THE NORWEGIAN ENVIRONMENT AGENCY

Reduced Littering of Single-Use Plastics

Mapping and Analysis of Potential Measures to Reduce the Littering of Certain Single-Use Plastic Products

eunomia mepex

Project report

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1 Abbreviations

SUP	Single-use plastic
SUNP	Single-use non-plastic
MU	Multi-use
KNB	Keep Norway Beautiful
NGO	Non-Governmental Organisation
LDPE	Low-density polyethylene
LCI	Life Cycle Inventory
ICC	International Coastal Cleanup
GDP	Gross Domestic Product
DRS	Deposit Return System
EfW	Energy from Waste

2 Summary

The European Commission has agreed on a new Directive that will implement restrictions on the use of single-use plastics (SUPs). The Norwegian Environment Agency requires more knowledge on SUPs, what alternatives are available, and what environmental consequences and costs are tied to the use of SUPs and their alternatives.

The study includes a mapping of 19 single-use plastics in Norway and an analysis to evaluate whether a transition to alternative materials and multi-use products can contribute to a reduction in marine litter. An analysis of the costs and environmental consequences related to a transition to the different alternatives has also been completed. The analysis is based on today's consumption of single-use plastics (SUP) (2018) and the amount of waste generated, in relation to 2 scenarios.

1) A complete transition to single-use non-plastic products (SUNP)

2) A complete transition to multi-use items (MU)

To assess the impacts of a transition away from SUP to SUNP / MU alternatives, the same methodology developed by Eunomia for the European Commission study on *Plastics: Reuse, recycling and marine litter – Impact assessment of measures to reduce litter from single use plastics* was used. The assessment presents the impacts of a complete switch away from SUP, and towards viable single use non-plastics (SUNP), or multi-use (MU) alternatives. This approach establishes the environmental, economic and social impacts of measures that may be used to encourage a switch to products in other materials than plastic. and thereby address the issue of SUPs being mis-managed and ending up on beaches and in the ocean. The method has been updated with a range of Norway-specific data, where available.

Providing Norwegian data was time consuming and challenging. Information on littering rates, was especially difficult. Where Norwegian data didn't exist, EU-data was used as a basis when assessing Norwegian conditions. For certain products where market data was difficult to trace, estimates were used as a basis to calculate the total market share. The assumptions behind each parameter have been thoroughly explained in the report.

Products, volumes and consumption

Scandinavian data on marine and urban littering make up the basis for determining the SUP items of focus for this study. The table outlines the selected SUPs, estimated consumption levels for 2018, and the amount of waste produced, and the selected alternatives to each SUP item.

	Single-Use Plastic Item	Consumption (millions pa)	Waste generated (Tons, 2018)	Selected Alternatives
1	Beverage bottles, caps and lids	632	22 570	Glass bottles/ aluminium cans/ Multi-use bottles
2	Cotton buds	631	150	Cardboard/paper stick Multi-use plastic
3	Very lightweight plastic carrier bags (bags for fruit)	263	360	Paper bags Multi-use plastic bags

	Single-Use Plastic Item	Consumption (millions pa)	Waste generated (Tons, 2018)	Selected Alternatives
4	Balloons and balloon sticks	26 / 0.3	80 / 2	Wooden/card stick
5	Fast food packaging, plates and trays (non-EPS)	137	2 750	Card+wax (cold applications) Foil container+card (hot applications) Multi-use alternatives
6	Beverage cups and lids	106	1 490	Paper (with natural wax coating) Multi-use cup
7	Fast food packaging (EPS)	122	610	Card+wax (cold applications) Foil container+card (hot applications) Multi-use alternatives
8	Straws and stirrers	526 / 79	210 / 50	Paper/ wood Multi-use alternative
9	Snus packaging	80	1 200	*No suitable alternatives*
10	Lightweight plastic carrier bags	770	6 670	Paper bags Multi-use plastic bags
11	Wet wipes	599	650	Single use cotton pads Reusable cotton flannel
12	Crisp packets/sweet wrappers	58 / 126	380/ 610	*No suitable alternatives /* Foil + Paper/card wrapping
13	Cutlery	455	1 180	Wood Multi-use alternative
14	Drink cartons	1 361	18 240	Glass bottles/ aluminium cans/ Multi-use bottles
15	Sanitary towels (pads) and tampons and tampon applicators	229 / 249	1 420 / 1 360	Menstrual cup Sanitary pads of cloth (inserts only)
16	Shotgun cartridges	8	30	*No suitable alternatives*
17	Cigarette filters	800	96	*No suitable alternatives*
18	Cigarette plastic packaging	126	1	*No suitable alternatives*
19	Contact lenses	274	3.4	*No suitable alternatives*

Results from the analysis

Based on today's consumption levels of SUPs (2018), we have assessed which products have the largest potential to enter the ocean. The most significant flow related to marine plastic is predicted to be from lightweight plastic carrier bags. It has been estimated that 29 tonnes of lightweight plastic carrier bags enter the ocean every year. Despite the low weight of the carrier bags, the large number of bags put on the Norwegian market each year is the most important contributor to this result. The next most significant contributors to SUP marine litter are sanitary items and drinks containers, which contribute respectively 20.8 and 14.7 tonnes to marine litter (see Table 18).

Results from scenario 2: A 100 % transition to MU items

The first clear conclusion to be drawn is that a switch to MU over SUNP items provides by far the greatest overall benefits. A full transition to multi-use items leads to a reduction in the number of

units that end up in the ocean by 11 million units, or 76 tonnes. The total amount of waste generated is reduced by 62,000 tonnes (see Table 19).

The consumers achieve the largest savings by reduced expenditure on SUP items when transitioning to multi-use items (NOK 4.3 billion). The total External cost savings of a transition to MU items is NOK 2.6 billion and the total financial savings is calculated to be NOK 3.5 billion per annum. This benefit is achieved even though increased water usage from washing MU items leads to an increase in consumption levels by 924 000 m^3, compared to 9000 m^3 for SUNP items. Those products that cause the greatest increase in water usage are food service items and sanitary products.

Results from scenario 1: A 100 % transition to SUNP items

Single-use items made of materials other than plastic have a higher unit weight. If drinks bottles are replaced with glass alternatives, the amount of waste generated increases significantly. It is estimated that the amount of waste will increase by 545 000 tons, where 448 000 tonnes will be sent to material recycling.

The transition to SUNP items results in reduced greenhouse gas emissions of 950 000 CO2-eq. per year. The use of alternative materials contributes to reducing the amounts of plastic products entering the ocean by 8 million units (see Table 19).

According to the results, there will be increased costs for the consumer on most items. The only item to see a cost saving under the assumptions used is SUNP wet wipes. For some products, a transition from plastic to other materials will result in a net cost, opposed to savings. These costs are more prominent for drinks containers than any other item. Strategies targeting a switch to MU for drinks containers may be more beneficial.

Likely switches

The likelihood of achieving a transition to single-use non-plastic items or multi-use items will depend on the types of measures that are put in place to incentivise consumers to change their behaviour and adopt SUNP/ MU items.

Single-use plastics	Likely switches
Drinks bottles, caps and lids/ drinks cartons	A 100% switch to SUNP items is unlikely
Cotton buds/ straws/ stirrers/ cutlery/ balloon sticks	A 100% switch away from such items is feasible
Very lightweight carrier bags/ lightweight carrier bags	A switch away from such items is possible however not for all uses
Fast food packaging, plates and trays/ beverage cups and lids	A 100% switch away from EPS is feasible
Wet wipes/ Tampons and tampon applicators/ sanitary towels	A switch to MU alternatives would be possible
Sweet wrappers	A 100% switch to SUNP items is unlikely for all products

3 Norsk sammendrag

EU kommisjonen har vedtatt et nytt direktiv som skal forby bruk av engangsartikler i plast. Miljødirektoratet har behov for mer kunnskap om engangsartikler i plast, hvilke alternativer som er tilgjengelig og om miljøkonsekvensene og kostnadene knyttet til bruken både av engangsartikler i plast og til de alternative produktene.

Denne utredningen omfatter en kartlegging av det norske forbruket av 19 engangsartikler i plast og en analyse for å se om produkter i andre materialer og alternative flerbruksprodukter kan bidra til å redusere den marine forsøplingen. Kostnadene og miljøkonsekvensene ved en overgang til de ulike alternativene er også beregnet.

I analysen har vi tatt utgangspunkt i dagens konsum av engangsartikler i plast (2018-tall) og mengde avfall dette generer, og sett på to scenarier for hvert av de 19 produktene:

Scenario 1: En 100% overgang til bruk av engangsartikler i andre materialer

Scenario 2: En 100 % overgang til bruk av flerbruksprodukter.

Metoden som er benyttet i analysen, er den samme som Eunomia utviklet for EU kommisjonen i studien *«Plastics: Reuse, recycling and marine litter – Impact assessment and measure to reduce litter from single use plastics»*. Denne tilnærmingen ser på miljømessige, økonomiske og sosiale konsekvenser av tiltak som kan bidra til en overgang til produkter i andre materialer enn plast, og som kan bidra til å løse utfordringen med at engangsartikler i plast ender opp som marin forsøpling. Så langt som mulig er det benyttet data for norske forhold.

Det har vært viktig, men tidkrevende å fremskaffe norske data til bruk i modelleringen av de to scenariene. Dette gjelder spesielt grad av forsøpling. Mangel på data har også gjort at vi for enkelte engangsprodukter i plast har lagt estimater til grunn for å beregne totale mengder satt på det norske markedet. Der vi ikke har kunnet fremskaffe norske data eller estimater, har vi benyttet EU-data. Forutsetninger som er lagt til grunn for analysen, er det gjort grundig rede for i rapporten.

Analyserte produkter, konsum og mengde avfall

Skandinaviske data om marin forsøpling er lagt til grunn for utvelgelsen av engangsartiklene i plast. Tabellen viser hvilke artikler som ble valgt, mengder satt på det norske markedet og hvilke alternativer vi har modellert.

	Engangsartikler i plast	Konsum (millioner per år)	Mengde avfall generert (tonn, 2018)	Valgte alternativer
1	Drikkeflasker, korker og lokk	632	22 570	Glass flasker/ aluminiums bokser/ flerbruksflasker
2	Bomullspinner	631	150	Papp/papirpinne Flerbruks ørepinne
3	Veldig tynn plastpose (for frukt)	263	360	Papirpose Flerbrukspose i plast
4	Ballonger og ballongpinner	26 / 0.3	80 / 2	Tre/papppinne

5	Takeawayemballasje, tallerkener og brett	137	2 750	Papp+voks (kaldt innhold) Beger i folie+papp (varmt innhold) Flerbruksalternativer
6	Drikkebeger og lokk	106	1 490	Papir (med vokset belegg) Flerbrukskopp
7	Takeawayemballasje (EPS)	122	610	Papp+voks (kaldt innhold) Beger i folie+papp (varmt innhold) Flerbruksalternativer
8	Sugerør og rørepinner	526 / 79	210 / 50	Papir/tre Flerbruksalternativ
9	Snusbokser	80	1 200	*Ingen egnede alternativer*
10	Bæreposer	770	6 670	Papirposer Flerbrukspose i plast
11	Våtservietter	599	650	Engangs bomullspads Gjenbrukbar bomullsflanell
12	Snacksemballasje	58 / 126	380/ 610	Folie+ papir/papp pakning
13	Bestikk	455	1 180	Tre Flerbruksalternativ
14	Drikkekartonger	1 361	18 240	Glass flasker/ aluminiumsbokser/ flerbruksflasker
15	Sanitetsbind, tamponger og tampong applikatorer	229 / 249	1 420 / 1 360	Menskopp Gjenbrukbare menspads
16	Patronhylser	8	30	*Ingen egnede alternativer*
17	Sigarettfilter	800	96	*Ingen egnede alternativer*
18	Sigarettpakke-emballasje	126	1	*Ingen egnede alternativer*
19	Kontaktlinser	274	3.4	*Ingen egnede alternativer*

Resultater fra analysen

Med utgangspunkt i dagens forbruk av engangsartikler i plast (2018), har vi sett på hvilke produkter som utgjør den største faren for marin forsøpling. Bæreposen er det produktet som topper denne listen. Det er beregnet at 29 tonn bæreposer ender opp som marin forsøpling hvert år. Til tross for den lave vekten på en bærepose, er den store mengden bæreposer satt på det norske markedet årlig den viktigste årsaken til dette resultatet. På de neste plassene finner vi sanitærprodukter (våtservietter, sanitetsbind, tamponger og tampongapplikatorer) drikkevareemballasje (flasker og drikkekartong). Disse bidrar til henholdsvis 20,8 og 14,7 tonn (se Table 18).

Resultater fra scenario 2: 100 % overgang til flerbruksprodukter

Den største gevinsten oppnås ved en overgang fra engangsartikler i plast til flerbruksprodukter. Antall plastartikler som ender som marin forsøpling reduseres med 11 millioner enheter, eller 76 tonn ved en 100 % overgang. Avfallsmengden reduseres med totalt 62 000 tonn, (se Table 19).

Ved en overgang til flerbruksprodukter, viser resultatene at det er forbrukerne som oppnår de største besparelsene i form av reduserte utgifter til engangsartikler (4,3 mrd NOK). De samlede økonomiske besparelsene ved overgang til alternative flebruksprodukter er kalkulert til 3,5 mrd NOK per år. I tillegg oppnås en samfunnsmessig gevinst som er beregnet til 2,6 mrd NOK

Ved beregning av denne gevinsten er det tatt hensyn til at vask av flerbruksproduktene medfører et forbruk av vann på om lag 924 000 m^3, sammenlignet med 9000 m^3 for engangsartikler i alternative materialer. De produktene som medfører størst vannforbruk er take-away-emballasje og sanitetsprodukter.

Resultater fra scenario 1: Overgang til engangsartikler i andre materialer

Velger vi engangsartikler i andre materialer enn plast, øker vekten per enhet. Erstattes eksempelvis drikkeflasker i plast med glass, øker avfallsmengden vesentlig. Totalt er det beregnet en avfallsøkning på 545 000 tonn; 448 000 tonn blir materialgjenvunnet og 96 000 tonn går til energigjenvinning.

Overgang til engangsartikler i andre materialer gir reduserte utslipp av klimagasser som utgjør 950 000 tonn CO2-ekv. per år. Det bidrar også til at antall plastartikler som ender som marin forsøpling reduseres med 8 millioner enheter (se Table 19).

Bruk av alternative materialer vil ifølge beregningene føre til økte kostnader for forbrukeren. Våtservietter er det eneste produktet forbrukerne kan oppnå besparelser på ved å velge et alternattiv materiale. For noen produkter vil en overgang fra plast til andre materialer medføre en vesentlig kostnadsøkning. Dette gjelder først og fremst for drikkevareemballasje. For dette produktet vil derfor en overgang til flerbruksprodukter kunne være mer fordelaktig.

Gjennomførbarhet

Hvor sannsynlig det er å gjennomføre en 100 % overgang fra engangsprodukter i plast til andre materialer eller til alternative produkter, er avhengig av hvilke incentiver som tas i bruk for å få forbrukerne til å endre adferd og velge alternative materialer og flerbruksprodukter.

Engangsartikler i plast	Gjennomførbarhet
Drikkeflasker, korker og lokk og drikkekartonger	En 100 % overgang til andre materialer er ikke sannsynlig
Bomullspinner, sugerør, rørepinner, bestikk, ballongpinner	En 100 % overgang er gjennomførbar
Take-away-emballasje og servise	En 100 % overgang fra EPS til andre materialer er gjennomførbar
Veldig tynne poser (fruktposer) og bæreposer	En overgang er mulig for enkelte bruksområder
Våtservietter, sanitetsbind, tamponger og tampongapplikatorer	En overgang til alternative produkter er mulig
Snacksemballasje	En 100 % overgang til andre materialer er ikke sannsynlig for alle produkter

4 Introduction

The topic of marine litter has over the last couple of years increased in political and public focus in Norway and the EU. The littering of plastics is a growing problem, both on land and the marine environment. The Institute of Marine Research (HI) has spent the last 10 years mapping the oceanic currents along the coast of Norway. They have studied the currents to understand where marine litter will wash up on Norway's beaches. In the worst places there are 7 tonnes of plastic litter per square kilometre.[1] The littering of plastics can cause major damage to animals, plants and the environment.

Beach clean-up efforts have increased along the Norwegian rivers, lakes and coastline, and following this trend, so has the awareness of our use of plastic products, and especially those that are created for single-use. The discovery of the 'plastic whale' in Sotra, Norway, last year was a breakthrough for the Norwegian people in terms of increasing their awareness of the problems of plastic litter and microplastics in the marine environment.

Keep Norway Beautiful (KNB) (*Hold Norge Rent*) is a non-profit, member funded organisation that coordinates beach clean-up efforts to extract as much marine litter from the Norwegian coastline as possible. To ensure well targeted actions for clean-ups, waste handling as well as preventive actions, volunteers record what different items have been collected. These data represent valuable insights to the composition and likely origin of the marine litter and yearly reports from KNB indicate which items are the most commonly found.

Analyses by KNB and other organisations indicate that roughly 90 % of the litter on Norwegian beaches is plastic (based on the number of items found).[2] Single-use plastics (SUP) constitute a large part of this amount. These are items that are produced to be used once, characterised by very short use lifespans – sometimes just a few minutes - before they are thrown away. These items, along with other types of plastics, can break down into microplastics in the environment and cause damage to environments on land and in water.

In 2015, the European Commission adopted the EU Action Plan for a circular where it identified plastics as a key priority.[3] Subsequently, in 2018, the Commission adopted a Europe-wide plastics strategy.[4] This strategy lays the groundwork for transforming the way products are designed, produced, used and recycled within the EU. The overall aim of this strategy is to protect the environment whilst laying the foundations for a new plastics economy where reuse, repair and recycling are central. The EU Single-Use Plastics Directive is a central part of the EU Action Plan and targets many common consumer items (explained further in section 4.3).

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[1] Jensen, A. B. (2018). *De har snart kartlagt hele norskekysten. På det verste stedet er det inntil 7 tonn plast per kvadratkilometer.* TU. Website article. Available at: https://www.tu.no/artikler/de-har-snart-kartlagt-hele-norskekysten-pa-det-verste-stedet-er-det-inntil-7-tonn-plast-per-kvadratkilometer/444202 Last accessed 12.02.19

[2] Hold Norge Rent (2018). *Strandrydderapporten 2017.* Report. https://holdnorgerent.no/wp-content/uploads/2017/12/Strandrydderapporten-2017.pdf Last accessed: 12.02.19

[3] European Commission (2016). *A European Strategy for Plastics in a Circular Economy*. Available at: http://ec.europa.eu/environment/circular-economy/pdf/plastics-strategy-brochure.pdf

[4] European Commission (2018). *Plastic Waste: a European Strategy to Protect the Planet, Defend our Citizens and Empower our Industries.* Available at: http://europa.eu/rapid/press-release_IP-18-5_en.htm

Over the last year there has been a lot of debate of whether certain SUPs can be replaced by other materials or other products. There is consensus that beach clean-ups are not enough. The consumer market must be evaluated, and the pile of plastics reduced. In the evaluation of alternative concepts holistic thinking is important. There are many alternative concepts that could present part of the solution, however they could also potentially cause more problems than already existing ones. Quick-fixes will not solve any problems. Those alternative concepts that have the best cost-benefit ratio and are the most sustainable and environmentally friendly, are those solutions that must be marketed to producers and consumers.

4.1 Aims and Objectives

The overall aim of this study is to provide information on single-use plastics to the Norwegian Environment Agency in their work on providing guidance and expertise to the Ministry of Climate and Environment. The European Commission is proposing a ban of several SUPs by 2020. It is important that the Norwegian government has knowledge of these products, their value chains and environmental impacts before implementing any national regulations in this field.

Firstly, this study will include a mapping of today's use of SUPs in Norway. To understand the market, the project report will highlight information in these 5 areas:

1) **Volume**: What is the volume of SUP on the market today in tonnage and item numbers? (section 7.1)
2) **Consumption patterns**: Who are the consumers of SUP? Where are SUPs found? (Section 7.2)
3) **Plastic materials**: Most SUPs are made from fossil-based material, either PS, PP or PE. SUPs can also be bio-based or based on recycled plastics. The choice of material will impact the product's ability to be recycled. (section 6.3)
4) **Advantages of SUP**: Why do we have SUP on the market today? What are the advantages of these items? (section 7.3)
5) **Environmental consequences of current SUP in use**: Which single-use products contribute to littering? To evaluate alternative concepts, either alternative materials or products, it is necessary to understand the environmental impact of the current products in use. This information will be used when comparing existing products to alternative products/solutions. (section 0)

This study will also include knowledge regarding alternative products and solutions that can help reduce the littering and marine litter problems. The alternatives will be compared to the current products by studying these 4 main areas (section 0):

1) **Advantages**: What advantages do the alternative concepts have?
2) **Suitability:** To what extent are the alternative concepts suitable or do they require other changes?
3) **Environmental impacts**: What are the environmental impacts of the alternative concepts and how do they compare to SUP?
4) **Cost assessment**: What is the cost of the alternative concepts compared to current SUPs?

4.2 Refining the Scope

The assignment is limited to products made entirely or partly of plastics, which have a short service life before they become waste and can contribute to urban littering and marine littering. The scope also includes consumer-related products, regardless if they are used in households, or by private/public institutions (hospitals, schools, etc.). Plastic cups can for instance be used in schools, hospitals, at home, or somewhere they serve drinks. A closer look at the products chosen can be found in chapter 6.

Some products can be made using recycled material, however, this will not impact the fate of the product if littered. Plastic products can also be produced using bio-based or biodegradable material. Bio-based materials give the plastic product the same characteristics as products made using fossil material. Biodegradable plastics are made using bio-based material but can also include fossil-based plastics. As there is high uncertainty regarding whether these materials can degrade in the Norwegian environment, on land or in the ocean, these materials have been excluded from the scope of this study.[5]

Fishing gear, and other plastic products from various industries that are found on Norway's beaches are also excluded from the scope. Marine litter from fishing, aquaculture, building and construction, and various other industries, constitutes a large part of the litter that is found along Norway's coastline. We suggest these items are investigated in more detail in a separate study.

The report does to a minimal extent discuss the possibility of alternative solutions such as information campaigns, new deposit systems and improved collection of selected recycling fractions. An evaluation of measures related to government policy-making that can be implemented to incentivise the use of alternative materials or products has not been included.

4.3 European Commission – SUP Directive

In May 2018, the European Commission released an EU-wide proposal to target the 10 most common single-use plastic products found on beaches across Europe.[6] The aim is to reduce marine litter by implementing different measures for different products. These include bans, consumption reduction targets, collection targets, obligations for producers, labelling requirements, and awareness-raising measures. In late December 2018, the Presidency of the Council reached a provisional agreement with the European Parliament on the proposal.[7] An amended text was adopted in January 2019 by the European Parliament's Committee on the Environment, Public Health and Food Safety (ENVI) by 44 votes to 1 and will be put to a vote by the full House during its 25-28th March plenary session in Strasbourg.[8] The single-use plastics directive proposal builds on existing waste legislation; however,

[5] Mepex and Eunomia (2018). *Bio-based and Biodegradable Plastics.* Available at: http://www.miljodirektoratet.no/no/Publikasjoner/2019/Januar/Bio-Based-and-Biodegradable-Plastics/

[6] European Commission (2018). *Single-Use Plastics: NEW EU Rules to Reduce Marine Litter*. Press Release Database. Available at: http://europa.eu/rapid/press-release_IP-18-3927_en.htm Last accessed 21.02.19

[7] European Council of the European Union (2018). *Single-Use Plastics: Presidency Reaches Provisional Agreement with Parliament*. Press release. Available at: https://www.consilium.europa.eu/en/press/press-releases/2018/12/19/single-use-plastics-presidency-reaches-provisional-agreement-with-parliament/ Last accessed 21.02.19

[8] European Parliament Committee on the Environment, Public Health and Food Safety (2019), *Provisional Agreement resulting from Interinstitutional Negotiations*, accessible at http://www.europarl.europa.eu/doceo/document/A-8-2018-0317_EN.html?redirect

it goes even further by setting stricter rules for certain products. Table 1 shows which SUP items are facing which measures.

Table 1 – List of measures to reduce marine litter proposed by the European Commission[9]

Measure	Single-Use Plastic Items
Product bans (2 years after Directive entry into force)	• Plastic cutlery • Plastic plates • Plastic straws • Plastic stirrers • Plastic balloon sticks • Food containers made of EPS • Beverage containers made of EPS • Products made from oxo-degradable plastic • Cotton bud sticks made of plastic
Consumption reduction measures	• Take away food containers made of plastic • Plastic cups for beverages, incl. covers and lids
Use of recycled plastic	• 25 % recycled content in PET beverage bottles (2025) • 30 % recycled content in PET beverage bottles (2030)

Labelling requirements (2 years after Directive entry into force)	• Labelling on environmental impact and recycling options for:
	  ○ wet wipes
	  ○ balloons
	  ○ sanitary towels

Product design requirements	• Attach caps and lids to beverage containers
Extended Producer Responsibility Schemes	• Balloons • Plastic cups for beverages, incl. covers and lids • Take away food containers made of plastic • Beverage containers • Cigarette filters • Lightweight plastic carrier bags • Plastic packets and wrappers (crisps/ sweets) • Wet wipes • Fishing gear
Separate collection targets	• 77 % of all beverage bottles (2025) • 90 % of all beverage bottles (2029)

The provisional agreement in its current form still awaits confirmation by EU ambassadors of the member states. Following that confirmation, the directive can be submitted for approval to the

[9] Reloop (2018). *Update on Europe's New Waste Legislation: Single Use Plastics Directive*. Available at: https://reloopplatform.eu/wp-content/uploads/2018/12/SUPD-Backgrounder.pdf Last accessed 05.03.19

European Parliament and then back to the Council for final adoption.[10] As of March 2019 there have been no official developments on the Directive since December, however the importance of this Directive is clear and gives reason to believe that it will be accepted and confirmed before the summer of 2019. When the directive is finally accepted by the Parliament and Council, the member states will have 2 years to implement the directive in national regulations. For Norway, the directive must first be adopted in the EEA Joint Committee, although Norway can also decide to adopt the legislation at an earlier point.[11]

This study will assist the Norwegian Environment Agency in developing a Norwegian proposal on reducing marine litter by implementing measures for SUP items.

5 Methodology

The assessment presented in this report establishes the impacts of a complete switch away from single use plastics (SUPs) being mis-managed, and ending up on beaches and in the ocean, and towards viable single use non-plastic (SUNP), or multi-use (MU) alternatives. This movement from SUPs to SUNP or MU alternatives has been referred to as "item switches" throughout this report.

It is noted that the 100% item switches modelled represent the maximum level of environmental, economic and social costs and benefits that are likely to be associated with a complete move away from single use plastic items towards the SUNP/ MU alternatives modelled. In reality, 100% item switches may not be possible, or realistic, for all the categories of SUPs being considered, depending on the type and design of mechanism applied to encourage behaviour change associated with a particular level of switching.

As outlined in Section 4.2, the analysis of such mechanisms is out of the scope of this phase of work, precluding an assessment of further scenarios of likely levels of switches between SUP and SUNP/ MU items. As a result, the only scenario that has been modelled in this phase is that of a complete switch (100%) from SUP to SUNP/ MU alternatives.

The method used for the analysis of this scenario mirrors that used in Eunomia's prior study for the European Commission on *Plastics: Reuse, recycling and marine litter – Impact assessment of measures to reduce litter from single use plastics*.[12] This method includes the following key tasks:

- Identify key SUP items found in Norwegian beaches and terrestrial litter;
- Gather consumption data;
- Define viable alternatives;
- Model impacts of 100% switch from SUPs to alternatives;

[10] European Council of the European Union (2018). *Single-Use Plastics: Presidency Reaches Provisional Agreement with Parliament*. Press release. Available at: https://www.consilium.europa.eu/en/press/press-releases/2018/12/19/single-use-plastics-presidency-reaches-provisional-agreement-with-parliament/ Last accessed 21.02.19

[11] Sæther, M. (2019). *EU Enige om Resirkulering av Plastflasker og Produsentansvar på Sigaretter.* News Avfall Norge. Available at: https://avfallnorge.no/bransjen/nyheter/eu-enige-om-resirkulering-av-plastflasker-og-produsentansvar-p%C3%A5-sigaretter Last accessed 21.02.19

[12] Eunomia and ICF (2018). *Assessment of Measures to Reduce Marine Litter from Single Use Plastics*. European Commission DG ENV. Available at: http://ec.europa.eu/environment/waste/pdf/Study_sups.pdf Last accessed 05.03.19

- Model impacts of 100% switch from SUPs to alternatives; and
- Analysis of results and reporting.

Work undertaken in each of these tasks is described further below.

5.1 Data Gathering for SUP Items

In order to derive a Norway specific list of SUP items that are commonly found in beach litter, country level data from OSPAR and ICC (International Coastal Cleanup) were compared and analysed using the average ranking method, as used previously by the JRC.[13] To carry this out, a comparable category list was defined between the two datasets. All items that were either unidentifiable, non-plastic, multi-use, or fishing-related were removed from the analysis, leaving only single use plastic items. The full Keep Norway Beautiful dataset on terrestrial litter was not available at the time and so was not part of the dataset used in this ranking method, however, their top 10 list was used to refine the list of the top items that was derived using the OSPAR and ICC data. Accordingly, several items that were highly ranked in the OSPAR/ ICC data were removed (e.g. plastic yokes, syringes) in order to include other items that were more relevant to the litter issue in Norway (e.g. snus packaging). Finally, the list was reviewed and refined with the Norwegian Environment Agency.

A mass flow model structure for the SUP market was developed and based upon information on mass flows both in terms of tonnages and number of items. Information gathered includes current levels of manufacture and the consumption of specific SUP items, and information on their pathways (i.e. the routes by which they get to consumers and their subsequent fates).

Mass flow data has been good in some cases, but not for all SUP items. Several data gathering activities were undertaken to collect as much accurate data as possible. Data was gathered in different ways:

- Through commercially available data-sets
- Through publicly available data online
- By conducting interviews and questionnaires
- Through market reports
- By using available reports and other documentation

Consumption trends in Norway differ in many cases than those from the EU. Accordingly, the baseline was populated, to the extent possible, with data as to the number/tonnages of the relevant SUP items consumed in Norway. Import statistics as well as information from suppliers was used to collect data on the consumption estimates of the various SUP items in Norway. Where Norwegian estimates were not available, market data on consumption levels at a regional scale (either Western Europe or the Nordic region) were apportioned by GDP (gross domestic product) to arrive at an estimated figure for Norway. EU trends (for Sweden) were used as a baseline for calculating Norwegian consumption patterns. Although trends for Sweden cannot be directly transferred to Norway, the similarity of these societies implies that the littering trends and content will be similar. In all cases, the consumption

[13] Addamo A.M., Laroche P., Hanke G. (2017). *Top Marine Beach Litter Items in Europe: a review and synthesis based on beach litter data*. JRC Technical Report EUR 29249 EN, accessible at https://ec.europa.eu/jrc/en/publication/top-marine-beach-litter-items-europe

data were used to arrive at an estimate of the total number of items (in millions), that are likely to be consumed (and therefore constitute waste generation) in Norway in the reference year.

A questionnaire was conducted with NGOs, users and consumers of SUPs, the industry, both producers and suppliers of SUP items. This questionnaire was useful for gathering information on the various SUP items on the market and their consumption patterns.

5.2 Investigating Alternatives

In order to identify the single use non-plastic and multi-use alternatives to the SUP items of interest in Norway, the following key steps were undertaken:

1. A workshop with key stakeholders who are familiar with the form, functionality and practicality associated with SUP items and their alternatives was undertaken to develop a long list of potentially suitable alternatives (a list of attendees can be found in Appendix 12.1)
2. The project steering group undertook an expert assessment of the long list to determine a maximum of 1-2 key SUNP and MU alternatives that were most suited to replacing the SUP items studied in the Norwegian context – solutions that are currently not viable or do not meet the criteria for the alternatives were disregarded.

For those items for which suitable alternatives were not deemed to be currently viable/ freely accessible, alternative solutions/ measures to the issue of SUP litter associated with these were discussed, though no modelling of a switch to alternatives was undertaken.

The workshop also identified many ideas and suggestions on how to reduce littering and by listening to the actors directly involved, it helped to create a depth to the project that is difficult to achieve without this dialogue. Specific focus was placed on alternative materials and products that are available today, but attention was also placed on alternative solutions or concepts. Improvements on how waste management solutions can reduce littering were discussed to a small extent.

5.3 Modelling the Impacts of 100% Item Switches

In order to assess the impacts of a switch from SUP to SUNP / MU alternatives, a model previously developed by Eunomia for the European Commission study on *Plastics: Reuse, recycling and marine litter – Impact assessment of measures to reduce litter from single use plastics* (the EU SUP model) was used. The EU SUP model establishes the environmental, economic and social impacts of measures that may be used to encourage a switch to less environmentally harmful products and thereby address the issue of single use plastics (SUPs) being mis-managed and ending up on beaches and in the ocean.

The EU SUP model was modified to calculate the impacts associated with a 100% switch to SUP product alternatives, in order to assess the costs and benefits associated with a range of SUNP/ MU products relative to their SUP counterparts.

In addition, the model was updated with a range of Norway-specific data and key assumptions, including:

- Consumption and waste mass flow data (collection, sorting, treatment) for key SUP items that are commonly found in litter in Norway;

- Suitable alternatives for the Norwegian market based on conclusions from the workshop and Norwegian market information;
- Littering rates, litter fates, and externalities associated with litter;
- Financial information on the costs of products, as well as external cost of carbon in Norway; and
- LCI data on the additional items and alternatives modelled for Norway relative to those in the EU SUP model, as well as Norwegian energy mix data to inform the life cycle inventory analysis.

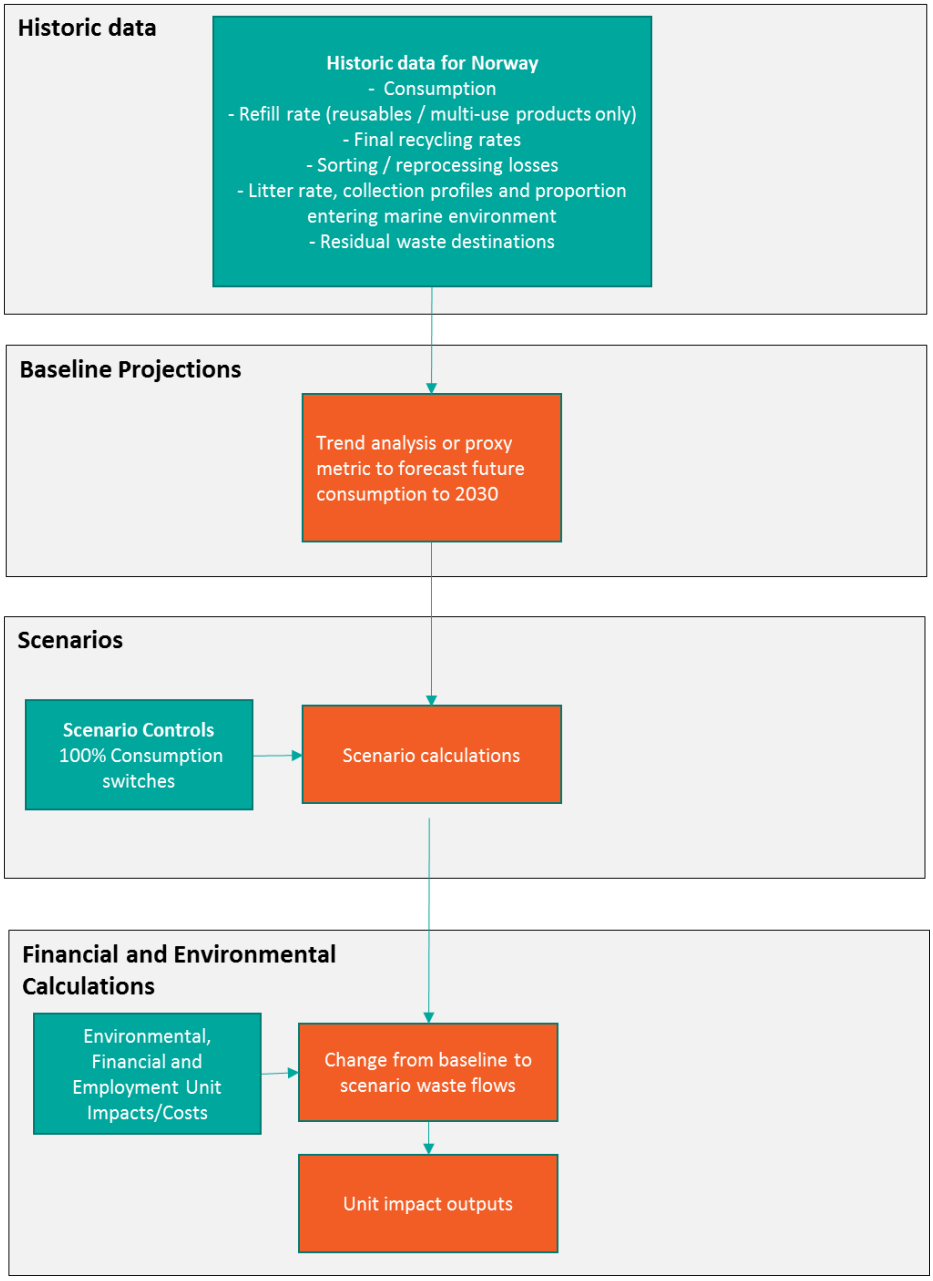
The method used to gather these data is further described in Section 5.4 below, with details on the findings and key assumptions finally used in the model further on in Sections 6 to 10.

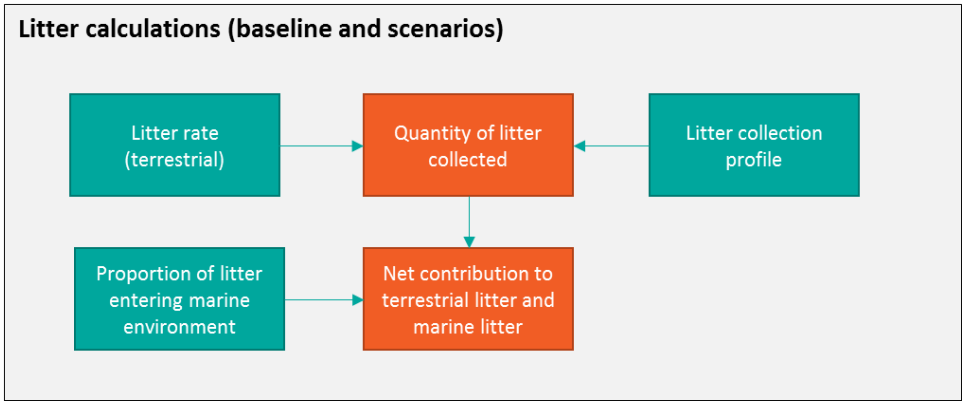
This information was fed into a range of modules that calculate the difference in environmental, economic and social costs between a baseline scenario, in which SUPs continue to be consumed at their current rate without any intervention (business as usual scenario), and a 100% switch scenario (in which SUPs are completely substituted by SUNP or MU alternatives). This was estimated as a function of the rate of change in mass flows between these two scenarios. The changes in mass flows associated with the 'switches' to alternatives therefore drove the calculation of the impacts. The model was also used to help clarify the advantages of the alternatives. In terms of modelling environmental impacts, the mass flow includes the consideration of changed behaviour at end of product life for multiple use products compared to single use ones (i.e. likelihoods for the items being recycled, treated as residual waste, or becoming litter persisting in the environment). The following impacts were estimated within this framework:

- Greenhouse gas emissions and environmental externalities. These include emissions from
  - Manufacturing
  - Washing/ refill of MU items
  - Recycling
  - Incineration/ landfill
- Social costs:
  - Manufacturing employment
  - Waste management employment
- Financial costs:
  - Consumer's Purchases
  - Retailer Sales
  - Producer Turnover
  - Washing/ refill of MU items
  - Recycling/ mixed waste treatment
- Litter related externalities:
  - Land based litter
  - Marine litter

The figure below summarises the design of the model and the key modules and data described above. In the following sections, the method used to update the model with Norway-specific data, as well as the findings of this data gathering, and the key assumptions applied in the model are explained.

Figure 1: Summary of Model Design





5.4 Identifying Norway-Specific Parameters in the Model

Having already completed similar projects for the European Commission on single-use plastic items, Eunomia has built a model used to assess the environmental consequences of the existing SUP items up against the suggested alternative solutions. To use the model in this study, the parameters were updated to illustrate the Norwegian situation.

5.4.1 Costs

The production of SUP items in Norway is limited, and most items are manufactured abroad and imported to the Norwegian market. The unit cost of each item (cost to the consumer) was investigated and will form the basis for the cost assessment of the alternatives.

5.4.2 Littering Rates

Where EU specific data on litter rates for items were available, these were apportioned down to account for the lower per capita littering rate in Norway (2 kg per capita compared to ~4 kg per capita EU-wide).[14,15] This data on littering was further reviewed and adjusted to derive best estimates for littering rates in Norway. Mepex provided data and knowledge based on experiences from working in the field of marine litter and waste management systems across Norway. Similarly, based on the littering rates thus estimated for SUPs Norway, the existing data in the EU SUP model regarding the relative proportion of SUNP and MU alternatives that are littered were apportioned down to provide a Norwegian *estimate*.

5.4.3 Litter Capture

Information on the prevalence of storm drain screening in Norway was investigated to establish the likely quantity of litter in drains that is intercepted in this way (and therefore the amount likely to enter the marine environment through sewer overflows etc.), as well as urban street clean-up services and water way clean-up programmes. Waste water treatment systems in Norway were also investigated, looking into:

- The proportion of combined sewers in the total network;

[14] Average 2012 and 2014/UNdata – personal contact with Oslo municipality
[15] Eunomia and ICF (2018). *Assessment of Measures to Reduce Marine Litter from Single Use Plastics*. European Commission DG ENV. Available at: http://ec.europa.eu/environment/waste/pdf/Study_sups.pdf Last accessed 05.03.19

- Screening systems used in waste water treatment works and how widespread they are; and
- Combined sewer overflows and potential screening on them.

Experts in this field were consulted and provided Norway-specific information on these points. Items discarded of in toilets are to a certain degree caught by screening systems in place in wastewater treatment plants, but this depends on the treatment method of the area. Mechanical treatment is common to reduce the outflux of suspended solids to the environment. However, over 100 000 households are not part of the waste water network, and 1,3 million households are part of smaller treatment centres that have lower treatment requirements. In general, there is little screening on combined sewer outflow.[16]

5.4.4 Item Recycling and Reject Rates

Information on waste management systems and recycling was important to indicate in the evaluation of the fate of SUP items in Norway. There are collection systems in place for certain SUP items, but due to the sorting and recycling systems in place, not all items will be successfully recycled. This is due to the intricate sorting and recycling technologies. The level of recycling will also highly depend on the downstream market for recycled material in the value chain. A full overview of downstream solutions to SUP items in Norway can be found in section 9.

5.4.5 Residual Waste Management

There is no dumping of residual waste on landfill sites. In Norway, all residual waste is sent to incineration with energy recovery. The plants produce energy for district heating only, but they can also be combined heat and power plants. Costs per tonne waste at these plants were given.

5.4.6 Emission costs

Regarding climate change impacts (GHG impacts estimated in tonnes CO2 equivalent), there are no agreed standard rates for CO_2 equivalents or other related emissions in Norway, and different costs are used. However, in the proposed Tax Bill for 2019, the Ministry of Finance uses a tax rate of 508 NOK/ton CO_2-equivalents. Standard rates for other environmental pollutants (e.g. NH_3, methane, NOx, SO_2 etc.) are not agreed upon and previous work on this is outdated.[17]

For air quality impacts, including nitrogen oxides (NOx), sulphur oxides (SOx), and particulate matter (PM), the specific monetary value of air quality impacts is based on those used in the EU Municipal Waste Model. These were based on modelling undertaken for the European Environment Agency. [18] As no data input for Norway was available in the EU model, the damage costs associated with key pollutants in Sweden were used as a proxy in this work.

5.4.7 Employment Intensity Data for Waste Management Systems

The number of jobs and the value of each worker at the waste management sites in Norway is unknown. As a result, employment intensity data for the EU has been used as a proxy.

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[16] Communication with Norsk Vann
[17] Communication with Menon Economics
18 The methodology used is summarised in: European Environment Agency (2011) Revealing the Costs of Air Pollution from Industrial Facilities in Europe, EEA Technical Report No 15/2011, November 2011, https://www.eea.europa.eu/publications/cost-of-air-pollution

5.4.8 Energy Mix Data

Life Cycle Inventory (LCI) data used in the EU SUP model were not updated for the items that overlapped between the EU study and the Norway study. New data were sought out for the additional items included in the Norwegian model, though the energy mix used in the manufacture of these items was not updated to reflect the Norwegian energy mix (which is less carbon intense for electricity than the EU on average). This is appropriate, as the bulk of the SUP items being analysed are not primarily manufactured in Norway, with the majority being imported from other countries – a situation similar to that of the rest of the EU. However, the LCI data used for the impacts of washing reusable items in Norway were updated to reflect the Norwegian energy mix (19.4 g/kWh for fossil CO2, 48.27 gCO2eq./ kWh for fossil, non-fossil CO2, methane in Norway, compared to 196.75 g/kWh for fossil CO2, 312.82 gCO2eq./kWh for fossil, non-fossil CO2, methane in the rest of Europe). Non-fossil CO2 here refers to biogenic emissions in the life-cycle (such as from peat disturbance but also, pertinent to this case, biogenic GHG emissions from hydropower).

6 Identifying SUP Items of Focus

A range of methods were used to categorise which SUP items were to be the focus of this study. The following subchapters indicate the level of pollution data that exists on the SUP items, as well as the reasoning behind choosing them and information on their material types.

6.1 Pollution Data

Single-use plastic items are those which are characterised by a very short use phase - sometimes just a matter of seconds in the case of plastic stirrers. Moreover, they do not need to be solely comprised of plastic, but plastic-containing. A good example of such an item is the disposable 'paper' cup, which includes a thin plastic lining.

The volume of single-use plastic products on the market today is extensive so the focus must be narrowed down to a selected number of products. Statistics on beach litter in Europe and Norway indicate which plastic items are most commonly found on beaches.

6.1.1 Marine Litter Data

The top 10 items found on beaches in Europe will vary between regions. The prevalence of certain items will be different in the Mediterranean Sea from the Baltic Sea, the North Sea and the Black Sea.[19] Table 2 shows how the prevalence of items will vary between countries across the Mediterranean Sea.

[19] Georg Hanke, Joint Research Centre (2016) *Marine Beach Litter in Europe – Top Items.* Technical Reports. Available at: http://mcc.jrc.ec.europa.eu/documents/Marine_Litter/MarineLitterTOPitems_final_24.1.2017.pdf Last accessed 20.02.19

Table 2 – Top 10 items by country (International Coastal Clean-up, ICC 2014 expressed as number of items/100m of beach.[20]

	Number of items per 100 m									
COUNTRY	Cigarette butts	Food wrappers	Beverage bottles (plastic)	Bottle caps (plastic)	Straws Stirrers	Grocery bags (plastic)	Beverage bottles (glass)	Other plastic bags	Paper bags	Beverage cans
Croatia	1540	97	21	86	0	83	34	74	36	22
Egypt	1	2	40	18	1	15	33	6	0	6
Greece	116	6	11	15	13	4	3	3	2	5
Italy	0	0	2	0	0	4	14	0	0	7
Malta	0	15	22	40	13	0	7	3	0	0
Slovenia	21	5	3	6	6	1	1	2	0	2
Spain	79	9	15	23	57	13	5	9	4	8
Turkey	785	14	29	73	22	26	18	4	4	26

OSPAR data for the North Sea is the European dataset that is likely to be the most similar to the Norwegian condition. Yet datasets from other sources were also evaluated. A normalized ranking of data from OSPAR, HELCOM, the MARLIN Project, the Mediterranean Action Plan, the Black Sea Commission, and the EEA Marine Litter Watch, was produced to indicate the common top 10 marine litter items found in Europe. A comparison of OSPAR data from the North Sea and the normalized data can be seen in Table 3. Other items that rank high are plastic food containers, plastic cutlery, balloons and plastic bags.

Table 3 – Ranking of the top 10 items found on beaches in the North Sea (according to OSPAR) and a normalized ranking of the top 10 items found on beaches in Europe.[21]

OSPAR ranking - North Sea		Normalized Ranking - Europe	
1	Plastic/EPS pieces (2.5-50 cm)	**1**	Nets and ropes
2	Plastic/EPS pieces <2.5 cm	**2**	Plastic pieces 2.5-50cm
3	String and cord (diameter <1 cm)	**3**	EPS pieces 2.5-50cm
4	Caps and lids	**4**	Caps and lids
5	Other textiles	**5**	Cigarette butts
6	Cotton bud sticks	**6**	Crisp packets/sweets wrappers
7	Crisp/sweets wrappers	**7**	String and cord (diameter <1 cm)
8	Rope (diameter >1 cm)	**8**	EPS pieces < 2.5 cm
9	Nets and pieces of nets (<50 cm)	**9**	Cotton bud sticks
10	Food incl. fast food containers	**10**	Drink bottles

[20] Ibid.
[21] Ibid.

The top 10 items found in Europe are somewhat different to those found in Norway. As previously seen in Table 2, the prevalence of marine litter items can vary largely between countries with coastlines on the Mediterranean Sea. Marine litter on Norway's beaches is a mix of litter coming from consumption on land, and litter arising from activities in the North Sea and in other countries. The currents along Norway's coastline impact the type of products that are found. Items from domestic consumption are arguably of greatest relevance in this study as these can be addressed these directly.

Table 4 shows the top 10 items found on beaches in Norway. The statistics derived from KNB come from findings recorded by volunteers during beach clean ups. This list is based on registered number of items collected. The list derived by Mepex is based on thorough analyses of beach litter from 10 locations in Norway. The lists are not identical, though multiple items are mutual for both lists.

Table 4 – Top 10 items found on beaches in Norway

Top 10 Marine Litter Items (KNB)		Top 10 Marine Litter items (Mepex)	
1	Unidentified plastic pieces	**1**	Unidentified plastic pieces
2	Rope (<50 cm)	**2**	Polystyrene (EPS)
3	Drink bottles and cans	**3**	Drink bottles and cans
4	Polystyrene (EPS)	**4**	Other bottles*
5	Caps and lids	**5**	Rope (>50 cm)
6	Plastic bags	**6**	Food packaging/take-away
7	Rope (>50 cm)	**7**	Rope (<50 cm)
8	Packing strips	**8**	Industrial plastic film
9	Cotton buds	**9**	Caps and lids
10	Cigarette buds	**10**	Packing strips

*A category that includes bottles that do not contain drinks or food-related items, e.g. liquid detergents, motor oil, lighter fluid etc.

6.1.2 Urban Littering

There have been few studies on urban littering in Norway. KNB increased their focus on urban litter starting in late 2018. Items littered on land can potentially end up as marine litter in the ocean. KNB completed an analysis of litter in urban areas in the city of Kristiansand in October 2018. The results of this study are displayed in the table below in addition to results from studies in Sweden and Denmark.

Table 5 – Top 10 urban litter items found in Kristiansand (Norway) (2018), Sweden (2017) and Denmark (2018).[22,23,24]

Top 10 Urban Litter Items (Norway)			Top 10 Urban Litter Items (Sweden)			Top 10 Urban Litter Items (Denmark)		
1	Chewing gum	53.7 %	**1**	Cigarette butts	63.2 %	**1**	Crisp/sweets wrappers	29 %
2	Cigarette butts	21.3 %	**2**	Snus packets	15.4 %	**2**	On-the-go products	20 %
3	Snus packets	7.8 %	**3**	Plastic pieces	7.4 %	**3**	Other metal	13 %
4	Other plastic pieces	4.0 %	**4**	Paper/carton	7.0 %	**4**	Sanitary items	10 %
5	Crisp/sweets wrappers	1.9 %	**5**	Other	2.6 %	**5**	Cigarette packs	8 %
6	Other metal	1.9 %	**6**	Other metal	1.6 %			
7	Other paper	1.5 %	**7**	Organics	1.4 %			
8	Take away cups	1.0 %	**8**	Glass	1.3 %			
9	EPS pieces	0.5 %						
10	Paint/tape/etc	0.5 %						
Total		**94.1 %**	**Total**		**100 %**	**Total**		**80 %**

One cannot draw conclusions from the study in Kristiansand for Norway as a whole. More knowledge is needed on this topic from several areas. Keep Sweden Tidy has conducted multiple studies on urban littering and one can assume that Swedish and Norwegian littering rates are quite similar as the consumption patterns in these societies are similar.

The limitations to data on urban littering rates is existing documentation is on the quantity of litter found at the time of recording. There is limited information on the total amount of items littered as wind, rain and other conditions will impact the dispersal of these items. It is therefore important to consider that these results provide knowledge of the items that have remained on the streets of the city, and do not include all the items littered.[25] The results from the analyses conducted in Norway, Sweden and Denmark contributed to determining the SUP items of focus for this study.

6.2 Items of Focus – 19 Single Use Plastic Items

The complete list of items that were used in this study can be found in Table 6. The selection of these items includes less visible items that pose problems to the marine environments to an unknown extent. Items such as cutlery, straws, plates and wet wipes are not commonly found littered in Norway. Although these items have a smaller presence in the Nordic top 10 items lists, they are

[22] Keep Norway Beautiful (2018). Presentation at workshop hosted by Mepex at the Norwegian Environment Agency
[23] Håll Sverige Rent (2018). *Skraprapporten 2018*. https://www.hsr.se/sites/default/files/skraprapport_2018_.pdf
[24] Hold Danmark Rent (2018). https://www.holddanmarkrent.dk/
[25] Sherrington, C. (2015). *Picking the Right Cherries: Packaging Waste and Litter.* Available at: https://isonomia.co.uk/picking-the-right-cherries-packaging-waste-and-litter/ Last accessed 20.02.19

included in the SUP Directive, and Norway could be required to implement measures to reduce the consumption of these items.

Drink cartons, snus packaging, and cartridge cases are examples of items that have been added to compiling the first list. After discussions with relevant actors within the field of marine litter and urban littering (Keep Norway Beautiful, WWF, Avfall Norge, Naturvernforbundet etc.) it became apparent that certain items must be included in the final item list even though their presence among litter has not been recorded to a great extent.

Table 6 – Complete list of single-use plastic items that will be the focus of this study

#	SUP item	Reasoning behind inclusion in this study
1	Drink bottles, caps and lids	Found on all beaches in Norway and in urban areas. A large share of the drink bottles found on beaches are of foreign origin, however, over half of all the bottles found were produced in Norway. This segment has been included in the EU SUP Directive and is therefore included here too.
2	Cotton buds	An item that is found at large on beaches near large populated areas. It is constantly on the top 10 lists of items found in Norway. This segment has been included in the EU SUP Directive and is therefore included here too.
3	Very lightweight plastic carrier bags (bags for fruit)	Large amounts of plastic film are found on Norway's beaches and in urban areas, though it is often difficult to know which product the film came from. As thin bags are often used for fruit, vegetable and baked goods, often on-the-go, it is assumed that these bags contribute a great deal to the total volume of littered plastic film.
4	Balloons and balloon sticks	Mass emissions of balloons have been banned in many cities, as have the sales of foil balloons. Ribbons and balloon sticks are often found on beaches and have therefore been included in this study. This category has been included in the EU SUP Directive and is therefore included here too.
5	Fast food packaging, plates and trays (non-EPS)	Not commonly found on Norwegian beaches but can be found to a smaller extent in urban areas. This category has received a lot of focus in the EU SUP Directive and it is therefore included in this study. These items have been paired in this category because their alternatives will be similar.
6	Beverage cups and lids	Although it has become more common to bring your own coffee cup from home, coffee in on-the-go cups are still frequently purchased. These are found to a lesser extent as marine litter but are a large contributor to urban pollution. This segment has been included in the EU SUP Directive and is therefore included here too.
7	Fast food packaging (EPS)	Small quantities are found on beaches, but large cities are more likely to experience littering from this type of item. This category

		has been included in the EU SUP Directive and is therefore included here too.
8	Straws and stirrers	Stirrers are used to a lesser extent in Norway compared to other countries. Existing stirrers are also commonly made of wood. The use of straws is more common. They have been paired in the same segment because the alternatives will in most cases be the same. This category has been included in the EU SUP Directive and is therefore included here too.
9	Snus packaging	Found both in urban and rural areas and on beaches.
10	Lightweight plastic carrier bags	The consumption of plastic carrier bags is high in Norway and they are commonly found on beaches and on the streets in urban areas. This category has been included in the EU SUP Directive and is therefore included here too.
11	Wet wipes	Wet wipes are not commonly found on beaches; however, this item is found in increasing amounts in the environment in Norway. People bring these along when they are hiking in the Norwegian countryside and as they do not dissolve in the same way as regular toilet paper, they end up littering the Norwegian wilderness. People also dispose of wet wipes in the toilet which can subsequently end up in the environment if they are not stopped by screening systems in waste water treatment plants. This segment has been included in the EU SUP Directive and is therefore included here too.
12	Crisp packets/sweet wrappers	A common on-the-go product and often found littered in public areas. This segment has been included in the EU SUP Directive and is therefore included here too.
13	Cutlery	Found to a smaller extent on beaches, but in higher quantities in urban areas. This segment has been included in the EU SUP Directive and is therefore included here too.
14	Drink cartons	Drink cartons, with a plastic barrier layer, are found in different sizes and a significant share of these are drink that are consumed on-the-go. It is expected that this segment will likely be found littered in urban areas. They are also found at different extents on beaches.
15	Sanitary towels (pads), tampons and tampon applicators	A large amount of tampons and sanitary packaging are disposed of in toilets and subsequently end up in the ocean as a result of the current wastewater treatment systems in place in Norway.
16	Shotgun cartridges	Hunting activities occurs in the mountains, by forests and lakes and along the coast. Shotgun cartridges are commonly found littered in these areas.
17	Cigarette filters	The littering of cigarette butts is a major problem in Norway. This segment has been included in the EU SUP Directive and is therefore included here too.

18	Cigarette plastic packaging	Plastic film is a large share of the total littered amounts in urban areas and on beaches. This plastic film is difficult to identify among litter if it has been exposed to weathering for a longer period of time. It is expected that this item will be heavily littered as the product is mostly used outside.
19	Contact lenses	Contact lenses are used by ca. 8 % of the Norwegian population. Every person uses on average 730 contact lenses per year. It is assumed that a large share of these people disposes of their contact lenses in the toilet. There is no record contact lenses being found littered in urban areas or on beaches, however their presence is inevitable, and the impacts related to this are unknown. This item is therefore included here.

It is noted that for the purposes of the modelling, several of these item categories were separated in order to facilitate analysis of the impacts of switching to alternatives SUNP/ MU items. Accordingly, straws and stirrers were assessed separately, as were crisp packets and sweet wrappers, and tampons (and applicators) and sanitary pads. In addition, several items were not included in the modelling due to a lack of known viable alternatives at present (both in terms of functionality and well as availability). These included balloons (though balloon sticks were modelled), crisp packets, shotgun cartridges, cigarette filters and packaging, and contact lenses. For these items, suitable policy measures can be designed in order to reduce either their consumption or the pattern of littering associated with them – though this is out of the scope of the present study. This is further described in section 8.2.

7 SUP Market in Norway and Consumption Patterns

7.1 Volume Data

The table below outlines the volume of items estimated to be consumed in Norway in 2018 (number of items used in the model), and the associated tonnage of waste generated associated with this level of consumption (2018).

Table 7 – Information on the volume of SUP items in Norway in 2018

	Single-Use Plastic Item	Final # of items modelled (millions pa, 2018)	Final waste generated (Tons, 2018)
1	Beverage bottles, caps and lids	632	22 570
2	Cotton buds	631	150
3	Very lightweight plastic carrier bags (bags for fruit)	263	360
4	Balloons and balloon sticks	26 / 0.3	80 / 2
5	Fast food packaging, plates and trays (non-EPS)	137	2 750
6	Beverage cups and lids	106	1 490
7	Fast food packaging (EPS)	122	610

8	Straws and stirrers	526 / 79	210 / 50
9	Snus packaging	80	1 200
10	Lightweight plastic carrier bags	770	6 670
11	Wet wipes	599	650
12	Crisp packets/sweet wrappers	58 / 126	380/ 610
13	Cutlery	455	1 180
14	Drink cartons	1 361	18 240
15	Sanitary towels (pads) and tampons and tampon applicators	229 / 249	1 420 / 1 360
16	Shotgun cartridges	8	30
17	Cigarette filters	800	96
18	Cigarette plastic packaging	126	1
19	Contact lenses	274	3.4

7.2 Consumption Patterns

The volumes, number of users, points of sale and overall selection of SUP items has been increasing over the last decade. Since the discovery of the 'plastic whale' in Sotra in 2018, our attention to and awareness of plastics has increased, and this is altering our consumption patterns.

The sale of typical on-the-go products has gone up in the last decade. There are a range of biodegradable and compostable alternatives available on the market and there is a growing interest among companies, industry and the public to pay for alternatives that are marketed as eco-friendly. The demand for alternatives made from bamboo, wood, paper or metal are increasing.

Some industries have been required to make changes to their product to reduce consumption. The producers of snus packaging had to standardise their colour and label in 2017. However, this change has not resulted in a decrease in consumption levels. A study undertaken by SSB indicates that 12% of the Norwegian population between 16-74 years of age, uses snus on a regular basis.[26] To reduce the risk of littering, the snus industry has initiated a deposit system to collect snus packaging for recycling.[27]

The use of cigarettes in Norway changed drastically after the new law came into play in 2004. Prior to that, people could smoke in smoking rooms in restaurants, inside public areas, or at the work place. There were even smoking rooms in hospitals! Over the last decade the habits have changed and people now smoke their cigarettes outside. With an increase in people smoking outside, there is a

[26] Helsedirektoratet (2018). *Standardiserte Tobakkspakninger).* Available at: https://helsedirektoratet.no/folkehelse/tobakk-royk-og-snus/standardiserte-tobakkspakninger Last accessed 15.03.19

[27] Infinitum Movement (2018). *Millioner av Norske Snusbokser Kastes Årlig i Søpla eller i Naturen. Nå Initieres et Pantesystem for Plastboksene.* Available at: https://infinitummovement.no/vil-ha-pant-pa-snusbokser/ Last accessed 15.03.19

higher chance that cigarette filters will contribute to the littering. Recent statistics from SSB (2018) indicate that the number of daily smokers has decreased from 21% to 12% over the last decade.[28] E-cigarettes are becoming more and more popular to reduce consumption and as a replacement for conventional cigarettes.

Some SUP items, e.g. wet wipes, have a usage area that keeps expanding. They are used for cleaning babies and children, for removing make up, at restaurants, on planes, at festivals, and to clean your computer or the dashboard in your car. Increased tourism levels have also led to an increase in the amount of littered wet wipes in the environment. The durable wet wipes, if flushed down the toilet, can get caught in the drainage system and create blockages.[29]

Another product that gets flushed down the toilet is contact lenses. Daily contact lenses have become more and more common and are not always disposed of in the waste bin. Awareness campaigns produced by the industry has increased awareness amongst consumers and this is hopefully starting to give results.

Handelens Miljøfond, the Norwegian Retailers Environment Fund, was created in 2017 by the industry to reduce the consumption of lightweight plastic bags. Members of this fund pay 0,50 NOK for each lightweight plastic bag they purchase. The collected funds will be used to assist in the implementation of measures to reduce consumption. Although the fund has not been in operation for a full year yet, it has already led to a reduction in the number of plastic bags purchased by 10%.

An example where the industry has independently made a change, is for cotton bud sticks. In 2018, most of the producers of cotton bud sticks switched from paper to plastic. Shops of different sorts have also started their own initiatives to reduce the consumption of plastic by offering a wider selection of different SUP items with different materials. In many of the larger retailers today you can choose between plastic and paper bags. Demand for niche products has increased and many suppliers have specialised in alternatives to single-use plastic products, such as products made from bio-based materials. It is a niche market, but with growing interest among companies and institutions willing to pay for these more expensive alternatives.

The focus on sustainable packaging has also contributed to an increase in the use of multi-use items such as bags for fruit, carrier bags and multi-use coffee cups. It is becoming more accepted to bring your own coffee cup to a café, and some cafes even offer a discount if the consumer brings their own cup.

Some SUP items can be purchased at several locations, such as crisps and sweets. These can be purchased in grocery stores, pharmacies, kiosks and petrol stations, cafés etc. While other products, e.g. contact lenses, can only be purchased at limited locations: at opticians or on the internet. A non-exhaustive list of the locations where SUP items can be purchased can be found in Table 8.

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[28] NTB (2019). *Flere Snuser og Færre Røyker.* Available at: https://www.abcnyheter.no/helse-og-livsstil/helse/2019/01/18/195493357/flere-snuser-og-faerre-royker Last accessed 15.03.19

[29] Dagbladet (2018). *Sjokkbildet Viser Hvorfor Myndighetene har Fått Nok. Nå går de til Krig mot Våtservietter.* Available at: https://www.dagbladet.no/nyheter/sjokkbildet-viser-hvorfor-myndighetene-har-fatt-nok-na-gar-de-til-krig-mot-vatservietter/69785459

Table 8 – Non-exhaustive list of locations where SUP items can be purchased

SUP-item	Pharmacies	Grocery Stores	Kiosks and Petrol Stations	Hotels, Cafes and Restaurants	Other Specialist Shops	Festivals and Events	Online Suppliers
Sanitary towels (pads), tampons and tampon applicators	X	X	X	X			
Wet wipes	X	X	X		X		X
Cotton buds	X	X					
Contact lenses					X		X
Very lightweight plastic carrier bags (bags for fruit)		X	X				
Lightweight plastic carrier bags	X	X	X		X	X	X
Crisp packets/ sweet wrappers	X	X	X	X	X	X	X
Snus packaging		X	X	X			
Cigarette plastic packaging		X	X	X			
Beverage bottles, caps and lids	X	X	X	X	X	X	
Drink cartons		X	X	X	X	X	
Fast food packaging, plates and trays (non-EPS)		X	X				X
Fast food packaging (EPS)		X	X				X
Beverage cups and lids		X	X				X
Straws/ stirrers		X	X		X		X
Cutlery		X	X		X		X
Cigarette filters		X	X				
Shotgun Cartridges					X		
Balloons and balloon sticks		X	X		X		X

7.3 Advantages of SUPs

Single-use plastics have many advantages and these highly account for why they have become so widely used in society today. Plastic has many great qualities. It is a lightweight, durable material that is mechanically strong and can withstand high force. It is an inexpensive material that is easy to produce and can be used in many different products depending on the requirements.

Single-use plastics offer an easy, time-saving alternative that have numerous benefits in many parts of society. Many of the selected SUP items in this study are on-the-go items used outside homes, restaurants and cafes. On-the-go items make it easy for people to buy coffee and snacks and other types of food to eat when they are on their way from A to B or enjoying their meal in a park on a sunny day. SUPs provide a simple, accessible way of enjoying a beverage or snack.

Single-use items are also effortless and require little clean-up. They can be discarded of in the waste bin and there is no hassle with washing up dishes or drying them afterwards. Items that can be discarded of after use also offer benefits in hospitals and other areas where the risk of contamination and the spread of diseases is high. Single-use products offer security to hospitals and institutions where the spread of an infection could be detrimental. Wet wipes are often found where there is limited access to running water. The use of wet wipes will limit the growth of bacteria and will improve personal hygiene.

Other SUP items categorised in this study have purposes and benefits that do not necessarily impact the consumer directly. Drink bottles made from plastic are more lightweight than those made of glass and offer various savings and advantages along the value chain, e.g. a reduction in transport costs as more bottles can be transported at once. The plastic surrounding cigarette packs increases the longevity of the cigarettes and prevents them from going stale.

7.4 Item Weights and Compositions for SUP items

A criterion for the single-use items chosen were that they were, to some extent, made from plastic. All the chosen single-use items are made from plastic or have plastic incorporated in their design. Table 9 shows the composition and weights of each SUP item used in the model.

Table 9 – List of material types for each SUP item.

SUP Item	Weight (g)	Composition
Caps and lids for drinks bottles	2	100% plastic
Drinks bottles	34.3	100% plastic
Cotton buds	0.23	74% plastic 26% cotton
Very lightweight plastic carrier bag (>15 microns)	1.36 g (0.68 kg per roll @500)	100% plastic
Balloon sticks	5.75	100% plastic (Polystyrene)
Fast food packaging, plates and trays (non-EPS)	20 g (est.)	100% plastic
Beverage cups and lids	14	65% plastic

		35% paper/card
Fast food packaging (EPS)	5	100% EPS
Straws	0.4	100% plastic
Stirrers	0.6	100% plastic
Snus packaging	13	100% plastic
Lightweight plastic carrier bag (>50microns)	15.0	100% plastic
Wet wipes	1.1 (dry)	45% plastic 55% other (Composition is split into "petroleum-based materials" and "cellulose based materials", here separated into Plastic and Other)
Crisp packets	6.6	50% plastic 50% foil
Sweet wrappers	4.8	100% plastic
Cutlery	2.6	100% plastic
Drinks cartons	13 g (330 ml) (straw = 0.4g, prorate impacts from SUP straw impacts based on relative weights)	Paperboard (72%) Polyethylene/other plastic (24%) Aluminium foil (4%)
Sanitary towels	6.2	49% plastic 51% paper/ pulp
Sanitary towels (pads) and tampons and tampon applicators	Tampon - 2.95 g Applicator – 2.5 g	Cotton – 26.5% (core/string) Viscose rayon – 26.5% (core) Polyethylene/polyester – 2% (around core) Card – 45% (applicator)
Shotgun cartridges	3.7	100 % plastic (although they do contain a part made of brass, this is not typically found littered)

8 Alternative Concepts

These sections highlight the key results from the tasks undertaken to identify suitable SUNP and MU alternatives to the 19 SUP items of focus in this study, as outlined in Section 5.2

8.1 Final List of Alternatives

The table in Appendix 12.1 gives an overview of all the suggested alternatives that were proposed during the workshop. Not all alternatives suggested are feasible substitutions today, and the scope of modelling was limited to 1-2 key alternatives for each item. The shortlisted key alternatives in Table 10 are likely to impact on littering behaviour and constitute non-plastic or multi use alternatives that are already available, and that provide a feasible, functional alternative to the SUP items of focus. It is noted that these alternatives were considered both from the point of view of material substitution (e.g. single use paper instead of single use plastic) as well as product substitution in respect of the way in which products are used (e.g. refillable plastic water bottle instead of SUP bottle).

Table 10 – Final list of alternatives included in the model

Included in SUP Directive	SUP Item	Alternatives
X	Beverage bottles, caps and lids	Glass bottles/ aluminium cans/ Multi-use bottles
X	Cotton buds	Cardboard/paper stick Multi-use plastic alternative
	Very lightweight plastic bags (bags for fruit)	Paper bags Multi-use plastic bags
X	Balloons and balloon sticks	Wooden/card stick
X	Fast food packaging, plates and trays (non-EPS)	Card + wax for cold applications Foil container and card for hot applications Multi-use alternatives
X	Beverage cups and lids	Paper (with natural wax coating) Multi-use cup
X	Fast food packaging (EPS)	Card + wax for cold applications Foil container and card for hot applications Multi-use alternatives
X	Straws and stirrers	Paper/ wood Multi-use alternative
	Snus packaging	*No suitable alternatives*
X	Lightweight plastic carrier bags	Paper bags Multi-use plastic bags
X	Wet-wipes	Single use cotton pads Reusable cotton flannel
X	Crisp packets	*No suitable alternatives*
X	Sweet wrappers	Foil + Paper/card wrapping
X	Cutlery	Wood Multi-use alternative
	Drink cartons	Glass bottles/ aluminium cans/ Multi-use bottles
	Sanitary towels (pads) and tampons and tampon applicators	Menstrual cup Sanitary pads of cloth (inserts only)
	Shotgun cartridges	*No suitable alternatives*
X	Cigarette filters	*No suitable alternatives*
	Cigarette plastic packaging	*No suitable alternatives*
	Contact lenses	*No suitable alternatives*

As discussed above, for certain SUP items, there are a range of materials that can substitute plastic. Straws can for instance be made of metal, different types of wood, or paper. Not all materials are suitable or viable alternatives today. Other alternatives did not have the same function as the original SUP item.

In these cases, some of the alternatives suggested for these items were reduction measures. A reduction measure is not an alternative, but a target that can be enforced to reduce consumption. For example, a deposit system is a way to enhance the collection of a product to reduce the amount that ends up in the environment, but it is not an alternative to the existing product and will not replace that product. It does not involve a transfer from one alternative to another, though in some cases such measures can drive innovation in the development of more suitable alternatives. The measures proposed for items with no viable alternative at present are discussed in the next section.

8.2 Items with No Suitable Alternatives

Not all SUP items on the list have direct alternatives that could be included in the modelling. A discussion around these items and the reasoning behind why they have been excluded from the modelling can be found in the sub-chapters below.

8.2.1 Crisp Packets

Crisp packets (metallised film packaging in which crisps are commonly pre-packaged and sold) commonly have a thin layer of metallised plastic film on the inside of the packaging to keep contaminants and moisture outside, while simultaneously preventing the leaching of its own components. [30] These barrier properties are necessary to keep the product crisp and crunchy for a long period of time. If this layer is removed, the longevity of the product is significantly reduced. Additionally, the metallised film allows for vivid printing and branding on the product – this cannot be achieved using single-layer films. Therefore, no tried and tested SUNP or MU alternatives currently exist that have the same performance characteristics as metallised film.

As per today, there are no alternatives materials that can replace crisp packets. This item has therefore been excluded from the modelling. Instead it is proposed that extended producer responsibility (EPR) for the management of waste crisp packets at end of life (including litter clean up, awareness campaigns, collection, treatment and disposal) is likely to help with tackling the issue at present and provide an incentive to producers (in terms of cost avoidance) to develop practically recyclable and/ or reusable alternatives.

[30] Kowatsch, A. (2017). *Smart Packaging: Potato Chip Bags.* Website. Medium. Available at: https://medium.com/@AntonioKowatsch/smart-packaging-potato-chip-bags-ba6ea39274e7 Last accessed 05.03.19

8.2.2 Cigarette Filters

Cigarette filters were created in the 1950s in an effort to make filtered cigarettes a 'healthier' alternative to the cigarettes without filters. These filters contain small plastic particles that will not break down in the environment if littered.[31]

However, the most detrimental consequence from the littering of these filters comes from the content of harsh chemicals like nicotine, arsenic and heavy metals. These chemicals can leach into the environment and be toxic to land and aquatic organisms. They also contain human carcinogens that can accumulate in the environment.[32]

There have been few advances in producing a cigarette filter that does not contain plastic. Filters made from organic material, like hemp and wood pulp have been developed, though only on small scale. It is also uncertain whether such filters will meet the requirements set for filters in terms of functionality and draw.[33] So far there are no viable alternatives for cigarette filters, and this category has been removed from the modelling.

Alternatively, cigarettes could be redesigned to be produced without filters, or with limits on the amount of plastic in filters, with consumers given the additional choice of buying a reusable filter should they so desire. Extended producer responsibility for the end of life management of cigarette related waste and litter would further incentivise innovation on this front.

8.2.3 Cigarette Plastic Packaging

The plastic packaging that surrounds cigarette packs is a thin layer of PP film. This film prevents the cigarettes from losing their moisture and becoming stale. This film is essential in providing this barrier property, and there are no known materials that can replace the PP film, while still providing longevity to the cigarettes. This product has therefore been excluded from the modelling. Alternatively, the packaging could be redesigned to ensure the plastic packaging remains attached to the cigarette carton, though this should not be incorporated in the format of a multi-layer material (which is then prone to recycling barriers).

8.2.4 Shotgun Cartridges

There are several types of shotgun cartridges, and they contain different material types such as brass, plastic and paper. The two plastic elements pose a threat to the environment if littered: the case and the wad. The case stays put in the shotgun after firing, while the wad is transported 10-20m away after firing the shot.

Hunters are responsible for the littering of shotgun cartridges in the environment. Around 80 % of the total volume of shotgun cartridges are used on shooting ranges. It is the last 20 % that pose a threat to the environment and that could end up as marine litter.

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[31] Dangerfield, K. (2018). *Cigarette Butts are Polluting the Ocean more Than Plastic Straws – so Why not Ban These?* Global News. Website. Available at: https://globalnews.ca/news/4418956/cigarette-butts-ocean-pollution-ban/ Last accessed 05.03.19

[32] Ibid.

[33] Ibid.

There are no existing material alternatives to plastic today that have these same qualities. A solution that has been developed is a shotgun cartridge case made of paper and felt, materials that were in use before plastic made its headway into this market.[34] However, a paper casing will be difficult to use if the paper gets wet due to rain and moist weather. There are also technical challenges tied to using felt.

The Norwegian hunter's and fisheries organisation mention that studies have investigated biodegradable alternatives; however, it is uncertain whether they will decay in the environment, and how long it will take. There is no consensus that biodegradable material is a solution to the littering problem.[35]

Wads made from fibre (based on corn fibre/starch) is an alternative available for certain cartridges. The challenge these types of cartridge cases pose it that they are bulky and difficult to combine with the larger cartridges. Plastic is the most suitable material for cartridge wads and cases and a shift to other materials demands technological developments that will take time to achieve.[36]

8.2.5 Contact lenses

There are several alternatives to daily contact lenses, such as weekly or monthly contact lenses or glasses. A switch to weekly or monthly contact lenses represents a reduction in consumption and is not covered by the definition we have created in this study, which is a switch to an alternative material, product or solution. Glasses have the same function as contact lenses, though they cannot replace contact lenses in all usage areas (e.g. sports).

Eye surgery can remove the need for contact lenses, but this is not a direct alternative to contact lenses where the function remains the same. It is an expensive, alternative solution that is not available to everyone in society.

A measure to reduce the incorrect disposal of contact lenses could be to introduce labelling on the packet with information on the appropriate way of disposal. Information on this has been added to the packets by some suppliers, and this trend appears to be increasing.

8.2.6 Snus Packaging

Snus packaging for pre-portioned snus is usually made of coloured polypropylene with labels/ branding adhered to the surface. The snus pouches themselves are made of synthetic cellulose fibres (similar to tea bags). While the snus cans are often found in beach litter clean ups, the pouches also pose a problem in the wider environment when flushed down the toilet or littered instead of proper disposal.

While recycled paper/ cardboard alternatives for snus packaging are available for loose snus, the pre-portioned snus pouches are more vulnerable to drying out, making this solution unviable. In addition,

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[34] Stokke, S. (2005). *For Mange Tomme Haglpatroner Etterlates i Rypeterrengene.* Website. Naturvernforbundet. Available at: https://naturvernforbundet.no/naturogmiljo/import/for-mange-tomme-haglpatroner-etterlates-i-rypeterrengene-article9745-1009.html Last accessed 05.03.19

[35] Farstad, E. (2018). *Vil ha Slutt på Plastforurensning.* Norges Jakt og Fiskerforbund. Website. Available at: https://www.njff.no/nyheter/Sider/Plast-fra-haglpatroner.aspx Last accessed: 05.03.19

[36] Ibid.

aluminium cans/ tinplated reusable cans are available internationally, though these are not a viable solution in Norway. Regulations in Norway set strict standards for the design of the snus packaging and there are no suggested alternatives to the polypropylene box used today.

8.3 Item Weights and Compositions for Alternatives

The material compositions and unit weights of the final alternatives modelled for each SUP item included in the model are summarised in Table 11 and Table 12 respectively below. It is noted that where the alternatives for several categories of SUPs were the same, the categories have been suitably combined to avoid repetition of information in the presentation of the data (e.g. drinks bottles and drinks cartons, sanitary towels and tampons, etc.).

In order to gather these data, for those shortlisted alternatives that were previously studied in the EU SUP model, composition and weight data was not updated. For others, data on the material composition and weights of the key alternatives were derived on the basis of:

- Market share/ proportion of material by weight (only where more than one SUNP/ MU alternative was identified) from product manufacturer/ sellers websites;
- Secondary literature on the composition of individual items;
- Personal communication with key producers/ sellers where necessary; and
- Primary research (particularly for weight data) undertaken by weighing relevant items.

Table 11 – The final alternatives modelled for each SUP items included in the model.

SUP item	SUNP Composition	MU Composition
Caps and lids for drinks bottles	100% aluminium	N/A
Drinks bottles/ drinks cartons	28% aluminium cans 72% glass bottles[37]	Plastic= 44% Aluminium = 56%
Cotton buds	74% paper 26% cotton	100% plastic (MDPE)
Very lightweight plastic bags	100% paper	100% polyester
Balloon sticks	100% wood 100% paper	N/A
Fast food packaging, plates and trays (non-EPS)	Foil = 66% aluminium 33% cardboard Card container (with mineral oil coating) = 100% cardboard (minimal wax so not counted) TOTAL: 66.5% card, 33.5% aluminium (assuming 50-50 market share)	100% stainless steel
Beverage cups and lids	100% cardboard (plus minimal amount of mineral oil)	100% plastic (silicone mix)
Fast food packaging (EPS)	Foil = 66% aluminium 33% cardboard	100% stainless steel

[37] Market data on the share of the total volume (tonnes) of beverages sold in rigid metal and glass containers in Norway in the year 2018 (forecast from 2016), Global Data (2017)

SUP item	SUNP Composition	MU Composition
	Card container (with mineral oil coating) = 100% cardboard (minimal wax so not counted) TOTAL: 66.5% card, 33.5% aluminium	
Straws	100% paper/card	50% silicone, 50% stainless steel
Stirrers	100% Wood	50% polyester, 50% stainless steel
Lightweight plastic carrier bag	100% paper	100% woven polypropylene
Wet wipes	100% cotton	100% cotton
Sweet wrappers	Foil 12-20% Paper/card 80-88%	N/A
Cutlery	100% Wood	50% polyester, 50% stainless steel
Sanitary towels (pads), tampons and tampon applicators	N/A	61% medical grade silicone 39% cotton

The unit weights of the final alternatives modelled for each SUP item included in the model are summarised in Table 12 below.

Table 12 – The final alternatives modelled for each SUP items included in the model.

SUP item	SUNP Item/ weight (grams per unit)	MU Item/ weight (grams per unit)
Caps and lids for drinks bottles	2	N/A
Drinks bottles/ drinks cartons	284.64	152.5 (includes cap)
Cotton buds	0.23	3
Very lightweight plastic bags	3.56	23
Balloon sticks	5.75	N/A
Fast food packaging, plates and trays (non-EPS/ EPS)	15.55	158.10
Beverage cups and lids	10	96
Straws	0.8	11.05
Stirrers	1.9	13.5
Lightweight plastic carrier bag	34.4	98
Wet wipes	2.5	6.7
Sweet wrappers	9.35	N/A
Cutlery	2.6	20.7
Sanitary towels (pads) and tampons and tampon applicators	N/A	21

Finally, the number of uses associated with the multi-use items before they are assumed to become waste was also estimated using pre-existing data from the EU SUP model (see EU SUP impact assessment report Annex section 2.3.2).[38] This was done in the previous study by benchmarking current consumption data against estimated lifetime in years of a product. Some input from industry sources was also gathered. The final estimates used are summarised in the table below.

Table 13 - Estimated Number of Uses of MU Items before Waste

SUP item	MU item	Per capita per day consumption	Lifetime, years	# uses before waste
Caps and lids for drinks bottles/ drinks bottles/ drinks cartons	Plastic/ metal bottle	0.32	10	1,168
Cotton buds	U-tip ear cleaner	0.32	2	234
Very lightweight plastic bags	MU woven plastic bag	0.13	10	475
Fast food packaging, plates and trays (non-EPS/ EPS)	MU plastic/ metal box	0.07	5	128
Beverage cups and lids	MU plastic cup (silicone/ rubber)	0.05	10	183
Straws	MU Plastic/ metal straw	0.27	10	986
Stirrers	MU Plastic stirrer/ metal teaspoon	0.04	20	292
Lightweight plastic carrier bag	MU woven plastic bag	0.39	10	1,424
Wet wipes	Cotton flannel	0.31	20	2,263
Cutlery	MU Plastic/ metal cutlery	0.23	20	1,679
Sanitary towels (pads), tampons and tampon applicators	MU pad/ menstrual cup	0.13	5	237

9 Waste Management and Recyclability

On-the-go products are those items that are regularly thought of as contributing the most to the littering problem. Straws, cutlery, take away packaging, and beverage cups and lids are some of the items that are commonly found on beaches across Europe. The litter found on beaches in Norway consists of typical on-the-go items, but their share is much smaller than in Europe because of the high share of litter from fisheries and aquaculture, industry and other personal non-on-the-go items.

[38] Eunomia and ICF (2018). *Assessment of Measures to Reduce Marine Litter from Single Use Plastics*. European Commission DG ENV. Available at: http://ec.europa.eu/environment/waste/pdf/Study_sups.pdf Last accessed 05.03.19

This is the case when looking at products both by item and by weight according to data collected by Mepex on marine litter.

9.1 Littering Rates

It is assumed that a large proportion of the littered items are subsequently intercepted (i.e. collected and disposed of either through waterway cleaning, street cleaning, etc.) in Norway (~90% litter interception), through street cleaning/ sweeping efforts. Of the remaining 10% of litter in the wider environment, it is assumed for the majority of items that 50% of this stream final enters the marine environment (through drains, canals, rivers, direct disposal in marine environment). The impact model assumes a range of material fates for the items of interest. These are shown in Figure 2 below. The baseline assumptions modelled for each of these pathways, as well as the assumptions underlying the analysis of alternatives are further discussed in these sections.

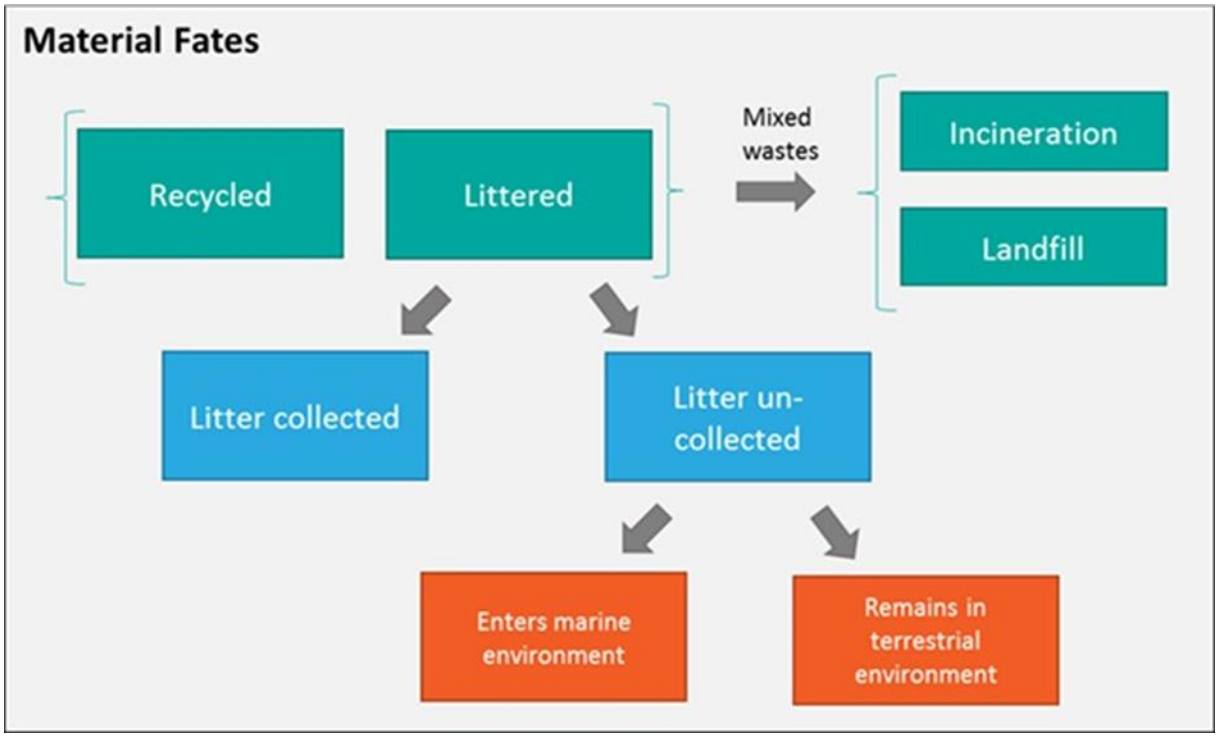


Figure 2 - Schematic of Modelled Fates of Materials

It is noted that for sanitary items (wet wipes, sanitary towels and tampons), it is uncommon for such items to enter the wider environment through direct littering, though they are lost due to improper disposal through flushing (which can lead to environmental release during overflow events). For these items therefore, the littering rates used in the model referred to flushing rates in addition to direct littering, particularly related to tourist activity in Norway.

Most shotgun cartridges are used at shooting ranges (80 %).[39] This limits their dispersion in nature and the likelihood that they end up as marine litter. That last 20 % are used during hunting, either

[39] Personal communication with Norges Jeger og Fiskerforbund

by the shore or inland where there is a potential that the cartridges can be transported long distanced by waterways and can ultimately end up in the ocean.

Where EU specific data on litter rates for items were available, these were apportioned down to account for the lower per capita littering rate in Norway (~2 kg per capita compared to ~4 kg per capita on average in the EU), and further adjusted to account for the data provided by Mepex. This data is based on experiences from working in the field of marine litter and waste management systems across Norway. Similarly, based on the littering rates thus estimated for SUPs Norway, the existing data in the EU SUP model regarding the relative proportion of SUNP and MU alternatives that are littered were apportioned down to provide a Norwegian estimate. It must be emphasized that the littering rates are only estimates based on a range of assumptions, and that there is no solid data on the number of items littered for each category.

The final littering rates applied to the SUP/SUNP alternatives in the model are summarised below. It is noted that multi-use items were assumed to be associated with a much lower litter rate due to their inherent design to be reused again and again rather than being disposed of. This is a reasonable assumption given that such items are usually sturdier, with more uses in life and costing more up front.

Table 14 - Summary of Litter Rates Modelled for Items/Alternatives (estimated rates)

Item	SUP	SUNP	MU
Beverage bottles, caps and lids	3%	3%	0.00107%
Cotton bud sticks	7.4%	7.4%	0.01%
Very lightweight plastic carrier bags (bags for fruit)	3%	3%	0.0004%
Balloon sticks	2%	2%	
Fast food packaging, plates and trays (non-EPS)	3%	3%	0.01%
Beverage cups and lids	6%	6%	0.00%
Fast food packaging (EPS)	2.7%	2.7%	0.0005%
Straws and stirrers	1%	1%	0.0004%/ 0.0001%
Lightweight plastic carrier bags	5%	5%	0.0117%
Wet wipes	3%	3%	0.00%
Sweet wrappers	3.2%	3.2%	
Cutlery	0.5%	0.5%	0.0002%
Drinks cartons	0.83%	0.83%	0.0002%
Sanitary towels (pads), tampons and tampon applicators	15%		0.004%

Voluntary beach litter clean-ups have increased in volume over the last few years, and although the results for 2018 are not official yet, over 100 000 people joined a beach clean-up in 2018.[40] Many items littered in Norway can end up on a beach somewhere along the coast. Even though the littering should be reduced, it is helpful that volunteers spend time cleaning the coastlines and removing the litter to prevent it from causing more environmental damage.

9.2 Recyclability

To reduce littering, attention must be placed on creating awareness and changing habits, but also on improving the existing collection systems. The Norwegian household waste collection system varies from area to area, i.e. not all municipalities have a separate collection for plastic packaging waste. Household plastic packaging is in most municipalities collected through a separate collection system before it is bailed and sent to Germany for sorting and ultimately recycling. In some municipalities, plastic packaging can be disposed of together with residual waste because the waste is sent to a sorting plant that separates the plastic packaging from the other waste.

The value chain for the disposal of plastic packaging is developed and managed by Green Dot Norway based on an extended producer responsibility (EPR) scheme. This scheme includes all plastic packaging, regardless of material types. According to Green Dot Norway, about 80 % of the collected plastic packaging is sorted for recycling, however only 38 % of this is actually recycled.[41] All items that are to be source-separated into the plastic fraction fall under this EPR scheme. Even though some SUP items can be recycled, they are not included in the scheme and are therefore to be disposed of in the residual waste fraction. The table below gives an overview of the downstream solutions to the various SUP items.

Table 15 – List of SUP items and their recommended recycling paths[42] in the Norwegian waste management system.

SUP Item	Disposal location of item at end-of-life	Comments
• Beverage bottles, caps and lids	Separate deposit system	Recycling is possible. Nearly all PET drink bottles are part of Norway's deposit system. If the cap/lid is attached, recycling of these is possible. If the cap/lid is separated from the bottle, they will fall through the sieve in the sorting plant and be sent to incineration.

[40] Hold Norge Rent (2018). *Strandryddeuka.* Website. Available: https://holdnorgerent.no/om-strandryddedagen/ Last accessed 04.03.19

[41] NRK (2018). *Bare en Tredjedel av all Plast blir Gjenvunnet*. Available at: https://www.nrk.no/viten/bare-en-tredjedel-av-all-plast-blir-gjenvunnet-1.14155047 Accessed 15.11.2018

[42] According to sortere.no

• Straws and stirrers • Cutlery	Residual solid waste	Material recycling is possible, though due to their size they are likely to fall through the sieve in the sorting plant. Instructions say they are to be disposed of in the residual solid waste fraction.
• Cotton buds • Balloons and balloon sticks • Fast food packaging (EPS) • Wet-wipes • Cigarette filters • Contact lenses	Residual solid waste	Material recycling is not possible
• Shotgun cartridges	Residual solid waste	All undetonated ammunition must be delivered to the police. The leftover plastic cartridge post-use can in theory be recycled, however if instructions say they are to be disposed of as residual waste.
• Sanitary towels (pads) and tampons and tampon applicators	Residual solid waste and Plastic packaging	Material recycling is possible for sanitary packaging and tampon applicators, but due to their small size they are likely to fall through the sieve in the sorting plant. Material recycling is not possible for sanitary pads and tampons.
• Beverage cups and lids	Residual solid waste Plastic packaging	Material recycling is possible for plastic lids. Instructions say that beverage cups of paper with a film layer should be disposed of in the residual solid waste fraction
• Snus packaging • Lightweight plastic carrier bags • Cigarette plastic packaging • Very lightweight plastic bags (bags for fruit) • Fast food packaging, plates and trays (non-EPS)	Plastic packaging	Material recycling is possible
• Crisp packets • Sweet wrappers	Plastic packaging	Instructions indicate it should be source separated into the plastic fraction at home, but material recycling is not possible.
• Drink cartons	Paper and carton	The paper can be material recycled but the barrier film layer is sent to incineration.

The downstream solutions for the selected SUP items are divided between the plastic recycling stream and the residual waste fraction. Source separated plastic packaging in Norway goes through the same system of collection, except for PET bottles. Norway's PET stream is exceptional due to the fully incorporated return system that has been in place for many years. 88 % of all PET bottles sold within the system are returned by the consumers.

In order to appropriately represent this variation in the amounts of waste collected for recycling and the final tonnage of individual SUP items that gets recycled, a range of assumptions were made regarding the collection service for each item, the likely level of contamination it is associated with, and the final method used for its disposal. For the proportion of items entering the recycling stream, further assumptions were made regarding the size, shape, material composition, and colour of each item, which influences the likelihood of it entering the final recycling process (or conversely of being sorted out/ rejected). In each stage of sorting (mixed plastic waste sorting/ polymer and colour based automated sorting, etc.) a "pass rate" was estimated for each of the items i.e. a likely percentage of the items that are likely to pass the sorting stage to enter the next key stage of processing (either further sorting or final recycling). This method therefore followed the logic and data used in the EU SUP model (see Annex 2 of the EU SUP impact assessment report[43]) for more detail), applying this to the Norway specific collection/ recycling data described above. For those items for which additional sorting is likely to be applied therefore, the following calculation was applied:

$$Final\ recycling\ rate = Item\ collection\ rate\ OR\ basic\ material\ recycling\ rate * \%pass\ rate\ for\ early\ sorting\ phase * \%\ pass\ rate\ for\ late\ sorting\ phase$$

The key assumptions applied to the collection data are listed below, with the final recycling rates applied in Norway shown in Table 16. These data were applied in the model in order to determine the actual tonnage of various items that are managed in the recycling stream in Norway, as opposed to those that are treated in residual treatment facilities (incineration), and the associated costs and benefits of waste management in the scenarios of interest (environmental, economic, and social). It must be stressed that these recycling rates are estimates based on a range of assumptions. There is no real data on recycling rates for these specific items (apart from beverage bottles that have a separate recycling stream).

A consideration of fate of specific items within a materials recovery facility lead to the following assumptions being determined:

- Sanitary items (including sanitary towels, tampons/ applicators/ wet wipes) were assumed to have a 0% collection rate for recycling.
- Plastic bottles, cans, glass bottles, snus packaging and cups would have varying collection rates, though all were assumed to have a 'very good' 'pass rate' throughout each stage of the sorting process, particularly due to the separate collection in the deposit return system (at 87%); though some plastic bottle tops (made out of PP) were assumed to be detached from the bottle and taken out of the process during the early screening stages due to small size

[43] Eunomia and ICF (2018). *Assessment of Measures to Reduce Marine Litter from Single Use Plastics*. European Commission DG ENV. Available at: http://ec.europa.eu/environment/waste/pdf/Study_sups.pdf Last accessed 05.03.19

leading to a slightly lower pass rate for bottle caps. Additionally, it was assumed that in some cases, the bottle tops were black and also rejected from the recycling process.

- Cotton bud sticks, cutlery, straws and stirrers were assigned a very poor 'pass rate' in the early sorting stages of 20%, due to their size and shape. Balloon sticks were allocated a slightly higher pass rate of 40% in early stages due to their slightly larger size and lower level of contamination. Cotton bud sticks, balloon sticks, straws and stirrers were also assigned a very poor 'pass rate' – 55% - in the later sorting stages, owing to the likelihood that they were going to be difficult to directionally blow with accuracy. Cutlery were assigned a 'good' pass rate – 85% - at this stage owing to greater average weight and larger size. However, for cutlery and straws it was also assumed that in 10% of cases, they were black and also rejected from the recycling process.
- For take away containers, a 'pass rate' of 90% was assigned in both the early and late phases of sorting, to account for the fact that a proportion of lids might be erroneously removed in the 2D/3D sort (the former sorting for the lighter fraction of plastics e.g. plastic films, and the latter for the heavier fraction e.g. rigid pots) due to their structure; and that they might be prone to being double layers and being obscured. It was also assumed that in 10% of cases, the food containers/trays were black and also rejected from the recycling process. EPS takeaway containers were assumed to have a 0% collection/ pass rate.
- For films, a low 'pass rate' of 40% was assigned to sweet wrappers in the early phase of sorting, to account for the fact that most of the items would probably be removed through size screening and only some would be large enough to continue through the process. The retained fraction (including bags, crisp packets etc.) would be recoverable at a good rate – 95%. However, it was also assumed that in 10% of cases, the film would be black and rejected from the recycling process as unsortable. The paper and foil alternatives were assumed to be even smaller items and most lost in the early stages of sorting – with a pass rate of only 15% for paper and 20% for foil. Anything making it through the early screen was assigned a 'very good' pass rate of 95% for the later sorting stages.

Table 16 - Summary of Final Recycling Rates applied to Items/ Alternatives (estimated rates)

Item	SUP	SUNP	MU
Beverage bottles, caps and lids	87%	81%	64%
Cotton bud sticks	1%	1%	1%
Very lightweight plastic carrier bags (bags for fruit)	38%	75%	38%
Balloon sticks	2%	15%	
Fast food packaging, plates and trays (non-EPS)	5%	25%	38%
Beverage cups and lids	3%	25%	38%
Fast food packaging (EPS)	0%	25%	38%
Straws and stirrers	1%	25%	75%
Snus packaging	16%	16%	37%
Lightweight plastic carrier bags	38%	75%	38%
Wet wipes	0%	0%	50%
Sweet wrappers	9%	14%	
Cutlery	1%	25%	75%
Drinks cartons	56%	81%	64%
Sanitary towels (pads), tampons and tampon applicators	0%		40%

It is noted that in many cases the final recycling rate for the SUNP and MU alternatives are not necessarily higher than that associated with the SUP items. In some cases, this is due to fact that many of the alternatives suffer from the same issues as single use plastic items in terms of recovery for recycling, because of characteristics around their size, composition and shape. Where multi-use items are associated with a lower recycling rate, however, it should be noted that due to the nature of these items, overall waste generation is likely to be lower for these items, as is the littering rate associated with them. Similarly, for SUNP items, though littering rates may persist, the long-term harmful impacts of plastic litter in the wider environment can be mitigated through the use of more benign alternatives. The greatest benefit can be seen for those items for which a truly biodegradable alternative is available (e.g. paper bags, paper cups with mineral oil coating, etc.) as these can enter the composting stream directly without having to undergo further sorting phases.

10 Financial and Environmental Assumptions

In addition to developing a mass flow for the items and alternatives of interest as described above, several key impact parameters were considered in the model, including the economic and environmental costs associated with the items and their alternatives.

The following impact categories are considered:

1. Greenhouse gas emissions. These include emissions from manufacturing, refill schemes (incl. washing), recycling, incineration, landfill, transport.
2. External costs: manufacturing, refill schemes, recycling, incineration, landfill, land-based litter, marine litter.
3. Financial costs: consumer's purchases, retailer sales, producer turnover, retailer turnover, producer profit, retailer profit, refill schemes, consumer's washing, recycling, mixed waste treatment, litter clean-up, business administration, wastewater treatment costs
4. Employment: manufacturing, refill schemes, recycling, mixed waste treatment, litter clean-up.

The key assumptions applied in the model for each of these parameters are discussed below.

10.1 GHG Emissions and Environmental Externalities

The model assesses the environmental impacts of changes in the quantity of waste generated and management destinations (managed via recycling/ incineration/ landfill, or unmanaged in the litter stream) between the SUPs and their alternatives. Two types of impacts are analysed:

1. Greenhouse gas (GHG) emissions: Climate change impacts are considered in isolation (as tonnes of CO2 equivalent); and
2. Environmental externalities: The combined effect of both the climate change impacts together with those impacts associated with other emissions to air (air quality (AQ) impacts) such as nitrogen oxides (NOx), sulphur oxides (SOx), and particulate matter (PM). Pollutant impacts are monetised (NOK).

The sources and assumptions underlying this analysis in Norway are the same as those used in the EU SUP model (see Annex 2 of the EU SUP Impact Assessment Report[44]), with Sweden used as a proxy for Norway where specific data were not available. The damage costs associated with carbon were updated to reflect the Norwegian market situation as stated in Section 3.3.6.

In addition, the environmental impacts associated with the manufacture of the SUP items and their alternatives, as well as any washing impacts associated with the use of multi-use items were considered. In summary, to derive these data, manufacturing load factors per item, based upon the item compositions (see Sections 7.4, 8.3 above) were derived from the lifecycle product environmental database Ecoinvent[45], and provided to the project team. Emissions such as GHGs, air pollutants, water use, and land use were included. The full details of the approach used here can be found in Annex 2 of the EU SUP model report.[46]

10.2 Social Costs

The employment intensity (#FTEs) of manufacture associated with the items and their alternatives, as well as those associated with the collection, reprocessing and treatment of wastes were derived from the EU model report. These were assessed to be representative of the Norwegian market.

10.3 Financial Costs

The model assesses the financial impacts of changes in the quantity of items consumed, waste generated and management destinations between the SUPs and their alternatives. Three types of impacts are analysed:

1. Consumption related costs, including consumers' expenditure per item on the one hand, and retailer income on the other (these values are equivalent, with one treated as a cost, and the other as an income). In addition, any costs to producers are also assessed, estimated on the basis of retail sales value, less he estimated retail mark-up value (usually ~2 times).

The unit costs per SUP, SUNP and MU item modelled are shown in Table 17 below. These costs were gathered by Mepex by researching the cost of these items from platforms available to private consumers.

Table 17 - Summary of Consumer Costs per Item Modelled (NOK) (including VAT)

Item	SUP	SUNP	MU
Beverage bottles, caps and lids	NOK 0.26	NOK 0.70	NOK 184.49
Cotton bud sticks	NOK 0.13	NOK 0.13	NOK 1.52
Very lightweight plastic carrier bags (bags for fruit)	NOK 0.05	NOK 0.50	NOK 10.07
Balloon sticks	NOK 2.14	NOK 2.14	

[44] Eunomia and ICF (2018). *Assessment of Measures to Reduce Marine Litter from Single Use Plastics*. European Commission DG ENV. Available at: http://ec.europa.eu/environment/waste/pdf/Study_sups.pdf Last accessed 05.03.19

[45] Ecoinvent (2019) *The Ecoinvent Database*. Available at: https://www.ecoinvent.org/database/database.html

[46] Eunomia and ICF (2018). *Assessment of Measures to Reduce Marine Litter from Single Use Plastics*. European Commission DG ENV. Available at: http://ec.europa.eu/environment/waste/pdf/Study_sups.pdf Last accessed 05.03.19

Fast food packaging, plates and trays (non-EPS)	NOK 2.72	NOK 4.03	NOK 64.25
Beverage cups and lids	NOK 3.01	NOK 3.01	NOK 159.41
Fast food packaging (EPS)	NOK 2.33	NOK 4.08	NOK 64.25
Straws and stirrers	NOK 0.17	NOK 0.39/ NOK 0.15	NOK 22.74 / NOK 9.33
Lightweight plastic carrier bags	NOK 1.60	NOK 2.00	NOK 14.90
Wet wipes	NOK 0.85	NOK 0.34	NOK 36.35
Sweet wrappers[47]	NOK 27.70	NOK 27.70	
Cutlery	NOK 0.49	NOK 0.97	NOK 15.89
Drinks cartons[48]	NOK 0.40	NOK 0.70	NOK 184.53
Sanitary towels (pads), tampons and tampon applicators	NOK 2.04		NOK 263.41

2. Cost of municipal waste management, including the change in costs associated with collecting, treating and disposing of the alternative items is considered. In addition, avoided waste management costs associated with waste prevention and litter prevention (especially when switching to MU items) were assessed. The baseline costs for these variables were derived from the EU SUP model (see Annex 2.5.6 in the EU SUP Impact Assessment final report[49]).
3. Washing of multi-use items - the switch from SU to MU items is likely to involve costs related to washing the MU items between uses in addition to the waste management costs described above. In this study, washing costs for the following MU product types have additionally been assessed:
    a. Sanitary towels and tampons – reusable sanitary towels and menstrual cups;
    b. Wet Wipes – reusable cotton flannel;
    c. Food containers including fast food – reusable steel/ plastic containers;
    d. Cup and cup lids – reusable silicone cups;
    e. Drink bottles, caps and lids, drinks cartons – reusable steel/ plastic bottle;
    f. Straws and stirrers – reusable steel/ plastic straws and stirrers; and
    g. Cutlery – reusable steel/ plastic cutlery.

Due to the wide prevalence of technologies and processes available for washing the above product types, a range of assumptions had to be made regarding those technologies that are most widely used in Norway, as well as those processes and settings that are likely to be used for the products in question. These parameters were assessed to be similar to those used across the EU. Data on the key

[47] Unit costs of sweet wrappers shown here reflect the price of both the product and the packaging as data on the unit cost of the packaging alone were not available, nor was data on the extent of the differential between the prices of the two. Accordingly, a zero net change was assumed between the SUP and SUNP alternatives. In reality, it is likely that the use of plastic/ card + foil alternatives will be relatively more costly than metallised films for the same application.
[48] Industry sources state the manufacture of drink cartons is roughly 1.5 times higher than the price for plastic drink bottles per unit.
[49] Eunomia and ICF (2018). *Assessment of Measures to Reduce Marine Litter from Single Use Plastics*. European Commission DG ENV. Available at: http://ec.europa.eu/environment/waste/pdf/Study_sups.pdf Last accessed 05.03.19

cost components (energy, water) from the existing EU model were therefore used (further detail available in Annex 2.5.3 of the EU SUP Impact Assessment report)[50].

Finally, the costs of a switch to multi use bottles were also considered at an industrial scale (assumed a 50-50 split between consumer and industry related process costs). In this respect, logistics costs for transporting empty refillable bottles from return locations to filling plants was estimated using some general assumptions. It was assumed 40 bottles could be stored in a crate, 20 crates could be stacked on a pallet and 33 Euro pallets could be transported on an HGV. The average distance of the collection route to the filling locations was assumed to be 500km. This figure would be highly variable in practice, depending on the balance of local versus imported beverages on the Norwegian market. Using an average road freight transport cost per tonne km (tkm)[51], this equates to around NOK 22.1 per km travelled or NOK 0.41 per container.

10.4 Valuing External Impacts of Litter

It is challenging to try and place a value on each tonne of plastics prevented from entering, as litter, the terrestrial and marine environments. This is usually estimated, in monetary terms, as the 'welfare loss' - i.e. the extent to which citizens are negatively impacted – from the existence of littered items in their local neighbourhood. This welfare loss is often referred to as the 'disamenity' arising from litter – much of which is considered to be due to the 'visual disamenity' which is understandable given that litter can transform the look and feel of a place.

The disamenity value associated with litter in Norway is estimated using the same methodology used in the EU SUP model study (see Annex 4 accompanying the final EU SUP Impact Assessment report[52]) i.e. using estimates on disamenity values associated with varying forms of litter from the literature and apportioning to the Norwegian context by using data on purchasing power parity adjusted GDP, as well as population estimates in order to arrive at a per household estimate of the disamenity values associated with litter.

For Norway, the final estimates of the litter externalities in the baseline associated with the use of the SUP items prioritised were based on an estimate of NOK 292 per household for use and non-use values of beach litter that is sewage related (e.g. wet wipes etc.), and a further NOK 146 per household for use and non-use values of other single use plastic related beach litter.

[50] ibid
[51] Schade W. et al (2006). *COMPETE Final Report: Analysis of the contribution of transport policies to the competitiveness of the EU economy and comparison with the United States*. Funded by European Commission – DG TREN. Karlsruhe, Germany. Available at: http://ec.europa.eu/ten/transport/studies/doc/compete/compete_report_en.pdf
[52] ibid

11 Modelled Results

This section presents the baseline flows and the results of the modelling under two scenarios, firstly if all SUP items were switched to SUNP items, and secondly if all were switched to MU items. The following sections outline the key findings and conclusions from the study. Detailed results for each SUP item can be found in Appendix 12.

11.1 Baseline Flows of SUP Items

This section summarises the baseline flows of the SUP items under consideration, including the total amounts estimated to be entering the sea. Key data are presented in Table 18. The items are ordered from the top according to the total weight of the items entering the sea; note, for items which include plastic and other materials, the weight relates to the total SUP item weight not the weight of the plastic element only. The most significant flow related to marine plastic is predicted to be from lightweight carrier bags. Despite the relatively light unit weight of carrier bags, due to the high volumes consumed (around 770 million in 2018), the total generation of carrier bag waste is still 11.5 thousand tonnes per annum, the third most significant after bottles and beverage cartons. The proportion of carrier bags generated that enter the sea is also one of the highest out of all the items, as shown in Figure 3. Both these factors are key determinants of the modelled results, which suggest carrier bags are the most significant contributor to the overall flow of plastic entering the sea out of all the items. It is worth noting, however, that the consumption of carrier bags has been decreasing, particularly since the introduction of the carrier bag charge in August 2018. Some further reduction in consumption may be expected, which would thus lead to a lowering of the amounts entering the sea, however, the Norway charge is not structured in the same way as for example Ireland and the UK - where overall reductions of 80% were realised - and so it is too early to forecast reductions of this scale. This is backed up through personal communication with the Norwegian Retailers Environmental Fund (Handelens Miljøfond), who suggest the reductions in consumption, since introduction in 2017, has been limited, as the costs increased as of August 2018. Compared to other countries, citizens in Norway are used to paying for their thicker, high quality LDPE bags at grocery stores, and the price increase in mid-2018 was thus not as big of a shock like it was in Britain, where people used to be free. The overall reduction for 2018 compared to 2017 was still 10%. Predictions for future consumption patterns are uncertain. However, the retailers have committed themselves to a 20% reduction in the number of plastic carrier bags by 2020. It is noted that the model assumes that the price paid by consumers is equivalent to the amount earned by retailers – in reality, this will not be the case for lightweight carrier bags in Norway, as retailers who are members of the Environmental Fund will pay in NOK 0.05 to the fund for each bag sold (and therefore will not retain the full amount paid by consumers as assumed by the model).

The next most significant contributors to SUP marine litter are sanitary items. These feature high up in the list because the proportion of generated waste that enters the sea is the highest out of all the items, at 0.75%, as shown in the figure below. The figure is high because of the direct pathway of flushed items into the sea, i.e. directly into the drainage system and direct to the sea during storm water overflow events which by-pass screens at waste water treatment plants.

Drinks containers (bottles and beverage cartons) are estimated to be the next most significant contributors. Despite the relatively low proportions of the generated wastes that enters the sea - around 0.03-0.04% - the amounts generated in total are the most significant out of all the items (18-

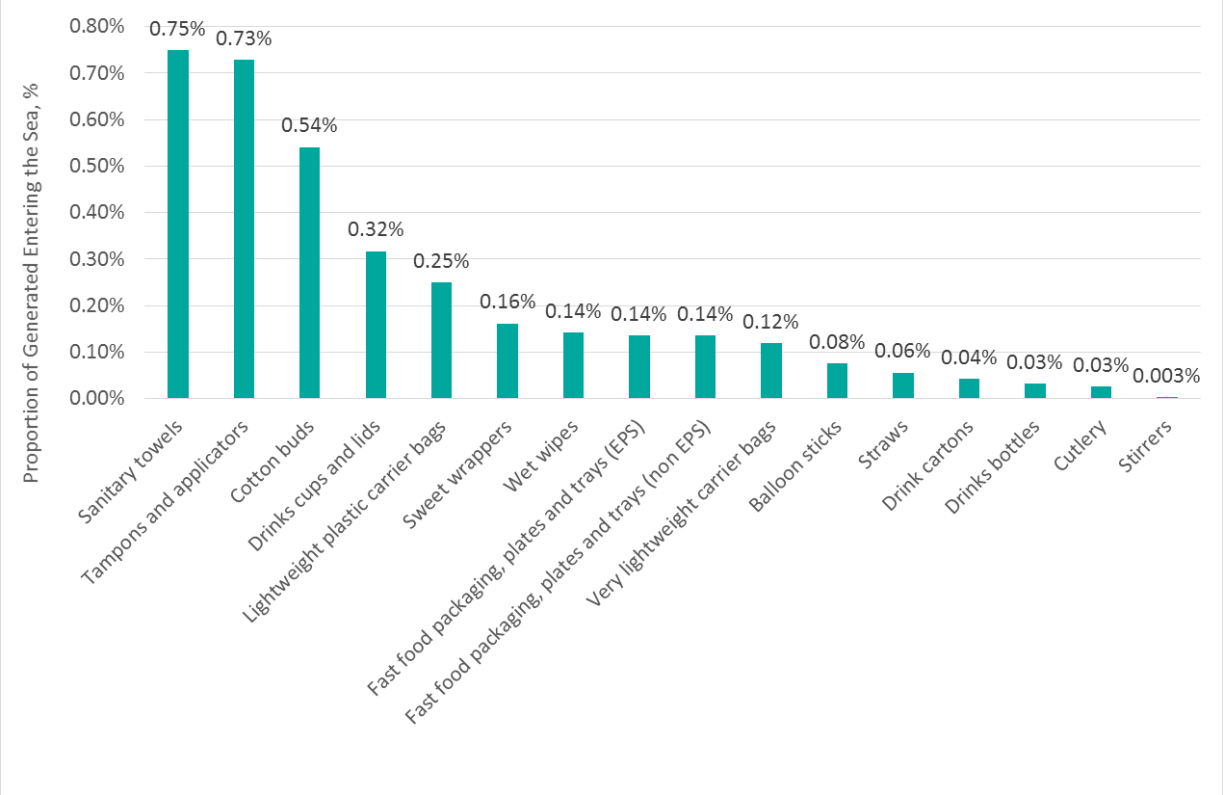
22 kt per annum). So only minor proportions entering the sea lead to significant tonnages, relative to other items.

The remainder of the items decrease in significance, related to a combination of a) the lower unit weights, b) lower levels of consumption and c) lower proportions of the generated amounts that enter the sea.

Table 18 - SUP Baseline Flows

Item	Total production / waste generated	Recycling	Incineration	Litter left in terrestrial environment	Litter that enters marine environment
Units	**Tonnes**	**Tonnes**	**Tonnes**	**Tonnes**	**Tonnes**
Lightweight plastic carrier bags	11,600	4,400	7,100	28.9	28.9
Sanitary towels	1,420	0.7	1,400	10.6	10.6
Sanitary towels (pads), tampons and tampon applicators	1,400	0.7	1,300	10.2	10.2
Drink cartons	18,200	10,200	8,000	7.5	7.5
Drinks bottles	22,600	19,600	2,900	7.2	7.2
Drinks cups and lids	1,500	37	1,400	4.8	4.8
Fast food packaging, plates and trays (non-EPS)	2,700	100	2,600	3.7	3.7
Wet wipes	700	n/a	700	1.0	1.0
Sweet wrappers	600	100	500	1.0	1.0
Fast food packaging, plates and trays (EPS)	600	n/a	600	0.8	0.8
Cotton buds	100	1.2	100	0.54	0.54
Very lightweight carrier bags	400	100	200	0.48	0.48
Cutlery	1,200	12	1,200	0.31	0.31
Straws	200	2	200	0.11	0.11
Balloon sticks	2	0.03	1.5	0.002	0.002
Stirrers	47	0.47	47	0.001	0.001
Total	**63,300**	**34,600**	**28,200**	**94**	**94**

Figure 3 - Proportion of Litter Generated Entering the Sea, %



11.2 Benefits from a Switch to Multi-Use (MU) Items

This section outlines the key overarching trends from the analysis. Table 19 shows the key data from the model, aggregated across all the items. The first clear conclusion to be drawn is that a switch to MU over SUNP items provides by far the greatest overall benefits; this is shown by the difference between the SUNP and MU scenarios in the final column. Whilst there are some changes in production impacts (environmental, economic and social) between SUP and SUNP items, related to differences in both the unit weights and type of materials used, the reductions are significantly larger when considering MU items on a per use basis. This is because, despite the actual item being significantly heavier than a SUP item, MU items are used many times, and can therefore replace many SUP items over their lifetime. The number of uses a MU item can be attributed to before it becomes waste, and a new MU item needs to be purchased, is therefore a key determinant of the magnitude of the benefits under the MU scenario.

Equally, the variation in impacts (environmental, economic and social) between the scenarios, related to recycling and EfW, are attributed to the reductions in the amount of material recycled or sent to EfW plants. Whilst there are large reductions in plastic items entering the sea under both scenarios (around 9-13 million items) there is a greater increase when MU items are used due to the broader scope of items covered compared to SUNP.

Table 19 - Results from Switches

Parameter	SUP to SUNP	SUP to MU	MU relative to SUNP
SUP Waste Generated, thousand tonnes	**545**	**-62**	**-607**
Recycling, thousand tonnes	**448**	**-34**	**-483**
EfW, thousand tonnes	**96**	**-28**	**-123**
Plastic litter that enters marine environment, tonnes	-56	-76	-21
Plastic litter that enters marine environment, million items	-8	-11	-4

Environmental emissions and other resource impacts are given in Table 20 (+ve externality = cost, -ve externality = saving). Interestingly, because the total amount of recycling falls between the SUNP and MU scenarios, the total GHGs increase, however, under both scenarios net GHG savings are achieved. Total external costs are lower when MU items are considered, compared with SUNP, so is the total land area needed for production and washing — note that as most production occurs outside of Norway the change in land area associated with this activity would not occur within the country. However, as washing MU items utilises water as a primary resource input, the total amount of water used increases, relative to a switch to SUNP. As washing would occur within Norway this does represent a net increase in Norwegian water demand. As water scarcity in the country is not problematic, a very minor increase in water usage (~ 3/100th of a % given a total annual water use of 3bn m^3) does not present any concerns.[53]

Table 20 - Results from Switches

Parameter	SUP to SUNP	SUP to MU	MU relative to SUNP
Total GHGs, thousand tonnes CO2 eq	-950	-228	722
Total Externalities, thousand NOK (2018 Real Terms)	-2,017,000	-2,588,000	-571,000
Total Land Use, km2	142	-232	-374
Total Water Use, thousand m3	9	924	915

Table 21 provides data on the distribution of financial impacts (+ve value = increase, -ve a reduction). Under a switch from SUPs to MU items, consumers will save money. The upfront purchase of a multi-use item being more than offset by the avoided costs of the SUPs over time.

For businesses (both retailers and producers), despite the higher per-unit revenue from the upfront purchase of the multi-use items, the reduced sales of SUPs bring about an overall decline in revenues. However, it's important to note that this is a simple static analysis. In the real world, retailers would

[53] SSB (2018). *Kommunal Vannforsyning.* Available at: https://www.ssb.no/natur-og-miljo/statistikker/vann_kostra/aar Last accessed: 15.03.19

use the shelf space that becomes available to sell other items that might well provide an equivalent margin, while producers would innovate and identify other products to manufacture. For Norwegian based manufacturers of SUPs, unless all other markets globally put in place equivalent measures, they retain the possibility of an increased focus on export of their SUPs. Accordingly, the changes in producer surplus will be much lower than the changes in revenue, but without detailed modelling of the dynamic changes in the market in response to shifts in demand, it is not possible within this study to provide an estimate of the change in producer surplus. As such changes in business turnover are not included in the net financial cost figures.

While consumers will save from a financial perspective, for some, there will likely be a perceived negative impact from the reduced convenience of being able to use, and promptly discard, the SUP item. However, against this, some consumers may derive an increase in utility from a sense of satisfaction of using reusable items. Indeed, both these sentiments may apply to the same individuals over a more extended period of time, with the initial sense of a loss from reduced convenience being eroded over time as consumers adapt to, accept, and indeed gain a sense of satisfaction from the new behavioural patterns (which will likely include a cleaner local environment, which we know from research improves self-reported wellbeing, and for which citizens express a positive willingness-to-pay). Changes in the value of consumer sales are included in the net financial cost figures.

Services costs relate to waste management activities (recycling, EfW and litter collection) and the operation of commercial washing, reuse / refill schemes or activities. Again, the costs are significantly lower than compared to the SUNP scenario.

Table 21 - Results from Switches

Parameter	SUP to SUNP	SUP to MU	MU relative to SUNP
Total Business Turnover, thousand NOK (2018 Real Terms)	1,657,000	-4,409,000	-6,066,000
Total Consumer Cost, thousand NOK (2018 Real Terms)	1,523,000	-4,256,000	-5,779,000
Total Services Costs, thousand NOK (2018 Real Terms)	799,000	754,000	-45,000
Total Employment, number of jobs	1,566	577	-988

Table 22 provides a comparison between the changes in externalities (environmental benefits) and financial costs (which include services and consumer costs only). In the context of the method used for this study, it is not strictly accurate to sum the costs and benefits. However, some general remarks can be made. Firstly, under the SUNP scenario, the magnitude of the monetised benefits (around NOK 2bn) is very similar to the magnitude of the financial costs (around NOK 2bn). This suggests come careful consideration around the magnitude and nature of the switch to SUNP should be considered on an item by item basis to ensure the environmental benefits are maximised and the financial costs minimised, such that overall benefits to society are achieved. Under the MU scenario, the modelling suggests more significant benefits, but also that the financial *costs* now change to much large financial

savings. Under this scenario, therefore, it would appear very likely that overall benefits to society would be achieved.

Table 22 - Results from Switches

Parameter	SUP to SUNP	SUP to MU	MU relative to SUNP
Total Externalities, thousand NOK (2018 Real Terms)	-2,017,000	-2,588,000	-571,000
Total Financial Costs, thousand NOK (2018 Real Terms)	2,322,000	-3,502,000	-5,824,000

11.3 MU Scenario Results

This section outlines further results for the MU scenario, building in detail on the summary given above. Table 23 provides the key data and some commentary on the results (+ve value = increase, -ve a reduction). All figures are relative to the SUP baseline scenario.

Table 23 - Results from Switches

Parameter	Value	Comment
SUP Waste Generated, thousand tonnes	-62	Overall waste generation decreases due to a reduced need for production material inputs. Consequently, the amounts of recycling and EfW fall in absolute terms. The net impacts result in a significant reduction in the amounts of plastic litter entering the marine environment.
Recycling, thousand tonnes	-34	
EfW, thousand tonnes	-28	
Plastic litter that enters marine environment, tonnes	-76	
Plastic litter that enters marine environment, million items	-11	
Total GHGs, thousand tonnes CO2 eq	-228	The most significant contributor to overall GHG reductions is from reduced emissions in the manufacturing sector. Given that a large proportion of production occurs outside of Norway, these emissions will be saved elsewhere.
Production GHG emissions, thousand tonnes CO2 eq	-238	
Washing GHG emissions, thousand tonnes CO2 eq	10	
Recycling GHG emissions, thousand tonnes CO2 eq	35	
EfW GHG emissions, thousand tonnes CO2 eq	-36	
Total Externalities, thousand NOK (2018 Real Terms)	-2,588,000	A large proportion of the external cost saving is derived from the

Production GHG + AQ Externalities, thousand NOK (2018 Real Terms)	-167,000	decrease in emissions related to production. The most significant savings come from reduced littering, both in the terrestrial and marine environments. Whilst there is some uncertainty in these figures, the figures are very likely to be higher than the other external costs highlighted here. External costs related to recycling increase because there is a net reduction in the absolute amount of recycling. Additional increases in external costs are also related to increases in washing, but these are minimal in relation to the total.
Washing GHG + AQ Externalities, thousand NOK (2018 Real Terms)	106,000	
Recycling GHG + AQ Externalities, thousand NOK (2018 Real Terms)	15,000	
EfW GHG + AQ Externalities, thousand NOK (2018 Real Terms)	3,240	
Terrestrial Litter Externalities, thousand NOK (2018 Real Terms)	-2,292,000	
Marine Litter Externalities, thousand NOK (2018 Real Terms)	-253,000	
Total Land Use, km2	-232	Whilst there is a slight increase in land use related to washing impacts, these are more than offset by reductions association with reduced material demand from manufacturers.
Production Land Use, km2	-232	
Washing Land Use, km2	-0.2	
Total Water Use, thousand m3	924	There are small decreases in water use associated with reduced production, but these are outweighed by increases in water needed for washing MU items.
Production Water Use, thousand m3	-2	
Washing Water Use, thousand m3	926	
Total Business Turnover, thousand NOK (2018 Real Terms)	-4,409,000	Producer's turnover is expected to fall, but the total is much less than for retailers as only a fraction of the production is within Norway itself.
Producer's Turnover, thousand NOK (2018 Real Terms)	-56,000	
Retailers's Turnover, thousand NOK (2018 Real Terms)	-4,353,000	
Total Consumer Cost, thousand NOK (2018 Real Terms)	-4,256,000	Despite some increase in cost associated with consumers washing their own MU items, the savings derived from reduced purchase of SUP items leads to significant overall cost savings.
Consumer's Purchases, thousand NOK (2018 Real Terms)	-4,353,000	
Consumer's Washing Costs, thousand NOK (2018 Real Terms)	97,000	
Total Services Costs, thousand NOK (2018 Real Terms)	754,000	Due to the reductions in the amount of litter needing to be collected, and

Refill scheme costs, thousand NOK (2018 Real Terms)	871,000	the amount of waste recycled or sent to EfW plants, cost savings are achieved. However, these are offset by the cost of washing activities and running reuse / refill schemes.
Recycling Financial costs, thousand NOK (2018 Real Terms)	-74,000	
EfW Financial costs, thousand NOK (2018 Real Terms)	-26,000	
Litter clean-up costs, thousand NOK (2018 Real Terms)	-17,000	
Total Employment, number of jobs	577	Despite the reductions in the total number of jobs related to production, and waste management, increased demand for employment in running reuse / refill schemes leads to a net increase in the total level of employment.
Production Employment, number of jobs	-26	
Refill scheme Employment, number of jobs	888	
Recycling Employment, number of jobs	-266	
EfW Employment, number of jobs	-19	

The following charts now show the key results by item, to help explain which items are contributing more or less significantly to the overall impacts.

Figure 4 shows the change in waste generation by item. The key determinants of the results are the number of items consumed and the unit weight per item. The most significant items have the highest rates of consumption and unit weights. The figure shows that the most significant contributors to overall waste generation are beverage containers (bottles and cartons), carrier bags, fast food packaging (non-EPS), drinks cups and lids, and sanitary items.

Figure 4 - Change in Waste Generation, thousand tonnes per annum

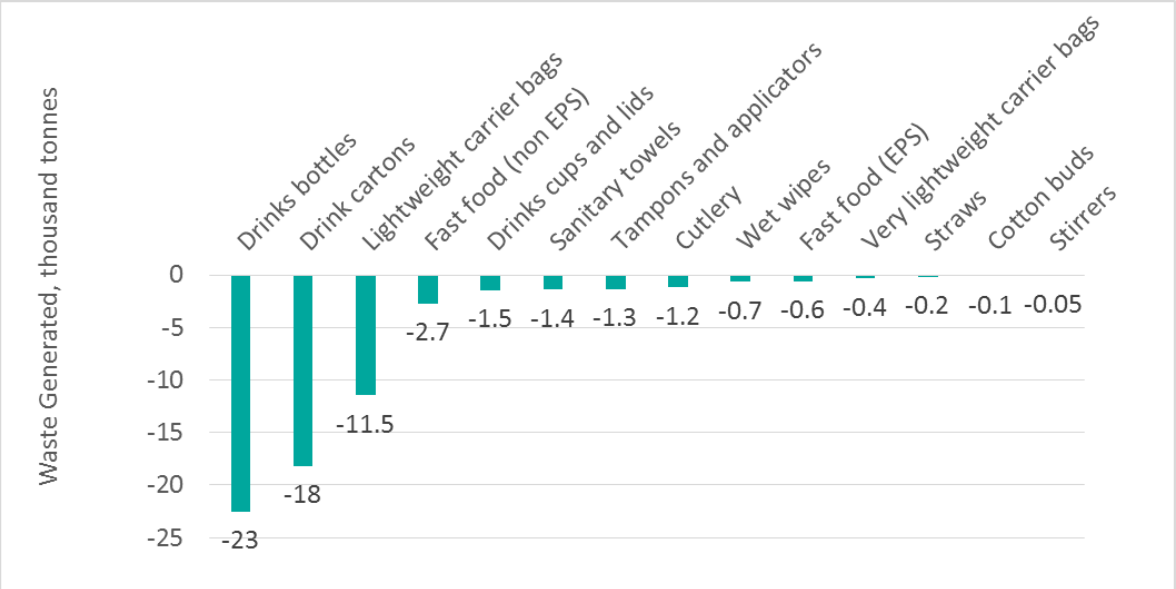


Figure 5 shows the change in GHGs per item. This broadly reflects the pattern shown above related to total generation, however, drinks cartons are less significant due to the higher proportion of non-fossil-based materials (i.e. paper) in the construction of the item.

Figure 5 - Total GHGs, thousand tonnes CO_2 eq

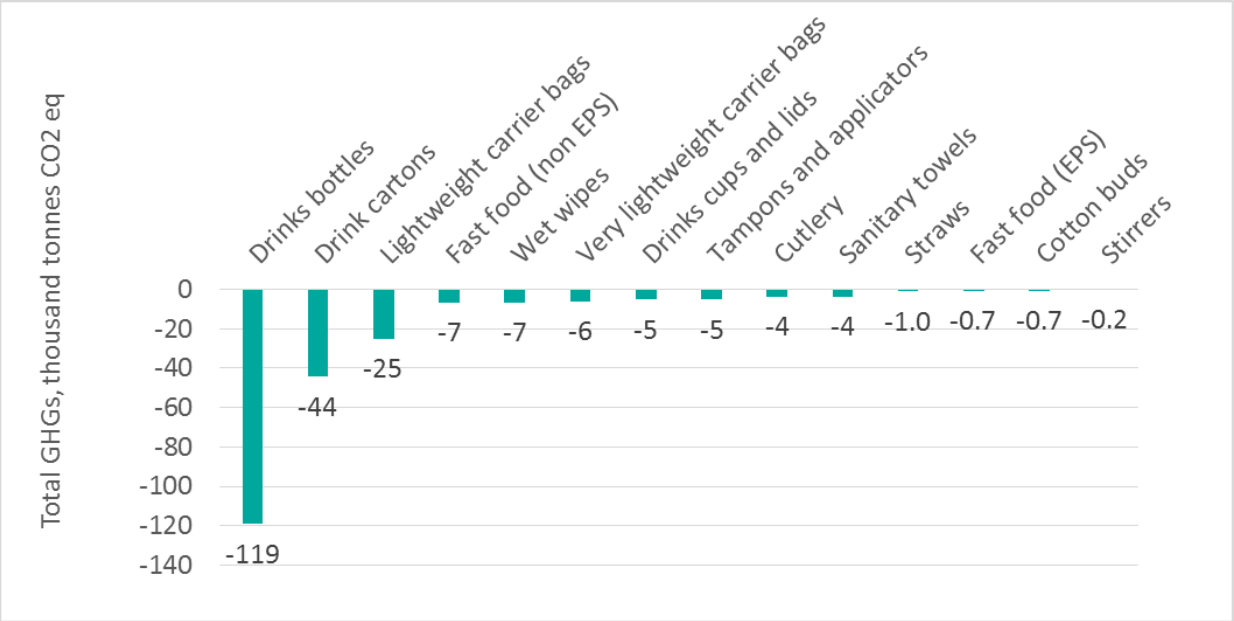


Figure 6 shows the total water use by item, with items utilising very minor quantities of water omitted. The most significant contributors to water demand are from food service items, and sanitary items; particularly, MU wet wipes, sanitary towels and tampons, due to water usage from household washing machines. As noted above, this is a very small fraction of the total water abstracted in Norway. The use of water related to washing of MU beverage containers is lower than the other items, despite the significant number of items being washed. This is due to a much lower amount of water used per item wash by consumers and from industry led refillable bottle washing plants, which are highly efficient, compared to washing methods for other items.

Figure 6 - Total Water Use, thousand m³

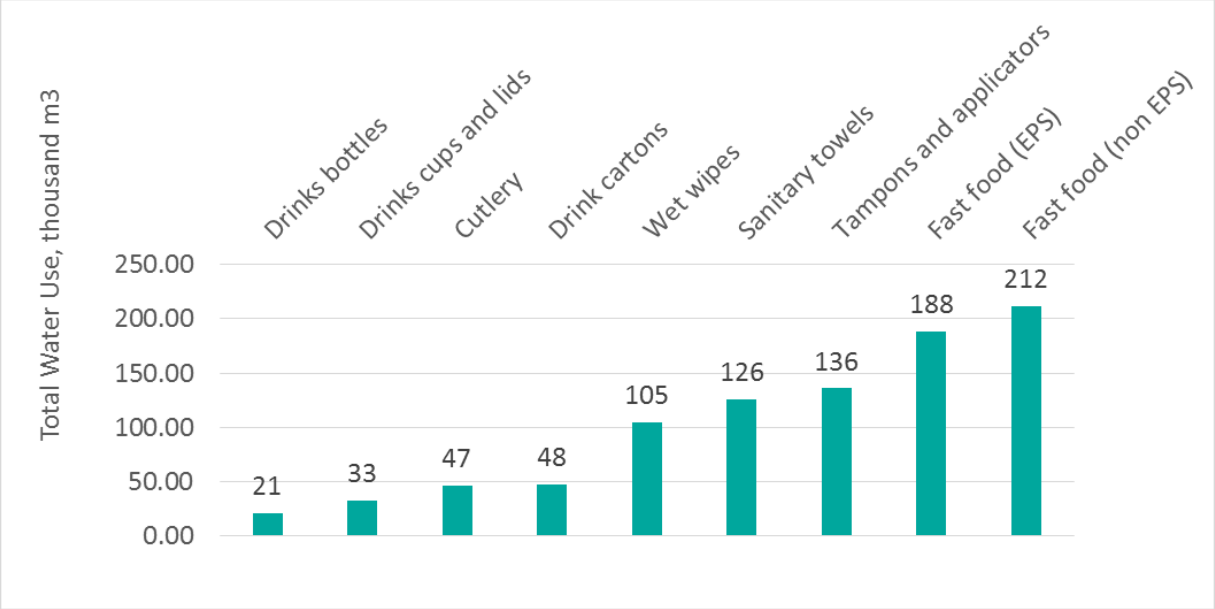


Figure 7 - Total Land Use, km²

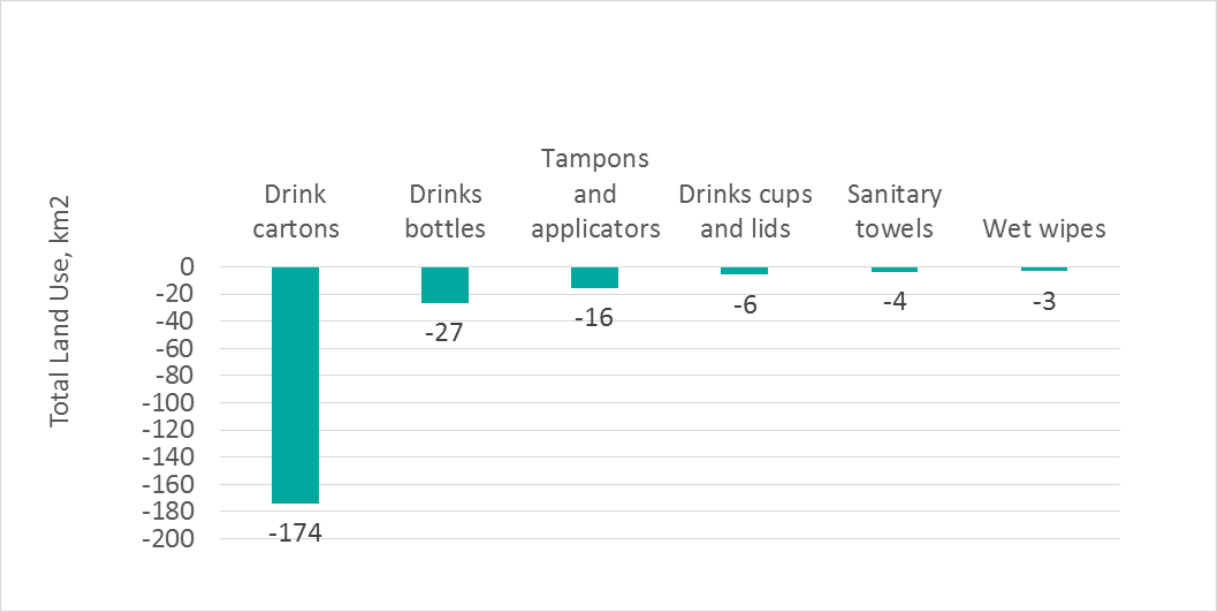
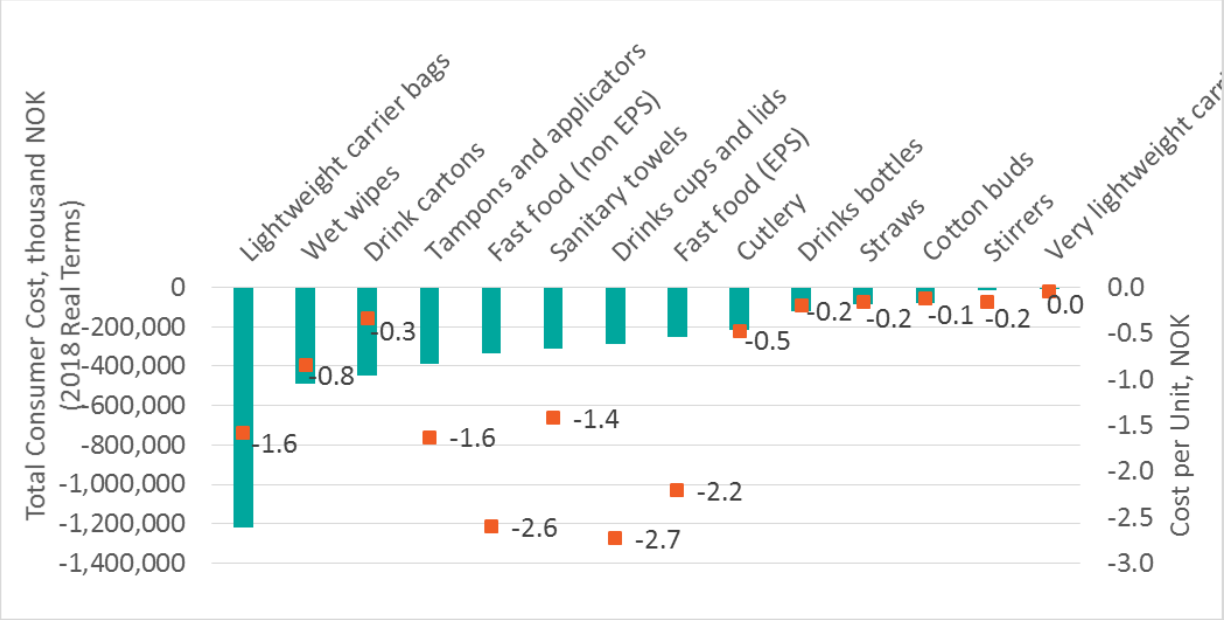


Figure 7 indicates the total change in land use under the MU scenario. Items with very minor land use impacts (e.g. <1km2) are omitted from the chart (e.g. Cotton buds, Fast food (non-EPS), Cutlery, Straws, Fast food (EPS) and Stirrers). Drinks cartons see the most significant decrease in land requirements, as a large proportion of their material composition is paper, which requires lumber for pulping. Other items achieve a net decrease in land use, despite slight increases related to increased water demand, as highlighted above.

Figure 8 now sets out the change in consumer costs by item. Whilst there are increases in washing costs for consumers, the savings from reduced expenditure on SUP items are significant, given the millions of uses per annum of these products. These savings occur despite relatively minor increases in washing costs for consumers. The chart also indicates the change in cost on a per use basis between the SUP and MU items. This shows the influence of price changes versus the total volume of items placed on the market in determining the overall savings. These figures should be caveated because the unit price data is uncertain, particularly as some items are not well established in the market and high-volume prices paid by large scale fillers, retailers and distributors are not available in the public domain. However, whilst the exact cost distribution across the items is likely to be different, to a certain extent, it is more certain that, on average, high levels of savings to consumers would be realised in practice.

Figure 8 - Total Consumer Cost, thousand NOK (2018 Real Terms)



The total costs associated with waste management services and reuse / refill schemes are given in Figure 9. The distribution is highly influenced by the use, or otherwise, of commercial washing activities or reuse / refill schemes. For items which are not part of these schemes, the figures only relate to reduced waste management costs, and so savings accrue (e.g. carrier bags and sanitary items). Food service items, such as stirrers, cups and cutlery, all need washing, which leads to costs associated with additional staff time, water rates, water heating and detergents. Some of the most significant increases in cost are associated with refillable takeaway box schemes, which require multiple staff for collecting and washing boxes, as well as communications, marketing, administration etc.

In addition, relatively significant costs occur from washing of refillable beverage bottles. In the modelling it was assumed that half of the market could be suitable for consumer led refill options (e.g. water from the tap, or carbonated soft drink dispensers), where the washing costs at home are minimal. However, for the remaining half of the market, it was assumed industry led refill schemes would be required. The additional costs related to transporting empty bottles back to washing and

refill centres, outweigh any savings related to avoided waste management costs of SUP items, and lead to relatively significant overall services costs for drinks bottles and beverage cartons. The cost increase is lower for drinks bottles, compared to drink cartons, because the avoided waste management costs are larger for this type of item. This is because the unit cost of the system used to collect plastic drinks bottles in the baseline (the deposit refund system) is higher than the unit cost of the wider household packaging collection system (which collects drinks cartons).

Figure 9 - Total Services Costs, thousand NOK (2018 Real Terms)

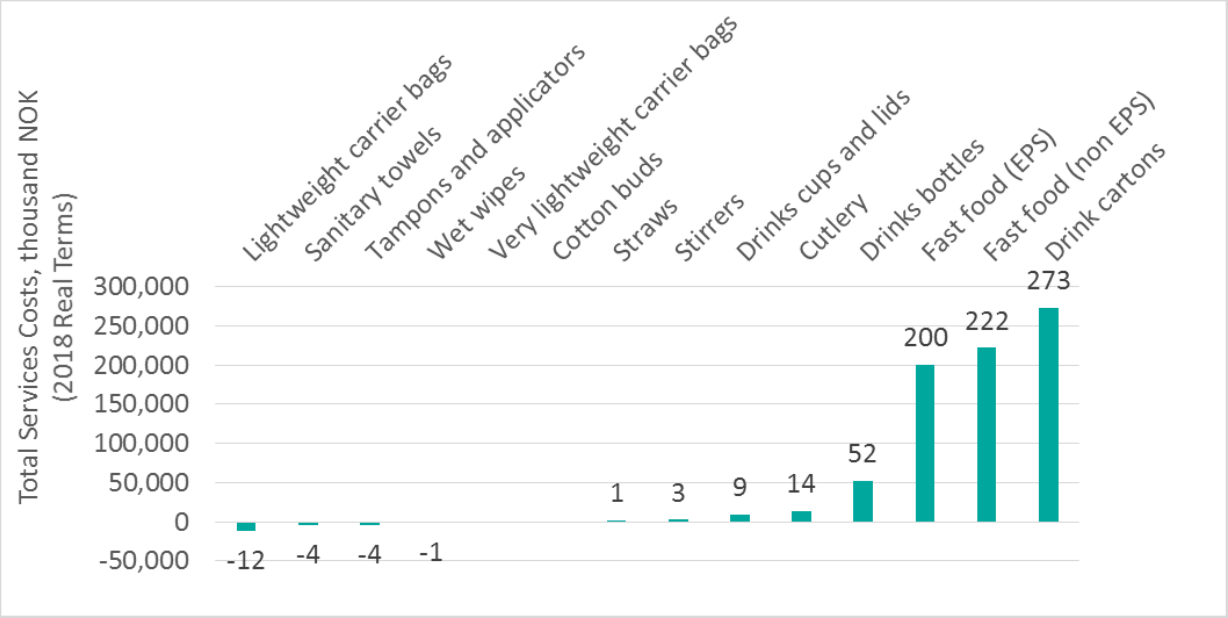
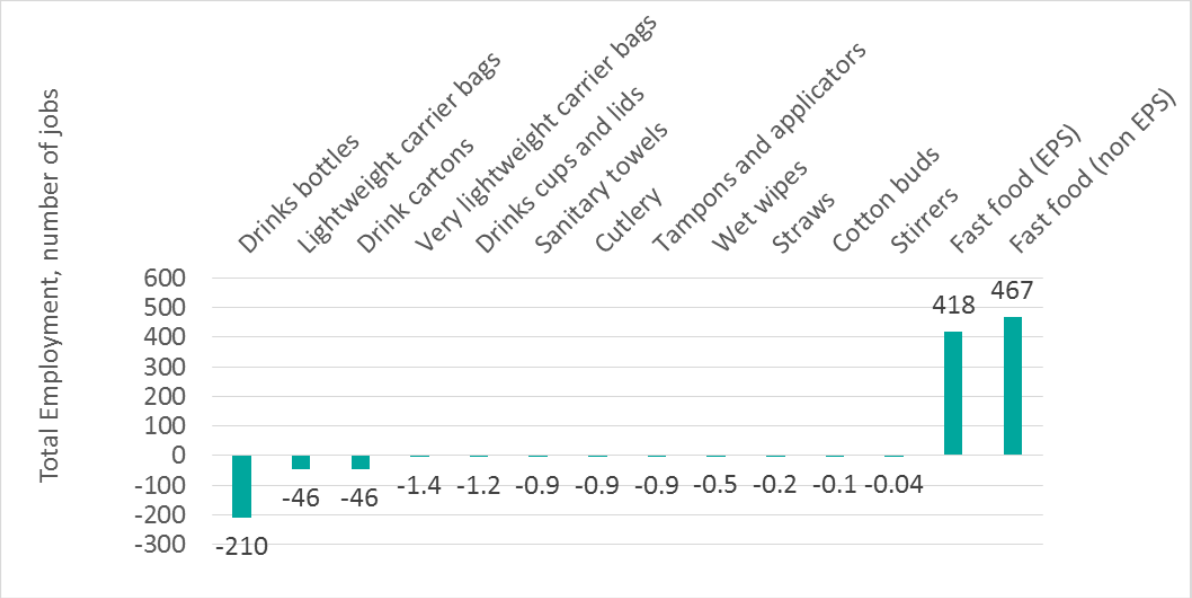


Figure 10 - Total Employment, number of jobs



In terms of the change in jobs by item, Figure 10 shows that the most significant job reductions may result under switches related to drinks containers, and also carrier bags. These would relate mostly to reduced employment in the manufacturing and waste management sectors. However, additional jobs related to industry led bottle refill schemes were not included in the modelling. This reduction could be less significant if additional jobs in the logistics and beverage filling industries were created. Significant numbers of jobs could be created through the introduction of refillable takeaway box schemes.

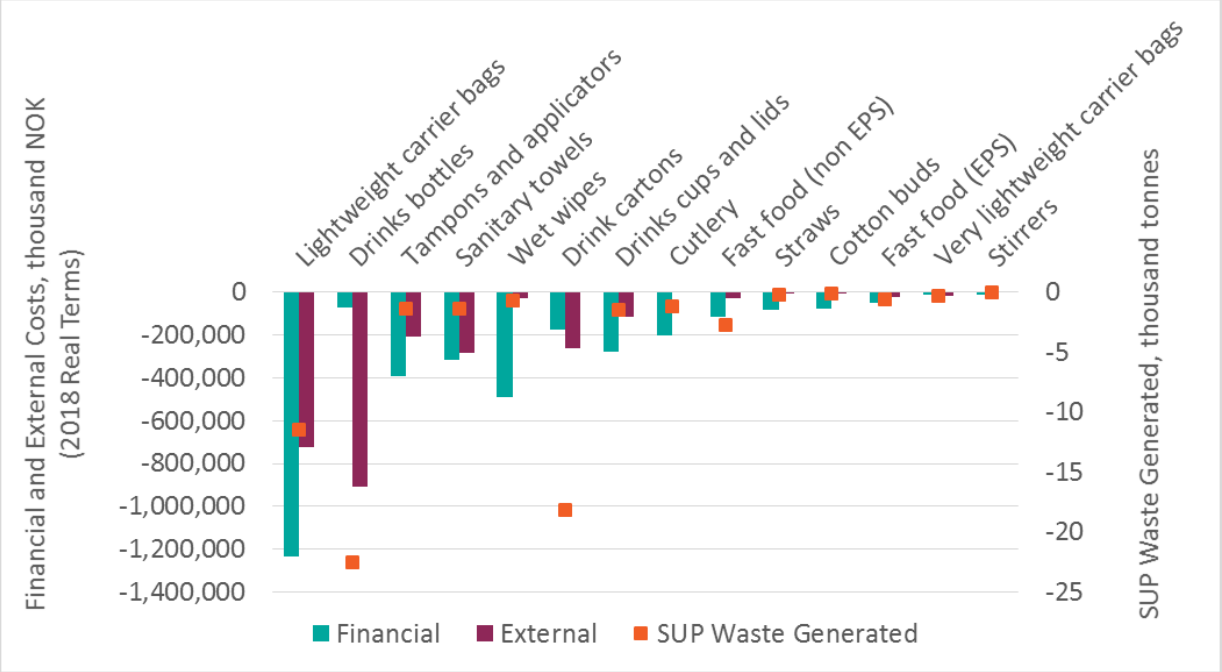
Figure 11 provides a comparison of the total financial costs (consumer and services costs) and the environmental benefits (external costs). The total changes in the weight of waste generated is also plotted on the right axis (orange markers). This shows that the costs and benefits of the different items are somewhat correlated to the total weight of all products of each type placed on the market. This suggests that policies related to encouraging a switch to MU items should be prioritised for those with the largest market share by total weight.

Some further remarks related to the relative balance of costs and benefits on an item by item basis can be made. Tackling lightweight carrier bags would appear to be the biggest 'win-win' from and environmental and cost perspective. It may be valuable, therefore, to review the carrier bag charge, in order to determine how more significant shifts away from lightweight SUP carrier bags could be achieved.

Due to the large market size and unit weight, plastic drinks bottles contribute highly to overall external costs, thus maximising the switch away from these items seems favourable. Though, the less significant reduction in financial costs suggests that the suitability of beverage formats, and nature of refill and washing approaches, should be carefully considered to target the more cost-effective market segments first (e.g. where consumer led refill options are available).

Whilst consumers may benefit from some amenity from using SU sanitary items, these preferences should be considered against the benefits from an environmental and cost perspective. Indeed, some of the items (e.g. wet wipes) deliver much more significant financial savings from switching to MU alternatives, which were widely used before these items appeared on the market. Moreover, additional cost savings, not modelled here, relating to reduced cleaning costs of sewers and waste water treatment plant screens should also be considered.

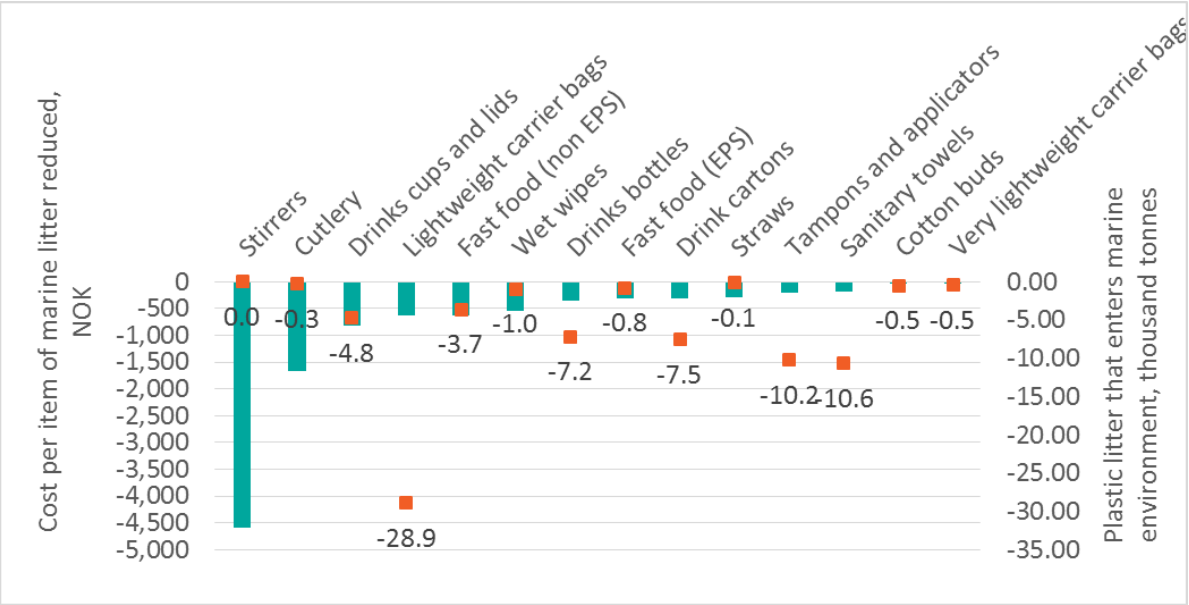
Figure 11 - Costs and Benefits, thousand NOK (2018 Real Terms)



It may also be instructive to consider the cost efficiency of the switches relative to a unit of each item diverted from marine litter. This is given in Figure 12, where 'cost' relates to the financial costs for consumers and services. This suggests that small, lightweight food service items, like stirrers and cutlery, would be the priority for policies to address. Other fast food items, like food containers or drinks cups, would be the next priority, alongside wet-wipes and potentially very lightweight carrier bags or tampons. Other items, whilst still suggesting a net saving per item diverted from marine litter, would be of lower priority. These considerations have to be balanced against the absolute reductions in marine litter though (shown on the right axis with orange markers), as there is some negative correlation between cost efficiency and total reduction in marine plastics; in other words, it would be necessary to target lower cost-efficient items to achieve large overall reductions in marine plastic litter.

What this suggests is that items with high cost efficiency should be tackled as a priority, despite smaller reductions being achieved, with the other items addressed in a targeted way to ensure larger reductions in marine plastics can be achieved in the most cost-effective manner possible.

Figure 12 - Cost per item of marine litter reduced, NOK



However, it is quite unlikely that a 100% switch from SUP to MU for all items would be achieved in reality, despite the much greater benefits than from switching to SUNP. Therefore, to ensure as significant reductions in marine plastic litter as possible are achieved, it is likely that further policies will need to target material substitution from plastic to other alternatives. The next section, therefore, outlines the impacts from the switch of SUP to SUNP alternatives.

11.4 SUNP Scenario Results

This section outlines the detailed results for the SUNP scenario, as mentioned previously. Table 24 provides the key data and some commentary on the overall results (+ve value = increase, -ve a reduction). All figures are relative to the SUP baseline scenario.

Table 24 - Results from Switches

Parameter	Value	Comment
SUP Waste Generated, thousand tonnes	545	Overall waste generation increases mainly due to the significantly increased unit weight of SUNP (glass) beverage containers compared to SUP (plastic bottles), and the need for additional production material inputs. Consequently, the amounts of recycling and EfW rise in absolute terms. The net impacts still result in a significant reduction in the amounts
Recycling, thousand tonnes	448	
EfW, thousand tonnes	96	
Plastic litter that enters marine environment, tonnes	-56	
Plastic litter that enters marine environment, million items	-8	

		of plastic litter entering the marine environment.
Total GHGs, thousand tonnes CO2 eq	-950	The most significant contributor to overall GHG reductions is from the waste management sector, related to increased recycling (mainly of the aluminium cans replacing a proportion - around one third - of the SUP bottles on the market) and from the switch of plastics away from EfW to glass and aluminium containers. Offsetting this are increased emissions in the manufacturing sector. Given that a large proportion of production occurs outside of Norway, these emissions will be produced elsewhere.
Production GHG emissions, thousand tonnes CO2 eq	631	
Recycling GHG emissions, thousand tonnes CO2 eq	-1,250	
EfW GHG emissions, thousand tonnes CO2 eq	-331	
Total Externalities, thousand NOK (2018 Real Terms)	-2,017,000	The most significant savings come from reduced littering, both in the terrestrial and marine environments. Whilst there is some uncertainty in these figures, the figures are likely to be higher than the other external costs highlighted here. External costs related to recycling and EfW decrease because there is a net reduction in the increase in the amount of recycling, mainly deriving from the aluminium. Some increase in external costs is also seen, as a factor of increased emissions related to production.
Production GHG + AQ Externalities, thousand NOK (2018 Real Terms)	473,000	
Recycling GHG + AQ Externalities, thousand NOK (2018 Real Terms)	-398,000	
EfW GHG + AQ Externalities, thousand NOK (2018 Real Terms)	-84,000	
Terrestrial Litter Externalities, thousand NOK (2018 Real Terms)	-1,821,000	
Marine Litter Externalities, thousand NOK (2018 Real Terms)	-187,000	
Total Land Use, km2	142	The only change in land use is associated with production, as washing impacts are only relevant to MU items.
Production Land Use, km2	142	
Total Water Use, thousand m3	9	The only change in water use is associated with production, as washing impacts are only relevant to MU items.
Production Water Use, thousand m3	9	

Total Business Turnover, thousand NOK (2018 Real Terms)	1,657,000	Producer's turnover is expected to rise, but the total is much greater for retailers as only a fraction of the production is within Norway itself.
Producer's Turnover, thousand NOK (2018 Real Terms)	134,000	
Retailers's Turnover, thousand NOK (2018 Real Terms)	1,523,000	
Total Consumer Cost, thousand NOK (2018 Real Terms)	1,523,000	Under the SUNP scenario, costs of alternative products tend to be more expensive on a per use basis, resulting in a net increase in costs for consumers.
Consumer's Purchases, thousand NOK (2018 Real Terms)	1,523,000	
Total Services Costs, thousand NOK (2018 Real Terms)	799,000	Due to the increases in the amount of litter needing to be collected, and the amount of waste recycled or sent to EfW plants, costs related to services increase.
Recycling Financial costs, thousand NOK (2018 Real Terms)	582,000	
EfW Financial costs, thousand NOK (2018 Real Terms)	91,000	
Litter clean-up costs, thousand NOK (2018 Real Terms)	126,000	
Total Employment, number of jobs	1,566	In addition to minor increase in the total number of jobs related to production, significant additional jobs related to waste management might be achieved. These are mainly related to jobs associated with the collection and recycling of glass bottles.
Production Employment, number of jobs	56	
Recycling Employment, number of jobs	1,443	
EfW Employment, number of jobs	67	

The following charts now show the key results by item, to help explain which items are contributing more or less significantly to the overall impacts.

Figure 13 shows the reduction in SUP waste generation by item. As highlighted above, the key determinants of the results are the number of items consumed and the unit weight per item. The most significant items have the highest rates of consumption and unit weights. Figure 4 shows that the most significant contributors to overall waste generation are beverage containers (bottles and cartons) and carrier bags, all the remaining items only result in a change in weight of less than 1 thousand tonnes, so do not appear visible on the chart. The significance of the increase in the weight of beverage containers is associated with a switch from plastic bottles to mainly glass bottles (~70%) with the remainder being aluminium cans (~30%). The unit weight rises from 250 grams per container, on average, from around 36 for a plastic bottle. This rise in weight most influences the whole set of results under the SUNP scenario.

Figure 13 - Change in Waste Generation, thousand tonnes per annum

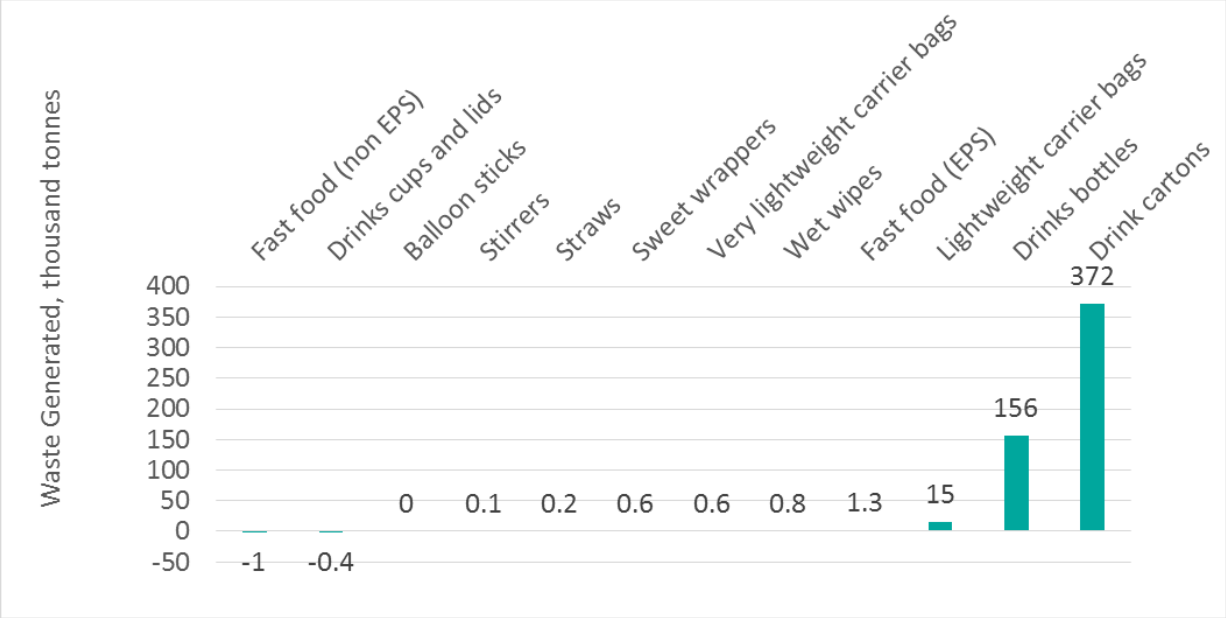


Figure 14 shows the change in GHGs per item. This broadly reflects the pattern shown above related to total generation and is strongly related to the benefits from the increased absolute quantities of glass, but mainly aluminium, containers under this scenario.

Figure 15 and Figure 16 shows the distribution of water and land impacts by item, which relate solely to the change in amounts of both resources needed to manufacture the SUNP items compared with SUP.

Figure 14 - Total GHGs, thousand tonnes CO_2 eq

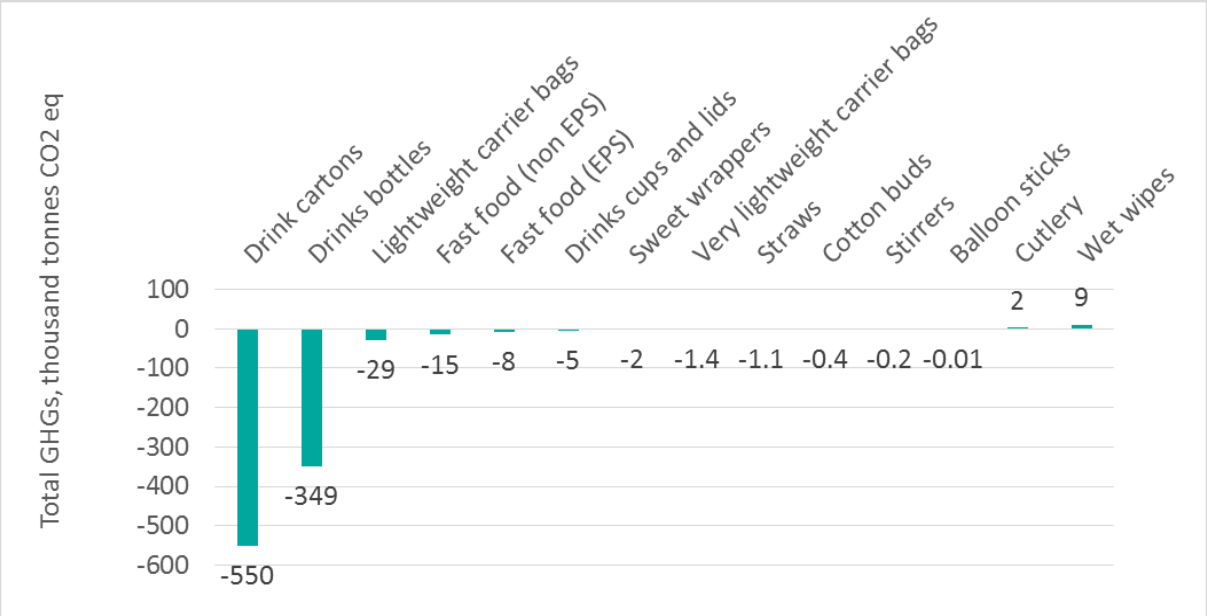


Figure 15 - Total Water Use, thousand m³

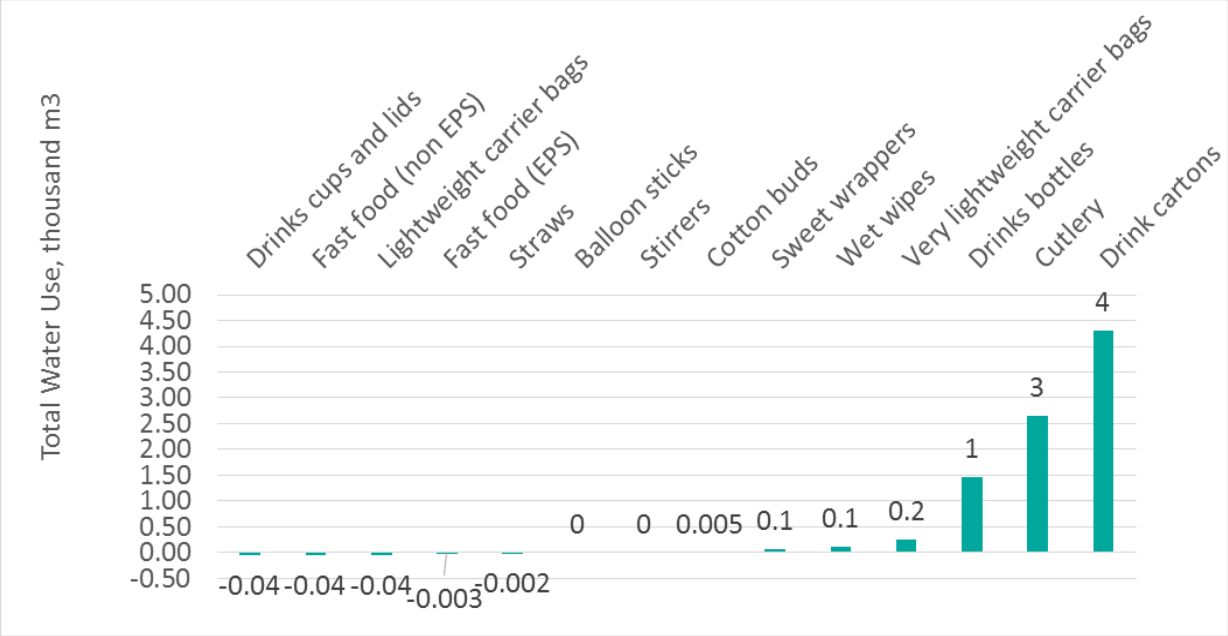


Figure 16 - Total Land Use, km²

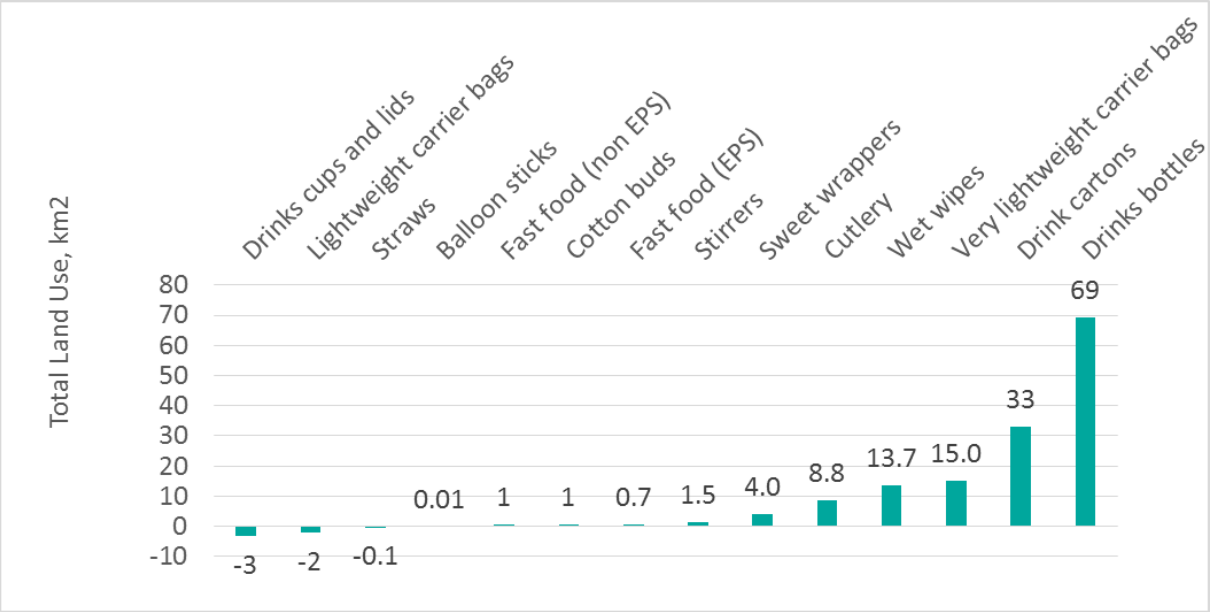
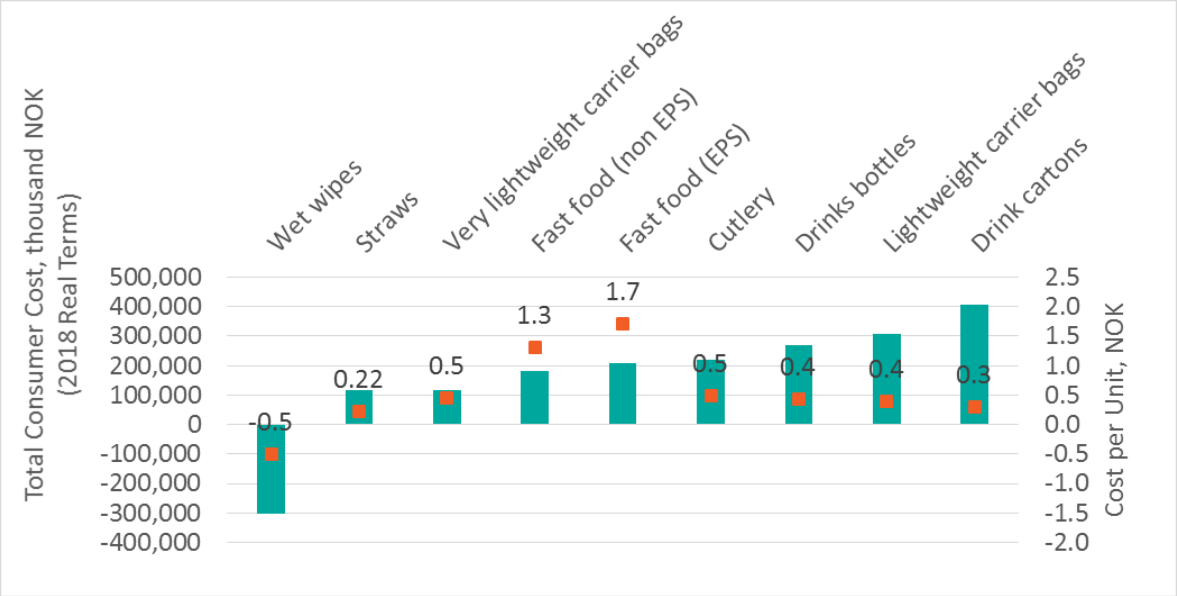


Figure 17 sets out the change in consumer costs by item, which relate solely to the change in the total sales cost. Only the items for which a non-zero cost is evident are shown on the graph. For most items it is clear that there may be increased costs for consumers. The chart also indicates the change in cost on a unit basis between the SUP and SUNP items. This shows the influence of price changes versus the total volume of items placed on the market in determining the overall costs. The net change in costs is directly related to the net change in the unit price of the items. The only item to

see a cost saving is SUNP wet wipes that are taken to be cotton pads with lotion and are in fact cheaper to buy than pre-packs of wet-wipes.

These figures should be caveated, though, because the unit price data is uncertain, particularly as some items are not well established in the market and high-volume prices paid by large scale fillers, retailers and distributors are not available in the public domain. However, whilst the exact cost distribution across the items is likely to be different to a certain extent, it is more certain that on average some additional cost to consumers would be realised in the short term. In the longer term, as the market adapts, and production volumes increase, it may be that SUNP unit prices are more in-line with existing SUP products, and the net costs to consumers falls.

Figure 17 - Total Consumer Cost, thousand NOK (2018 Real Terms)



The total costs associated with waste management services are given in Figure 18. The distribution is highly influenced by the total amounts generated, as depicted in Figure 13. As such cost increases associated with increased recycling and EfW of SUNP containers are expected. Costs related to other items are minor. The same rationale can also be applied to the distribution of employment impacts, as evident in Figure 19.

Figure 18 - Total Services Costs, thousand NOK (2018 Real Terms)

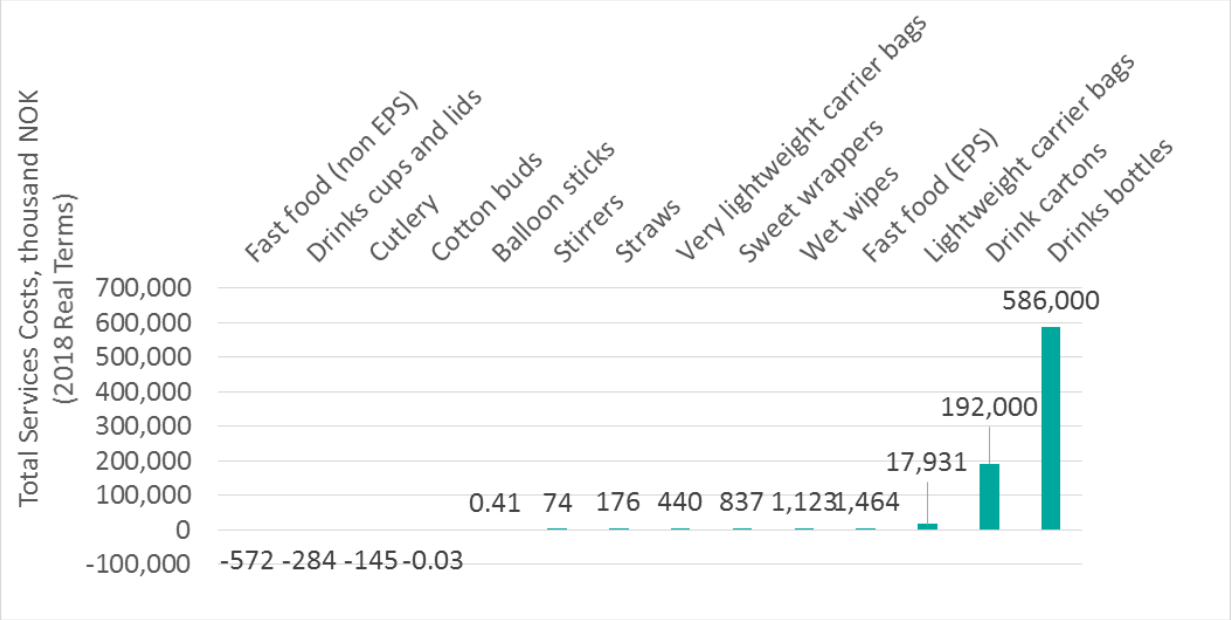


Figure 19 - Total Employment, number of jobs

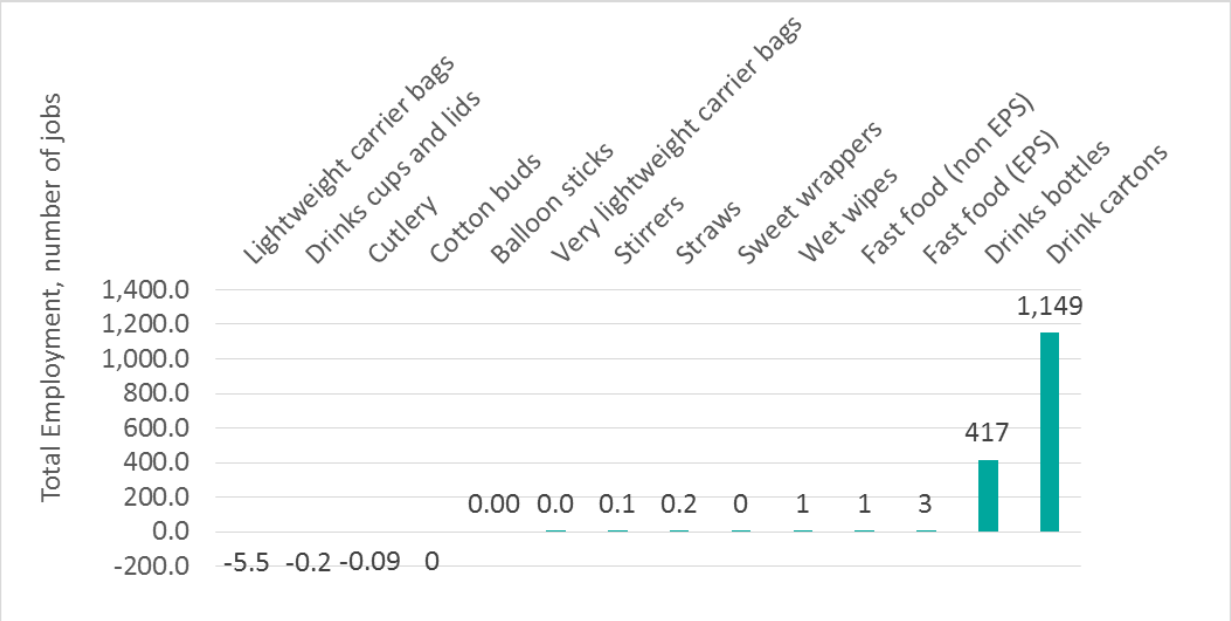


Figure 20 provides a comparison of the financial costs (consumer and services costs) and the environmental benefits (external costs). The picture is quite different to the MU scenario. Whilst there are some items that seem to have more significant environmental benefits than financial costs (e.g. lightweight carrier bags), for many items the balance of costs and benefits is close, and for some the change in financial costs greater is greater than the expected reduction in externalities. Overall, this suggests that the nature of the SUNP alternatives should be carefully considered when the choice of

alternatives is being made. Policies that encourage efficient design of SUNP alternatives should therefore be strongly encouraged.

Figure 20 - Costs and Benefits, thousand NOK (2018 Real Terms)

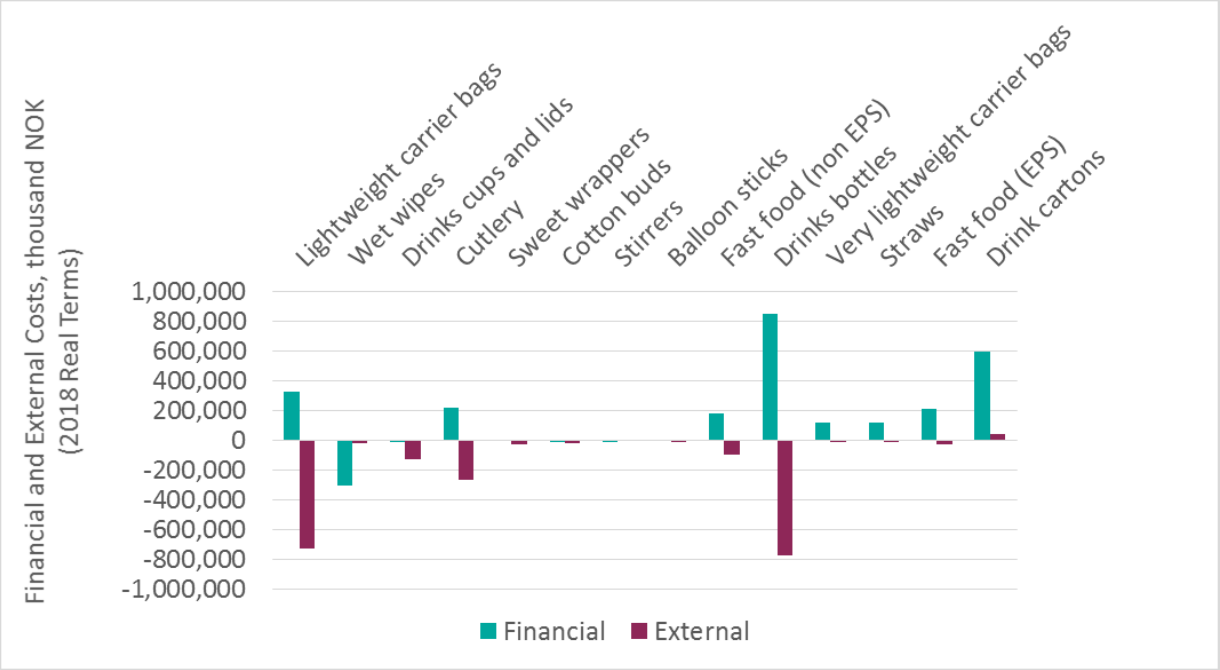


Figure 21- Cost per item of marine litter reduced, NOK

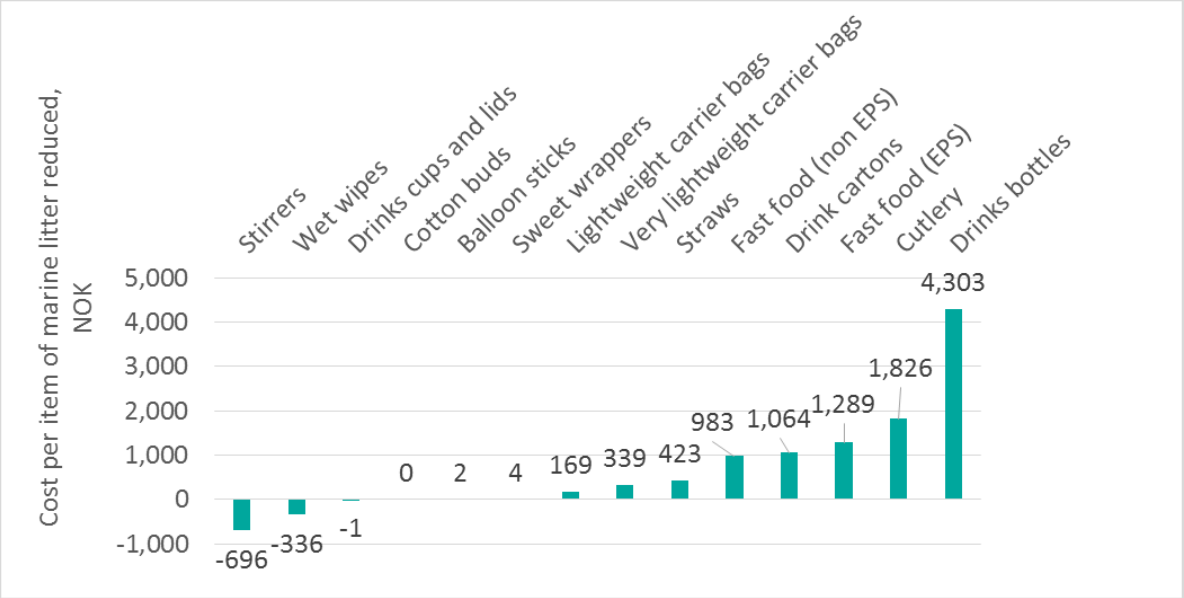


Figure 21 shows that the cost effectiveness is poorest for beverage and food containers; where 'cost' relates to the financial costs for consumers and services. This suggests that for these items, strategies targeting a switch to MU may be more beneficial than switching to SUNP alternatives. However, if there were constraints to achieving a high switch to MU alternatives, the switching of some key items

to SUNP would be required to ensure the most significant quantity of marine plastic litter as possible could be reduced. For example, switches of drinks containers and carrier bags should be prioritised given the large reductions that could be achieved through targeting these items.

Again, it is quite unlikely that a 100% switch from SUP to SUNP for all items would be achieved in reality, despite the reductions in marine plastic litter that could be achieved. Therefore, to ensure as significant reductions in marine plastic litter as possible in a cost-efficient manner, it is likely that a mix of policies will be needed to incentivise an uptake of MU items by consumers, as well as targeting material substitution from plastic to other alternatives in an efficient manner. The next section, therefore, outlines some likely switches which may be assessed in more detail through future instrument / measure specific analysis.

11.5 Identifying Likely Switches

In some cases, consumer preferences may affect the viability of alternatives and therefore a 100% switch is not feasible. These have already been discussed in Section 8 above. In other cases, there is already a visible shift away from using plastic in certain SUP products. For example, nearly all cotton buds sold in Norway as of 2019 are made from paper. Stirrers made from wood have also in many circumstances replaced those made from plastic. Other plastic items, such as snus packets, have many restrictions tied to their design and can therefore not be changed as easily.

In addition, there are other cases in which a degree of switching away from SUP products may be feasible. Some examples of these considerations, for the items modelled in this study, are provided below:

- Drinks bottles, caps and lids/ drinks cartons: Given the existing incentives from the deposit refund system to stop littering of SUP bottles in Norway, a 100% switch to SUNP items is unlikely. A 100% switch to reusable alternatives is similarly, if not more, unlikely as refill options for beverages other than water are less likely to become widespread in the short term, and some proportion of "emergency" purchases on the go are likely to continue. Additionally, it is possible that, depending on the measure in place, people will switch away from SUP items to a combination of SUNP/ MU items, rather than one or the other.
- Cotton buds/ straws/ stirrers/ cutlery/ balloons and balloon sticks: Plastic elements of such items are largely non-essential, with a number of alternatives readily available and widely in use (e.g. paper cotton bud sticks and straws) – as such a 100% switch away from such items is feasible.
- Very lightweight carrier bags/ lightweight carrier bags: 100% switch away from such items is unlikely for certain applications (e.g. plastic bags for raw meat/fish, medical applications, etc.) at present.
- Fast food packaging, plates and trays/ beverage cups and lids: 100% switch away from EPS fast food packaging, cups and lids is feasible at present, due to the widespread availability of both non-EPS plastic as well as single use plastic alternatives that are less environmentally harmful at the end of life. For non-EPS plastic fast food packaging, and PE-lined paper cups, a similar switch is feasible, though the suitability of foil/ card alternatives particularly for hot liquid-based foods and beverages, are likely to pose a barrier. Incentivising innovation in this area to develop SUNP alternatives or support a switch to MU refill schemes.

- Sanitary towels (pads), tampons and tampon applicators: Given the widespread availability of alternatives, a switch to MU alternatives would be possible, albeit potentially restricted due to consumers preferences around the use of female hygiene products.
- Sweet wrappers: 100% switch to SUNP items is unlikely to be feasible for all products in this category – foil and card/ paper alternatives, particularly for sugar-based soft sweets, are unlikely to provide the long shelf life and durability that is necessary for such products.

For each of these items, the likely level of switches that are actually accomplished in reality will depend on the types of measures that are put in place to incentivise consumers to change their behaviour and adopt alternative SUNP/ MU items. A useful indication of this is provided in the EU's proposed SUP Directive (see Section 4.3) which identifies product bans and consumption reduction measures for certain SUP items. The likely level of reduction in SUP consumption that is feasible for each item under these measures is shown in Table 25 below.

Table 25 - EU SUP Reduction Measures and Likely Level of Consumption Reduction

SUP Item/s	Measure proposed (EU SUP Directive)	Feasible SUP consumption reduction (%)
• Plastic cutlery • Plastic plates • Plastic straws • Plastic stirrers • Plastic balloon sticks • Food containers made of EPS • Beverage containers made of EPS • Cotton bud sticks made of plastic	Product ban	100%
• Take away food containers made of plastic • Plastic cups for beverages, incl. covers and lids	Significant consumption reduction measures[54]	25% - 80% by 2030 (depending on target/ measures set)

Further consideration of the likely level of switches have not been explored in this study, but must be balanced according to market, behavioural or political limitations in Norway's context. However, the current approach provides a useful indication of the level of switching for each of the alternatives.

[54] These may include national consumption reduction targets, measures ensuring that reusable alternatives to those products are made available at the point of sale to the final consumer, economic instruments such as ensuring that single-use plastic products are not provided free of charge at the point of sale to the final consumer.

12 Appendix

12.1 List of Attendees at the Workshop

Attendees	Representing
Mari Mo Osterheider	Hold Norge Rent
Henrik Lystad	Avfall Norge
Lars Brede Johansen	Grønt Punkt Norge
Øivind Brevik	KS Bedrift
Anja Stokkan	Bymiljøetaten, Oslo kommune
Fredrik Myhre	WWF
Erlend Carlsen	Swedish Match
Terje Sletnes	NHO Mat og Drikke
Halvard Hauer	Norges Gruppen
Thomas Rem	ROAF
Elisabeth Magnus	Miljømerk
Kenneth Bruvik	NJFF
Camilla Skjelsbæk Gramstad	Virke
Kari Bunes	Emballasjeforeningen
Kjell Olav Maldum	Infinitum
Susi Jahren	SINTEF
Mats Hjørnevik	Borregaard
Anette Bastviken	Radikal Broccoli
Susanne Bastviken	Radikal Broccoli
Marit Elise Aune	Ruskenaksjonen
Timothy Elliott	Eunomia
Thor Kamfjord	Norner
Andreas Andersen	Miljødirektoratet
Elise Amland	Mepex
Rebecca Briedis	Mepex
Kathrine Kirkevaag	Mepex
Miriam Mekki	Miljødirektoratet

12.2 Workshop results

Table 26 – The suggested alternative materials, products and solutions that were presented during the workshop.

Original Product	Type of Alternative	Suggested Solutions	Pros/Cons
Beverage bottles, caps and lids	Materials	Recycled PET	Lower carbon footprint. Will not reduce plastic littering
		Metal and glass	Carbon footprint
	Products	Multi-use bottles	People buy too many
	Solutions	Strengthen the deposit system to prevent littering	
Cotton buds	Materials	Cardboard or wooden stick	Increase in price?
	Products	Ear wash	Difficult for consumer?
	Solutions	Do it yourself' matchstick + cotton	Difficult for consumer?
		Communication --> labelling	Could raise awareness
		Unnecessary product?	
Very lightweight plastic bags (bags for fruit)	Materials	Paper bags	Carbon footprint
		Pre-packed products	Less work for the consumer
	Products	Multi-use (plastic) bags	People buy too many
	Solutions	Public awareness to reduce consumption	Costly
Balloons and balloon sticks	Materials	Wooden sticks	
	Solutions	Unnecessary product?	
Fast food packaging, plates and trays (non-EPS)	Materials	Cellulose	Less incentives for not littering
		Biodegradable laminates	
	Products	Multi-use packaging	Cheaper if you bring your own
	Solutions	Differentiate use of product	
		Public awareness campaigns	Not necessarily effective
		Focus on EPR	
		Environmental tax	
Beverage cups and lids	Materials	Uncoated fibre for lid (or other material types)	Resources?
	Products	Multi-use cup	
	Solutions	Drink in	
		Deposit scheme	
		Discounted pricing for re-use	
Fast food packaging (EPS)	Materials	Carton + film for some types of food	Not recyclable
		PP	Recyclable
		PLA	Not recyclable
	Products	Glass containers	Less waste

		Metal boxes	Resources?
	Solutions	Bring your own box	No waste
		Rent a tray	Will these be returned?
		More expensive to take away	
Straws and stirrers	Materials	Paper	Single-use
		Metal	Multi-use
	Solutions	Replace straw with 'easy to drink' packaging	
		Labelling requirements and information campaigns	
Snus packaging	Materials	Paper box - old style	
	Products	Luxury reusable box + refill	
	Solutions	Info campaigns	
		Deposit system	
Carrier bags	Materials	100 % recycled LDPE bags	Lower carbon footprint, but will not reduce littering
	Products	R-PET woven reusable nets	Carbon footprint?
	Solutions	Reduce use especially by online groceries, return system	
Wet-wipes	Products	Paper and spray	
	Solutions	Packaging design: section in pack for used wet wipes	
		Labelling requirements and information campaigns	
Crisp packets/sweet wrappers	Materials Solutions	Harmonization of laminate structures	Will not reduce littering
		Information campaigns	
		Reduce weight of packaging	Will decrease waste
Cutlery	Materials	Wood	Resources
	Products	Reusable plastic	Will not reduce littering
		Spork	
	Solutions	Change food style - Finger food	
		Extra fee for take away cutlery	
		Information campaigns	
Drink cartons	Materials	HDPE	Will not reduce littering
		PET	Integrate in deposit system
		Fossil-free solutions	Resources?
		Aluminium	
	Products	Deposit system	High collection rate, challenge of infrastructure
	Solutions	Reusable cups	
		Material tax virgin plastic	Will not reduce littering

		Information campaigns	
		Producer responsibility	
Sanitary towels (pads), tampons and tampon applicators	Materials	Covered in paper	Reduced pollution
		Organic cotton	Higher carbon footprint
	Products	Menstrual cup	Change consumer behaviour
		Sanitary pads of cloth	Change consumer behaviour
	Solutions	Information campaigns	
		Producer responsibility	
Shotgun cartridges	Materials	Cardboard (paper) + filt	Degradable, less durable?
		Recycling	Will not necessarily reduce littering
	Solutions	Information campaigns	
		Training (incl. in Jegerprøven)	
		Turn off ejector mechanism	No waste from cartridges
		Deposit scheme	
		Enforcement of littering --> withdraw licence for a period	Resources
Cigarette filters	Materials	Paper	Reduced littering
	Products	E-cigarettes/Vape	EE-waste increase
		Cigarette mouth piece	
	Solutions	Producer responsibility	
		Information campaigns	
Cigarette plastic packaging	Materials	Plastic film --> wax coating	Degradable, worse H_2O barrier, shorter shelf life?
	Products	E-cigarettes/Vape	Less litter
		Nicotine gum/patch	Different type of litter
	Solutions	Remove outer film	Reduce waste, health benefits, dryer cigarettes
Food packaging	Materials	Paper	
	Solutions	Package-free for certain products	
		More use of local produce and season-based products with less packaging for transport	
		Bring your own packaging	
Contact lenses	Materials	Biodegradable material	Less persistent in environm., still polluting, more likely to flush down the toilet
	Products	Glasses	
		Monthly contact lenses	
	Solutions	Laser surgery	
		Information campaigns	

12.3 Drinks Bottles

Table 27 – Modelled Results for Drinks Bottles.

Output	From SUP...	...to SUNP	Change	From SUP...	...to MU	Change	SUNP to MU
Consumption, million items used	622	622	0	622	622	0	0
Material	Plastic			Plastic			
Unit weight of item, grams	36	287	250	36	153	116	-134
Number of refills before waste, #					2,808		
Adjusted weight of item per use, grams				36	0.05	-36	-36
SUP Waste Generated, thousand tonnes	23	178	156	23	0.03	-23	-178
Production impacts:							
GHG emissions, thousand tonnes CO2 eq			124			-137	-261
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			170,000			-124,000	-294,000
Land Use, km2			69			-25	-94
Water Use, thousand m3			1			-1	-2
Unit price of item, NOK	0.26	0.70	0.43	0.26	185	184	184
Adjusted unit price of item, NOK				0.26	0.07	-0.20	-0.20
Producer's Turnover, thousand NOK (2018 Real Terms)			134,000			-55,662	-189,662
Employment, number of jobs			56			-26	-82
Retail impacts:							
Retailers's Turnover, thousand NOK (2018 Real Terms)			268,000			-124,000	-392,000
Refill scheme's impacts:							
Refill scheme costs, thousand NOK (2018 Real Terms)						130,022	130,022
Employment, number of jobs						0	0
Consumer impacts:							
Consumer's Purchases, thousand NOK (2018 Real Terms)			268,000			-124,000	-392,000

Consumer's Washing Costs, thousand NOK (2018 Real Terms)						1,854	1,854
Washing impacts (refill schemes):							
GHG emissions, thousand tonnes CO2 eq						2	2
GHG + AQ Externalities, thousand NOK (2018 Real Terms)						656	656
Land Use, km2						-1	-1
Water Use, thousand m3						22	22
Recycling / EfW impacts:							
Recycling rate, %	87%	81%	-6%	87%	64%	-23%	-17%
Recycling, thousand tonnes	20	144	125	20	0.02	-20	-144
Recycling impacts:							
GHG emissions, thousand tonnes CO2 eq			-379			22	401
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			-119,000			8,366	127,366
Financial costs, thousand NOK (2018 Real Terms)			488,000			-70,000	-558,000
Employment, number of jobs			340			-182	-522
EfW, thousand tonnes	3	33	30	3	0.01	-3	-33
EfW impacts:							
GHG emissions, thousand tonnes CO2 eq			-94			-6	88
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			-26,000			444	26,444
Financial costs, thousand NOK (2018 Real Terms)			29,000			-2,758	-31,758
Employment, number of jobs			21			-2	-23
Litter impacts:							
Litter generation, thousand tonnes			5			-1	-6
Terrestrial Litter Externalities, thousand NOK (2018 Real Terms)			-770,000			-770,000	0
Litter collected, thousand tonnes			4			-1	-5
Litter clean-up costs, thousand NOK (2018 Real Terms)			69,000			-5,147	-74,147
Litter that enters marine environment, tonnes	7.20	284	277	0.01	0.00002	-7.20	-284
Marine Litter Externalities, thousand NOK (2018 Real Terms)			-24,000			-24,000	0

Plastic litter that enters marine environment, tonnes	7.20	0	-7.20	7.20	0	-7.20	0.00
Plastic litter that enters marine environment, million items	0.20	0	-0.20	0.20	0	-0.20	0.00
Total GHGs, thousand tonnes CO2 eq			-349			-119	230
Total Externalities, thousand NOK (2018 Real Terms)			-769,000			-908,534	-139,534
Total Land Use, km2			69			-27	-96
Total Water Use, thousand m3			1			21	20
Total Consumer Cost, thousand NOK (2018 Real Terms)			268,000			-122,146	-390,146
Total Services Costs, thousand NOK (2018 Real Terms)			586,000			52,117	-533,883
Total Employment, number of jobs			417			-210	-627
Cost per item of marine litter reduced, NOK			4,303			-353	-4,656

12.4 Cotton Buds

Table 28 – Modelled Results for Cotton Buds.

Output	From SUP…	…to SUNP	Change	From SUP…	…to MU	Change	SUNP to MU
Consumption, million items used	631	631	0.00	631	631	0.00	0.00
Material	Plastic			Plastic			
Unit weight of item, grams	0.23	0.23	0.00	0.23	3	3	3
Number of refills before waste, #					734		
Adjusted weight of item per use, grams				0.23	0.004	-0.23	-0.23
SUP Waste Generated, thousand tonnes	0.15	0.15	0.00	0.15	0.003	-0.14	-0.14
Production impacts:							
GHG emissions, thousand tonnes CO2 eq			-0.17			-0.48	-0.31
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			-10			8,203	8,213
Land Use, km2			1			0	-1
Water Use, thousand m3			0.005			-0.09	-0.09
Unit price of item, NOK	0.13	0.13	0.00	0.1	2	1	1
Adjusted unit price of item, NOK				0.13	0.00	-0.12	-0.12
Producer's Turnover, thousand NOK (2018 Real Terms)			0.00			0.00	0.00
Employment, number of jobs			0.00			0.00	0.00
Retail impacts:							
Retailers's Turnover, thousand NOK (2018 Real Terms)			0.00			-78,000	-78,000
Refill scheme's impacts:							
Refill scheme costs, thousand NOK (2018 Real Terms)						0.00	0.00
Employment, number of jobs						0.00	0.00
Consumer impacts:							
Consumer's Purchases, thousand NOK (2018 Real Terms)			0.00			-78,000	-78,000
Consumer's Washing Costs, thousand NOK (2018 Real Terms)						0.00	0.00

Washing impacts (refill schemes):							
GHG emissions, thousand tonnes CO2 eq						0.00	0.00
GHG + AQ Externalities, thousand NOK (2018 Real Terms)						0.00	0.00
Land Use, km2						0.00	0.00
Water Use, thousand m3						0.00	0.00
Recycling / EfW impacts:							
Recycling rate, %	1%	1%	0%	1%	0%	-1%	-1%
Recycling, thousand tonnes	0.001	0.001	0.000	0.001	0.00	-0.001	-0.001
Recycling impacts:							
GHG emissions, thousand tonnes CO2 eq			0.001			0.002	0.002
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			0.1			1	1
Financial costs, thousand NOK (2018 Real Terms)			0.02			-0.3	-0.4
Employment, number of jobs			-0.01			-0.01	-0.003
EfW, thousand tonnes	0.1	0.1	-0.0001	0.1	0.003	-0.1	-0.1
EfW impacts:							
GHG emissions, thousand tonnes CO2 eq			-0.2			-0.2	0.01
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			26			21	-6
Financial costs, thousand NOK (2018 Real Terms)			-0.05			-133	-133
Employment, number of jobs			-0.00004			-0.1	-0.1
Litter impacts:							0.00
Litter generation, thousand tonnes			0.00			-0.01	-0.01
Terrestrial Litter Externalities, thousand NOK (2018 Real Terms)			-13,000			-13,000	0.00
Litter collected, thousand tonnes			0.00			-0.01	-0.01
Litter clean-up costs, thousand NOK (2018 Real Terms)			0			-142	-142
Litter that enters marine environment, tonnes	0.54	1	0	0.001	0.00001	-0.54	-1
Marine Litter Externalities, thousand NOK (2018 Real Terms)			-1,799			-1,799	0.06
Plastic litter that enters marine environment, tonnes	0.54	0.00	-0.54	0.54	0.00	-0.54	0.00

Plastic litter that enters marine environment, million items	2.35	0.00	-2.35	2.35	0.00	-2.35	0.00
Total GHGs, thousand tonnes CO2 eq			-0.4			-1	-0.3
Total Externalities, thousand NOK (2018 Real Terms)			-14,782			-6,574	8,208
Total Land Use, km2			1			-0.4	-1
Total Water Use, thousand m3			0.005			-0.1	-0.1
Total Consumer Cost, thousand NOK (2018 Real Terms)			0.00			-78,000	-78,000
Total Services Costs, thousand NOK (2018 Real Terms)			-0.03			-275	-275
Total Employment, number of jobs			-0.01			-0.1	-0.1
Cost per item of marine litter reduced, NOK			-0.00001			-33	-33

12.5 Very Lightweight Plastic Bags (bags for fruit)

Table 29 – Modelled Results for Very lightweight bags.

Output	From SUP…	…to SUNP	Change	From SUP…	…to MU	Change	SUNP to MU
Consumption, million items used	263	263	0.00	263	263	0.00	0.00
Material	Plastic			Plastic			
Unit weight of item, grams	1	4	2	1	23	22	19
Number of refills before waste, #					1,040		
Adjusted weight of item per use, grams				1	0.02	-1	-1
SUP Waste Generated, thousand tonnes	0	1	1	0.36	0.01	-0.35	-1
Production impacts:							
GHG emissions, thousand tonnes CO2 eq			-1			-6	-5
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			7,183			-4,643	-11,825
Land Use, km2			15			-1	-16
Water Use, thousand m3			0			-0.01	-0.26
Unit price of item, NOK	0.05	0.50	0.45	0.05	10	10	10
Adjusted unit price of item, NOK				0.05	0.01	-0.04	-0.04
Producer's Turnover, thousand NOK (2018 Real Terms)			0.00			0.00	0.00
Employment, number of jobs			0.00			0.00	0.00
Retail impacts:							
Retailers's Turnover, thousand NOK (2018 Real Terms)			118,000			-11,000	-129,000
Refill scheme's impacts:							
Refill scheme costs, thousand NOK (2018 Real Terms)						0.00	0.00
Employment, number of jobs						0.00	0.00
Consumer impacts:							
Consumer's Purchases, thousand NOK (2018 Real Terms)			118,000			-11,000	-129,000
Consumer's Washing Costs, thousand NOK (2018 Real Terms)						0.00	0.00

Washing impacts (refill schemes):							
GHG emissions, thousand tonnes CO2 eq						0.00	0.00
GHG + AQ Externalities, thousand NOK (2018 Real Terms)						0.00	0.00
Land Use, km2						0.00	0.00
Water Use, thousand m3						0.00	0.00
Recycling / EfW impacts:							
Recycling rate, %	38%	75%	37%	38%	0%	-38%	-75%
Recycling, thousand tonnes	0.14	0.70	0.57	0.14	0.00	-0.14	-0.70
Recycling impacts:							
GHG emissions, thousand tonnes CO2 eq			0.03			0.15	0.13
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			-160			58	219
Financial costs, thousand NOK (2018 Real Terms)			165			-40	-205
Employment, number of jobs			0			-1	-1
EfW, thousand tonnes	0.22	0.23	0.01	0.22	0.01	-0.21	-0.23
EfW impacts:							
GHG emissions, thousand tonnes CO2 eq			-0.46			-0.44	0.02
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			56			34	-22
Financial costs, thousand NOK (2018 Real Terms)			10			-204	-214
Employment, number of jobs			0.01			-0.15	-0.16
Litter impacts:							0.00
Litter generation, thousand tonnes			0.02			-0.01	-0.02
Terrestrial Litter Externalities, thousand NOK (2018 Real Terms)			-10,000			-10,000	0.00
Litter collected, thousand tonnes			0			-0.01	-0.02
Litter clean-up costs, thousand NOK (2018 Real Terms)			264			-62	-327
Litter that enters marine environment, tonnes	0.48	1	1	0.0005	0.000001	-0.48	-1
Marine Litter Externalities, thousand NOK (2018 Real Terms)			-1,583			-1,583	0.01
Plastic litter that enters marine environment, tonnes	0.48	0.00	-0.48	0.48	0.00	-0.48	0.00

Plastic litter that enters marine environment, million items	0.35	0.00	-0.35	0.35	0.00	-0.35	0.00
Total GHGs, thousand tonnes CO2 eq			-1			-6	-5
Total Externalities, thousand NOK (2018 Real Terms)			-4,504			-16,133	-11,629
Total Land Use, km2			15			-1	-16
Total Water Use, thousand m3			0.2			-0.01	-0.3
Total Consumer Cost, thousand NOK (2018 Real Terms)			118,000			-11,000	-129,000
Total Services Costs, thousand NOK (2018 Real Terms)			440			-306	-745
Total Employment, number of jobs			0.01			-1	-1
Cost per item of marine litter reduced, NOK			339			-32	-371

12.6 Balloons and balloon sticks

Table 30 – Modelled Results for Balloon Sticks.

Output	From SUP…	…to SUNP	Change	From SUP…	…to MU	Change	SUNP to MU
Consumption, million items used	0.3	0.3	0.00	0.00			
Material	Plastic			Plastic			
Unit weight of item, grams	6	7	1	6			
Number of refills before waste, #							
Adjusted weight of item per use, grams				6			
SUP Waste Generated, thousand tonnes	0.002	0.002	0.0003	0.002			
Production impacts:							
GHG emissions, thousand tonnes CO2 eq			-0.004				
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			-2				
Land Use, km2			0.006				
Water Use, thousand m3			0.00001				
Unit price of item, NOK	2.14	2.14	0.00	2			
Adjusted unit price of item, NOK				2.14			
Producer's Turnover, thousand NOK (2018 Real Terms)			0.00				
Employment, number of jobs			0.00				
Retail impacts:							
Retailers's Turnover, thousand NOK (2018 Real Terms)			0.00				
Refill scheme's impacts:							
Refill scheme costs, thousand NOK (2018 Real Terms)							
Employment, number of jobs							
Consumer impacts:							
Consumer's Purchases, thousand NOK (2018 Real Terms)			0.00				
Consumer's Washing Costs, thousand NOK (2018 Real Terms)							

Washing impacts (refill schemes):							
GHG emissions, thousand tonnes CO2 eq							
GHG + AQ Externalities, thousand NOK (2018 Real Terms)							
Land Use, km2							
Water Use, thousand m3							
Recycling / EfW impacts:							
Recycling rate, %	2%	15%	13%	2%			
Recycling, thousand tonnes	0.00003	0.0003	0.0002	0.00003			
Recycling impacts:							
GHG emissions, thousand tonnes CO2 eq			0.000002				
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			-0.032				
Financial costs, thousand NOK (2018 Real Terms)			0.071				
Employment, number of jobs			0.0001				
EfW, thousand tonnes	0.001	0.002	0.0001	0.001			
EfW impacts:							
GHG emissions, thousand tonnes CO2 eq			-0.003				
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			0.326				
Financial costs, thousand NOK (2018 Real Terms)			0.057				
Employment, number of jobs			0.00004				
Litter impacts:							
Litter generation, thousand tonnes			0.000006				
Terrestrial Litter Externalities, thousand NOK (2018 Real Terms)			-32				
Litter collected, thousand tonnes			0.000005				
Litter clean-up costs, thousand NOK (2018 Real Terms)			0.3				
Litter that enters marine environment, tonnes	0.002	0.002	0.0003	0.000002			
Marine Litter Externalities, thousand NOK (2018 Real Terms)			-5				
Plastic litter that enters marine environment, tonnes	0.002	0.00	-0.002	0.002			

Plastic litter that enters marine environment, million items	0.0003	0.00	-0.0003	0.0003			
Total GHGs, thousand tonnes CO2 eq			-0.01				
Total Externalities, thousand NOK (2018 Real Terms)			-39				
Total Land Use, km2			0.01				
Total Water Use, thousand m3			0.00001				
Total Consumer Cost, thousand NOK (2018 Real Terms)			0.00				
Total Services Costs, thousand NOK (2018 Real Terms)			0.41				
Total Employment, number of jobs			0.0001				
Cost per item of marine litter reduced, NOK			2			**0**	**-2**

12.7 Fast Food Packaging, plates and trays (non-EPS)

Table 31 – Modelled Results for Fast food packaging.

Output	From SUP…	…to SUNP	Change	From SUP…	…to MU	Change	SUNP to MU
Consumption, million items used	137	137	0.00	137	137	0.00	0.00
Material	Plastic			Plastic			
Unit weight of item, grams	20	16	-4	20	158	138	143
Number of refills before waste, #					515		
Adjusted weight of item per use, grams				20	0.31	-20	-20
SUP Waste Generated, thousand tonnes	3	2	-1	3	0.04	-3	-2
Production impacts:							
GHG emissions, thousand tonnes CO2 eq			-3			-3	0
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			-3,003			-3,142	-139
Land Use, km2			1			-0.28	-1
Water Use, thousand m3			-0.04			-0.04	-0.0002
Unit price of item, NOK	2.72	4.03	1.31	3	64	62	60
Adjusted unit price of item, NOK				2.72	0.12	-2.60	-2.60
Producer's Turnover, thousand NOK (2018 Real Terms)			0.00			0.00	0.00
Employment, number of jobs			0.00			0.00	0.00
Retail impacts:							
Retailers's Turnover, thousand NOK (2018 Real Terms)			180,000			-356,000	-536,000
Refill scheme's impacts:							
Refill scheme costs, thousand NOK (2018 Real Terms)						225,000	225,000
Employment, number of jobs						470	470
Consumer impacts:							
Consumer's Purchases, thousand NOK (2018 Real Terms)			180,000			-356,000	-536,000
Consumer's Washing Costs, thousand NOK (2018 Real Terms)						20,000	20,000

Washing impacts (refill schemes):							
GHG emissions, thousand tonnes CO2 eq						1	1
GHG + AQ Externalities, thousand NOK (2018 Real Terms)						63,000	63,000
Land Use, km2						0.0	0.0
Water Use, thousand m3						212	212
Recycling / EfW impacts:							
Recycling rate, %	5%	25%	20%	5%	38%	33%	13%
Recycling, thousand tonnes	0.1	1	0.4	0.1	0.02	-0.1	-1
Recycling impacts:							
GHG emissions, thousand tonnes CO2 eq			-2			0.1	2
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			-585			51	636
Financial costs, thousand NOK (2018 Real Terms)			116			-35	-151
Employment, number of jobs			1			-1	-2
EfW, thousand tonnes	3	2	-1	3	0.03	-3	-2
EfW impacts:							
GHG emissions, thousand tonnes CO2 eq			-10			-5	5
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			-1,063			406	1,468
Financial costs, thousand NOK (2018 Real Terms)			-954			-2,442	-1,488
Employment, number of jobs			-1			-2	-1
Litter impacts:							0.00
Litter generation, thousand tonnes			-0.02			-0.1	-0.1
Terrestrial Litter Externalities, thousand NOK (2018 Real Terms)			-78,000			-78,000	0.00
Litter collected, thousand tonnes			-0.01			-0.1	-0.1
Litter clean-up costs, thousand NOK (2018 Real Terms)			266			-479	-745
Litter that enters marine environment, tonnes	3.65	3	-1	0.004	0.00	-3.65	-3
Marine Litter Externalities, thousand NOK (2018 Real Terms)			-12,000			-12,000	0.00
Plastic litter that enters marine environment, tonnes	3.65	0.00	-3.65	3.65	0.00	-3.65	0.00

Plastic litter that enters marine environment, million items	0.18	0.00	-0.18	0.18	0.00	-0.18	0.00
Total GHGs, thousand tonnes CO2 eq			-15			-7	8
Total Externalities, thousand NOK (2018 Real Terms)			-94,651			-29,686	64,965
Total Land Use, km2			1			-0.3	-1
Total Water Use, thousand m3			-0.04			212	212
Total Consumer Cost, thousand NOK (2018 Real Terms)			180,000			-336,000	-516,000
Total Services Costs, thousand NOK (2018 Real Terms)			-572			222,043	222,616
Total Employment, number of jobs			1			467	466
Cost per item of marine litter reduced, NOK			983			-624	-1,607

12.8 Beverage Cups and Lids

Table 32 – Modelled Results for Beverage Cups.

Output	From SUP…	…to SUNP	Change	From SUP…	…to MU	Change	SUNP to MU
Consumption, million items used	106	106	0.00	106	106	0.00	0.00
Material	Plastic			Plastic			
Unit weight of item, grams	14	10	-4	14	96	82	86
Number of refills before waste, #					564		
Adjusted weight of item per use, grams				14	0.17	-14	-14
SUP Waste Generated, thousand tonnes	1	1	-0.4	1	0.02	-1	-1
Production impacts:							
GHG emissions, thousand tonnes CO2 eq			-3			-4	-0.1
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			-4,380			-4,915	-535
Land Use, km2			-3			-6	-3
Water Use, thousand m3			-0.04			-0.1	-0.01
Unit price of item, NOK	3.01	3.01	0.00	3	159	156	156
Adjusted unit price of item, NOK				3.01	0.28	-2.73	-2.73
Producer's Turnover, thousand NOK (2018 Real Terms)			0.00			0.00	0.00
Employment, number of jobs			0.00			0.00	0.00
Retail impacts:							
Retailers's Turnover, thousand NOK (2018 Real Terms)			0.00			-290,000	-290,000
Refill scheme's impacts:							
Refill scheme costs, thousand NOK (2018 Real Terms)						11,000	11,000
Employment, number of jobs						0.00	0.00
Consumer impacts:							
Consumer's Purchases, thousand NOK (2018 Real Terms)			0.00			-290,000	-290,000
Consumer's Washing Costs, thousand NOK (2018 Real Terms)						3,103	3,103

Washing impacts (refill schemes):							
GHG emissions, thousand tonnes CO2 eq						0.2	0.2
GHG + AQ Externalities, thousand NOK (2018 Real Terms)						10,000	10,000
Land Use, km2						0.00	0.00
Water Use, thousand m3						33	33
Recycling / EfW impacts:							
Recycling rate, %	3%	25%	23%	3%	38%	36%	13%
Recycling, thousand tonnes	0.04	0.3	0.2	0.04	0.01	-0.03	-0.3
Recycling impacts:							
GHG emissions, thousand tonnes CO2 eq			-0.02			0.02	0.04
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			-68			11	80
Financial costs, thousand NOK (2018 Real Terms)			67			-9	-76
Employment, number of jobs			0.2			-0.2	-0.4
EfW, thousand tonnes	1	1	-1	1	0.01	-1	-1
EfW impacts:							
GHG emissions, thousand tonnes CO2 eq			-2			-2	0.1
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			175			101	-74
Financial costs, thousand NOK (2018 Real Terms)			-618			-1,357	-739
Employment, number of jobs			-0.5			-1	-1
Litter impacts:							0.00
Litter generation, thousand tonnes			-0.03			-0.1	-0.1
Terrestrial Litter Externalities, thousand NOK (2018 Real Terms)			-102,000			-102,000	0.00
Litter collected, thousand tonnes			-0.02			-0.1	-0.1
Litter clean-up costs, thousand NOK (2018 Real Terms)			267			-623	-891
Litter that enters marine environment, tonnes	4.75	3	-1	0.005	0.00	-4.75	-3
Marine Litter Externalities, thousand NOK (2018 Real Terms)			-16,000			-16,000	0.00
Plastic litter that enters marine environment, tonnes	4.75	0.00	-4.75	4.75	0.00	-4.75	0.00

Plastic litter that enters marine environment, million items	0.34	0.00	-0.34	0.34	0.00	-0.34	0.00
Total GHGs, thousand tonnes CO2 eq			-5			-5	0
Total Externalities, thousand NOK (2018 Real Terms)			-122,273			-112,802	9,471
Total Land Use, km2			-3			-6	-3
Total Water Use, thousand m3			-0.04			33	33
Total Consumer Cost, thousand NOK (2018 Real Terms)			0.00			-286,897	-286,897
Total Services Costs, thousand NOK (2018 Real Terms)			-284			9,011	9,295
Total Employment, number of jobs			-0.2			-1	-1
Cost per item of marine litter reduced, NOK			-1			-819	-818

12.9 Fast Food Packaging (EPS)

Table 33 – Modelled Results for Fast food packaging.

Output	From SUP…	…to SUNP	Change	From SUP…	…to MU	Change	SUNP to MU
Consumption, million items used	122	122	0.00	122	122	0.00	0.00
Material	Plastic			Plastic			
Unit weight of item, grams	5	16	11	5	158	153	143
Number of refills before waste, #					515		
Adjusted weight of item per use, grams				5	0.31	-5	-5
SUP Waste Generated, thousand tonnes	1	2	1	1	0.04	-1	-2
Production impacts:							
GHG emissions, thousand tonnes CO2 eq			-1			-1	-0.03
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			-537			-661	-124
Land Use, km2			1			-0.06	-1
Water Use, thousand m3			-0.003			-0.003	-0.0002
Unit price of item, NOK	2.33	4.03	1.70	2	64	62	60
Adjusted unit price of item, NOK				2.33	0.12	-2.21	-2.21
Producer's Turnover, thousand NOK (2018 Real Terms)			0.00			0.00	0.00
Employment, number of jobs			0.00			0.00	0.00
Retail impacts:							
Retailers's Turnover, thousand NOK (2018 Real Terms)			208,000			-270,000	-478,000
Refill scheme's impacts:							
Refill scheme costs, thousand NOK (2018 Real Terms)						201,000	201,000
Employment, number of jobs						418	418
Consumer impacts:							
Consumer's Purchases, thousand NOK (2018 Real Terms)			208,000			-270,000	-478,000
Consumer's Washing Costs, thousand NOK (2018 Real Terms)						17,822	17,822

Washing impacts (refill schemes):							
GHG emissions, thousand tonnes CO2 eq						1	1
GHG + AQ Externalities, thousand NOK (2018 Real Terms)						0.00	0.00
Land Use, km2						0.00	0.00
Water Use, thousand m3						188	188
Recycling / EfW impacts:							
Recycling rate, %	0.0%	25%	25%	0.0%	38%	38%	13%
Recycling, thousand tonnes	0.00	0.47	0.47	0.00	0.01	0.01	-0.46
Recycling impacts:							
GHG emissions, thousand tonnes CO2 eq			-2			-0.02	2
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			-573			-7	566
Financial costs, thousand NOK (2018 Real Terms)			138			4	-134
Employment, number of jobs			2			0.1	-2
EfW, thousand tonnes	1	1	1	1	0.02	-1	-1
EfW impacts:							
GHG emissions, thousand tonnes CO2 eq			-6			-1	5
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			-1,217			90	1,307
Financial costs, thousand NOK (2018 Real Terms)			769			-556	-1,325
Employment, number of jobs			1			-0.4	-1
Litter impacts:							0.0
Litter generation, thousand tonnes			0.03			-0.02	-0.05
Terrestrial Litter Externalities, thousand NOK (2018 Real Terms)			-17,000			-17,000	0.00
Litter collected, thousand tonnes			0.03			-0.01	-0.05
Litter clean-up costs, thousand NOK (2018 Real Terms)			556			-107	-663
Litter that enters marine environment, tonnes	0.81	3	2	0.00	0.00	-0.81	-3
Marine Litter Externalities, thousand NOK (2018 Real Terms)			-2,704			-2,704	0.04
Plastic litter that enters marine environment, tonnes	0.81	0.00	-0.81	0.81	0.00	-0.81	0.00

Plastic litter that enters marine environment, million items	0.16	0.00	-0.16	0.16	0.00	-0.16	0.00
Total GHGs, thousand tonnes CO2 eq			-8			-1	7
Total Externalities, thousand NOK (2018 Real Terms)			-22,031			-20,282	1,749
Total Land Use, km2			1			-0.1	-1
Total Water Use, thousand m3			-0.003			188	188
Total Consumer Cost, thousand NOK (2018 Real Terms)			208,000			-252,178	-460,178
Total Services Costs, thousand NOK (2018 Real Terms)			1,464			200,342	198,878
Total Employment, number of jobs			3			418	415
Cost per item of marine litter reduced, NOK			1,289			-319	-1,609

12.10 Straws

Table 34 – Modelled Results for Straws.

Output	From SUP…	…to SUNP	Change	From SUP…	…to MU	Change	SUNP to MU
Consumption, million items used	526	526	0.00	526	526	0.00	0.00
Material	Plastic			Plastic			
Unit weight of item, grams	0.4	1	0.4	0.4	11	11	10
Number of refills before waste, #					5,412		
Adjusted weight of item per use, grams				0.4	0.002	-0.4	-0.4
SUP Waste Generated, thousand tonnes	0.2	0.4	0.2	0.2	0.001	-0.2	-0.4
Production impacts:							
GHG emissions, thousand tonnes CO2 eq			-1			-1	0.01
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			-519			-511	8
Land Use, km2			-0.1			-0.1	0.002
Water Use, thousand m3			-0.002			-0.002	0.00005
Unit price of item, NOK	0.17	0.39	0.22	0.2	23	23	22
Adjusted unit price of item, NOK				0.17	0.00	-0.16	-0.16
Producer's Turnover, thousand NOK (2018 Real Terms)			0.00			0.00	0.00
Employment, number of jobs			0.00			0.00	0.00
Retail impacts:							
Retailers's Turnover, thousand NOK (2018 Real Terms)			118,000			-85,000	-203,000
Refill scheme's impacts:							
Refill scheme costs, thousand NOK (2018 Real Terms)						1,568	1,568
Employment, number of jobs						0.00	0.00
Consumer impacts:							
Consumer's Purchases, thousand NOK (2018 Real Terms)			118,000			-85,000	-203,000
Consumer's Washing Costs, thousand NOK (2018 Real Terms)						1,568	1,568

Washing impacts (refill schemes):							
GHG emissions, thousand tonnes CO2 eq						0.00	0.00
GHG + AQ Externalities, thousand NOK (2018 Real Terms)						0.00	0.00
Land Use, km2						0.00	0.00
Water Use, thousand m3						0.00	0.00
Recycling / EfW impacts:							
Recycling rate, %	1%	25%	24%	1%	75%	74%	50%
Recycling, thousand tonnes	0.002	0.1	0.1	0.002	0.001	-0.001	-0.1
Recycling impacts:							
GHG emissions, thousand tonnes CO2 eq			-0.02			0.001	0.02
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			-32			1	32
Financial costs, thousand NOK (2018 Real Terms)			30			-0.4	-30
Employment, number of jobs			0.2			-0.01	-0.2
EfW, thousand tonnes	0.2	0.3	0.1	0.2	0.0003	-0.2	-0.3
EfW impacts:							
GHG emissions, thousand tonnes CO2 eq			-0.4			-0.4	0.01
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			62			33	-29
Financial costs, thousand NOK (2018 Real Terms)			102			-197	-299
Employment, number of jobs			0.1			-0.1	-0.2
Litter impacts:							0.00
Litter generation, thousand tonnes			0.002			-0.002	-0.004
Terrestrial Litter Externalities, thousand NOK (2018 Real Terms)			-2,392			-2,392	0.006
Litter collected, thousand tonnes			0.002			-0.002	-0.004
Litter clean-up costs, thousand NOK (2018 Real Terms)			44			-15	-59
Litter that enters marine environment, tonnes	0.11	0.2	0.1	0.0001	0.00	-0.11	-0.2
Marine Litter Externalities, thousand NOK (2018 Real Terms)			-372			-372	0.001
Plastic litter that enters marine environment, tonnes	0.11	0.00	-0.11	0.11	0.00	-0.11	0.00

Plastic litter that enters marine environment, million items	0.28	0.00	-0.28	0.28	0.00	-0.28	0.00
Total GHGs, thousand tonnes CO2 eq			-1			-1	0.04
Total Externalities, thousand NOK (2018 Real Terms)			-3,253			-3,242	11
Total Land Use, km2			-0.1			-0.1	0.002
Total Water Use, thousand m3			-0.002			-0.002	0.00005
Total Consumer Cost, thousand NOK (2018 Real Terms)			118,000			-83,432	-201,432
Total Services Costs, thousand NOK (2018 Real Terms)			176			1,356	1,180
Total Employment, number of jobs			0.2			-0.2	-0.4
Cost per item of marine litter reduced, NOK			423			-293	-716

12.11 Stirrers

Table 35 - Modelled Results for Stirrers.

Output	From SUP...	...to SUNP	Change	From SUP...	...to MU	Change	SUNP to MU
Consumption, million items used	79	79	0.00	79	79	0.00	0.00
Material	Plastic			Plastic			
Unit weight of item, grams	1	2	1	1	14	13	12
Number of refills before waste, #					11,274		
Adjusted weight of item per use, grams				1	0.001	-1	-1
SUP Waste Generated, thousand tonnes	0.05	0.1	0.1	0.05	0.0001	-0.05	-0.1
Production impacts:							
GHG emissions, thousand tonnes CO2 eq			-0.1			-0.1	-0.1
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			236			-116	-352
Land Use, km2			1			-0.02	-2
Water Use, thousand m3			0.0003			-0.0004	-0.001
Unit price of item, NOK	0.17	0.15	-0.02	0.2	9	9	9
Adjusted unit price of item, NOK				0.17	0.001	-0.16	-0.16
Producer's Turnover, thousand NOK (2018 Real Terms)			0.00			0.00	0.00
Employment, number of jobs			0.00			0.00	0.00
Retail impacts:							
Retailers's Turnover, thousand NOK (2018 Real Terms)			-1,533			-13,000	-11,467
Refill scheme's impacts:							
Refill scheme costs, thousand NOK (2018 Real Terms)						2,637	2,637
Employment, number of jobs						0.00	0.00
Consumer impacts:							
Consumer's Purchases, thousand NOK (2018 Real Terms)			-1,533			-13,000	-11,467
Consumer's Washing Costs, thousand NOK (2018 Real Terms)						769	769

Washing impacts (refill schemes):							
GHG emissions, thousand tonnes CO2 eq						0.05	0.05
GHG + AQ Externalities, thousand NOK (2018 Real Terms)						2,415	2,415
Land Use, km2						0.1	0.1
Water Use, thousand m3						8	8
Recycling / EfW impacts:							
Recycling rate, %	1%	25%	24%	1%	75%	74%	50%
Recycling, thousand tonnes	0.0005	0.04	0.04	0.0005	0.0001	-0.0004	-0.04
Recycling impacts:							
GHG emissions, thousand tonnes CO2 eq			-0.002			0.0004	0.002
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			-1			0.2	1
Financial costs, thousand NOK (2018 Real Terms)			11			-0.1	-11
Employment, number of jobs			0.02			-0.004	-0.03
EfW, thousand tonnes	0.05	0.1	0.1	0.05	0.00002	-0.05	-0.1
EfW impacts:							
GHG emissions, thousand tonnes CO2 eq			-0.1			-0.1	0.01
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			10			7	-3
Financial costs, thousand NOK (2018 Real Terms)			62			-44	-107
Employment, number of jobs			0.05			-0.03	-0.1
Litter impacts:							0.00
Litter generation, thousand tonnes			0.0001			-0.00003	-0.0001
Terrestrial Litter Externalities, thousand NOK (2018 Real Terms)			-27			-27	0.0001
Litter collected, thousand tonnes			0.00005			-0.00002	-0.00007
Litter clean-up costs, thousand NOK (2018 Real Terms)			1			-0.2	-1
Litter that enters marine environment, tonnes	0.001	0.004	0.003	0.000001	0.00	-0.001	-0.004
Marine Litter Externalities, thousand NOK (2018 Real Terms)			-4			-4	0.00002
Plastic litter that enters marine environment, tonnes	0.001	0.00	-0.001	0.001	0.00	-0.001	0.00

Plastic litter that enters marine environment, million items	0.002	0.00	-0.002	0.002	0.00	-0.002	0.00
Total GHGs, thousand tonnes CO2 eq			-0.2			-0.2	-0.02
Total Externalities, thousand NOK (2018 Real Terms)			215			2,276	2,061
Total Land Use, km2			1			0.1	-1
Total Water Use, thousand m3			0.0003			8	8
Total Consumer Cost, thousand NOK (2018 Real Terms)			-1,533			-12,231	-10,698
Total Services Costs, thousand NOK (2018 Real Terms)			74			2,593	2,519
Total Employment, number of jobs			0.1			-0.04	-0.1
Cost per item of marine litter reduced, NOK			-696			-4,595	-3,899

12.12 Lightweight plastic carrier bags

Table 36 – Modelled Results for Lightweight carrier bags.

Output	From SUP…	…to SUNP	Change	From SUP…	…to MU	Change	SUNP to MU
Consumption, million items used	770	770	0.00	770	770	0.00	0.00
Material	Plastic			Plastic			
Unit weight of item, grams	15	34	19	15	98	83	64
Number of refills before waste, #					1,040		
Adjusted weight of item per use, grams				15	0.09	-15	-15
SUP Waste Generated, thousand tonnes	12	26	15	12	0.07	-11	-26
Production impacts:							
GHG emissions, thousand tonnes CO2 eq			-16			-16	-0.001
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			-13,000			-12,000	1,000
Land Use, km2			-2			-2	0
Water Use, thousand m3			-0.04			-0.03	0.01
Unit price of item, NOK	1.60	2.00	0.40	2	15	13	13
Adjusted unit price of item, NOK				1.60	0.01	-1.59	-1.59
Producer's Turnover, thousand NOK (2018 Real Terms)			0.00			0.00	0.00
Employment, number of jobs			0.00			0.00	0.00
Retail impacts:							
Retailers's Turnover, thousand NOK (2018 Real Terms)			308,000			-1,221,000	-1,529,000
Refill scheme's impacts:							
Refill scheme costs, thousand NOK (2018 Real Terms)						0.00	0.00
Employment, number of jobs						0.00	0.00
Consumer impacts:							
Consumer's Purchases, thousand NOK (2018 Real Terms)			308,000			-1,221,000	-1,529,000

Consumer's Washing Costs, thousand NOK (2018 Real Terms)						0.00	0.00
Washing impacts (refill schemes):							
GHG emissions, thousand tonnes CO2 eq						0.00	0.00
GHG + AQ Externalities, thousand NOK (2018 Real Terms)						0.00	0.00
Land Use, km2						0.00	0.00
Water Use, thousand m3						0.00	0.00
Recycling / EfW impacts:							
Recycling rate, %	38%	75%	37%	38%	0%	-38%	-75%
Recycling, thousand tonnes	4	20	15	4	0.00	-4	-20
Recycling impacts:							
GHG emissions, thousand tonnes CO2 eq			1			5	4
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			-4,307			1,879	6,186
Financial costs, thousand NOK (2018 Real Terms)			4,513			-1,280	-5,793
Employment, number of jobs			-5			-41	-36
EfW, thousand tonnes	7	6	-1	7	0.07	-7	-6
EfW impacts:							
GHG emissions, thousand tonnes CO2 eq			-15			-14	0.44
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			1,721			1,119	-603
Financial costs, thousand NOK (2018 Real Terms)			-582			-6,669	-6,087
Employment, number of jobs			0			-5	-4
Litter impacts:							0.000
Litter generation, thousand tonnes			1			-1	-1
Terrestrial Litter Externalities, thousand NOK (2018 Real Terms)			-617,000			-617,000	0.000
Litter collected, thousand tonnes			1			-1	-1
Litter clean-up costs, thousand NOK (2018 Real Terms)			14,000			-3,789	-17,789
Litter that enters marine environment, tonnes	28.88	66	37	0.03	0.000	-28.87	-66
Marine Litter Externalities, thousand NOK (2018 Real Terms)			-96,000			-96,000	0.000

Plastic litter that enters marine environment, tonnes	28.88	0.000	-28.88	28.88	0.000	-28.88	0.000
Plastic litter that enters marine environment, million items	1.93	0.000	-1.93	1.93	0.000	-1.93	0.000
Total GHGs, thousand tonnes CO2 eq			-29			-25	4
Total Externalities, thousand NOK (2018 Real Terms)			-728,586			-722,003	6,583
Total Land Use, km2			-2			-2	0.02
Total Water Use, thousand m3			-0.04			-0.03	0.01
Total Consumer Cost, thousand NOK (2018 Real Terms)			308,000			-1,221,000	-1,529,000
Total Services Costs, thousand NOK (2018 Real Terms)			17,931			-11,738	-29,669
Total Employment, number of jobs			-5			-46	-40
Cost per item of marine litter reduced, NOK			169			-640	-810

12.13 Wet wipes

Table 37 – Modelled Results for Wet Wipes.

Output	From SUP…	…to SUNP	Change	From SUP…	…to MU	Change	SUNP to MU
Consumption, million items used	599	599	0	599	599	0.0	0.0
Material	Plastic			Plastic			
Unit weight of item, grams	1	3	1	1	7	6	4
Number of refills before waste, #					6,330		
Adjusted weight of item per use, grams				1	0.00	-1	-1
SUP Waste Generated, thousand tonnes	1	1	1	1	0.00	-1	-1
Production impacts:							
GHG emissions, thousand tonnes CO2 eq			9			-6	-15
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			9,000			-7,367	-16,367
Land Use, km2			14			-4	-17
Water Use, thousand m3			0.1			-0.2	-0.3
Unit price of item, NOK	0.85	0.34	-0.51	1	36	36	36
Adjusted unit price of item, NOK				0.85	0.01	-0.84	-0.84
Producer's Turnover, thousand NOK (2018 Real Terms)			0.00			0.00	0.00
Employment, number of jobs			0.00			0.00	0.00
Retail impacts:							
Retailers's Turnover, thousand NOK (2018 Real Terms)			-303,000			-503,000	-200,000
Refill scheme's impacts:							
Refill scheme costs, thousand NOK (2018 Real Terms)						0.00	0.00
Employment, number of jobs						0.00	0.00
Consumer impacts:							
Consumer's Purchases, thousand NOK (2018 Real Terms)			-303,000			-503,000	-200,000
Consumer's Washing Costs, thousand NOK (2018 Real Terms)						14,000	14,000

Washing impacts (refill schemes):							
GHG emissions, thousand tonnes CO2 eq						0.2	0.2
GHG + AQ Externalities, thousand NOK (2018 Real Terms)						7,044	7,044
Land Use, km2						0.3	0.3
Water Use, thousand m3						105	105
Recycling / EfW impacts:							
Recycling rate, %	0.0%	0.0%	0.0%	0.0%	50%	50%	50%
Recycling, thousand tonnes	0.00	0.00	0.00	0.00	0.0003	0.0003	0.0003
Recycling impacts:							
GHG emissions, thousand tonnes CO2 eq			0.00			-0.001	-0.001
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			0.00			-0.5	-0.5
Financial costs, thousand NOK (2018 Real Terms)			0.00			0.1	0.1
Employment, number of jobs			0.00			0.002	0.002
EfW, thousand tonnes	1	1	1	1	0.0003	-1	-1
EfW impacts:							
GHG emissions, thousand tonnes CO2 eq			-1			-1	0.1
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			-139			34	173
Financial costs, thousand NOK (2018 Real Terms)			793			-623	-1,416
Employment, number of jobs			1			-0.5	-1
Litter impacts:							0.0
Litter generation, thousand tonnes			0.03			-0.02	-0.04
Terrestrial Litter Externalities, thousand NOK (2018 Real Terms)			-23,000			-23,000	0.00
Litter collected, thousand tonnes			0.02			-0.02	-0.04
Litter clean-up costs, thousand NOK (2018 Real Terms)			330			-259	-590
Litter that enters marine environment, tonnes	0.99	2	1	0.001	0.00	-0.99	-2
Marine Litter Externalities, thousand NOK (2018 Real Terms)			-3,290			-3,290	0.00
Plastic litter that enters marine environment, tonnes	0.99	0.00	-0.99	0.99	0.00	-0.99	0.00

Plastic litter that enters marine environment, million items	0.90	0.00	-0.90	0.90	0.00	-0.90	0.00
Total GHGs, thousand tonnes CO2 eq			9			-7	-15
Total Externalities, thousand NOK (2018 Real Terms)			-17,429			-26,580	-9,150
Total Land Use, km2			14			-3	-17
Total Water Use, thousand m3			0.1			105	105
Total Consumer Cost, thousand NOK (2018 Real Terms)			-303,000			-489,000	-186,000
Total Services Costs, thousand NOK (2018 Real Terms)			1,123			-882	-2,006
Total Employment, number of jobs			1			-0.5	-1
Cost per item of marine litter reduced, NOK			-336			-545	-209

12.14 Sweet Wrappers

Table 38 – Modelled Results for Sweet Wrappers.

Output	From SUP…	…to SUNP	Change	From SUP…	…to MU	Change	SUNP to MU
Consumption, million items used	126	126	0.00	0.00			
Material	Plastic			Plastic			
Unit weight of item, grams	5	9	5	5			
Number of refills before waste, #							
Adjusted weight of item per use, grams				5			
SUP Waste Generated, thousand tonnes	1	1	1	1			
Production impacts:							
GHG emissions, thousand tonnes CO2 eq			1				
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			1,930				
Land Use, km2			4				
Water Use, thousand m3			0.1				
Unit price of item, NOK	27.70	27.70	0.0	28			
Adjusted unit price of item, NOK				27.70			
Producer's Turnover, thousand NOK (2018 Real Terms)			0.0				
Employment, number of jobs			0.0				
Retail impacts:							
Retailers's Turnover, thousand NOK (2018 Real Terms)			0.0				
Refill scheme's impacts:							
Refill scheme costs, thousand NOK (2018 Real Terms)							
Employment, number of jobs							
Consumer impacts:							
Consumer's Purchases, thousand NOK (2018 Real Terms)			0.0				
Consumer's Washing Costs, thousand NOK (2018 Real Terms)							

Washing impacts (refill schemes):							
GHG emissions, thousand tonnes CO2 eq							
GHG + AQ Externalities, thousand NOK (2018 Real Terms)							
Land Use, km2							
Water Use, thousand m3							
Recycling / EfW impacts:							
Recycling rate, %	9%	14%	5%	9%			
Recycling, thousand tonnes	0.1	0.2	0.1	0.1			
Recycling impacts:							
GHG emissions, thousand tonnes CO2 eq			-0.2				
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			-99				
Financial costs, thousand NOK (2018 Real Terms)			32				
Employment, number of jobs			0.03				
EfW, thousand tonnes	1	1	0.5	1			
EfW impacts:							
GHG emissions, thousand tonnes CO2 eq			-3				
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			-311				
Financial costs, thousand NOK (2018 Real Terms)			437				
Employment, number of jobs			0.3				
Litter impacts:							
Litter generation, thousand tonnes			0.02				
Terrestrial Litter Externalities, thousand NOK (2018 Real Terms)			-21,000				
Litter collected, thousand tonnes			0.02				
Litter clean-up costs, thousand NOK (2018 Real Terms)			367				
Litter that enters marine environment, tonnes	0.97	2	1	0.001			
Marine Litter Externalities, thousand NOK (2018 Real Terms)			-3,218				
Plastic litter that enters marine environment, tonnes	0.97	0.0	-0.97	0.97			

Plastic litter that enters marine environment, million items	0.20	0.0	-0.20	0.20			
Total GHGs, thousand tonnes CO2 eq			-2				
Total Externalities, thousand NOK (2018 Real Terms)			-22,698				
Total Land Use, km2			4				
Total Water Use, thousand m3			0.1				
Total Consumer Cost, thousand NOK (2018 Real Terms)			0.0				
Total Services Costs, thousand NOK (2018 Real Terms)			837				
Total Employment, number of jobs			0.4				
Cost per item of marine litter reduced, NOK			4			**0**	**-4**

12.15 Cutlery

Table 39 – Modelled Results for Cutlery.

Output	From SUP…	…to SUNP	Change	From SUP…	…to MU	Change	SUNP to MU
Consumption, million items used	455	455	0.00	455	455	0.00	0.00
Material	Plastic			Plastic			
Unit weight of item, grams	3	3	0.00	3	21	18	18
Number of refills before waste, #					4,416		
Adjusted weight of item per use, grams				3	0.005	-3	-3
SUP Waste Generated, thousand tonnes	1	1	0.00	1	0.002	-1	-1
Production impacts:							
GHG emissions, thousand tonnes CO2 eq			4			-2	-6
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			-255,000			-1,266	253,734
Land Use, km2			9			-0.1	-9
Water Use, thousand m3			3			-0.01	-3
Unit price of item, NOK	0.49	0.97	0.49	0.5	16	15	15
Adjusted unit price of item, NOK				0.49	0.004	-0.48	-0.48
Producer's Turnover, thousand NOK (2018 Real Terms)			0.00			0.00	0.00
Employment, number of jobs			0.00			0.00	0.00
Retail impacts:							
Retailers's Turnover, thousand NOK (2018 Real Terms)			221,000			-219,000	-440,000
Refill scheme's impacts:							
Refill scheme costs, thousand NOK (2018 Real Terms)						15,000	15,000
Employment, number of jobs						0.00	0.00
Consumer impacts:							
Consumer's Purchases, thousand NOK (2018 Real Terms)			221,000			-219,000	-440,000
Consumer's Washing Costs, thousand NOK (2018 Real Terms)						4,431	4,431

Washing impacts (refill schemes):							
GHG emissions, thousand tonnes CO2 eq						0.3	0.3
GHG + AQ Externalities, thousand NOK (2018 Real Terms)						14,000	14,000
Land Use, km2						0.5	0.5
Water Use, thousand m3						47	47
Recycling / EfW impacts:							
Recycling rate, %	1%	25%	24%	1%	75%	74%	50%
Recycling, thousand tonnes	0.01	0.3	0.3	0.01	0.002	-0.01	-0.3
Recycling impacts:							
GHG emissions, thousand tonnes CO2 eq			-0.004			0.01	0.02
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			-1			4	5
Financial costs, thousand NOK (2018 Real Terms)			83			-3	-86
Employment, number of jobs			0.1			-0.1	-0.2
EfW, thousand tonnes	1	1	-0.3	1	0.001	-1	-1
EfW impacts:							
GHG emissions, thousand tonnes CO2 eq			-2			-2	0.1
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			209			186	-24
Financial costs, thousand NOK (2018 Real Terms)			-269			-1,109	-840
Employment, number of jobs			-0.2			-1	-1
Litter impacts:							0.00
Litter generation, thousand tonnes			0.00			-0.01	-0.01
Terrestrial Litter Externalities, thousand NOK (2018 Real Terms)			-6,723			-6,723	0.006
Litter collected, thousand tonnes			0.00			-0.01	-0.01
Litter clean-up costs, thousand NOK (2018 Real Terms)			41			-41	-83
Litter that enters marine environment, tonnes	0.31	0.3	0.00	0.0003	0.0000002	-0.31	-0.3
Marine Litter Externalities, thousand NOK (2018 Real Terms)			-1,047			-1,047	0.001
Plastic litter that enters marine environment, tonnes	0.31	0.00	-0.31	0.31	0.00	-0.31	0.00

Plastic litter that enters marine environment, million items	0.12	0.00	-0.12	0.12	0.00	-0.12	0.00
Total GHGs, thousand tonnes CO2 eq			2			-4	-5
Total Externalities, thousand NOK (2018 Real Terms)			-262,561			5,154	267,716
Total Land Use, km2			9			0.3	-8
Total Water Use, thousand m3			3			47	44
Total Consumer Cost, thousand NOK (2018 Real Terms)			221,000			-214,569	-435,569
Total Services Costs, thousand NOK (2018 Real Terms)			-145			13,846	13,992
Total Employment, number of jobs			-0.1			-1	-1
Cost per item of marine litter reduced, NOK			1,826			-1,660	-3,486

12.16 Drink Cartons

Table 40 - Modelled Results for Drinks cartons.

Output	From SUP...	...to SUNP	Change	From SUP...	...to MU	Change	SUNP to MU
Consumption, million items used	1,361	1,361	0.0	1,361	1,361	0.0	0.0
Material	Plastic			Plastic			
Unit weight of item, grams	13	287	273	13	153	139	-134
Number of refills before waste, #					2,808		
Adjusted weight of item per use, grams				13	0.05	-13	-13
SUP Waste Generated, thousand tonnes	18	390	372	18	0.07	-18	-390
Production impacts:							
GHG emissions, thousand tonnes CO2 eq			516			-56	-573
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			561,000			-82,000	-643,000
Land Use, km2			33			-174	-207
Water Use, thousand m3			4			-0.3	-5
Unit price of item, NOK	0.40	0.70	0.30	0.4	185	184	184
Adjusted unit price of item, NOK				0.40	0.07	-0.33	-0.33
Producer's Turnover, thousand NOK (2018 Real Terms)			0.0			0.0	0.0
Employment, number of jobs			0.0			0.0	0.0
Retail impacts:							
Retailers's Turnover, thousand NOK (2018 Real Terms)			407,000			-451,000	-858,000
Refill scheme's impacts:							
Refill scheme costs, thousand NOK (2018 Real Terms)						284,589	284,589
Employment, number of jobs						0.0	0.0
Consumer impacts:							
Consumer's Purchases, thousand NOK (2018 Real Terms)			407,000			-451,000	-858,000
Consumer's Washing Costs, thousand NOK (2018 Real Terms)						4,058	4,058

Washing impacts (refill schemes):							
GHG emissions, thousand tonnes CO2 eq						5	5
GHG + AQ Externalities, thousand NOK (2018 Real Terms)						0.0	0.0
Land Use, km2						0.0	0.0
Water Use, thousand m3						48	48
Recycling / EfW impacts:							
Recycling rate, %	56%	81%	25%	56%	64%	8%	-17%
Recycling, thousand tonnes	10	316	306	10	0.05	-10	-316
Recycling impacts:							
GHG emissions, thousand tonnes CO2 eq			-869			8	877
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			-273,000			4,470	277,470
Financial costs, thousand NOK (2018 Real Terms)			89,000			-2,964	-91,964
Employment, number of jobs			1,103			-40	-1,143
EfW, thousand tonnes	8	74	66	8	0.03	-8	-74
EfW impacts:							
GHG emissions, thousand tonnes CO2 eq			-197			-1	196
GHG + AQ Externalities, thousand NOK (2018 Real Terms)			-58,000			678	58,678
Financial costs, thousand NOK (2018 Real Terms)			62,000			-7,573	-69,573
Employment, number of jobs			46			-6	-52
Litter impacts:							0.0
Litter generation, thousand tonnes			3			-0.2	-3
Terrestrial Litter Externalities, thousand NOK (2018 Real Terms)			-161,000			-161,000	0.0
Litter collected, thousand tonnes			3			-0.1	-3
Litter clean-up costs, thousand NOK (2018 Real Terms)			41,000			-990	-41,990
Litter that enters marine environment, tonnes	7.55	161	154	0.01	0.000007	-7.55	-161
Marine Litter Externalities, thousand NOK (2018 Real Terms)			-25,000			-25,000	0.0
Plastic litter that enters marine environment, tonnes	7.55	0.0	-7.55	7.55	0.0	-7.55	0.0

Plastic litter that enters marine environment, million items	0.56	0.0	-0.56	0.56	0.0	-0.56	0.0
Total GHGs, thousand tonnes CO2 eq			-550			-44	505
Total Externalities, thousand NOK (2018 Real Terms)			44,000			-262,852	-306,852
Total Land Use, km2			33			-174	-207
Total Water Use, thousand m3			4			48	44
Total Consumer Cost, thousand NOK (2018 Real Terms)			407,000			-446,942	-853,942
Total Services Costs, thousand NOK (2018 Real Terms)			192,000			273,062	81,062
Total Employment, number of jobs			1,149			-46	-1,195
Cost per item of marine litter reduced, NOK			1,064			-309	-1,373

12.17 Sanitary towels (pads)

Table 41 – Modelled Results for Sanitary towels/ menstrual cups.

Output	From SUP…	…to SUNP	Change	From SUP…	…to MU	Change	SUNP to MU
Consumption, million items used				265	265	0.00	0.00
Material				Plastic			
Unit weight of item, grams				6	21	15	15
Number of refills before waste, #					426		
Adjusted weight of item per use, grams				6	0.05	-6	-6
SUP Waste Generated, thousand tonnes				1	0.01	-1	-1
Production impacts:							
GHG emissions, thousand tonnes CO2 eq						-3	-3
GHG + AQ Externalities, thousand NOK (2018 Real Terms)						-4,692	-4,692
Land Use, km2						-4	-4
Water Use, thousand m3						-0.04	-0.04
Unit price of item, NOK				2	263	261	261
Adjusted unit price of item, NOK				2.04	0.62	-1.42	-1.42
Producer's Turnover, thousand NOK (2018 Real Terms)						0.00	0.00
Employment, number of jobs						0.00	0.00
Retail impacts:							
Retailers's Turnover, thousand NOK (2018 Real Terms)						-326,000	-326,000
Refill scheme's impacts:							
Refill scheme costs, thousand NOK (2018 Real Terms)						0.00	0.00
Employment, number of jobs						0.00	0.00
Consumer impacts:							
Consumer's Purchases, thousand NOK (2018 Real Terms)						-326,000	-326,000
Consumer's Washing Costs, thousand NOK (2018 Real Terms)						14,000	14,000

Washing impacts (refill schemes):							
GHG emissions, thousand tonnes CO2 eq						0.2	0.2
GHG + AQ Externalities, thousand NOK (2018 Real Terms)						8,414	8,414
Land Use, km2						0.3	0.3
Water Use, thousand m3						126	126
Recycling / EfW impacts:							
Recycling rate, %				0%	40%	40%	40%
Recycling, thousand tonnes				0.00	0.005	0.005	0.005
Recycling impacts:							
GHG emissions, thousand tonnes CO2 eq						-0.01	-0.01
GHG + AQ Externalities, thousand NOK (2018 Real Terms)						-4	-4
Financial costs, thousand NOK (2018 Real Terms)						1	1
Employment, number of jobs						0.03	0.03
EfW, thousand tonnes				1	0.01	-1	-1
EfW impacts:							
GHG emissions, thousand tonnes CO2 eq						-1	-1
GHG + AQ Externalities, thousand NOK (2018 Real Terms)						43	43
Financial costs, thousand NOK (2018 Real Terms)						-1,319	-1,319
Employment, number of jobs						-1	-1
Litter impacts:							0.00
Litter generation, thousand tonnes						-0.2	-0.2
Terrestrial Litter Externalities, thousand NOK (2018 Real Terms)						-251,000	-251,000
Litter collected, thousand tonnes						-0.2	-0.2
Litter clean-up costs, thousand NOK (2018 Real Terms)						-2,792	-2,792
Litter that enters marine environment, tonnes				0.01	0.00	-10.64	-11
Marine Litter Externalities, thousand NOK (2018 Real Terms)						-35,000	-35,000
Plastic litter that enters marine environment, tonnes				10.64	0.00	-10.64	-10.64

Plastic litter that enters marine environment, million items				1.72	0.00	-1.72	-1.72
Total GHGs, thousand tonnes CO2 eq						-4	-4
Total Externalities, thousand NOK (2018 Real Terms)						-282,239	-282,239
Total Land Use, km2						-4	-4
Total Water Use, thousand m3						126	126
Total Consumer Cost, thousand NOK (2018 Real Terms)						-312,000	-312,000
Total Services Costs, thousand NOK (2018 Real Terms)						-4,110	-4,110
Total Employment, number of jobs						-1	-1
Cost per item of marine litter reduced, NOK			**0**			-184	-184

12.18 Tampons and tampon applicators

Table 42 – Modelled Results for Tampons and tampon applicators.

Output	From SUP…	…to SUNP	Change	From SUP…	…to MU	Change	SUNP to MU
Consumption, million items used				286	286	0.00	0.00
Material				Plastic			
Unit weight of item, grams				5	21	16	16
Number of refills before waste, #					426		
Adjusted weight of item per use, grams				5	0.05	-5	-5
SUP Waste Generated, thousand tonnes				1	0.01	-1	-1
Production impacts:							
GHG emissions, thousand tonnes CO2 eq						-5	-5
GHG + AQ Externalities, thousand NOK (2018 Real Terms)						69,997	69,997
Land Use, km2						-16	-16
Water Use, thousand m3						-1	-1
Unit price of item, NOK				2	176	174	174
Adjusted unit price of item, NOK				2.04	0.41	-1.63	-1.63
Producer's Turnover, thousand NOK (2018 Real Terms)						0.00	0.00
Employment, number of jobs						0.00	0.00
Retail impacts:							
Retailers's Turnover, thousand NOK (2018 Real Terms)						-406,000	-406,000
Refill scheme's impacts:							
Refill scheme costs, thousand NOK (2018 Real Terms)						0.00	0.00
Employment, number of jobs						0.00	0.00
Consumer impacts:							
Consumer's Purchases, thousand NOK (2018 Real Terms)						-406,000	-406,000
Consumer's Washing Costs, thousand NOK (2018 Real Terms)						15,474	15,474

Washing impacts (refill schemes):							
GHG emissions, thousand tonnes CO2 eq						0.3	0.3
GHG + AQ Externalities, thousand NOK (2018 Real Terms)						0.00	0.00
Land Use, km2						0.00	0.00
Water Use, thousand m3						137	137
Recycling / EfW impacts:							
Recycling rate, %				0%	40%	40%	40%
Recycling, thousand tonnes				0.00	0.005	0.005	0.005
Recycling impacts:							
GHG emissions, thousand tonnes CO2 eq						-0.01	-0.01
GHG + AQ Externalities, thousand NOK (2018 Real Terms)						-4	-4
Financial costs, thousand NOK (2018 Real Terms)						1	1
Employment, number of jobs						0.04	0.04
EfW, thousand tonnes				1	0.01	-1	-1
EfW impacts:							
GHG emissions, thousand tonnes CO2 eq						-1	-1
GHG + AQ Externalities, thousand NOK (2018 Real Terms)						46	46
Financial costs, thousand NOK (2018 Real Terms)						-1,263	-1,263
Employment, number of jobs						-1	-1
Litter impacts:							
Litter generation, thousand tonnes						-0.2	-0.2
Terrestrial Litter Externalities, thousand NOK (2018 Real Terms)						-241,000	-241,000
Litter collected, thousand tonnes						-0.2	-0.2
Litter clean-up costs, thousand NOK (2018 Real Terms)						-2,676	-2,676
Litter that enters marine environment, tonnes				0.01	0.00001	-10.20	-10
Marine Litter Externalities, thousand NOK (2018 Real Terms)						-34,000	-34,000
Plastic litter that enters marine environment, tonnes				10.20	0.00	-10.20	-10.20

Plastic litter that enters marine environment, million items				1.87	0.00	-1.87	-1.87
Total GHGs, thousand tonnes CO2 eq						-5	-5
Total Externalities, thousand NOK (2018 Real Terms)						-204,962	-204,962
Total Land Use, km2						-16	-16
Total Water Use, thousand m3						136	136
Total Consumer Cost, thousand NOK (2018 Real Terms)						-390,526	-390,526
Total Services Costs, thousand NOK (2018 Real Terms)						-3,938	-3,938
Total Employment, number of jobs						-1	-1
Cost per item of marine litter reduced, NOK			**0**			-211	-211