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David Watson, Leonidas Milios, Ioannis Bakas, Márton Herczeg, Birgitte Kjær (CRI) and Naoko Tojo (IIEEE)

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Executive Summary

Background, aim and approach

The EU's Waste Framework Directive (2008/98) gives waste prevention the highest priority in waste management. The Directive defines waste prevention as "*measures taken before a substance, material or product has become waste that reduce:*

- The quantity of waste, including through the reuse of products or the extension of life span of products,
 - The adverse impacts of the generated waste on the environment and human health, or
 - The content of harmful substances in materials and products"
- (Article 3 Paragraph 12).

The Directive requires Member States to establish national waste prevention programmes by the end of 2013. The program must contain waste prevention objectives and specific qualitative or quantitative benchmarks for waste prevention measures, and may determine specific qualitative or quantitative targets and indicators for waste prevention. Accordingly, the Nordic countries, consisting of EU Member States (Denmark, Finland, Sweden) and Members of European Free Trade Association (Norway and Iceland), must establish a national waste prevention programme or plan.

This project, commissioned by the Nordic Council of Ministers, had the objective of providing first proposals for targets and indicators that can be used in the Nordic countries' waste prevention programmes. Four waste streams were considered: *food waste, construction- and demolition waste (C&D waste), waste electrical and electronic equipment (WEEE) and textile waste.*

The targets and indicators should address the relevant scope of waste prevention defined in the EU Waste Framework Directive for each waste stream. The proposed targets could be qualitative and/or quantitative. Where the targets are quantitative the aim of this project was not to propose actual values that should be reached by a certain date in Nordic countries. It was rather to propose the subject, scope and formula-

tion of useful targets. The proposed indicators should be able to monitor progress towards the formulated targets as far as possible. Importantly, they should be designed so that they can be followed up using the Nordic countries' national waste statistics or through collection of new data at an acceptable cost for the countries.

The project took the following two-step approach. Firstly, a literature review of international experiences was conducted regarding waste prevention policy, waste definitions, target setting and use of indicators for the respective four waste streams. This included a review of existing waste prevention programmes and measures in EU Member States. Secondly, based on the findings from the literature as well as experiences of the project team, proposals for targets and indicators were developed.

A typology of waste prevention indicators was developed for the project. This typology categorises indicators into output-based indicators, input-based indicators, input-versus-output indicators, decoupling indicators, impacts indicators, hazardous content indicators and response indicators. These are described in the Box 1.

Box 1

Typology of Indicators for Waste Prevention

The following typology of waste prevention indicators has been developed for use in this report:

1. *Output-based indicator*: waste generation (physical quantity) indicator – trends in generation of this stream or some fraction of this stream over time in absolute quantities or per capita or per household.
2. *Input-based indicator*: changes in consumption of goods or resources (physical quantities or economic value) leading to this waste stream over time.
3. *Input-versus-output indicator*: combination of above two. Indicator showing waste output per unit input (physical quantities).
4. *Decoupling indicator*: either an output or input indicator as above but shown per unit GDP or some other economic variable.
5. *Impacts indicator*: showing how environmental impacts of generated waste is reduced – not as a result of changing waste management but through changing product design/consumption etc.
6. *Hazardous content indicator*: measuring changes in the hazardous contents of products which end as waste, or in the changing hazardous content of waste.
7. *Response indicator*: indicators measuring political actions taken to deliver waste prevention i.e. investments in eco-design research, economic instruments, level of integration of waste prevention into sectoral policies etc.
8. *Other*: any found which don't meet any of above classifications.

Key findings from the literature

The key findings of the literature review can be summarised as follows:

- Only a few indicators have been proposed, and even fewer are operational in Europe and worldwide. Most proposals were identified for C&D waste (5) and fewest for textiles (2 general indicators and 0 textile specific).
- With a single exception all indicators proposed fall directly under part a) of the waste prevention definition i.e. a reduction in *quantities* of waste.
- Within that area indicators proposed are reasonably well distributed between: output, input versus output, decoupling and response-type indicators as defined by the indicator typology developed for the study.
- Not many targets have been proposed for any waste stream apart from food. For food 11 targets have been proposed. For textiles only a single target was found.
- The proposed targets all fall under part a) of waste prevention definition.
- Most targets relate to output, input and input versus output type variables according to the indicator typology. There are also a few response based targets. Some targets are concrete and well-defined—others are vaguer and open to interpretation in terms of their scope and boundaries.
- No identified targets have been related to indicators. However, there is an overlap between the types of targets and proposed indicators i.e. both mostly cover part a) of definition and both mostly are quantity based output, input or input versus output. Therefore, there is potential for some of proposed indicators to be adapted to be able to monitor targets.

With respect to the last finding, even where politically adopted targets exist, they remain unsupported by related indicators that can monitor them. This may be in recognition of the current data availability challenges which undermine development of suitable indicators. This is not atypical of political targets and objectives which are based on ambitions in response to identified issues. Nevertheless, without supporting indicators that can monitor progress towards or away from targets, the targets remain inoperable until such indicators are developed. Hence the objective of this study: to develop targets and supporting indicators in parallel.

Proposal for targets and indicators for the four waste streams

The task of developing proposal for targets and indicators required a somewhat different approach and has given different results for the four waste streams. This is because the four streams are markedly different in terms of where the wastes arise along the production and consumption chain, which of the three elements of the waste prevention definition are of most relevance to them and the availability of data relevant to the streams.

An analysis was carried out for each waste stream on which of the typologies is useful or not for that stream. Input-versus-output indicators and input-based indicators are most useful for waste streams where there is a reasonably short time period between the purchase of the product and it becoming waste i.e. food. For construction and demolition waste these indicators are not so useful.

Input-based indicators can often be used instead of output-based indicators where data for the latter is not available or where there is a long time lag between the purchase of the product and it becoming waste i.e. C&D waste. Input-based indicators are also more generally useful given that one of the underlying objectives of waste prevention is to reduce demands on material resources.

An analysis was also carried out on which parts of the consumption and production chain dominate in terms of generation of wastes. This differs for each stream. For example, textiles wastes arise mostly at the consumption stage and from private households. Construction and demolition wastes are mostly generated by activities of the construction industry.

Finally, the parts of the waste prevention definition which were most relevant for each stream was analysed. For WEEE and, to a lesser extent construction and demolition waste, the third part of the waste prevention definition is of key importance while for food it is has no relevance. For food the focus is on reducing quantities of waste under part a) of the definition, but specifically reducing quantities of avoidable (i.e. edible) food waste.

As might be expected, data availability on waste generation quantities is markedly better for the separately collected waste streams (C & D waste and WEEE) than for the waste streams which are typically mixed with other wastes in municipal waste streams (food and textiles). However, even for WEEE, the collection rates cannot be assumed to be more than roughly representative of actual quantities of WEEE generated.

Taking account of these analyses, a total of 48 potential indicators were developed including those identified in the literature. The 48 indicators were split between the four waste streams ranging from 8 for C&D waste to 16 for food waste.

Following identification of potentially relevant indicators, data components which could be used to build them were identified with emphasis as far as possible on existing data, supplemented by data that could be collected at acceptable cost. The relative advantages and disadvantages of each indicator was subsequently assessed using the RACER indicator assessment system. The RACER system consists of the following five assessment criteria: *Relevant, Accepted, Credible, Easy* and *Robust*.

Simultaneously, targets for each stream were proposed, taking into account the characteristics of the targets-specific, measurable and monitorable, precise and time bound-indicated by the Nordic Council Ministers.

Finally, potentially useful targets and indicator pairs were suggested for the respective waste stream. For some targets both *best-available* and *best-needed* indicators were identified. Best-available indicators are those that can be created from currently available data. In some cases these indicators can provide only a proxy measure of progress against a target. In these cases a best-needed indicator which better corresponds to the target but which cannot be created from currently available data was also suggested. However, priority was given to those for which data collection was considered reasonably practicable.

The first proposals for target and indicator pairs were consulted with a total of 15 external independent experts, as well as Waste Prevention Group of the Nordic Council of Ministers. Their comments were accommodated as far as possible in subsequent revisions.

The following targets and indicators are put forward for the consideration of policy makers responsible for selection of waste prevention targets and indicators for national waste prevention plans or programmes.

Food Waste

Reduce avoidable food waste from households by x% or x tonnes by year y, compared to base year y₀

This target targets households but, if data is available, the target could be combined for households, retail and the hospitality sector.

- For measuring the progress of this target the *best-needed* indicator *Avoidable food waste generation per household (capita/food industry/hospitality sector)* can be used in the longer term.
- The *best-available* indicator *food consumption in kg/capita/year* could potentially be used in the short term as a proxy indicator but policy makers must understand the weaknesses of this proxy indicator due in part to the indicator methodology and underlying methodology and also the indicator's sensitivity to changing diets.

Reduce the amount of food waste from households by x% or x tonnes by year y, compared to base year y₀

Again this target could also be applied to other economic sectors depending on data availability.

- For measuring the progress of this target the *best-needed* indicator *Amounts of food waste generated per household (capita/food industry/hospitality sector)* can be used accordingly.
- Again the *best-available* indicator *food consumption in kg/capita/year* could potentially be used as a proxy and again policy makers must understand the weaknesses of this proxy indicator.

Should food waste data be collected from households with a sufficient level of detail the following target could also be considered, due to its aware-raising strengths and also its links to the resource efficiency agenda.

Reduce the cost of avoidable food waste to households by x% by year y, compared to base year y₀

- The *best-needed* indicator *Economic value of avoidable household food waste (EUR/capita/year)* would be used for measuring the progress of this target. This indicator requires a somewhat more detailed household food waste survey than for the two best-needed indicators for the two targets above, requiring a division by food product.

Together with these targets, it would be also useful to take into consideration some of the response targets, which could help monitoring waste prevention initiatives.

Increase government budget used for waste prevention measures by x% by year y, compared to base year y_0

- The following *best-needed* indicator would be used to monitor this response based target: *Government (local authority, etc.) budget used on food waste prevention activities.*

Increase the number of enterprises signing voluntary commitments on food waste prevention by x (number or%) by year y, compared to base year y_0

- The following *best-needed* indicator would be used to monitor this response based target *Number of enterprises signed (actively involved in) food waste prevention voluntary agreements.*

Data collection systems to allow these final two indicators to be operationalised could be included as an integral element of the instruments implemented to meet the targets.

Construction & Demolition Waste

Reduce waste generation by the construction sector by x% annually with y_0 as base year

- For measuring progress against this target, the indicator *C&DW generation per unit Gross Value Added (GVA) in the construction sector* is considered to be the *best-available* indicator for the target, since it is unaffected by variations in the activity level of the construction sector.

Increase the material efficiency in construction with x% by year y compared to base year y_0

This target is perhaps the most relevant for encouraging waste prevention policies and implementation now. Targets based on waste generation are affected by the long time lag between construction and subsequent demolition of buildings and other construction works.

- For measuring progress towards this target, data on consumption of construction materials used directly in production of buildings would be needed to produce a *best-needed* indicator on *Material consumption in the construction of buildings versus the area of new construction*.
- Alternatively, as a *best-available* indicator the *Domestic extraction of construction materials per floor area of new buildings* can be used as a good proxy for measuring progress against the target.

Reduce the hazardous content of construction materials by x% annually with y₀ as base year

- Progress towards this target would ideally be best measured by an indicator on *hazardous content of construction materials*. However, data for this indicator does not exist and would be very difficult to operationalise. A proxy *best-needed* response-based indicator *Number of new buildings and sales of building materials certified by labelling schemes which limit quantities of hazardous or harmful substances* is suggested as an alternative. Data for such an indicator should not prove difficult to gather.
- The indicator *Hazardous C&DW as a% of total C&DW (%)* could also be considered as a *best-available* indicator for the target. Its usefulness with respect to waste prevention policy, however, is somewhat affected by the long timelag between construction and demolition of construction works.

Increase life span of buildings with x years and roads with z years by year y

- Information to create a *best-needed* indicator on *Average design life expectancy of buildings and roads* is currently not widely available to follow up this target but could potentially be gathered from civil engineering associations.

Waste Electrical and Electronic Equipment

Reduce the consumption of EEE (in kg) by x% by year y with y₀ as a reference year

- For measuring progress against this target, the indicator *Amount of EEE put on the market (kg) per capita* can be used and described as a *best-available* and sufficient indicator for the target.

**Increase the re-use of EEE by x% by y with y_0 as a reference year–
Number of repair services for EEE**

- For measuring progress towards this target a *best-needed* indicator on *Amount of re-used EEE sold* is proposed.
- No indicator currently exists with a dataset sufficient to support the target, so no *best-available* indicator is proposed.

Reduce the WEEE generation by x% by year y with y_0 as a reference year

- For measuring progress towards this target, data on waste generation of WEEE are essential in order to produce a *best-needed* indicator on *WEEE generation (kg) per capita* which is not available at the moment.
- Alternatively, the *best-available* indicator the *Collection of WEEE (kg) per capita* can be used as a proxy.

Reduce the content of hazardous substances in EEE by x% by y with y_0 as a reference year

- Information to create a *best-needed* indicator on *Hazardous substances found in EEE (% weight/total weight of EEE)* is currently not available widely to follow up this target.
- At the moment, no indicator exists with a dataset sufficient to support this target, so no *best-available* indicator is proposed.

Increase the material efficiency in EEE by x% by y with y_0 as a reference year

- A *best-needed* indicator *WEEE generation (kg) versus EEE put on the market (EUR) per capita* is suggested to monitor efforts of the EEE industry to improve the existing material efficiency of the products.
- At the moment, no indicator exists with a dataset sufficient to support this target, so no *best-available* indicator is proposed.

Textiles Waste

Reduce generation of waste from clothing and home textiles from households by x% or x tonnes by year y compared to base year y_0

- For measuring progress against this target, ideally the *best-needed* indicator *Textiles waste generation per capita per year* would be developed. This indicator would require investment of considerable resources in surveys of the composition of household wastes plus other end points for waste textiles.

- The *best-available* indicator *New textile products (by weight) put on the market per capita per year* could also be used if countries do not have the resources available for collecting data on textiles wastes. This indicator is considered to represent a good proxy indicator for reduction of textile wastes.

Reduce consumption of new textiles by x% or x kg/capita by year y compared to base year y₀

This target is a more directly measurable alternative to the first target. It would be directly connected to waste prevention and waste prevention initiatives although it may be more politically sensitive than the first target.

- The *best-available* indicator *New textile products (by weight) put on the market per capita per year* could directly measure progress against the target. This indicator can be produced from existing datasets.

Increase the purchase of high quality over budget low quality textiles products

- For measuring progress towards this target, the *best-available* indicator *Household expenditure on textile products per tonne of textile products put on the market* is seen as a valuable proxy for increasing emphasis on quality over quantity. It is also seen as a useful indicator in a more general context since a higher price per kg would be a *driver* of prolonged active lifetime of garments/textiles.

Increase the share of second-hand products in total sales of textiles by x% by year y compared to base year y₀

- For measuring progress towards this target, data on consumption of textiles would be needed to produce a *best-needed* indicator on *Share (by value) of second-hand products in total textile products put on the market* would have to be created which is not available at the moment. This indicator is considered to be more easily developed than an indicator measuring share (by weight) but nevertheless would require a considerable investment of time for data-gathering and processing.

Increase the number of products certified with labels requiring reduced use of hazardous substances in textiles production by x% by year y compared to base year y_0

- Although the hazardous content is not a key issue in textiles wastes, the ease by which this target could be monitored suggests its adoption by policy makers. It would also have wider environmental implications since some of the labels which would be monitored include additional criteria related to production of textiles.
- The *best-available* indicator proposed for monitoring this target is Textile product models certified by eco-labelling schemes relevant to the Nordic countries (Nordic Swan, Swedish Good Environmental Choice, EU Flower). The data for this indicator can be relatively easily accessed.

1. Background

Indicators are used to quantify and communicate developments and help us understand complex realities, including trends and evolutions over time. A widely recognised rule in environmental policy making is that “what does not get measured does not get managed.” Developing indicators is therefore essential in tracking progress on objectives and targets and to evaluate the impacts of waste prevention policies.

The EU’s Waste Framework Directive (2008/98) affords waste prevention the highest priority in waste management. Waste prevention is defined in this context (article 3 (12)) as actions taken before a substance, material or product has become waste and that leads to a reduction in:

- The amount of waste, including through the reuse of products or the extension of life span of products,
- The negative impact of the environment and human health from the generated waste,
- The content of harmful substances in materials and products.

The Directive requires Member States to establish national waste prevention programmes by the end of 2013. The programmes must contain objectives for waste prevention. Further, the programmes must include specific qualitative or quantitative benchmarks for waste prevention measures and the programme may determine specific qualitative or quantitative targets and indicators (Article 29 (3)). In this context, the Nordic countries which are also EU Member States must formulate waste prevention objectives and would be advised to formulate waste prevention targets that are specific, measurable and monitorable, accurate, time-bound and that lead society towards greater resource efficiency. Indicators should be defined that can illustrate progress toward these targets.

Norway and Iceland are EFTA members and have signed the agreement on the European Economic Area. Norway and Iceland are required through this agreement to implement the directives in the environment area. They therefore should develop waste prevention programmes along similar lines to those required of EU Member States.

To aid with this process in the Nordic countries, CRI and IIIIEE were commissioned by the Nordic Council of Ministers to make first proposals for targets and associated indicators for Nordic countries for waste prevention in four specific waste streams: food waste, construction- and demolition waste, WEEE and textile wastes. This report presents these proposals. The proposals have been reviewed by a Reference Group of Nordic waste experts.

2. Objectives

The aim of the project was to make first proposals for targets and indicators that can be used in the Nordic countries' waste prevention programmes for the waste streams: food waste, construction- and demolition waste, WEEE and textile waste. The targets and indicators should address the relevant scope of waste prevention within each waste stream including reductions in waste quantities, reductions in the content of hazardous substances in the waste stream, and measure decoupling between economic growth and the negative impact on people and the environment from waste generation. With respect to the last element of the waste prevention definition it is important to note that this only addresses decoupling resulting from actions taken *before* the product became waste. Developments in waste management are outside the scope of waste prevention.

The proposed targets can be qualitative and/or quantitative. Where the targets are quantitative the objective of this project is not to propose actual values that should be reached by a certain date in Nordic countries. The objective is rather to propose the subject, scope and formulation of useful targets.

The proposed indicators should be able to monitor progress towards the formulated targets as far as possible. Importantly, they should be designed so that they can be followed up using the Nordic countries' national waste statistics or through collection of new data at an acceptable cost for the countries.

3. Approach

3.1 Stage 1 Review of international, European and national experiences

The first stage of the project comprised a literature review of international experiences regarding waste prevention policy, definitions, scope target setting and use of indicators for each of the four waste streams. The following key reports were considered in the review:

- Bakas I. et al., 2011, Assessment of initiatives to prevent waste from building and construction sectors. Nordic Council of Ministers.
- European Commission (EC), 2011, Analysis associated with the Roadmap to a Resource Efficient Europe Part II (EC 2011a).
- European Commission (EC) DG ENV, 2009, Preparation of guidelines on waste prevention programmes according to the revised Waste Framework Directive, including best practices. (EC 2009).
- European Commission (EC) DG ENV, 2010, Analysis of the evolution of waste reduction and the scope of waste prevention. (EC 2010 a).
- European Commission (EC) DG ENV, 2011, Evolution of (bio-) waste generation/prevention and (bio-) waste prevention indicators (EC 2011b).
- EEA's compilation "Selected Waste Prevention Indicators–A compilation of proposals" that was used as input to the EEA workshop on green economy in October 2011 (EEA 2011).
- OECD, 2004, Towards waste prevention performance indicators.
- Pre-Waste, 2010, Component 4: Build up of shared indicators and web tool. State of the art of waste prevention monitoring.
- German Federal Environment Agency (UBA) , 2010, Development of scientific and technical foundations for a national waste prevention programme.

In addition, the national waste prevention programmes that had been developed by September 2012 were checked for targets and indicators in the four waste streams. These comprised the national waste prevention plans of seven countries/regions: Austria, Brussels, Finland, Ireland, Luxembourg, Portugal and Poland (ETC/SCP 2012). Waste prevention

measures have also been included in national waste management plans and several regional and local waste prevention programmes/plans have also been established in different Member States and in the UK in particular. These were also reviewed. Finally, further literature was also considered under each waste stream. These are referred to in the text.

Chapter 4 of this report presents the findings of this review. For each waste stream, an overview of the definition and magnitude of the waste stream is provided, a short analysis of what waste prevention may mean for that waste stream, and an overview of targets and indicators that have already been adopted or proposed for waste prevention in that waste stream. The indicators found in the literature review are described in more detail in Appendix 1.

3.2 Stage 2 Formulation of indicators and proposals for target setting

The second part of the project concerned developing proposals for targets and indicators. Prior to beginning to develop such proposals some general principles and considerations for indicators and targets for waste prevention were developed which together formed a methodology for selection. These principles and considerations were partially inspired by the findings of Stage 1 of the project but also by the consultants' wider experience in developing waste, resource efficiency and sustainable consumption and production indicators. The principles are presented in detail in Chapter 5 of this report.

An important element of the principles is that in the absence of either existing targets or indicators they should be developed in parallel. Reliable and timely indicators are a pre-requisite for target setting—or at least for any applied targets to be meaningful and operational. At the same time targets should be easily communicated and reflect political focus and therefore may need to be formulated in a somewhat different way to the indicators supporting them. This is described in more detail in Chapter 5.

The principles and considerations were subsequently used to guide the assessment and selection of targets and indicator pairs in each waste stream. These proposals are presented in Chapter 6–9 of this report. Assessments of the value of individual indicators were carried out using the so-called RACER assessment methodology. This methodology is described in Chapter 5. One of the elements important for such an assessment is the availability of data. The project team has taken effort in identifying availability of data useful for indicator development in both in-

ternational and Nordic statistics banks. The results of these searches are provided in Appendix 2.

3.3 A typology for waste prevention indicators

Widely used typologies have been developed for environmental indicators by, for example, the EEA (1998) and OECD (2003). However, the differentiation between types of indicators used in those typologies was not felt to be particularly useful for waste prevention indicators. A typology was developed for this project which is more nuanced in the types of indicators likely to be useful for waste prevention. The typology is given in Box 2.

Box 2

Typology of Indicators for Waste Prevention

The following typology of waste prevention indicators has been developed for use in this report:

- *Output-based indicator*: waste generation (physical quantity) indicator - trends in generation of this stream or some fraction of this stream over time in absolute quantities or per capita or per household.
- *Input-based indicator*: changes in consumption of goods or resources (physical quantities or economic value) leading to this waste stream over time.
- *Input-versus-output indicator*: combination of above two. Indicator showing waste output per unit input (physical quantities).
- *Decoupling indicator*: either an output or input indicator as above but shown per unit GDP or some other economic variable.
- *Impacts indicator*: showing how environmental impacts of generated waste is reduced - not as a result of changing waste management but through changing product design/consumption etc.
- *Hazardous content indicator*: measuring changes in the hazardous contents of products which end as waste, or in the changing hazardous content of waste.
- *Response indicator*: indicators measuring political actions taken to deliver waste prevention i.e. investments in eco-design research, economic instruments, level of integration of waste prevention into sectoral policies etc.
- *Other*: any found which don't meet any of above classifications.

The typology can also be related to the typology used by the EEA. Indicator types 1–3 and 5–7 can comprise Descriptive Indicators which are simply describing a trend and/or Performance Indicators which relate the trend to a policy target. Decoupling indicators under type 4 could equally well be described as Efficiency Indicators using the EEA typology.

The types can be coupled to different parts of the waste prevention definition. Indicator type 5 is only relevant to part b) of the waste prevention definition. Indicator type 6 is related to part c) of the definition. Response indicators under type 7 could relate to all parts of the waste prevention definition. Types 1–4 would generally be used to show progress against part a) of the definition.

The typology was used both during Stage 1 and Stage 2 of the project.

3.4 Reference Group

A reference group was formed of external independent experts with detailed knowledge of the 4 waste streams. The members of the Reference Group are listed in Table 3.1. The value of the Reference Group was to identify gaps in knowledge and to provide a broader perspective on the suggestions for targets and indicators. The reference group was consulted on the results of both Stage 1 and Stage 2 of the project. Their comments were accommodated as far as resources would allow in subsequent revisions to the targets and indicators proposals. Where more study would be required to address issues raised by the reference group experts, this is identified in the conclusions to this report.

Table 3.1. Stakeholder involvement

Stakeholder's name	Organisation	Country
Annica Carlsson	Statistics Sweden	SE
Ulf Gilberg	DPA –system	DK
Ole Gravgaard Pedersen	Statistics Denmark	DK
Ingun Grimstad Klepp	SIFO	NO
Klaus Hansen	SBI, Aalborg University	DK
Hanna Hartikainen	MTT Agrifood Research Finland	FI
Gudmundur B. Ingvarsson	Icelandic EPA	IC
Kari B. Mellem	Statistics Norway	NO
David Palm	IVL	SE
Anna-Leena Perälä	VTT Technical Research Centre of Finland	FI
Anne Marie Schrøder	FORMAT	NO
Kirsi Silvennoinen	MTT Agrifood Research Finland	FI
Åsa Stenmarck	IVL	SE
Martin Sune Møller	Danish EPA	DK
Henrik Wejdling	AffaldPlus	DK

Note: In addition to the stakeholder group comments were also received from the Waste Prevention Group of the Nordic Council of Ministers.

4. Waste Prevention in the Four Streams

The following sections present the results of a first information gathering exercise on the 4 waste streams, what waste prevention may mean for them and an overview of existing or proposed indicators and targets for the waste streams.

Box 3 gives the definition of Waste Prevention that is referred to under each waste stream.

Box 3

Waste Prevention Definition

In the Waste Framework Directive (2008/98/EC) waste prevention is defined as follows in article 3(12):

“Prevention” means measures taken before a substance, material or product has become waste, that reduce:

- The quantity of waste, including through the re-use of products or the extension of the life span of products,
- The adverse impacts of the generated waste on the environment and human health, or
- The content of harmful substances in materials and products.

It should be noted that part b) of the waste prevention definition in the WFD has not been included in the interpretation of the waste prevention definition given in the European Commission’s recently published guidelines for the preparation of Waste Prevention Programmes (EC, 2012).

4.1 Food Waste

4.1.1 *Definition of Food Waste*

Food waste has not been strictly defined at the EU level. Food waste has been defined differently under different studies.

According to a definition given by WRAP (2009), and used by the European Commission (2010b) in the preparatory study on food waste, edible food waste refers to food waste which was, at some point prior to disposal, fit for human consumption. This includes both avoidable food waste (e.g. slices of bread, apples, meat), which could potentially be consumed, and possibly avoidable food waste (e.g. potato skins, bread crusts), which people tend to consume/waste according to preference. In contrast, inedible food waste refers to food waste arising from food preparation that was not at any point edible (e.g. bones, egg shells). Inedible food waste is considered to be unavoidable food waste. In this study the term avoidable food waste cover food waste which was at some point prior to disposal, fit for human consumption. Unavoidable food waste refers to food waste arising from food preparation that was not at any point edible (e.g. bones, egg shells).

Most studies include both avoidable and unavoidable wastes arising in households, restaurants and other catering services. Food waste from retailers is also generally included and in some cases wastes from food manufacturers. Wastes produced further up the production chain in agricultural production are generally not included. However one study included unharvested or harvested but subsequently discarded fruit and vegetables in primary production¹ (CONCITO, 2011). Primary production should perhaps come into more focus in the future since there are systematic issues which cause potentially significant waste quantities in agriculture.

In all cases food waste comprises biowastes only. Food packaging, for example, is not included.

¹ Inclusion of primary production is of importance because there are structural difficulties that lead to food waste in agriculture.

4.1.2 Quantities of food waste in Nordic countries

Data on food waste do not exist as such in any national or European database. Some one-off studies collected primary data on food waste arising while other studies have used primary data collected in other countries to estimate waste arisings in the country in focus, making a number of assumptions along the way. In the Nordic context, a few reports have produced estimations on food waste in households as well as the catering and restaurant sector in the different Nordic countries. Most of the studies identify households as the major food waste producers (see for example Swedish EPA, 2011). The figures of estimated food waste generation in Sweden are provided in Table 4.1.

Table 4.1. Generated (tonnes) and % of total generated amount food waste in different sectors in 2010. The figures are rounded

Sector	Generated amounts (tonnes)	% of total generated amount
Farming	-	-
Food industry	171,000	17
Grocery stores	39,000	4
Restaurants	99,000	10
School canteens	26,000	3
Households	674,000	67
-unavoidable food waste	435,000	
-avoidable food waste	239,000	
Total	1,010,000	

Source: Jensen et al, 2011.

Food waste in the retail sector, as well as in restaurants, canteens and similar establishments (hospitality sector) has been estimated in recent studies for the Nordic countries, see Tables 4.2 and 4.3.

Table 4.2. Total amount of food waste from hospitality sector

Country	Tonnes/year (range of values)	Tonnes/year (best estimate)
Denmark	46,000–148,000	140,000
Finland	106,000–143,500*	140,000
Norway	80,000–176,500	140,000
Sweden	125,000–350,000	260,000
Total	357,000–818,000	680,000

Source: Marthinsen et al, 2012.

*Results for Finland are for avoidable food waste.

Table 4.3. Total amount of food waste from the retail sector

Country	Tonnes/year (range of values)	Year of data reference
Denmark	40,000–46,000	2002
Finland	65,000–75,000	2010
Norway	43,000	2008
Sweden	83,500	2008
Total	231,500–247,500	

Source: Stenmarck et al, 2011.

Limited data exist which distinguish between avoidable and unavoidable food waste. Such data are difficult and costly to acquire requiring extensive surveys. However, the political focus on food waste may increase the potential for reliable datasets to become available in the future.

The most comprehensive study for avoidable food waste from households in the Nordic countries has recently been published by the Danish EPA. It covers a representative sample of around 800 Danish households in one-family houses. Avoidable food waste per capita in one-family households was measured at 42 kg per year for one-family houses (Danish EPA, 2012). A study was also carried out in Finland in 2010 with 380 participating households. The study estimated avoidable food waste in Finland at 28 kg per person per year (Katajajuuri et al. 2012).

4.1.3 Waste Prevention in Context of Food Waste

The first group of measures under part a) of the definition is that most relevant to the food waste stream. Part b) is also of some relevance. Since food waste does not contain harmful or hazardous substances type c) of measures is not considered relevant.

A great potential exists for reducing quantities of food waste under part a) of the waste definition, in the whole food chain from “farm to fork.” However, the main focus on prevention has been on food wastes arising in households, along with retailers, restaurants and canteens.

Waste prevention in households can be encouraged through public information campaigns giving advice on reuse of food leftovers, better meal planning and better management of purchased food so that it is used while it is still edible.

Partnerships can be made with food retailers focusing on optimising ordering and distribution of food products to reduce quantities of food which cannot be sold before the best-before-date has been passed. Voluntary agreements with retailers and food manufacturers can also be made to optimise packaging’s design and functionality, to optimise the sizes of individual food products, and to refrain from

campaigns such as buy one get one free which encourage over purchasing of food by households.

Food waste in canteens and restaurants can be tackled again through better optimisation of meal planning and food procurement, integration of leftovers into the next meals and finally redistribution of food leftovers and unused food within the time span of its real (not suggested) expiry date, for example to homeless etc.. There is also a general potential to work with the setting and communication of expiry dates in the whole food industry to reduce food waste, though respecting demands for food security.

Under part b) of the waste definition, little can be done to food products to reduce the downstream environmental impacts resulting from the management of food waste. However, changes in the food products being consumed can lead to large reductions in life cycle environmental impacts of food. For example a reduced meat content of consumed food will reduce life cycle impacts of food consumption. Whether measures to change diets to reduce life cycle impacts can really be defined as waste prevention under part b) is open for discussion. These kinds of uncertainties may explain why the European Commission has not tackled part b) in their guidelines for Preparing a Waste Prevention Programmes (EC, 2012).

4.1.4 Policy context

Food waste prevention has been the focus of increasing political concern over the past few years. The Roadmap to a Resource Efficient Europe (COM(2011) 571 final; EC 2011a) is the first European policy document in which food waste is addressed separately (not only as a fraction of the bio-waste stream) and also includes a milestone for reducing food waste. In 19 January 2012, the European Parliament also adopted a resolution (2011/2175(INI)) on how to avoid food wastage, promoting strategies for a more efficient food chain in the EU and includes a waste reduction target. The resolution also pushes for many waste-reducing measures, like less confusing date labelling on food packaging, a wider range of package sizes with perishables, and country specific food waste prevention targets by 2014.

At national level, the Netherlands put forward a strategy towards sustainable production and consumption of food in 2008 which also addresses food waste prevention and in Sweden the parliament has proposed food waste prevention targets. These are described later.

4.1.5 Food Waste Prevention in National Waste Prevention Plans

The waste prevention plan of the Brussels region targets households, businesses and schools for waste prevention measures, setting specific targets of food waste reduction per inhabitant/worker/student per year for each sector. The Brussels region has worked with prevention of food waste for several years (Brussels Environment, 2010).

Austria's National Waste Management Plan and the Irish and Portuguese national waste prevention programme also makes a special mention of food waste prevention proposing measures that can be applied in this direction but without any accompanying measurable targets (Austrian FMAFEWM, 2011; Irish EPA, 2009; Portuguese EPA, 2010). The same applies to the current Danish and Swedish waste management plans (Danish Government, 2010; Swedish EPA, 2012). Several regional waste prevention plans in the UK take into consideration the need for food waste prevention and offer a multitude of measures, some of them being more measurable than others.

The private sector in food production and retailing has been very active in the UK and Norway, establishing voluntary agreements within the sector (often with the support of public authorities) in order to tackle the problem of rising food waste amounts. The Courtauld commitment in the UK (WRAP, 2010) and the ForMat project in Norway (ForMat, 2010) are some promising examples setting frameworks for these types of agreements.

The literature survey found no currently operational indicators for food waste in the EU, but there has been a concentrated effort the last years to develop and streamline relevant indicators. These indicators combine elements of input, output and combination indicators (see later). A food waste specific indicator was also one of the indicators proposed in Annex 6 of the Roadmap to a Resource Efficient Europe. Eurostat is working on development of an indicator. However, a number of data constraints have been identified. Some of the data problems were demonstrated in the report on biowaste from the Commission in 2010 (EC, 2010b).

There is poor availability of data on food waste. Data on bio-waste exist in the Eurostat database but it contains mixed quantities of waste deriving from biological sources and therefore it is not currently possible to extract concise data only for food waste. The same applies for Material Flow Accounts data in Eurostat. Input data, such as household purchases of food, are regularly maintained by Eurostat. It should be noted, however, that unlike many other categories of products, in the

case of food only a portion of the purchased products weight will ever end up as solid waste. The larger (consumed) proportion will finally end in the waste water system, emissions to air or elsewhere.

There are currently some surveys under way on food waste reporting in several Member States but still no common reporting framework has been developed by Eurostat. The most comprehensive data on food waste from households has been carried out for the UK (WRAP, 2009). The most comprehensive study for avoidable food waste from households in the Nordic countries has recently been published by the Danish EPA. It covers a representative sample of 800 Danish households (Danish EPA 2012).

A lack of reliable data in the whole food chain is a common problem for most countries. A new FP7 project named FUSIONS has initiated research on food waste prevention and within this project one task is to create a dataset of food waste in EU-level.

4.1.6 Indicators and Targets

The identified indicators can be grouped according to the indicator typology given in Section 3.3 of this report as follows:

Indicators	Proposed by	Is it operational?
Output indicators		
1.Share of edible food waste in households, retailers and catering	EC	No
2.Amount of food waste generated per household		No
Input-Output indicators		
1.Resource loss on bio-products	EC	No
2.Amount of food waste generated against the consumption of food in tonnes		No

The indicators are described in detail in Appendix 1.

Although it is identified as a simple output indicator, the first indicator measures the % of avoidable food waste in total food waste generated by households, retailers and catering. It therefore specifically targets reductions in the edible parts of food waste, not in food waste in general and would require analysis of the composition of food waste rather than developments in its overall weight. This makes it a perhaps more useful indicator than a simple output indicator but at the same time significantly more difficult to operationalise. The second indicator is a simpler total food waste quantity indicator though limited to households.

The final two indicators are similar to one another despite the different names. They are both measuring total food waste as a ratio of inputs to food consumption. However, the difference lies in the stage at which inputs are measured. The first would make use of material flow accounts to identify the total weight of biomass input to the food industry i.e. crops (though not for fodder), animals and fish. The second measures inputs further up the chain; the weight of food following processing i.e. prior to point of sale (but not including packaging).

None of the indicators are currently operational and questions still remain in some cases about the specific types of data that could be used to generate them. Improvement in data collection and reporting in the future will enable a better use of the so far theoretically developed indicators.

As already described a number of targets for prevention of food waste have been identified.

In the European Commission's Roadmap to a Resource Efficient Europe (COM(2011) 571 final) (EC 2011a) there is a milestone about food waste:

- By 2020: 20% reduction in the food chain's resource inputs. Disposal of edible food waste should have been halved in the EU.

Disposal in the formulation of this target does not refer to landfill but to the action of throwing away or discarding edible food which becomes waste.

A European Parliament resolution (2011/2175(INI)) (EP 2012) proposed:

- A target of 50% reduction in food waste from "farm to fork" by 2025.

In their sustainable food production and consumption strategy from 2008 the Netherlands Ministry of Agriculture, Nature and Food Quality (2009) proposed:

- A target of reducing food waste throughout the product chain by at least 20% by 2015.

In the Brussels Environment (2010) waste prevention plan, 3 specific quantitative food waste prevention targets are set, each referring to a different target group:

- Reduction of food wastage in households by 2 kg /inhabitant/yr by 2013 and by 5 kg/inhabitant (= 5,000 tonnes) by 2020.
- Reduction of food wastage in business/office by 3 kg/worker/yr by 2013 and by 6 kg/worker/yr by 2020.
- Reduction of food wastage in schools by 3 kg/student/yr by 2020.

In several local waste prevention plans in the UK, targets were proposed for:

- Increasing the number of Committed Food Waste Reducers to a certain % of residents by 2020. The North London waste prevention plan, for example, set the target to 10% of North London residents (NLWA 2010).

The Scottish Household waste prevention action plan from 2007 (Scottish EPA, 2007) set the target:

- To reduce the amount of food waste from Scottish households by 10,000 tonnes by 2008 and 15,000 tonnes by 2010.

The Courtauld commitment (WRAP, 2010), a voluntary agreement between major UK supermarkets and the Waste & Resources Action Programme (WRAP), set a target of:

- Reducing UK household food and drink waste by 4% in the 3-year period 2010–2012.

WRAP, established in 2000 to encourage waste prevention and waste recycling in the UK, also adopted a goal for the results of their activities in the UK. This goal is to:

- Reduce carbon dioxide equivalent emissions associated with avoidable food and drink waste by 3.2 million tonnes a year by 2015 (WRAP 2012a).

Finally in Norway, the Format project (ForMat 2010), a voluntary agreement by several private actors in the food industry and other institutions and public organisations set the target of:

- A national 25% reduction of food waste by 2015, compared to 2010.

Unlike targets set for the other waste streams in this study all the targets set for waste are quantitative.

Almost all the targets can be described as output type targets referring to quantities of food waste. The exception is the more response-based target set by the regional waste prevention plans in the UK and the pressure type target of WRAP which considers CO₂ emissions caused by food waste.

All of the output based targets refer to a reduction of food waste generation by an appointed target year. In this way the targets are relatively concrete. However, in some cases measurability against the target is made more difficult by a lack of baseline year or clear information at what point in the life cycle of food production and consumption the waste being targeted is arising.

There are some differences in the scope of food waste being considered by the targets. Some targets refer to avoidable food waste and others to general food wastage, some targets focus on food waste from end users (Brussels region target) others to food waste along the full production chain (EU Parliament and the Netherlands).

None of the targets have been directly linked to an indicator, which is perhaps odd considering the concrete nature of the targets. However, the way the targets have been stated makes it reasonably clear what kind of indicators would be required. Only in one case, is it known that the adoption of the target has been accompanied by a drive towards development of a corresponding indicator. This is the European Commission's target on halving edible food waste.

Only one of the indicators identified in the literature could be used to monitor progress against the targets identified above. None of the targets are input-output based, which rules out use of indicators 3 and 4. Neither is Indicator 1 directly usable since it measures changes in edible food waste as a share of total food waste from households. This targets which concern edible or avoidable food waste refer to total quantities not shares.

Indicator 2, however, could potentially be used to monitor the first of the Brussels Region targets, and the Courtauld Commitment target.

4.2 Construction & Demolition Waste

4.2.1 Definition of C&D Waste

C&D waste is a source defined waste. It comprises wastes arising from the construction, demolition and refurbishment of buildings and other civil engineering works. It is generally not considered to include wastes arising during the manufacturing of building components i.e. cement, bricks, tiles, steel components, glass etc. It is generally also considered to include only wastes that are removed from the construction sites, though not always. Several countries included soils in C&D waste traditionally, but in accordance with the Waste Framework Directive (2008/98/EC), soil cannot be included for the recovery target of 70% for construction and demolition waste by 2020.

4.2.2 Quantities of C&D waste in Nordic countries

The following data show the development of C&DW generation per capita in the Nordic countries. The data display great differences between countries spanning from less than 100 kg to more than 4.5 tonnes per capita (in 2008). Therefore, the reliability of data is questionable, when trying to compare countries. The differences are probably a result of different reporting systems in these countries.

Table 4.4. Construction and demolition waste generated (tonnes)

	2004	2005	2006	2007	2008	2009	2010
Denmark	4,495,570	5,270,352	6,112,658	5,766,726	6,008,791	4,969,758	
Finland ²	20,842,637		23,145,712		24,455,231		24,645,393
Sweden	10,271,183		8,943,363		3,310,326		9,381,226
Iceland	17,000	22,000	44,000	33,000	21,000		
Norway	1,239,131					1,701,652	1,539,420

Sources: DK-ISAG database; FI, SE-Eurostat; IS-Bakas et al, 2011; NO-Statistics Norway.

² The figures for Finland include waste materials from buildings and excavation soils and rock in civil engineering.

Table 4.5. Construction and demolition waste generated per capita (kg/cap)

	2004	2005	2006	2007	2008	2009	2010
Denmark	833	974	1,126	1,059	1,097	902	
Finland	3,993		4,404		4,614		4,605
Sweden	1,144		988		360		1,004
Iceland	59	75	147	107	67		
Norway	271					355	317

Sources : DK-ISAG database; FI, SE-Eurostat; IS-Bakas et al, 2011; NO-Statistics Norway.

Population data source: Eurostat.Waste Prevention in Context of C&D Waste.

All three types of waste prevention measures identified in Box 2 at the beginning of this chapter, are relevant to the C&D waste stream to a greater or lesser extent.

Reducing quantities of waste covered by part a) would mostly focus on reducing the use of materials in construction projects. This could occur through reducing the floor space required for a given functional use (i.e. dampening growth in average size of flats per person); switching to more material and space efficient consumption patterns (i.e. switching transport demand from private cars to which require parking, to public transport or bicycle); and denser use of urban and suburban space. It could also include reducing quantity (by weight) of materials used in housing per m² of floor space over a certain period of time; through use of alternative materials of equivalent function and performance (e.g. prefabricated elements); through better construction site management (e.g. ordering and control of materials), and through more intelligent design.

It should be noted that reducing quantities of waste by replacing heavier materials with lighter ones could be controversial, as this procedure does not necessarily lead to lower environmental impacts. The reason is that lighter materials may be more environmentally intensive and/or harmful. An example from the construction industry is the replacement of wooden window frames with aluminium. This reduces the weight of the waste, but aluminium is a very energy intensive material with high corresponding impacts. Another issue to consider is the effect of changing materials on the use phase of the building, on e.g. the energy performance.

In- and ex-situ reuse of building components is also a possibility. Current waste management mostly focuses on recycling of C&D waste as aggregate for new construction projects, which can not be considered as waste prevention under the WFD definition. However, there is also potential for increasing reuse of building components such as bricks, roof tiles, floorboards and wooden beams, doors and even concrete wall slabs (examples are mostly found for bricks). Designing building components

and building construction in more modular form to allow deconstruction and reuse also has potential for waste prevention.

Life spans of roads and buildings can also be extended. The life span is normally determined by its structural elements. By increasing the performance of the structural elements and the design for flexibility and adaptability, the construction's life span can be extended significantly. Other limiting factors for the life span, such as the change in functional demand, can be dealt with through flexible, modular design that allows for changing room sizes and functional use of buildings.

It should be noted that there is a potential conflict between extending life spans of buildings and improving the energy performance of the building stock in general. However, energy performance of older buildings can also be improved through refurbishment rather than replacement with new buildings (although the energy performance would still be lower than that of new buildings, as for example old buildings cannot be insulated in their foundations).

Reducing the environmental impacts of generated waste under part b) of the waste prevention definition is perhaps not so relevant for C&D waste since a large proportion of C&D waste is inert. However, the other, non-inert part, although not a large proportion of the waste stream, is large in absolute numbers due to the magnitude of C&DW stream. C&D waste includes, for example, an increasing share of plastics with potential adverse effects during treatment including climate change, air quality impacts etc.

Furthermore definition b) of the waste prevention definition has relevance to the C&D waste stream when one considers *upstream* rather than *downstream* environmental impacts. If a design change in construction reduces the environmental impacts during the production phase of the construction (from an LCA perspective), this can also be considered as waste prevention under part b). An example is when the design of a construction allows for easier separation and subsequent reuse of its components. This will then offset upstream environmental impacts caused by production of new building components.

Moreover, C&D waste may contain many hazardous materials such as asbestos, heavy metals, PCBs and flame retardants. Reducing the quantity of these materials under part c) through use of more benign substances and materials would both reduce the adverse impacts of generated waste and also in some cases improve indoor environments for human health.

The general challenge with C&D waste prevention is the time frame. Most constructions (buildings, roads etc.) are designed to last for many decades. This means that an implementation of prevention measures in the constructions' design phase (where most possibilities for prevention initiatives lie; Bakas et al., 2011), would yield results in the C&D waste generation scheme only after a long time. So, the prevention initiatives need to be carefully planned and monitored.

4.2.3 Policy context

Construction and demolition waste has been identified as a priority waste stream in Europe. There is a high interest in creation of recycling markets for aggregates derived from C&D waste in roads, drainage and other construction projects. C&D waste accounts for approximately 25%–30% of all waste generated in the EU and consist of numerous materials, including also hazardous wastes.

A key objective of the Waste Framework Directive (2008/98/EC) is to promote the waste hierarchy as a guiding principle for waste management and to provide a framework for moving towards a European recycling society. Specifically for C&D waste, the WFD includes the objective that:

“by 2020, the preparing for re-use, recycling and other material recovery, including backfilling operations using waste to substitute other materials, of non-hazardous construction and demolition waste...shall be increased to a minimum of 70% by weight.”

There have been some limited local regulations on C&D waste prevention, as for example in the case of Vienna municipality, where the Municipal Department for Environmental Protection initiated and promoted the creation of rule ONR 192130 “*Identification of Harmful Substances in Buildings before Demolition Work*” since 2006. The regulation determines that there must be an identification of hazardous substances in buildings prior to demolition (Bakas et al, 2011). This is mostly relevant to part c) of the WFD waste prevention definition.

Other initiatives concerning the prevention of C&D waste include voluntary measures, such as building certificates which can be issued according to Green Public Procurement (GPP) requirements for public buildings or for example the BASTA³ system in Sweden, in which

³ <http://www.bastaonline.se/>

producers register construction materials and thus certify that they are free of certain hazardous substances. Several certification schemes are operational in the Nordic countries, but they have not yet included as requirements in GPPs. Other initiatives/schemes aim at improving maintenance of buildings, thus achieving waste prevention through extending the life span (e.g. Austrian Building Pass).

According to the qualifications of the certificate systems in general, buildings should be designed to reduce the overall impact of the built environment on human health and the natural environment by efficiently making use of energy, water, and other resources, by protecting occupant health and reducing waste.

4.2.4 C&D Waste Prevention in National Waste Prevention Plans

There is a special provision for prevention of C&D waste in the waste prevention plan of Brussels, introducing an integrated “eco-construction” approach. The strategy deals with minimising the impact of construction on the environment through all phases of the life of the building, from the construction site to dismantling, including the period of occupation (Brussels Environment, 2010). More specifically, use of resources and generation of waste can be avoided by:

- Promoting renovation rather than new construction.
- The most efficient use of the materials involved in a project, taking particular care to minimise scrap and promote use of appropriate and durable materials.
- The choice of materials as a function of their suitability for reuse and disassembly selectively, in safe recycling and disposal.
- The promotion of alternatives to products and materials generating hazardous waste.

Austria, Finland, Luxembourg and Poland in their waste prevention plans also recognise C&D waste prevention as a priority area and propose qualitative measures on how to avoid both waste arising and the use of hazardous materials (Austrian FMAFFEWM, 2011; Finnish Ministry of Environment, 2009; Luxembourg MSDI, 2011; and Polish Ministry of Environment; 2010) in their waste prevention plans. In the National Waste Management plan of Sweden for 2012–17, there is a special mention on the C&D waste stream and few measures on waste prevention are provided (Swedish EPA, 2012).

Only one of the WPPs contains a quantitative target. The overarching Waste Strategy of Wales includes the target (Welsh Assembly Government, 2010):

- Reducing generation of C&D waste (by weight) which is managed off-site by 1.4% per year (based on a 2006/07 baseline) for each year until 2050.

This target implies the use of an indicator based on the generation of C&D waste per year. Such generation based indicators are operational and in use by several Member States. Other operational indicators covering other aspects of C&D waste prevention as described above don't seem to exist although there has been a concentrated effort the last years to develop and streamline relevant indicators.

A dashboard of comprehensive indicators has been proposed, taking into account data availability and best needed indicators for C&D waste by the Copenhagen Resource Institute together with BIO Intelligence (EC, 2009). These indicators combine elements of input, output and combination indicators (see later).

The available data for the C&D waste sector is limited to the Eurostat reporting scheme. Under code F, countries have reported their C&D waste generation under code F of the reporting scheme for years 2004, 2006, 2008 and 2010 and will continue to report biannually. Most Member States have also domestic estimates available. Following the introduction of mandatory waste management plans across many Member States, the quality of C&D waste reporting is likely to improve in quality and level of detail over time. Member States will have to report by 2020 on their recycling performance and total waste arisings (without the amount of soil excavated) according to the Waste Framework Directive. Other required data, such as economic data (e.g. GDP), material flow data and physical construction data, are easily available through Eurostat.

4.2.5 Indicators and Targets

The only operational indicator that has been identified is an output type indicator (see the indicator typology in Section 3.3) describing the amount of waste generated every year by construction and demolition activities within a country.

For the C&D waste stream, output indicators are more appropriate than input indicators due to the long time lapse between production and end of life. For example, roads are designed for a service time of approx-

imately 30 years, whereas buildings for about 50 years (EC, 2009). Input indicators can be useful for assessing current waste generation, if only construction waste is considered.

The operational and proposed indicators that were identified by the literature review can be grouped according to the indicator typology are as follows:

Indicator	Proposed by	Is it operational?
Output indicator		
1.Generation of construction and demolition waste (tonnes/a)	OECD	Yes
Input-Output indicators		
2.Domestic extraction of construction materials per area of new construction (DE/PA)		No
3.Construction and demolition waste generated per area of new construction (CDWG/PA)	EC	No
4.Combined indicator of DE and CDWG per area of new construction (DE+CDWG/PA)		No
Decoupling Indicator		
5.Construction and demolition waste generated per unit GDP (CDWG/GDP)	EC	No

The indicators are described in detail in Appendix 1.

Indicators 2 to 5 in the table are aimed at providing information on the waste intensity of the construction industry expressing whether ongoing construction activities are conducted by using less materials and generating less waste per physical or economic unit of output. As such they provide more information than a simple output-type indicator. They do not go a step further and consider the waste per *functional unit* of buildings or infrastructure works i.e. C&D waste per new/refurbished family flat/house, or per unit transport capacity of transport infrastructure.

Moreover, all the indicators currently operational or proposed only respond to part a) of potential waste prevention measures.

As already described the only targets for waste prevention in C&D waste that have been found are:

- Development of an integrated “eco-construction” approach (Brussels region).
- C&D annual waste prevention target of 1.4% (based in a 2006/07 baseline) for the construction and demolition waste managed off site by 2050 (Wales).

The target set by the Brussels region is qualitative rather than quantitative describing measures that can be applied in order to save resources and prevent C&D waste generation, rather than putting a target on the results of those measures. As such it is difficult to link to indicators. It is worth mentioning because all waste prevention measures are incorporated into a holistic action plan while similar measures taken in Finland or Austria have mostly a stand alone character within the framework of the national waste prevention plan.

The target set in the overarching waste strategy of Wales is quantitative and specific and refers to a base year in 2006/7 but takes into account only C&D waste that leave the site and doesn't deal with waste prevention of C&D waste on the actual site of construction or demolition.

Neither in the case of the Brussels Region target, nor the Welsh Action Plan target, has a specific indicator been identified in the policy document which can be used to monitor progress towards or away from the target.

None of the identified indicators could be used directly to measure the target of the Brussels region. However, the input-output type indicators could potentially be used to measure the *results* of this target since they relate in some way to the resource efficiency of products which can be influenced by an eco-construction approach. Indicator 2 might be of particular relevance here.

Meanwhile Indicator 1 concerning *C&D waste generation per year* could be used to measure the prevented waste in the case of the target set in Wales. This is provided that, for the indicator, the C&D waste is measured offsite and doesn't include wastes which are recycled on-site.

4.3 Waste Electronic and Electrical Equipment (WEEE)

4.3.1 Definition of WEEE

Among the four waste streams covered in this study, WEEE is the only stream whose scope is defined at the European level. A directive on WEEE (2002/96/EC) ⁴ came into force in early 2003. A few years after Member States transposed the Directive, it went into the review process,

⁴ Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE).

and five years after the review started, the revised Directive (2012/19/EU)⁵ came into force in August 2012.

In both the original and the revised WEEE Directive, electrical and electronic equipment (EEE) is defined as:

“equipment which is dependent on electric currents or electromagnetic fields in order to work properly and equipment for the generation, transfer and measurement of such currents and fields and designed for use with a voltage rating not exceeding 1 000 volts for alternating current and 1 500 volts for direct current.” (Article 3 (a) of the original Directive, Article 3 Paragraph 1 (a) of the revised Directive).

WEEE, in turn, is defined as “EEE which is a waste” within the meaning of the waste framework Directive “including all components, sub-assemblies and consumables which are part of the product at the time of discarding” (Article 3 (b) of the original Directive, Article 3 Paragraph 1 (e) of the revised Directive).

While the scope of the original Directive was limited to WEEE listed under 10 categories in Annex IA and IB (Article 2 Paragraph 1),⁶ the revised Directive, after a transition period of 6 years, sets a so-called open scope, in which EEE are categorised into six in Annex III, with some exemptions specified (e.g. large-scale stationary industrial tools, military equipment) (Article 2 Paragraph 3 and 4). In practice, except for the addition of solar panels, there is not much difference in the types of products covered: the change is mainly in line with the collection categories that takes place in reality in the majority of Member States.⁷ As found in various parts of the Directive (e.g. Article 5 of both the original and revised Directive, allocating the responsibility for collection), the sources of WEEE include both household and non-household (i.e. business, public entities).

Another EU Directive governing this waste stream is the so-called RoHS Directive, which restrict the use of certain hazardous substances

⁵ Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE) (recast).

⁶ The 10 categories found in the original WEEE Directive are: 1. Large household appliances, 2. Small household appliances, 3. IT and telecommunications equipment, 4. consumer equipment, 5. lighting equipment, 6. Electrical and electronic tools, 7. Toys, leisure and sports equipment, 8. Medical devices, 9. Monitoring and control instruments, and 10. Automatic dispensers.

⁷ The new categorisation are: 1 temperature changing equipment, 2. Screens and monitors, 3. Lamps, 4. Large equipment, 5. Small equipment, 6. Small IT and telecommunication equipment.

in EEE. The original RoHS Directive (2002/95/EC)⁸ was developed in parallel with the WEEE Directive and came into force in early 2003. Similarly to the WEEE Directive, the RoHS Directive went under the review process and its revision (2011/65/EU)⁹ came into force in 2011. The scope of the original RoHS Directive was set based on the original WEEE Directive. Out of 10 categories in Annex IA of the original WEEE Directive, the RoHS Directive was applied to 8 categories (1–7 and 10, Article 2 Paragraph 1): exempted two categories were medical devices (category 8) and monitoring and control equipment (category 9). The scope of the revised RoHS Directive is all the 10 categories of the original WEEE Directive. They did not change the way they set the scope in the same way as the revised WEEE Directive, but added a category which covers other EEE not covered by 10 categories. In this sense, the scope of RoHS is also open to other EEE. Meanwhile, the Directive set a number of exemptions based on specific application (Article 4 Paragraph 6, Annexes III and IV). It also provides exemption to the spare parts/reused spare parts, as listed in Article 4 Paragraph 4 and 5.

4.3.2 Quantities of WEEE in Nordic countries

Waste electrical and electronic equipment (WEEE) poses problems both in terms of its quantity and its quality. It is one of the fastest growing waste streams in Europe, although it seems to be stabilising in the Nordic countries. It contains various types of toxic substances that, if not treated properly once coming to its end-of-life phase, can cause serious impacts on the environment and human health. It also contains metals which have high economic value.

No figure on the amount of WEEE generated is available. However, it is possible to find figures for 1) the amount of EEE put on the market (reported by Eurostat annually) as well as 2) the amount of WEEE collected in the collection system set up under the producer responsibility systems

Generally, data availability on WEEE collection has been improving continuously since 2005 since the annual data reporting for the European countries started at Eurostat's Waste Data Centre in accordance with the WEEE Directive and corresponding national legislation (i.e. excluding

⁸ Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of certain substances in electrical and electronic equipment.

⁹ Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of certain substances in electrical and electronic equipment (recast).

those that are collected by actors other than those who are part of the producer responsibility systems). However, no complete data set is available yet for all EU and EEA Member States. Aggregated and EU level comparison and visualization of trends is not possible. The latest available data from 2008 on total WEEE collection is available for 26 EEA countries.

Table 4.6 summarises the amount of EEE put on the market in Denmark, Finland, Norway and Sweden between 2006 and 2010, categorised in accordance with the Annex IA of the original WEEE Directive, on a per capita basis. The figure indicates the level of EEE consumption. Although in all four countries the amount of EEE put on the market is highest in 2007 and there is a small tendency in the reduction since 2008, Nordic countries are among the highest in terms of sold quantities of EEE per capita. It should be also noted that the reduction in kg does not necessarily mean that the per-capita EUR/pcs consumption decreased, due to the changes in the size and weight of individual products.

Table 4.6. Amount of EEE put on the market per capita in four Nordic countries from 2006–2010, categorised in accordance with Annex IA of 2002/96/EC (in kg)

Country	Denmark					Finland					Norway					Sweden				
Year	06	07	08	09	10	06	07	08	09	10	06	07	08	09	10	06	07	08	09	10
Large household appliances	16.2	20.2	13.9	12.8	12.1	11.8	12.8	12.9	13	13.9	15.4	15.2	15	12.9	13.4	11.2	9.2	10.8	10.4	10.9
Small household appliances	2.3	2.5	1.9	2.1	2.5	1.3	1.2	1.2	1.1	1.2	3	2.7	2.7	2.8	3.2	2.7	2.2	2.3	2.4	2.4
IT & telecommunications equipment	4.7	5.4	4.7	4.4	4.9	3.5	4.6	5.8	4	3.8	6.7	6.6	6.5	3.2	3.3	4.8	12.3	4.8	4.1	4.5
Consumer equipment	4.9	4.9	4.3	3.6	3.2	3.7	4.1	2.4	2.9	1.9	5.5	6.1	6	5.2	5.2	3.2	3.6	3.4	3.3	3.2
Lighting equipment	0.9	1	1.2	0.5	0.4	2.1	2.1	2.4	2	1.9	3.9	6.5	6.4	6.1	6.6	1.8	1.5	1.7	1.2	1.2
Gas discharge lamps	0.2	0.3	0.3	0.3	0.3	0.6	0.3	0.3	0.3	0.5	0.6	0.7	0.7	0.6	0.6	0		0	0.3	0.4
Electrical and electronic tools	1.7	2.3	1.8	1.4	1.7	1.7	2.8	2	1.9	1.9	2.9	3.8	3.7	2.3	3	0.7	1.4	1.5	1	1.2
Toys, leisure and sports equipment	0.4	0.4	0.5	0.7	0.8	0.4	0.4	0.7	0.5	0.6	0.8	0.6	0.6	0.9	0.9	0.2	0.6	0.5	0.4	0.6
Medical devices	0.3	0.8	0.8	0.3	0.3	0.2	0.2	0.9	0.2	0.2	0.6	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.2
Monitoring and control instruments	0.2	0.1	0.1	0.2	0.2	0.9	2.5	1.7	0.8	1.7	0.6	1.5	1.5	0.8	0.4	0.1	0.2	0.2	0.1	0.1
Automatic dispensers	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.4	0.1	0	0.2	0.2	0.5	0.3	0.1	0.1	0.1	0.1	0.1
Total put on the market	31.9	37.8	29.6	26.4	26.6	26.4	31.1	30.6	27.1	27.6	40.2	44.2	43.6	35.7	37.1	25	31.2	25.4	23.5	24.8

Source: Eurostat 2012¹⁰.

¹⁰ epp.eurostat.ec.europa.eu/portal/page/portal/waste/key_waste_streams/waste_electrical_electronic_equipment_weee

The amount of WEEE collected per capita under the producer responsibility systems set up in the same four Nordic countries between 2006 and 2010 is found in Table 4.7. It is affected by many factors, not least the effectiveness of the collection systems in the respective countries, the longevity of the products, the convenience of the collection system to the user and the value of WEEE. However, it provides some indication of the amount of WEEE generated.

Table 4.7. Amount of WEEE collected per capita under producer responsibility systems in four Nordic countries from 2006–2010, categorised in accordance with Annex IA of 2002/96/EC (in kg)

Country	Denmark					Finland					Norway					Sweden				
Year	06	07	08	09	10	06	07	08	09	10	06	07	08	09	10	06	07	08	09	10
Large household appliances	5.8	9.5	6.5	6.7	6.4	4.1	4.6	5	4.8	5.2	9.4	9.9	9.8	9.4	9	6.6	8.4	7.6	7.4	8
Small household appliances	0.3	1	0.9	1.1	0.6	0.3	0.3	0.3	0.4	0.2	1.3	1	1	2	1.6	1.2	1.2	0.8	0.8	1
IT and telecommunications equipment	2.1	3.1	3	2.6	3.3	1.3	2	2.2	2.1	1.5	4	4.3	4.5	4.1	3.4	2.8	3.3	3.2	3.3	3.4
Consumer equipment	2.6	3.5	3	4.1	4.2	1.5	1.9	2.3	2.2	2.3	2.4	2.8	3.1	3.3	3.8	2.9	3.2	4	4.2	4
Lighting equipment	0	0	0	0	0	0	0	0.1	0.1	0	1.3	1.3	1.4	1.3	1.4	0.6	0.6	0.4	0.2	0.3
Gas discharge lamps	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0		0	0.2	0.2
Electrical and electronic tools	0.1	0.4	0.4	0.4	0.1	0.1	0.1	0.1	0.1	0.1	2.6	2.8	3	2.8	2	0.2	0.2	0.2	0.2	0.2
Toys, leisure and sports equipment	0.1	0.2	0.1	0.2	0.1	0	0	0	0	0	0.1	0.4	0.1	0.1	0.1	0.1	0	0	0.1	0.1
Medical devices	0	0	0	0	0	0	0	0	0	0	0.1	0.1	0.1	0.1	0.1	0	0	0	0.1	0.1
Monitoring and control instruments	0	0.1	0	0	0.1	0	0	0	0	0	0.5	0.5	0.4	0.5	0.4	0	0	0	0	0
Automatic dispensers	0	0	0	0	0	0.1	0.1	0.1	0.1	0	0	0	0	0.1	0	0	0	0	0	0
Total WEEE collected	11.1	18	14.1	15.3	14.9	7.5	9.2	10.3	10	9.5	21.8	23.3	23.8	23.9	22	14.3	17	16.3	16.5	17.2

Regarding Iceland, the only information available is the total amount of WEEE generated in 2007 and 2008, which was 2000 tonnes in total (roughly 6.3–6.5 kg per capita) (Statistics Iceland, 2012). It should also be noted, that Norway operates with a wider scope of products than that found in the WEEE Directive, which means that Norway both collects more WEEE than reported in the table, but also puts more EEE on the market according to Norway's own scope definition¹¹.

4.3.3 Waste Prevention in Context of WEEE

All three types of measures identified in the waste prevention definition in Box 2 at the beginning of this Chapter are relevant to the WEEE stream to a greater or lesser extent.

Reducing generated quantities of WEEE under part a) could occur through a number of types of actions in a variety of areas. A longer life span of products can be encouraged through changing requirements on minimum guarantee periods for electrical and electronic equipment and engaging in voluntary agreements with producers to combat planned obsolescence. Voluntary agreements could also include design of EEE to reduce the material content and with a view to upgrading rather than replacement for example of mobile phones, computers etc., In addition, various measures on design changes that improve the products' longevity, reparability, durability and overall resource efficiency (e.g. miniaturisation) should be considered as measures under part (a) of the definition. All these are issues which individual countries would find hard to tackle alone given the global profile of production.

At the more local level a longer life could be achieved through economic instruments to encourage repair rather than replacement of EEE and seeding of repair services for EEE. Waste generation can also be reduced by encouraging a second life for EEE through setting up markets for used EEE either within Europe or for use in developing countries. Close monitoring of these markets and especially the transboundary shipments of WEEE is required to ensure that the EEE is in fact reused and does not end as hazardous waste in landfill or open dumps (EEA, 2009). For the purpose of laying down the rules governing the shipment of EEE for re-use, the "Correspondent's Guidelines No.1" as revised in 2007, applies for setting specific requirements for EEE, which have not

¹¹ See <http://www.eeregisteret.no/ShowHTML.aspx?file=Statistikk.htm>

yet become WEEE, for shipment (EC, 2007). Furthermore, the British Standards Institute has recently introduced a new specification (PAS 141:2011) which aims to help reduce illegal exports of WEEE by making it easier to identify whether used electrical equipment is truly fit for reuse and can therefore legally be sent overseas (BSI, 2011).

It should be noted that for those electrical goods for which the use stage dominates the life cycle environmental impacts, there is an argument against prolonging the product life span to the point where stock is not replaced by more modern products with significantly lower energy use during the use phase. These arguments have been weakened somewhat by inclusion of impacts beyond energy related impacts throughout the lifecycle.

Increasing consumer awareness of the possibilities for repair and the environmental impacts and resource scarcity implications from the production of EEE may also have potential for reducing WEEE generation.

Reducing the environmental impacts of generated waste under part b) is also essential since e.g. recycling of WEEE, when compared to land-filling, yields much more environmental benefits. In order to achieve improved WEEE management, their collection rate needs to increase. There is a significant amount of this waste stream that is not accounted for, despite the presence of extensive producer responsibility schemes, and is assumed to end up in MSW collection systems, especially for smaller WEEE. This issue needs to be clarified in order to assess the levels of WEEE collection and their management options.

According to data from Denmark and Sweden, gathered by sorting experiments in municipalities, only a little more than 1 kg per inhabitant per year of WEEE ends up in the household waste bin. Data losses account for much more than that, reaching up to 1/3 of the household WEEE flow, and can only be explained due to methodological shortcomings in data collection by the statistical offices. In addition there are close to no official data on professional EEE/WEEE. In general, Nordic collection systems are very effective and little is lost to landfill and incineration. The value of WEEE is very high and therefore much is collected outside the monitored streams (DPA-system, 2012).

Several design improvements could increase the recyclability of WEEE, focusing in particular in specific materials with high environmental impacts. A typical example of these materials is the rare metals included in WEEE in very small quantities (ETC/SCP, forthcoming).

Prevention of waste under part c) of the definition is also particularly relevant to WEEE due to the high level of content of hazardous materials. Reducing the quantity of these materials through use of alternative more benign substances and materials would also reduce the adverse impacts of generated waste. This is in part tackled through the RoHS Directive as well as the REACH Regulation—see below.

4.3.4 Policy context

WEEE is currently considered to be one of the fastest-growing waste streams in Europe and therefore this waste stream has concentrated much attention in policy consideration in a European, as well as national level. In 2003 the European Commission Directive 2002/96/EC as amended by Directive 2003/108/EC set the ground principles of management of this waste stream, introducing waste minimisation, eco-design and producer responsibility as building blocks of a sound management practice. As it is stated in Article 1 of the WEEE directive:

“The purpose of this Directive is, as a first priority, the prevention of waste electrical and electronic equipment (WEEE), and in addition, the reuse, recycling and other forms of recovery of such wastes so as to reduce the disposal of waste. It also seeks to improve the environmental performance of all operators involved in the life cycle of electrical and electronic equipment, e.g. producers, distributors and consumers and in particular those operators directly involved in the treatment of waste electrical and electronic equipment.”

A recast of the WEEE directive came into force in July 2012 with the new directive 2012/19/EU, amending previous shortcomings and introducing for the first time targets for preparation for re-use of electronic appliances.

Additionally to the WEEE directive, special concern arises from the use of hazardous substances in electrical and electronic equipment. A Directive on the Restriction of Hazardous Substances (RoHS Directive 2002/95/EC) was developed and came into force in parallel with the WEEE Directive. The recast of the RoHS (2011/65/EU) came earlier than the revised WEEE directive but maintained its supportive character to the WEEE directive and its integrity about contributing to the protection of human health and the environment, including the environmentally sound recovery and disposal of waste EEE. In addition, authorisation and information requirements on the substances put on the candidate list of SVHC (Substances of Very High Concern) have been helpful in the achievement of qualitative waste prevention.

4.3.5 WEEE Waste Prevention in National Waste Prevention Plans

The waste prevention plan of the Brussels region in Belgium includes three targets relating to WEEE, though only two of these can be strictly identified as waste prevention targets. The third is more concerned with collection of WEEE. The two waste prevention targets comprise a quantitative measurable target on reducing consumption of gadgets by weight and a qualitative target concerning establishing systems enabling the reuse of end-of-life EEE (Brussels Environment, 2010). The targets are described in the next section.

No other national or regional targets have been set for WEEE prevention in national or regional waste prevention plans.

Fully developed, operational or widely used indicators for the WEEE stream do not exist. A concentrated effort has been in place in recent years to develop relevant indicators. So far, a few comprehensive proposals have come forward, mainly through work undertaken in response to DG Environment and the EEA. For WEEE prevention, input, output and combination indicators, as well as hazardous content and response indicators have been proposed.

4.3.6 Indicators and Targets

The operational and proposed indicators that were identified by the literature review can be grouped according to the indicator typology given Section 3.3, as follows:

Indicator	Proposed by	Is it operational?
Input-Output indicators		
1.Collection efficiency of WEEE	ETC/SCP	No
Response Indicators		
2.Total amount (EUR) of assets (e.g. EEE) bought with the purpose to re-use them per capita	EC	No
3.The amount of re-used goods (e.g. EEE) sold.	EC	No
Hazardous substance indicators		
4.Hazardous substance indicator	EC	No

The indicators are described in detail in Appendix 1.

None of these indicators are operational. The first indicator is not really a waste prevention indicator since it was originally proposed as an indicator on the degree to which WEEE is separated from other wastes. Eurostat collects via Member States data on the quantities of WEEE separately collected. To create the indicator, this figure is then divided by the quantity in tonnes of EEE which is sold for final consumption. It is assumed that this will eventually end as WEEE although with a time lag. Different EEE items have different life spans (ETC/SCP, 2011). However, one divided by the other gives some indication to what extent WEEE is separately collected or mixed in with other streams such as municipal waste. It should be noted that EEE tend to become lighter year by year and thus the WEEE/EEE ratio is heavily influenced by this fact and the indicator is expected to be biased.

Although not in the form proposed by the ETC, many member states maintain similar indicators on WEEE collection rates and WEEE recycling rates, which they use for measuring and reporting against the targets set in the WEEE directive.

If one could assume that all WEEE is separately collected then the indicator would also give an idea over the extent to which EEE is reused in the economy or ends immediately as waste. However, this is not a reasonable assumption. The WEEE collection schemes fail to include all generated WEEE (as some waste EEE are not accounted or bypass the collection mechanisms and some small quantities end up in other waste streams). Therefore, amounts collected cannot give a good representation of waste prevention since collected amounts fluctuate according to collection schemes and not necessarily as a result of prevention initiatives.

On the other hand a reducing quantity of new EEE sold for consumption in any one year would be a useful input-type indicator. A reduced quantity might indicate increasing life spans of EEE goods through reuse or otherwise, or reduction in weight of individual types of WEEE.

The two response indicators are very similar to one another. In fact, given the limited detail included in the proposals the differences between them are not clear. Either of these indicators could potentially be used in combination with the input element of Indicator 1 to thus get an indicator of reused EEE sold, divided by new EEE sold which could be a useful waste prevention indicator for WEEE.

The final indicator concerns quantities of substances covered by the RoHS Directive to test adherence to the Directive. The indicator would be based on sampling data from manufactured and imported EEE goods and the sampling could presumably be extended to cover other hazardous substances. However, the data would be rather costly to collect.

As already described the following targets for waste prevention in WEEE have been found:

Brussels region:

- Support the social economy to facilitate its access to reusable WEEE, as well as the technical information necessary for any repair.
- To reduce the annual consumption of certain products (gadgets) by at least 2 kg/cap (compared to the 2005 baseline).

The revised WEEE directive (2012/19/EU) includes targets on preparation of WEEE for reuse and recycling. However, the European Commissions guidelines on preparation of waste prevention programmes are quite clear in the interpretation of the waste prevention definition that this should not include preparation for reuse after a product has become a waste (see Figure 2 in EC, 2012). These targets are, therefore, not discussed further here.

The target set by the Brussels region is very specific about the quantity that needs to be reduced and the waste stream (small-medium gadget electronic devices). However, it has not been directly linked to any indicators which can measure progress against the target. The target could potentially be monitored by an indicator based on the input element of Indicator 1 discussed earlier i.e. the quantity of EEE going on to the market. However, the sales data would need to be differentiated by size of product in order to allow for such an indicator. None of the other indicators identified could be used in the context of the target.

4.4 Textiles Waste

4.4.1 *Definition of Textiles Waste*

Unlike for WEEE, there is no legislation at the EU level that directly and specifically addresses end-of-life management of textile waste. The situation is the same at the national level in Nordic regions: none of the Nordic countries have introduced government interventions in the area.

Due to lack of government interventions no legally defined scope for textiles waste exists. This waste stream is generally more defined by the type of material than its source. The scope of textile wastes considered by different studies vary: some include end-of-life clothing from households only, some include all textiles wastes (i.e. including carpets, curtains, towels, textiles on furniture etc.) found in municipal wastes, and

some include all textile wastes created in an economy including wastes from clothing manufacturers etc. The Joint Research Centre (2009) found 15 different codes (including 2 hazardous fractions) in the European Waste Catalogue as relevant to this waste stream (JRC 2009).

4.4.2 Quantities of Textiles Waste in Nordic countries

In Nordic countries, pilot initiatives and studies to reduce environmental impacts from end-of-life phase of textiles has begun in recent years. Some of such works focus on clothing,¹² while others also include home textiles (e.g. towels, curtains, table clothes) that would eventually end up in municipal waste stream.¹³ Another implication of the lack of government interventions is lack of systematic source separation systems for textile waste. This contributes to the current lack of consistent data on the development of generation of textiles waste.

Table 4.8 summarises the estimation of the consumption of textile products (covering clothing and home textiles) and their destiny afterwards in three Nordic countries. As seen in the table, the studies indicate that a rather low use of second-hand textile products in the Nordic countries, and that a large part of textiles wastes are collected without being sorted from other waste streams.

Table 4.8. Flow of clothing and home textiles/ their waste in Denmark (2010), Finland (2010) and Sweden (2008) (kg/capita)

		Denmark	Finland	Sweden
Consumption (A)	New textile products	16.0	13.1	14.2
	Second-hand textile products	0.5	1.3	0.3
	Consumption Total	16.5	14.4	14.6
Collection (B)	Used textile products collected by second-hand actors	6.3	4.7	2.8
	Used textiles mixed in municipal waste	4.4	9.3	7.6
	Collection Total	10.7	14.0	10.4
Textile waste treated in the country (C)		5.6	11.5	8.0
Export of used textile products (D)		4.7	1.2	2.1

Source: Carlsson et al., 2011; Tojo et al., 2012.

¹² Examples include NICE (Nordic Initiative, Clean and Ethical) in the Nordic countries (www.nicefashion.org/en/), series of studies by National Institute for Consumer Research and Norwegian University of Science and Technology in Norway in Norway and Mistra Fashion Project, a research project on Sustainable fashion in Sweden (www.mistrafuturefashion.com/en/Sidor/default.aspx).

¹³ See, for instance, Carlsson et al., 2011, and Tojo et al., 2012.

4.4.3 Waste Prevention in the Context of Textiles Waste

All three types of measures identified in the waste prevention definition in Box 2 at the beginning of this chapter are relevant to the textiles waste stream to a greater or lesser extent.

With respect to part a) of the waste prevention definition, reuse of textiles and particularly clothing and other garments is perhaps the most currently utilised form of prevention of waste of textiles from households and has a high potential for being further expanded to reduce textiles waste. Reuse can occur through many different mechanisms: reuse outside of the economy proper by family and friends through informal donations, clothes swaps etc.; resell via flea markets; donation to used-clothing shops for resell (i.e. returning to economy); donation to charities for reuse in developing countries etc.¹⁴ (WRAP, 2012b). In addition, some producers have started to organise the collection and re-selling of their own products as second-hand products (Eder-Hansen et al, 2012).

This reuse is effectively extending the lifetime of the product where it is otherwise no longer of use to the original owner, not because of physical damage, but because the owner has grown out of it or it is no longer a part of their active wardrobe.

Where a garment is to be disposed of due to physical damage other types of measures can be used to extend its lifetime. These can include encouraging home repair through educational or economic instruments, greater access and use of repair shops, or at the product design stage, improving the durability of garments through use of higher quality materials.

Perhaps of even more importance, quantities of textiles waste, both in households but also during production of textiles and clothing, can be reduced through measures encouraging a reduced purchase of new clothing in kg/capita/year (Grimstad Klepp, 2009). This could occur through encouraging purchase of fewer more high quality (and expensive) garments, efforts by the fashion world to reduce the new numbers of collections and thereby speed of changes in fashion, or general awareness-raising amongst the population.

Measures under part b) of the waste prevention definition might include design of products so that they are easier to recycle rather than dispose of. This could include refraining from blending different fibres

¹⁴ See SIFO research project at

<http://www.forskningssradet.no/servlet/Satellite?c=Nyhet&pagename=miljo2015%2FHovedsidemal&cid=1253955021625>

or from including metal or plastic components on clothing. Existing studies on the environmental impacts of textiles indicate that, from a life cycle perspective, the most notable impacts occur during the use phase of textile products—through the use of chemicals, water and energy, accompanied by the production phase of both textile products and raw materials (Swedish EPA 1996; Chapman 2010). Waste prevention measures for textile products address primarily the impacts arising during the production phase. Environmental impacts of the production phase have been increasing, due primarily to the sheer increase of the consumption of new textile products.¹⁵ Thus, it is important to address the demand for textile products, via in part through encouraging the prolonged use and reuse of textile products.

Part c) of the prevention definition - reducing the hazardous content in materials and products - is also relevant for textiles. Textile waste is generally not classified as hazardous waste. However, various types of hazardous substances are used during the production process. A recent study in Denmark indicated that many of these substances remain in the textile sold in the market, and phthalates, some heavy metals, flame retardants and antibacterial agents remained in the clothes even after washing (Brunn Paulsen et al, 2011). This may also be the case for other types of textiles including carpets, towels, curtains etc. This suggests that there is some potential for waste prevention under part c) of the definition. These hazardous materials may cause impacts on human health and also on the environment if unused textiles end as waste without having been washed.

There are also textile wastes coming directly from the production process and textile products that are not part of sold products and come directly into the waste stream—hazardous substances remained in these flow would most likely cause negative impacts at the end-of-life phase. Carpets used especially in office space also often contain flame retardants that are toxic.

¹⁵ The textile fibre consumption worldwide grew from 3.7 kg per capita in 1950 to 11.1 kg in 2007 (FAO and ICAC 2011). Between 2004 and 2007, the textile fibre consumption increased by 8% in developed countries (FAO and ICAC 2011).

4.4.4 Policy context

Regarding Part c) of the waste prevention definition in the Waste Framework Directive, some substances listed as candidates to Substances of Very High Concern (SVHC) in the EU REACH Regulation (EC/1907/2006) have been used in the production process of textiles (and some could remain in the products). In case a textile product contains a substance listed as a SVHC candidate more than a threshold level specified in the REACH Regulation, actors putting the product in the EU market need to communicate its existence to actors further along the product chain.

A handful of Type I eco-labelling¹⁶, among others the EU flower and Nordic swan, include in their criteria documents restrictions on the use of various chemical and heavy metals in the production process. Although these criteria were not created with that intention they may have a positive impact on reducing hazardous or harmful trace residues left in textile products.

Concerning part a) of waste prevention, the Swedish Good Environmental Choice label¹⁷ sets criteria for second-hand (reused clothing) and re-design (reused and altered clothing).

A number of pilot initiatives have surfaced in response to the need for better textiles waste management, including waste prevention, such as the NICE initiative in the Nordic countries¹⁸ and the UK's Sustainable Clothing Roadmap and associated Action Plan (Defra, 2010). The UK's Sustainable Clothing Roadmap aims to improve the environmental and social performance of clothing, building on existing initiatives and by coordinating action by key clothing supply chain stakeholders. One of the key actions of the Action Plan is aimed at maximising reuse, recycling and end-of-life management of used clothing.

France has introduced extended producer responsibility programme for clothing, linen and footwear (EcoTLC 2012). The system requires that companies selling or importing these goods provide or manage the recycling of their products at the end of their usage. Although it is not specified whether or not collected used clothing should be reused or recycled, EcoTLC, the company who is providing such services to com-

¹⁶ See: http://project.ecolabel-products.eu/display/cid/_20.html

¹⁷ See: <http://www.ecolabelindex.com/ecolabel/good-environmental-choice-bra-miljoval>

¹⁸ See: <http://www.nordicfashionassociation.com/28035/The%20NICE%20project>

panies under the scheme has included reuse as an element in their collection and redistribution system.

None of the legislation and policy instruments and initiatives have set quantitative targets for waste prevention in textiles.

4.4.5 Textiles Waste Prevention in National Waste Prevention Plans

For textiles, no specific targets have been found anywhere in the waste prevention plans of the Member States or other policy documents.

No fully developed, operational or widely used indicators for textiles waste have been found in the literature. Nor has any reference to studies developing relevant indicators which specifically target textiles wastes been found. More general indicators have been proposed by the European Commission and the OECD which could be used for textiles wastes.

In addition, some data on textiles waste does exist from which indicators can be developed. Eurostat maintains data on textile waste generation and treatment from all economic activities (NACE Rev.2), which can readily be used for the construction of simple indicators, e.g. textiles waste generation. In the waste database, maintained by Eurostat (env_wasgen), there is data for textile waste for all economic categories and households for the years 2004, 2006, 2008 and 2010. Nevertheless the quality of this data is not good and not representative for all the Nordic countries. For example Denmark doesn't report any textile waste or at least the reported figures are highly uncertain. Textile waste is part of the mixed municipal waste going to incineration, except from a small fraction which is separated for recycling. The same applies also to Sweden, where most of textiles are discarded for incineration with other materials and consequently no specific amount of textile waste is measured. Iceland doesn't report on textile waste generation and treatment.

Furthermore, clothes in general are discarded in batches rather than continuously, which makes one-off picking analyses more unreliable. For producing better representative figures on clothing waste, a much bigger sample is needed spread out in time and area. Another factor also relevant for the quality of data of textile waste is the amount of waste being exported for recycling or re-use.

4.4.6 Indicators and Targets

Two generalised indicators have been identified which can potentially be used for measuring textiles waste prevention activities. These can be grouped according to the indicator typology given in Section 3.3, as follows:

Indicator	Proposed by	Is it operational?
Response indicators		
1. Consumption and recycling of selected materials (e.g. textiles)	OECD	No
2. Total amount (EUR) of assets (e.g. clothes) bought with the purpose to re-use them per capita.	EC	No

The indicators are described in detail in Appendix 1.

Both indicators are related to the part a) of the waste prevention definition in the WFD i.e. measuring elements related to reducing the volume of textiles waste being generated. Neither of the indicators are as yet operational but rather were proposed by the OECD and the European Commission as indicators for future development. Neither of them are textile-specific indicators but they could be adapted accordingly.

No specific policy targets were found for textiles waste. Nevertheless, a target found in the waste prevention plan of the Brussels region can be applied to textiles waste as well as other goods (Brussels Environment, 2010).

- Selectively collect and return to the market 3 kg of additional reusable goods per capita per year by 2013 and 6 kg/cap/yr by 2020.

The target is concrete in terms of quantities, but not about which goods are covered nor from which waste streams. By the target formulation, it can be deduced that all reusable goods (i.e. electronics and electrical goods, toys, tools, furniture and other household goods including clothing) in household waste streams are likely to be covered by the target. No indicators have been described in the policy document which can be used to monitor progress towards or away from the target. Indicator 1 described above is, however, well suited to measuring progress against the Brussels region target.

5. General Principles for the Selection of Indicators and Targets

5.1 Introduction

A widely recognised rule in environmental and waste policy is that “*what does not get measured does not get managed.*” Developing indicators is therefore essential in tracking progress on objectives and targets and to evaluate the efficacy of waste prevention policies.

However, past experience in EU and OECD countries has shown that difficulties in measuring waste prevention using reliable indicators have limited the efficacy of waste prevention measures. This is often the result of the inherent difficulty in measuring “*prevented*” waste (you cannot measure something “that is not there”), as opposed to measuring waste recycled or waste sent to incinerators and landfills.

The following section outlines some general considerations that should be taken into account when proposing indicators and targets for waste prevention in the four waste streams. These can be viewed as guidance notes for indicator and target formulation and selection.

Before outlining the general considerations it is worth looking at the key findings from the literature review. It was hoped that the literature review would identify a pool of indicators and targets which could inspire targets and indicator selection for the Nordic countries.

The key findings of the literature review can be summarised as follows:

- Only a few indicators have been proposed, and even fewer are operational in Europe and worldwide. Most proposals were identified for C&D waste (5) and fewest for textiles (2 general indicators and 0 textile specific).
- With a single exception all indicators proposed fall directly under part a) of the waste prevention definition i.e. a reduction in *quantities* of waste.

- Within that area indicators proposed are reasonably well distributed between: output, input versus output, decoupling and response-type indicators.
- Not many targets have been proposed for any waste stream apart from food. For food 11 targets have been proposed. For textiles no textile-specific target was found.
- The proposed targets all fall under part a) of waste prevention definition.
- Most targets relate to output, input and input versus output type variables.¹⁹ There are also a few response based targets. Some targets are concrete and well-defined—others are vaguer and open to interpretation in terms of their scope and boundaries.
- No identified targets have been related to indicators. However, there is an overlap between the types of targets and proposed indicators i.e. both mostly cover part a) of definition and both mostly are quantity based output, input or input versus output. Therefore, there is potential for some of proposed indicators to be adapted to be able to monitor targets.

5.2 Which Elements of the Waste Prevention Definition?

Indicators relating to all three parts of the waste prevention definition (see Box 2 at the beginning of Chapter 4) could be defined. However, as described in more detail later, hazardous content of products as covered by part c) of the definition mostly has relevance to WEEE and C&D waste and is not at all relevant to the food waste stream.

¹⁹ For typology, see Box 1 at the beginning of this report.

Figure 5.1. Visualization of the concept of waste prevention

Source: Lilja, (2009).

Figure 5.2. Visualisation of the concept of material efficiency

Source: Lilja (2009).

Waste prevention is visualised in Figure 5.1. Part b) of the waste prevention definition is difficult to measure, over and above the extent to which it would be covered by the other two elements part a) and part c). This is because it refers to actions taken *prior to* products becoming waste that would reduce the environmental and human health impacts of the generated waste. The environmental and human health impacts of waste will in part be dependent on the quantity of waste that is generated. This is covered by part a) of the waste prevention definition. It also depends on a combination of the material content of the waste and its subsequent treatment.

However, part b) of the waste prevention is not simple to interpret. This may be one of the reasons why it has not been addressed in the EU Commissions' waste prevention guideline (EC, 2012). One uncertainty is whether "*the adverse impacts of the generated waste...*" refer only to the *direct* impacts from waste management or to the full life cycle impacts of the management of the waste including for example impacts avoided upstream when waste is recycled. Here we choose to interpret part b) to include the latter i.e. the full lifecycle impacts related to the treatment of the waste.

Whether waste is recycled, incinerated with or without energy recovery or landfilled makes a significant difference to the life cycle environment and human health impacts of the generated waste. However, waste prevention only refers to measures taken *before a product becomes waste*. In this context waste treatment can potentially be influenced through waste prevention measures such as designing products for increasing recyclability. Examples could be through avoiding mixtures of different materials, producing products where individual components can easily be disassembled and including material labels on products.

Material choice can influence treatment type and also the environmental impacts of a given material. Material substitutions can therefore potentially have a waste prevention effect under part b) of the definition. Here, avoidance of hazardous materials is of particular importance and is covered by part c) of the definition.

Figure 5.3. LCA scores for different building materials per kg (Eco-Indicator 99)

Production of building material (in millipoints per kg)			
	Indicator	Description	
Alkyd varnish	520	Production + emissions during use of varnish, containing 55% solvents	5
Cement	20	Portland cement	1
Ceramics	28	Bricks etc.	1
Concrete not reinforced	3.8	Concrete with a density of 2200 kg/m ³	1
Float glass coated	51	Used for windows, Tin, Silver and Nickel coating (77 g/m ²)	1
Float glass uncoated	49	Used for windows	1
Gypsum	9.9	Selenite. Used as filler.	1
Gravel	0.84	Extraction and transport	1
Lime (burnt)	28	CaO. Used for production of cement and concrete. Can also be used as strong base	1
Lime (hydrated)	21	Ca(OH) ₂ . Used for production of mortar	1
Mineral wool	61	Used for insulation	1
Massive building	1500	Rough estimate of a (concrete) building per m ³ volume (capital goods)	1
Metal construction building	4300	Rough estimate of a building per m ³ volume (capital goods)	1
Sand	0.82	Extraction and transport	1
Wood board	39	European wood (FSC criteria); CO ₂ absorption in growth stage disregarded	1*
Wood massive	6.6	European wood (FSC criteria); CO ₂ absorption in growth stage disregarded	1*
Land-use	45	Occupation as urban land per m ² yr	*

Source: Eco-Indicator 99 VROM (2000).

However, other material substitutions could also be of importance. For example, substituting steel with wood in construction projects could reduce the *life-cycle* environmental impacts associated with the waste treatment of the resulting C&D waste and also reduce the waste amounts as measured by weight. In other cases, however, reducing the weight of the material input and thus the weight of the waste output through material substitutions might have a negative effect on the impacts from waste management. An example would be substituting wood with aluminium. It is possible to conceive input-type indicators which measure the material content of inputs to each product type, or alternatively output-type indicators measuring the material content of a waste stream as illustrated by Figure 5.2. This would be most relevant to WEEE and C&D waste.

A prior requirement would be detailed LCA analyses of which materials would be environmentally preferable, for a given breakdown of waste treatment types. Some LCA-based data are already available on certain type of materials. For example, the Eco-indicator 99 (VROM 2000) is one of the most widely used impact assessment methods in LCA. It is a unique endpoint impact assessment method, which allowed the environmental load of a product to be expressed in a single score.

Results are also available for several materials, including building materials (Figure 5.3).

Unfortunately, such results are not currently available at a comprehensive level, therefore it would seem that feasible indicators are likely for the time being to be limited to part a) and part c) of the waste definition, with the emphasis on part a) for at least the textiles and food waste streams.

5.3 Which Parts of the Production-Consumption Chain?

Wastes occur along the entire length of the product chain between extraction of resources, through each part of the production chain, at retailers prior to sale to the end consumer and following consumption.

However, with the exception of C&D waste the four waste streams subject to this study are closely related to products for final consumption. Therefore, the scope of indicators should encompass the downstream end of the production-consumption chain in each case. However, there are some differences in which parts should be included. It should be noted that of all four waste streams only WEEE is defined categorically for the EU, via the WEEE Directive.

- *Food waste* prevention policy is generally aimed at households, restaurants and other catering services but also includes retailers and in some cases wastes from food manufacturers further up the stream. It is not considered to apply to wastes produced during agricultural production. However one study included unharvested or harvested but subsequently discarded crops in farms. In all cases food waste only comprises biowaste as defined in Article 3,(4) WFD 98/2008. Food packaging, for example, is not included.
- *WEEE* as defined by the WEEE Directive only includes end-of-life electrical and electronic products which have been used as such by businesses, households and government. Wastes from electronics manufacturers are not included. Unlike food, WEEE includes a mixture of many different types of materials.

- *Textile wastes* have not been closely defined. It is generally more defined by the type of material than its source. The scope of textile wastes considered by different studies vary: some include end-of-life clothing from households only, some include all textiles wastes (i.e. including carpets, curtains, towels etc.) found in municipal wastes, and some include all textile wastes created in an economy including wastes from clothing manufacturers etc. For example, the Joint Research Centre (2009) found 15 different codes (including 2 hazardous fractions) in the European Waste Catalogue as relevant to this waste stream.
- *C&D waste* is a source defined waste. It comprises wastes arising from the construction, demolition and refurbishment of buildings and other civil engineering works. It is generally not considered to include wastes arising during the manufacturing of building components i.e. cement, bricks, tiles, steel components, glass etc. It is generally also considered to include only wastes that are removed from the construction sites, though not always. Several countries included soils in C&D waste traditionally, but in accordance with the WFD, soil cannot be included for the recovery target of 70% for construction and demolition waste by 2020.

The scope of the production and consumption chain covered by each waste stream is included in Figure 5.4. This scope would ideally be fully addressed by indicators. However, indicators may also be focussed on specific parts of the chain which produce the greatest quantities of wastes or which can most easily be tackled as a single entity i.e. households.

Figure 5.4. Scope of the four waste streams in the context of the production and consumption chain

Note: The typical scope of waste prevention indicators found in literature is marked by blue for all waste streams. The thickness of the blue line indicates the degree of consensus on the scope.

5.4 The RACER Indicator Assessment System

Prior to assessing types of indicators that might be proposed for individual waste streams it is worth selecting an assessment system for judging the suitability of indicators for monitoring waste prevention under each waste stream. Many sets of indicator selection criteria have been developed over the past years. For this project the RACER assessment system will be used due to its increasing acceptance within the environmental indicator community and its relative ease of use.

The RACER system comprises the following criteria against which each indicator will be assessed:

- Relevant (to the objective which in this case is waste prevention).
- Accepted (in particular by targeted stakeholders such as academia and policy-makers).
- Credible (transparency and the confidence that the users and stakeholders place in the indicator).

- *Easy* (in terms of quantification and follow-up over time with regard to data availability issues and in terms of communication towards the targeted group).
- *Robust* (data quality, scope and representativeness).

These criteria can be given different relative weights depending on the demands placed on the indicators i.e. long term or short term. The specific needs of the Nordic Council of Ministers and implications for the use of the RACER system are considered later in this chapter.

5.5 Strengths and Weaknesses of Various Indicator Types

An indicator typology for waste prevention indicators has been developed for this study. This is described in Box 1 at the beginning of this report. The indicator types relate to different parts of the waste prevention definition as described in the box.

The following presents a discussion on the strengths and weaknesses of each indicator type.

Output-based indicators are likely to be the most readily available type due to availability of waste generation statistics. However, a reduction in generated waste can have other causes than what would strictly be called waste prevention measures. Primary amongst these would be an economic downswing. In addition changing methods for collecting or reporting on waste could also lead to an increase or decrease in apparent waste generation, which might be misinterpreted as a result of waste prevention measures.

Input-based indicators suffer from the same issue as output type i.e. a reduction in the value or quantity of consumed goods or resources may result from an economic recession rather than successful waste prevention measures.

Decoupling indicators and *Input-versus-output indicators* are not so open to such misinterpretations. These indicators relate the consumption of certain goods to the amount of waste generated, i.e. wasted resources. Such indicators are particularly solid in terms of identifying changing resource efficiency resulting from waste prevention measures whether inputs are measured by economic value or by weight.

In both cases it is important that the input or economic variable is closely related to the output variable. Otherwise trends can be misleading. For example a *decoupling indicator* showing C&D waste per unit

economic output of the construction industry would be more appropriate than one showing C&D waste per unit GDP, for showing improvements in the material efficiency of the construction industry and its works. Similarly, a decoupling indicator calculating food waste per unit of household expenditure on food may be more appropriate than one calculating food waste per unit income of households since increasing income tends to lead to increased spending on other items—communication, recreation and culture. Spending on food has tended to remain relatively stable (EEA, 2012).

Recent studies have been made of the relationship between municipal waste generation over the last 10 years and different household-related variables. These studies conclude that at EU level household-related variables like size, age, population density or share of urban population provide some useful hints for waste management, but they do not seem to have a great influence (Mazzanti and Zoboli, 2008). The study underlines that in the old EU Member States there is a more positive correlation with the hypotheses that the larger size of households, the less waste is generated per capita.

If the output variable is waste then *Input-versus-output indicators* are most appropriate for waste streams with a relatively rapid throughput. Of the 4 streams food is the most appropriate for such indicators and C&D waste the least appropriate. Inputs to construction projects are first likely to become waste after several decades whereas food inputs become waste often within the same month. However, other types of input-versus-output indicators may be appropriate for C&D waste such as material inputs per unit output of usable floor space. It should be noted, however, that the data availability for inputs is often restricted to economic rather than physical data i.e. inputs measured in EUR rather than tonnes. There are some exceptions to this, for example Material Flow Accounts and other physical data. These are described later under the Core Elements section.

Care must be taken with *Input Indicators* and *Input-versus-output indicators* which have an input variable measured in EUR since this would not necessarily pick up on waste prevention measures. This is particularly the case for products for which there is a lack of correlation between weight and price. For example, reducing the size and thereby weight of electronic goods serving a specific function may have a positive waste prevention effect. However, the price of the electronics would be unlikely to show a corresponding fall in price. An Input indicator based on economic value of purchases of electronic goods would therefore not pick up on this waste prevention effect.

All of *the first four indicator types* that consider quantities of waste or material flows suffer from a further important weakness. This is that all types of waste materials, either as inputs or outputs, are treated with equal importance, regardless of the environmental impacts resulting from their treatment. This is most problematic for the WEEE and C&D waste streams since these comprise a wide range of different material types. In these cases even if the material and waste intensity in tonnes are being reduced according to reported data, this can still result in increasing pressures and impacts on the environment. This can occur if the declining material or waste intensity does not reflect a real decline in consumption, but a shift towards using a lighter material, which has a higher environmental burden, for example measured as CO₂ emission, per kg material used. Food and textile wastes are less diverse both in material type. However, even here different types of avoided wastes have very different environmental impacts when considered under the life cycle perspective as we have chosen to do here. For example one kg of avoided beef waste (and thus beef production) gives much greater environmental benefits than one kg of avoided bread.

Impact type indicators would avoid this weakness. However, as noted earlier such indicators are currently not widely available. The Eco-indicator 99 (VROM, 2000) is one of the most widely used impact assessment methods in LCA and gives an indication of impact for a range of different material types but results are not currently available at a comprehensive level sufficient for waste prevention indicators.

Response type indicators could be valid for all streams. However, care needs to be taken over the relevance of a given response indicator. In particular there should be a strong connection between the variable being measured and actual achieved waste prevention. In general the connection is likely to be weaker for soft measures like awareness raising than for hard measures such as economic instruments.

5.6 Are there Indicator Types that would be Valid for all Streams?

As described above, not all indicator types are valid to the same extent for all 4 waste streams. Indicators based on material inputs versus waste outputs are not valid for C&D waste for example due to the long time lag between construction of a building and its end of life, nor hazardous content indicators valid for the Food stream.

Simple output indicators are likely to be valid as proxy for waste prevention measures for all waste streams along with decoupling indicators based on an output and economic variable. They are also among the indicator types which are easiest to produce. Some input based indicators are also likely to be valid for all waste streams. Such general types of useful indicators would include:

- Developments in waste generation (thousand tonnes).
- Waste generation (kg) per capita.
- Waste generated (kg) in economy per unit GDP.
- Material inputs to the relevant industry.
- Material inputs to the relevant industry per unit economic output.

However, for each indicator stream there are likely to be more nuanced indicators which are more useful, and more closely tailored to policy objectives. For example for food waste it is perhaps the edible and hence avoidable element of the waste which is of most concern and not simply total food waste generation.

5.7 Best-needed and Best-available Indicators

While all elements of the RACER criteria are important, the Nordic Council of Ministers wishes to identify waste prevention indicators using, as far as possible, existing data sources. As such, the *Easy* criterion is particularly relevant to the evaluation in this project.

In practice, the most commonly used waste prevention indicators can be considered as meeting the *Easy* criteria but may not be the most *Relevant* indicators imaginable to waste prevention. However, they can be considered to be the *best available indicators* given data constraints. The very limited pool of operational indicators available in each waste stream can be evaluated against the RACER criteria to identify which of them are best available indicators.

Best needed indicators should also be identified for each waste stream for a longer term perspective. These are indicators based on a more academic approach that are more *Relevant* to answer policy questions on waste prevention, but perhaps do not yet meet the other four criteria: *Accepted*, *Credible* and *Robust*.

The most preferable best needed indicators will be those based on existing datasets but combining them in new ways. Such indicators

would be input-versus-output indicators, input indicators and decoupling indicators.

The starting point will be indicators already proposed in the literature but which are not currently available. Gaps in data availability should be identified and the effort required to fill these gaps assessed. However, some additional indicators could also be proposed based on novel combinations of existing core elements. Such core element datasets might include the following:

- Waste statistics (EWC codes, Eurostat Waste Data Centre).
- Household consumption data broken down by COICOP classification (Eurostat).
- Material Flow Accounts (MFA) and its elements (i.e Domestic Extraction) as reported to Eurostat.
- Physical food consumption data from FAOstat.
- Data on construction of new buildings, (i.e. Eurostat data on average floor size of new dwellings, etc.).
- Data on amount of electronic and electrical goods put on market (Eurostat).
- Economic output from industries given in national accounts (Eurostat).
- GDP (Eurostat).

Other relevant datasets will be identified for each waste stream in the following chapters, followed by an assessment of how they might be combined to form useful and operational indicators.

The intention will be to *combine the characteristics of best needed and best available data indicators as far as possible*. The aim will be to select those core elements that can be supported by data that is already subject to European and national Nordic reporting in order to minimize initial resource demand for creating new waste prevention indicators that also better fit the relevancy criteria of the RACER set.

Such an assessment has also been carried out for the European Commission (2009) by CRI but for a different set of waste streams.

It should be noted that this core element approach is not of much relevance to Response-type indicators. These are likely to be based on single datasets measuring one variable rather than combinations of physical, social and economic data.

5.8 Criteria for Proposed Targets

The Nordic Council of Ministers have stressed that proposed targets should be specific, measurable and monitorable, precise and time bound. According to NCM they can be qualitative as well as quantitative. A qualitative target might be for example that waste prevention is integrated into all sectoral policy. It seems hard to imagine qualitative targets which are also specific and precise. It is therefore assumed that qualitative targets would not be bound by these requirements.

5.9 Interrelationship Between Indicators and Targets

As identified by the literature survey, none of the waste prevention targets that have been adopted by countries or at EU level have been specifically associated with an indicator. It would appear that measurability has not been a key consideration when adopting these targets. This is not atypical of political targets and objectives which are based on ambitions in response to identified issues. It is then the indicator specialist's job to develop indicators which can measure progress against these targets as far as possible.

However, with respect to the four waste streams, we have the situation in the Nordic countries where neither waste prevention targets nor waste prevention indicators exist to any real extent.

Two polarised approaches could therefore be utilised:

- Propose some qualitative and quantitative targets which are most relevant to waste prevention covering the most important types of waste prevention measures and consequences. Subsequently propose best-needed and best-available indicators which can monitor these targets as far as possible.
- Propose some best-available and best-needed indicators using the RACER assessment criteria focusing on those indicators which can most easily be made operational. Then propose targets using the same formulation as the indicators.

The first process is perhaps that that most closely fits the political cycle. However, this would not fit the need for measurable and monitorable targets as defined by NCM for this project. On the other hand in the second approach the ambition of targets will be restricted by the availability of indicators. It would be a mistake to adopt medium or long term

targets which are lacking in ambition and relevance, simply as a result of the short term availability of indicators.

A middle road is suggested where two parallel processes are developed: one for indicator proposals and one for proposals for targets. Target selection can be based on what is considered most relevant with respect to the waste stream and interpretation of the waste prevention definition, taking inspiration from targets found in the literature. These can then be compared and iterative adjustments made to each to produce a set of relevant targets which could be measured by a set of indicators which could, without the use of excessive resources, be made operational in the medium term.

Proposed targets will not include actual quantities but rather formulations leaving the quantity up to individual countries to decide depending on the current state of play in their country. For example a target would be proposed as:

- Reduce the share of edible food in total food waste from households by x% by year y relative to base year y_0 .

5.10 Procedure for Indicator and Target Selection for Each Stream

The following procedure has been used for developing proposals for targets and indicators for each of the four waste streams.

1. Assessment of generalised types of indicators that might be useful for this waste stream	This assessment made use of the indicator typology and discussions in Section 5.5 but with specific reference to the waste stream. The general types under Section 5.6 were also considered.
2. Identification of core data elements which could be useful for indicators for this waste stream	Output waste flow elements (W1, W2...) Specific Input elements in economic/physical units (i.e. material flow data, product production/consumption data etc. (I1, I2...)) More general socio-economic variables (i.e. population, number of households, consumption expenditure, GDP, sectoral output, etc) (SE1, SE2,...)
3. Suggested sources of data	Data availability for Core elements was investigated including databases (i.e. list of EWC codes, etc). In addition to international datasets consider data available in Nordic Council database and at national level in Nordic countries where relevant. The results are given in Appendix 2.
4. List of potential indicators based on core elements	This made use of generalised ideas developed during stage 2 of the process. A list of potential indicators was produced that addressed these ideas and that that could be created based on the identified core elements. (W1/SE1; W2/I1, etc)
5. RACER assessment of these indicators	Brief RACER assessment of the indicators identified in the literature survey and the indicators identified under stage 5
6. Draft proposed indicators	Proposal for best available and best needed indicators based on RACER results. Best needed and best available indicators are defined in Section 5.7 Estimation of data efforts needed to make best needed operational.
7. Scoping on targets (can occur in parallel with Stages 2–8)	Examination of the type of targets that might be relevant to this stream taking into account 1) existing targets proposed for this indicator from the literature review 2) considerations of waste prevention measures relevant to this stream (see section 5.2 of this document, 3) which part of the production/consumption chain is in focus (Figure 5.4)
8. First stage target setting	Examination of proposed indicators under stage 8 with reference to target setting. Could targets set for these be specific, measurable and monitorable, precise and time bound? Would they look like any of the targets identified in the literature and the other potential targets identified under Stage 8 above?
9. Draft proposals for targets and indicators	Adjustments of targets if necessary to make them understandable and relatively simple. Identification of best-needed and best-available indicators for each of the selected targets.
10. Consultation with Reference Group and Final proposal for targets and indicators	The Reference Group was consulted in the first draft. Their suggestions were incorporated as far as possible in the final proposals for targets and indicators.

6. Proposals for Food Waste Prevention Indicators and Targets

6.1 Indicator Types Useful for Food Waste Prevention

Due to the nature of food waste (i.e. lack of hazardous content) indicators measuring food waste prevention should ideally focus on part a) of the waste prevention definition (see Box 2 at the beginning of chapter 4) i.e. reducing amounts of food waste arising from the whole food chain. Part b) on measures taken before a product has become waste, that reduce the adverse impacts of the eventually generated waste on the environment and health also has some importance. Here though the focus should be on initiatives which reduce upstream environmental impacts caused by food waste rather than downstream impacts. This can be done for example through initiatives which reduce the share of products in food waste which cause a particularly high environmental impact during their production phase. Meat and dairy products are a prime example.

It is important to maintain the distinction between total food waste and avoidable food waste, as there is a fraction in food waste that wouldn't be possible to prevent (e.g. fruit peelings etc.). The more edible food waste that is avoided in an economy, the less food production that is required to feed the population, with an accompanying reduction in environmental impacts caused during food production. Downstream impacts resulting, for example, from landfill of food waste will also be reduced. Reducing the amount of avoidable food waste would be the most appropriate indication of successful waste prevention measures or programmes.

The distinction between avoidable and unavoidable food waste is not immediately straightforward. For the purposes of this report we will define it to include:

- Leftover prepared food from meals.
- Partially consumed food products (other than meals) which otherwise could have been eaten.
- Whole food items that remain as they were when purchased—here the whole weight is included even if this includes skin and bones etc. which would have been removed during preparation.

In other words the only food waste which is considered to have been unavoidable are peelings, bones, fish heads, feathers etc. *which have been separated from food products during preparation* and which would not normally be eaten. Thus all food waste from retailers can be considered to be avoidable.

A typology of indicators has been developed for this project. This is given in Box 1 at the beginning of this report.

Output indicators would typically comprise indicators on generation of food waste from various entities i.e. households, retailers, food manufacturing industry etc. Reliable data for output indicators is difficult to collect and is not currently available on a regular basis. This seems to be the major problem in constructing food waste prevention indicators of any type. However, as the need for more comprehensive data on food waste generation increases it is expected that governments will invest in collection of more reliable data in a longer term perspective.

One weakness with output indicators is that trends can be influenced by factors other than waste prevention measures. Trends in food waste generation by households will be influenced by changes in diets and household income. Trends in food waste generation by the food production industry in Nordic countries would be affected by increased import of finished food products or economic downturns. It should be noted, however, that output-based indicators on food waste are perhaps less susceptible to macro-economic trends than output based indicators on other waste streams. Historical data on household expenditure on food shows that this has remained relatively stable over the past two decades of economic growth, while expenditure on other consumption areas has increased significantly.

The general weakness, however small, can be avoided through the use of input vs. output indicators. Such indicators can be more representative of real waste prevention according to the definition. Such indicators relate quantities of generated food waste to flows of inputs such as final consumption or the total production of food measured either in physical or economic units. Thus they better reflect the effectiveness in the use of food within the production and consumption system and are

less affected by macro-level changes such as economic growth or recession. Input versus output indicators are suitable for measuring food waste prevention due to the relatively rapid throughput of food materials which can span from several days to few years. It is more appropriate to use physical rather than economic variables. However, the latter are often more easily obtained. Where economic data is used as a denominator for an indicator, the resulting indicator can be described as a decoupling indicator. An example is the generation of food waste per EUR of household expenditure on food.

Where output data (i.e. on food waste generation) is not available, indicators using input data alone (input type indicators) can potentially be used as proxies for waste prevention. This would for example be quantities of food purchased by households, measured by economic value or preferably, by weight. Trends in input-type indicators can provide some reasonable reflection of the success of food waste prevention measures. However, as for output indicators, trends in input indicators can be strongly influenced by factors not related to waste prevention measures. This includes changes in types of food being produced or consumed, demographic changes (i.e. changes in the age profile of the population) or simply increases or decreases in nutrient intake by people.

Impact indicators are important to the second part of the waste prevention definition. Impact indicators take account of the fact that prevention of different types of food waste can give significantly different environmental benefits. This is because the production of 1 kg of meat or dairy products requires far more energy, material, fertiliser, land, water inputs and leads to more emissions to air, soil and water than the production of 1 kg of vegetables. Impact type indicators could include, for example, GHG emissions gains from prevented food waste. However, such indicators require information on the detailed composition of food waste which would need considerable additional survey work.

Finally, response indicators are useful and reasonably easy to develop. Extra care needs to be paid to the nature of the indicator and the objective outcomes that it is expected to measure. Indicators measuring the spread of soft policy measures such as “awareness raising” can be a good indicator of political will to reduce food waste, but may not provide a useful measure of reductions in waste generation. This would only be the case where the response measure is effective.

6.2 Useful Core Data Elements

In order to construct realistic, reliable and applicable indicators an initial screening of the core data elements required is essential. Taking into account all the above, the most suitable core data elements for the food waste streams are as follows:

- Food waste generation (tonnes, kg/cap).
- Avoidable food waste generation (tonnes, kg/cap).
- Final consumption expenditure of households (total, food related categories) (value).
- Economic output of food related industries and services (value).
- Production of food (tonnes).
- Consumption of food (kg/cap).
- Food retail sales (value).
- Material flow accounts (tonnes).
- Number of households (number).
- Number of different households types (one-family/more family houses).
- Number of enterprises (industry, retail, services) (number).
- Population (number).
- GHG emissions of food products (tonnes CO₂-eq).
- Carbon footprint of food products.
- Resources Total Material Requirement (TMR).

There might be other national data i.e. on bio waste from different surveys. However, data on bio-waste include garden waste in addition to food wastes. Therefore such data cannot be used as a proxy for food waste.

The availability of the core elements for constructing food waste prevention indicators in the Nordic databases or elsewhere (e.g. Eurostat) has been investigated. A list of available datasets is provided in Appendix 2.

6.3 Potential Indicators Based on Core Elements

The indicators described in Section 6.1 which can be constructed from combinations of core data element described under section 6.2 are presented in Table 6.1.

Table 6.1: Potential food waste prevention indicators by combining the core data elements (tonnes)

Core data elements → ↓	Total Food Waste generation ¹	Food Waste generation in house-holds ¹	Food Waste generation in industry/ retail/ hospitality ¹	Total Avoidable Food Waste generation ¹	Avoidable Food Waste generation in households ¹	Avoidable Food Waste generation in industry/ retail/ hospitality ¹
Population (number) ³	Food waste generation per capita			Avoidable food waste generation per capita		
Number of households (number) ³		Food waste generation per household			Avoidable food waste generation per household	
Number of enterprises (industry, retail, hospitality) (number) ³			Food waste generation per enterprise (relevant sector)			Avoidable food waste generation per enterprise (relevant sector)
Value added of food related industries and services (value) ³	Food waste generation per unit of food production			Avoidable food waste generation per unit of food production		
Final consumption expenditure of households (total, food related categories) (value) ³		Food waste generation per unit of household consumption expenditure			Avoidable food waste generation per unit of household consumption expenditure	
Consumption of food (kg/cap) ²	Food waste generation against food consumption			Avoidable food waste generation against food consumption		
GHG emissions (product/ food industry) ²		{GHG emissions} x {Food waste generation}		{GHG emissions} x {Avoidable food waste generation}		
Total Material Requirement (TMR) (food)		{TMR} x {Food waste generation}		{TMR} x {Avoidable food waste generation}		

¹ Core elements with low availability of data.

² Moderate availability of data.

³ Good data availability.

Note: The data availability of each constructed indicator is influenced by the core element with the lowest data availability. All indicators proposed that include “Food waste generation” and “Avoidable food waste generation” as core elements suffer from low data availability, under current conditions.

The columns and rows present various core data elements. The columns include waste output variables while the rows comprise some socio-economic variables, input variables and some environmental pressure variables. These can be combined as shown in the cells within the table to produce various output, input vs output and decoupling indicators. Some of the core elements can also be used as the basis for input or output indicators without the need for combination with other core elements.

Only indicators felt of particular relevance to waste prevention have been identified in the table.

One potentially useful input indicator can be developed directly from one of the core elements on the left hand edge of the table without the need for combining with other core elements:

- Consumption of food (kg/capita/year).

Output indicators constructed from core elements in Table 4 are as follows:

- Food waste generation in kg/capita/year.
- Food waste generation in households in kg/household/year.
- Food waste generation in enterprises (retail sale)
kg/enterprise/year.
- Food waste generation per enterprise (hospitality)
kg/enterprise/year.
- Food waste generation per enterprise (food processing industry)
kg/enterprise/year.

All these indicators would measure generated waste quantities from entities i.e. households, retailers, industries etc. Trends in these indicators can reflect the implementation of waste prevention measures for each of these entities and allow future measures to be targeted on the sector where it is most needed. For this reason it is very important to use a specialised dataset for each constructed indicator.

Data on food waste are still not well developed, so there is a specific interest into developing datasets more closely to what needs to be measured. Data on population, number of households (also by type of household) and enterprises in different economic sectors (NACE rev.2) are already available in most of the Nordic databases and also in Eurostat.

For end users of food (i.e. households, hospitality) moving one step further where the nature of the food waste can be distinguished, it would be useful to develop indicators which consider only the avoidable fraction of food waste i.e.:

- Avoidable food waste generation in kg/capita/year.
- Avoidable food waste generation in households in kg/household/year.
- Avoidable food waste generation per enterprise (retail/sale) kg/enterprise/year.
- Avoidable food waste generation per enterprise (hospitality) kg/enterprise/year.

For input vs. output indicators care should be taken on the units of the input and output datasets so as to be as more as possible compatible with each other. In this way, more accurate indications about the state of the prevention of food waste can be drawn and more reliable the indicator would be. The indicators that follow are both expressed in a % of the food wasted against the production of foodstuffs or the consumption per capita.

- Amount of food waste generated per unit (physical) production of foodstuffs (excluding intermediates, e.g. fodder, etc.).
- Amount of food waste generated per unit (physical) consumption of food per capita.

Data on production of foodstuffs are maintained by Eurostat while data on consumption per capita can be found in Nordic databases as well as Eurostat. Care must be taken here to match the perspective of the input variable to the output. The food waste generated under the first indicator should be waste generated along the full production chain, while under the second indicator it would be most appropriate to include waste generated at the point of consumption.

Decoupling indicators which relate food waste to economic indicators can also be generated. Most relevant may be:

- Food waste generation in households per unit of household expenditure on food (kg/EUR).

Impact indicators can also be developed, which can estimate the impacts arising from food waste. These will estimate the environmental impacts/pressures resulting from the production of the food that is then wasted. In other words, indicators estimating avoidable impacts in the upstream production processes. Such indicators would include:

- GHG emissions (upstream) associated with avoidable food waste (thousand tonnes).

- TMR (upstream) associated with avoidable food waste (th. tonnes).
- Share of animal-derived food waste in the total food waste generation.

The latter is a proxy indicator for impact. The greater the share of animal-derived food waste in total avoidable food waste, the greater the impacts that could have been avoided further up the production chain. This is because the production of 1 kg of meat or dairy products requires far more energy, material, fertiliser, land, water and leads to more emissions to air, soil and water than 1 kg of vegetable production.

An impact-type indicator which can measure direct economic impacts of avoidable food waste could be:

- Economic value of avoidable household food waste (EUR/capita/year).

Table 4 does not allow construction of any response based indicators. These use other types of core elements than those included along the rows and columns of the table: typically non-physical elements.

Response indicators although they don't measure quantitatively food waste or inputs and outputs of the food related production chain, can potentially offer indications of the scale of food waste prevention measures undertaken and the subsequent impacts those may have in behaviour, lifestyles, in the economy and ultimately in the food waste generation itself. There is a multitude of indicators to choose from but here only the most relevant and possible would be proposed.

- Number of food waste prevention initiatives (national/regional/local).
- Number of people/homes/ communities actively involved in food waste prevention actions.
- Number of personnel involved in food industry/ retail sector/hospitality sector who have completed prevention courses.
- Government (local authority, etc.) budget used on food waste prevention activities.
- Number of enterprises signed (actively involved in) food waste prevention voluntary agreements.

A further response type indicator that would be aimed more at reducing the upstream environmental impacts associated with food waste could be economic measures aimed at increasing price differentials of more environmentally impact-intensive (impact per kg) foods i.e. meat and dairy products. This would discourage households from wasting these particular foods. Such a response indicator could be:

- % difference in VAT between meat and dairy products and general food products.

6.4 RACER Assessment of Indicators

6.4.1 *RACER assessment of existing indicators*

The literature review on food waste reported on in Section 4.2 of this report identified four indicators addressing food waste prevention, proposed in a number of reports and policy papers in different time instances from the European Commission. These are:

- Share of edible food waste in households, retailers and catering (e.g. measured as %).
- Amount of food waste generated per household (e.g. kg/household per year).
- Resource loss on bioproducts (ratio between biological waste generated (by weight) and biological resources used (by weight), expressed as %).
- Amount of food waste generated against the consumption of food in tonnes (e.g. measured as %).

Of those four indicators, the first two indicators are output indicators and the other two are of input vs. output typology. None of them has been used so far for measuring food waste prevention but rather exist in a development stage, pending the provision of more reliable and robust data. In the following tables (Tables 6.2–6.5) a brief RACER assessment is conducted for each of the identified indicators.

Table 6.2. RACER assessment of the indicator “Share of edible food waste in households, retailers and catering (measured in %)”

RACER	Score	Comments
Relevant	3	This is a very relevant indicator about food waste prevention, as it refers to the avoidable part of food waste (avoidable and potentially avoidable), and spans from households to retailers and catering. Nevertheless, the share of avoidable food waste compared to total food waste need to be treated carefully. The share can change not due to waste prevention but due to different behaviour. A restaurant or a household which change from prepared food to “home-made” food will decrease the share of avoidable food waste due to more unavoidable waste. No avoidable food waste prevention can be measured in this way.
Accepted	4	This indicator is considered accepted, as it was presented in the European Commission’s Roadmap to a Resource Efficient Europe and consequently it has been subject to a multitude of consultations.
Credible	2	The credibility of this indicator is mostly dependant on the data reliability. The methodology is quite transparent and can be confidently used by relevant stakeholders, provided the data exist and they are credible. It is also difficult to communicate the share of something.
Easy	1	Collecting data on avoidable food waste is considered extremely costly and therefore very difficult to achieve. It needs high mobilisation of capital and labour resources and a robust methodology on quantifying avoidable food amounts according to accepted definitions and sampling methods which concentrate the highest consensus. Data is required from three different sectors.
Robust	3	The scope and representativeness of this indicator fits very well to the objectives of food waste prevention but the score in this category is low because data is not available (or very low quality data).
Final Score	2.4	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 6.3. RACER assessment of the indicator “Amount of food waste generated per household (kg/household per year)”

RACER	Score	Comments
Relevant	3	This is a relevant indicator though it refers to total amount of food waste and does not distinguish between avoidable and unavoidable food waste. It is limited to households but these have been found to be the greatest source of food waste in the economy in various studies. One weakness in this indicator is that it will be influenced by changes in household composition i.e. reduced family sizes etc..
Accepted	4	It has not reached high level of acceptance since it is only proposed by a European Commission report and not promoted further or used in any food waste prevention initiatives so far. It is considered that this indicator would be highly acceptable by all relevant stakeholders because it can communicate directly the effects of food waste prevention. Households are considered the most appropriate unit for quantifying food waste prevention. Being large food waste emitters, measuring food waste generation from households would be the most beneficial. Additional information about households (e.g. type of household, size, etc.) could potentially give an added to the indicator.
Credible	3	The credibility of this indicator is mostly dependant on data reliability. The methodology is quite transparent and can be confidently used by relevant stakeholders, provided the data exist and are credible.
Easy	3	It is currently costly to collect accurate data on food waste arisings and therefore it is considered difficult to operationalise this indicator. The limited scale of data collection only to households makes it relatively simple compared to food waste data collected throughout the production and consumption chain.
Robust	2	The scope and representativeness of this indicator fits well to the objectives of food waste prevention but the score in this category is low because data on food waste are mostly estimated and are of low quality. If data quality improves, robustness of this indicator will also improve
Final Score	3	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 6.4. RACER assessment of the indicator “Resource loss on bioproducts” (ratio between biological waste generated (by weight) and biological resources used (by weight), expressed as %)

RACER	Score	Comments
Relevant	2	This indicator is relevant to measure food waste prevention but it can also give some other associated information, describing not only shifts in waste prevention, but also shifts in consumer behaviour (e.g. shifting away from meat consumption).
Accepted	3	The combination of MFA statistics and waste statistics, as proposed in this indicator, is rather new, although both composing statistics are broadly known and applied. Therefore it is expected that such an indicator would enjoy some degree of acceptability.
Credible	3	The method used for the calculation of this indicator is straightforward and once the data needed is available it can be used with confidence from relevant stakeholders. However, the indicator might be difficult to communicate.
Easy	2	Data on both datasets needed for the construction of this indicator exist in most of the Nordic countries (and also in EU-level). The main problem about data availability concerns the long time period required for the processing and production of reliable data, which usually takes 2-3 years after the reference reporting year. Therefore this indicator can be considered only with longer time intervals and it is unsure if it can serve the purpose of waste prevention in the short term.
Robust	2	Robustness may be an issue when defining which material flows are “food related”, and because of the poor quality and limited time series of the input data. The indicator is rather immature, as the basic data will need to gain consistency and reliability.
Final Score	2.3	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

See full description in Appendix 1.

Table 6.5. RACER assessment of the indicator “Amount of food waste generated (by weight) against the consumption of food (by weight) (measured as %)”

RACER	Score	Comments
Relevant	3	This is also a relevant indicator The total amounts of food waste generated are measured against the consumption of food per capita, which in theory translates well the progress of waste prevention in food.
Accepted	3	It has not reached high level of acceptance since it is only proposed by a European Commission’s report and not promoted further or used in any food waste prevention initiatives so far. It is considered that this indicator would be highly acceptable by all relevant stakeholders.
Credible	3	The credibility of this indicator is mostly dependant on the data reliability. The methodology is quite transparent and can be confidently used by relevant stakeholders, provided the data exist and they are credible
Easy	2	At the moment it is costly to collect accurate data on food waste arisings and therefore it is considered difficult to operationalise this indicator. Data on food consumption have also been debated concerning credibility but lately it seems that they have been improving.
Robust	2	The scope and representativeness of this indicator fits good to the objectives of food waste prevention but the score in this category is low because data on food waste are mostly estimated and of low quality so far. If data quality improves, robustness of this indicator will also improve
Final Score	2.5	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

6.4.2 RACER assessment of the list of potential indicators

In section 6.3, after a thorough consideration of available core data elements, a pool of potential indicators for development was selected. In order to evaluate the possibility of promoting those indicators further as proposals for working indicators for the Nordic countries a RACER assessment has been performed for each one individually in the following tables (Tables 6.6–6.11).

The indicators which were assessed are as follows:

- Consumption of food (kg/capita/year).
- Total food waste generation (kg/capita/year).
- Food waste generation per enterprise (specific sector: retail sales, hospitality, food processing) kg/enterprise/year.
- Total avoidable food waste generation (kg/capita/year).
- Avoidable food waste generated per household (kg/ household/year).
- Avoidable food waste generated per enterprise (specific sector: retail sales, hospitality, food processing) kg/enterprise/year.

- Food waste generated (kg) along the production chain against the total production of foodstuffs (kg) (excluding intermediates, e.g. fodder, etc.) (%).
- Food waste generated (kg) by end users per unit (kg) consumption of food per capita.
- Food waste generated in households per unit of household expenditure on food (kg/EUR).
- GHG emissions (upstream) associated with avoidable food waste (thousand tonnes).
- Share of animal-derived food waste in the total food waste generation.
- Economic value of avoidable household food waste (EUR/capita/year).

Note that although the indicator “Food waste generation per household” derives directly from the core elements investigation, it will not be assessed in this stage because the same indicator was found in the literature review and has been assessed above.

No RACER assessments have been performed for response indicators as they constitute a group of indicators which are very relevant to waste prevention activities and awareness in general but their connection with the actual observable waste prevention is indirect and only can be assumed and not proven. Response indicators can ideally be used additionally with other indicators as a package to measure waste prevention effectiveness.

Table 6.6. RACER assessment of the indicator “Consumption of food (kg/capita/year)”

RACER	Score	Comments
Relevant	2	This indicator is based on food delivered for final consumption by households, restaurants etc. The indicator has an indirect relevance to food waste prevention since the more food waste that is avoided the lower should be the amount of food that is purchased for consumption to provide for the same intake of nutrients. It should be noted that the indicator is only relevant to reducing food waste at the end point of consumption i.e. in households, restaurants canteens etc. and not to food waste along the production chain since this is already removed from the data during the calculations of food consumption. However, the indicator can be affected by factors which are unrelated to waste prevention. These can include changes in food consumption behaviour—i.e. an increasing in total intake of food per capita by weight due to changes in the types of food consumed or increasing/reducing levels of overeating.
Accepted	2	This indicator already exists in a somewhat different form in Eurostat. However, the indicator has been criticised in the past due to assumptions made in the calculations. Its acceptability as a food waste indicator might also be reduced as it has not been used in this context before.
Credible	3	The credibility of this indicator is mostly dependent on the data reliability. The methodology is quite transparent and can be confidently used by relevant stakeholders, provided the data exist and they are credible. It is a reasonably simple indicator to communicate although the connection between food consumption and food waste needs to be explained.
Easy	4	The data for producing this indicator already exists and is maintained by Eurostat and at a different level of aggregation in the Nordic indicator database. However there are some gaps in the dataset (especially for Denmark and Iceland).
Robust	2	Food consumption is normally estimated as a residual: production - export + imports + stock changes - use for other purposes = consumption. It also includes food bought by tourists and brought abroad This means that the consumption figure is associated with quite some uncertainty.
Final Score	2.7	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 6.7. RACER assessment of the indicator “Total food waste generation (kg/capita/year)”

RACER	Score	Comments
Relevant	4	This is a very relevant indicator as it refers to food waste amounts and therefore can indicate progress (or not) in the prevention of food wastage. It describes food waste as a whole including unavoidable waste so the relevance is scored by 4 and not 5.
Accepted	4	It is considered that this indicator would be highly acceptable by all relevant stakeholders because it can communicate directly the effects of food waste prevention.
Credible	3	The credibility of this indicator is mostly dependent on the data reliability. The methodology is quite transparent and can be confidently used by relevant stakeholders, provided the data exist and they are credible.
Easy	2	At the moment it is costly to collect accurate data on food waste arisings and therefore it is considered very difficult to operationalise this indicator. Data on population are widely available.
Robust	2	The scope and representativeness of this indicator fits good to the objectives of food waste prevention but the score in this category is low because data on food waste are mostly estimated and of low quality so far. If data quality improves, robustness of this indicator will also improve
Final Score	3	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 6.8. RACER assessment of the indicator “Food waste generation per enterprise (specific sector: retail sale, hospitality, food processing) (kg/enterprise/year)”

RACER	Score	Comments
Relevant	3	This is a very relevant indicator as it refers to food waste amounts and therefore can indicate progress (or not) in the prevention of food wastage. It describes food waste as a whole including unavoidable waste so the relevance is scored by 4 and not 5.
Accepted	4	It is considered that this indicator would be highly acceptable by all relevant stakeholders because it can communicate directly the effects of food waste prevention. It focuses mainly on the distribution of food and the food waste generated in all those intermediate steps of the production chain before reaching the final consumer.
Credible	3	The credibility of this indicator is mostly dependent on the data reliability. The methodology is quite transparent and can be confidently used by relevant stakeholders, provided the data exist and they are credible.
Easy	3	At the moment it is costly to collect accurate data on food waste arisings and therefore it is considered very difficult to operationalise this indicator. Data on the number of enterprises in relevant economic sectors (NACE Rev.2) are widely available.
Robust	2	The representativeness of this indicator fits well to the objectives of food waste prevention but the score in this category is low because data on food waste are mostly estimated and of low quality so far. If data quality improves, robustness of this indicator will also improve. Furthermore the scope is quite limited only to the distribution on food.
Final Score	3	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

All indicators referring to avoidable food waste and are similar to those assessed for general food waste above (i.e. Tables 6.3, 6.6 & 6.8) and score exactly the same totals in the RACER assessment. This is due to the fact that higher scores were appointed to the Relevance part (+1) and lower to the Easy part (-1) to all corresponding indicators. The RACER tables are not provided here.

Table 6.9. RACER assessment of the indicator “Food waste generated (kg) along the production chain per unit production of foodstuffs (kg) (excluding intermediates, e.g. fodder, etc.) (%)”

RACER	Score	Comments
Relevant	3	This indicator measures the efficiency of the food industry. The lower the rate, the more efficient the food processing industry. Food waste in the food industry is not as significant as in households and is only relevant to that branch. It should be noted that as the demand for more processed food increases i.e. ready-made meals food waste will in general be shifted from households to the food production industry.
Accepted	4	It is considered that this indicator would be acceptable by relevant stakeholders because it can describe (simply) the efficiency of food use.
Credible	2	There could be several issues raised as there is a certain uncertainty on matching corresponding datasets for the construction of this indicator. A generally accepted methodology should be laid down first and followed by the developers of this indicator in order to increase confidence in its use.
Easy	2	At the moment it is costly to collect accurate data on food waste arisings and therefore it is considered very difficult to operationalise this indicator. Data on the production of food products (in kg) exist in Eurostat.
Robust	2	This indicator has a good scope and its representativeness depends on the better inclusion of data during the methodology development. Data on food waste generation in the food processing industry remain uncertain with a low level of confidence.
Final Score	2.6	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 6.10. RACER assessment of the indicator “Amount of food waste generated (kg) by end users per unit (kg) of food consumption (%)”

RACER	Score	Comments
Relevant	3	This indicator is very relevant because it describes the rate in which food consumed per capita ends up as food waste. The lower the rate, the more efficient the use of food. This indicator refers to total food waste by households (and potentially also in the hospitality industry) and no distinction is made to avoidable/unavoidable food waste.
Accepted	4	It is considered that this indicator would be highly acceptable by relevant stakeholders because it can describe (simply) the efficiency of food use.
Credible	2	There are still issues to be resolved on the credibility of food consumption data. Otherwise, provided data become available, this indicator can be use with confidence by relevant stakeholders.
Easy	2	At the moment it is costly to collect accurate data on food waste arisings and therefore it is considered very difficult to operationalise this indicator. Data on food consumption is becoming increasingly available in the Nordic databases as well as Eurostat.
Robust	2	The scope of this indicator is good and can describe very accurately the food losses of human consumption of food. Once food waste data and food consumption data become more reliable, this indicator would be much more robust.
Final Score	2.6	The final score is weighted double for the <i>Relevant</i> and <i>Easy</i> criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 6.11. RACER assessment of the indicator “Food waste generated in households per unit of household expenditure on food (kg/EUR)”

RACER	Score	Comments
Relevant	3	This indicator is highly relevant to food waste prevention, as it measures the amount of food ending up as waste against the consumption of food in value. It communicates the decoupling (or not) of food waste from the level of consumption of food. It should be noted that the waste per unit of consumption will be affected by the degree of processing. Expenses will be higher and wastes less if consumers demand processed foods (ready-made meals etc.) giving a reducing indicator trend. In this case the generation of food waste will be shifted to the food processing industry.
Accepted	4	It is considered that this indicator would be highly acceptable by all relevant stakeholders because it can communicate directly the decoupling effect of household food expenditure against the food waste generation.
Credible	3	Credibility on decoupling indicators is increasing as they can communicate effectively physical units against their economic backdrop. The methodology is well documented and it can be used with confidence by experts and policymakers alike.
Easy	2	At the moment it is costly to collect accurate data on food waste arisings and therefore it is considered very difficult to operationalise this indicator. Data on household expenditure on food are available in all Nordic databases as well as in Eurostat.
Robust	2	This indicator has a good scope and representativeness. Data on household expenditure is good but care need to be taken when combining physical and monetary units to a single indicator. Data on food waste generation are still in a low level of confidence.
Final Score	2.7	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 6.12. RACER assessment of the indicator “GHG emissions (upstream) associated with avoidable food waste (thousand tonnes)”

RACER	Score	Comments
Relevant	3	The indicator is relevant specifically in measuring the environmental impact of food waste generation and therefore it is linked to part b of the definition of waste prevention as it is given in the WFD. However, it considers only one type of environmental pressure.
Accepted	3	This indicator could be potentially well accepted since GHG emissions are particularly high on the political agenda and well understood and accepted as an important environmental impact.
Credible	3	This indicator requires acceptance of methodologies on measuring GHG emissions related to the production of various food types. However, many LCAs exist in this area and credibility of the results for broad product types has increased considerably over past years.
Easy	1	This indicator would require data on the composition of food waste arisings i.e. split by food type. Such data would be very costly to collect on a regular basis from a representative share of households/enterprises etc.
Robust	1	The scope and representativeness of the indicator is good but the data needed for this indicator suffer low levels of robustness and thus it could be easily misinterpreted.
Final Score	2.1	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 6.13. RACER assessment of the indicator “Share of animal-derived food waste in total food waste generation”

RACER	Score	Comments
Relevant	3	This indicator is relevant because it refers to food waste prevention activities, in the sense of measuring food waste with high environmental impacts and the rate which it's reducing or not.
Accepted	3	It could be potentially accepted because of its ability to evaluate the prevention of environmental impacts of food.
Credible	1	The data transparency should be good but the result needs to be indirectly interpreted so the indicator fails to correlate strongly to the objective and it cannot inspire confidence.
Easy	1	Collecting data on the contents of food waste is considered extremely costly and therefore very difficult to achieve. It needs high mobilisation of capital and labour resources.
Robust	1	The scope of the indicator is specific and seeks to translate the share of high production intensity food products to their corresponding environmental impacts. The representativeness is satisfactory but the result can only indirectly describe the objective of the indicator.
Final Score	1.9	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 6.14. RACER assessment of the indicator “Economic value of avoidable household food waste (EUR/capita/year)”

RACER	Score	Comments
Relevant	4	Although it doesn't specifically relate to any parts of the waste definition the indicator is of interest politically since it can be used to raise awareness amongst households of the economic importance of food waste to household budgets and can also be used to measure the socio-economic benefits of food waste prevention.
Accepted	4	This indicator could be potentially well accepted particularly during the current economic recession.
Credible	3	The credibility depends on the quality of necessary food waste generation data and the degree to which it is split by food type.
Easy	1	This indicator would require data on the composition of food waste arisings i.e. split by food type. Such data would be very costly to collect on a regular basis from a representative share of households/enterprises etc. The indicator requires data on prices for different food types at national level.
Robust	1	The scope and representativeness of the indicator is good but the data needed for this indicator suffer low levels of robustness and thus it could be easily misinterpreted.
Final Score	2.6	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Of all these indicators, only that described under Table 6.6—*consumption of food in kg/capita/year*—can be described as an available indicator. Only this indicator can be selected as a *best-available* indicator, while the others could only be selected as *best-needed* indicators.

6.4.3 Summary of RACER assessment results

In Table 6.14 all the RACER assessments conducted above are summarised and the selection of indicators from this first set, taking account of these RACER assessments is carried out under section 6.7 and 6.8. First, consideration must be given to types of targets that might be politically relevant. These are then linked to the assessed indicators to produce a final set of targets and related indicators.

Table 6.15. Summary of RACER assessments for food waste prevention indicators

Indicator	R	A	C	E	R	Final Score
Share of edible food waste in households, retailers and catering (%)	3	4	2	1	3	2.4
Amount of food waste generated per household (kg/capita/year)	3	4	3	3	2	3
Resource loss on bioproducts (%)	2	3	3	2	2	2.3
Amount of food waste generated (by weight) against the consumption of food (by weight) (measured as %)	3	3	3	2	2	2.5
Consumption of food (kg/capita/year)	2	2	3	4	2	2.7
Total food waste generation (kg/capita/year)	4	4	3	2	2	3
Food waste generation per enterprise (specific sector: retail sales, hospitality, food processing) kg/enterprise/year	3	4	3	3	2	3
Total avoidable food waste generation (kg/capita/year)	5	4	3	1	2	3
Avoidable food waste generated per household (kg/ household/year)	4	4	3	2	2	3
Avoidable food waste generation per enterprise (specific sector: retail sales, hospitality, food processing) kg/enterprise/year	4	4	3	2	2	3
Food waste generated (kg) along the production chain against the total production of foodstuffs (kg) (excluding intermediates, e.g. fodder, etc.) (%)	3	4	2	2	2	2.6
Food waste generated (kg) by end users per unit (kg) consumption of food per capita	3	4	2	2	2	2.6
Food waste generated in households per unit of household expenditure on food (kg/EUR)	3	4	3	2	2	2.7
GHG emissions (upstream) associated with avoidable food waste (thousand tonnes)	3	3	3	1	1	2.1
Share of animal-derived food waste in total food waste generation	3	3	1	1	1	1.9
Economic value of avoidable household food waste (EUR/capita/year)	4	4	3	1	1	2.6

In addition to the assessed indicators above the following response based indicators are also considered as having some potential for use:

- Number of food waste prevention initiatives (national/regional/local).
- Number of people/homes/ communities actively involved in food waste prevention actions.
- Number of personnel involved in food industry/ retail sector/hospitality sector who have completed prevention courses.
- Government (local authority, etc.) budget used on food waste prevention activities.
- Number of enterprises signed (actively involved in) food waste prevention voluntary agreements.
- % difference in VAT between meat and dairy products and general food products.

6.5 Scoping on Targets

The literature review in Section 4.2 of this report revealed some interesting targets which countries or regional authorities have already put in place or considering for a future proposal. Below are listed the most suitable of the targets that would be of specific interest of taking into consideration later in this process.

- A national 25% reduction in avoidable food waste by 2015, compared to 2010.
- A target of reducing food waste throughout the product chain by at least 20% by 2015.
- Disposal of edible food waste should have been halved in the EU.
- A target of 50% reduction in food waste from “farm to fork” by 2025.
- Reduce carbon dioxide equivalent emissions associated with avoidable food and drink waste by 3.2 million tonnes a year by 2015.
- Increasing the number of Committed Food Waste Reducers to a certain% of residents by 2020.

Most of the targets identified in the literature review can be described as output type targets referring to quantities of food waste. The exception is the more response-based target of the Committed Food Waste Reducers initiative and the impact target which considers CO₂ emissions caused by food waste. All of the output based targets refer to a reduction in food waste generation by an appointed target year. In this way the targets are relatively

concrete. However, in some cases measurability against the target is made more difficult by a lack of baseline year or clear information at what point in the life cycle of food production and consumption the waste being targeted is arising. There are also some differences in the scope of the food waste being considered by the targets. Some targets refer to avoidable food waste and others to general food waste, while other targets focus on food waste from end users and others to food waste along the production chain.

6.6 First Stage Targets and Indicators

Combining all the above findings on targets and indicators so far in the whole process, a first set of potentially proposed targets could be as follows:

- Reduce avoidable food waste from households by x% or x tonnes by year y compared to base year y_0 .
- Reduce the amount of food waste from households by x% or x tonnes by year y compared to base year y_0 .
- Absolute decoupling of food waste from food consumption expenditure by households by year y.
- Reduce food loss throughout the production and consumption phase by x% by year y compared to base year y_0 .
- Reduce GHG emissions associated with (avoidable) food waste by x tonnes by year y compared to base year y_0 .
- Increase government budget used for waste prevention measures by x% by year y, compared to base year y_0 .
- Increase the number of enterprises signing voluntary commitments on food waste prevention by x (number or %) by year y compared to base year y_0 .
- Reduce the cost of avoidable food waste to households by x% by year y, compared to base year y_0 .

It is of particular interest to assess how these targets can be addressed by corresponding indicators which can measure progress towards the target and monitor the development throughout the years. For each first stage target proposed above, one or more indicators which can best relate to the target will be paired to that target and constitute a set of interrelated target-indicator proposal that can be used directly as such. On the left side the targets are presented one by one and on the right side the most appropriate indicator(s) which fit the target are identified and their potential use is analysed.

Box 4

Target

Reduce avoidable food waste from households by x% or x tonnes by year y compared to base year y₀

Comments: This target addresses specifically households which have been identified to be of increased importance. Similarly specific targets for different sectors of the economy can be set in the same fashion as this target. For example:

- Reduce avoidable food waste from the retail sector by x% or x tonnes by year y compared to base year y₀.
- Reduce avoidable food waste from the hospitality sector by x% or x tonnes by year y compared to base year y₀
- Reduce avoidable food waste from households, retailers and catering by x% or x tonnes by year y compared to base year y₀.
- Reduce avoidable food waste from the whole chain of food production by x% or x tonnes by year y compared to base year y₀.

Indicators

Avoidable food waste generated per household

Comments: This indicator relates well to the target. Data on avoidable food waste is not available at the moment but when they become available with some time series this indicator will be very useful. The only observable difference is that the indicator is describing amounts of avoidable food waste per household while the target aims at the accumulative amount of all households. This might require an extra calculation or the adjustment of the indicator to fit the target and vice versa. Similarly, indicators for targets with a broader scope can be used for measuring amounts of food waste generation. For example:

- Avoidable food waste generation per capita.
- Avoidable food waste generation per enterprise (retail, hospitality, food processing industry).

Consumption of food (kg/capita/year)

This indicator can only provide a proxy for changes in generation of waste. It is an input rather than output based indicator but can potentially be used to estimate reductions in avoidable food waste from households. The better households use the food by reducing avoidable food waste the less food they need to buy. The reduction in kg per capita of food consumed could be assumed to be directly relative to reductions in avoidable food waste. However, a factor would need to be applied equivalent to the ratio of avoidable to total food waste for households. Note, however that factors other than changes in food waste can affect trends in this indicator. It has to be taken into account that around 1/3 of the food consumed is consumed in the hospitality sector (Marthinsen et al 2012). Moreover the calculation methods for food consumption lead to quite some uncertainty (see under Racer assessment).

Box 5

Target

Reduce the amount of food waste from households by x% or x tonnes by year y compared to base year y_0

Comments: This target addresses specifically house-holds which have been identified to be of increased importance. This is an amount related target which points out to the absolute reduction of food waste from households by a certain tonnage by an appointed year in the future without comparing to a base year. This target can be expanded to include other economic sectors throughout the product chain of food. For example:

- Reduce the amount of food waste from the retail sector by x% or x tonnes by year y compared to base year y_0 .
- Reduce the amount of food waste from restaurants and catering services by x% or x tonnes by year y compared to base year y_0 .
- Reduce the amount of food waste from households, retailers, restaurants and catering services by x% or x tonnes by year y compared to base year y_0 .
- Reduce the amount of food waste from the whole chain of food production by x% or x tonnes by year y compared to base year y_0 .

Indicators

Food waste generated per household (kg/ household/year)

Comments: This indicator has already been proposed in literature and can be made operational as soon as data on food waste improve and become readily and regularly available. The only observable difference is that the indicator is describing amounts of food waste per household while the target aims at the accumulative amount of all households. A factor needs to be included for the increase in the number of households. Similarly, indicators for targets with a broader scope can be used for measuring amounts of food waste generation. For example:

- Food waste generation per capita.
- Food waste generation per enterprise (retail, hospitality, food processing industry).

Consumption of food (kg/capita/year)

Comments: This indicator can only provide a proxy for changes in generation of waste. It is an input rather than output based indicator but can potentially be used to estimate reductions in avoidable food waste from households. The better households use the food by reducing avoidable food waste the less food they need to buy. The reduction in kg per capita of food consumed could be assumed to be directly equivalent to reductions in avoidable food waste. Note, however that factors other than changes in food waste can affect trends in this indicator. It has to be taken into account that around 1/3 of the food consumed is consumed in the hospitality sector (Marthinsen et al 2012).

Box 6

Target

Absolute decoupling of food waste from food consumption expenditure by households by year y

Comments: This target refers to the decoupling of food waste generation from the economic activity of households. This is a very useful target which can indicate whether by an appointed year y the (probable) increasing income expenditure of households is leading to increasing food waste or not, in other words the dependency of food waste to economic parameters.

Indicator

Food waste generation in households per unit of household expenditure on food (kg/EUR)

Comments: This indicator can measure the proposed target rather satisfactory compared to the general economic variable of GDP. On the other hands there is a weak correlation to the price of food and its physical properties, such as waste, which would be the measurable output of this indicator. Sometimes bulk food is cheaper than gourmet or organic food which comes in higher prices and lower quantities.

Box 7

Target

Reduce food loss throughout the production and consumption phase by x% by year y, compared to base year y₀

Comments: This is a very broad target and refers generally to food waste in all stages of production and consumption. This target probably will require a combination of indicators. The broad target may be difficult to communicate to the public.

Indicators

Food waste generated (kg) along the production chain against the total production of foodstuffs (kg) (excluding intermediates, e.g. fodder, etc.) (%)

Comments: This indicator takes a production perspective describing the amount of food waste generated in the food processing industry against the material output of food production.

Food waste generated (kg) by end users per unit (kg) consumption of food per capita

Comments: This indicator takes a consumption perspective describing the amount of food waste generated compared to the material consumption of food per capita. However there are some data issues to be solved in the consumption of food per capita dataset. As de-scribed earlier food waste data is not currently collected on a regular basis.

Resource loss on bioproducts

Comments: This is a Material Flow Accounts indicator which considers the whole process of the food production and measures the material loss in the food production and consumption chain. Theoretically this indicator fits best to the target but still some methodological issues as well as its communicative value need to be improved.

Box 8

Target

Reduce GHG emissions associated with (avoidable) food waste by x tonnes by year y , compared to base year y_0

Comments: This target specifically addresses the environmental benefits which could arise from the potentially reducing amounts of food waste through food waste prevention. The higher the reduced amount of food waste the bigger the climate benefit in the form of avoided GHG emissions from food products.

Indicator

GHG emissions (upstream) associated with avoidable food waste

Comments: Two components are essential for this indicator to be of use for this target. First, the composition of the food waste and secondly the carbon footprint of products or the GHG emissions of the food related industries. The first component is extremely difficult, so approximations need to be done relying only on amounts of waste and not the composition of food waste. The second component is less difficult since there is relatively good LCA-based information on GHG emissions related to different product types. This information is not regularly updated but that is perhaps not so critical for the needs of the indicator given the uncertainties in food waste composition.

Box 9

Target

Increase the share of government budget for waste prevention measures to $x\%$ by year y , compared to base year y_0

Comments: This is a policy initiative target and can measure the level of engagement of government bodies to food waste prevention.

Indicator

Government (local authority, etc.) budget used on food waste prevention activities

Comments: This is a response indicator which relates well to the target.

Box 10

Target

Increase the number of enterprises signing voluntary commitments on food waste prevention by x% by year y, compared to base year y_0

Comments: This is a voluntary initiative target and can measure the level of engagement of food related businesses to food waste prevention.

Indicator

Number of enterprises signed (actively involved in) food waste prevention voluntary agreements

Comments: This is a response indicator which relates well to the target.

Box 11

Target

Reduce the cost of avoidable food waste to households by x% by year y, compared to base year y_0

Comments: Although it doesn't specifically relate to any parts of the waste definition the indicator is of interest politically since it can be used to raise awareness amongst households of the economic importance of food waste to household budgets and can also be used to measure the socio-economic benefits of food waste prevention.

Indicator

Economic value of avoidable household food waste (EUR/capita/year)

Comments: The indicator relates well to the target. However, this indicator requires a reasonably detailed breakdown of the composition of food waste since the price of food products even in the same broad category can vary significantly.

6.7 Final Proposals for Targets and Indicators for food waste prevention

It is the responsibility of the policy maker to set targets for waste prevention and the policy maker must take account of a large number of factors when choosing national targets. The proposals below are only suggestions which might be useful to consider.

Apart from the two response-based target/indicator pairs at the end of the list described under Section 6.6, the target/indicator pairs would mostly require data collection on food waste generated from various entities i.e. households, retailers, food processing industry etc. The exception is under the first two targets where an alternative input based indicator—that of food consumption in kg/capita/year—could be used as a proxy for avoidable and total food waste generation in households.

The food consumption indicator can be described as a *best-available* indicator for these two targets, while alternative indicators based on collection of actual food waste data can be classed as *best-needed* indicators for the same targets.

The relative strengths of the two types of indicators need to be weighed up carefully. As identified in the RACER assessments the food consumption indicator, its strength is that the data for the indicator is already collected and maintained on a regular basis although there are country-year gaps and the methodologies are perhaps questionable due to assumptions of food losses during the production processes of finally consumed food. Its key weakness lies in the fact that changing consumption of food can be due to increased/decreased actual intake of food as well as changes in food waste. As such its direct relevance to the food waste reduction targets are limited.

The RACER assessment for the indicators on avoidable and total food waste generation from households respectively, identifies that regular data collection with a sufficient level of certainty could be costly to operationalise. This is most problematic for collection of data on avoidable food waste.

As an example, the cost of the Danish survey for 1,200 households (800 one-family houses and 400 households in multi-apartment housing) is (DKK 1.8 mio). However, it covers sorting in 19 fractions including some not related to food waste.

On the other hand the indicator once operationalised (maybe through surveys every 5–10 years) would be significantly more relevant to the respective targets than the food consumption targets and would be much more easily accepted and communicable to policy makers and the public alike.

Looking more broadly at the other target and indicator pairs, in the long run targets and indicators covering the whole food chain, rather than only households, would be preferable covering the full scope of food waste and food waste prevention initiatives. Taking into account waste along the full production and consumption chain would for example avoid misinterpretations of food waste trends resulting from shifts in

food waste from one part of the food chain to another. An example of this would be an increasing demand for ready-made meals which can potentially shift generation of food wastage from households to the food production industry.

However, taking the poor data situation in consideration for the different sectors involved developing indicators covering the full production and consumption chain does not seem to be the solution for the moment. It may be better to focus the target setting for one or two sectors for the time being. These targets could be combined with some targets using response indicators, which are less costly to monitor. More complicated targets, e.g. on reducing GHG emission from food waste, can be included later when the basic data issues for food waste/avoidable waste are in place.

6.7.1 Suggested target and indicators:

Concluding from the whole process, a list of targets along with their corresponding indicators are proposed here for consideration by countries during the selection, evaluation and use of targets in national waste prevention plans or programmes.

1. Reduce avoidable food waste from households by x% or x tonnes by year y, compared to base year y_0 .
 - As it has been discussed earlier this target is specifically targeting households, but it can be adjusted according to the special needs of targeting each economic sector. If data is available the target can be combined for households, retail and the hospitality sector.

For measuring the progress of this target the *best-needed* indicator “Avoidable food waste generation per household (capita/food industry/hospitality sector)” can be used in the longer term. The *best-available* indicator food consumption in kg/capita/year could potentially be used in the short term (for households or households plus hospitality sector only—not for food industry and retail) or if countries do not have the resources available for collecting data on food waste.

However, policy makers must understand the weaknesses of this proxy indicator. A factor would need to be applied to the indicator equivalent to the ratio of avoidable food waste to total food waste (i.e. including both avoidable and unavoidable food waste). This could be drawn from less comprehensive one-off food waste surveys.

2. Reduce the amount of food waste from households by x% or x tonnes by year y, compared to base year y_0 .
 - As it has been discussed earlier this target is specifically targeting households, but it can be adjusted according to the special needs of targeting each economic sector.

For measuring the progress of this target the *best-needed* indicator “Amounts of food waste generated per household (capita/food industry/hospitality sector)” can be used accordingly. Again the *best-available* indicator food consumption in kg/capita/year could potentially be used in the short term (for households or households plus hospitality sector only—not for food industry and retail) or if countries do not have the resources available for collecting data on food waste. However, policy makers must understand the weaknesses of this proxy indicator. A factor would need to be applied to the indicator equivalent to the ratio of avoidable to total food waste. This could be drawn from less comprehensive one-off food waste surveys.

Should food waste data be collected from households with a sufficient level of detail the following target could also be considered, due to its aware-raising strengths and also its links to the resource efficiency agenda.

3. Reduce the cost of avoidable food waste to households by x% by year y, compared to base year y_0 .

For measuring the progress of this target the *best-needed* indicator “Economic value of avoidable household food waste (EUR/capita/year)” would be used. This indicator requires a somewhat more detailed household food waste survey than for the two best-needed indicators for the two targets above, requiring a division by food product. This would involve additional costs.

Together with these targets, it would be also useful to take into consideration some of the response targets, which could help monitoring waste prevention initiatives.

4. Increase government budget used for waste prevention measures by x% by year y, compared to base year y_0 .
5. Increase the number of enterprises signing voluntary commitments on food waste prevention by x (number or %) by year y, compared to base year y_0 .

The following *best-needed* indicators would be used to monitor such response based targets:

- Government (local authority, etc.) budget used on food waste prevention activities.
- Number of enterprises signed (actively involved in) food waste prevention voluntary agreements.

Data collection systems to allow these indicators to be operationalised could be included as an integral element of the instruments implemented to meet the targets.

7. Proposals for Construction and Demolition Waste Prevention Indicators and Targets

7.1 Indicator Types Useful for C&D Waste Prevention

C&DW is a waste stream with an important particularity: it is the sum of two sub-streams, namely construction waste and demolition waste. These two streams are fundamentally different since the former can be directly associated with the construction sector's economic activity (waste occurring within the same year of activity) but not the latter (demolition waste occurs many years after the original economic activity, depending on the construction's life span). Demolition waste can also be linked to economic activity of the sector. For brown-field construction, new construction follows on directly from demolition activities. However, the materials used in new constructions will first become waste after many years. Due to the time delay between material inputs and the material becoming waste, indicators that compare material inputs with waste outputs are not appropriate for this waste stream.

A typology of indicators has been developed for this project. This is given in Box 1 towards the beginning of this report.

Output-based indicators

An output-based indicator would involve measuring the generation of C&DW. This is the only operational indicator for C&DW at the moment. This indicator is assessed analytically in section 7.4.

Input-based indicators

As described above due to the difficulties presented in interpreting consumption in the construction sector in terms of waste prevention, this type of indicators is not considered appropriate for C&DW. Instead a combination of input and output indicators is discussed in more detail below.

Input-versus-output indicators

With respect to C&D waste some of the indicators in this group can better be termed as output-versus-output indicators. Input-vs-output and output-vs-output indicators can, in theory, measure the efficiency of material use in the sector. An example would be C&D waste generation per physical unit (e.g. floor area) of construction. However, the time lapse between consumption in the construction industry and the waste generation (for the part that refers to demolition wastes) hinders the use of these indicator types for accounting for waste prevention. The proposed indicators by (EC, 2009) attempt to tackle this issue by introducing indicators that refer specifically to construction, such as Domestic Extraction (DE) of construction materials Per Area of new construction PA) (DE/PA). However, the area of new construction is not reported as such in most countries (in particular, data normally refer to buildings but not total construction). As a potential proxy, data is available on the area of buildings permitted in a year. Similarly, domestic extraction of construction materials is not directly available, but domestic extraction of sand and gravel from Material Flow Accounts might be a good proxy for the input element of the indicator.

Decoupling indicators

This indicator type includes the inherit problems of the previous indicator. However, as demolition (and renovation) activities are also accounted for in the construction sector's economic output, this indicator could be potentially used as a proxy for waste prevention. The proposed indicator by (EC, 2009) is construction and demolition waste generated per unit GDP (CDWG/GDP) or preferably the C&D waste generation per EUR of the construction sector's economic output (Gross Value Added-GVA). Such an indicator would be a useful decoupling indicator and data to support it are available for all countries.

Impact indicators

This type of indicators attempts to address part b) of the waste prevention definition, as it appears in the Waste Framework Directive. The indicator type presents two key challenges. Firstly, there is not sufficient life cycle assessment data to support the estimations of environmental impacts through the entire life cycle of all construction materials. Secondly individual life cycle assessments should, ideally, be performed for every change induced in the construction practices so that the indicator is accurate enough (e.g. when one material is replaced by another), since life cycle assessment information are very much dependent on the individual case and cannot normally be generalised. Therefore, the estab-

lishment and streamlining of this indicator is very difficult and could only be approximated by using general data suitable for the region. This data could be found in specialised LCA databases such as Ecoinvent and Eco-Indicator 99, potentially in Environmental Product Declaration (EPD) systems and by monitoring general trends in construction practices regarding design and material use. The data demand will be heavy for such indicators. On the other hand, this type of indicator addresses the core issue regarding waste prevention, namely the consequences of prevention measures on the environment. This indicator could be expressed as environmental impacts' score versus consumption of construction materials and reported annually.

Hazardous content indicators

This type of indicators addresses part c) of the waste prevention definition. In order to compile this indicator, the hazardous content of C&DW should be available. This indicator is relevant for C&DW as it is a waste stream that contains many hazardous materials (asbestos, paints, flame retardants etc.), although in low quantities compared with the total amounts of C&DW. There is no data available accounting specifically for the hazardous content in C&DW materials, but data exist on hazardous C&DW generation in Eurostat (however, there are many cases with very large differences from year to year in one country). However, while this indicator could be considered fully operational it would take many years before it responds to policies implemented now that reduce the use of hazardous materials in construction.

An alternative might be a response-based indicator on the number of buildings constructed which meets standards requiring limits in hazardous substances. Standards used internationally mostly do not restrict the use of such substances (e.g. LEED in US see EHHI, 2010). Some do, however, e.g. the UK's BREEAM standard²⁰. There are a few voluntary certification schemes established or emerging in Nordic countries e.g. the Nordic Swan certificate for which criteria have recently been defined for buildings and for which hazardous materials are included as a criterion. In addition there are voluntary certificate standards for products being implemented in Nordic countries some of which include or are focused on building materials; e.g. the BASTA system in Sweden which aims directly at reducing the hazardous content of building materials; the international

²⁰ See <http://facilities.anu.edu.au/IARU/ESD-Building-Standards-Assessment-Criteria.pdf> for an overview of the criteria in various building certificate standards around the world.

Environmental Product Declaration, EPD, based on ISO standard ISO 14025; Nature Plus, an international label for building and home products i.e. paints and; the Finnish M1 system and a Danish indoor climate label which both set limits on the degree to which building materials may release emissions which are damaging to human health. See Nordic Innovation (2012) for an overview of these labels and certification systems.

Response indicators

There are a few response-based indicators that are specifically suitable for the C&DW stream. Because of its particularity regarding the time lapse between consumption and waste generation, it is important to monitor actions that are expected to yield waste prevention results, even in the distant future.

Increasing the life span of constructions (buildings, roads and other civil engineering applications) is an effective way to prevent C&DW waste. Therefore, a potentially useful indicator in this area could be to monitor the average design life expectancy of buildings and roads.

Another way to increase buildings' life spans is renovation. Therefore, a useful indicator in this direction is the renovation economic output versus the total output of the sector. Renovation for maintenance purposes or just change in use is already established as common practice in the Nordic countries and does not always directly increase the lifespan of the building. Therefore, the indicator should be interpreted only in a time series where increases/decreases could be attributed to renovation activities outside the common practice. However, there is no detailed data regarding the breakdown of the construction sector's output.

Finally, waste prevention in C&D could be achieved indirectly through increasing the density of urban areas or the area efficiency of buildings, i.e. having the same functionality with less input of concrete, tarmac and other construction materials that will eventually end up as waste.

7.2 Useful Core Data Elements

In order to construct realistic, reliable and applicable indicators an initial screening of the core data elements required is essential. Taking into account all the considerations of the previous section, the most suitable core data elements for the C&D waste streams are as follows:

- C&DW generation.
- Hazardous C&DW generation.
- Consumption of construction materials.
 - alternatively: Domestic extraction of (selected) construction materials.
- Population.
- GDP.
- Construction sector's economic output (or Gross Value Added).
- Renovation economic output.
- Physical area of new buildings.
- Life cycle assessment impacts on construction materials.
- Average design life expectancy of buildings and roads.

The availability of the core elements for constructing C&D waste prevention indicators in the Nordic databases or elsewhere (e.g. Eurostat) has been investigated. A list of available datasets is provided in Appendix 2.

7.3 Potential Indicators Based on Core Elements

The indicators described in chapter 7.1 which can be constructed from combinations of core data element described under chapter 7.2 are presented in Table 7.1.

The columns and rows present various core data elements. The include material and economic flow variables while the rows comprise mainly some socio-economic variables, input variables and some environmental pressure variables. These can be combined as shown in the cells within the table to produce various output, input-vs-output and decoupling indicators. Some of the core elements can also be used as the basis for input or output indicators without the need for combination with other core elements. Only indicators felt of particular relevance to waste prevention have been identified in the table.

Table 7.1. Potential C&D waste prevention indicators by combining the core data elements

Core data elements → ↓	C&DW generation ²	Hazardous C&DW generation ²	Consumption of construction materials (preferably) ¹ Domestic extraction of construction materials (alternatively) ²	Renovation economic output ²
Population ³	C&DW / capita	Hazardous C&DW / capita		
GDP ³	C&DW /GDP	Hazardous C&DW /GDP		
Construction sector's economic output (or Gross Value Added) ³	C&DW /Economic output	Hazardous C&DW /Economic output	Consumption of construction materials/Economic output Domestic extraction of construction materials/Economic output	Renovation economic output versus the total output of the sector
Physical area of new buildings ²	C&DW / Physical area of new buildings	Hazardous C&DW /area of new buildings	Consumption of construction materials/ area of new dwellings Domestic extraction of construction materials/ area of new buildings	
C&DW generation ²		Hazardous C&DW / C&DW	Material consumption in the construction sector/waste generation Domestic extraction of construction materials/waste generation	
		Average design life expectancy of buildings and roads		
		Life cycle assessment data on construction materials		

¹Core elements with low availability of data.

²Moderate availability of data.

³Good data availability.

Note: The data availability of each constructed indicator is influenced by the core element with the lowest data availability.

There are a limited number of indicators readily available (or that can be easily created based on available data) for monitoring C&DW prevention. The indicators proposed in the literature and further potential indicators which are considered relevant and can be built from core elements are as follows:

1. C&DW generation (optionally per capita or GDP). Data already exist to support this indicator, although scattered in different years.
2. C&DW generation per unit of Gross Value Added (GVA) in the construction sector. Data already exist to support this indicator, although scattered in different years.
3. Material consumption in the construction of buildings per floor area of new buildings.

4. Domestic extraction of construction materials per economic output and/or floor area of new buildings (or proxy).
5. Hazardous C&DW as% of total C&DW generation (%). Data already exist to support this indicator, although scattered in different years.
6. Environmental impacts versus consumption of construction materials.
7. The average design life expectancy of buildings and roads.
8. The renovation economic output versus the total output of the sector.

In addition, a useful response indicator with respect to restriction of hazardous materials in buildings would be:

9. Number of new buildings and sales of building materials certified by labelling schemes which limit quantities of hazardous or harmful substances.

7.4 RACER Assessment of Indicators

7.4.1 *RACER assessment of existing indicators*

The only indicator proposed in the literature regarding C&DW prevention is the one proposed by OECD, referring to total volumes of waste generated annually per country (output indicator). In general, this is an indicator, which is difficult to interpret: most of C&DW originate from demolition activities and at a lesser degree from waste occurring during construction or refurbishment. Therefore, due to the time lapse between construction and demolition, monitoring prevention activities is hard. Ideally, one would differentiate between construction waste and demolition waste. However, these wastes are currently not differentiated in waste statistics and unlikely to be in the future.

Using C&DW waste as an indicator of waste prevention presents many challenges. The assessment of the indicator is performed using the RACER criteria both qualitatively and quantitatively (score of 1–5 points per criterion).

Table 7.2. RACER assessment of the indicator “C&DW generation” (kg per capita and/or unit GDP)

RACER	Score	Comments
Relevance	2	Waste generation is not influenced solely by waste prevention measures, since other factors such as economic developments play an important part as well. The indicator will mostly reflect the level of economic activity in the construction sector rather than any waste prevention measures. Since a large part of C&DW is generated from products constructed many years before (i.e. waste from demolition) this further reduces the relevance of the indicator to waste prevention activities carried out now.
Accepted	5	This is an accepted indicator as it is already proposed and operated by OECD.
Credible	1	Stakeholders would be reluctant to base decisions on waste prevention or monitor initiatives by using this indicator, as it does not directly relate to waste prevention. Moreover, the development of the indicator is affected by many (mainly economic) developments such as the sector’s activity, the constructions’ designed life spans etc.
Easy	4	The fact that the data supporting this indicator are mandatory to report and exist over a time series is a great advantage. Moreover, the indicator is straightforward and easy to understand and interpret. However, explanations and transparency regarding the indicator’s challenges are required.
Robust	4	As the data for the Nordic countries demonstrate, the reporting of C&DW is very different among countries. The reasons for this are not fully investigated and the data confidence weakens due to this. However, there is relative consistency in the data reporting in each individual country.
Final Score	3.1	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

7.4.2 RACER assessment of potential indicators

In section 7.3, after a thorough consideration of available core data elements, a pool of potential indicators for development was proposed. In order to evaluate the possibility of promoting those indicators further as proposals for working indicators for the Nordic countries a RACER assessment has been performed for each one individually in the following tables (Tables 7.3–7.10).

Table 7.3. RACER assessment of the indicator “C&DW generation per unit gross value added in the construction sector (kg/EUR)”

RACER	Score	Comments
Relevance	3	This indicator attempts to relate waste to the activity of the construction industry. Thus the influence of the activity level of the industry on C&DW generation is removed, improving its relevance to actual waste prevention initiatives compared to the pure C&DW indicator assessed in table 7.2. However, since a large part of C&DW is generated from products constructed many years before (i.e. waste from demolition) the relevance of the indicator to waste prevention activities carried out now is reduced.
Accepted	5	This indicator is generally accepted as a waste prevention indicator in other waste streams, although the particularly long time lapse issue in C&DW might create problems. The same indicator per unit GDP is proposed by (EC, 2009), so its improvement (GDP replaced by the sector's GVA) is assumed to be perhaps even more acceptable.
Credible	3	The economic activity of the construction sector, related to waste generation is only a proxy to describe efficiency in material use, and therefore waste prevention.
Easy	4	This indicator can be directly implemented and also a historical time series exists for most countries (except for Iceland).
Robust	5	C&DW data are commented on in chapter 1. Normally economic data are very robust, so overall the robustness of this indicator is quite satisfactory.
Final Score	3.7	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 7.4. RACER assessment of the indicator “Material consumption in the construction of buildings versus the area of new construction (tonnes/m²)”

RACER	Score	Comments
Relevance	5	This indicator assesses the material efficiency in construction which will result in waste prevention when the construction is decommissioned in the future. The indicator thus avoids the time lapse problem that weakens C&DW generation as an indicator of current waste prevention activities. It also relates material inputs to an output factor (floor area of new buildings) thus removing fluctuations due to changes in construction activity.
Accepted	4	This type indicator of indicator is generally accepted as a waste prevention indicator in other waste streams, so it is assumed as relatively accepted for C&DW.
Credible	4	The credibility of the indicator is high since it measures material efficiency, which is a vital component of waste prevention and benchmarks this against constructed area of buildings which is considered as a reasonable measure of the useful output of the construction industry. Decisions could be based on this indicator.
Easy	1	Data availability for this indicator is very difficult to obtain. As far as is understood data on the direct material input to buildings is not readily available in Nordic countries. It could be possible to identify in Eurostat's ProdCom and Comext databases all products produced or imported for construction although this would be very resource intensive work. However, even if this data was gathered it could not readily be differentiated into products used for buildings and products used for other construction works.
Robust	2	It is difficult to assess the robustness of the indicator since no methodology has been defined for differentiating construction materials for buildings from materials used for other construction works.
Final Score	3.1	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 7.5. RACER assessment of the indicator “Domestic extraction of construction materials per floor area of new buildings (tonnes/m²)”

RACER	Score	Comments
Relevance	4	This indicator assesses the material efficiency in construction which will result in waste prevention when the construction is decommissioned in the future. The indicator thus avoids the time lapse problem that weakens C&DW generation as an indicator of current waste prevention activities. It also relates material inputs to an output factor (floor area of new buildings) thus removing fluctuations due to changes in construction activity. The indicator has two weaknesses. Firstly, that the output is measured only in terms of buildings and not other constructions such as roads, bridges etc. Secondly, the input variable, domestic extraction, omits materials used in construction imported from abroad. However, this import is not considered to be significant.
Accepted	4	This type indicator of indicator is generally accepted as a waste prevention indicator in other waste streams, so it is assumed as relatively accepted for C&DW.
Credible	4	The credibility of the indicator is high since it measures material efficiency, which is a vital component of waste prevention and benchmarks this against constructed area of buildings which is considered as a reasonable measure of the useful output of the construction industry. Decisions could be based on this indicator.
Easy	4	Data availability for this indicator is reasonably good. Domestic extraction data is readily available for all Nordic countries. Data availability on floor area of new construction is variable from country to country. For some countries it is only available for dwellings for example. Eurostat data covers permits for buildings which may not be implemented.
Robust	3	The data for both input and output variables are considered to be reasonably robust but may differ from country to country.
Final Score	3.9	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 7.6. RACER assessment of the indicator “Number of new buildings and sales of building materials certified by labelling schemes which limit quantities of hazardous or harmful substances”

RACER	Score	Comments
Relevance	3	This is relevant to part c) of the waste prevention definition. The indicator would consider the numbers of new buildings which have been certified with a label which restricts use of hazardous or harmful substances such as the Nordic Swan, together with sales of building materials which are labelled under standards which restrict the use or emissions of hazardous or harmful substances i.e. BASTA, Nature Plus, Finnish M1 system, the international EPD and the Danish indoor climate certificate. This indicator would provide only a proxy for the use of hazardous and harmful substances in construction projects since they would not take account of reductions of such substances in non-labelled products. However in the absence of data on the actual use of such materials it remains a relevant indicator. It also does not suffer from the timelag problem of hazardous C&DW generation indicator.
Accepted	4	This indicator is would be considered to be potentially accepted as a useful waste indicator provided that the methodology for its generation is robust and credible.
Credible	3	The credibility of this indicator would be reasonably high since the labelling systems such as the Nordic Swan, in particular have a high credibility in Nordic countries. However, there may be questions concerning the representativeness of the indicator if the certificates are not widely used in the construction industry.
Easy	4	Data for this indicator ought to be available from the relevant bodies responsible for the administration of the various labels.
Robust	3	It is difficult to assess the robustness of the data gathered by each individual administration body, but is expected to be reasonably good.
Final Score	3.4	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 7.7. RACER assessment of the indicator “hazardous C&DW as% of total C&DW generation (%)”

RACER	Score	Comments
Relevance	2	This indicator refers to part c) of the waste prevention definition and it should be assessed accordingly. The fact that a large part of hazardous C&DW stems from old buildings on which contemporary hazardous materials’ regulations do not apply demonstrates that it is difficult to account for existing prevention regulations and measures based on this indicator.
Accepted	4	This indicator is generally accepted as the only proxy to address hazardous content in C&DW generation. It is not proposed or operated by an official institution.
Credible	3	Since a great number of hazardous C&DW generated occur due to the use of materials, which are now banned, reduced the credibility of the indicator.
Easy	5	This indicator can be directly implemented and also a historical time series exists for the Nordic countries.
Robust	4	Hazardous C&DW data are quite robust and reported biannually to Eurostat similarly to C&DW generation.
Final Score	3.6	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 7.8. RACER assessment of the indicator “environmental impacts versus consumption of construction materials (unit pressure per kg)”

RACER	Score	Comments
Relevance	5	This indicator is very relevant for waste prevention as it reflects the environmental consequences of prevention measures (as it is defined in part b) of the definition in the Waste Framework Directive).
Accepted	2	The indicator is not used nor has been proposed to date. However, as it clearly addresses waste prevention in a comprehensive manner, its acceptance would not present many challenges.
Credible	4	Decisions should be based on this indicator as it demonstrates clearly the environmental implications of shifts in production and use of construction materials.
Easy	1	There heavy demand for data, not publicly available. It is very difficult to implement this indicator.
Robust	2	The data requirements for the compilation of this indicator could only be materialised if generic environmental data are used, which reduce the robustness substantially. Consumption of materials’ data would be more robust, but not existing at the moment for the Nordic countries.
Final Score	2.9	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 7.9. RACER assessment of the indicator “average design life expectancy of buildings and roads (years)”

RACER	Score	Comments
Relevance	4	This indicator refers to a particular measure for implementing waste prevention, namely increasing the life expectancy of constructions. However, in the case of C&DW, this measure is of particular importance, since it may have very significant results with regard to prevention.
Accepted	3	This indicator has not been proposed or been operated, so its acceptance is difficult to assess. However, since it is an indicator that clearly monitors an important aspect of waste prevention, it would probably be accepted by relevant stakeholders.
Credible	3	The indicator relates very clearly to waste prevention within the construction sector, so its credibility should be reasonably high.
Easy	2	Data to support this indicator do not exist in a large scale, but common practice by engineers and architects is not difficult to monitor. However, the design life expectancy is seldom well defined. ISO standards exist concerning durability, but a number of other aspects also have a high influence on the resulting service life.
Robust	1	Due to the absence of data, it is difficult to assess the indicator’s robustness. However, the monitoring of design life span of buildings and roads in a large scale would probably be based on average practice, which reduces its robustness.
Final Score	2.7	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 7.10. RACER assessment of the indicator “renovation economic output versus the total output of the sector (%)”

RACER	Score	Comments
Relevance	3	This indicator refers to a specific measure for implementing waste prevention, namely extending buildings’ life span through renovation. Therefore, the indicator only partially covers waste prevention and also only a part of C&DW that originates from buildings.
Accepted	3	This indicator has not been proposed or been operated, so its acceptance is difficult to assess. However, since it is an indicator that clearly monitors an important aspect of waste prevention, it ought to be accepted by relevant stakeholders.
Credible	2	The indicator monitors very clearly a specific measure of waste prevention. Therefore, it is difficult to base decisions on it.
Easy	1	Detailed data are required for the compilation of this indicator, namely economic data on renovation activities. This dataset does not exist and its creation would be difficult and costly.
Robust	3	Due to the absence of data (except for DK), it is difficult to assess the indicator’s robustness. If data collection is implemented, then its robustness would probably be high, since economic data are normally precise and robust.
Final Score	2.3	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

7.4.3 Summary of RACER assessment results

Table 7.10 summarises the results from the previous RACER assessments.

The majority of the indicators were awarded with a medium final score. The table suggests that most existing and potential indicators suffer from at least one weak critical element, either relevance or “easy” and/or “robust” that relate to data availability and quality. The 3 indicators that are ranked with the highest score include waste generation data and extraction of construction materials data which is widely available in most countries.

Table 7.11. Summary of RACER assessments for C&D waste prevention indicator

Indicator	R	A	C	E	R	Final Score
C&DW generation (kg per capita and/or unit GDP)	2	5	1	4	4	3.1
C&DW generation per unit GVA in the construction sector (kg/EUR)	3	5	3	4	5	3.7
Material consumption in the construction of buildings per floor area of new buildings	5	4	4	1	2	3.1
Domestic extraction of construction materials per floor area of new buildings (tonnes/m ²)	4	4	4	4	3	3.9
Number of new buildings and sales of building materials certified by labelling schemes which limit quantities of hazardous or harmful substances	3	4	3	4	3	3.4
Hazardous C&DW generation as a% of total C&DW generation (%)	2	4	3	5	4	3.6
Environmental impacts versus consumption of construction materials (unit pressure per kg)	5	2	4	1	2	2.9
Average design life expectancy of buildings and roads (years)	4	3	3	2	1	2.7
Renovation economic output versus the total output of the sector (%)	3	3	2	1	3	2.3

7.5 Scoping on Targets

The literature review (Section 4.3) revealed the absence of many quantitative targets for C&DW prevention. Most of the provisions on waste prevention refer to general qualitative considerations such as the efficient use of materials, the promotion of renovation rather than new construction, the reduction of hazardous content (and therefore waste) in construction and taking prevention into account in the design phase. The only quantitative target found is included in the Welsh Waste Strategy, referring to reduction of C&DW by 1.4% annually with a time horizon until 2050.

However, it is possible to set a variety of quantitative targets for C&DW.

- Reduce waste generation by the construction sector by x% annually with y_0 as base year.
- Increase the material efficiency in construction with x% by year y with y_0 as base year.
- Reduce the hazardous content of construction materials by x% annually with y_0 as base year.
- Reduce the life cycle GHG emissions from construction with x% by year y with y_0 as base year.
- Increase the renovation economic output with x% by year y with y_0 as base year.

- Increase the buildings life span with x years and roads life span with z years by year y with y_0 as base year.
- x% of building permits issued by local authorities to include waste prevention plans by year y with y_0 as base year.

In the above list, there are multiple targets corresponding to all types of indicators. The target setting process is, however, limited by the absence of data or, more in particular, by the absence of data for the base year.

The matching of targets and indicators is performed in the following chapter.

7.6 First Stage Targets and Indicators

It is particularly important to locate possible indicators that can measure and monitor the progress towards the targets set. These indicators should ideally refer specifically to the target and evaluate the progress in a comprehensive manner. On the left side the targets are presented one by one and on the right side the most appropriate indicator(s), which fit the target, are identified and their potential use is analysed.

Box 12

Target

Reduce waste generation by the construction sector by $x\%$ annually with y_0 as base year

Comments: This target addresses specifically waste generation, which is exactly what waste prevention primarily refers to. This is a useful target, set at an annual basis, as it records the year to year differences of the effect on waste generation of waste prevention activities.

Indicator

C&DW generation

Comments: This indicator relates well to the target and data on the indicator exist in a time series for most Nordic countries (except for Iceland with a value available only for 2004). There are big differences among C&DW generation per country, so the target and its indicator should be applied separately on the individual countries. However, the indicator is greatly influenced by the level of activity in the construction sector from year to year.

C&DW generation per unit GVA in the construction sector

Comments: This indicator relates well to the target and data on the indicator exist in a time series for most Nordic countries (except for Iceland with a value available only for 2004). There are big differences among C&DW generation per country, so the target and its indicator should be applied separately on the individual countries. Moreover, it removes the influence of the level of activity in the construction sector on trends in the indicator. *Proposals for targets and indicators for waste prevention*

Box 13

Target

Increase the material efficiency in construction with $x\%$ by year y with y_0 as base year

Comments: This target addresses one specific measure for achieving waste prevention, which is the increase in efficiency of the use of materials. This is an important interpretation of waste prevention which has influence not only on waste generation as such but potentially on parts b) and c) of its definition. Therefore, the higher material efficiency the higher prevention is achieved.

Indicator

Material consumption in the construction of buildings versus the area of new construction

Comments: This indicator is directly relevant to the target as it reflects the amount of materials extracted per unit of construction, thus addressing efficiency issues. However, data on material use in the construction of buildings does not exist in the Nordic countries and would be very difficult to gather.

Domestic extraction of construction materials per floor area of new buildings

Comments: This indicator is directly relevant to the target as it reflects the amount of materials extracted per unit of construction, thus addressing efficiency issues. Data availability is good for this indicator. The domestic extraction does not cover all construction materials used, but the indicator is accurate enough as most of the construction materials are locally produced. A more important weakness is that the indicator compares somewhat dissimilar variables. Extraction of construction materials is for all construction works including roads etc. whereas the output variable only concerns buildings. Approximately half of all construction materials are used for buildings (Bio-Intelligence, 2011).

Box 14

Target

Reduce the hazardous content of construction materials by x% annually with y_0 as base year

Comments: This target addresses specifically part c) of the waste prevention definition. The target is difficult to implement as current construction activities will have a limited influence on the current hazardous C&DW generation due to the time lapse between material use and waste generation reflecting the constructions' long life span. Construction waste (not demolition waste) only occurs directly after construction activities.

Indicator

Number of new buildings and sales of building materials certified by labelling schemes which limit quantities of hazardous or harmful substances

Comments: This indicator would provide only a proxy for the use of hazardous and harmful substances in construction projects since they would not take account of reductions of such substances in non-labelled products. However in the absence of data on the actual use of such materials it remains a relevant indicator. It also does not suffer from the timelag problem of hazardous C&DW generation indicator.

Hazardous C&DW as a % of total C&DW generation (%)

Comments: This indicator relates reasonably well to the target although there will be a considerable delay between reductions of hazardous content in construction and changes in the hazardous content in C&DW. On the other hand, data on the indicator exist in a time series for most Nordic countries (except for Iceland with a value available only for 2004). There are big differences among C&DW generation per country, so the target and its indicator should be applied separately on the individual countries.

Box 15

Target

Reduce the life cycle GHG emissions from construction with $x\%$ by year y with y_0 as base year

Comments: This target addresses directly the desired consequences of waste prevention, namely the environmental impacts, by using GHG as a proxy. Although the GHG emissions are proven to be, in some cases, insufficient to account for overall environmental impacts, this target would touch upon a politically prioritized theme (reduction of GHGs) and align well with similar targets set in other parts of the total economy. Note, however, that in some cases such a target could potentially risk encouraging material substitutions with a lower carbon footprint but higher hazardous content. Note also that the reduction of GHGs should refer to construction activities in general in order to reflect the life cycle character of waste prevention, as it is expressed in part b) of its definition. If the GHG emissions were measured against C&DW management, prevention would not be represented accurately as the target would refer to activities after waste is produced.

Indicator

Environmental impacts versus consumption of construction materials

Comments: This indicator could be adjusted (simplified) to GHG emissions only in order to correspond to the target. The measurement of GHG emissions throughout the entire life cycle of construction materials is a complicated process, as it requires the combination of macro-economic data (consumption of materials in the sector) with micro-level environmental data. This indicator has to be populated with generic data as monitoring each and every activity in the sector is not possible, thus its robustness is reduced. However, it is possible to compile this indicator, although with heavy workload and expenses required.

Box 16

Target

Increase the renovation economic output with $x\%$ by y with y_0 as base year

Comments: This target addresses specifically one particular way of achieving waste prevention. References to this target have been found in the literature, although on a descriptive, qualitative basis. This target could work well if not standalone, namely with a combination to targets covering overall waste prevention. The target is based on the idea that the higher economic output from renovation would mean a shift on extending constructions' life span from constructing new buildings.

Indicator

Renovation economic output versus the total output of the sector.

Comments: The indicator refers directly to the target by comparing the economic output of renovation compared to the total output of the sector. In this way, developments in the overall sectoral activity do not affect the indicator as it only measures renovation as % of the total. The absence of data, however, poses challenges to the implementation of the indicator.

Box 17

Target

Increase the buildings life span with x years and roads life span with z years by y with y_0 as base year

Comments: This target addresses specifically one particular way of achieving waste prevention, but which is particularly relevant to the sector. It could be combined with the previous target as a set towards reduced activity on new constructions and increased "reuse" of the sector's production. This target could work well if not standalone, namely with a combination to targets covering overall waste prevention. The reasoning behind the target is that by increasing buildings and roads' life span, C&DW generation is "delayed", thus achieving waste prevention.

Indicator

Average design life expectancy of buildings and roads.

Comments: The indicator refers to the target by monitoring the life span architects and designers operate on. The target and indicator are not directly interconnected, as the designed life span is often not representing reality, as renovations might extend it, or outstanding circumstances lead to its reduction. However, this indicator would work as a good proxy for the target. The data to support it are not readily available but the cost and workload for its registration are not high.

Box 18

Target

x% of building permits issued by local authorities to include waste prevention plans by year y with y_0 as base year

Comments: This is a response based target which nevertheless is quantitative. It would require implementation through building permit regulations or guidelines.

Indicator

x% of building permits issued by local authorities which include waste prevention plans

Comments: This indicator has not been assessed in detail. It would require going through all building permits in central registers for inclusion of requirements on waste prevention. This would require additional resources and procedures which could potentially be integrated into a policy response in this area.

7.7 Final Proposals for Targets and Indicators for C&D waste prevention

It is the responsibility of the policy maker to set targets for waste prevention and the policy maker must take account of a large number of factors when choosing national targets. The proposals below are only suggestions which might be useful to consider.

Out of the eight indicators assessed in more details, some of the proposed targets and indicators require new reporting schemes in order to obtain the necessary data. This fact restricts the application of the targets/indicators sets based also on the wish of the Nordic Council of Ministers for relatively easily implemented sets.

Indicators using waste generation as core element can be described as a *best-available* indicator, while alternative indicators based on collection of additional data (on consumption of building materials, lifetime of buildings and life cycle impacts) classed as *best-needed* indicators for the same targets.

More elaborate sets such as the reduction of environmental impacts from C&DW could be implemented later, when a basis for monitoring waste prevention is established. Based on these considerations, as well as on the relevance of the sets towards waste prevention, the following sets of targets-indicators are suggested for application in the Nordic countries context.

7.7.1 *Suggested targets and indicators*

1. Reduce waste generation by the construction sector by x% annually with y_0 as base year.

For measuring progress against this target, the indicator “*C&DW generation per unit GVA in the construction sector*” is considered to be the *best-available* indicator for the target, since it is unaffected by variations in the activity level of the construction sector.

2. Increase the material efficiency in construction with x% by year y compared to base year y_0 .

This target is perhaps the most relevant for encouraging waste prevention policies and implementation now. Targets based on waste generation are affected by the long time lag between construction and subsequent demolition of buildings and other construction works.

For measuring progress towards this target, data on consumption of construction materials used directly in production of buildings would be needed to produce a *best-needed* indicator on “*Material consumption in the construction of buildings versus the area of new construction.*”

Alternatively, as a *best-available* indicator the “*Domestic extraction of construction materials per floor area of new buildings*” can be used as a good proxy for measuring progress against the target.

3. Reduce the hazardous content of construction materials by x% annually with y_0 as base year.

Progress towards this target would ideally be best measured by an indicator on “*hazardous content of construction materials*.” However, data for this indicator does not exist and would be very difficult to operationalise. A proxy *best-needed* response-based indicator “*Number of new buildings and sales of building materials certified by labelling schemes which limit quantities of hazardous or harmful substances*” is suggested as an alternative. Data for such an indicator should not prove difficult to gather.

The indicator “*Hazardous C&DW as a % of total C&DW (%)*” could also be considered as a *best-available* indicator for the target. Its usefulness with respect to waste prevention policy, however, is somewhat affected by the long timelag between construction and demolition of construction works.

4. Increase life span of buildings with x years and roads with z years by year y–Average design life expectancy of buildings and roads.

Information to create a *best-needed* indicator on “*Average design life expectancy of buildings and roads*” is currently not widely available to follow up this target but could potentially be gathered from civil engineering associations.

8. Proposals for WEEE Prevention Indicators and Targets

8.1 Indicator Types Useful for WEEE Prevention

This section indicates the types of indicators drawn from Box 1 at the beginning of this report that might be useful for the respective types of WEEE prevention, as given in Box 2 at the beginning of Chapter 4.

Regarding part a) of the waste prevention definition, the most relevant indicator type would be an output indicator, which follows the generation of WEEE from both household and non-household sources. As of today, however, the output data on WEEE is not readily available. As found in Table 4.6, the amount of WEEE collected by the systems established based on the requirement on the WEEE Directive and corresponding national legislation exist. However, as can be found from a simple comparison between amount of EEE put on the market and of WEEE collected (figures in Table 4.6 and 4.7), there is a big gap between what is put on the market and how much of that becomes waste. The varying length of EEE's life, collection of WEEE in other waste streams' collection schemes and by actors other than those whose collection are registered in the national waste statistics for purposes such as (illegal) export of second-hand products, parts or material recycling and hoarding by consumers, are among the many factors that would contribute to the gap.

A study on the material flow of WEEE in Sweden for six product categories mainly used by households (large and small household appliances, IT and telecommunications equipment, consumer equipment, electrical and electronic tools, toys, leisure and sports equipment) indicates that more than 4 kg of those products put on the market are retained in households per year (Hemström et al., 2012). This figure might change over time, as for example, the amount of EEE put in the market is declining, as shown in table 1. The same study indicates that the amount of WEEE found in unsorted waste streams is 0.6 kg per capita in 2010. When compared to the amount of EEE belonging to the six categories which are put on the Swedish market in 2010 (22.8 kg) and WEEE of the

same categories collected (16.7 kg), and take into consideration the WEEE in unsorted municipal waste stream (0.6 kg) and amount of EEE retained in the household (4 kg), the gap (the unaccounted stream) of the six categories becomes 1.5 kg.

In contrast, in the case of WEEE, input indicator—changes in EEE consumption—is perhaps more reliable, with put-on-the market figures found at national registers required under the WEEE Directive (see Table 4.6). However, similarly to food waste, trends in input indicators will be influenced by factors not (directly) related to waste prevention measures, such as products starting to have multiple functions (e.g. a mobile phone with the function of a computer and a camera), and economic downturns affecting demand for products²¹ etc.

The use of input-versus-output indicator, where input is measured by economic value of purchased EEE, and output measured in volume of WEEE, may not be most suitable for the WEEE waste stream due to the typically long time lag between the purchase of EEE product and it becoming waste and also the varying life spans of EEE products even within the same product category. Therefore, EEE becoming waste in any particular year will have little relationship to EEE purchased in the same year.

In relation to reuse and extension of life span of EEE, indicators measuring the availability and use of repair services and second-hand shops, as well as the use of second-hand products per se, could be considered. A related aspect could be the length of guarantee period of EEE. These can be considered to be Response type indicators.

Regarding part b) of the waste prevention definition—measures taken prior to EEE becoming WEEE, to reduce the adverse impacts of generated WEEE on the environment and human health—typical measures considered are design changes by producers to ease end-of-life management of WEEE. Producers, especially in anticipation of the WEEE Directive and similar policy measures in other parts of the world, have indeed taken various measures to enhance ease of dismantling, recyclability (e.g. reduce the number of types of plastics used in products) and similar (Tojo 2004). Quantification of these types of measures at the overall national economy level poses challenges, however. A simple proxy could be the number of manufacturers and importers that explicitly include design change measures which contribute to the adverse impacts of generated

²¹ However, relevant trade organisations in DK claim that EEE products are perceived as necessary commodity and therefore might not be affected much by economic fluctuations.

WEEE (design-for-end-of-life), as found, for instance, in their design strategy/guideline/manual.

Concerning part c) of the waste prevention definition—reducing the content of hazardous substances - indicators measuring the changes in hazardous substances contained in EEE and/or WEEE would be useful. The most obvious candidates to be measured are the six substances restricted by the RoHS Directive—lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE). Other substances that could be of relevance are those found on the so-called SVHC (substances of very high concern) list under the REACH Regulation (EC No 1907/2006)²² governing chemicals. Surveillance of the content of these substances in products requires much work, however.

8.2 Useful Core Data Elements

In light of the consideration discussed above, the core data elements needed for indicators for WEEE prevention are as follows:

- WEEE generation (tonnes, kg/cap).
- WEEE collection (tonnes, kg/cap).
- EEE put on the market (tonnes, kg/cap).
- Use of second-hand EEE (tonnes, kg/cap).
- Hazardous substances found in EEE (% in homogenous materials found in EEE).
- Second-hand shops handling EEE (number).
- Repair services (number).
- Manufacturers and importers of EEE that include end-of-life consideration in their design strategies (number).
- Population (number).
- GDP.

²² Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC.

The availability of the core elements for constructing WEEE prevention indicators in the Nordic databases or elsewhere (e.g. Eurostat) has been investigated. A list of available datasets is provided in Appendix 2.

The data availability around WEEE is poor with respect to the development of appropriate indicators, as the data sources indicate. WEEE is not a traditional waste stream, so registration of data measuring various aspects of it (including input data) are not well established. Moreover, the most obvious way for constructing indicators on a waste stream is to base them on waste generation itself. WEEE generation is very difficult to measure, despite the existence of a registration system. There are multiple factors that explain this situation: collection of WEEE together with other streams (e.g. MSW or industrial waste), export (illegal or not) of WEEE for re-use in other countries and stockpiling of EEE in the households.

8.3 Potential Indicators Based on Core Elements

The core elements described in chapter 8.2 may function as a basis for formulating potential indicators. Most of the elements can be directly used as indicators or be combined with other core elements to create additional indicators.

Table 8.1. Potential WEEE prevention indicators by combining the core data elements

Core data elements → ↓	WEEE Generation ²	WEEE collecti- on ³	EEE put on the market ³	EEE bought for re-use ¹	Re-used EEE sold ¹	Hazardous substances ²
WEEE genera- tion ²		WEEE collecti- on efficiency				
Population ³	WEEE generation per cap	WEEE collecti- on per cap	EEE put on the market per cap	EEE bought for re-use per cap	Re-used EEE sold per cap	
GDP ³	WEEE genera- tion/GDP per cap					
EEE put on the market ³	WEEE generation/ EEE put on the market per cap					Hazardous substances in EEE
Second-hand shops handling EEE EEE repair services Manufacturers and importers of EEE that include end-of-life consideration in their design strategies						

¹. No data available.

². Poor data availability.

³. Good data availability.

Note: Table 8.1 groups the indicators based on the combinations of core data elements.

The examination of potential indicators for the WEEE stream faces many challenges since the data availability is poor. Some potential or already proposed indicators for covering waste prevention in WEEE are:

1. WEEE generation (kg) per capita.
2. WEEE generation (kg) per unit GDP per capita.
3. WEEE generation versus EEE put on the market (EUR) per capita.
4. WEEE collection efficiency (proposed by ETC/SCP).
5. Total amount (EUR) of EEE bought with the purpose to re-use them per capita (proposed by EC).
6. The amount of re-used EEE sold (proposed by EC).
7. Hazardous substances found in EEE (% weight/total weight of EEE) (proposed by EC).
8. Number of second-hand shops handling EEE.
9. Number of repair services for EEE.
10. Number of manufacturers and importers of EEE that include end-of-life consideration in their design strategies.

8.4 RACER Assessment of Indicators

8.4.1 RACER assessment of existing indicators and proposed indicators from literature review

The literature review on WEEE reported on in Section 4.4 of this report did not identify operational indicators specific to prevention of WEEE. In the literature review performed in the course of this project four indicators have been found addressing WEEE proposed in a number of reports and policy papers in different time instances from the European Topic Centre on Sustainable Consumption and Production and the European Commission. These are:

- WEEE collection efficiency (proposed by ETC/SCP).
- Total amount (EUR) of EEE bought with the purpose to re-use them per capita (proposed by EC).
- The amount of re-used EEE sold (proposed by EC).
- Hazardous substances found in EEE (% weight/total weight of EEE) (proposed by EC).

Of those four indicators, the first one is an input versus output indicator while the other ones are of the output typology. None of them has been used so far for measuring WEEE prevention but rather exist in a development stage, pending the provision of more reliable and robust data. In the following tables (Tables 8.2–8.5) a brief RACER assessment is conducted for each of the identified indicators.

Table 8.2. RACER assessment of the indicator “Collection efficiency of WEEE”

RACER	Score	Comments
Relevance	2	Measuring the efficiency of collection does not directly relate to waste prevention. Changes in collection efficiency are determined much more by waste management measures such as producer responsibility schemes, demand for recycling.
Accepted	4	This could be considered as an accepted indicator as it has been officially proposed by the ETC/SCP.
Credible	1	As this indicator does not directly account for waste prevention, decisions on prevention measures and initiatives cannot be supported based solely on this indicator.
Easy	1	In order to measure collection efficiency, data on waste generation and collection are required. WEEE generation data is not available at the moment. Therefore, the indicator is difficult to implement currently but also in the future.
Robust	1	As a part of the data requirements is not available, the robustness of the indicator cannot be assessed. In general, collection efficiency is an established indicator for waste streams.
Final Score	1.7	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 8.3. RACER assessment of the indicator “Total amount (EUR) of EEE bought with the purpose to re-use them per capita”

RACER	Score	Comments
Relevance	2	This indicator addresses one way of achieving waste prevention by giving the products a second life through re-use. Therefore, it is partially relevant, since it does not provide a complete picture of waste prevention developments. On the other hand, the intention of re-use is only a proxy for the actual re-use of the products.
Accepted	4	This could be considered as an accepted indicator as it has been officially proposed by the EC.
Credible	3	The indicator’s credibility should be assessed carefully, as it should be taken into account only when investigating re-use. In this case, it is considered as a relatively credible indicator.
Easy	1	Data for the implementation of the indicator is missing, so it is difficult to apply it directly at the moment. In order to obtain data, a registration system needs to be put in place or a survey is required, as this data cannot be deduced from any other data source.
Robust	1	The unavailability of data reduces the robustness of this indicator. Also, the uncertainty regarding intention to re-use should be taken into account when addressing this criterion.
Final Score	2.0	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 8.4. RACER assessment of the indicator “The amount of re-used EEE sold”

RACER	Score	Comments
Relevance	3	This indicator addresses one way of achieving waste prevention by giving the products a second life through re-use. Therefore, it is partially relevant, since it does not provide a complete picture of waste prevention developments. On the other hand, the sold quantities of re-used EEE does not account for the total re-use as some EEE are re-used without entering the market, so the indicator can only be used as a proxy for re-use.
Accepted	4	This could be considered as an accepted indicator as it has been officially proposed by the EC.
Credible	3	The indicator’s credibility should be assessed carefully, as it should be taken into account only when investigating re-use. In this case, it is considered as a relatively credible indicator.
Easy	1	Data for the implementation of the indicator is missing, so it is difficult to apply it directly at the moment.
Robust	1	The unavailability of data reduces the robustness of this indicator. It should also be taken into account that this indicator is a proxy for the total re-use of EEE.
Final Score	2.3	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 8.5. RACER assessment of the indicator “hazardous substances found in EEE (% weight/total weight of EEE)”

RACER	Score	Comments
Relevance	3	This indicator addresses part c) of the waste prevention definition (see chapter 2). Therefore, it is only relevant regarding WEEE hazardous content and it describes very clearly waste prevention in this perspective. However, the time frame between EEE put on the market and their becoming WEEE hinders the indicator from accounting for the current situation.
Accepted	5	This indicator has been proposed by the EC (under the general title “hazardous substance indicator,” so it is considered as accepted by relevant stakeholders.
Credible	5	The hazardous content of EEE reveals information about the hazardous WEEE that is destined to appear in the future (depending of the EEE products’ life spans). Therefore, the indicator is rather credible for decision-making.
Easy	2	Data is missing regarding the first part of this indicator so its direct implementation is difficult. However, the countries are monitoring the use of banned substances in new EEE products by sampling systematically the market. This information could potentially lead to the development of this indicator.
Robust	1	Due to partial data unavailability, the robustness of the indicator is reduced.
Final Score	3.0	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

8.4.2 RACER assessment of the list of potential indicators

A brief assessment of the potential indicators follows, based on the RACER criteria.

Table 8.6. RACER assessment of the indicator “WEEE generation (kg) per capita”

RACER	Score	Comments
Relevance	3	This indicator addresses a classical approach for measuring and monitoring waste prevention. However, the WEEE generation is affected by many factors others than prevention measures, such as consumer habits, economic developments affecting household expenditure.
Accepted	4	This could be considered as an accepted indicator as it is an established approach in measuring prevention, although it has not been proposed or operated by any official body.
Credible	4	As any prevention measure would have a direct effect on waste generation, waste prevention-related decisions based on waste generation are considered credible enough.
Easy	1	Data for the implementation of the indicator is missing, so it is difficult to apply it directly at the moment. Also, obtaining data in the future might be difficult due to the problems encountered already in the efforts that have been made.
Robust	1	The unavailability of data reduces the robustness of this indicator.
Final Score	2.4	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 8.7. RACER assessment of the indicator “WEEE generation (kg) versus GDP per capita”

RACER	Score	Comments
Relevance	4	This indicator attempts to connect waste generation and economic data. It expresses the WEEE generation per unit GDP in order to disassociate the waste from influence of economic developments. GDP is used here as a proxy for the economy since it describes generic developments and not specific ones to the EEE sector. Therefore, this indicator could be slightly more relevant than investigating WEEE generation separately.
Accepted	4	This could be considered as an accepted indicator as it is an established approach in measuring prevention, although it has not been proposed or operated by any official body.
Credible	4	The generic nature of GDP as an economic indicator is a barrier for the credibility of this indicator. However, waste generation is the basis for making decisions about waste prevention, especially if the influence of economic developments is limited.
Easy	1	Data for the implementation of the indicator is missing, so it is difficult to apply it directly at the moment. As for the previous indicator, the future data situation does not look promising, despite the necessity of waste generation data.
Robust	1	The unavailability of data reduces the robustness of this indicator.
Final Score	2.7	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 8.8. RACER assessment of the indicator “WEEE generation (kg) versus EEE put on the market (EUR) per capita”

RACER	Score	Comments
Relevance	4	This output versus input indicator directly refers to prevention as it expresses waste generation in terms of material consumption. It encompasses all prevention initiatives that might have an effect. A drawback of the indicator is that most EEE have a life spanning more than one year, so this time lag is a barrier for the connection of EEE put on the market and waste generated in the same year.
Accepted	4	This could be considered as an accepted indicator as it is an established approach in measuring prevention, although it has not been proposed or operated by any official body.
Credible	4	The credibility of this indicator is high since it is a comprehensive approach to WEEE prevention and decisions can be made based on it.
Easy	1	The partial absence of data (on waste generation) makes the direct implementation of the indicator difficult. The future data situation was commented on in the first indicator.
Robust	2	The robustness of the indicator cannot be assessed properly due to absence of data on waste generation. The data on EEE put on the market have been registered for a substantial time period so, this indicator is partially robust.
Final Score	2.9	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 8.9. RACER assessment of the indicator “amount of EEE put on the market (kg) per capita”

RACER	Score	Comments
Relevance	4	This indicator refers to prevention by investigating consumption alone, as consumed products are destined to become waste. The information on waste generation is vaguer as products become waste after their life spans are over, which vary a lot according to product category. The indicator encompasses prevention measures targeting reduction in material consumption itself either directly or indirectly through e.g. increasing product life spans.
Accepted	3	This indicator, although not proposed or operated by any official body, is deemed relatively accepted since it is quite straightforward and easily understandable by relevant stakeholders.
Credible	3	The credibility of indicator is medium because the effect of policies or decisions on waste prevention is not directly reflected on it. Decision-makers cannot distinguish which specific measure is responsible for developments on the indicator but can, however, get a general idea on prevention.
Easy	5	Data on this indicator have been collected and registered for some years and the data quality is high. Moreover, detailed data exist for specific EEE categories. These facts render the indicator easy to implement directly.
Robust	4	This indicator is based on good quality data and addresses in a comprehensive manner waste prevention. Its robustness is, therefore, high. One weakness with the data is that it may include the weight of packaging. As electronic devices reduce in size this may not be accompanied by an accompanying reduction in size of the packaging, thus this trend may not be fully picked up by the indicator. This issue is not felt to be significant, however.
Final Score	4.0	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 8.10. RACER assessment of the indicator “WEEE collection (kg) per capita”

RACER	Score	Comments
Relevance	2	Collection of waste in most cases could be considered as a good proxy for determining the waste generation. However, due to the problems identified for the WEEE stream specifically, collection schemes fail to include a substantial or representative part of waste generated. Also, waste generation (or collection) does not accurately reflect prevention as it is affected by factors other than waste prevention.
Accepted	2	This indicator has been adopted by any official body, so its acceptance by relevant stakeholders is low.
Credible	2	The relation between prevention and collection presents many problems, so the credibility of the indicator in terms of support to decision-making processes is reduced.
Easy	5	Data to support the indicator exist for all Nordic countries for a number of years; therefore the direct implementation of the indicator is possible.
Robust	5	There is good quality and very relevant dataset to support the indicator, therefore its robustness is high.
Final Score	3.3	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 8.11. RACER assessment of the indicator “Number of second-hand shops handling EEE”

RACER	Score	Comments
Relevance	3	This indicator targets a specific, but very important for WEEE, way of achieving prevention, namely prolonging the products’ life spans. The number of second-hand shops is only a proxy for that, but gives a good indication regarding the market for re-use.
Accepted	2	This indicator has not been proposed by any official body, so its acceptance is questioned.
Credible	2	As the number of second-hand shops is only a proxy for lifetime extension, this indicator could not support by itself decisions regarding waste prevention. Also, it only refers to one specific prevention measure.
Easy	2	The data for this indicator are not readily available, therefore its direct implementation is not possible. However, a survey or a disaggregation of existing data could help establishing a data set.
Robust	1	The absence of existing data reduces the robustness of the indicator as also its character as a proxy for measuring re-use.
Final Score	2.1	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 8.12. RACER assessment of the indicator “Number of repair services for EEE”

RACER	Score	Comments
Relevance	3	This indicator, similarly to the previous one, addresses re-use of EEE specifically. Repairing is only a proxy, though, for re-use as re-use can be considered for products not requiring repair operations.
Accepted	2	This indicator has not been proposed by any official body, so its acceptance is questioned.
Credible	3	The repair services is a good proxy for extending the life span of products, although not a comprehensive indicator. It also refers only to a specific prevention measure.
Easy	5	Eurostat data exists for a number of EEE categories for all Nordic countries except Finland, so the indicator can be directly implemented.
Robust	3	The dataset existing at an EU level and the observed trends can lead to relatively robust conclusions on waste prevention of WEEE.
Final Score	3.4	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 8.13. RACER assessment of the indicator “Number of manufacturers and importers of EEE that include end-of-life consideration in their design strategies”

RACER	Score	Comments
Relevance	3	This indicator addresses waste prevention in terms of how much it is taken in consideration at the design stage of EEE. It refers to a specific measure for prevention, thus is not comprehensive.
Accepted	1	This indicator has not been proposed by any official body, so its acceptance is questioned.
Credible	3	The design considerations for waste prevention are an important prevention measure, but this indicator is not a standalone indicator for waste prevention decision-making processes.
Easy	2	Data for this indicator does not exist. A potential survey in all Nordic countries could provide with some input to this indicator.
Robust	1	Since no data exists to support this indicator, its robustness is questioned.
Final Score	2.1	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

8.4.3 Summary of RACER assessment results

In Table 8.14 all the RACER assessments conducted above are summarised and the final selection of indicators from this first set, taking account of these RACER assessments is carried out under section 8. First, consideration must be given to types of targets that might be politically relevant. These are then linked to the assessed indicators to produce a final set of targets and related indicators.

The table reveals that, with a few exceptions, the indicators suffer mostly in the “easy” and “robustness” criteria, which is due to the poor data availability of this waste stream.

Table 8.14. Summary of RACER assessments for WEEE prevention indicators

Indicator	R	A	C	E	R	Final Score
Collection efficiency of WEEE	2	4	1	1	1	1.7
Total amount (EUR) of EEE bought with the purpose to re-use them per capita	2	4	3	1	1	2.0
The amount of re-used EEE sold	3	4	3	1	1	2.3
Hazardous substances found in EEE (% weight/total weight of EEE)	3	5	5	2	1	3.0
WEEE generation (kg) per capita	3	4	4	1	1	2.4
WEEE generation (kg) versus GDP per capita	4	4	4	1	1	2.7
WEEE generation (kg) versus EEE put on the market (EUR) per capita	4	4	4	1	2	2.9
Amount of EEE put on the market (kg) per capita	4	3	3	5	5	4.0
WEEE collection (kg) per capita	2	2	2	5	5	3.3
Number of second-hand shops handling EEE	3	2	2	2	1	2.1
Number of repair services for EEE	3	2	3	5	3	3.4
Number of manufacturers and importers of EEE that include end-of-life consideration in their design strategies	3	1	3	2	1	2.1

8.5 Scoping on Targets

The literature review (Section 4) revealed a limited number of quantitative waste prevention-related targets for the WEEE stream. The Brussels region has a target on reduction of the consumption of relatively small EEE (gadgets) and the WEEE Directive provides with an overall target for both recycling and re-use. Other qualitative prevention provisions refer to the support for re-use and repair of EEE. However, no target or policy provision is accompanied with an indicator to help monitor progress or implementation.

Based on the literature review and the appropriateness of generic targets specifically for WEEE, a number of targets could be compiled to cover this waste stream:

- Reduce the consumption of EEE (in kg) by x% by year y with y_0 as a reference year.
- Reduce the consumption of a and b EEE categories (in kg) by x% by year y with y_0 as a reference year.
- Increase the re-use of EEE by x% by year y with y_0 as a reference year.

- Extend the average life span of EEE products by x% by year y with y_0 as a reference year.
- Reduce the WEEE generation by x% by year y with y_0 as a reference year.
- Reduce the content of hazardous substances in EEE by x% by year y with y_0 as a reference year.
- Increase the material efficiency in EEE by x% by year y with y_0 as a reference year.

These targets aim at different aspects and definitions of waste prevention. Some of them are supplementary to others and cannot themselves comprehensively address waste prevention: targets on re-use of EEE and hazardous content, for example, should be accompanied with more comprehensive targets such as the reduction of EEE consumption or WEEE generation.

It should be underlined at this stage that the prevention targets have to be accompanied with relevant policy initiatives of encouragement of private initiatives, in order to ensure their success.

8.6 First Stage Targets and Indicators

It is of particular interest to assess how these targets can be addressed by corresponding indicators which can measure progress towards the target year by year. These indicators should ideally refer specifically to the target and evaluate the progress in a comprehensive manner. On the left side the targets are presented one by one and on the right side the most appropriate indicator(s), which fit the target, are identified and their potential use is analysed.

Box 19

Target

Reduce the consumption of EEE (in kg) by x% by y with y_0 as a reference year

Comments: This target refers to consumption of EEE as this would reflect the generation of waste when the EEE products exhaust their life spans. Therefore, the more reduced the EEE consumption is the less waste will be generated in the future. The results of this target will present themselves in different years for different products, as there is a great variety of typical product life spans in EEE.

Indicator

Amount of EEE put on the market (kg) per capita

Comments: This indicator describes the targets accurately and directly. The relatively long time series of data allows also for the determination of a base year and the analysis of existing or past trends.

Box 20

Target

Reduce the consumption of a and b EEE categories (in kg) by x% by y with y_0 as a reference year

Comments: This target refers to consumption of EEE as this would reflect the generation of waste when the EEE products exhaust their life spans. Therefore, the more reduced the EEE consumption is the less waste will be generated in the future. The results of the target would have an effect on waste generation in future years. The target is detailed enough to allow selective targeting of specific products or EEE product categories, so that the accompanying measures are also detailed and specific.

Indicator

Amount of EEE put on the market (kg) per capita

Comments: This indicator describes the targets accurately and directly. The relatively long time series of data allows also for the determination of a base year and the analysis of existing or past trends. The EEE categories included in the target must match the product categories for which data exist in order for the indicator to directly account for the target.

Box 21

Target

Increase the re-use of EEE by x% by y with y0 as a reference year

Comments: This target refers specifically to re-use as a way to achieve waste prevention. Re-use is a way of delaying waste generation by giving products a second life and potentially reducing the demand for new products which would then become waste. The target is also an accurate way of measuring waste prevention as it actually measures waste that are not there, but would have occurred if the target was not achieved.

Indicator

Total amount (euro) of EEE bought with the purpose to re-use them per capita

Comments: This indicator describes the economic activity related to EEE bought for re-use. Although the indicator refers to re-use itself, it does not cover the entire re-use activity since routes such as repairing for own purposes and re-use of a product without entering the market. Therefore, it can be used for monitoring and measuring progress towards the target, but only as a proxy.

The amount of re-used EEE sold

Comments: This indicator has the same characteristics as the previous one in relation to its pairing with the target. It refers to re-use by accounting for amounts of re-used EEE sold, but does not describe the entire re-use in the EEE domain. This indicator can potentially be used together with the re-use target but interpreted carefully as a proxy.

Number of second-hand shops handling EEE

Comments: This indicator is a proxy indicator for measuring re-use in accordance with the relevant target. The number of second-hand shops are themselves a proxy for re-used EEE sold, as the amount of re-used products cannot be determined by solely the number of second-hand shops. In case of data unavailability for the previous two indicators, this indicator might be used if data exist or is easy to obtain.

Box 22**Target**

Extend the average life span of EEE products by x% by year y with y₀ as a reference year

Comments: Extending a product's life span by e.g. exhausting its life span (this is particularly relevant for EEE products as people tend to throw them away much before they are not functional anymore) or repairing it, is a way to delay waste, thus achieve waste prevention. According to this target, the more the increase in average life span, the less waste is produced.

Indicator

Number of repair services for EEE

Comments: This indicator does not directly address the increase of life span of the products, as it is described in the target. Repairing is one way of extending the life span of the product (another is e.g. increased average designed life span). Moreover, the number of repair services does not refer to the quantity of EEE products treated or the period of time that the life spans are extended. Since this is, however, an indicator with supporting data, it could be used as a proxy indicator to monitor progress towards the target.

Box 23

Target

Reduce the WEEE generation by x% by y with y_0 as a reference year

Comments: This target is a represents a classic approach to waste prevention, which monitors developments in WEEE generation and aims at is reduction by a certain % per year or for a period of years. It should be carefully compiled so that it is both ambitious and that it does not underestimate the effects of prevention measures. The target is based on the fact that the higher the effectiveness and intensity of waste prevention, the higher reduction is achieved on waste generation. However, the WEEE generation is influenced by factors other than waste prevention, such as economic developments or technological advancements in the EEE sector.

Indicator

WEEE generation (kg) per capita

Comments: This indicator directly corresponds to the target by measuring the WEEE generation itself. However, data to support this indicator is poor and the monitoring and measurement of the target is not feasible under current conditions.

WEEE collection (kg) per capita

Comments: This indicator could be used as a proxy to waste generation, due to absence of WEEE generation data. However, collection of WEEE is not representative for waste generation as relatively high quantities of waste escape the collection systems because of e.g. stockpiling, export to other countries and collection of WEEE in other waste streams schemes. Therefore, there is a general policy objective to increase the collection of WEEE in order to secure more appropriate waste management. This objective might cause problems to the interpretation of this indicator in terms of waste prevention.

Box 24

Target

Reduce the content of hazardous substances in EEE by x% by y with y_0 as a reference year

Comments: This target refers to part c) of the waste prevention definition, namely the reduction of hazardous substances in WEEE. This definition is particularly relevant as a large part of WEEE (e.g. batteries) is considered to be hazardous waste. Therefore, there is ground to be covered in terms of hazardous content in EEE. The target does not refer to waste but to EEE products, thus indirectly covering the hazardous content of waste.

Indicator

Hazardous substances found in EEE (% weight/total weight of EEE)

Comments: This indicator matches well the target as it directly measures the hazardous substances by weight found in EEE.

Box 25

Target

Increase the material efficiency in EEE by x% by y with y_0 as a reference year

Comments: This target represents a traditional approach to prevention by addressing the efficient use of materials in EEE production. The target bypasses consumption patterns and can be interpreted as: the higher the material efficiency the lower amount of waste is generated for a given consumption of EEE products. Targeting all EEE could be difficult due to the different characteristics of the included products (e.g. great size reduction cannot be easily applied to the category of large household appliances). Therefore, perhaps the target can be broken down to individual targets for each EEE product category.

Indicator

WEEE generation (kg) versus EEE put on the market (EUR) per capita

Comments: This indicator could be used as a potential pair with the material efficiency target. Juxtaposing waste generation against EEE put on the market in the same year is difficult since many of the EEE products have a life spanning more than one year. Besides this drawback, the indicator aims at efficiency since a decrease of waste per unit (EUR) of product put on the market indicates higher material efficiency.

8.7 Final Proposals for Targets and Indicators for WEEE prevention

It is the responsibility of the policy maker to set targets for waste prevention and the policy maker must take into account a large number of factors when choosing national targets. The proposals below are only suggestions which might be useful to consider.

Out of the eleven pairs of targets/indicators assessed in detail, some of the proposed targets and indicators require new reporting schemes in order to obtain the necessary data. This fact restricts the application of the targets/indicators pairs based also on the wish of the Nordic Council of Ministers for relatively easily implemented sets.

Indicators using existing datasets as core element can be described as a *best-available* indicators, while alternative indicators based on collection of additional data (mainly waste generation data, but also hazardous substances content of EEE, re-used EEE sold etc.) are classified as *best-needed* indicators for the same targets.

8.7.1 Suggested targets and indicators

Concluding from the whole process, a list of targets along with their corresponding indicators are proposed here for consideration by countries during the selection, evaluation and use of targets in national waste prevention plans or programmes:

1. Reduce the consumption of EEE (in kg) by x% by year y with y_0 as a reference year.

For measuring progress against this target, the indicator "*Amount of EEE put on the market (kg) per capita*" can be used and described as a *best-available* and sufficient indicator for the target.

2. Increase the re-use of EEE by x% by y with y_2 as a reference year
3. For measuring progress towards this target a *best-needed* indicator on "*The amount of re-used EEE sold*" is proposed.

At the moment, no indicator exists with a dataset sufficient to support this target, so no *best-available* indicator is proposed.

4. Reduce the WEEE generation by x% by year y with y_0 as a reference year.

For measuring progress towards this target, data on waste generation of WEEE are essential in order to produce a *best-needed* indicator on “WEEE generation (kg) per capita” which is not available at the moment.

Alternatively, as a *best-available* indicator the “Collection of WEEE (kg) per capita” can be used as a proxy.

5. Reduce the content of hazardous substances in EEE by x% by y with y_0 as a reference year–Hazardous substances found in EEE (% weight/total weight of EEE).

At the moment, no indicator exists with a dataset sufficient to support this target, so no *best-available* indicator is proposed.

Information to create a *best-needed* indicator on “Hazardous substances found in EEE (% weight/total weight of EEE)” is currently not widely available to follow up this target.

6. Increase the material efficiency in EEE by x% by y with y_0 as a reference year–WEEE generation versus EEE put on the market per capita.

At the moment, no indicator exists with a dataset sufficient to support this target, so no *best-available* indicator is proposed.

The *best-needed* indicator on “WEEE generation (kg) versus EEE put on the market (EUR) per capita” is suggested to monitor efforts of the EEE industry to improve the existing material efficiency of the products.

9. Proposal for Indicators on Prevention of Textiles Waste

9.1 Indicator Types Useful for Textiles Waste Prevention

This section indicates the types of indicators that can be drawn from the indicator typology given in Box 1 at the beginning of this report that might be useful for the elements of waste prevention given in Box 2 at the beginning of Chapter 4.

9.1.1 *Quantitative waste prevention (part a of the waste prevention definition)*

One of the most direct indicators to measure the progress of quantitative waste prevention would be the output type indicator i.e. textiles waste generation. However, to date, except for some one-shot data based on detailed case study (e.g. as found in Table 4.8), no reliable dataset is available for estimating quantities of textiles wastes generated.

Nonetheless, since a crucial issue that quantitative waste prevention seeks to address is the increase in the consumption of new textile products, input-type indicators (i.e. consumption of textile products) could be used as reasonable proxies for waste generation. Following the methodology of recent studies (Carlsson et al., 2011; Tojo et al., 2012), the input indicator, consumption of textile products can be calculated using three types of datasets: the amount of textile products manufactured within the country, amount of new textile products exported, and amount of new textile products imported from abroad.

In order to understand the changes in the consumption pattern of households, it would be also relevant to monitor the changes of final consumption expenditures of households on textile products via the use of decoupling type indicators i.e. consumption of textile products by weight per EUR of consumption. When expenditure is constant but quantity (by weight) of consumption is increasing, it most likely means that consumers go for the purchase of higher number of prod-

ucts with lower price. This would imply a compromise in the quality of the products, and a general reduced willingness of consumers to take good care of the products and keep the products for longer.

Another barometer for the consumption of the textile products could be the trend in the trade of second-hand textile products. If the purchase of new textile products is replaced by that of second-hand textile products, the upstream environmental arising from the production of new textile products would decrease. In this regard, changes in the sales of second-hand textile products (and proportion of such sales in the total amount of textile products traded) would provide useful response-type indicators. It should be noted, however, that the “trade” or “exchange” of second-hand textile products take various forms, and not all go through the “official” channels that would be registered in the national accounts. Examples include the exchange of used textile products between family members and friends, consumer to consumer trade of second hand clothing via Internet trading sites and flea markets, and “textile exchange” events (Tojo et al., 2012). A survey for adult population in Norway indicates that between 2010 and 2012, 30% of the respondents received used clothing without going through commercial channels, while 17% have bought used clothing (Laitala & Grimstad Klepp, 2012). Moreover, the ratio of reuse would be different between different types of textile products. For instance, there is an indication that reuse of children’s clothing is most likely more frequent than other types of clothing. Generally, the data on the second-hand textile products is not available in a consistent manner.

The trade of second-hand products takes place not only within countries but also across national borders. Observing the trend of the amount of second-hand textile products exported could provide an important indication on the enhancement of reuse. Information in this area is available in the trade statistics. It should be noted, however, that the export of second-hand textile products is not free from controversy, not least in relation to the potential impacts they give on the local economy of recipient countries.

Finally, prolongation of the life of textile products could benefit from the possibility of repairing textile products, either by the users themselves by professional repair services. While some of the repairs (e.g. missing buttons) could be easily done at home, others (e.g. fixing a broken zipper) could be complicated and not everyone may have the skill/time/confidence in handling such repairs him/herself. The need of repair also depends on the original quality of textile products (e.g. if the

quality of zipper is high, the necessity of repair is reduced). A response-type indicator could cover this area. However, as it stands now, no data on the availability of repair shops for textile products exist, and except for some one-shot studies (see for example Laitala et al, 2011), information on the repair practices of citizens (e.g. textile products repaired per year, and by which means) is limited.

Further response-type indicators could be included in the following areas:

9.1.2 Upstream design changes (part b of the waste prevention definition)

There exist various possible upstream changes to improve the environmental performance of textiles at post-consumer stage of their life cycle (i.e. responding to part b) of the waste prevention definition). One often-mentioned improvement necessary to enhance recyclability of materials is to avoid mixing different material types in products. In this regard, it would be useful to follow trends in the sales of fibres made of single materials out of total amount of fibres traded. However, such data does not exist.

9.1.3 Qualitative waste prevention (part c of the waste prevention definition)

This concerns the third part of the waste prevention definition i.e. upstream actions to reduce the environmental impacts of textiles wastes. There are a number of labelling schemes/certification schemes to address the issue of inclusion of hazardous substances in textiles. Examples that are relevant for the Nordic region include, but are not limited to, i) the ISO Type I eco-labelling schemes (Nordic Swan,²³ Swedish Good Environmental Choice,²⁴ EU Flower²⁵), ii) Oeko-Tex Standard 100,²⁶ and iii) bluesign certification scheme.²⁷ Among them, those under the first category have an extensive requirement for hazardous substances used during the production process, and include the use of recycled fibres as a

²³ <http://www.svanen.se/en/>

²⁴ <http://www.naturskyddsforeningen.se/bra-miljoval>

²⁵ <http://ec.europa.eu/environment/ecolabel/>

²⁶ <http://www.oeko-tex.com/en/manufacturers/manufacturers.xhtml>

²⁷ <http://www.bluesign.com/>

way of compliance to the criteria. The Oeko-Tex Standard 100 focuses on the effects of chemicals in the products on the user of the products. Those two categories certify textiles at the product level (e.g. clothes, towels, etc.). Bluesign is different from the others in that that it certifies textiles at the material (fibre) level.

A potential approach to check the progress in qualitative waste prevention is to find out how many products/materials are certified by such labelling/certification schemes. The approach faces some limitations. First, although information as to which product models are certified is available from the organisations running such schemes, the absolute number of the respective product models put on the market is not. Thus one could count the changes in the number of models, but NOT the share of such models in the market. In addition, the way the models are registered in the labelling schemes are not standardised, and essentially the same type of products (e.g. organic cotton shirt) could be registered as separate items (e.g. depending on the colour). Moreover, due partly to the cost involved in certification, some producers may not apply for a label even when the quality of their products meet the criteria set forth in the labelling schemes.

Nevertheless, in the light of lack of other available data, monitoring the changes in the number of models certified in the aforementioned labelling schemes would provide at least some indication in the progress (or lack of) in qualitative waste prevention.

Another potential approach is to monitor the chemical content of textile products imported to the country. According to a stakeholder consulted in the process of developing the indicator, customs usually already conduct random controls. Recent studies on the textile flow in three Nordic countries show that the vast majority of textile products put on the market are imported (Carlsson et al., 2011; Tojo et al., 2012). If the frequency of the check is increased and the substances monitored can be specified (e.g. perflourinated substances, flame retardants, phthalates), a proxy for qualitative waste prevention could be established. Namely, one could monitor the approximate amount of the specified substances that would end up in waste water (when washing) or in incinerators/landfills.

9.2 Useful Core Data Elements

In light of the consideration discussed above, the core data elements needed for indicators for prevention of textiles waste are as follows:

- Amount of textile waste generation (tonnes, kg/cap).
- Amount of textile products manufactured within the country (tonnes, kg/cap).
- Amount of new textile products exported (tonnes, kg/cap).
- Amount of new textile products imported from abroad (tonnes, kg/cap).
- Final consumption expenditure of households on textiles (total, textile related categories) (value).
- Sales of second-hand textile products (value).
- Amount of second-hand textile products exported (tonnes, kg/cap).
- Textile products repaired (number).
- Population (number).
- Number of textile product models certified by one of the following eco-labelling schemes Nordic Swan, Swedish Good Environmental Choice Program, EU Flower.
- Number of textile product models certified by Oeko-Tex Standard 100 and number of material products certified by bluesign.
- Amount of specific chemicals present in imported textile products (g).

The availability of the core elements for constructing textiles waste prevention indicators in the Nordic databases or elsewhere (e.g. Eurostat) has been investigated. A list of available datasets is provided in Appendix 2.

9.3 Potential indicators based on core data elements

The indicators described in Section 9.1, using the core data elements introduced in Section 9.2, are presented in Table 9.1.

Table 9.1. Potential Indicators using the Core Data Elements (tonnes)

Core data elements → ↓	Total textiles waste generation ¹	Total domestic production of new textile products (a1) ³	Total export of new textile products (a2) ³	Total import of new textile products (a3) ³	Purchase of second-hand textile products (b) ¹	Final consumption expenditure of households (total, related to textile products) (value) ³	Total export of second-hand products ³	Textile products repaired (number) ¹
Total new textile products put on the market (a1-a2+a3= a4) ³								
Population (number) ³	Textiles waste generation per capita	New textile products put on the market per capita		Purchase of second-hand textile products for the purpose of reuse, per capita	Household expenditure on textile products per capita			Repaired textile products per capita
Total textile products put on the market (a4 +b in the column) ³				% of second-hand products out of total textile products put on the market	Household expenditure on textile products per tonne of textile products put on the market	% of export of second-hand products out of total textile products put on the market		
Textile product models certified by eco-labelling schemes* (number)								
Textile product models certified by Oeko-Tex Standard 100 and bluesign (number)								
Amount of specific chemicals present in imported textile products (g)								

*Eco-labelling schemes considered for the indicator in the Nordic countries are Nordic Swan, Swedish Good Environmental Choice and EU Flower.

¹. Core data elements with low data availability.

² Core data elements with moderate availability.

³. Core data elements with good availability.

Note: While many of the indicators are combination of two or more core data elements, some of them are stand-alone (full rows).

One output indicator is constructed from the core data elements, that is:

- Textiles waste generation (kg per capita per year).

Ideally, it would be good to distinguish the sources of textile waste between households and non-households (i.e. various types of institutions), as different waste prevention measures could be used for different users of textiles. For instance, measures to enhance the longevity of uniforms used by public transport companies (i.e. non-household users) may look different from the prolongation of life of clothing used in private households. However, a recent study on the material flow of textile products in three Nordic countries indicated that flow of textiles to these two different actors are not very well known (Tojo et al., 2012). Without

clearly grasping the typical actors in the non-household users of textiles, it is difficult to set separate indicators.

Input indicators constructed include:

- New textile products put on the market per capita per year,
- Purchase (by weight) of second-hand textile products per capita per year, and
- Household expenditure on textile products per capita per year.

While datasets needed to generate the first and the third are well established, the second (purchase of second hand products by weight) have not been well documented, except for a few time-limited studies. A more systematic data collection in this area is needed. It should be noted that the first dataset require some calculations which will have a cost.

Two input vs output indicators suggested are:

- Share (by weight or by value) of second-hand products in total textile products put on the market.
- Ratio (by weight) of exported second-hand products to total textile products put on the market.

These indicators help grasp the progress in one way of prolongation of the life of textile products' life. The datasets for export of second-hand products is better established than the domestic sale/use of second-hand products, and policy measures related to these two indicators would be different.

As a way of understanding the changes in price of textile products consumers are purchasing, the following indicator is considered.

- Household expenditure on textile products per tonne of textile products put on the market.

The intention is to understand how the trend between buying cheap and more products, and buying expensive (and hopefully with better quality) and fewer products, develop over time.

As a proxy for the changes in the amount of hazardous substances that end up either in waste water or solid waste disposal facilities, one hazardous content indicator is suggested.

- Amount of specific chemicals present in imported textile products (g).

Finally, a number of response-type indicators are proposed.

- Number of textile product models certified by eco-labelling schemes relevant to the Nordic countries (Nordic Swan, Swedish Good Environmental Choice, EU Flower).
- Number of textile product models certified by Oeko-Tex Standard 100 and Bluesign.
- Repaired textile products (number/ capita/year).

The first two are proxy for hazardous content indicator, while the third is a means to help estimate the amount of textile products repaired by different means.

9.4 RACER Assessment of Indicators

9.4.1 RACER assessment of existing and proposed indicators from literature review

The literature review on textiles waste reported on in Section 4.5 of this report did not identify operational indicators specific to prevention of textiles waste. Three indicators were identified that had been proposed by the OECD and the European Commission:

- Textiles waste generation per capita per year.
- Consumption and recycling of selected materials (e.g. textile products).
- Total amount (EUR) of assets (e.g. textile products) bought with the purpose to re-use them per capita.

The content of the indicators are the same or similar to some of the indicators discussed in the previous sections, as follows:

- Textiles waste generation per capita per year.
- New textile products (by weight) put on the market per capita per year (proxy for consumption).
- Purchase (by weight) of second-hand textile products per capita per year (addressing the second indicator above, but in volume rather than monetary value).

The first one is an output indicator, while the second and the third are input indicators.

Below a brief RACER assessment of these three indicators are conducted.

Table 9.2. RACER assessment of the indicator “textiles waste generation (kg per capita per year)”

RACER	Score	Comments
Relevant	4	This is directly relevant to waste prevention in textiles wastes although the amount of waste generated per se does not capture the main impact that textiles waste prevention measures seek to address (i.e. upstream environmental impacts that occur during the production and use phase of products).
Accepted	3	Provided that the datasets were robust behind such an indicator the acceptance of this indicator could be reasonably high since it has also been proposed by the EC.
Credible	2	Currently, none of the Nordic countries legislate separate collection of textiles waste. This hinders a systematic collection of data on textiles waste generated.
Easy	1	Lack of systematic collection of datasets would make it difficult to follow-up over time. As textile waste tends to be thrown away at one time in bulk rather than little by little, finding representative figures from pick analysis requires very large samples.
Robust	2	It would be difficult to get the representative sample from, for instance, pick analysis, making the quality of data low.
Final Score	2.4	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 9.3. RACER assessment of the indicator “new textile products (by weight) put on the market (kg per capita per year)”

RACER	Score	Comments
Relevant	4	Considering the main aim of prevention of textiles waste being the reduction of environmental impacts occurring during the production phase of new products, use of this indicator is highly relevant in addressing prevention of this waste stream. Moreover the indicator can be used as a proxy for the generation of textiles waste in absence of waste generation data since all textile purchases will eventually end as waste eventually end as waste. Moreover, reductions in purchase of new textiles can reflect trends in waste prevention activities i.e. the more one purchases quality rather than quantity the lower the weight of purchased new textiles. Similarly, the more used clothes that are purchased the fewer new clothes might be expected to be bought (although this depends on the price differential between new and used clothing).
Accepted	3	The indicator is in line with what is proposed by the OECD. Encouraging reduced consumption may be controversial. However, shifting from consumption of more and cheap textile products to less and more expensive/quality textile products may not be problematic, so long as it does not jeopardise the supply of basic needs at reasonable price.
Credible	4	Data sets needed for this indicator is well established and reliable. Some issues exist regarding the conversion of the number of items into weight.
Easy	4	Once the methodology for calculation is established, it is quite easy to have continuity. However, there will be some relatively moderate cost involved in carrying out the calculations each year.
Robust	5	The scope and representativeness of this indicator fits very well to the objectives of textiles waste prevention. Data sets needed for this indicator is well established and reliable.
Final Score	4.0	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 9.4. RACER assessment of the indicator “purchase (by weight) of second-hand products (kg per capita per year)”

RACER	Score	Comments
Relevant	4	Increasing the use of second-hand products directly contributes the main aim of textiles waste prevention (reduction of environmental impacts arising during the production phase of new products). However, it is not certain that the purchase of second-hand products will replace that of new products.
Accepted	3	The importance of the measurement of goods re-circulated in the economy is acknowledged one way or another.
Credible	2	At the moment, there is no established method of collecting data for the sales of second-hand textile products. Existing studies rely on information of representative actors who handle second-hand textile products, most notably charity organisations.
Easy	1	Without the establishment of official data collection systems, follow-up overtime would face challenges. Information on economic value is more likely to be easier to obtain than purchase by weight.
Robust	3	Representativeness and scope score high, but not the data quality.
Final Score	2.9	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

9.4.2 RACER assessment of the list of potential indicators

In addition to the indicators which were (in some cases, elements of which were) identified in literature and assessed above, the study has identified eight more indicators for consideration. These indicators, for which RACER assessments are conducted in this section, are:

- Household expenditure on textile products per capita per year.
- Share (by weight) of second-hand products in total textile products put on the market.
- Share (by value) of second-hand products in total textile products put on the market.
- Ratio (by weight) between exported second-hand products and total textile products put on the domestic market.
- Household expenditure on textile products per tonne of textile products put on the market.
- Amount of specific chemicals present in imported textile products (g).
- Number of textile product models certified by eco-labelling schemes relevant to the Nordic countries (Nordic Swan, Swedish Good Environmental Choice, EU Flower).
- Number of textile product models certified by Oeko-Tex Standard 100 and Bluesign.
- Repaired textile products per capita.

The first is an input indicator, and the second and the third are input-vs.-output indicators. The fourth indicator assesses the ratio of two input indicators. The fifth and sixth indicators serve as proxy for hazardous content indicators but can also be considered as response type indicators. The final indicator is a response type indicator.

Table 9.5. RACER assessment of the indicator “household expenditure on textile products (EUR per capita per year)”

RACER	Score	Comments
Relevant	3	This indicator complements the indicator on total amount of new textile products put on the market and helps understand consumption of textile products in terms of economic value. Consumption of new textiles should reduce in value as the lifetime of existing textiles is prolonged through waste prevention initiatives including promoting reuse. However, to fully pick up on such initiatives this requires that spending on new textiles is distinguished from spending on second-hand textiles. This is not possible to date. Nevertheless, the indicator should react to less official prolonging activities such as clothes swapping and increased repair activities.
Accepted	3	Reliability of the datasets as well as the relatively high level of relevance would ease the acceptance of this indicator.
Credible	4	The methodology for collection of the datasets for this indicator is well established.
Easy	4	The availability of the established datasets allow follow-up of changes over time. The data is readily available and requires little further processing.
Robust	3	Although the quality of the data is high, the fact that no distinction is made between the new and second-hand textile products make it somewhat difficult to connect the trend of the expenditure to that of upstream environmental impacts caused by production of new products.
Final Score	3.4	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 9.6. RACER assessment of the indicator “share (by weight) of second-hand products in total textile products put on the market (%)”

RACER	Score	Comments
Relevant	4	This indicator, if supplied with reliable data, would be very relevant to the main aim of textiles waste prevention. As the % becomes higher, the proportion of new products circulated in the economy becomes lower. However, if the overall consumption of textile products continue to increase, the relative increase of second-hand products in society does not necessarily connect to the decrease of upstream impacts occurred when during the production phase of new products.
Accepted	3	Lack of reliable data source would lower the acceptance of this indicator.
Credible	2	The indicator suffers from lack of reliable datasets for second-hand products, which also reduces the reliability of the total textile products put on the market (i.e. total new textile products + total second-hand products put on the market).
Easy	1	Lack of systematic collection of sales of textile products in second-hand market pose challenge in follow up changes over time. Collecting reliable datasets would be difficult particularly because it is the share by weight that is of interest.
Robust	2	While the scope and representativeness of the indicator is high, it suffers from low quality of data.
Final Score	2.4	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 9.7. RACER assessment of the indicator “share (by value) of second-hand products in total textile products put on the market (%)”

RACER	Score	Comments
Relevant	3	This indicator, if supplied with reliable data, would be relevant to the main aim of textiles waste prevention. As the% becomes higher, the proportion of new products circulated in the economy becomes lower. This indicator has somewhat lower relevance to the target than the indicator above which measures share of second hand products in total products by weight. Measuring the share by value will underestimate the importance of second hand goods in the market since these will tend to have a lower price per clothing/textiles item than new products. This therefore underestimates the offsetting of new purchases by purchase of second hand and subsequent effects on waste prevention.
Accepted	3	Lack of reliable data source would lower the acceptance of this indicator.
Credible	2	The indicator suffers from lack of reliable datasets for second-hand products, which also reduces the reliability of the total textile products put on the market (i.e. total new textile products + total second-hand products put on the market).
Easy	3	Lack of systematic collection of sales of textile products in second-hand market pose challenge in follow up changes over time. Collecting reliable datasets for this indicator would be significantly simpler than collecting data on share by weight in the indicator above. Sales by the second hand sector and the mainstream clothing/textiles sector is likely to be held by tax offices. However, consumer to consumer sales will not be available.
Robust	2	While the scope and representativeness of the indicator is high, it suffers from low quality of data.
Final Score	2.7	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 9.8. RACER assessment of the indicator “ratio (by weight) of exported second-hand products to total textile products put on the market (%)”

RACER	Score	Comments
Relevant	2	This indicator provides some information on the proportion of textile products whose life is extended. As the second-hand products go outside of the country, they do not replace the purchase of new products in the country. However, it could be argued that consumption of new products is lowered on the global scale due to the trade of second-hand products, which would contribute to the overall reduction of environmental impacts arising from the production of new products. This benefit would diminish/disappear if second-hand products sent abroad are not used and become waste. However, little is known on the destiny of the second-hand textile products, especially when they leave the country.
Accepted	2	Uncertainty in the destiny of exported second-hand textile products, as well as lack of continuous supply of reliable data needed for calculation of the denominator (see comments under “credible” criterion) would decrease the acceptance of this indicator.
Credible	3	The datasets for exported second-hand products are readily available in all the Nordic countries. Uncertainty exists in the calculation of the denominator (i.e. total textile products put on the market), as one of the datasets required for the calculation is the domestic sale of second-hand products, a systematic data collection for which is currently missing. However, as the rest of the dataset needed for the denominator is readily available, the remaining could be supplemented by, for instance, periodic surveys.
Easy	3	While the figure for exported second-hand products exists, the continuous update of the denominator, as discussed under “credible” criterion, faces challenges.
Robust	2	The judgment on scope and representativeness requires more knowledge on what happens to second-hand textile products once they are sent abroad. The uncertainty in the quality of part of the datasets required for this indicator also lowers its score on robustness.
Final Score	2.4	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 9.9. RACER assessment of the indicator “household expenditure on textile products per tonne of textile products put on the market (EUR/tonne)”

RACER	Score	Comments
Relevant	4	In general, as trends in this indicator increase the lower the environmental impacts upstream per EUR of spending. Trends in the indicator can reflect two different trends; 1) that when purchasing, consumers are increasingly putting more weight on quality of textiles/clothing over quantity and/or 2) changes in prices of raw materials i.e. cotton. In either case an increase in price of textiles which are being purchased should act as a driver towards encouraging a more prolonged life.
Accepted	2	This could potentially be a controversial indicator for policy makers since it could be interpreted to mean that indicate that policy makers wish for a higher price of textiles. This may not be well received by consumer groups.
Credible	3	The datasets for household expenditure on textile products are readily available in all the Nordic countries. Uncertainty exists in the calculation of the denominator (i.e. total textile products put on the market), as one of the datasets required for the calculation is the domestic sale of second-hand products, a systematic data collection for which is currently missing. However, as the rest of the dataset needed for the denominator is readily available, the remaining could be supplemented by, for instance, periodic surveys.
Easy	3	Except for the missing datasets that constitutes part of the denominators, the remaining datasets are established and easy to follow-up.
Robust	3	The overall data quality, scope and representativeness of this indicator is relatively high.
Final Score	3.1	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 9.10. RACER assessment of the indicator “quantities of specific chemicals present in imported textile products (mg/kg)”

RACER	Score	Comments
Relevant	4	Monitoring the amount of specific chemicals present in imported textile products would provide direct indication on the progress on qualitative waste prevention.
Accepted	3	If the frequency of the customs’ check on the content of specific chemicals in textile products increases and the quality of such check is secured, it would most likely be well accepted by stakeholders.
Credible	2	The level of credibility would be largely dependent on the frequency and quality of tests conducted by customs. As it stands now, the frequency of such tests is not well known.
Easy	1	Although a knowledgeable source indicate that customs already conduct random test of chemical content in the imported textile products, the frequency and coverage of such test is unknown. More regular tests would require additional resources.
Robust	2	As a very large portion of textile products put on the Nordic market are currently imported, the scope of this indicator is adequate. Data quality and representativeness would largely depend on the practices of custom officers, and as of today, such practices would be insufficient to provide a representative figure.
Final Score	2.4	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 9.11. RACER assessment of the indicator “number of textile product models certified by eco-labelling schemes relevant to the Nordic countries (Nordic Swan, Swedish Good Environmental Choice, EU Flower)”

RACER	Score	Comments
Relevant	3	Monitoring the number of textile products certified by eco-labelling schemes addressing the issues aimed by textiles waste prevention measures is one feasible way of checking the residual hazardous substances in textile products used/come into waste streams in a practical manner.
Accepted	2	The low representativeness of the indicator (see comments for “Robust”) would most likely lower the acceptance by academia.
Credible	2	The three eco-labels are well known among the Nordic citizens and their credibility is very high. However, companies do not necessarily go for certification of products even when products meet the criteria set forth in the eco-labelling schemes, and there are uncertainties as to how many of such products exist.
Easy	4	A list of textile product models certified is available on the website of the respective eco-labelling schemes, and is easy to follow the development over time.
Robust	1	Due to the difficulties of obtaining the absolute number of products sold which belong to the respective certified product models, representativeness and scope of this indicator becomes low. In addition, as commented under “credible”, the indicator does not capture the products which are not certified by eco-labelling schemes but are meeting the criteria nonetheless.
Final Score	2.7	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 9.12. RACER assessment of the indicator “number of textile product models certified by Oeko-Tex Standard 100 and Bluesign”

RACER	Score	Comments
Relevant	3	Monitoring the number of textile products certified by Oeko-Tex Standard 100, and Bluesign is one feasible way of checking the residual hazardous substances in textile products used/come into waste streams in a practical manner. This then addresses part 3 of the waste prevention definition.
Accepted	2	The low representativeness of the indicator (see comments for “Robust”) would most likely lower the acceptance by academia.
Credible	2	Oeko-Tex Standard 100 is well established and their credibility is very high. Although it is not well known to ordinary citizens, Bluesign is spreading rapidly among the manufacturers/suppliers of garments and is gaining their trust. However, companies do not necessarily go for certification of products even when products meet Oeko-Tex Standard 100 or Bluesign and there are uncertainties as to how many of such products exist.
Easy	2	Data can be obtained on the number of nationally-based manufacturers who have been certified so that they may use the Oeko-Tex certificate on their products. However, no data is obtainable on the numbers of products that have been labeled by these manufacturers. However, the bluesign certification coordinator only holds data on how many textiles manufacturers worldwide have been certified as being able to use the label, and how many brands are participating in the scheme in order to source materials from bluesign certified manufacturers. No product level or country level data is available. The individual brands using bluesign certified textiles may have this information but it would be difficult to collect.
Robust	1	Due to the difficulties of obtaining the absolute number of products sold which belong to the respective certified product models, representativeness and scope of this indicator becomes low. In addition, as commented under “credible”, the indicator does not capture the products which are not certified by either label but which would meet the criteria nonetheless.
Final Score	2.1	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

Table 9.13. RACER assessment of the indicator “repaired textile products (number/capita/year)”

RACER	Score	Comments
Relevant	3	This indicator provides information on the potential for prolonging the life of textile products by looking at the actual number of textile products being repaired. In general, the increase in the number of repaired products would contribute to the reduction of the purchase of new products and thus address upstream environmental impacts, the main aim of textiles waste prevention.
Accepted	2	Although a relatively simple indicator, the current lack of data may make it less attractive for policy makers.
Credible	3	Although no statistical data is currently available, it is not very difficult to secure transparency once such data starts to be collected.
Easy	2	The information currently available for this indicator is limited to one-shot studies. Collecting data for this indicator may prove to be resource intensive.
Robust	3	The indicator provides a direct indication on the amount of products repaired, which would also serve as a proxy for eventual reduction on the purchase of new products.
Final Score	2.6	The final score is weighted double for the Relevant and Easy criteria as it is of primary concern to the Nordic Council of Ministers in order to build waste prevention indicators in a short term.

9.4.3 Summary of RACER assessment for indicators

A summary of the RACER assessment for indicators proposed for prevention of textiles waste is found in Table 9.14. The following indicators achieve scores of over 3:

- New textile products (by weight) put on the market per capita per year,
- Household expenditure on textiles per capita per year, and
- Household expenditure on textile products per tonne of products put on the market.

Table 9.14. Summary of RACER assessments for textiles waste prevention

Indicator	R	A	C	E	R	Final score
Textiles waste generation (kg per capita per year)	4	3	2	1	2	2.4
New textile products (by weight) put on the market (kg per capita per year)	4	3	4	4	5	4.0
Purchase (by weight) of second-hand textile products (kg per capita per year)	4	3	2	1	3	2.6
Household expenditure on textile products (EUR per capita per year)	3	3	4	4	3	3.4
Share (by weight) of second-hand products in total textile products put on the market (%)	4	3	2	1	2	2.4
Share (by value) of second-hand products in total textile products put on the market	4	3	2	3	2	2.7
Ratio (by weight) of exported second-hand products to total textile products put on the domestic market (%)	2	2	3	3	2	2.4
Household expenditure on textile products per tonne of textile products put on the market (EUR/tonne)	4	2	3	3	3	3.1
Quantities of specific chemicals present in imported textile products (mg/kg)	4	3	2	1	2	2.4
Textile product models certified by eco-labelling schemes relevant to the Nordic countries (Nordic Swan, Swedish Good Environmental Choice, EU Flower)	3	2	2	4	1	2.7
Number of textile product models certified by Oeko-Tex Standard 100 and Bluesign	3	2	2	2	1	2.1
Repaired textile products (number/capita/year)	3	2	3	2	3	2.6

9.5 Scoping on Targets

The literature review (Section 4) did not identify any targets specific to textiles waste prevention. A target found in the waste prevention plan of the Brussels region can be applied to textiles waste as well as other goods.

- Selectively collect and return to the market 3 kg of additional reusable goods per capita per year by 2013 and 6 kg/cap/yr by 2020.

In the absence of any directly relevant existing targets, target setting must be guided by the scope of waste prevention in textiles, where textile wastes arise, where the environmental impacts concerned with textiles waste arise and the kinds of responses that can best reduce textiles wastes and their environmental impacts. Target selection can be guided by the subject of the indicators that have been proposed in the previous sections, since such considerations were also taken here.

As stated earlier pilot initiatives and studies In Nordic countries, mostly focus on clothing,²⁸ while others also include home textiles (e.g. towels, curtains, table clothes) that would eventually end up in municipal waste streams. It is rarer to consider textile wastes produced in the clothing industry. Targets should perhaps therefore be focused on clothing and textiles from housing.

Due to the environmental impacts related to textile wastes, targets for textile waste prevention should perhaps focus on reducing quantities of waste, via reuse and other measures, rather than the second or third parts of the waste prevention definition which are of lesser importance for this waste stream. Key means for reducing quantities of textile wastes will be via encouraging longer *active* lifetimes of textile products and prioritising quality of purchases over quantity. Longer lifetimes of products can be achieved in part through re-use and repair and again through purchase of higher quality products.

9.6 First Stage Targets and Indicators

Combining all the above findings on targets and indicators so far in the whole process, a first set of potentially proposed targets could be as follows:

- Reduce generation of waste from clothing and home textiles from households by x% or x tonnes by year y compared to base year y_0 .
- Reduce the consumption of new textiles by x% or x kg/capita by year y compared to base year y_0 .
- Increase the share of second-hand products in total sales of textiles by x% by year y compared to base year y_0 .
- Increase the sales of second-hand textiles products by x% or x tonnes per year, by year y compared to base year y_0 .
- Increase the number of textile products repaired to the level of x per capita by the year y.
- Reduce the amount of specific chemicals present in imported textile products by x% by year y compared to base year y_0 .

²⁸ Examples include NICE (Nordic Initiative, Clean and Ethical) in the Nordic countries (www.nicefashion.org/en/), series of studies by National Institute for Consumer Research and Norwegian University of Science and Technology in Norway in Norway and Mistra Fashion Project, a research project on unsustainable fashion in Sweden. (www.mistrafuturefashion.com/en/Sidor/default.aspx)

- Increase the number of products certified with eco-labels limiting use of hazardous substances in textiles production by x% by year y compared to base year y_0 .
- Promote purchase of high quality over budget low quality textiles products.

It is of particular interest to assess how these targets can be addressed by corresponding indicators which can measure progress towards the target and monitor the development throughout the years. For each first stage target proposed above, one or more indicators which can best relate to the target will be paired to that target and constitute a set of interrelated target-indicator proposal that can be used directly as such. On the left side the targets are presented one by one and on the right side the most appropriate indicator(s) which fit the target are identified and their potential use is analysed.

Box 26

Target

Reduce generation of waste from clothing and home textiles from households by x% or x tonnes by year y compared to base year y⁰

Comments: This target represents a classic approach to waste prevention, which monitors developments in textile waste generation from households and aims at its reduction by a certain % per year or for a period of years. The target is based on the fact that the higher the effectiveness and intensity of waste prevention, the higher reduction is achieved on waste generation. However, generation is influenced by factors other than waste prevention, such as macro-economic developments. Moreover, in a situation where reductions in textiles waste is caused by an increasing export of used clothes, a target might be met without any corresponding reductions in upstream pressures resulting from reductions in the production of clothes. However, provided that the exported clothes for reuse offset purchases in the importing country, from a global perspective, production of clothing would be likely to be reduced.

Indicators

Textiles waste generation per capita per year

Comments: This indicator relates well to the target. Data on textile waste generation is not available at the moment but when they become available with some time series this indicator will be very useful. The indicator could perhaps be focused on textiles wastes from households, and also initially focus on, waste from clothing and home textiles, the area where information on input data is readily available. Used clothing meant for reuse would not be included in this indicator.

New textile products (by weight) put on the market per capita per year

This indicator can provide a proxy for changes in generation of textiles waste and data for its production is currently available. It is an input rather than output-based indicator but it can be assumed that a reduction in the quantity of textiles waste generated, if this has resulted from reuse, prolonged life or other means, will result in a reduction in the demand for new clothing. The link may be partially weakened due to a rebound effect since used clothing will be cheaper (even free) for the receiver, releasing further budget for use on additional new textiles, thus increasing total consumption of textiles. Taking a different perspective, most new textiles purchases will eventually end as waste, once the product is no longer fit for use. The longer the lifetime of the product, the longer the timelag between purchase and waste generation. On the other hand trends in this proxy indicator might better represent trends in reductions in upstream pressures than reductions in the waste generation indicator above. For example, in the case where reductions in waste generation are caused by increasing export of textiles for reuse in other countries.

Box 27**Target**

Reduce the consumption of new textiles by x% or x kg/capita by year y compared to base year y_0

Comments: This target can be considered to present a more monitorable alternative to the target on waste generation above. Consumption of new textiles has a direct connection to waste prevention. The longer that the life of textile products is extended through waste prevention measures the lower the demand for new textiles. The link may be partially weakened due to a rebound effect since used clothing will be cheaper (even free) for the receiver, releasing further budget for use on additional new textiles, thus increasing total consumption of textiles. Conversely, reducing the consumption of new textiles will in itself have a direct effect on reducing textiles waste generation. It is an input rather than output based target.

Indicators

New textile products (by weight) put on the market per capita per year

This indicator is directly connected to the target and the data to develop the indicator already exists.

Box 28

Target

Increase the share of second-hand products in total sales of textiles by $x\%$ by year y compared to base year y_0

Comments: This target relates directly to the extent to which clothing is returned back into the economy when a user no longer has a use for a product, but it is still fit for use. This will thus reflect avoidance of unnecessary textile wastes. The share is ideally measured by weight since used products will tend to be cheaper than equivalent used products.

Indicators

Share (by weight) of second-hand products in total textile products put on the market

Comments: This indicator would directly be able to monitor the target. However, the indicator is currently not available and data collection needed for this indicator would require significant resources. A share by value (see below) would be simpler to produce but less directly relevant to waste prevention.

Share (by value) of second-hand products in total textile products put on the market

Comments: This indicator has somewhat lower relevance to the target than the indicator above which measures share of second hand products in total products by weight. Measuring the share by value will underestimate the importance of second hand goods in the market since these will tend to have a lower price per clothing/textiles item than new products. This therefore underestimates the offsetting of new purchases by purchase of second hand and subsequent effects on waste prevention. On the other hand the indicator will take some account of the rebound effect that can occur as a result of buying cheap second hand products instead of new. Money saved may subsequently be used on buying additional products increasing the overall volume of purchases. In addition data collection would be simpler than for the indicator above although still far from simple. Unorganised sale of second hand clothes would be unlikely to be captured.

Box 29

Target

Increase the sales of second-hand textiles products by x% or x tonnes per year, by year y compared to base year y_0

Comments: This target relates directly to the extent to which clothing is returned back into the economy when a user no longer has a use for a product, but it is still fit for use. However, it is not certain that the purchase of second-hand products will replace that of new products.

Indicator

Purchase (by weight) of second-hand textile products per capita per year

Comments: This indicator would directly be able to monitor the target. However, the indicator is currently not available and data collection needed for this indicator would require significant resources.

Target

Increase the number of textile products repaired to the level of x per capita by the year y

Comments: This target is a response type target focusing on actual repair practice of citizens. An increase in such practices would prolong life of clothing and subsequent reduction in clothing purchases and wastes.

Indicator

Repaired textile products per capita

Comments: This indicator is directly relevant to the target. Data for this indicator does not currently exist in any collated form. Collection of necessary data may be resource intensive, requiring the establishment of regular household questionnaire surveys.

Box 30**Target**

Reduce the amount of specific chemicals present in im-ported textile products by x % by year y compared to base year y_0

Comments: This target indirectly concerns the third part of the waste prevention definition, that of reducing the con-tent of hazardous substances in wastes. The amount of specific chemicals found in imported textile products (which is the vast majority of textile products available in the Nordic countries) would provide good indication on the amount of such chemicals that would end up in either waste water or waste disposal facilities.

Indicators

Amount of specific chemicals present in imported textile products

Comments: This indicator is directly relevant to the target. However, the current lack of systematic approach at customs and potential resource required to make more frequent and systematic control pose challenges. The methodology for this indicator would need to identify which chemicals to include and assign relative weights to each with respect to the degree to which they cause environmental and human impacts.

Box 31

Target

Increase the number of products certified with labels requiring reduced use of hazardous substances in textiles production by x% by year y compared to base year y₀

Comments: This target indirectly concerns the third part of the waste prevention definition, that of reducing the content of hazardous substances in wastes. This is not a key issue for textile wastes. It is perhaps of more concern for the use phase of the product where small residuals in clothing/textiles can potentially have a negative effect on human health. The target is a response based target, aimed at increasing the quantity of textiles which are produced according to certain criteria, including criteria for limiting use of hazardous substances in production of textiles products. Note that the target will not take account of products which are not certified by eco-labelling schemes but are meeting the criteria nonetheless.

Indicators

Textile product models certified by eco-labelling schemes relevant to the Nordic countries (Nordic Swan, Swedish Good Environmental Choice, EU Flower)

Comments: This indicator is directly relevant to the indicator although it is missing products certified under other labelled schemes such as Oeko-Tex Standard 100 and Bluesign (see previous indicator) which will also have the effect of reducing residues of hazardous substances in textiles. This indicator would be relatively simple to make operational.

Number of textile product models certified by Oeko-Tex Standard 100 and Bluesign

Comments: This indicator would be directly relevant to the indicator although it is missing products certified under eco-labelled schemes such as Nordic Swan (see next indicator) which will also have the effect of reducing residues of hazardous substances in textiles. However, data which is relevant at the national level is difficult to obtain especially on number of products available in a country which have been certified under these schemes.

Box 32

Target

Increase the purchase of high quality over budget low-quality textiles products

Comments: Prioritising quality of purchases over quantity may be an important means for encouraging longer active lifetimes of textile products and thereby reducing quantities of textile waste. Moreover, since quality products in general will cost more per item than budget low quality products, greater shares of quality products in purchases will tend to reduce total quantities (by weight) of purchases which will also reduce the quantities of products eventually ending as textile wastes. Due to the nature of the theme the target is qualitative rather than not quantitative. A quantitative target could have been defined based on the indicator to the right—but this would be difficult to communicate.

Indicator

Household expenditure on textile products per tonne of textile products put on the market

Comments: Trends in the indicator can reflect two different trends; 1) that when purchasing, consumers are increasingly putting more weight on quality of textiles/clothing over quantity and/or 2) changes in prices of raw materials i.e. cotton. In other words the indicator isn't solidly linked to the target since other factors are in play. However, in general, as trends in this indicator increase the lower the environmental impacts upstream per EUR of spending regardless of whether the increase in expenditure per tonne has been caused by changes in consumer choice or increases in resource costs. This should act as a driver towards encouraging a more prolonged life of products.

9.7 Final Proposals for Targets and Indicators for textile waste prevention

It is the responsibility of the policy maker to set targets for waste prevention and the policy maker must take into account a large number of factors when choosing national targets. The proposals below are only suggestions which might be useful to consider.

Out of the eleven pairs of targets/indicators assessed in detail, some of the proposed targets and indicators require new reporting schemes in order to obtain the necessary data. This fact restricts the application of the targets/indicators pairs which reflect the wish of the Nordic Council of Ministers for relatively easily implemented sets.

Indicators using existing datasets as core element can be described as a *best-available* indicators, while alternative indicators based on collection of additional data are classified as *best-needed* indicators for the same targets.

Based on these considerations as well as on the relevance of the sets towards waste prevention, the following sets of targets-indicators are suggested for application in the Nordic countries context.

9.7.1 Suggested targets and indicators

1. Reduce generation of waste from clothing and home textiles from households by x% or x tonnes by year y compared to base year y_0 .

For measuring progress against this target, ideally the *best-needed* indicator “Textiles waste generation per capita per year” would be developed. This indicator would require investment of considerable resources in surveys of the composition of household wastes plus other end points for waste textiles.

The *best-available* indicator “New textile products (by weight) put on the market per capita per year” could also be used if countries do not have the resources available for collecting data on textiles wastes. This indicator is considered to represent a good proxy indicator for reduction of textile wastes.

As an alternative to the target above a more directly monitorable target with the same best available indicator would be:

2. Reduce consumption of new textiles by x% or x kg/capita by year y compared to base year y_0 .

This target is directly connected to waste prevention and waste prevention initiatives although it may be more politically sensitive than the target above.

The *best-available* indicator “New textile products (by weight) put on the market per capita per year” could directly measure progress against the target. This indicator can be produced from existing datasets.

3. Increase the purchase of high quality over budget low quality textiles products.

For measuring progress towards this target, the *best-available* indicator “Household expenditure on textile products per tonne of textile products put on the market” is seen as a valuable proxy for increasing emphasis

on quality over quantity. It is also seen as a useful indicator in a more general context since a higher price per kg would be a driver of prolonged active lifetime of garments/textiles.

4. Increase the share of second-hand products in total sales of textiles by x% by year y compared to base year y_0 .

For measuring progress towards this target, data on consumption of textiles would be needed to produce a *best-needed* indicator on “*Share (by value) of second-hand products in total textile products put on the market*” would have to be created which is not available at the moment. This indicator is considered to be more easily developed than an indicator measuring share (by weight) but nevertheless would require a considerable investment of time for data-gathering and processing.

5. Increase the number of products certified with labels requiring reduced use of hazardous substances in textiles production by x% by year y compared to base year y_0 .

Although the hazardous content is not a key issue in textiles wastes, the ease by which this target could be monitored suggests its adoption by policy makers. It would also have wider environmental implications since some of the labels which would be monitored include additional criteria related to production of textiles. The *best-available* indicator proposed for monitoring this target is *Textile product models certified by eco-labelling schemes relevant to the Nordic countries (Nordic Swan, Swedish Good Environmental Choice, EU Flower)*. The data for this indicator can be relatively easily accessed.

10. Conclusions

The EU's Waste Framework Directive prioritises waste prevention above all other activities within waste management. Waste prevention is defined in this context as actions taken before a substance, material or product has become waste and that leads to a reduction in:

- a. The amount of waste, including through the reuse of products or the extension of life span of products.
- b. The negative impact of the environment and human health from the generated waste.
- c. The content of harmful substances in materials and products.

The EU's Waste Framework Directive requires Member States to establish national waste prevention programmes by the end of 2013. The programmes must contain objectives for waste prevention. Further, the programmes must include specific qualitative or quantitative benchmarks for waste prevention measures and the programme may determine specific qualitative or quantitative targets and indicators (Article 29 (3)). In this context, the Nordic countries which are also EU Member States have to formulate waste prevention targets that are specific, measurable and monitorable, accurate, time-bound and that lead society towards greater resource efficiency. The indicators must illustrate progress toward goals. Norway and Iceland are EFTA members and therefore should develop waste prevention programmes along similar lines to those required of EU Member States.

The objective of this report was to make first proposals for the formulation of targets and associated indicators for Nordic countries for waste prevention in four specific waste streams: food waste, construction- and demolition waste, WEEE and textile wastes.

A typology of waste prevention indicators was developed for the project. This typology categorises indicators into output-based indicators, input-based indicators, input-versus-output indicators, decoupling indicators, impacts indicators, hazardous content indicators and response indicators. These are described in the following box.

Box 33

Typology of Indicators for Waste Prevention

The following typology of waste prevention indicators has been developed for use in this report:

- *Output-based indicator*: waste generation (physical quantity) indicator – trends in generation of this stream or some fraction of this stream over time in absolute quantities or per capita or per household.
- *Input-based indicator*: changes in consumption of goods or resources (physical quantities or economic value) leading to this waste stream over time.
- *Input-versus-output indicator*: combination of above two. Indicator showing waste output per unit input (physical quantities).
- *Decoupling indicator*: either an output or input indicator as above but shown per unit GDP or some other economic variable.
- *Impacts indicator*: showing how environmental impacts of generated waste is reduced – not as a result of changing waste management but through changing product design/consumption etc.
- *Hazardous content indicator*: measuring changes in the hazardous contents of products which end as waste, or in the changing hazardous content of waste.
- *Response indicator*: indicators measuring political actions taken to deliver waste prevention i.e. in-vestments in eco-design research, economic instruments, level of integration of waste prevention into sectoral policies etc.
- *Other*: any found which don't meet any of above classifications.

The study began with a literature review of proposed and existing indicators and targets in European countries. The key findings of the literature review can be summarised as follows:

- Only a few indicators have been proposed, and even fewer are operational in Europe and worldwide. Most proposals were identified for C&D waste (5) and fewest for textiles (2 general indicators and 0 textile specific).
- With a single exception all indicators proposed fall directly under part a) of the waste prevention definition i.e. a reduction in *quantities* of waste.

- Within that area indicators proposed are reasonably well distributed between: output, input versus output, decoupling and response-type indicators as defined by the indicator typology developed for the study.²⁹
- Not many targets have been proposed for any waste stream apart from food. For food 11 targets have been proposed. For textiles only a single target was found.
- The proposed targets all fall under part a) of waste prevention definition.
- Most targets relate to output, input and input versus output type variables according to the indicator typology. There are also a few response based targets. Some targets are concrete and well-defined—others are vaguer and open to interpretation in terms of their scope and boundaries.
- No identified targets have been related to indicators. However, there is an overlap between the types of targets and proposed indicators i.e. both mostly cover part a) of definition and both mostly are quantity based output, input or input versus output. Therefore, there is potential for some of proposed indicators to be adapted to be able to monitor targets.

With respect to the last finding, even where politically adopted targets exist, they remain unsupported by related indicators that can monitor them. This may be in recognition of the current data availability challenges which undermine development of suitable indicators. This is not atypical of political targets and objectives which are based on ambitions in response to identified issues. Nevertheless, without supporting indicators that can monitor progress towards or away from targets, the targets remain empty and somewhat meaningless until such indicators are developed. Hence the objective of this study: to develop targets and supporting indicators in parallel.

The task required a somewhat different approach and has given different results for the four waste streams. This is because the four streams are markedly different in terms of where the wastes arise along the production and consumption chain, which of the three elements of the waste prevention definition are of most relevance to them and the availability of data relevant to the streams.

²⁹ For typology, see Box 1 at the beginning of the document.

For example, textiles wastes arise mostly at the consumption stage and from private households. Construction and demolition wastes are generated by activities of the construction industry during the production phase.

For WEEE and, to a lesser extent construction and demolition waste, the third part of the waste prevention definition is of key importance while for food it has no relevance. For food the focus is on reducing quantities of waste under part a) of the definition, but specifically reducing quantities of avoidable (i.e. edible) food waste.

An analysis was also carried out for each waste stream on which of the indicator types from the typology is useful or not for that stream. Input-based indicators can often be used instead of output-based indicators where data for the latter is not available or where there is a long time lag between the purchase of the product and it becoming waste i.e. C&D waste.

Input-based indicators are also more generally useful given that one of the underlying objectives of waste prevention is to reduce demands on material resources.

As might be expected data availability on waste generation quantities is markedly better for the separately collected waste streams (C & D waste and WEEE) than for the waste streams which are typically mixed with other wastes in municipal waste streams (food and textiles). However, even for WEEE, the collection rates cannot be assumed to be even roughly representative of actual quantities of WEEE generated.

The study took a pragmatic view when developing proposals for targets and indicators. The Nordic Council had requested that targets be selected which could be supported by indicators which could be developed using currently available data or data that could be collected at acceptable costs. Following identification of potentially relevant indicators to the particular nature of each waste stream, data components which could be used to build up these indicators were identified with emphasis as far as possible on existing data. RACER assessments were carried out on each indicator to examine their relative advantages and disadvantages.

Potentially useful targets and indicator pairs were identified. For some targets both *best-available* and *best-needed* indicators were identified. Best-available indicators are those that can be created from currently available data. In some cases these indicators can provide only a proxy measure of progress against a target. In these cases a best-needed indicator which better corresponds to the target but which cannot be

created from currently available data was also suggested. However, priority was given to those for which data collection was considered reasonably practicable. However, development of all best-needed indicators will incur costs.

Where a best-needed and best-available indicator are identified, countries must weigh up the need for accuracy and reliability of waste prevention monitoring against the costs of measurement.

The following targets and indicators are put forward for the consideration of policy makers responsible for selection of waste prevention targets and indicators for national waste prevention plans or programmes.

10.1.1 Food Waste

Reduce avoidable food waste from households by x% or x tonnes by year y, compared to base year y₀

This target targets households but if data is available the target could be combined for households, retail and the hospitality sector.

- For measuring the progress of this target the *best-needed* indicator *Avoidable food waste generation per household (capita/food industry/hospitality sector)* can be used in the longer term.
- The *best-available* indicator *food consumption in kg/capita/year* could potentially be used in the short term as a proxy indicator but policy makers must understand the weaknesses of this proxy indicator due in part due to the indicator methodology and underlying methodology and also the indicator's sensitivity to changing diets.

Reduce the amount of food waste from households by x% or x tonnes by year y, compared to base year y₀

Again this target could also be applied to other economic sectors depending on data availability.

- For measuring the progress of this target the *best-needed* indicator *Amounts of food waste generated per household (capita/food industry/hospitality sector)* can be used accordingly.
- Again the *best-available* indicator *food consumption in kg/capita/year* could potentially be used as a proxy and again policy makers must understand the weaknesses of this proxy indicator.

Should food waste data be collected from households with a sufficient level of detail the following target could also be considered, due to its aware-raising strengths and also its links to the resource efficiency agenda.

Reduce the cost of avoidable food waste to households by x% by year y, compared to base year y_0

- The *best-needed* indicator *Economic value of avoidable household food waste (EUR/capita/year)* would be used for measuring the progress of this target. This indicator requires a somewhat more detailed household food waste survey than for the two best-needed indicators for the two targets above, requiring a division by food product.

Together with these targets, it would be also useful to take into consideration some of the response targets, which could help monitoring waste prevention initiatives.

Increase government budget used for waste prevention measures by x% by year y, compared to base year y_0

- The following *best-needed* indicators would be used to monitor this response based targets: *Government (local authority, etc.) budget used on food waste prevention activities*.

Increase the number of enterprises signing voluntary commitments on food waste prevention by x (number or %) by year y, compared to base year y_0

- The following *best-needed* indicators would be used to monitor this response based targets *Number of enterprises signed (actively involved in) food waste prevention voluntary agreements*.

Data collection systems to allow these final two indicators to be operationalised could be included as an integral element of the instruments implemented to meet the targets.

10.1.2 C&D Waste

Reduce waste generation by the construction sector by x% annually with y_0 as base year

- For measuring progress against this target, the indicator *C&DW generation per unit Gross Value Added (GVA) in the construction sector* is considered to be the *best-available* indicator for the target, since it is unaffected by variations in the activity level of the construction sector.

Increase the material efficiency in construction with x% by year y compared to base year y_0

This target is perhaps the most relevant for encouraging waste prevention policies and implementation. Targets based on waste generation are affected by the long time lag between construction and subsequent demolition of buildings and other construction works.

- For measuring progress towards this target, data on consumption of construction materials used directly in production of buildings would be needed to produce a *best-needed* indicator on *Material consumption in the construction of buildings versus the area of new construction*.
- Alternatively, as a *best-available* indicator the *Domestic extraction of construction materials per floor area of new buildings* can be used as a good proxy for measuring progress against the target.

Reduce the hazardous content of construction materials by x% annually with y_0 as base year

- A proxy *best-needed* response-based indicator *Number of new buildings and sales of building materials certified by labelling schemes which limit quantities of hazardous or harmful substances* is suggested. Data for such an indicator should not prove difficult to gather.
- The indicator *Hazardous C&DW as a% of total C&DW (%)* could also be considered as a *best-available* indicator for the target. Its usefulness with respect to waste prevention policy, however, is somewhat affected by the long timelag between construction and demolition of construction works.

Increase life span of buildings with x years and roads with z years by year y

- Information to create a *best-needed* indicator on *Average design life expectancy of buildings and roads* is currently not widely available to follow up this target but could potentially be gathered from civil engineering associations.

10.1.3 Waste Electrical and Electronic Equipment

Reduce the consumption of EEE (in kg) by x% by year y with y_0 as a reference year

- For measuring progress against this target, the indicator *Amount of EEE put on the market (kg) per capita* can be used and described as a *best-available* and sufficient indicator for the target.

Increase the re-use of EEE by x% by y with y_0 as a reference year

- For measuring progress towards this target a *best-needed* indicator on *Amount of re-used EEE sold* is proposed.
- No indicator exists with a dataset sufficient to support the target, so no *best-available* indicator is proposed.

Reduce the WEEE generation by x% by year y with y_0 as a reference year

- For measuring progress towards this target, data on waste generation of WEEE are essential in order to produce a *best-needed* indicator on *WEEE generation (kg) per capita* which is not available at the moment.
- The *best-available* indicator the *Collection of WEEE (kg) per capita* can be used as a proxy.

Reduce the content of hazardous substances in EEE by x% by y with y_0 as a reference year

- Information to create a *best-needed* indicator on *Hazardous substances found in EEE (% weight/total weight of EEE)* is currently not widely available to follow up this target.
- At the moment, no indicator exists with a dataset sufficient to support this target, so no *best-available* indicator is proposed.

Increase the material efficiency in EEE by x% by year y with y_0 as a reference year

- A *best-needed* indicator *WEEE generation (kg) versus EEE put on the market (EUR) per capita* is suggested to monitor efforts of the EEE industry to improve the existing material efficiency of the products.
- At the moment, no indicator exists with a dataset sufficient to support this target, so no *best-available* indicator is proposed.

10.1.4 Textiles Waste

Reduce generation of waste from clothing and home textiles from households by x% or x tonnes by year y compared to base year y_0

- For measuring progress against this target, ideally the *best-needed* indicator *Textiles waste generation per capita per year* would be developed. This indicator would require investment of considerable resources in surveys of the composition of household wastes plus other end points for waste textiles.
- The *best-available* indicator *New textile products (by weight) put on the market per capita per year* could also be used if countries do not have the resources available for collecting data on textiles wastes. This indicator is considered to represent a good proxy indicator for reduction of textile wastes.

Reduce consumption of new textiles by x% or x kg/capita by year y compared to base year y_0

- This target is a more directly measurable alternative to the first target. It would be directly connected to waste prevention and waste prevention initiatives although it may be more politically sensitive than the first target.
- The *best-available* indicator *New textile products (by weight) put on the market per capita per year* could directly measure progress against the target. This indicator can be produced from existing datasets.

Increase the purchase of high quality over budget low quality textiles products

- For measuring progress towards this target, the *best-available* indicator *Household expenditure on textile products per tonne of textile products put on the market* is seen as a valuable proxy for increasing emphasis on quality over quantity. It is also seen as a useful indicator in a more general context since a higher price per kg would be a *driver* of prolonged active lifetime of garments/textiles.

Increase the share of second-hand products in total sales of textiles by x% by year y compared to base year y₀

- For measuring progress towards this target, data on consumption of textiles would be needed to produce a *best-needed* indicator on *Share (by value) of second-hand products in total textile products put on the market* would have to be created which is not available at the moment. This indicator is considered to be more easily developed than an indicator measuring share (by weight) but nevertheless would require a considerable investment of time for data-gathering and processing.

Increase the number of products certified with labels requiring reduced use of hazardous substances in textiles production by x% by year y compared to base year y₀

- Although the hazardous content is not a key issue in textiles wastes, the ease by which this target could be monitored suggests its adoption by policy makers. It would also have wider environmental implications since some of the labels which would be monitored include additional criteria related to production of textiles.
- The *best-available* indicator proposed for monitoring this target is *Textile product models certified by eco-labelling schemes relevant to the Nordic countries (Nordic Swan, Swedish Good Environmental Choice, EU Flower)*. The data for this indicator can be relatively easily accessed.

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12. Sammenfatning

Affaltdirektivet (2008/98/EC) prioriterer affaldsforebyggelse frem for alle andre former for affaldshåndtering. Affaldsforebyggelse er defineret i affaltdirektivet som værende foranstaltninger, der træffes, inden stoffer, materialer eller produkter bliver til affald, og som mindsker:

- a) Affaldsmængden, herunder via genbrug af produkter eller forlængelse af produkternes levetid,
- b) De negative konsekvenser, som det producerede affald har for miljøet og menneskers sundhed, eller
- c) Indholdet af skadelige stoffer i materialer og produkter

Affaltdirektivet forpligter medlemsstaterne til at etablere nationale programmer for affaldsforebyggelse ved udgangen af 2013. Programmerne skal indeholde overordnede mål for affaldsforebyggelse. Desuden anbefales det at programmerne inkluderer mere specifikke kvalitative eller kvantitative mål og tilknyttede indikatorer for affaldsforebyggelse.

Formålet med denne rapport er at give et første forslag til formulering af mål og tilknyttede indikatorer for affaldsforebyggelse i fire specifikke affaldsstrømme i de nordiske lande: *madspild, bygge- og anlægsaffald, elektrisk og elektronisk affald (WEEE) og tekstilaffald*.

Undersøgelsen indeholder et litteraturstudie af indikatorer for affaldsforebyggelse og mål i europæiske lande. De vigtigste resultater af studiet er følgende:

- Kun få *indikatorer* for affaldsforebyggelse er blevet foreslået, og endnu færre er i brug i Europa og resten af verden.
- Der blev identificeret flest indikatorforslag for bygge- og anlægsaffald (5) og færrest for tekstiler (2 generelle indikatorer og 0 tekstil specifikke).
- Med en enkelt undtagelse falder alle foreslåede *indikatorer* direkte under del a) i affaldsforebyggelsesdefinitionen, dvs. reduktion i affaldsmængder.
- Der er kun foreslået få *mål* for hver affaldsstrøm, bortset fra for fødevarer, hvor 11 mål er fundet. For tekstiler er der kun fundet et enkelt mål.

- Alle de foreslåede *mål* falder ind under del a) i affaldsforebyggelsesdefinitionen. Nogle mål er konkrete og veldefinerede, andre er mere vage og åbne for fortolkning af deres omfang og grænser.
- Ingen af de identificerede affaldsforebyggelsesmål er blevet understøttet af indikatorer.

Mht. det sidste resultat, bliver politiske målsætninger forholdsvis tomme og meningsløse, hvis der ikke er indikatorer til at understøtte dem. Formålet med denne undersøgelse er derfor at udvikle mål og understøttende indikatorer parallelt.

Opgaven har givet forskellige resultater for de fire affaldsstrømme. Dette skyldes, at de fire strømme er markant forskellige med hensyn til, hvor affaldet opstår langs værdikæden, hvilket af de tre elementer af affaldsforebyggelsesdefinitionen, der er af størst relevans, og tilgængeligheden af relevante data.

For eksempel opstår tekstilaffald hovedsagelig i private husholdninger mens bygge- og anlægsaffald genereres af aktiviteter i bygge- og anlægsbranchen. For WEEE, og i mindre grad bygge- og anlægsaffald, er den tredje del af affaldsforebyggelsesdefinitionen af central betydning, mens den ikke har nogen relevans for fødevarer. For fødevarer er fokus på at reducere mængden af affald, men mere specifikt at reducere mængderne af undgåeligt madaffald (dvs. spiseligt mad)

Som det kunne forventes er tilgængeligheden af data for mængden af affaldsdannelse markant bedre for separat indsamlede affaldsstrømme (C&D affald og WEEE) end for de affaldsstrømme, der typisk er blandet med andet affald i de kommunale affaldsstrømme (fødevarer og tekstiler). Men selv for WEEE, kan indsamlingsraterne ikke antages at være repræsentative for de genererede mængder af WEEE. I flere tilfælde er indikatorer baseret på ressourceforbrug eller forbrug af produkter (såkaldt input-baserede indikatorer) nemmere at udvikle end indikatorer for affaldsdannelsen (såkaldt output-baserede indikatorer).

Undersøgelsen tog en pragmatisk tilgang ift. forslag til mål og indikatorer. Nordisk Ministerråd havde anmodet om, at der blev valgt mål, der kan støttes af indikatorer, der kan udvikles ved hjælp af tilgængeligt data eller data, der forholdsvis let kan indsamles.

Der blev identificeret fire til fem mål for affaldsforebyggelse for hver af de fire affaldsstrømme, samt indikatorer der kan understøtte målene.

For nogle mål blev både *best-available* og *best-needed* indikatorer identificeret. *Best-available* indikatorer er dem, der kan oprettes fra data, der er tilgængelig pt. I nogle tilfælde giver *best-available* indikatoren

et noget begrænset billede i forhold til målet. I disse tilfælde blev der også foreslået en *best-needed* indikator, som bedre svarer til målet, men som ikke kan skabes fra data, der er tilgængelig på nuværende tidspunkt. Der er foreslået *Best-needed* indikatorer, hvor dataindsamling betragtes som praktisk mulig. Dog vil udviklingen af enhver ny indikator indebære omkostninger.

Når både en *best-available* og en *best-needed* indikator er identificeret, skal de nordiske lande tage stilling til deres behov for nøjagtig måling af affaldsforebyggelse i forhold til de omkostninger der er forbundet derved.

13. Appendix 1

Full Inventory of existing Indicators

This appendix gives a full description of the indicators identified during the literature review for each waste stream given in Chapter 4 of the report.

13.1.1 Food waste

Table 12.1. Non-operational indicators

Name	Share of edible food waste in households, retailers and catering
Short description	This indicator measures the % of edible food waste (by weight) that occurs over a certain period of time (yearly, bi-yearly), out of the total food waste generated (by weight), in households and the retail and catering sectors. Edible food waste refers to food waste which was, at some point prior discarding, fit for human consumption. This includes both avoidable food waste (e.g. slices of bread, apples, meat), which could potentially be consumed, and possibly avoidable food waste (e.g. potato skins), which people tend to consume/waste according to preference. In contrast, inedible food waste refers to food waste arising from food preparation that was not at any point edible (e.g. bones, egg shells). Inedible food waste is considered as unavoidable food waste. Data on edible/inedible and avoidable/unavoidable food waste do not exist and it is considerably difficult to acquire. This could be done on separate surveys on food waste, measuring the total and edible/inedible fraction of food waste.
Basic type	Output indicator.
Indicator/source	European Commission (EC 2011c). http://ec.europa.eu/environment/resource_efficiency/pdf/working_paper_part2.pdf

Table 12.2. Non-operational indicators

Name	Amount of food waste generated per number of households
Short description	This indicator includes the amount of food waste generated divided by the number of households. Although it is not specified by the source, it would make sense that such an indicator would refer over a certain period of time (yearly, bi-yearly) according to the data availability. The indicator describes the generation of total food waste stemming from households and no distinction is made between avoidable/unavoidable food waste. Data specifically on food waste is still in an early stage of development and exist sparsely in some Member States which have implemented relevant surveys. Data on food waste are subject to local, regional or national data collection and currently are not reported to Eurostat but the number of households is regularly reported to Eurostat.
Basic type	Output indicator.
Indicator/source	DG Environment. European Commission DG ENV, 2009, Preparation of guidelines on waste prevention programmes according to the revised Waste Framework Directive, including best practices.

Table 12.3. Non-operational indicators

Name	Resource loss on bio-products
Short description	This indicator constitutes the ratio between biological waste generated (by weight) and biological resources used (by weight), expressed in a % of the amount of resources that ends up as a waste. In other words, it measures an unwanted output per input. This means that the higher the output, the less efficient the material use. Data used for the calculation of this indicator derive from material flow accounts (MFA) maintained by Eurostat. From the MFA statistics, data are retrieved on biomass material input (EUROSTAT MF1), but limited to MF11 crops, MF 14 fish and MF15 animals. Fodder crops (MF12) are not included to avoid double counting the same material. This indicator is strictly limited to food related resources and wastes. Both pre-consumer and post-consumer waste from food generation and consumption are considered.
Basic type	Input versus Output indicator.
Indicator/source	DG Environment. http://ec.europa.eu/environment/waste/prevention/pdf/SR1008_FinalReport.pdf

Table 12.4. Non-operational indicators

Name	Amount of food waste generated against the consumption of food in tonnes
Short description	This indicator shows the annual amount of food waste generated (by weight) by households against private food consumption per capita per year. Data on food consumption is available at FAOSTAT, expressed in kg/capita/year and is the weight of food following processing prior to the point of sale but not including packaging. With regard to the waste element it is perhaps inconsistent that only food waste from households is proposed. Since the food input data from FAOSTAT includes all food prior to sale it would perhaps be more appropriate to include food waste from retail, restaurants and catering sectors as well.
Basic type	Input versus Output indicator.
Indicator/source	DG Environment. European Commission DG ENV, 2009, Preparation of guidelines on waste prevention programmes according to the revised Waste Framework Directive, including best practices.

13.1.2 Construction and demolition waste

Table 12.5. Operational indicators

Name	Generation of construction and demolition waste (tonnes/capita/a)
Short description	This indicator is describing the amount of waste generated every year by construction and demolition activities within an economy. The development of the total C&D waste generation in a country with time would show the effect of any possible waste prevention initiatives. This is a rough indicator as the generated amount will be influenced by factors other than waste prevention (e.g. fluctuations in construction activity). However, the indicator would document in the long-term whether waste generation is increasing or decreasing. This indicator only focuses on part a) of the waste prevention definition. Unit: tonnes.
Basic type	Output indicator.
Indicator/source	Eurostat: Under code F, countries are reporting C&D waste generation for 2004, 2006 and 2008.
Weblink	http://epp.eurostat.ec.europa.eu/portal/page/portal/environment/data/database#
Year when initiated	2004.
Linked to a target?	No.
Source of data	http://epp.eurostat.ec.europa.eu/portal/page/portal/environment/data/database#
Geographic coverage	EU27, Croatia, Iceland, Norway.
Update periodicity	2 years.

Table 12.6. Non-operational indicators

Name	Construction and demolition waste generated per area of new construction (CDWG/PA)
Short description	This indicator refers to the total amount of construction and demolition waste generated (in tonnes) per area of new constructions, measured in m ² of useful floor area of new building permits as reported to Eurostat. C&D waste generation data are currently scattered and not comparable between Member States. In the future there will be obligatory reporting to Eurostat of national C&D waste arisings. Data on new construction is drawn from building permit data held by Eurostat in m ² of useful floor area. It should be noted that there is some inconsistency between the two parts of the indicator since total C&D waste will be for all types of construction including roads, railways, bridges parking lots etc. while the output element is for buildings only.
Basic type	Input versus Output indicator.
Indicator/source	DG Environment. European Commission DG ENV, 2009, Preparation of guidelines on waste prevention programmes according to the revised Waste Framework Directive, including best practices.

Table 12.7. Non-operational indicators

Name	Domestic extraction of construction materials per area of new construction (DE/PA)
Short description	This indicator describes the ratio between newly extracted virgin materials (in tonnes) and newly physical construction activities for buildings in m2 of useful floor area. Taking into account the fact that most of materials used in construction in a country come from domestic sources, an appropriate measure of the material use and subsequently the waste generation in the construction sector would be the domestic extraction figures, which can be found in the national Material Flow Accounts. Materials are categorised under different material types in MFA and the weight of domestically extracted materials for construction would have to be calculated as a sum of the different materials used in building construction activities. Data on new construction activities are maintained regularly (monthly/quarterly/annually) by Eurostat under the short-term business statistics. Data on new construction is drawn from building permit data held by Eurostat in m2 of useful floor area. It should be noted that there is some inconsistency between the two parts of the indicator since the material extraction will be for all types of construction including roads, railways, bridges parking lots etc. while the output element is for buildings only. Therefore a decreasing waste per area of construction might simply indicate a slow down in construction of transport infrastructure relative to buildings.
Basic type	Input versus Output indicator.
Indicator/source	DG Environment. European Commission DG ENV, 2009, Preparation of guidelines on waste prevention programmes according to the revised Waste Framework Directive, including best practices.

Table 12.8. Non-operational indicators

Name	Combined indicator of DE and CDWG per area of new construction (DE+CDWG/PA)
Short description	This indicator is a combination of the previous two and refers to the newly extracted domestic virgin materials plus the total amount of construction and demolition waste generated (both in tonnes), and can provide information on the waste intensity of the construction industry expressing whether ongoing construction activities are conducted by using less materials and generating less waste in contrast to the physical output of this sector. The new construction area is measured in m2 of useful floor area of new building permits as reported to Eurostat. C&D waste generation data are currently scattered and not comparable between Member states. In the future there will be obligatory reporting to Eurostat of national C&D waste arisings. Amounts of construction materials can be measured by the Domestic extraction output found in the Material Flow Accounts maintained by Eurostat. Construction materials are categorised under different material types in MFA and the weight of domestically extracted materials for construction would have to be calculated as a sum of the different materials used in building construction activities.
Basic type	Input versus Output indicator.
Indicator/source	DG Environment. European Commission DG ENV, 2009, Preparation of guidelines on waste prevention programmes according to the revised Waste Framework Directive, including best practices.

Table 12.9. Non-operational indicators

Name	Construction and demolition waste generated per GDP (CDWG/GDP)
Short description	This indicator refers to the total amount of construction and demolition waste generated (in tonnes) against the respective GDP development, over time. It is measured in tonnes per EUR of GDP. Due to great price differences between the EU countries, it should be considered to measure GDP weighted by purchasing power parity (PPP). C&D waste generation data are currently scattered and not comparable between Member states. In the future there will be obligatory reporting to Eurostat of national C&D waste arisings.
Basic type	Decoupling indicator.
Indicator/source	DG Environment. European Commission DG ENV, 2009, Preparation of guidelines on waste prevention programmes according to the revised Waste Framework Directive, including best practices.

13.1.3 Waste Electrical and Electronic Equipment (WEEE)

Table 12.10. Non-operational indicators

Name	Collection efficiency of WEEE
Short description	This indicator aims at providing information on estimated collection efficiency (collection amounts/generation amounts) for WEEE. This could be used as a proxy for estimating waste generation coupled with the amount of EEE put on the market. Data on waste generation of WEEE do not exist at the moment but Eurostat maintains data on WEEE collection since 2005. Also data on EEE put in the EU market is available and can be used as a proxy for generation, although this is largely an assumption which can generate substantial errors due to the time lag between the point at which an electronic product is put on the market and when it is discarded. Finally, data on reuse of WEEE is also available in the same database but covers only very few Member States.
Basic type	Input versus Output indicator
Indicator/source	ETC/SCP ETC/SCP, 2011, Internal paper on best needed waste indicators within the SCP Indicator Framework.

Table 12.11. Non-operational indicators

Name	Total amount (EUR) of assets (e.g. EEE) bought with the purpose to re-use them per capita
Short description	This indicator shows the value of EEE re-circulated in the economy. No more specifications have been provided by the source, so only general assumptions can be made about the structure of the indicator (e.g. using purchaser prices? Bought by whom? etc.) It is a general indicator that can be used for any asset. In case of good data provision for WEEE, this indicator can be used specifically for WEEE.
Basic type	Input indicator.
Indicator/source	DG Environment. DG ENV, 2009, Preparation of guidelines on waste prevention programmes according to the revised Waste Framework Directive, including best practices.

Table 12.12. Non-operational indicators

Name	Total amount of re-used goods (e.g. EEE) sold
Short description	This indicator shows the amount of EEE re-circulated in the economy. There is no other specific information provided by the source about the structure of this indicator and potential data sources nor even what units the indicator would use i.e. amount in EUR or tonnes.
Basic type	Input indicator.
Indicator/source	DG Environment. DG ENV, 2009, Preparation of guidelines on waste prevention programmes according to the revised Waste Framework Directive, including best practices.

Table 12.13. Non-operational indicators

Name	Hazardous substance indicator
Short description	This indicator is based upon genuine data generation through testing. Unlike the other indicators it is not based on administrative sources or official statistics. A standardised test procedure has to be defined in testing how many out of 300 random samples of WEEE components contain quantities of RoHS substances above thresholds. The intention of the indicator is to measure if hazardous substances in WEEE are prevented above what is legally binding. Finally, it is estimated that considerable resources would be assigned for the development of this indicator.
Basic type	Hazardous substance indicator.
Indicator/source	DG Environment. http://ec.europa.eu/environment/waste/prevention/pdf/SR1008_FinalReport.pdf

13.1.4 Textile waste

Table 12.14. Operational indicators

Name	Generation of waste (tonnes, kg per person)
Short description	In the Eurostat database of Environment statistics, at the section of Waste statistics (env_was) and under the Waste generation and treatment (env_wasgt), the dataset Generation of waste (tonnes, kg per person) (env_wasgen) includes data on textile waste generation (under code: W076) for the years 2004, 2006, 2008 and 2010 deriving from all NACE Rev.2 categories plus households. Data can be found in absolute amounts (tonnes) or kg per capita of textile waste. It must be noted that the available data do not cover all Nordic countries and the quality of the data is relatively poor.
Source	Eurostat.
Weblink	http://epp.eurostat.ec.europa.eu/portal/page/portal/environment/data/database
Year when initiated	2004.
Geographic coverage	EU27, Member State.
Update periodicity	Every 2 years (2010 data coming soon).

Table 12.15. Non-operational indicators

Name	Consumption and recycling of selected materials (e.g. textiles)
Short description	This indicator describes the consumption of virgin material (e.g. cotton etc.) and (collection for) recycling of the material. There are no specifications given in the source about data availability or way of collection. Data on consumption can be found in Eurostat, in database (nama_co), about consumption categories (COICOP) at a yearly basis. Furthermore, data on recycling of textiles is also available from Eurostat. The exact structure of these indicators is not specified by the source, but as a proposal could take into consideration the above-mentioned available data from Eurostat.
Basic type	Response indicator.
Indicator/source	OECD, 2004, Towards Waste Prevention Performance Indicators. http://www.oecd.org/officialdocuments/displaydocumentpdf?cote=env/epoc/wgwpwr/se%282004%291/final&doclanguage=en

Table 12.16. Non-operational indicators

Name	Total amount (EUR) of assets (e.g. textiles) bought with the purpose to re-use them per capita
Short description	This indicator shows the value of goods re-circulated in the economy. These could include textiles but also any other type of goods. No more specifications have been provided by the source, so only general assumptions can be made about the structure of the indicator (e.g. using purchaser prices? Bought by whom? etc.) It is a general indicator that can be used for any asset. In case of good data provision for textile waste, this indicator can be used specifically for textiles.
Basic type	Input indicator.
Indicator/source	DG Environment. DG ENV, 2009, Preparation of guidelines on waste prevention programmes according to the revised Waste Framework Directive, including best practices.

14. Appendix 2

Catalogue of available datasets

Appendix 2 comprises a detailed catalogue of all the relevant available datasets in all the Nordic statistical databases and in Eurostat according to the core elements identified in part 2 of Chapters 6–9 (i.e. Sections 6.2, 7.2, 8.2 and 9.2).

14.1.1 General data (applicable to all waste streams)

Table 13.1. Population

Database	Dataset(s) name
Eurostat	Population on 1 January by age and sex (demo_pjan)
Nordic statistics	CITI01: Population 1 January by reporting country, time, citizenship, sex and age
Denmark statistics	FOLK2: Population 1. January by sex, age, ancestry, country of origin and citizenship
Sweden statistics	Population by region, marital status, age and gender. Year 1968-2011
Finland statistics	Population by sex and area 31.12.2011 and increase of population
Norway statistics	07459: Population, by sex and one-year age groups. 1 January (M) (1986–2012)
Iceland statistics	Population by sex and age 1841–2012

Table 13.2. GDP

Database	Dataset(s) name
Eurostat	GDP and main components—Current prices (nama_gdp_c) GDP and main components—volumes (nama_gdp_k)
Nordic statistics	NAAC04: Gross domestic product, PPP/EUR per capita by account, reporting country and time
Denmark statistics	NAT02: Main accounts (constant prices, DKK mio) by kind of account and price unit
Sweden statistics	GDP from the use side (ESA95), balance after use. Year 1993–2010 GDP from the production side (ESA95) by industry SNI 2007. Year 1993–2010
Finland statistics	Gross domestic product and -national income at current prices 1975–2011
Norway statistics	09189: Final expenditure and gross domestic product (1970–2011)
Iceland statistics	Gross domestic product and Gross national income 1980–2011

Table 13.3. Number of enterprises (industry, retail, services)

Database	Dataset(s) name
Eurostat	Annual detailed enterprise statistics for industry (NACE Rev.2 B-E) (sbs_na_ind_r2) Annual detailed enterprise statistics for trade (NACE Rev.2 G) (sbs_na_dt_r2) Annual detailed enterprise statistics for services (NACE Rev.2 H-N and S95) (sbs_na_1a_se_r2)
Nordic statistics	---
Denmark statistics	GF2: General enterprise statistics by industry (DB07, 127-grouping) and unit
Sweden statistics	Basic business of Business Statistics by industry SNI2007, 3-digit level. Year 2000–2010
Finland statistics	Openings and closures, the number of companies in 2005—in accordance with the classification of TOL2008 (Aloittaneiden ja lopettaneiden yritysten lukumäärä vuosina 2005– toimialaluokituksen tol2008 mukaisesti) –Available in Finnish
Norway statistics	07195: Enterprises except public administration, agriculture, forestry and fishing, by industry (SIC2007), organisational structure and number of employees (C)
Iceland statistics	Registered enterprises and organisations 2008–2011

Table 13.4. Number of households

Database	Dataset(s) name
Eurostat	---
Nordic statistics	HOUS01: Dwellings by reporting country, number of rooms, type of dwelling and time
Denmark statistics	FAM55N: Households 1. January by municipality, type of household and size of household
Sweden statistics	---
Finland statistics	06076: Private households and persons in private households (C)
Norway statistics	Household-dwelling units by number of persons and type of building 1985–2011
Iceland statistics	---

Table 13.5. Final consumption expenditure of households

Database	Dataset(s) name
Eurostat	Final consumption expenditure of households by consumption purpose - COICOP 3 digit - aggregates at current prices (nama_co3_c)
Nordic statistics	NAAC11: Final consumption expenditure of households by reporting country, purpose, prices, currency and time
Denmark statistics	NAT05: Private consumption (DKK mio) by classification of individual consumption and price unit FU5: Household yearly consumption by type of consumption, group of households and price unit (1993:1995–2009:2011)
Sweden statistics	Household final consumption expenditure (ESA95) by purpose COICOP. Quarterly 1993K1–2012K2 Expenditure on household (0–79 years) (HBS) by household type and expenditure. (Sample survey, see the footnotes.) Year 2003–2009
Finland statistics	Private consumption expenditure 1975–2011 Household consumption expenditure per household by type of household 1985–2006
Norway statistics	04882: Expenditure per household per year, by commodity and service group. Prices from the last year 09172: Final consumption expenditure of households
Iceland statistics	Household final consumption expenditure 1990–2011 Average household expenditure and size by type of household from 2002

Table 13.6. Material flow accounts

Database	Dataset(s) name
Eurostat	Material flow accounts (env_ac_mfa)
Nordic statistics	---
Denmark statistics	---
Sweden statistics	Commodity flows / material flows (MFA), biomass, minerals and fossil fuels. Imports, exports, domestic production and consumption of products / goods by product, level 3. Year 1998–2005
Finland statistics	Material requirements by material group
Norway statistics	---
Iceland statistics	---

14.1.2 Data related to food waste prevention indicators

a. Food waste generation.

There is no consistent dataset available about food waste generation. However, data from some surveys exist.

b. Avoidable food waste generation.

Data on avoidable food waste generation don't exist. Only estimates can be extracted. However, data from some surveys exist (Danish EPA, 2012).

c. Economic output of food related industries and services.

Table 13.7.

Database	Dataset(s) name
Eurostat	National Accounts by 64 branches - aggregates at current prices (nama_nace64_c) (selection INDIC_NA: P1 Output)
Nordic statistics	---
Denmark statistics	NAT07N: Production etc (DKK mio) by kind of activity, variable and price unit
Sweden statistics	Output, intermediate consumption and value added (ESA95) by industrial classification SNI 2007 and transaction item. Year 1993–2010
Finland statistics	Production and generation of income accounts 1975–2011
Norway statistics	09170: Production account and income generation, by industry
Iceland statistics	Gross output by kind of activity 1997–2010

d. Production of food (tonnes).

Table 13.8.

Database	Dataset(s) name
Eurostat	Prodcom Annual Sold (NACE Rev.2) (DS_066341)

e. Consumption of food (kg/cap).

Table 13.9.

Database	Dataset(s) name
Eurostat	Gross human apparent consumption of main food items per capita (food_ch_concap) Gross human apparent consumption of main food items (food_ch_cons)
Nordic statistics	PECA01: Consumption of food, kg per person per year, by reporting country, kind and time
Denmark statistics	FVF1: Human consumption of food by type and unit
Sweden statistics	---
Finland statistics	---
Norway statistics	04886: Quantities of food and beverages consumed per person per year, by commodity group (kg/litre)
Iceland statistics	Annual meat consumption per capita 1983–2010 Consumption of domestic dairy products 1990–2007

f. Food retail sales

Table 13.10.

Database	Dataset(s) name
Eurostat	Retail sales of foodstuffs (food_pd_sale1)
Nordic statistics	---
Denmark statistics	VARER2: Manufacturers' sales by main SITC groups
Sweden statistics	Sales (including VAT) of food and beverages in the trade by commodity group (COICOP 4-digit level). Year 2000–2011
Finland statistics	---
Norway statistics	---
Iceland statistics	---

g. GHG emissions of food products (tonnes CO₂-eq).

Table 13.11.

Database	Dataset(s) name
Eurostat	Emissions of greenhouse gases and air pollutants induced by final use of products, by place of origin—results from environmental input-output analysis (env_ac_io)
Nordic statistics	---
Denmark statistics	MREG6: Emissions to air caused by final demand by group of consumption, type of emission and unit (DISCONTINUED)
Sweden statistics	---
Finland statistics	Greenhouse gas emissions in Finland
Norway statistics	09288: Greenhouse gases from Norwegian economic activity, by industry and pollutant
Iceland statistics	---

14.1.3 Data related to construction and demolition waste prevention

Construction and demolition waste generation

Table 13.12.

Database	Dataset(s) name
Eurostat	Generation of waste (env_wasgen)
Norway statistics	09247: Generated waste amounts from construction, rehabilitation and demolition of buildings (tonnes), by material (2004–2010)

Consumption of construction materials

No dataset has been found.

Domestic extraction of (selected) construction materials

See material flow datasets above.

Construction sector's economic output

Table 13.13.

Database	Dataset(s) name
Eurostat	Construction production index—annual data—(2005 = 100) (NACE Rev.2) (sts_copr_a) Construction new orders index—annual data—(2005 = 100) (NACE Rev.2) (sts_cono_a)
Nordic statistics	NAAC05: Gross value added, mill. national currency, by reporting country, activity, prices and time
Denmark statistics	---
Sweden statistics	---
Finland statistics	Turnover of construction Index of turnover of construction (TOL 2008)
Norway statistics	03512: Construction sales statistics (NOK million) (C) (1998T1–2012T2) 07288: Construction sales statistics, by industrial groupings (SIC2007) (2008T1–2012T2)
Iceland statistics	---

Renovation economic output

Table 13.14.

Data-base	Dataset(s) name
Sweden statistics	Rebuilt residential area in apartment buildings by region, type of ownership and construction period. Year 1989–2011 Remodelled apartments in apartment buildings by region, type of ownership, construction period and apartment type. Year 1989–2011 Redevelopment of apartment buildings, the addition of apartments, in the kingdom after the operation, ownership, construction period, dwelling and with / without state support. Year 1989–2011
Finland statistics	Building permits for renovation building 2000–2012 Renovation, repair of the housing stock 1995–2011 (value)

Area of new construction

Table 13.15.

Data-base	Dataset(s) name
Eurostat	Building permits - monthly data - index (2005 = 100) (NACE Rev.2) (sts_cobp_m) Building permits - monthly data - percentage change (NACE Rev.2) (sts_cobpgr_m) Building permits - quarterly data - index (2005 = 100) (NACE Rev.2) (sts_cobp_q) Building permits - quarterly data - percentage change (NACE Rev.2) (sts_cobpgr_q) Building permits - annual data - index (2005 = 100) (NACE Rev.2) (sts_cobp_a) Building permits - annual data - percentage change (NACE Rev.2) (sts_cobpgr_a)
Nordic statistics	CONS01: Completed dwellings by reporting country, dwelling, time and number
Denmark statistics	BYGV01: Total Construction (not adjusted for delays) by condition, use and ownership (1982–2011) BYGV11: Total Construction (not adjusted for delays) by region, condition, use and ownership (2006–2011) BYGV02: New Buildings completed by year of commencement and type of building case (1981–2011) BYGV22: New Buildings completed (not adjusted for delays) by region, year of commencement and type of building case (2006–2011) BYGV8: Total floor area (adjusted for delays) by condition and use (1994M01–2012M06) BYGV10: Total Construction (adjusted for delays) by condition and use (1994M01–2012M06)
Sweden statistics	Building permits for new construction, number and gross floor area by region and type of building. Quarterly 1996K1–2012K2 Building permits for new construction, gross floor area by type of building. Quarterly 1996K1–2012K2 Building permits for new construction, apartments in residential buildings and homes by region and type of building. Quarterly 1996K1–2012K2 Apartments in new buildings by region and type of building. Quarterly 1975K1–2012K2 Completed apartments and room units in newly constructed buildings by region and type of building. Year 1975–2011 Completed in newly constructed buildings by region, dwelling and type of building. Year 1975–2011 Completed in newly constructed buildings by type of building (detached houses divided), tenure and dwelling. Year 1991–2011 Completed in newly constructed buildings by type, tenure and dwelling. Year 1991–2011 Completed in newly constructed buildings by region, type of building, tenure and ownership. Year 1991–2011 Completed, new houses, number of room units by type and tenure. Year 1991–2011
Finland statistics	Building permits 1990–2012 Volume index of new building 2005=100 Building and dwelling production 1990–2012

Norway statistics	03723: Building statistics. Dwellings and utility floor space in dwellings. Preliminary figures (C) (1993M01–2012M07)
	08843: Building statistics. Dwellings and utility floor space in dwellings, so far this year. Preliminary figures (C) (2000M01–2012M07)
	09286: Building statistics. Utility floor space other than in dwellings, by division (SIC2007) (1 000 m ²). Preliminary figures (C) (2012M01–2012M07)
	09287: Building statistics. Utility floor space other than in dwellings, by division (SIC2007), so far this year (1 000 m ²). Preliminary figures (C) (2012M01–2012M07)
	05808: Building statistics. Dwellings and utility floor space in dwellings. Not adjusted, seasonally adjusted and trend (1983M01–2012M07)
	05809: Building statistics. Utility floor space other than in dwellings. Not adjusted, seasonally adjusted and trend (1 000 m ²) (1983M01–2012M07)
	08669: Building statistics. Average monthly registration delay for buildings started (2001M01–2012M07)
	05889: Building statistics. Dwellings and utility floor space in dwellings, by type of building (M) (2000K1–2012K2)
	05887: Building statistics. Utility floor space other than in dwellings, by type of building (m ²) (M) (2000K1–2012K2)
	05940: Building statistics. Dwellings and utility floor space in dwellings, by type of building (M) (2000–2011)
	05939: Building statistics. Utility floor space other than in dwellings, by type of building (m ²) (M) (2000–2011)
	06512: Building statistics. Dwellings and dwelling units (1946–2011)
	06952: Building statistics. Holiday houses (M) (1983–2011)
Iceland statistics	Residential buildings in Iceland 1970–2011
	Residential buildings in the capital region 1983–2011
	Residential buildings in Reykjavik 1960–2011
	Dwellings by number of rooms and type of dwellings 2000–2009

Life cycle assessment data on construction materials

Life cycle data can be obtained by the relevant databases, e.g. Ecoinvent (<http://www.ecoinvent.org/database/>) and Ecolizer 2.0 based on Eco-Indicator'99.

(<http://ovam.be/jahia/Jahia/cache/offonce/pid/176?actionReq=actionPubDetail&fileItem=1212>)

Average design life expectancy of buildings and roads

No data has been found.

14.1.4 Data related to WEEE

WEEE generation

There is no consistent dataset available on WEEE generation. Although data on WEEE collected at the official collection sites in the respective countries, WEEE collected outside of the systems is not found

A study from Sweden which mapped out the material flow of WEEE from the time WEEE is put on the Swedish market could not estimate the magnitude of WEEE collected outside of the official systems. Statistics Iceland has the figure for total WEEE generated in 2007 and 2008, without breakdowns.

EEE put on the market

Table 13.16.

Database	Dataset(s) name
Eurostat	Waste Electrical and Electronic Equipment (WEEE) (env_waselee)

Use of second-hand EEE

Currently there is no data available on this dataset.

Hazardous substances found in EEE (% in homogenous materials found in EEE)

Currently there is no comprehensive data available on this data set. Some EU studies indicate potential reduction of six substances restricted under the RoHS Directive, based on the content of these substances that were previously found in EEE before the RoHS Directive came into force.

Second hand shops handling EEE (number)

Data on the number of second-hand shops (including sales of second-hand clothing) is generally available in most of the Nordic databases but the level is too much aggregated and the use of this dataset for the construction of indicators is very limited. However, statistical offices may possess better breakdown data which can be more useful.

Table 13.17.

Database	Dataset(s) name
Eurostat	Annual detailed enterprise statistics for trade (NACE Rev.2 G) (sbs_na_dt_r2)
Nordic statistics	---
Denmark statistics	GF2: General enterprise statistics by industry (DB07, 127-grouping) and unit
Sweden statistics	Enterprises and employees (FDB) by industrial classification SNI 2007, five digit level and size class. Year 2008–2011
Finland statistics	---
Norway statistics	07195: Enterprises except public administration, agriculture, forestry and fishing, by industry (SIC2007), organisational structure and number of employees
Iceland statistics	Registered enterprises and organisations 2008–2011

Repair service for EEE

Table 13.18.

Database	Dataset(s) name
Eurostat	Annual detailed enterprise statistics for services (NACE Rev.2 H-N and S95) (sbs_na_1a_se_r2)
Nordic statistics	---
Denmark statistics	GF2: General enterprise statistics by industry (DB07, 127-grouping) and unit
Sweden statistics	Enterprises and employees (FDB) by industrial classification SNI 2007, five digit level and size class. Year 2008–2011
Finland statistics	---
Norway statistics	07195: Enterprises except public administration, agriculture, forestry and fishing, by industry (SIC2007), organisational structure and number of employees
Iceland statistics	Registered enterprises and organisations 2008–2011

14.1.5 Data related to textiles

Textile waste generation

Data on Textile waste generation is difficult to acquire. Most probably the most complete/reliable data at the moment can be found in the report “Prevention of textile waste” by the Nordic Council of Ministers. Reference: Tojo N., Kogg B., Kjørboe N., Kjær B., Aalto K., 2012, *“Prevention of textile waste. Material flows of textiles in three Nordic countries and suggestions on policy instruments”* TemaNord 2012:545.

Amount of textile products manufactured within the country

Table 13.19.

Database	Dataset(s) name
Eurostat	Prodcum Annual Sold (NACE Rev. 2) (DS_066341)
Nordic statistics	---
Denmark statistics	VARER1: Industrial commodity statistics by commodity group and unit (annual)
Sweden statistics	Industrial production by commodity group of CN and payroll processing. Year 1996–2011
Finland statistics	Industrial production (Teollisuustuotanto) by year (divided in sectors)
Norway statistics	07345: Sold production of goods in the manufacturing industry
Iceland statistics	Total value of sold manufactured products 2007–2011

Amount of new textile products exported and imported

Table 13.20.

Database	Dataset(s) name
Eurostat	EU27 trade since 1988 by CN8 (DS_016890)
Nordic statistics	---
Denmark statistics	KN8Y: Imports and exports by imports and exports, commodities, country and unit
Sweden statistics	Varuexport till samtliga länder efter varugrupp KN 8-siffernivå och handelspartner (sekretessrensad). Ej bortfallsjusterat. År 1995–2011 Varuimport från samtliga länder efter varugrupp KN 8-siffernivå och handelspartner (sekretessrensad). Ej bortfallsjusterat. År 1995–2011
Finland statistics	---
Norway statistics	08801: External trade in goods, by commodity number (HS) and country 07336: Exports of goods and services (1970–2011) 07337: Imports of goods and services (1970–2011)
Iceland statistics	Exports by HS-Classification 2010–2012, chapters 51–99 Imports by HS-Classification 2010–2012, chapters 41–67

Amount of recycled fibres sold

No dataset is available concerning this element.

Total amount of fibres put on the market

The data on fibres put on the market is a combination of datasets already described above (*b*, *c* and *d*) and they are readily available and easy to find in all national statistics.

The data follow the rule: Fibres put on the market = Domestic production + imports–exports of textiles.

Second hand shops handling textile products

This data doesn't exist readily for use and is considered difficult to acquire in great detail. There is no data on the exact number of shops handling second hand textile products. It could be acquired by contacting relevant enterprises on the sector.

Sales of second-hand textile products

Data on the turnover of second-hand services (including sales of second-hand clothing) is generally available in most of the Nordic databases but the level is either too much aggregated or the time series very limited (one-shot).

Table 13.21.

Database	Dataset(s) name
Eurostat	Annual detailed enterprise statistics for trade (NACE Rev.2 G) (sbs_na_dt_r2)
Nordic statistics	---
Denmark statistics	FIKS44: Purchases and sales (detailed) by industry (DB07) and amount
Sweden statistics	Basic facts of business on Business Statistics by industry SNI2007, 5-digit level of NACE. Year 2000–2010
Finland statistics	---
Norway statistics	07434: Commodity trade. Principal figures, by industry group (SIC2007). Preliminary figures
Iceland statistics	Turnover in retail trade 1999–2010

Amount of second-hand textile products exported

This data is readily available in all Nordic databases and in Eurostat (comext database). The same CN codes are used across all countries for common reporting so it is easy to extract comparable data from all databases. The dataset described under core elements III and IV can be used here as well but the CN code relevant only to second hand textile products exports is 63090000.

Repair shops for textile products

No dataset has been found.

Amount of textiles made of single material (tonnes, kg/cap)

Amount of textile products certified by global recycled standard

The amounts (in tonnes) of the core elements suggested above would be difficult to acquire. Certifications are usually on product level, so additional information on the amounts of the certified products produced is essential for complete data to be calculated.

Number of textile products certified by one of the following eco-labelling schemes Nordic Swan, Swedish Good Environmental Choice Program, EU Flower

Data on ecolabeled textile products can be found in the webpages of the respective issuing institutions (e.g. svanen.se, ecolabel.eu, <http://www.naturskyddsforeningen.se/bra-miljoval/textil/>, etc.).

Number of textile products certified by Oeko-Tex Standard 100

Information on the Oeko-Tex textile products can be obtained from the national certifying institution (https://www.oeko-tex.com/en/manufacturers/certified_products/certified_products.html). Data can be obtained on the number of nationally-based manufacturers who have been certified so that they may use the Oeko-Tex certificate on their products. However, no data is obtainable on the numbers of products that have been labeled by these manufacturers. There is also no data on sales or numbers of products sold in a country which have been certified in other countries via their manufacturer.

Number of products certified by bluesign

Information on the bluesign certification scheme can be obtained from the bluesign office in Switzerland (<http://www.bluesign.com/>). However, the office only holds data on how many textiles manufacturers worldwide have been certified as being able to use the label, and how many brands are participating in the scheme in order to source materials from bluesign certified manufacturers. No product level or country level data is available. The individual brands using bluesign certified textiles may have this information but it would be difficult to collect.

14.1.6 Sources:

Eurostat: <http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/themes>
Nordic Statistics: <http://91.208.143.50/pxweb/pxwebnordic/dialog/statfile1.asp>
Statistics Denmark: <http://www.statbank.dk/statbank5a/default.asp?w=1680>
Statistics Sweden: <http://www.ssd.scb.se/databaser/makro/start.asp>
Statistics Norway: <http://www.ssb.no/english/>
Statistics Finland: http://pxweb2.stat.fi/database/StatFin/databasetree_en.asp
Statistics Iceland: <http://www.statice.is/>

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Proposals for targets and indicators for waste prevention in four waste streams

This project, commissioned by the Nordic Council of Ministers, had the objective of providing first proposals for targets and indicators that can be used in the Nordic countries' waste prevention programmes. Four waste streams were considered: food waste, construction- and demolition waste (C&D waste), waste electrical and electronic equipment (WEEE) and textile waste. The project took the following two-step approach. Firstly, a literature review of international experiences was conducted regarding waste prevention policy, waste definitions, target setting and use of indicators for the respective four waste streams. Secondly, based on the findings from the literature as well as experiences of the project team, proposals for targets and indicators were developed.

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