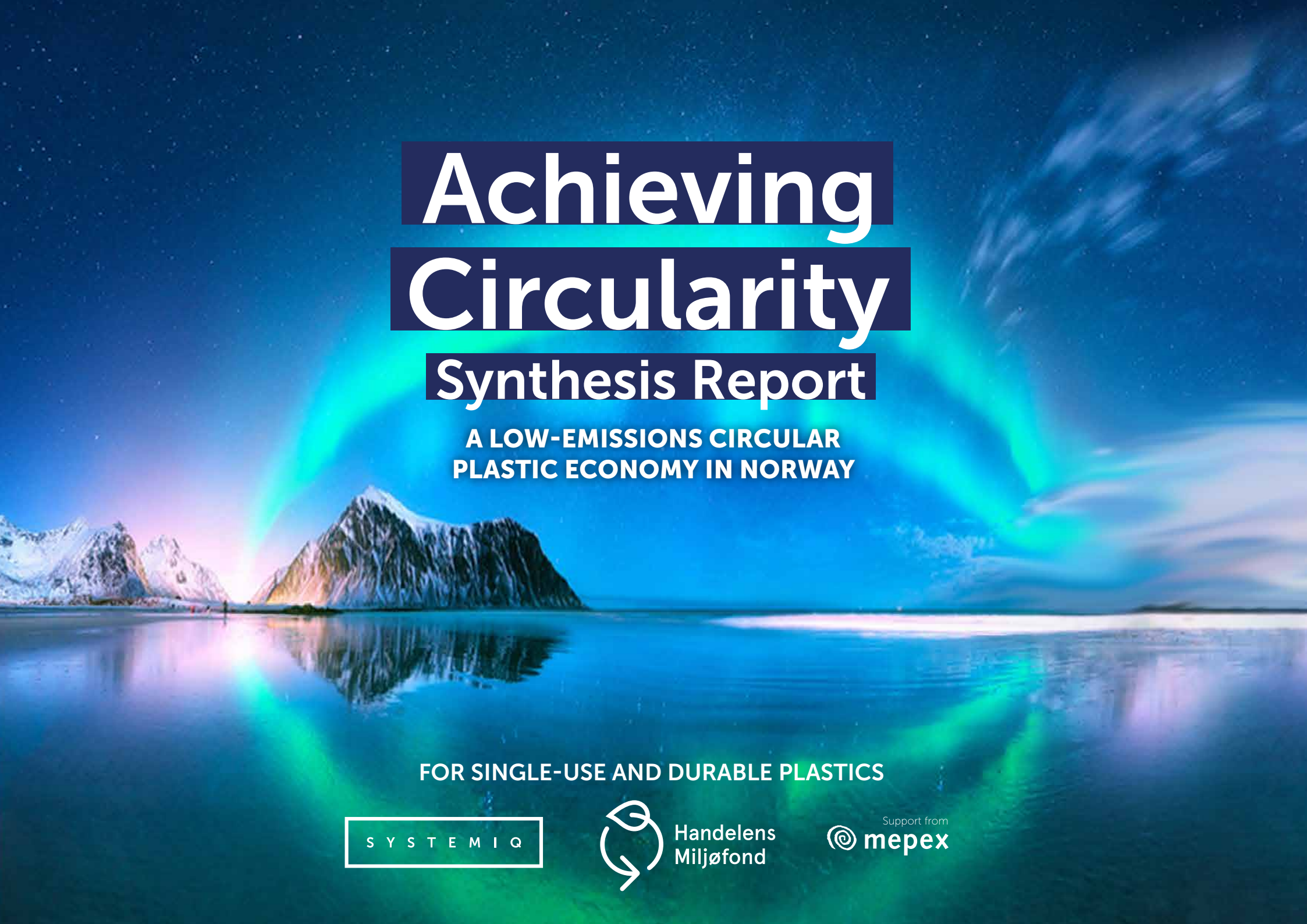

# Achieving Circularity

## Synthesis Report

### A LOW-EMISSIONS CIRCULAR PLASTIC ECONOMY IN NORWAY

FOR SINGLE-USE AND DURABLE PLASTICS

SYSTEMIQ

Handelens Miljøfond

Support from mepex

# Contents



This report is also available to view online at
https://www.systemiq.earth/reports/achieving-circularity-synthesis

# About

## Handelens Miljøfond

**(Norwegian Retailers' Environment Fund)**

Handelens Miljøfond is Norway's largest private environmental fund, and Norway's most important measure for complying with the EU Plastic Bags Directive. The fund supports national and international projects that reduce plastic pollution, increase plastic recycling, and reduce the consumption of plastic bags.

The fund's vision is to promote a circular plastic system and a pollution free environment. In 2021, Handelens Miljøfond launched "Achieving Circularity" together with Systemiq and Mepex. Part 1 of this study focused on post-consumer plastic packaging and non-electrical household products.

Learn more at: **www.handelensmiljofond.no**

## Systemiq

Systemiq is a B Corp founded in 2016 to drive the Paris Agreement and the Sustainable Development Goals by transforming markets and business models in five key systems: nature and food, materials and circularity, energy, urban areas, and sustainable finance.

In 2020, Systemiq and The Pew Charitable Trusts published "Breaking the Plastic Wave: A Comprehensive Assessment of Pathways Towards Stopping Ocean Plastic Pollution", an evidence-based roadmap that shows how industry and governments can radically reduce ocean plastic pollution by 2040, on which this report is based. The findings of our analysis were published in the peer-reviewed journal, Science.

Learn more at: **www.systemiq.earth**

## Mepex

Mepex is a Norwegian independent consultancy firm specialising in waste management, recycling and circular value chains. The aim is to be a catalyst for change, contributing to making the circular economy a reality through resource-efficient and climate-riendly solutions.

Mepex combines analytical competence with extensive experience in design, construction, and the operation of waste management infrastructure to support authorities, municipalities, organisations, and businesses in formulating strategies and achieving their environmental goals.

Learn more at: **www.mepex.no**

Suggested citation:
'Systemiq, Handelens Miljøfond, and Mepex (2023). Achieving Circularity – Synthesis Report – a low-emissions circular plastic economy in Norway'

# Endorsements

"This report describes a battery of sector-specific circular interventions that have the potential to significantly transform the Norwegian plastic system. The urgency for action is underlined by how even the most ambitious pathway falls short of Norway's 2030 climate target. It is now imperative for makers, users and regulators to collaborate to convert these insights into action!

**Elin Hansen**

**Head of Circular Economy**
ZERO

"Plastic is a fantastic material as its properties provide important possibilities of use. But plastic is also one of the biggest consumers of virgin fossil materials and a significant source of GHG emissions. High use combined with low reuse and recycling rates has created waste problems harming nature and wildlife. It simply cannot continue. Our members in the trade and service industry are committed to reducing the use of all unnecessary plastic and making plastic reusable and easy to recycle. Knowledge and cooperation are key to success. This report is an excellent example of both, and we hope its insights will be used by many.

**Tord Dale**

**Head of Sustainability**
Federation of Norwergian Enterprises (Virke)

"Significant amounts of plastic are accumulating in the Norwegian building stock. Given the long lifetimes of plastics in buildings, the failure to implement circular solutions today will result in the Norwegian plastics system being unable to cope with the large volumes of waste for decades to come. Circularity solutions are within reach and this report provides a roadmap to implementation, detailing where the opportunities lie to transform the system.

**Guro Hauge**

**Director Sustainability & Social Policy**
The Federation of Norwegian Construction Industries (BNL)

"The textiles industry is working towards higher levels of circularity and reducing emissions throughout its value chains. The "Accelerating Circularity" report helps all stakeholders to better understand opportunities and challenges on this path. I encourage the entire industry to closely collaborate, within the sector and with other actors across the value chain, to truly advance to a sustainable plastics economy.

**Linda Refvik**

**CEO**
NF&TA

"It is clear the Norwegian Plastic System has to become more sustainable and less dependent on virgin materials. Circular design and circular business models will be key for companies to succeed in the future, and this report outlines the path to achieve this. I call on the Norwegian Electrical Industry to follow these recommendations.

**Frank Jaegtnes**

**CEO**
Elektroforeningen (EFO)

"We need to acknowledge that the seafood industry contributes to a large amount of plastic use and marine plastic pollution - making our industry a significant contributor to marine waste along our shores. NCE Seafood Innovation believes that collaboration and knowledge sharing around industry challenges are essential to address our responsibility and tackle issues effectively. This report provides a solid foundation for action and offers findings and guidance that can help us improve and lead the way to a more circular plastic economy, for both the aquaculture and fishery industry, in Norway. We endorse this contribution.

**Nina Stangeland**

**Managing Director**
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# Acknowledgements

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This work was developed together with a panel of 16 Norwegian experts with diverse backgrounds and perspectives. We would like to thank them for their support:

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# Preface

## Reasons for writing this report

The world is facing a critical plastic pollution challenge that requires it to deepen its understanding of the root causes of plastic waste and define pathways to eliminate it at a global scale. By 2024, a global treaty is expected to be negotiated by UN member states that enables a thriving circular plastic economy capable of eradicating plastic pollution.

Norway has the ambition to continue to be a frontrunner on addressing this challenge, and – together with Rwanda – is leading the High Ambition Coalition to End Plastic Pollution, committed to developing a successful global plastic treaty. The goal of this study is to lay out a pathway that can accelerate Norway's own transition towards a low-emissions, zero-waste circular plastic economy by 2040. This is done through an in-depth analysis of different sectors of the plastic system and identifying tailored roadmaps with strategies that design out waste and pollution, eliminate unnecessary production and consumption, keep products and materials in the economy for longer, safely collect and dispose of waste that cannot be economically processed, and dramatically reduce greenhouse gas emissions.

This report provides a synthesis of the two studies produced in this series: "**Achieving Circularity for Single-Use Plastics**" and "**Achieving Circularity for Durable Plastics**". The former focuses on consumable applications of plastics in packaging and household goods of a single-use nature with lifetimes of less than a year. The latter focuses on durable plastics in five sectors: Construction, Textiles, Electronics & Electricals, Automotive, and Fishing & Aquaculture. Together, these studies cover ~80% of Norwegian plastic consumption, making it one of the most holistic views of a national plastic system presented to date.

Plastics have been instrumental to the growth of all sectors of Norway's economy, but today's system, considering all in-scope sectors, is around 78% linear, meaning 78% of plastic waste is either incinerated, landfilled, or left in nature. The objective of this Synthesis Report is therefore to paint a picture of the most ambitious levels of circularity and greenhouse gas emissions (GHG) abatement that could be realistically achieved by the Norwegian plastic system by 2040, providing each individual sector with a clear "North Star" to aim for.

The analysis underpinning this report was supported by 16 Norwegian and international experts, and the Norwegian consultancy Mepex, and builds on the "**Breaking the Plastic Wave**" study and methodology published by Systemiq and The Pew Charitable Trusts in 2020. Norway is the first country to apply this methodology to such a comprehensive scope of plastic sectors.

Our hope and objective is that this report can strengthen collaboration along the value chain, both in Norway and across the region, and guide policymakers, industry leaders, investors, and civil society in preparing the most effective initiatives to achieve a zero-waste circular plastic economy aligned with Norway's nationally determined emissions reduction targets.

This Synthesis Report and the two studies in the "Achieving Circularity" series set out to achieve the following objectives:

**A** To produce a data-driven scenario analysis for the entire Norwegian plastic system to inform strategies and resource allocation for all stakeholders in the value chain.

**B** To provide evidence-based recommendations on priority areas needed to transform the Norwegian plastic system.

**C** To strengthen partnerships and collaboration between stakeholders across the value chain, in both the public sector and civil society, by providing a quantitative reference point to facilitate evidence-based conversations in order to explore different strategies for achieving a better plastic system in Norway.

**Cecilie Lind**
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Handelens Miljøfond

**Yoni Shiran**
**Partner**
Systemiq

[a] incineration throughout the report refers to incineration with energy recovery

# The big picture

Plastics have been **indispensable** for the growth of the seven sectors, but this has come at a **high cost**

EXHIBIT 1

**Today, plastic use across the seven sectors** (Packaging, Household Goods, Construction, Textiles, Electronics, Automotive, Fisheries & Aquaculture) **is:**

very linear...

- **22%** Reused or recycled
- **>90%** Fossil based Virgin feedstock

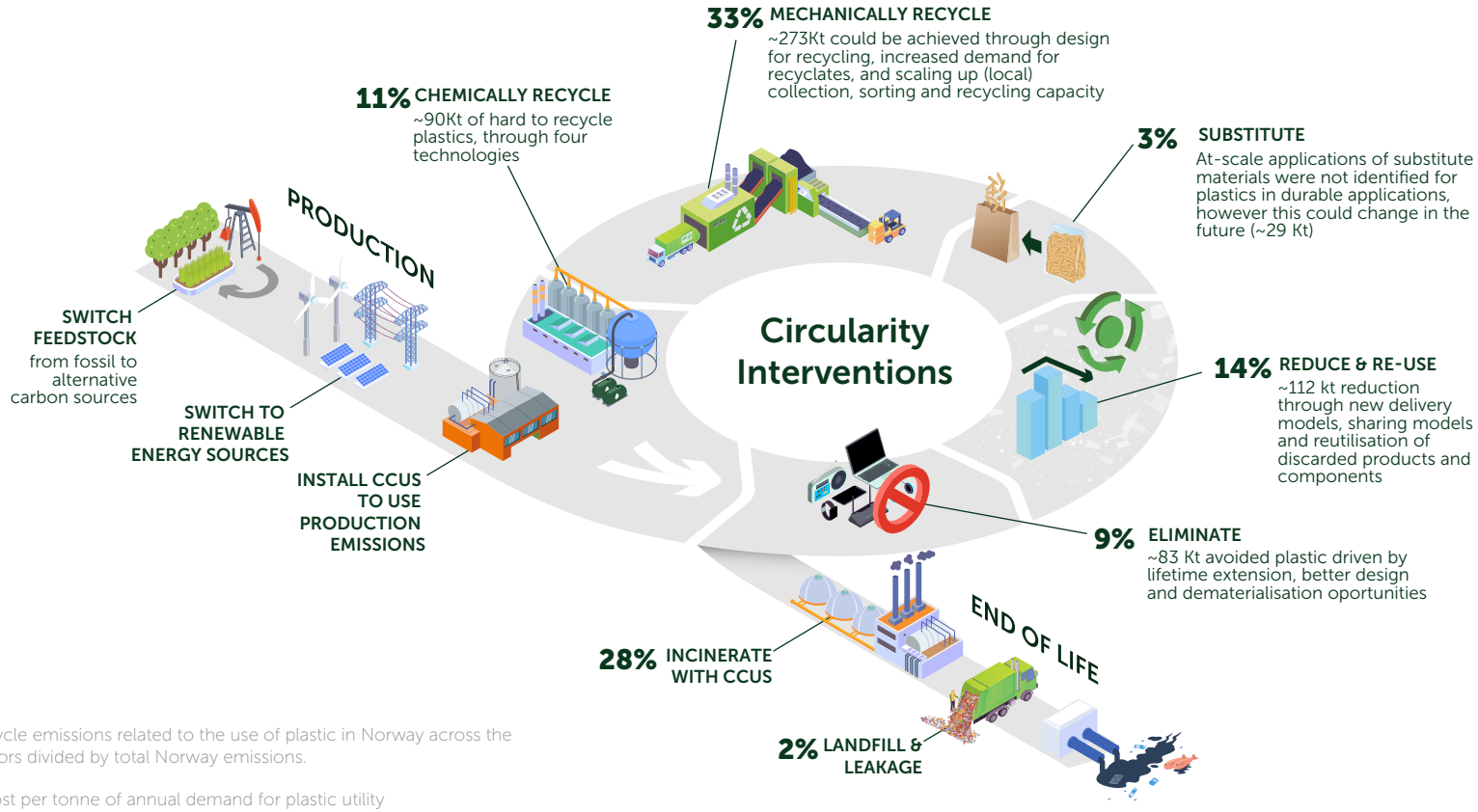
...and high GHG emitting...

- **>70%** Incinerated
- **7%*** of total equivalent Norwegian emissions

...and if **nothing changes** the impact in Norway will worsen by 2040**:

- **↑57%** waste generation
- **↑34%** Increase in virgin feedstock production
- **↑60%** incineration
- **↑21%** GHG emissions

## 70% circularity can be achieved under a System Change Net-Zero Scenario...




...**while reducing environmental impacts** and limiting the cost for society**

- **↓75%** Reduced GHG emissions
- **↑7%** Jobs
- **↑13%** cost p/tonne***
- **↓35%** waste disposal

*total lifecycle emissions related to the use of plastic in Norway across the seven sectors divided by total Norway emissions.
**vs 2020
***Total cost per tonne of annual demand for plastic utility

**Five enabling conditions** can accelerate the shift to a low-emissions circular plastic economy:

1. **Policies & Financing Model**
   Set the right standards and incentives for design, use and end-of-life management from both a waste and GHG perspective, whilst enabling a positive business case.
2. **Technology & Innovation**
   Prove sharing and reuse models, invest in advanced sorting technologies, improve (and communicate!) quality of recyclates, consider ramping up chemical recycling domestically, and pioneer low emissions technologies.
3. **Cross Value-Chain Collaboration**
   Guarantee cooperation regarding design, production and end-of-life management from a waste and GHG perspective, mainly with Nordic countries and the EU.
4. **Consumer & User Engagement**
   Ensure industry champions & large users demand sustainable models and designs from manufacturers and emphasise the link between plastics & GHG emissions.
5. **Labour Force Reskilling**
   Enable professionals, including from the oil and gas sector, to focus on sustainable domestic and end-of-life production

**The time to act is now**

# Introduction

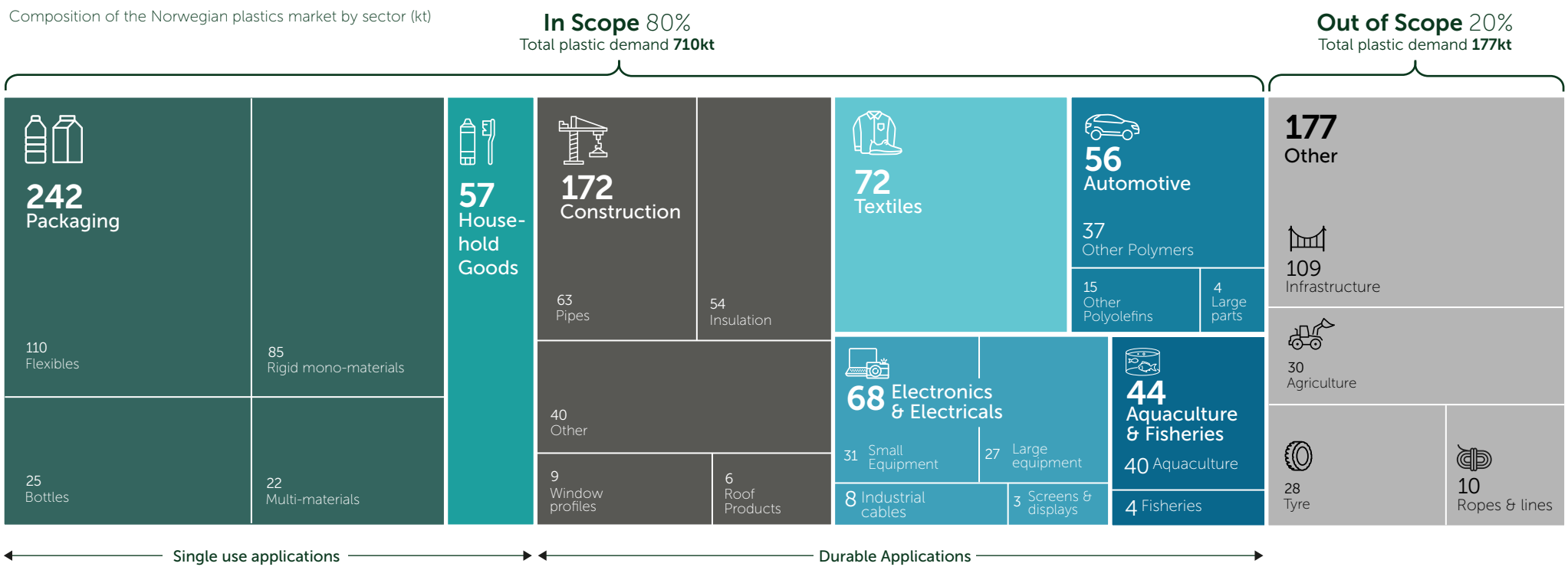
Plastic has been a key enabler of economic growth across many sectors in Norway. Its affordability, low density, and durability paved the way for plastic to become the material of choice in a wide range of applications, from food packaging to industrial cables to fishing nets. It is this diversity of application that has led to the ubiquity of plastics.

However, the rise in plastic consumption has come at a high cost to both the environment and society and is now incompatible with Norway's ambitions to achieve circularity and meet key climate targets. Today there is an urgent need for Norway to steer its plastic system off the unsustainable trajectory it is currently on, and towards a highly circular, low-emissions, resource efficient pathway.

This Synthesis Report provides seven key insights on the transformation of the Norwegian plastic system. It is a summary of the two studies in this series: "**Achieving Circularity for Single-Use Plastics**" and "**Achieving Circularity for Durable Plastics**". The former focuses on consumable applications of plastics, herein referred to as 'Consumables', while the latter focuses on durable plastic applications. Together, the seven sectors analysed in these two studies cover ~80% (~710,000 tonnes) of Norway's plastic consumption (Exhibit 2) and around two thirds (~500,000 tonnes) of its waste generation, providing the most comprehensive view of the Norwegian plastic system available to date.[b]

EXHIBIT 2 **The seven sectors analysed in this study account for 80% of total plastic demand in Norway in 2021**

Composition of the Norwegian plastics market by sector (kt)




Source: Mepex analysis

[b] All references to plastic in this report refer to plastic applications within these seven sectors alone, unless otherwise specified. Estimated waste numbers are higher than in previously reported studies due to a combination of increased consumption, and a deeper assessment of both the five durable sectors in scope of Part 2 and the "other" categories.

Plastic has been a key enabler of growth, but the rise of plastic consumption is incompatible with Norway's circularity and climate targets.

The fact that Norway imports most of its plastic and plastic products, and exports over a third of its plastic waste, has implications for how to assess both the impacts of the current plastic system and any prospective strategies, and was therefore considered across the key findings. Even though collaboration with other Nordic states and the EU will be key to defining future plastic solutions, this also poses a key question in terms of the extent to which Norway can domesticate its plastic value chain versus focusing on driving change abroad.

The analyses synthesised in this report rely on a stock-and-flow model, based on the approach used in the 2020 "**Breaking the Plastic Wave**" report, adjusted to the Norwegian context and extended to include all the sectors shown in Exhibit 2. The model quantifies stocks and flows, and the relationship between them, under three different scenarios:

- **a Baseline Scenario**, in which current trends are projected out;
- **a System Change Scenario**, in which circularity interventions are ambitiously applied across all sectors and over the full value chain; and
- **a Net-Zero Scenario**, in which greenhouse gas (GHG) emissions abatement measures are modelled on top of the System Change Scenario.

As well as the volumetric analysis, additional layers have been modelled to estimate the economic, climate and employment implications of different interventions and scenarios.[c]

[c] The numbers included in this study are modelled outputs, accurately represented from our model, which could be perceived as false precision. It is important to emphasise that these are scenario outputs, not forecasts, and therefore there is a margin of error. Additional information about the analysis and underlying assumptions can be found in the technical reports accompanying each study in the series.

# 7 critical insights on the path to a circular and net-zero aligned Norwegian plastic system

## 1 Plastics have been a key enabler of growth, efficiency and innovation across all the sectors analysed, utilising ~710,000 tonnes of plastics in Norway in 2021, but this has come at a high environmental cost.

Plastics have played a central role in delivering the goods and services of the seven sectors analysed, providing important benefits by reducing food waste and lowering use phase GHG emissions from vehicles and buildings. However, a consequence of their use to date are the high GHG emissions caused by the current linear, resource inefficient plastic system.

As Exhibit 3 shows, the **Norwegian plastic system today is 78% linear**, relying primarily on fossil-based plastic manufacturing processes and incineration at end-of-life, the most emissions intensive production and end-of-life routes, together are responsible for **96% of the 2.8 million tonnes of $CO_2$eq generated by the system every year**. This is an inefficient and unnecessary use of both primary resources and Norway's carbon emissions budget within the Paris Agreement on climate change.

Like many other European countries, in recent years Norway has pivoted away from landfilling waste, and towards **incineration with energy recovery**, in line with the EU waste hierarchy. About half of this incineration takes place outside of Norway. As a result, despite **renewables now making up 98% of Norway's electricity generation**[1], this trend towards a high-emissions form of waste disposal risks undermining Norway's leadership in the low-emissions electricity generation space by increasing the carbon intensity of its grid.

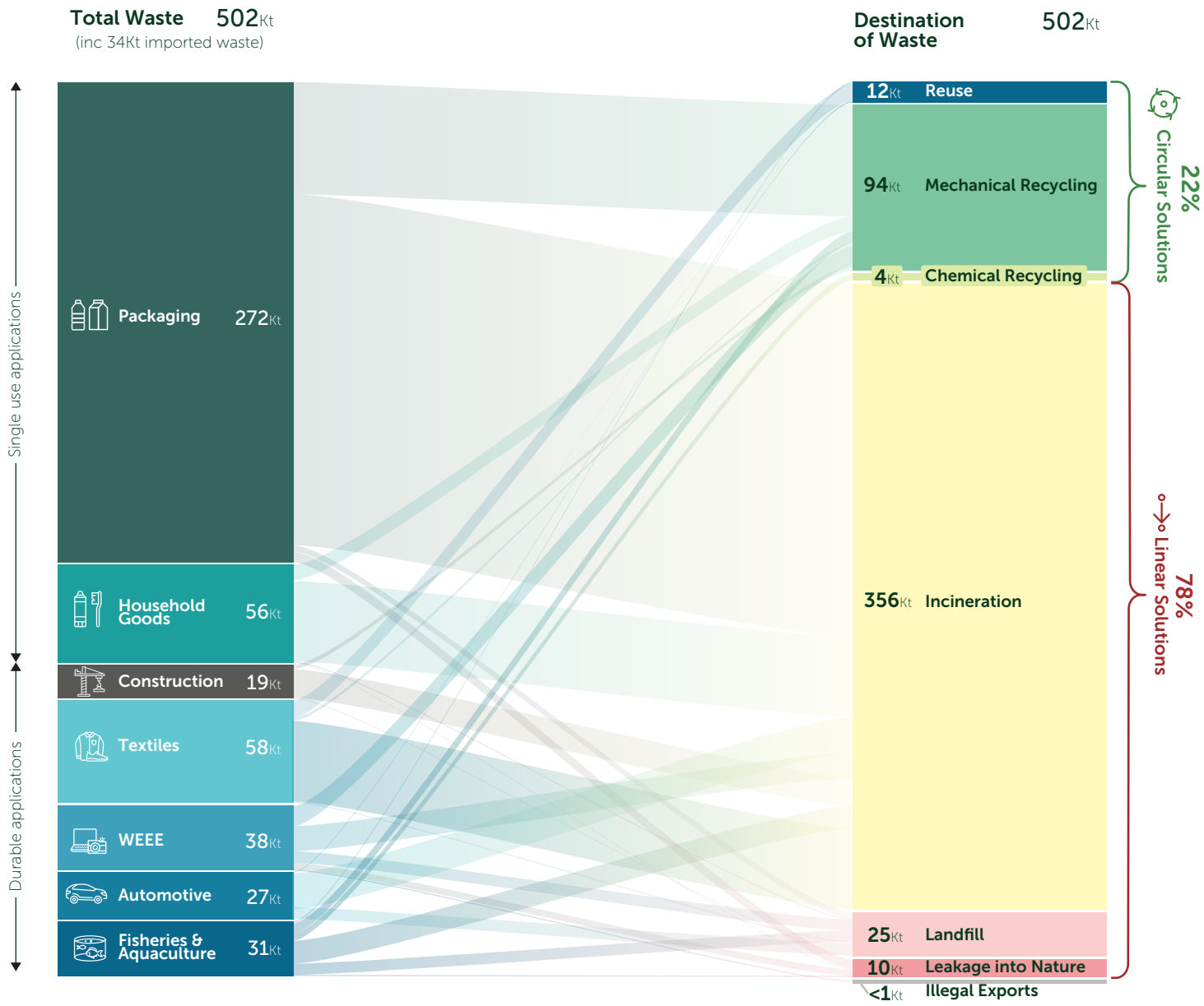
Combined with a heavy reliance on virgin fossil-based plastic production, due to the low uptake of recycled content both within Norway and in the wider region, this has led to **a GHG intensive system**. The plastic value chain in scope is today responsible for ~7% of Norway's total annual GHG emissions[d].[2]

The rising emissions related to plastics are undermining Norway's leadership on climate

[d] Note that this is the total GHG emissions associated with plastic consumption in Norway, including from production outside of Norway to meet Norwegian demand, as well as from waste management outside of Norway as a result of waste exports.

EXHIBIT 3 **Only 22% of waste from these 7 sectors is currently being circulated back into the system, with incineration being the most common end destination for plastic today.**

Baseline Scenario 2020 – Kt / t $CO_2$eq




While plastic pollution in Norway is much lower compared to less developed markets, and Norway has taken significant strides to minimise it, domestic plastic pollution has not been eradicated.

It is estimated that 10,000 tonnes[e] (2%) of the plastic waste produced annually in Norway leaked into nature in 2020, the majority of which in the form of plastic packaging (~5,000 tonnes), Waste from Electrical and Electronic Equipment (WEEE)[f] (~4,000 tonnes), and fishing gear (~1,000 tonnes). While not a focus of this study, in addition to the harmful impacts on the environment and natural habitats, plastic pollution is causing concerns among health experts due to the potential impacts on human health, including disruption to cellular activity.[3]

[e] This is a highly uncertain and much debated figure, particularly for leakage of fishing gear. In Norway, most of the leakage from fishing gear are small low weight items like rope cuts, as the majority of large gear is recovered.

[f] Note that for WEEE this refers only to large industrial cables being left underground.

## 2 The situation is worsening as the current trajectory of the Norwegian plastic system is fundamentally misaligned with national circularity ambitions and key climate targets, with a 57% increase in waste generation and a 21% increase in GHG emissions (to 3.4 million tonnes of $CO_2$eq) projected by 2040.

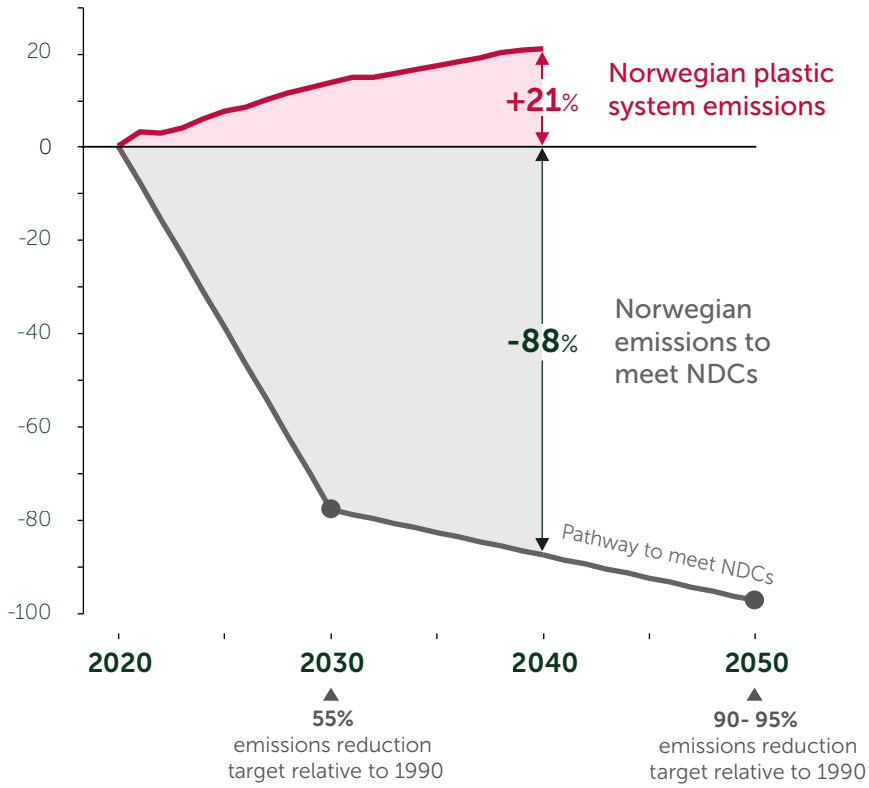
Plastic usage across consumable and durable applications is set to increase by 28% and 38%, respectively, by 2040 relative to 2020, representing a 34% growth in overall plastic demand. At the same time, waste generation across these applications is set to grow by 28% and 113%, respectively, representing a 57% overall growth by 2040. This rapid increase in plastic consumption and waste generation will intensify today's already severe challenges of high emissions, resource inefficiency, and pollution.

The challenges faced by consumable applications are quite distinct to those faced by durable applications. Consumables are generally a more resource intensive use of plastic, **as the economic value is lost after just one short use cycle spanning less than a year**. These applications of plastic – i.e., packaging and household goods - also contribute most to pollution, emissions, and system linearity. Durables are a much more efficient and effective use of plastic as they keep the material in the economy for several years. However, their use across a wide variety of sectors and applications has led to **a large accumulation of in-use stock**, estimated at 4.9 million tonnes in 2021 and set to grow to 8.3 million tonnes by 2040, which the existing waste management infrastructure in Norway is not equipped to handle.

As a result, Norway's reliance on fossil-based plastic manufacturing processes, followed by incineration at end-of-life, is currently set to continue. As shown in Exhibit 4, this will result in a 21% increase in system level emissions relative to 2020, rising to 3.4 million tonnes of $CO_2$eq by 2040, despite macro-decarbonisation factors. The trajectory of the Norwegian plastic system under a business-as-usual scenario is therefore fundamentally misaligned with Norway's nationally defined climate commitments, which stipulates a 55% emissions reduction by 2030 and a 95% reduction by 2050, relative to 1990 levels, as well as with the global climate target of limiting average global warning to 1.5 degrees.

EXHIBIT 4 **Even as the broader economy decarbonises, GHG emissions generated by the Norwegian plastic system on its current trajectory are set to grow by 21% to 2040**

GHG emissions, % change relative to 2020




Note that the 2030 and 2050 climate targets are not specific to the plastics system. These are emissions targets for the Norwegian economy and have been shown for reference.

Nationally Determined Contributions (NDCs) are targets set by individual countries to reduce national emissions.

Source: UNFCC

## 3 Momentum is building throughout the plastic system, but current policy and industry commitments are inadequate to bring about the required transformation.

The Norwegian plastic system is already taking notable strides towards addressing the dual challenges of resource inefficiency and climate change mitigation, but progress is not happening fast enough to align with the goals of either the European Green Deal[4], or the Paris[5] and Glasgow[6] climate agreements.

There are varying levels of awareness and ambition for change in each of the in-scope sectors, as shown in Exhibit 5, with most policy and industry initiatives currently focused on packaging. In recent years, Norway has adopted several key policies introduced by the EU, including the Packaging and Packaging Waste Regulation[7] and the Single Use Plastic Directive[8], both of which set ambitious targets for recycling rates and reduction. In addition, large fast-moving consumer goods (FMCG) companies are setting ambitious voluntary commitments to increase recyclability and integrate recycled content in their plastic products. If met, these commitments will go a long way towards curbing pollution, waste disposal, and GHG emissions, but will still fall short of achieving a highly circular, low-emissions system.

EXHIBIT 5

### Current commitments in most sectors, particularly durable applications and household goods, lack ambition

| | Sector | Ambition level of current/ upcoming commitments | Key Commitments | Key message |
|---|---|---|---|---|
| Single use applications | Packaging |  | • Packaging and Packaging Waste Regulation<br>• Single Use Plastic Directive | Recently introduced and upcoming regulation is high ambition but focuses on recyclability/ recycled content with very few commitments on scaling upstream solutions |
| | Household Goods |  | • None | No relevant targets being discussed |
| Durable Applications | Construction |  | • VinylPlus (PVC collection targets by 2025 and 2030) | Some voluntary commitments on separation collection and recycled content. Additional commitments being discussed, but very vague and lacking ambition. |
| | Textiles |  | • Separate collection by 2025 | Additionally, an EPR for textiles might be included in the 2023 revision of the Waste Framework Directive |
| | WEEE |  | • Waste Electrical and Electronic Equipment (WEEE) Directive | Mainly focused on collection rates with no plastic-specific recycling targets, and there is a concern that ambition levels will fail to align with EU regulation. |
| | Automotive |  | • End-of-life Vehicle Directive (upcoming revision expected soon) | No relevant commitments, but more ambitious regulations with material-specific recycling and recycled content targets expected in the ELV Directive revision |
| | Fisheries & Aquaculture |  | • Upcoming Extended Producer Responsibility (EPR) | Ambitious EPR being discussed – implementation to start as of 2024 |

Ambition Level: No | Limited | Medium | High | Very high

* Qualitative Assessment of all current commitments identified – not just the ones fitting the criteria

In the five durable plastic sectors, the credibility of existing policy and industry commitments, including their likelihood of being met, were assessed against criteria based on the influence of the target setter and their development of KPIs and a viable roadmap towards achieving the stated targets. Of the sixteen commitments assessed for durable sectors, only two met the criteria and were therefore quantified in the analysis: the **separate collection of textiles by 2025**, and the **PVC collection targets in construction set by VinylPlus**[9].

If met, these current commitments will result in an increase in the system circularity of durables from **21% today to 31% by 2040**, and a corresponding **~7% reduction in system GHG emissions** relative to the business-as-usual scenario.

The impact of existing commitments is clearly inadequate to transform the Norwegian plastic system into a highly circular, low-emissions system. There are growing levels of ambition throughout the system, but the translation into action, through setting strict, concrete targets – both in the policy space and across different industries – and the development of roadmaps towards these targets, is lacking. More needs to be done to formalise commitments and hold the parties responsible for achieving them accountable.

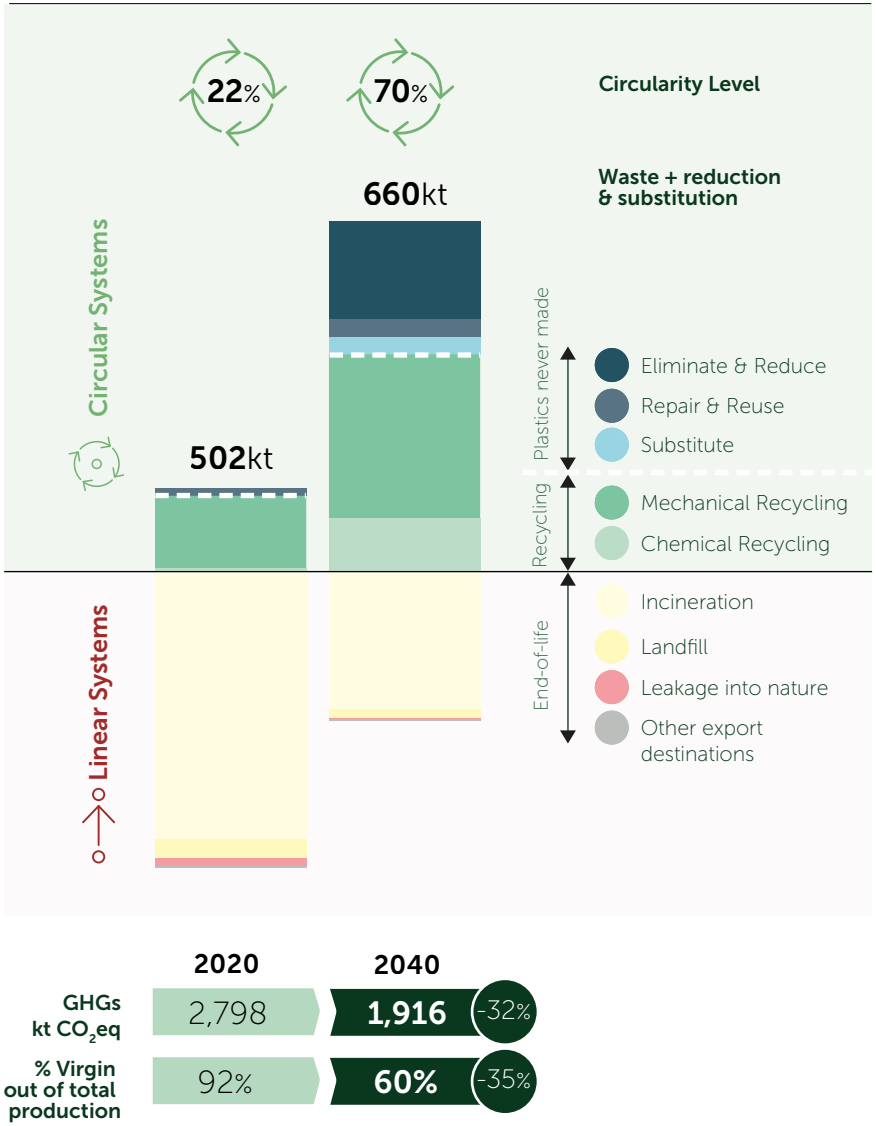
**4** Through the ambitious application of circularity interventions along the value chain, 70% circularity can be achieved by 2040, reducing emissions by 32%, disposal by 35%, and virgin plastic demand by 33% relative to 2020, while continuing to meet demand for utility and delivering the benefits plastic brings to society and the economy.

Circularity is the fastest, most cost-effective, and most reliable way to abate the GHG emissions generated by the Norwegian plastic system. Almost a third of the system's GHG emissions can be reduced through circularity interventions alone.

Five categories of system interventions (see Exhibit 6) must be applied ambitiously, concurrently and starting now in order to reach higher levels of circularity. Under this scenario, mechanical recycling could become the primary destination for Norway's plastic waste by 2040, accounting for 33% of demand for plastic utility, while reduction and reuse could account for 23% of the circularity solution, and chemical recycling for 11%.

> Circularity is the fastest, most cost-effective, and most reliable way to abate the GHG emissions generated by the Norwegian plastic system.

EXHIBIT 6 **Circularity interventions can take the system from 22% circular today, to 70% by 2040**



## Reduction

Reduction can avoid up to 23% of plastic consumption via three main strategies:

- **Elimination** through dematerialisation of products (e.g. shifting from keyboards/laptops to tablets), lifetime extension of products (e.g. fishing nets), and innovative design (e.g. using edible coatings as alternatives to packaging for food).
- **New delivery models** enabling the sharing and/or reutilisation of products (e.g. dispensers and refilling stations to replace single-use packaging, rental models for clothing, and car-sharing models).
- **Reuse** of products once they have been discarded as waste (e.g. reuse of a refurbished bumper on a vehicle, and reuse of window frames from a demolished building).

## Substitution

Substitution with alternative materials (mainly coated paper and compostables), where beneficial, avoids 3% of plastic consumption and is almost exclusively relevant for packaging applications. No at-scale applications of substitute materials were identified for plastics in durable applications, although this could change in the future.

## Mechanical Recycling

Mechanical Recycling of plastic products and materials could increase to 33% of demand for utility, relying primarily on the widespread adoption of design for recycling standards in all sectors, as well as the formation of supply-chain partnerships, and the rapid scaling up and optimisation of domestic collection and sorting infrastructure.

Policy support is also required via the setting of plastic-specific recycling targets in each sector, as well as industry commitments on recycled content in order to spur the growth of the recyclate market. This requires Norway's dedicated collection capacity to increase by 64% (~238,000 tonnes), either by moving away from mixed waste collection or by working with municipal waste systems to guarantee better sorting capacity and technologies (which are necessary to increase the quality of recyclates). This intervention requires mechanical recycling capacity to treat Norway's waste to almost triple to enable it to treat 273,000 tonnes of plastic waste by 2040, compared to 94,000 tonnes in 2020.

## Chemical Recycling

Chemical Recycling via plastic-to-plastic chemical conversion technologies could increase to 11% of demand for utility by 2040, tackling 90,000 tonnes of plastic waste that is hard to mechanically recycle, particularly in the packaging, automotive, WEEE and construction sectors. These technologies, while relatively nascent, could offer a solution for amongst others food-contaminated products, additive content, and mixed polymer shredder residue (e.g. in WEEE and automotive), and deliver virgin quality polymer. However, this intervention must be implemented complementarily with the expansion of mechanical recycling, tackling only plastic types that are hard to mechanically recycle, and be designed to minimise GHG emissions.

## Clean up

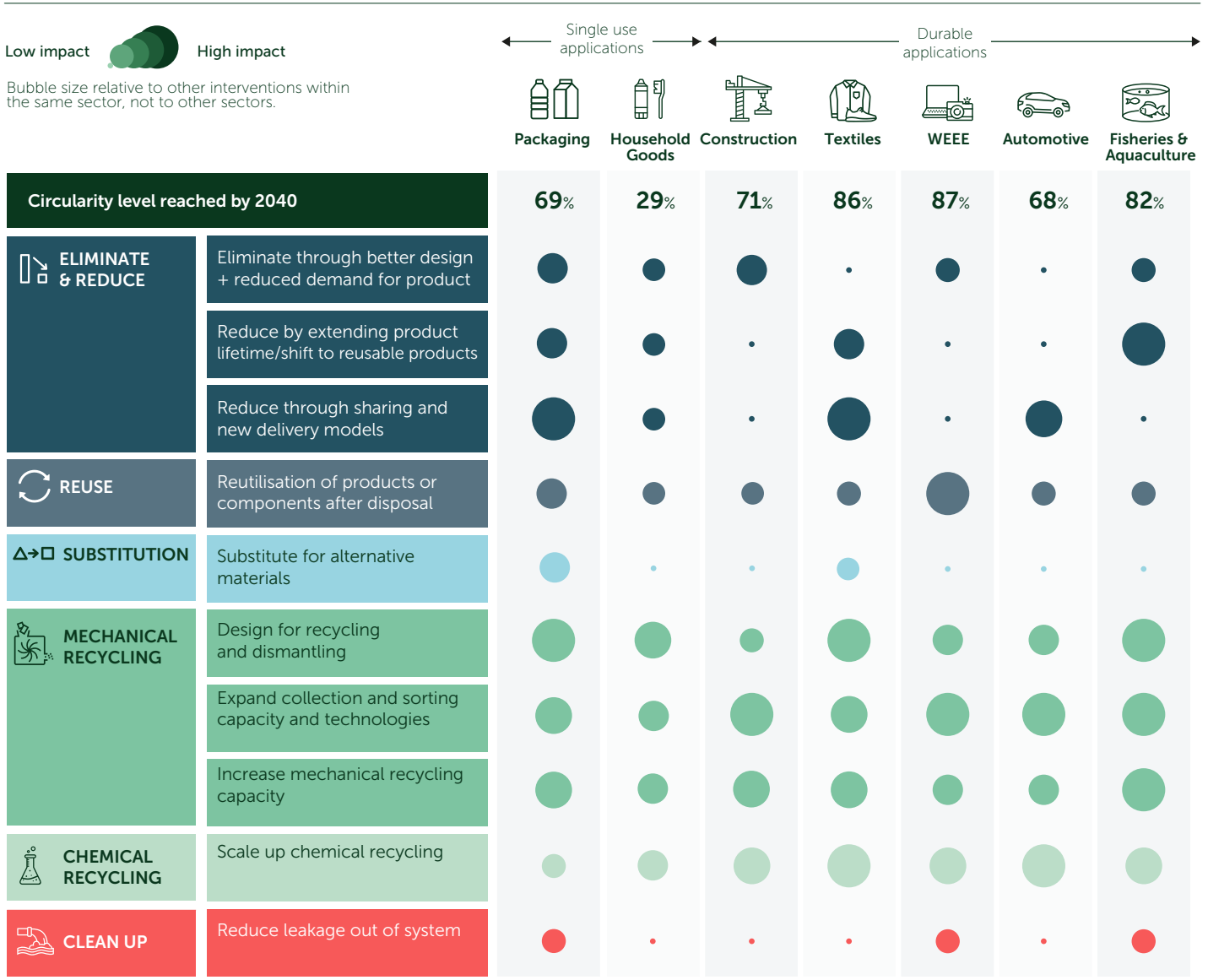
Clean up of polluting sources can reduce leakage into nature by 66%, to 3,500 tonnes by 2040, down from over 10,000 tonnes today. This is most relevant for packaging, industrial cables left underground, and fishing gear, and will most likely be driven by a combination of stronger regulation and greater levels of enforcement.

Sector-specific conditions and challenges mean that the seven sectors analysed rely on each intervention to varying degrees and will experience different levels of impact, as shown in Exhibit 7.

Consumable and durable applications also face distinct challenges, and hence their potential for circular transformation varies. While consumable applications are limited to circularity levels of 29% - 69% by 2040, durable applications could achieve much higher levels of 68% - 87%. A large part of the current problem stems from the single-use, disposable nature of many plastics and the convenience of the throwaway culture that consumers have become accustomed to. Therefore, upstream solutions – particularly **reduction via elimination, new delivery models, and substitution** – are most impactful for consumable applications, where single-use plastics should be eliminated, avoided, substituted, or made durable wherever possible.

On the other hand, in sectors that use plastics for an extended period of time, plastic proves to be a suitable choice for higher value, durable applications where it can provide utility for several years. In these cases, there are **greater incentives for repair, extension of lifetime, separate collection,** etc. However, there is still room for optimisation of the use of plastic in durable applications, particularly through greater reuse, elimination of unnecessary plastics, and a shift to sharing models. All applications rely on downstream solutions, mechanical and chemical recycling, to a large degree.

EXHIBIT 7 **System interventions and corresponding levers improve circularity in the sectors with varying degrees of impact, reaching circularity levels of 29% - 87% by 2040**



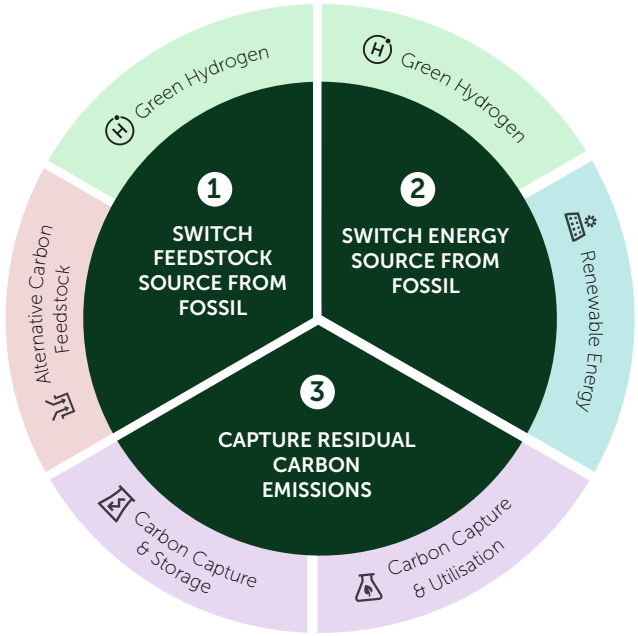
**5** Applying all circularity levers reduces GHG emissions by 32%, but still leaves 1.9 million tonnes of $CO_2$eq of emissions by 2040[h] (down from 2.8 million tonnes in 2020), requiring additional levers to achieve a Net-Zero Scenario.

Production and end-of-life emissions abatement technologies can reduce emissions by a further 22% and 14%, respectively, to just 0.7 million tonnes of $CO_2$eq of residual emissions by 2040, bringing the Norwegian plastic system into alignment with the Paris Agreement targets.

Circularity alone reduces emissions by only 32% by 2040 and **is therefore insufficient to bring the system into alignment with Norway's climate target** to achieve a 55% reduction in GHG emissions compared to 1990 levels by 2030 (equivalent to a ~63% reduction compared to 2019) and a 90-95% reduction by 2050.[10] Therefore, beyond circularity, there is a need for emissions abatement technologies.

The majority of residual system emissions are from fossil fuel-based manufacturing processes and end-of-life incineration. Three main supply-side strategies can be combined to abate these remaining emissions (see Exhibit 8).

EXHIBIT 8 **Three supply-side strategies to abate residual emissions along the value chain**



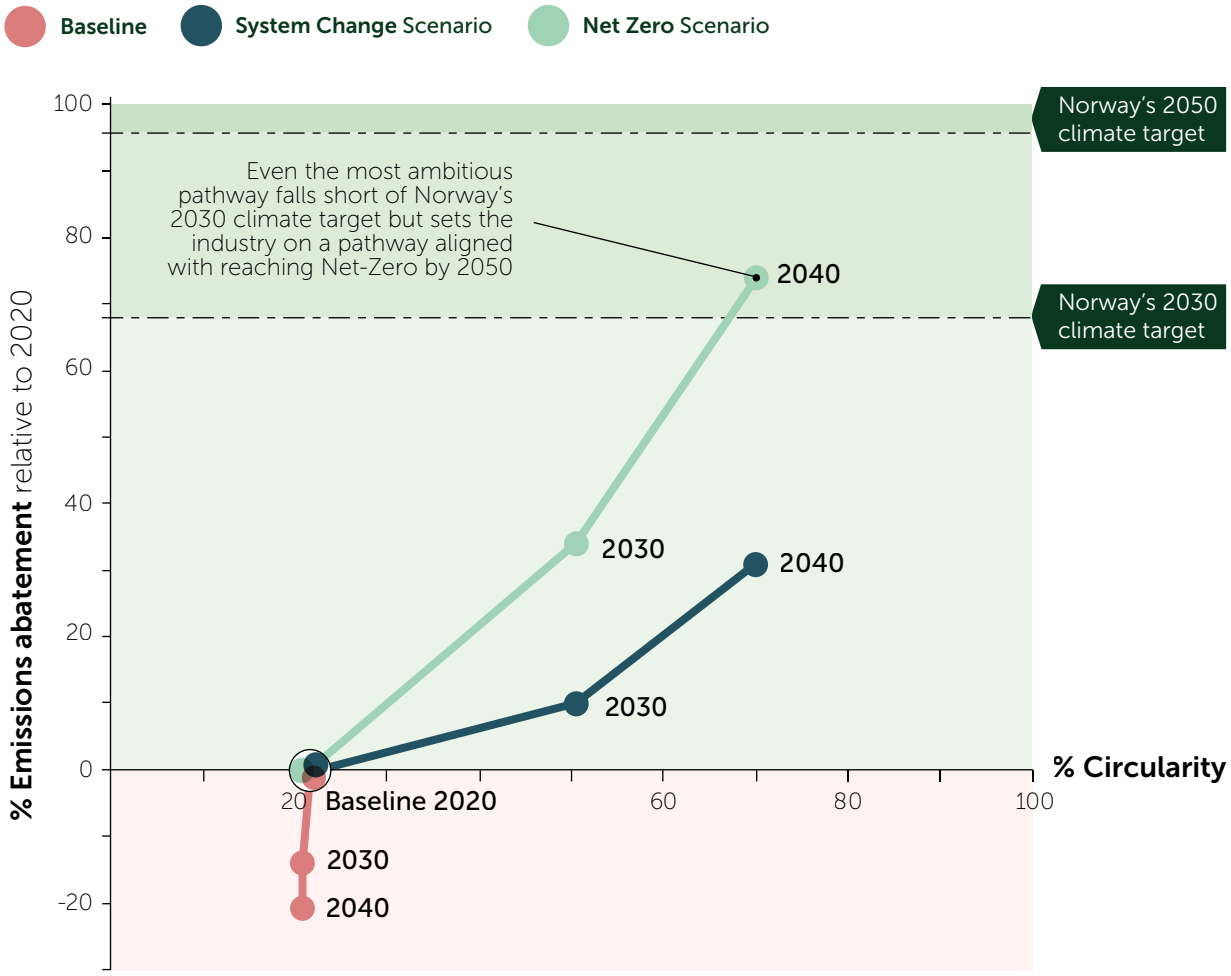

[h] Equivalent emissions as most of production and a proportion of end-of-life processes are happening outside of Norway.

By applying these three emissions abatement measures to virgin plastic production, i.e. using green hydrogen and alternative carbon feedstocks such as biomass and captured $CO_2$ to decouple from fossil fuel feedstocks, switching to renewable fuels, and capturing residual process emissions, **a further 700,000 tonnes of $CO_2$eq could be avoided by 2040**.

In addition to these supply side strategies, by capturing emissions from end-of-life incineration through the application of CCUS, it is estimated that an additional 500,000 tonnes of $CO_2$eq could be avoided by 2040.

Together with the circularity interventions, these measures can reduce emissions from the Norwegian plastic system by 75% by 2040 relative to 2020. While this pathway still falls short of achieving Norway's 2030 climate targets (Exhibit 9), it sets the system on track to achieving net-zero by mid-century, in line with Norway's 2050 climate goal.

EXHIBIT 9 **Through ambitious application of circularity and emissions abatement measures, a 75% emissions reduction can be achieved by 2040 relative to 2020 in the Net Zero Scenario.**




Norway's 2030 climate target is a 55% reduction relative to 1990, which is approximately a 68% reduction relative to 2020

## 6

**The System Change Scenario is the most economical scenario for durable plastic as it drives resource and capital efficiency. At the same time, it is slightly more expensive for consumable applications due to the start-up costs of new delivery models and substitution materials.**

**The Net-Zero Scenario requires an estimated capital investment which is about 30% higher than that required in the System Change Scenario[i]. At the same time, shifting to this low-emissions circular scenario creates 1,300 additional jobs in the system.**

Increasing circularity increases the 2020-2040 cumulative capex investment required in the System Change Scenario to **NOK ~30.3 billion**. This is only 9% more than the Baseline Scenario, because circularity drives both resource and capital efficiency as the expensive linear production infrastructure buildout is avoided and plastic utility is decoupled from production volume.

While there are also capital efficiency gains in some parts of the value chain due to a smaller, more circular system in the Net-Zero Scenario, the implementation of emissions abatement to production and end-of-life incineration requires an additional NOK 9 billion of direct capital to abate the residual emissions in the circular system (~63% of which is to abate virgin production and ~37% for end-of-life incineration[j]). This represents a 41% increase in total cumulative investment to NOK 39 billion compared to the unabated linear system in the Baseline Scenario, a non-trivial increase in transition costs.

While this is only a modest increase in cumulative capex relative to the Baseline Scenario considering the cost of future externalities, the Net-Zero Scenario requires significant capital reallocation from mature and thus low-risk business models and technologies to nascent, higher risk ones.

In terms of employment, 7% more jobs are created in a Net-Zero Scenario, representing a net job increase of ~1,300 jobs compared to 2020. As a result, 35% of system employment by 2040 could be in circular business models, i.e., reduction, reuse, and recycling value chains. However, jobs in primary production would decrease by around ~21%, requiring a large redistribution of employment opportunities along the value chain. A just transition must ensure that the legacy fossil fuel employee base is adequately reskilled to participate in the new low-emissions economy. Notably, if Norway chooses to domesticate its plastic value chain, this transition offers an employment opportunity for the highly skilled labour force currently dedicated to the declining oil and gas sector.

[i] This scenario considers 40% of production and 80% of incineration is abated by 2040.

[j] Noting that macro-economic decarbonisation factors, such as abatement costs of other sectors or broader economic electrification, have not been included.

## 7

**The transition of the Norwegian plastic system is highly complicated and thus centralising governance under a multi-stakeholder systems transformation body, involving makers, users, and regulators, may help accelerate the process.**

The framework in Exhibit 10 presents the key capabilities and actions needed over the next five years to accelerate the transition towards a highly circular, resource efficient, low-emissions Norwegian plastic system, as outlined in this report. The first step is to align behind a shared vision and strategy to address the current challenges of high GHG emissions and resource inefficiency.

EXHIBIT 10 **Systems change capability framework for the Norwegian plastic system**

## ESTABLISH A MULTI STAKEHOLDER GOVERNANCE BODY

### A Vision & Strategy

Develop cross-sector, cross value-chain strategy and roadmap and define key projects

### B Partnerships

Define and support local and regional cross value chain partnerships required to deliver the strategy

## CREATE AN ENABLING ENVIRONMENT

### C Incentivising policy

- Set up EPR in all sectors
- Level the playing field for reuse and new delivery models
- Set plastic-specific recycling and recycled content targets
- Support first-movers

### D Data sharing

- Digitise the value chain to enable data collection
- Enable system-wide information and best practice sharing, to gain stakeholder trust along the value chain

### E Behaviour change

- Appoint champions for upstream solutions and incentivise adoption
- Run engagement and awareness campaigns

### F Talent

- Cultivate talent to fill new value chain roles
- Reskill existing employee base to ensure just transition

## DELIVER SYSTEMS TRANSFORMATION PROJECTS

### G Upstream

- Incorporate design for recycling standards and drive innovation in design
- Scale reuse and new delivery models

### H Downstream

- Optimise and scale collection, sorting, and recycling capacity
- Support chemical recycling pilots

### I GHG Abatement

- Install CCS on incinerators and manufacturing sites

## FINANCE CHANGE

### J Innovation

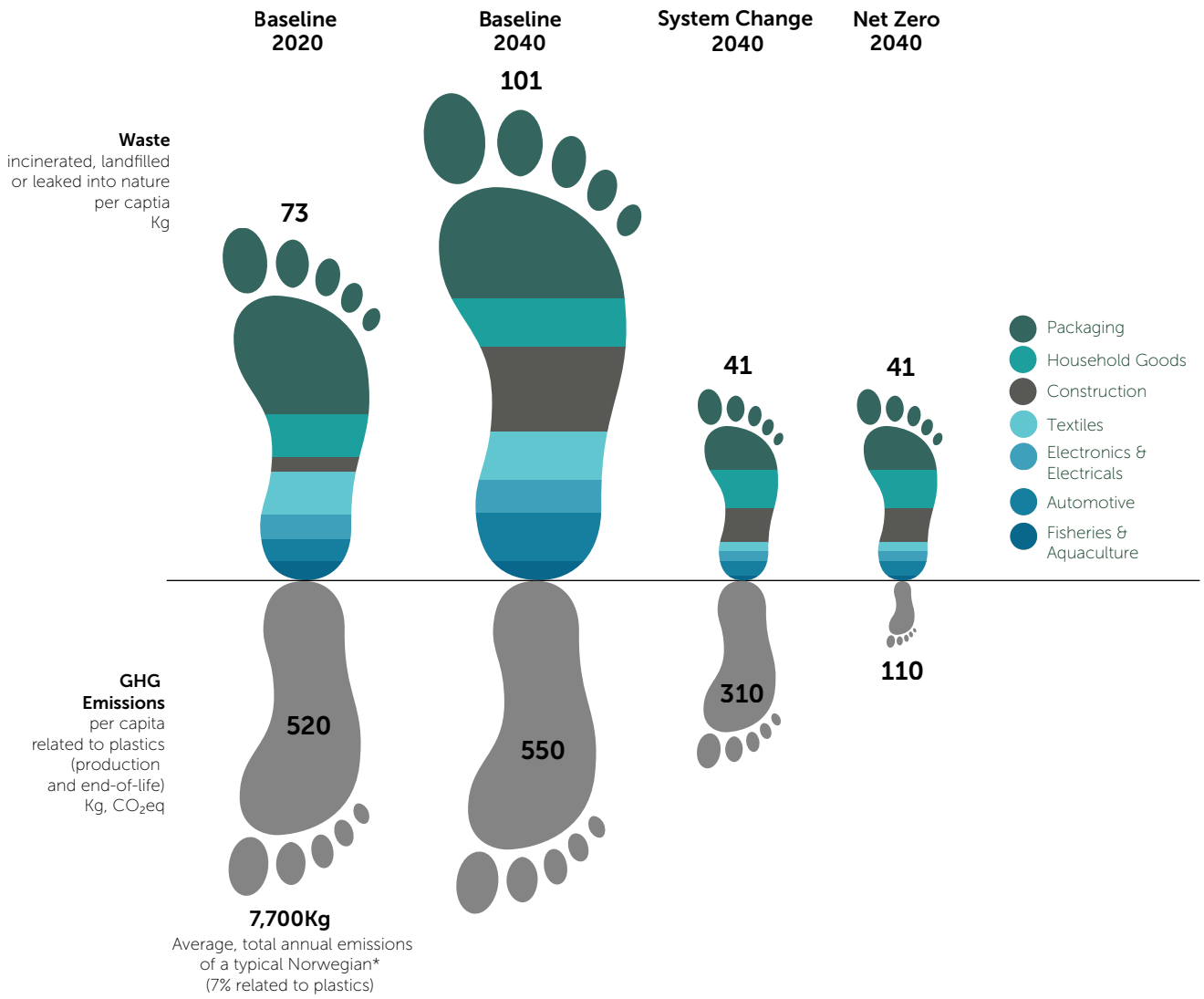
- Set up a plastic-dedicated innovation fund

### K Infrastructure

- Develop/source debt-based finance instruments for large infrastructure
- Blended finance to de-risk investments

EXHIBIT 11 **The yearly Norwegian per capita plastic disposal footprint has to reduce to 41kg per year to get on a net-zero pathway**

All figures per capita. Norway population: **2020** 5.4M - **2040** 6.2M (projected)




* Waste incinerated, landfilled or leaked into nature

# Conclusion

This Synthesis Report and the two full reports that make up the "Achieving Circularity" series provide a comprehensive view of the Norwegian plastic system, and offer a pioneering vision of how to transition it into a low-emissions, resource efficient, highly circular system over the next two decades.

Despite the many challenges and complexities this transformation entails, this study demonstrates that **circularity interventions can achieve unprecedented levels of resource efficiency across all sectors, and provide an affordable and scalable means of dramatically reducing GHG emissions.** The analysis shows that the solution must go beyond reusing and recycling plastic, and also focus on fundamentally "rethinking" the uses of plastic through new business models and dematerialisation. Also, it shows the importance of establishing system transition principles along the value chain between upstream circularity, downstream circularity, and supply-side abatement to ensure interventions are prioritised, incentivised and championed in the most effective way to guarantee an efficient system (see Exhibit 10).

The Norwegian plastic system faces important decisions that will determine the role it will play in the global transition to high circularity and low emissions. Norway has the opportunity to create a plastic system that is compatible with planetary boundaries and that can fulfil the needs of future generations of Norwegians; a system that the world needs to be shown is possible, not simply as a means of mitigating harm but as an opportunity for future growth and innovation.

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10. Norwegian Parliament. Norway's long-term low-emission strategy for 2050. (2019).

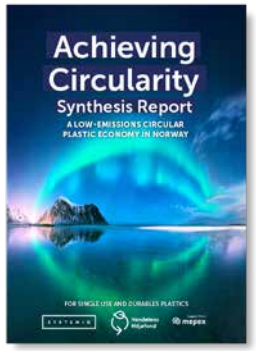

A full list of sources can be found in the Achieving Circularity for Single-Use Plastics and Achieving Circularity for Durable Plastics reports.

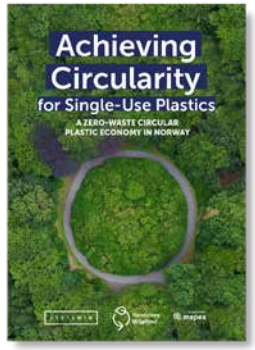
# Contact

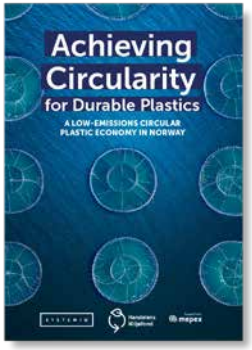
We would be happy to discuss or present the insights from the 'Achieving Circularity' studies in more detail. Please contact the team at **plastic@systemiq.earth**

# Further Reading

This study is part of the Breaking the Plastic Wave series



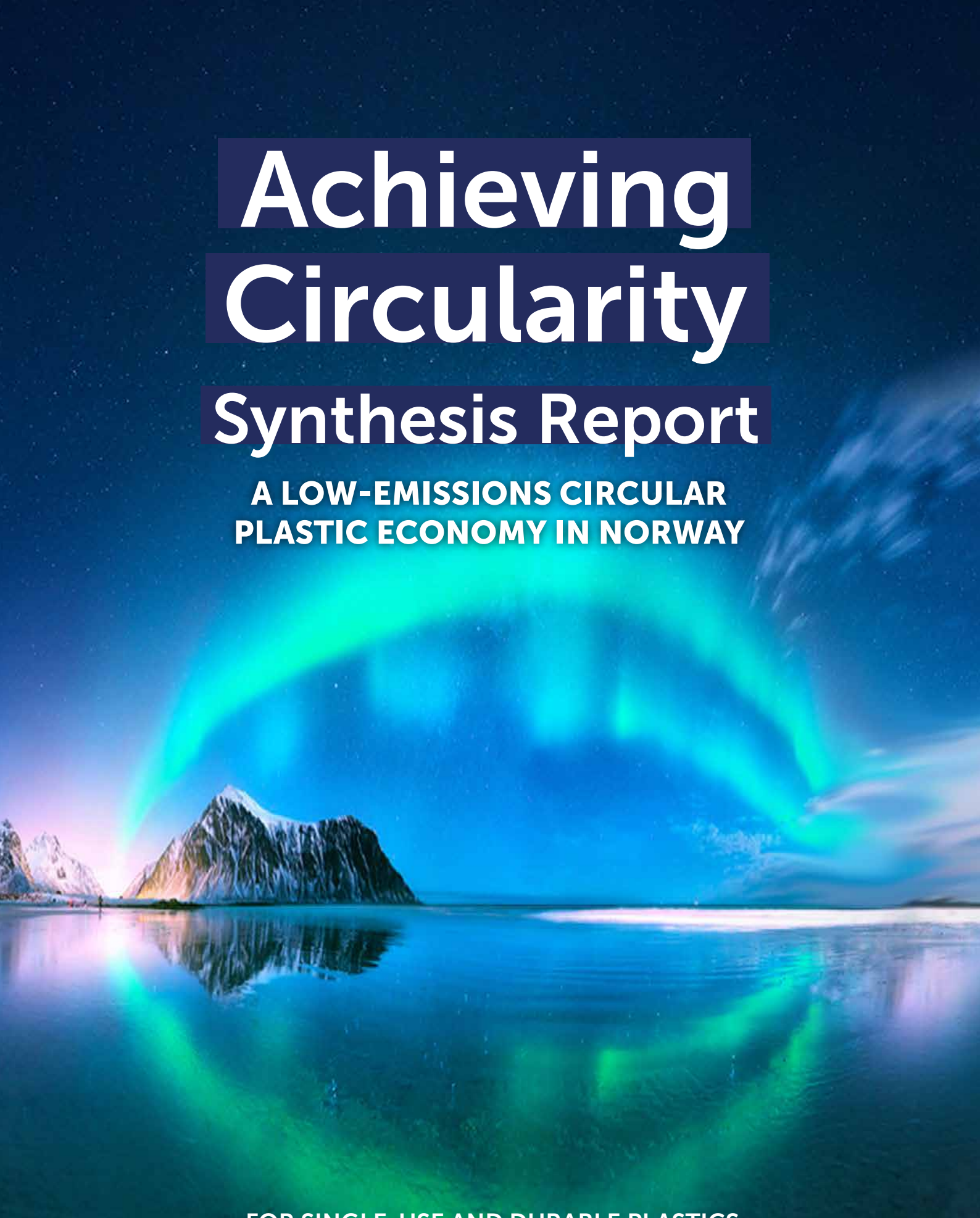




# Achieving Circularity

## Synthesis Report

### A LOW-EMISSIONS CIRCULAR PLASTIC ECONOMY IN NORWAY



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