, and that when hardened retain their given shape. Plastics are made up of large molecules called polymers, which again consist of identical small particles called monomers that are strung together like a chain.[2] Polymers have a range of characteristics along with properties which can be enhanced by additives.

Natural polymers are derived from renewable resources, such as cellulose from plants or proteins from animals. Examples of natural polymers include silk, wool, and rubber. Synthetic polymers, on the other hand, are made from petrochemicals and have limited biodegradability. Today, synthetic polymers in the form of plastics are in wide use, and its use is increasing. Over half of all plastic that has been produced, has been produced after the year 2000.[3]

Polymers can be divided into two main categories: thermoplastics and thermosets. Thermoplastics can be melted and re-moulded multiple times without losing their properties and are commonly used in food packaging and for medical uses. Thermosets cannot be melted and re-moulded once they have been formed, and are typically used in car parts, electrical components, and construction materials.[4] The properties of polymers and their low cost have made them essential in several industries, especially due to their ability to be easily modified, and engineered for specific applications. Compared to metal components, plastic has a high resistance to chemicals, and are low cost and light weight. However, the end-of-life recycling cost is high and because some forms of polymers are hard to both reuse and recycle, incineration or depositing the plastic at a landfill remain common options.

Because of their prevalence, limited biodegradability, and linear usage, plastic materials are known to cause significant damage to the environment. Plastics are degradable, but with a life span of 200 - 500 years[5] the rate of degradation is slow and cause problems such as microplastic, harm to ecosystems and the release of toxic chemicals.[6]

The raw material that is used for manufacturing plastic products is called a resin and is the main base of all plastic. When utilized, colours and product requirements can be integrated in the resins. There are many different types of resins, each with its own unique properties and applications. For example, epoxy resins are known for their strength and durability, and are commonly used in construction and aerospace industries. Polyester resins are used in the production of fiberglass, while polyurethane resins are used in the manufacture of foam products, such as mattresses and cushions. There are seven main plastic resin types, as shown in Figure 1.

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[2] Khan Academy. Introduction to macromolecules. Available at: https://www.khanacademy.org/science/ap-biology/chemistry-of-life/introduction-to-biological-macromolecules/a/introduction-to-macromolecules

[3] European Environment Agency. 2023. Plastics. Available at: Plastics (https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwjhgZa14c6GAxXCFBAIHW1iGBcQFnoECB4QAQ&url=https%3A%2F%2Fwww.eea.europa.eu%2Fen%2Ftopics%2Fin-depth%2Fplastics&usg=AOvVaw1DHKd4te2wz8jdvJ4WhKKO&opi=89978449.eu)

[4] Elisabette Morici and Nadka Tz. Dintcheva. 2022. Recycling of Thermoset Materials and Thermoset-Based Composites: Challenge and Opportunity. Available at: https://www.mdpi.com/2073-4360/14/19/4153

[5] WWF Australia. 2021. The lifecycle of plastics. Available at: https://wwf.org.au/blogs/the-lifecycle-of-plastics/

[6] Professor Marianne Gilbert. 2014. Plastics Materials. Available at: Plastic Material - an overview | ScienceDirect Topics

Figure 1: Overview of plastic resin types and their uses*

		RESIN TYPE[7]	GLOBAL PRODUCTION[8]	COMMON PRODUCTS OF EACH CATEGORY[9]	COMMON SECTORS[10]
EASIER TO RECYCLE	1 PET	Polyethylene Terephthalate	6.2%	Beverage bottles Food packaging Textiles	Packaging Textiles Consumer goods Food Industry
EASIER TO RECYCLE	2 HDPE	High-density Polyethylene	12.5%	Shampoo bottles Grocery bags Toys Pipe systems	Food industry Agriculture Construction Packaging
DIFFICULT TO RECYCLE	3 PVC	Polyvinyl Chloride	12.9%	Pipes Window frames Flooring Vinyl Wire & cable insulation	Construction Electrical & electronics Transportation Packaging
POSSIBLE TO RECYCLE	4 LDPE	Low-density Polyethylene	14.4%	Soft plastic products Squeeze bottles Plastic film Construction materials	Construction Packaging Agriculture Medical
EASIER TO RECYCLE	5 PP	Polypropylene	19.3%	Packaging Automotive parts Textiles Medical devices	Packaging Automotive Textiles Construction Consumer goods
DIFFICULT TO RECYCLE	6 PS	Polystyrene	5.3%	Packaging Disposable cups and plates Insulation	Packaging Consumer goods Appliances Construction Electronics
DIFFICULT TO RECYCLE	7 OTHER	All other plastics	19.6%	Toys Fibres Fiberglass Acrylic Bioplastics	Packaging Construction Automotive Electrical & electronics Aquaculture
CIRCULAR PLASTICS		Recycled and bio-attributed	9.8%	Packaging Textiles	Packaging Textiles

*Data from 2021

3.2 FLEXI-, MONO- AND BIOPLASTICS

In recent years there has been a growing debate about the use of plastic and the available alternatives to figure out what are the best materials to use going forward. Plastic can be categorised as either flexibles, mono-materials or multi-materials, while bioplastic is defined as either biobased plastics or biodegradable plastics.[11,12]

Biobased plastics are fully or partially derived from biological resources. However, it's important to note that not all biobased plastics are biodegradable or compostable.[13] Biodegradable plastics can biodegrade in certain conditions.[14] Because some bioplastics are neither biodegradable or compostable, and they can be partially made by petroleum, they can also produce microplastics and generate the same environmental problems as regular plastics.[15] Mono-plastics are made from one single type of plastic and as a result are easy to recycle. They do not require any sorting and can effectively be processed and are therefore a popular choice in a range of products. While mono-materials have several environmental and economic benefits downstream, they can be expensive for producers to invest in compared to multi- and flexi-materials. Flexi-materials are widely used in packaging and other applications due to their durability, and therefore represent a large portion of Norwegian plastic waste. Flexi plastics are hard to recycle and most of it is sent for incineration. Multi-materials consist of several types of materials. They are commonly used in a range of applications but are hard to recycle.

4. THE PLASTIC SYSTEM IN NORWAY

A total of 3.1 million tonnes of plastic products are in use in Norway, divided among different sectors of the economy and households.[16,17] The Norwegian economy generates more than 540 000 tonnes of plastic waste each year and only 132 500 tonnes get reused or recycled, which means that a significant amount ends up either in nature or unable to be reused or recycled.[18] To address this problem Norway has developed a net-zero strategy for plastic waste with the main goal being zero plastic waste by 2030. This requires that all plastic waste is either reused, recycled or reduced. To achieve this goal, it is necessary to reduce both usages, and to design for circularity. However, the current plastic system in Norway is mostly linear, relying on virgin fossil-based plastic and incineration at end-of-life. In fact, 78% of the Norwegian plastic system is linear.[19] A contributing factor to Norway being far away from a circular plastic economy, is that the profitability of a circular plastic economy remains challenging compared to the linear status quo. The European Investment Bank estimates that there is an investment gap of €6.7 – 8.6 billion to achieve Europe's recycled content targets by 2025.[20]

In Norway, projections estimate a 57% increase in waste, and a 34% increase in overall plastic demand, which the Norwegian waste management infrastructure is not currently equipped to handle. [2] In order to help reach the goals that have been set, Norway has implemented several regulations and initiatives to reduce plastic waste and promote circular systems. An extended producer responsibility system is implemented for plastic packaging, which holds producers responsible for the collection and recycling of their packaging waste. One example of this is Infinitum, a Deposit Return Scheme for plastic bottles, which encourages consumers to return their used bottles and cans for recycling. Norway also has a strict regulation on waste management that requires businesses to sort and separate their waste and ensure that plastic waste is properly managed and recycled. Norway has a national circular economy strategy that includes measures to reduce plastic waste and increase recycling, while also aiming to change production and consumption patterns.

[7] Ministry of the Environment, New Zealand. 2024. Phasing out hard-to-recycle and single-use plastics. Available at:https://environment.govt.nz/what-government-is-doing/areas-of-work/waste/plastic-phase-out/

[8] https://plasticseurope.org/wp-content/uploads/2022/10/PE-PLASTICS-THE-FACTS_V7-Tue_19-10-1.pdf

[9] Ministry of the Environment, New Zealand. 2024. Phasing out hard-to-recycle and single-use plastics. Available at: https://environment.govt.nz/what-government-is-doing/areas-of-work/waste/plastic-phase-out/

[10] Plastics Europe. 2022. Plastics – the facts. 2022. Available at: PE-PLASTICS-THE-FACTS_V7-Tue_19-10-1.pdf (plasticseurope.org)

[11] European commission. Biobased, biodegradable and compostable plastics. Available at: https://environment.ec.europa.eu/topics/plastics/biobased-biodegradable-and-compostable-plastics_en

[12] [12] Systemiq, Handelens Miljøfond, and Mepex. 2023. Achieving Circularity for Durable Plastics: a low-emissions circular plastic economy in Norway. Available at: https://www.systemiq.earth/reports/downloads/Systemiq_Achieving_Circularity_Synthesis_Report.pdf

[13] European commission. Biobased, biodegradable and compostable plastics. Available at: https://environment.ec.europa.eu/topics/plastics/biobased-biodegradable-and-compostable-plastics_en

[14] European commission. Biobased, biodegradable and compostable plastics. Available at: https://environment.ec.europa.eu/topics/plastics/biobased-biodegradable-and-compostable-plastics_en

[15] European commission. Biobased, biodegradable and compostable plastics. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10032476/

[16] The Norwegian Ministries. 2022. Norwegian Plastics Strategy. Available at:regjeringen.no/contentassets/ccb7238072134e74a23c9eb3d2f4908a/en/pdf/norwegian-plastics-strategy.pdf

[17] Materialstrømmen-til-plast-i-Norge-Hva-vet-vi_-1.pdf (dl8y9d78cbd9m.cloudfront.net)

[18] Handelens Miljøfond, Mepex Consult AS. 2020. Materialstrømmen til plast i Norge – hva vet vi?. Available at: https://dl8y9d78cbd9m.cloudfront.net/reports/Materialstr%C3%B8mmen-til-plast-i-Norge-Hva-vet-vi_-1.pdf

[19] Systemiq, Handelens Miljøfond, and Mepex. 2023. Achieving Circularity for Durable Plastics: a low-emissions circular plastic economy in Norway. Available at: https://www.systemiq.earth/reports/downloads/Systemiq_Achieving_Circularity_Synthesis_Report.pdf

[20] European Investment Bank. 2023. Plastic Pollution: New study finds at least €6.7 billion investment gap to meet Europe's plastics recycling targets. Available at: https://www.eib.org/en/press/all/2023-084-plastic-pollution-new-study-finds-at-least-6-7-billion-investment-gap-to-meet-europe-plastics-recycling-targets

5.0 THE USE AND ECONOMIC ROLE OF PLASTIC IN SELECT SECTORS

In the following chapter, we give a detailed description and analysis of the economic role plastics play in the construction, food and beverage, and fishery and aquaculture sectors. These industries heavily rely on plastics for various purposes, contributing significantly to their operations and output. We also provide a description of the challenges to increased plastic circularity and a reduction in the use of plastics in these sectors.

5.1 CONSTRUCTION

The construction sector in Norway is the largest consumer of plastic, accounting for 32% of the total plastic usage in the country.[21] Plastic is commonly used in construction products such as pipes, window profiles, insulation, roofing, and flooring due to its durability and ease of use.[22] In Europe, the most commonly used plastic types in construction are PVC, PE-HD, PS, PUR, and PP, which together make up over 70% of the total usage.[23] The use of plastic products in the construction industry has been increasing rapidly in recent decades and today plastic is used along the entire value chain. After packaging, construction represents the second largest end use market for plastics in Norway with 171 000 tonnes in 2020.[24] The growing consumption of plastic is driven by advantageous attributes such as affordability, versatility, and functionality. However, these qualities also contribute to the generation of large amounts of plastic waste. An important challenge in the sector is the significant delay between consumption and when the plastic is disposed of. The largest quantity of waste is usually created at the point of demolition of buildings. By 2040, it is projected that the Norwegian construction sector will generate approximately 130,000 tonnes of plastic waste, marking a nearly seven-fold increase compared to the 19,000 tonnes generated in 2020.[25] The construction industry has a large potential to become more circular and reduce its dependency on virgin plastics. Systemiq has estimated that by implementing certain circularity levers, the Norwegian system has the potential to increase its circularity from 13% to 71% by 2040. Additionally, the proportion of virgin plastic can be reduced to 67% by 2040, a significant decrease from the current rate of 82%.[26]

5.2.1 USES OF PLASTIC AND ITS NECESSITY

Plastic has become an integral part of the construction industry due to favorable material properties such as energy efficiency, light weight, tightness, and cost efficiency. The first plastic components were used in buildings in the early 50's and have since become increasingly common. To further improve product properties and enhance suitability of plastic as a raw material, various additives have been used and different types of plastic have been combined to achieve desired properties. As a result, plastic is often more suitable than other materials in the construction industry[27]. In many cases there is a lack of alternative materials that meet certain industry requirements such as durability and strength.[28] According to our interviewees, the use of plastic is necessary in buildings to protect from wind, water, and cold, but also often to meet technical standards regarding hygiene, weight, and fire-safety. Plastic serves a crucial role as a wind and vapor barrier in walls, doors and floors to ensure sufficient tightness in

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[21] Handelens Miljøfond, Mepex Consult AS. 2020. Materialstrømmen til plast i Norge – hva vet vi?. Available at: https://dl8y9d78cbd9m.cloudfront.net/reports/Materialstr%C3%B8mmen-til-plast-i-Norge-Hva-vet-vi_-1.pdf?mtime=20210504114521&focal=none

[22] Handelens Miljøfond, Mepex Consult AS. 2020. Materialstrømmen til plast i Norge – hva vet vi?. Available at: https://www.multiconsult.no/assets/20230106-Plast-i-bygg-hovedrapport.pdf

[23] Plastics Europe. 2021. Plastics - the Facts 2021. Available at: https://plasticseurope.org/wp-content/uploads/2021/12/Plastics-the-Facts-2021-web-final.pdf

[24] Systemiq, Handelens Miljøfond, and Mepex. 2023. Achieving Circularity for Durable Plastics: a low-emissions circular plastic economy in Norway. Available at: https://www.systemiq.earth/reports/downloads/Systemiq_Achieving_Circularity_for_Durable_Plastics.pdf

[25] Systemiq, Handelens Miljøfond, and Mepex. 2023. Achieving Circularity for Durable Plastics: a low-emissions circular plastic economy in Norway. Available at: https://www.systemiq.earth/reports/downloads/Systemiq_Achieving_Circularity_for_Durable_Plastics.pdf

[26] Systemiq, Handelens Miljøfond, and Mepex. 2023. Achieving Circularity for Durable Plastics: a low-emissions circular plastic economy in Norway. Available at: https://www.systemiq.earth/reports/downloads/Systemiq_Achieving_Circularity_for_Durable_Plastics.pdf

[27] Multiconsult, Mepex, Handelens Miljøfond. 2023. Plastgjenvinning i bygg og anlegg i et sirkulært perspektiv. Available at: https://www.multiconsult.no/assets/20230106-Plast-i-bygg-hovedrapport.pdf

[28] European Environmental Agency. 2021. Plastics, the circular economy and Europe's environment — A priority for action. Available at: https://www.eea.europa.eu/publications/plastics-the-circular-economy-and

buildings. It provides effective insulation and saves energy.[29] Here, alternatives such as recycled or bio-based plastic exist, but it is reportedly difficult to find other materials that meet the tightness requirements for such membranes. Further, plastic is sometimes necessary due to hygiene requirements.[30] According to the experts we have interviewed, this makes it difficult to replace plastics in products such as pipes carrying drinking water. Plastic pipes are, according to the industry representatives interviewed, ideal for the safe and hygienic transportation of water, and even recycled plastic does not meet the necessary standards for clean water. In addition, other alternatives, such as copper, are heavier and have the potential to corrode. Plastic is also useful for electrical components as it does not conduct electricity, which is an important fire resistance mechanism.[31] Features such as durability, resistance to corrosion, insulation, hygiene, and fire safety are also highlighted as important attributes of plastic.[32]

Lastly, plastic can sometimes be a better option than other materials in terms of CO_2 emissions due to its light weight and longevity. An example of this is water pipes made of virgin plastic compared to pipes made of iron, where iron has a higher CO_2 footprint. Multiconsult also found that for wind barriers, the alternative plastic has higher emissions compared to the plastic alternative. This is not always the case, however. For certain product groups such as roofing, insulation and floor coverings, pure plastic variants have the highest CO_2 emissions. For sewer pipes, the alternative of concrete has lower CO_2 emissions compared to the plastic alternative in pure PVC.[33] This supports the expert interview findings, saying that substituting plastic is not always the best alternative in terms of CO_2 footprint, but that this needs to be determined and calculated for every single component.

5.2.2 NEGATIVE EXTERNALITIES FROM PLASTIC USE

Steel and concrete are the materials that contribute to the largest part of emissions in the construction industry, however, products made of plastic also have significant emissions. In total, almost 10 % of GHG emissions from the use of materials in buildings come from plastic, however, GHG emissions generally occur only when the plastic is burned.[34] According to the expert interviews, an important problem in the construction industry is that plastic often is mixed with other materials such as concrete and iron, which makes it very hard or impossible to recycle. Additionally, as also highlighted by other studies, additives and substances of concern are also often part of the mix of materials.[35] As a result, there are no alternatives left other than incineration, due to lack of methods of how to recycle such compositions of materials. It is argued by Systemiq that it is time consuming and costly to manually pick out plastic fractions, and that this is often not possible to automate.[36] According to the interviews conducted, a recurring issue is the redundant use of plastic. Plastic is frequently chosen due to its affordability, even when it may not serve a technical purpose. Another problem highlighted in the expert interviews, is the lack of and inefficiencies in today's sorting systems. Systemiq also points out that the current waste-management system is not prepared for the plastic waste that is currently locked-in in buildings, and continuously accumulating. This could result in a large amount of plastic being disposed or incinerated in the future which again could lead to considerable GHG emissions.[37]

5.2.3 POTENTIAL FOR REDUCTION

Although plastic is an important material for the construction industry, there are also areas with a large potential for reducing plastic or switching to alternative materials. Systemiq shows that certain reuse and reduction opportunities can eliminate around 11% of plastic demand by 2040.[38] According to the expert interviews, the early phase of a project involves making critical decisions, including important design parameters. To ensure reduction of plastic usage in a project, it is crucial to establish designs that avoid plastic-intensive choices. In line with this, the European Environmental Agency highlights the need to design plastic products in a way that allows them to be recycled in the future.[39] Systemiq also suggests using innovative building design to find reuse and reduction opportunities.[40] The expert interviews shed further light on the significant amount of plastic that is utilized for packaging purposes, primarily to safeguard components. Although the specific numbers are uncertain, Multiconsult confirms that the construction industry annually produce large amounts of plastic waste generated during construction, rehabilitation and demolition work, often in the form of cut-offs, product scraps or packaging for building materials.[41] In the interviews, it was highlighted that packaging has a high potential for reduction, but at the same time it is difficult for suppliers to take on responsibility if parts break during transport. Another suggested enabler for plastic reduction according to the interviewees is the use of automation. This means that plastic parts are cut and adapted in a factory, rather than at the building site, which can reduce plastic consumption in various ways. For instance, there is a greater level of precision resulting in less waste as well as removing the need for using plastic foam and membranes to seal. The use of automation can also reduce the amount of microplastics at the construction sites as parts are not cut outside. The topic of reducing the use of plastic is, however, still relatively immature in the construction industry.

5.2.4 BARRIERS AND SOLUTIONS FOR INCREASED CIRCULARITY AND REDUCTION IN USE OF PLASTICS

A significant barrier but also important solution for improved circularity lies downstream in the waste management of the construction industry. According to the expert interviews, sorting and recycling are to a very little degree regulated and requirements for sorting are today not met by accumulating residual waste. In addition, different practices exist where some municipalities have good sorting practices, while there are many, especially small municipalities, with deviating practices. Hence, there could be a need for a national and commonly accepted sorting system that is led by the authorities rather than individual municipalities. According to Systemiq, it is possible to achieve a circularity level of 71% by 2040 by primarily focusing on on-site sorting to achieve a clean material stream. This increases the likelihood of material recovery in downstream sorting and recycling stages. Furthermore, it is crucial to scale up the sorting and recycling infrastructure in both Norway and the wider region to handle the higher volumes of sorted waste and to keep up with the rapid growth in plastic waste.[42]

A good waste system is highly intertwined with setting the right requirements and incentives to promote the reduction of plastic. There is a clear potential for improvements to the system, and especially as regards sorting, recycling and collection. At the same time, there is a need for incentives to be in place for the industry to reduce the consumption of virgin plastic. Further, we find that technical standards and requirements could act as a barrier to the use of alternative materials. A possible solution to this could be a revision of the standards, where

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[29] P.G.C. Nayanathara Thathsarani Pilapitiya, Amila Sandaruwan Ratnayake. 2024. The world of plastic waste: A review. Available at: https://www.sciencedirect.com/science/article/pii/S2772397624000042

[30] Plastics Europe. Building and construction. Available at: https://plasticseurope.org/sustainability/sustainable-use/sustainable-building-construction/

[31] P.G.C. Nayanathara Thathsarani Pilapitiya, Amila Sandaruwan Ratnayake. 2024. The world of plastic waste: A review. Available at: https://www.sciencedirect.com/science/article/pii/S2772397624000042

[32] P.G.C. Nayanathara Thathsarani Pilapitiya, Amila Sandaruwan Ratnayake. 2024. The world of plastic waste: A review. Available at: https://www.sciencedirect.com/science/article/pii/S2772397624000042

[33] Multiconsult, Mepex, Handelens Miljøfond. 2023. Plastgjenvinning i bygg og anlegg i et sirkulært perspektiv. Available at: https://www.multiconsult.no/assets/20230106-Plast-i-bygg-hovedrapport.pdf

[34] FutureBuilt. Fossilfrie løsninger for plast I bygg. 2023. Available at: https://www.futurebuilt.no/Nyheter#!/Nyheter/Fossilfrie-loesninger-for-plast-i-bygg

[35] Systemiq, Handelens Miljøfond, and Mepex. 2023. Achieving Circularity for Durable Plastics: a low-emissions circular plastic economy in Norway. Available at: https://www.systemiq.earth/reports/downloads/Systemiq_Achieving_Circularity_for_Durable_Plastics.pdf

[36] Multiconsult, Mepex, Handelens Miljøfond. 2023. Plastgjenvinning i bygg og anlegg i et sirkulært perspektiv. Available at: https://www.multiconsult.no/assets/20230106-Plast-i-bygg-hovedrapport.pdf

[37] Systemiq, Handelens Miljøfond, and Mepex. 2023. Achieving Circularity for Durable Plastics: a low-emissions circular plastic economy in Norway. Available at: https://www.systemiq.earth/reports/downloads/Systemiq_Achieving_Circularity_for_Durable_Plastics.pdf

[38] Systemiq, Handelens Miljøfond, and Mepex. 2023. Achieving Circularity for Durable Plastics: a low-emissions circular plastic economy in Norway. Available at: https://www.systemiq.earth/reports/downloads/Systemiq_Achieving_Circularity_for_Durable_Plastics.pdf

[39] European Environmental Agency. 2021. Plastics, the circular economy and Europe's environment — A priority for action. Available at: https://www.eea.europa.eu/about-us/publications/plastics-the-circular-economy-and/

[40] Systemiq, Handelens Miljøfond, and Mepex. 2023. Achieving Circularity for Durable Plastics: a low-emissions circular plastic economy in Norway. Available at: https://www.systemiq.earth/reports/downloads/Systemiq_Achieving_Circularity_for_Durable_Plastics.pdf

[41] Multiconsult, Mepex, Handelens Miljøfond. 2023. Plastgjenvinning i bygg og anlegg i et sirkulært perspektiv. Available at: https://www.multiconsult.no/assets/20230106-Plast-i-bygg-hovedrapport.pdf

[42] Systemiq, Handelens Miljøfond, and Mepex. 2023. Achieving Circularity for Durable Plastics: a low-emissions circular plastic economy in Norway. Available at: https://www.systemiq.earth/reports/downloads/Systemiq_Achieving_Circularity_for_Durable_Plastics.pdf

possible, and to open up for the use of alternative materials. Another important solution highlighted by the expert interviews was enhancing the knowledge of plastic in the industry. It was emphasized that although the use of plastic is widespread in the industry, there is more limited knowledge on how to avoid, reduce and recycle the material. The consequences and widespread use of plastics are also an immature topic in the industry and mapping and understanding where plastic is used is an important starting point. This can also further be used to explore new opportunities and circular strategies.

The urgency for change in the construction industry is underscored by the immense amount of waste facing the Norwegian society in the next decade. The use of plastic needs to be reduced in the construction industry, and preferably be limited to instances where plastic is absolutely necessary.

5.3 FOOD AND BEVERAGES

The food and beverage industry are an extensive user of plastics. Plastic is a popular choice for packaging of food and beverages due to its versatility, durability, and affordability. Yet, food packaging is usually single use and amounts to around 80% of household waste (in volume) [43] In Norway plastic packaging accounted for 242 kt of the plastic demand in 2021.[44]

5.3.1 USES OF PLASTIC AND ITS NECESSITY

Plastics currently play an important role in the Norwegian food and beverage sector. It is a versatile material that can be easily adapted, and the use of plastic serves multiple purposes, while also meeting consumer desires and needs. As a result, plastics provide a wide range of products such as bottles, containers, bags, and wraps that help to ensure the protection, quality, durability, extended shelf life and prevent food waste, while also providing branding and marketing opportunities for companies. The size and packaging type can also vary due to the properties of the food, such as water activity[45], the amount of oxygen and interactions with the external environment. With plastic meeting several requirements from the beverage and food sector, it is a material that is hard to replace for both the sector and its consumers.

Global food waste is a vastly overlooked problem and one-third of all food produced for human consumption is lost or wasted annually, which amounts to 1.3 billion tons per year.[46] In industrialized countries such as Norway, 40% of food waste happens at retail and consumer levels.[47] Packaging plays a crucial role in extending the expiration date of many food items. One of the interviewees notes that plastic packaging keeps fruits and vegetables fresh and appealing for a longer period, thereby reducing food waste. There are alternatives to plastic, such as cellulose and paper, but interviewees argue that these don't deliver the same results as plastics when it comes to extending the shelf life of food products.

In Norway, specific requirements and challenges, such as longer transportation distances, influence the use of plastic packaging. For instance, plastic wrapping around cucumbers can extend their shelf life by an additional two weeks.[48] The stated goal for plastic use in the food and beverage sector is to use as little plastic as possible, while still using enough to meet the necessary requirements. Fruits and vegetables typically quickly dry out without protective packaging and end up being discarded. Therefore, the industry experts we have interviewed note the need to find a balance that allows these products to stay fresh for as long as desired and to remain appealing for consumers to purchase. One of the interviewees noted that they had opted to change the product packaging to not contain plastic, but that this affected the quality of the food product too much compared to plastic. Avoiding food waste is also economically important to retailers, seeing as the spoilage of food before it is sold represents an economic loss. Another factor that makes plastic important in the food and beverage sector is the demand for mitigating emissions along the value chain.[49]

Global food waste is a vastly overlooked problem and one-third of all food produced for human consumption is lost or wasted annually, which amounts to 1.3 billion tons per year. In industrialized countries such as Norway, 40% of food waste happens at retail and consumer levels. Packaging plays a crucial role in extending the expiration date of many food items.

[43] Kaspara Stoltze, Benjamin Dyrdal (NrK). 2022. Plastmarerittet. Available at: https://www.nrk.no/klima/xl/derfor-er-maten-pakket-i-plast-1.15939017
[44] Systemiq, Handelens Miljøfond, and Mepex. 2023. Achieving Circularity – Synthesis Report – a low-emissions circular plastic economy in Norway. Available at: https://www.systemiq.earth/reports/downloads/Systemiq_Achieving_Circularity_Synthesis_Report.pdf
[45] Water activity in food is the measure of the amount of water vapor present in a substance or material. A higher water activity level typically means a higher likelihood of microbial growth and degradation, while a lower water activity level helps preserve the quality and shelf life of products.
[46] WFP. 2020. 5 facts about food waste and hunger. Available at: https://www.wfp.org/stories/5-facts-about-food-waste-and-hunger
[47] WFP. 2020. 5 facts about food waste and hunger. Available at:https://www.wfp.org/stories/5-facts-about-food-waste-and-hunger
[48] Meny. 2018. Derfor fjerner vi ikke all plast rundt frukt og grønt. Available at: https://meny.no/barekraft/miljo-matsvinn/derfor-fjerner-vi-ikke-all-plast-rundt-frukt-og-gront/
[49] McKinsey. Climate impact of plastics. Available at: https://www.mckinsey.com/industries/chemicals/our-insights/climate-impact-of-plastics?cid=app

Plastic is lightweight and flexible, which reduces emissions during transportation, compared to the use of other, heavier materials.[50] One of the interviewees points out that stretch film or plastic is also used around products during transportation to provide customizable protection.

If the beverage and food packaging sector were unable to use virgin plastics, this could potentially lead to negative consequences in the short term. Plastic substitutes could potentially result in increased water usage, emissions, and food waste. Halting the use of virgin plastics would also require that we can recycle and reuse all existing products with existing infrastructure, both industrial and consumer products. The transition from plastic to other materials takes time, as it is currently challenging to find an alternative that is both sufficiently effective and has lower CO_2 emissions. The benefit of a halt in the use of virgin plastics would be that all unnecessary plastic use would be eliminated, which would create a market where only necessary plastic in the beverage and food sector is in use.

5.3.2 NEGATIVE EXTERNALITIES FROM PLASTIC USE

Beverage and food packaging is primarily designed for single use, resulting in a short lifespan and generates significant amounts of plastic waste. Due to the lack of controlled disposal of plastic waste, food and beverages often end up as litter in nature. Mismanagement of this waste leads to CO_2 emissions through incineration, waste being deposited at landfills, and subsequent leakage the surrounding land and waterways.[51,52] In Norway, 72% of all plastic is sent for incineration and only 28% is recycled. [53] While waste-to-energy may reduce the amount of plastic in landfills and produce electricity and heat, it represents a linear economy and contributes to 4% of Norway's emissions. [54] This approach creates a dead end for materials that could have been recycled and reused, while increasing the demand for virgin materials.

Plastic packaging also increases the risk of contamination of food and beverage products with microplastics, which consumers end up consuming.[55] The effects of direct microplastic consumption are still unclear, but studies have found inflammatory, immune, and metabolic disorders in other species such as fish and mice. [56] These effects serve as an early warning of possible human health risks, particularly as the use of plastic packaging continues to increase.

Because plastic today is relatively cheap, it is also used in products for marketing purposes or strategically used to differentiate similar products. This creates consumer- and market preferences for plastic use, which generates a large demand for single use plastic in the beverage and food sector. If plastic were only used where absolutely necessary, there would be a decline in overall plastic packaging demand.[57]

5.3.3 POTENTIAL FOR REDUCTION

Efforts are underway to find alternatives to plastic, but identifying materials that are both effective and have a lower carbon footprint remains a challenge. Balancing the reduction of plastic usage with the requirements for product quality, safety, and shelf life presents a complex task. It is possible to mix different materials to create a product with less plastic, but it is important to consider the potential consequences of shifting pollution to other streams when using alternative materials. Mixing different materials can create new problems, such as difficulties in separating them during the recycling process and can contribute to a less efficient recycling process. Additionally, mixing materials can also result in lower-quality recycled products due to contaminants that are difficult to remove during the recycling process.[58]

Currently, 30% of all food packaging and 70% of beverage bottles are made from PET.[59] When it comes to recycled plastic in food products, only rPET is approved for food contact and considered safe.[60] This has led to an increased demand for rPET and there are few systems that ensure high quality recycled content other than the DRS system from Infinitum where they have reached a 98% recycling rate[61]. The rPET from systems such as Infinitum is under a high demand from the food and beverage sector, as the Norwegian recycling system only ensures that 28% of all plastic packaging gets recycled[62]. Therefore, there needs to be an increased demand for recycled plastic from other productions, which requires a better waste management to ensure a higher collection rate of plastic packaging. The food and beverage sectors today are currently designing for recycling, but the downstream process could be hindering a change towards increased circularity.

The ongoing search for the optimal packaging solution needs to consider factors such as emissions throughout the life cycle and ensuring food safety. The industry is actively engaged in developing recyclable products while addressing these considerations. Currently, the food and beverage sectors present plastic as the most viable solution available. Although plastic packaging represents a small portion of a product's overall footprint, it plays a crucial role in ensuring food safety and enabling lightweight design, which helps reduce emissions from transportation. There is a significant industry-wide effort to design packaging for recyclability, often using mono-materials. However, it is important to note that mono-materials can be more costly, underscoring the need for effective recycling to justify the investment. Businesses are not willing to lose their competitive edge because their packaging becomes more expensive than consumers are willing to pay, even though they want to invest in sustainable solutions.

5.3.4 BARRIERS AND SOLUTIONS FOR INCREASED CIRCULARITY AND REDUCTION IN USE OF PLASTICS

One of the interviewees representing the food and beverage industry noted that the industry wishes to shift its focus from solely reducing the use of plastic in packaging towards reducing the demand for virgin plastic. This interviewee requested increased attention from municipalities on increasing plastic recycling rates, thereby supplying more recycled plastic to the market.

Guidelines for businesses on how to design circular packaging can also encourage the industry to invest in mono-materials and increase their utilization of recycled materials. This approach promotes a circular economy by reducing the reliance on virgin plastic and maximizing the use of recycled materials, ultimately contributing to a circular packaging industry. Designing plastic packaging for circularity includes other requirements, such as reducing the amount of additives used in plastic production, using standard colors and eliminating the use of unnecessary plastics. Black plastic packaging is an example of a design that is not circular because when it is recycled it will impact the color of the recycled plastic, especially the plastic packaging that was previously transparent. This reduces the value of recycled plastic and reduces demand for it from industry.[63] Implementing design requirements could enable the industry to increase their recycling rate and get high quality recycled plastic back to the industry. An example of this is Infinitum, which operates with strict requirements for their

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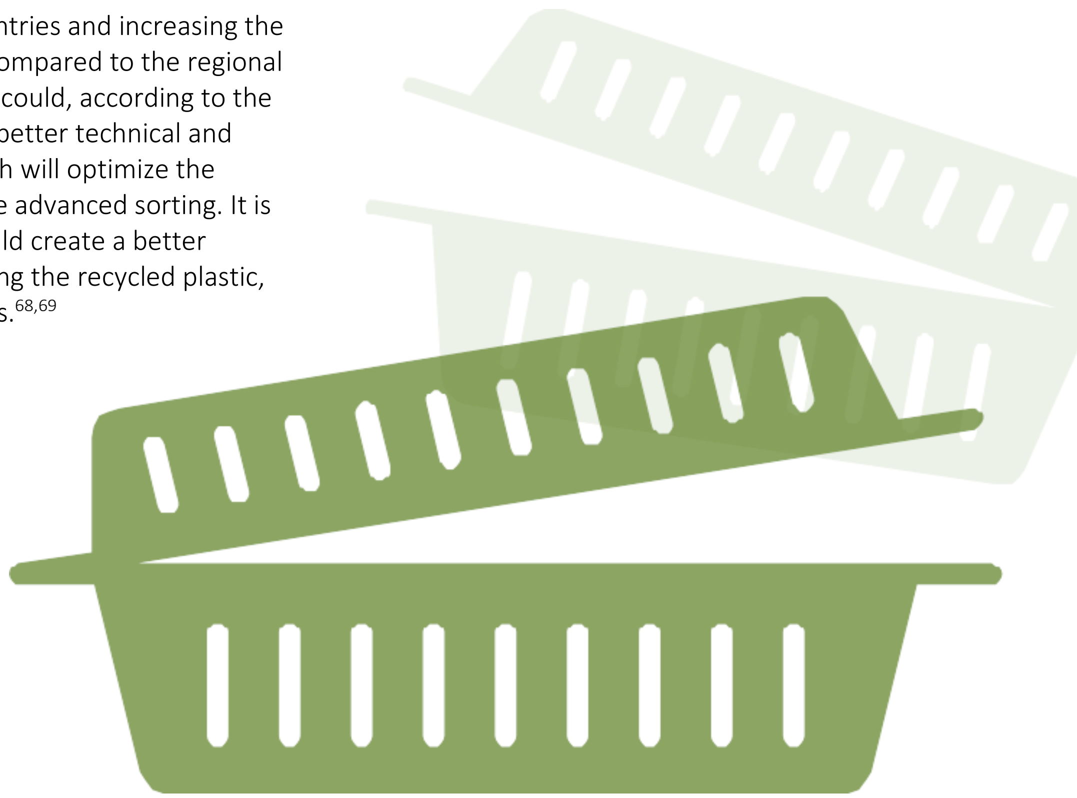
[50] McKinsey. Climate impact of plastics. Available at: https://www.mckinsey.com/industries/chemicals/our-insights/climate-impact-of-plastics?cid=app
[51] SSB. Plastic account for Norway. Preliminary methodological approach and use of data sources. Available at: https://www.ssb.no/natur-og-miljo/miljoregnskap/artikler/plastic-account-for-norway/_/attachment/inline/2b28faca-7256-4a69-9ec2-5f1931cc5116:9cdd713530df7f235581a13c9161afefe1c7eb4a/NOT2023-35.pdf
[52] Systemiq, Handelens Miljøfond, and Mepex. 2021. Achieving Circularity: A Zero-Waste Circular Plastic Economy In Norway. Available at: https://www.systemiq.earth/wp-content/uploads/2021/06/AchievingCircularity-MainReport-June2021.pdf
[53] Systemiq, Handelens Miljøfond, and Mepex. 2021. Achieving Circularity: A Zero-Waste Circular Plastic Economy In Norway. Available at: https://www.systemiq.earth/wp-content/uploads/2021/06/AchievingCircularity-MainReport-June2021.pdf
[54] Systemiq, Handelens Miljøfond, and Mepex. 2021. Achieving Circularity: A Zero-Waste Circular Plastic Economy In Norway. Available at: https://www.systemiq.earth/wp-content/uploads/2021/06/AchievingCircularity-MainReport-June2021.pdf
[55] Ekta Jadhay, Mahipal Signh Sankhla, Rouf Ahmad Bhat, D.S Bhagat. 2021. Microplastics from food packaging: An overview of human consumption, health threats, and alternative solutions. Available at: https://www.sciencedirect.com/science/article/abs/pii/S2215153221001835
[56] Ekta Jadhay, Mahipal Signh Sankhla, Rouf Ahmad Bhat, D.S Bhagat. 2021. Microplastics from food packaging: An overview of human consumption, health threats, and alternative solutions. Available at: https://www.sciencedirect.com/science/article/abs/pii/S2215153221001835
[57] Ellen MacArthur Foundation. Plastics and the circular economy – deep dive. Available at: Plastics and the circular economy (ellenmacarthurfoundation.org)
[58] A.E. Schwarz, T.N. Ligthart, D. Godoi Bizarro, P. De Wild, B. Vreugdenhil, T. van Harmelen. 2021. Plastic recycling in a circular economy; determining environmental performance through an LCA matrix model approach, Waste Management. Available at: Plastic recycling in a circular economy; determining environmental performance through an LCA matrix model approach - ScienceDirect
[59] Grønt Punkt. 2022. Kampen om rPet. Available at: https://www.grontpunkt.no/aktuelt/nyheter/kampen-om-rpet
[60] Grønt Punkt. 2022. Kampen om rPet. Available at: https://www.grontpunkt.no/aktuelt/nyheter/kampen-om-rpet
[61] Infinitum. Årsrapport 2022. Available at: infinitum_a-rsrapport_2022_web-6.pdf
[62] Avfall Norge. Plastavfall. Available at: Plastavfall - Avfall Norge
[63] The Consumer Goods Forum. 2022. The Golden Design Rules. Available at: https://www.theconsumergoodsforum.com/wp-content/uploads/2022/03/CGF-PWCoA_Golden-Design-Rules-Fact-Pack-v2-feb23-1.pdf.

members.[64] This is an example of fee modulation which can be used as a measurement to incentivize circular design requirements and the use of recycled plastic.[65] An improved waste management could be funded by fee modulations, such as a primary plastic fee.[66]

One interviewee noted that a potential solution to increase the volume of recycled plastic in Norway involves establishing a specialized facility that can handle a larger amount of plastic waste, rather than assigning each municipality the responsibility of managing its own waste. While a residual waste facility can handle 4-5 plastic fractions, a larger facility with a capacity of 100,000 tons can sort up to 10-15 different fractions due to the increased volume. This enables the facility to provide a consistent quality and high volume of recycled plastics, which can be returned to the industry as mono materials. However, achieving both high volume and quality requires significant investments. An analysis by Mepex indicates that a national facility for sorting, washing and recycling plastic waste will increase the recycling capacity in Norway. Several benefits are indicated, such as reducing the amount of plastic waste that is exported to European countries and increasing the national recycling rate.[67] Compared to the regional solution, a national facility could, according to the analysis by Mepex, create better technical and economic conditions, which will optimize the operation and enable more advanced sorting. It is also indicated that this could create a better market position when selling the recycled plastic, compared to small facilities.[68,69]



[64] Infinitum. 2023. Material and packaging specifications for beverage containers in the Infinitum deposit return system. Available at: infinitum.no/media/3xclnl2q/20230401-infinitum-material-specs-ver12-2.pdf
[65] Systemiq. 2024. Plastic treaty futures. Available at: https://www.systemiq.earth/reports/downloads/Systemiq-Plastic_Treaty_Futures_EN.pdf
[66] Systemiq. 2024. Plastic treaty futures. Available at: Systemiq-Plastic_Treaty_Futures_EN
[67] Handelens Miljøfond, Mepex, Norner. 2021. Available at: https://dl8y9d78cbd9m.cloudfront.net/reports/Tiltaksrapport-endelig-versjon.pdf
[68] Handelens Miljøfond, Mepex, Norner. 2021. Available at: https://dl8y9d78cbd9m.cloudfront.net/reports/Tiltaksrapport-endelig-versjon.pdf
[69] Systemiq. 2024. Plastic treaty futures. Available at: Systemiq-Plastic_Treaty_Futures_EN

5.4 FISHERIES AND AQUACULTURE

Fisheries and aquaculture are a highly important sector in the Norwegian economy, while also having a large impact globally, owing to its high export intensity. The seafood industry is one of Norway's largest export industries, with the value of exports from the sector amounting to 147 bn NOK in 2022.[70] The sector is growing and has been pointed to as one of the solutions to meeting the growing demand for food from a growing world population[71]. While economically important, the sector also operates in vulnerable areas along the coast, as well as at sea, where the consequences of plastic pollution are heightened. Weather in these localities also contributes to a relatively heightened risk of plastic spillage. Additionally, plastics are used extensively in the sector. It is estimated that approximately 46 % of marine plastic pollution in Norway originates from fisheries and aquaculture[72]

5.4.1 USES OF PLASTIC AND ITS NECESSITY

Plastics are used throughout the seafood value chain, from ocean to fork. Systemiq has estimated that 115 kgs of plastic are used per ton of fish produced in the Norwegian aquaculture and fishery sector.[73]This estimate is for the production phase, with additional use of plastic further downstream. In aquaculture, plastics are used in all aspects of the fish farm itself, including the flotation ring, walkway, nets, as well as feeding tubes and anchoring. [74] According to an insight report by the Business cluster NCE Seafood Innovation, "plastic feature many characteristics that make it an extremely competitive material. Therefore, the aquaculture industry is highly dependent on this resource and uses large volumes of it ".[75] According to NCE Seafood Innovation, approximately 192 000 tonnes of plastics are in use in Norwegian fish farms, with walkways making up the largest volume of the plastic used in Norwegian sea farms. The lifespan of plastic products used in aquaculture is relatively long, with an average lifespan of 10 years. Interviewees point out that the use of plastic in the aquaculture is considerable, and that the industry uses a mix of more "durable" plastics, as well as plastics with a shorter lifespan. The polymers commonly used in fish farms include PET, HDPE, PS and PV.[76] Likewise, plastics are used widely in fisheries, albeit to a lesser degree than in aquaculture, with an estimated 9 tonnes of plastic being used in fish tools per ton fish produced. Uses include in nets, ropes and other gear.[77] Additionally, the fishing vessels themselves can be constructed from composites. The use of composites for shipbuilding has increased in recent years, with glass and fiber composites making the vessels lighter and therefore allowing a reduction in fuel use, subsequently reducing CO_2-emissions, and making the vessels cheaper to operate.[78]

After the production phase, fish produced from aquaculture and fisheries are typically packaged and transported in boxes made primarily out of polystyrene (PS). These polystyrene boxes provide insulation that helps to keep the fish chilled, thereby avoiding spoilage. Polystyrene is lightweight and contributes to reducing transportation costs and emissions from transport. A large proportion of seafood is transported to overseas markets by air freight, making the use of lightweight materials economically and environmentally important. Finally, after processing, fillets and other processed products are packaged in plastic materials. Interviewees note that there are strict legal requirements on these types of "food contacting" materials, and that plastics are used both because of their excellent antibacterial properties as well as due to regulatory requirements.

Interviewees generally note that plastics are a prerequisite and necessity for the operation of fish farms, and that fish farming would not be operationally possible to today's scale without the use of plastic. This is, according to the interviewees, due to a lack of viable alternative materials, and because of the unique and specific properties of plastics. Specifically, operations in harsh weather conditions, and at sea makes plastics a necessity. Interviewees note that plastics are durable and strong, and that they can withstand sea, salt and movement in the sea, and that plastics are lightweight. These are all important qualities for the operation of sea farms. Interviewees also note that operators of sea farms need to consider the risk of escape and "biological pollution" from sea farms when choosing materials, and that this complicates the use of alternative materials.

5.4.2 NEGATIVE EXTERNALITIES FROM PLASTIC USE

About half of marine plastic pollution in Norway originates from fishery and aquaculture. A report from the Alfred Wegener Institute commissioned by the WWF notes that: "once plastic is in the ocean it's almost impossible to remove it. Moreover, once it has entered the ocean, it continues to break down: macroplastics become microplastics, and microplastics become nanoplastics, making recovery even more unlikely"[79]. The same report notes, unequivocally, that plastic pollution harms marine life and ecosystems. The sector operates in what are often vulnerable areas along the Norwegian coast, as well as at sea. This increases the consequences if pollution should occur. Because operations are sea-based, microplastics could be produced even from plastic components that are not lost, as well as chemical leakage. Harsh weather conditions in the areas of operation also presents unique challenges, with a heightened risk of tearing. As with all other use of plastic, incineration at end-of-life results in the emission of greenhouse gases as well. The Norwegian fishery and aquaculture industry also has a global impact, and there have been cases of polystyrene boxes used for the transportation of Norwegian seafood piling up on beaches as far flung as Thailand, despite polystyrene being 100 % recyclable.[80] The export of these products to countries with immature recycling systems thus prevents a further challenge for the sector.

Interviewees note that they have employed a range of measures and routines to prevent plastic pollution. These include training staff on the correct handling of plastic equipment, as well as increasing awareness of the risk of plastic pollution among staff. The company that one interviewee represents also employs labelling of plastic equipment in order to ensure traceability if plastic pollution should occur, as well as cleanup campaigns in the areas surrounding each farm. Interviewees also noted that they use high-quality equipment to reduce the risk of plastic pollution.

5.3.3 POTENTIAL FOR REDUCTION

Systemiq estimates a potential for a 48 % reduction in new plastic *demand* from the fisheries and aquaculture sector by 2040. Systemiq meanwhile estimates a potential 8 % reduction in the *use* of plastic in the sector.[81] This discrepancy is made up for with an estimated increase in the use of recycled plastics. Interviewees see the potential for reduction of usage of plastics as being limited, owing to the specific properties of plastic, and what they see as a lack of viable alternative materials.

Reuse of plastics is generally seen by the sector as the most viable alternative, rather than a reduction in the use of plastics, owing to the previously mentioned qualities and attributes. Interviewees note that they are working towards a "closed loop" system in the aquaculture sector, aiming for a large reduction in the demand for virgin plastics. Several projects are underway to increase circularity, with recycled plastics currently being used widely in a wide

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[70] Menon Economics. 2023. Eksportmeldingen 2023. Available at: https://www.nho.no/contentassets/b7945dd871a14d639946bc1a5d929f35/menon-eksportmeldingen-2023-med-fylkesvedlegg.pdf

[71] Norwegian Ministry of Trade, Industry and Fisheries. 2019. Blue Opportunities. The Norwegian Government's updated ocean strategy Available at: https://www.regjeringen.no/globalassets/departementene/nfd/dokumenter/strategier/w-0026-e-blue-opportunities_uu.pdf

[72] Mepex. 2020. A deep dive into our plastic ocean. Available at: https://mepex.no/en/prosjekter/deep-dive-into-the-plastic-sea/

[73] Systemiq, Handelens Miljøfond and Mepex. 2023. Veien til sirkulær plast. Plast med lang levetid, chapter 2. Figure 24. Available at: https://www.systemiq.earth/reports/veien-til-sirkulaer-plast/plast-med-lang-levetid/kapittel-2/fiskeri-og-akvakultur/

[74] NCE Seafood Innovation. 2023. Industry insight report: The future of plastics in the Norwegian aquaculture industry. Available at: https://seafoodinnovation.no/wp-content/uploads/2023/10/FINAL_2023-10-16_The-future-of-plastics-in-the-Norwegian-aquaculture-industry.pdf

[75] NCE Seafood Innovation. 2023. Industry insight report: The future of plastics in the Norwegian aquaculture industry. Page 18. Available at: https://seafoodinnovation.no/wp-content/uploads/2023/10/FINAL_2023-10-16_The-future-of-plastics-in-the-Norwegian-aquaculture-industry.pdf

[76] NCE Seafood Innovation. 2023. Industry insight report: The future of plastics in the Norwegian aquaculture industry. Available from: https://seafoodinnovation.no/wp-content/uploads/2023/10/FINAL_2023-10-16_The-future-of-plastics-in-the-Norwegian-aquaculture-industry.pdf

[77] Systemiq, Handelens Miljøfond and Mepex. 2023. Veien til sirkulær plast. Plast med lang levetid, chapter 2. Available from: https://www.systemiq.earth/reports/veien-til-sirkulaer-plast/plast-med-lang-levetid/kapittel-2/fiskeri-og-akvakultur/

[78] DNV. 2020. From composite evolution to vessel construction revolution. Available from: https://www.dnv.com/expert-story/maritime-impact/From-composite-evolution-to-vessel-construction-revolution/

[79] Tekman, M. B. , Walther, B. A. , Peter, C. , Gutow, L. and Bergmann, M. 2022. Impacts of plastic pollution in the oceans on marine species, biodiversity and ecosystems. Page 5. Available from: https://media.wwf.no/assets/attachments/WWF-Impacts-of-Plastic-Pollution-on-Biodiveristy.pdf

[80] NRK. 2024. Laksemballasje på asiatiske strender til sjenanse for regjeringa. Available from: https://www.nrk.no/vestland/lakseemballasje-pa-asiatiske-strender-til-sjenanse-for-regjeringa-1.16859177

[81] Systemiq, Handelens Miljøfond and Mepex. 2023. Veien til sirkulær plast. Plast med lang levetid, chapter 2. Available from: https://www.systemiq.earth/reports/veien-til-sirkulaer-plast/plast-med-lang-levetid/kapittel-2/fiskeri-og-akvakultur/

variety of components for sea farms. Projects are also looking at the reuse of the polystyrene boxes used for transport of fish. Interviewees note, however, that food contacting materials presents have regulatory requirements that makes the use of recycled plastics difficult.

Interviewees also note that the most important tool to reduce the demand for new plastic is to expand the durability and longevity of plastic equipment used. Interviewees point out that they are looking at using more expensive, specialized plastic products that reduce the risk of tearing, and that have a longer lifespan, thus reducing the demand for virgin plastic.

5.4.4 BARRIERS AND SOLUTIONS FOR INCREASED CIRCULARITY AND REDUCTION IN THE USE OF PLASTICS

The use of plastic in the fisheries and aquaculture industry faces regulatory and business development barriers. Leasing systems are being trialed, and interviewees note this as a potential lever for increased circularity, along with the implementation of producer responsibility schemes. Interviewees also note the special challenges of transporting plastic waste to recycling facilities, due to the long distances between where waste is generated and where it is handled. Interviewees further note that limited knowledge sharing and poor data quality hamper efforts to address plastic waste, and that increased inter-industry cooperation is needed.

Likewise, Systemiq points to the need to build an infrastructure for collection of plastic waste in hubs close to where sea farms are located, and that systems for reuse and equipment producer responsibility is needed.[82] The industry itself also points to CO_2 taxes, fees or prohibitions on [83]depositing plastic in landfills as possible solutions, along with government incentives.[84] Interviewees further note that the industry's value chains are immature and that these must be professionalized to effectively manage plastic waste, including developing a system to efficiently transport plastic waste along the coast.[85]

[82] Systemiq, Handelens Miljøfond and Mepex. 2023. Veien til sirkulær plast. Plast med lang levetid, chapter 2. Available from: https://www.systemiq.earth/reports/veien-til-sirkulaer-plast/plast-med-lang-levetid/kapittel-2/fiskeri-og-akvakultur/

[83] NRK. 2024. Laksemballasje på asiatiske strender til sjenanse for regjeringa. Available from: https://www.nrk.no/vestland/lakseemballasje-pa-asiatiske-strender-til-sjenanse-for-regjeringa-1.16859177

[84] NCE Seafood Innovation. 2023. Industry insight report: The future of plastics in the Norwegian aquaculture industry. Available from: https://seafoodinnovation.no/wp-content/uploads/2023/10/FINAL_2023-10-16_The-future-of-plastics-in-the-Norwegian-aquaculture-industry.pdf

[85] Systemiq, Handelens Miljøfond and Mepex. 2023. Veien til sirkulær plast. Plast med lang levetid, chapter 2. Available from: https://www.systemiq.earth/reports/veien-til-sirkulaer-plast/plast-med-lang-levetid/kapittel-2/fiskeri-og-akvakultur/

06 CONCLUSION

6. CONCLUSION

Across the industries studied in this report, plastic remains an economically vital material, which is not easily replaced. Plastic is inexpensive and easy to use, but it is also an enabler of various kinds of economic activity. Plastic plays a crucial economic role in various sectors, including construction, food and beverage, and fisheries and aquaculture. The versatility, durability, and affordability of plastic currently makes it an indispensable material in these industries. However, the use of plastic also has significant negative externalities, such as plastic pollution, overconsumption and greenhouse gas emissions, which are not currently accounted for in the low price of plastic materials.

In the construction sector, plastic is widely used in products like pipes, insulation, and roofing due to its properties and cost-effectiveness. While there are opportunities for reduction and reuse, the sector faces challenges in transitioning to alternative materials and improving waste management.

The food and beverage industry relies heavily on plastic packaging to ensure food safety, extend shelf life, and reduce food waste. While efforts are being made to reduce plastic usage and increase recycling, finding alternatives that meet the necessary requirements remains challenging.

In the fisheries and aquaculture sector, plastic is essential for operations, including for fish farms and transportation. However, plastic pollution could pose a threat to marine life and ecosystems. The sector is exploring reuse and recycling initiatives to minimize plastic waste, and to establish a closed loop in the sector.

Overall, there is a need for increased circularity and a reduction in the use of plastics in these sectors to reduce the negative externalities from plastic use. This requires collaboration among stakeholders, investment in recycling infrastructure, and the development of alternative materials that meet industry requirements. By addressing these challenges, we can work towards a more sustainable and circular economic role for plastic.

Plastics are, however, currently living up to its description as a workhorse material of the modern economy – and considerable work is needed for a successful transition away from plastic.

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