

Appendix I: Interview guide

Interview guide

Policy instruments are the focal point of the interview. Please specify each of the policy instruments that the interviewee highlight. Please find definition of policy instrument in the invitation letter.

Which goals has the government set for circular economy in the construction sector?

Please describe the policy instrument – please specify:

- its characteristics e.g. economic incentives, rules, agreements or information
- how it relates to the construction sector;
- the intentions of the policy instrument
- the percentage proportion of the construction sector that will be affected

Specify it according to type of resource the policy instrument targets:

- Concrete
- Tiles, bricks and masonry
- Wood
- Insulation material
- Space
- Other

Specify it according to which building component type the policy instrument targets:

- Façade
- Foundation
- Windows
- Insulation
- Other

Specify it according the value chain (where and how):

- Product design (including choice of raw materials for the products)
- Design of building

- Production process (construction)
- Consumption/use (operation and maintenance)
- Refurbishment (renovation)
- From waste to resources (demolition)
- Innovation, investment and other crosscutting issues

Specify it according to:

- Waste legislation
- Building regulation
- Transport legislation
- Environmental legislation
- Taxation and fees
- Other

Specify the opportunities, benefits, costs and trade-offs in the construction sector (who is primarily affected by the policy instrument, and how (to be specified in the question 7)

Please also specify the effect of the policy instrument by giving a -5 to +5 indication for each of the seven below listed aspects. Where -5 is a very negative effect, 0 is a neutral effect and +5 is a very high positive effect, including:

- The estimated and quantified savings in resources (). Please identify a data baseline for "as is" (in tonne) and the percentage change in this data baseline if the policy instrument is implemented. The percentage change is the specification of the -5 to +5 indication.
- The estimated effect on the economy for the public authorities – how is the national economy affected by a change in the policy instrument? This mainly concerns taxation and administration. Please identify a data baseline for "as is" (e.g. in EUR) and the percentage change in this data baseline if the policy instrument is implemented, the "as if" (preferably in both the short and long run). The percentage change is the specification of the -5 to +5 indication
- The estimated effect on the economy for the private companies – how is the companies economy affected by a change in the policy instrument? This mainly concerns turnover for the affected (group of) companies, including taxation and administration. Please identify a data baseline for "as is" (e.g. in EUR) and the percentage change in this data baseline if the policy instrument change is implemented, the "as if" (preferably in both the short and long run). The percentage change is the specification of the -5 to +5 indication
- The estimated effect on the export of goods and thus also the competitiveness of the companies in the Nordic countries. The estimation on the effect (from -5 to +5) must preferably be on trade organisation level.

- The estimated effect on the export of knowledge concerning circular economy, new technical solutions etc. The estimation on the effect (from -5 to +5) must preferably be on trade organisation level.
- The estimated benefits generated due to a higher degree of collaboration between the Nordic countries toward a Nordic circular economy. The estimation of the benefits (from -5 to +5) must preferably be on trade organisation level.

What is the level of uncertainty on the above information?

- Low: Below 10% uncertainty
- Medium: Up to 30% uncertainty
- High: Up to 60% uncertainty
- Very high: Over 60% uncertainty

Appendix II: Fact sheets template

The results from the interviews will be condensed in fact sheets (1–2 pages) - one for each of the highlighted policy instruments. The fact sheet is shown below.

Fact sheet template

- The existing policy instrument (characteristics).
- The policy instruments according to type of resource(s):
 - The policy instrument according to building component type
 - The policy instrument according to the value chain (and how, when and to whom is it a barrier?)
- The policy instrument according to legislation, taxation and fees.
- The policy instrument according to the opportunities, benefits, costs and trade-offs.
- Please also specify the effect of a change in the policy instrument by giving a -5 to +5 indication for each of the seven below listed aspects. Where -5 is a very negative effect, 0 is a neutral effect and +5 is a very high positive effect:
 - Environmental impact (e.g. CO₂ emissions) from the estimated and quantified savings in resources + the estimated effect on space efficiency (m² space).
 - Estimated effect on the economy for the public authorities.
 - Estimated effect on the economy for the private companies.
 - Estimated effect on the export of goods and thus also the competitiveness of the companies in the Nordic countries.
 - Estimated effect on the export of knowledge concerning circular economy, new technical solutions etc.
 - Benefits generated due to a higher degree of collaboration between the Nordic countries toward a Nordic circular economy.
- The level of uncertainty on the above information.

Please note, that if the interview cannot identify data for 7 a-c, the “as is” (e.g. in EUR), it is the responsibility of the interviewer to identify these data.

Appendix III: Fact sheets from interviews

Denmark

In Denmark, the following stakeholders were interviewed.

Table 16: The Danish interviewees

Organisation	Interviewee
The Danish Environmental Protection Agency	Niels Bukholt
The Danish Waste Association	Jacob Hartvig Simonsen
The Centre for Management and Recycling of Construction Waste	Anke Oberender
Confederation of Danish Industry	Elly Kjems Hove and Jakob Orbesen

The Danish Environmental Protection Agency: Niels Bukholt

Attendees:

- Niels Bukholt – NB, The Danish Environmental Protection Agency.
- Linda Høiby – LAN, COWI A/S Denmark.

The interview was performed on 7 April 2017.

NB is chief of part of the department Circular Economy & Waste (formerly “Soil and Waste”) at The Danish Environmental Protection Agency.

The goals for circular economy in Denmark are expressed through:

- Improved quality of recycling of materials from the building sector. Preferably increased direct reuse.
- Removal of the hazardous pollutants in building materials.

These goals are expressed in:

- Goals in the two Danish resource strategies¹
- Goals in the Danish prevention strategy²

¹ <http://mst.dk/virksomhed-myndighed/affald/affaldshaandtering-strategi-aktiviteter/danmark-uden-affald-strategi-plan/>

² http://mst.dk/media/131357/danmark_uden_affald_ii_web_29042015.pdf p. 34

The Danish Environmental Protection Agency is part of the secretariat for the Danish Advisory Board for Circular Economy.

A partnership for sustainable buildings and waste prevention has been established to investigate various aspects within the circular economy.³ Examples are investigation of needed initiatives to establish an effective market for reused and recycled materials. The projects performed by the partnership must serve as a solid base for development of improved requirements, identification of actions for the establishment of an effective market etc.

Overskrift til afsnittet her

The policy instrument (characteristics)

Increased demands/requirements for the development of a demolition plan which:

- must have focus on a higher quality of reuse and recycling of materials
- must not only set requirements to the removal of hazardous materials from the material flow – but also ensure that the hazardous materials are removed
- must be developed by a (private) certified demolition company. The demolition plan includes information about reusable materials, recyclable materials, contaminated materials etc
- must entail training and certifying the employees at the demolition companies
- must ensure that better supervision is performed within the existing financial frame for the municipalities.

The policy instruments according to type of resource(s)

All resources in a building. But maybe incorporation of a de minimis limit.

The policy instrument according to building component type

All building components. But maybe incorporation of a de minimis limit.

The policy instrument according to the value chain (and how, when and to whom is it a barrier?)

Phase f: from waste to resources (demolition).

When the instrument is in place, the gains can be obtained by reusing more materials.

³ <http://www.vhgb.dk/>

VHGB is organised by a consortium of specialists who physically situated at the Technological Institute in Taastrup, Denmark. The operation of VHGB is taken care of by a consortium consisting of the Technological Institute, Golder Associates and KommunikationsKompagniet A/S. Furthermore, VHGB has close contact to expert from the Danish Building Research Institute, Lauritzen Advising and the law firm Bech-Bruun.

VHGBs managing group consists of representatives from The Danish Construction organisation, The Danish Environmental Protection Agency, Danish Transport, Construction and Housing Authority, The Landowners' Investment Foundation, The Danish Association of Consulting Engineers, The Danish Association of Construction Clients and LOCAL GOVERNMENT DENMARK.

The policy instrument according to legislation, taxation and fees

The policy instrument is legislative.

The policy instrument according to the opportunities, benefits, costs and trade-offs

The costs to the building owner will rise as the price for the demolition of the building will rise. On the other hand, the price for selling the materials will rise.

The municipalities (supervising officials) will have a more detailed instruments for ensuring proper and legal demolition and correct handling of materials.

It is recognized that more materials are deposited at landfills as the content of hazardous materials will result in more deposited materials at the beginning – but as the materials with hazardous materials are phased out, the amount of deposited materials will decrease.

Please also specify the effect of a change in the policy instrument by giving a -5 to +5 indication for each of the seven aspects listed below. Where -5 is a very negative effect, 0 (zero) is a neutral effect and +5 is a very high positive effect

Zero, 0, is the baseline which must be linked to data to estimate the potential amount of resources as we have not focussed on a percentage change (we should consider changing this in the interview guide -5 to +5):

- Environmental impact (e.g. CO₂ emissions) from the estimated and quantified savings in resources.
 - 2–3 because a good demolition plan must be followed by the demolition companies and thus the reduction in environmental impacts will be reduced. It will be clear to the supervision officials if the demolition plans are not followed.
 - The data needed to calculate the savings are obtained by using the share of recycled and reused materials in a building today. But beware that no data are available due to the fact that the definitions concerning quality of recycling etc. have not been developed. Furthermore, the raw data are not available. Guess: 10% today.
 - The other data baseline is the expected (increased) share of materials with a higher quality of recycled materials and share of reused materials in buildings when the policy instrument is in operation. Perhaps 30% can be achieved – but not in the near future (e.g. 5 years).
- Estimated effect on the economy for the public authorities
 - Administration: The policy instrument will not result in increased costs and other burdens on the municipalities for increased supervision. Effect: 0.
 - Taxes: The income from tax on deposited materials will rise as the amount of deposited materials rises. It is estimated that the effect is +1.

- The data baseline is the increased share of deposited materials in buildings when the policy instrument is in operation. It will with great uncertainty affect 5–10 % of the building waste.
- Estimated effect on the economy for the private companies
 - The demolition companies: increased turnover as it takes more time to make a demolition plan and sort the waste even more than today.
 - Effect: 2–3 => 20–30% increased time consumption/turnover.
 - It has not been in focus to place gains or costs on either building owner or demolition companies, so whether the ownership of the waste and the financial gain from recycling and reusing materials stays with the building owner – or is transferred to the demolition companies has not been explored. The also applies to the time consumption for the increased reuse and recycling of materials: the demolition companies can transfer the costs to the building owners so that the demolition companies are not financially affected by the changes in policy instrument.
- Estimated effect on the export of goods and thus also the competitiveness of the companies in the Nordic countries.
 - Limited effect as the building materials are heavy and have a relatively low value. The transportation distances constitute the limiting parameter as transport can be very costly. Estimated effect: ½
 - Estimated effect: 1–2. If the construction companies can expand their business to other countries by showing that the circle can be closed, the concept can be marketed and branded in countries other than Denmark. This fact can increase the competitiveness of Danish companies positively.
- Estimated effect on the export of knowledge concerning circular economy, new technical solutions etc.
 - NB does not foresee any export of knowledge about technological aspects as the technology within sorting of materials etc. is “low key”.
 - Effect: 0? (not answered but qualitatively assessed by NB).
- Benefits generated due to a higher degree of collaboration between the Nordic countries toward a Nordic circular economy.
 - The benefits can be positive as the building traditions are almost the same. Norway, Sweden and Finland use quite a lot more wood – but Denmark has initiated many projects etc. to increase the use of wood in Denmark. This fact makes the Nordic countries even closer in the near future.
 - The knowledge can be shared between the Nordic countries.
 - Effect: 1–2.

The level of uncertainty on the above information

- Was not discussed.

En overskrift til afsnittet her

The policy instrument (characteristics)

Incorporation of new green criteria with focus on increased quality of recycling and increased reuse of resources into the national building regulations in Denmark:

- At the beginning as a green obligatory supplement to the national building regulations. As the knowledge and experience with the new criteria increases, the new green criteria becomes mandatory (just like incorporation of the Danish energy classes).

Requirements for a “building pass” (no further explanation and discussion occurred during the interview).

The policy instruments according to type of resource(s):

All resources in a building. But maybe incorporation of a de minimis limit.

The policy instrument according to building component type

All building components. But maybe incorporation of a de minimis limit.

The policy instrument according to the value chain (and how, when and to whom is it a barrier?)

The policy instrument is focused on the design of the building (b in the interview guide) – but the policy instrument has the potential to influence all of the other phases of a building as the choice of building products affects the manufacturer’s product design, the construction of the building, the use of the building, need for refurbishment, demolition including reuse and recycling of the resources. The largest gains can be obtained in the initial/first phases of the value chain.

The policy instrument according to legislation, taxation and fees

The incorporation of circular aspects and increased resource efficiency must be incorporated into the building legislation.

The policy instrument according to the opportunities, benefits, costs and trade-offs.

This policy instrument may have the following consequences:

- Increased costs in the planning phase – which will hopefully be gained again when selling the materials after demolition of the building.

The costs are higher at the beginning when the processes etc. are developed.

The costs will be higher to the building owners as they have to increase the work in the planning stage. But hopefully the increased costs can be gained again in the demolition phase as the value of the recycled and reused materials is increased.

When all interests are collected at the beginning of the life cycle of a building (the planning and design phase) the highest gains can be achieved as the most important decisions related to materials are made at the beginning. This process may be more expensive due to a higher number of meetings with the constructor, architect etc.

The loss from construction of buildings are:

- Cut off.
- Buying more materials than needed.
- Losses due to damage to materials at the construction site.

Total loss today of these three fractions: 8–10%.

The Danish Waste Association: Jacob Hartvig Simonsen

Attendees:

- Jacob Hartvig Simonsen – JHS, The Danish Waste Association.
- Henrik Sand – HESA, COWI A/S Denmark.
- Linda Højbye – LAN, COWI A/S Denmark.

The interview was performed on March 29, 2017.

JHS is CEO at The Danish Waste Association.

Goals for a circular economy in Denmark

No direct goals – only goals for the amount of recycled materials in the national regulation regarding waste. Not very concrete and specific.

There is a significant lack of goals due to the complexity of the regulation incorporating circular economy in the regulation, taxes, guides etc.

There are more soft “wishes” – especially from the European Commission.

Overskrift til afsnittet

The policy instrument (characteristics)

Dispensation from the capital cost ceiling for the Danish municipalities for construction works (“anlægsloftet”). Dispensations should be granted for municipal construction of buildings that are based on the principles of Circular Economy demanding the use of recycled and/or reused materials in new buildings. These principles should be included in a guideline.

An example would be:

- Use of 20% reused/recycled materials in new buildings etc.

- Dispensations will create a significant demand for building designs and construction products based on the principles of Circular Economy. As it will support the creation of a market for secondary raw materials.
- The policy instrument entails a need to verify the quality and performance of the recycled resources and reused products. – E.g. by using CE-marking, ETV schemes etc. Requirements to the content of hazardous substances have to be incorporated into the verification.

The policy instruments according to type of resource(s)

All resources in a building.

The policy instrument according to building component type

All building components.

The policy instrument according to the value chain (and how, when and to whom is it a barrier?)

Primarily the phase (b) where the buildings are designed and where the choice of materials is made. It also has an effect during the product design (phase a).

The remaining phases will also be affected. Especially, the cooperation between the Danish waste stations and the developers of new building materials. This is needed to facilitate an effective market for reused and recycled resources.

The cooperation on materials for buildings must also be facilitated by a stronger cooperation between private and public partners.

The policy instrument according to legislation, taxation and fees

The proposed policy instrument concerns the agreements made between the Danish government and the municipalities regarding the capital cost ceiling for construction works.

It also concerns the quality of reused and recycled materials.

Update of the building regulation to include the possibilities or requirements to use reused building materials or recycled materials.

The policy instrument according to the opportunities, benefits, costs and trade-offs.

There are great opportunities (see #7) – but beware that the market cannot control and ensure the circular transition on its own – the transition must to some extent be stimulated by the government.

Please also specify the effect of a change in the policy instrument by giving a -5 to +5 indication for each of the seven aspects listed below. Where -5 is a very negative effect, 0 (zero) is a neutral effect and +5 is a very high positive effect

- Environmental impact (e.g. CO₂ emissions) from the estimated and quantified savings in resources.
 - Short term: 0 to +1.

- It will take time for the market to effectively respond to a demand for construction of buildings that are based on the principles of Circular Economy. The environmental impact will therefore not be small in the short run. But some companies will be able to respond to an expected growing demand from the municipalities. In the short run it will start to grow the production of building materials from recycled materials – and thereby the demand for secondary raw materials. This will positively impact the CO₂ footprint and lessen the use of virgin materials per produced building component in the construction sector.
- Long term: 3. A growing demand from the municipalities will create a growing supply of CE-based solutions. This will further influence the demand for secondary raw materials as it will reduce the amount of waste materials in the construction sector as more and more building materials are expected to be designed for direct reuse and in loops. It will impact the CO₂ footprint and the use of secondary resources in the production of new materials. The score is set to 3 as the impact will affect constructions and buildings in the municipalities only and thereby not the private market, though there might be some positive spill-over effects.
- Estimated effect on the economy for the public authorities.
 - The public consumption increases – but the tax basis/revenue (income) will also increase due to more activity in the construction sector. The administrative burdens will also increase.
 - Quantified effect: -1 for increasing public consumption and for extra administrative time spent on dispensation from the capital cost ceiling on specifying and applying the principles of Circular Economy to the construction sector and on supervision and verification. Though at the beginning mainly as the market is not effective from the start. The market is expected to grow and the score for the long run is therefore -3.
- Estimated effect on the economy for the private companies.
 - The companies that succeed in transforming their business model to the principles of Circular Economy can benefit from the policy instrument and thereby be able to obtain a positive effect.
 - Estimated effect in total: 3 in extra turnover for the companies that are cable of commercially gain from the new construction activities in the municipalities. For other companies which do not engage in the transition, the effect can be negative. Plus it will only be constructions and buildings in the municipalities that will be affected. Summing all this up, the effect is 3 due to expected positive spill-over effects to the private market.
- Estimated effect on the export of goods and thus also the competitiveness of the companies in the Nordic countries.
 - First mover advantage can be obtained by the Danish companies. When the market becomes effective, the advantages become smaller.

- Estimated effect: Long term: 4 to 5. Short term: 0 (as models and products have to be developed)
- Estimated effect on the export of knowledge concerning circular economy, new technical solutions etc.
 - Short term: 0. Knowledge must be generated and collected before we can utilise the potential gains.
 - Long term: 4 to 5 when we utilise the potentials fully.
- Benefits generated due to a higher degree of collaboration between the Nordic countries toward a Nordic circular economy.
 - Knowledge sharing is very important. Quite unsure and a slow start.
 - Short term: 0 because it can be difficult to comply with the requirements and utilise the knowledge fully at the beginning. Long term: 1–3 due to the fact that cooperation can in fact strengthen the benefits when the sharing of knowledge becomes more effective.

The level of uncertainty on the above information

Cannot be quantified. But quite high uncertainty depending on the marked, potential will etc.

Overskrift til afsnittet her

The existing policy instrument (characteristics)

Lower or no VAT on building materials that are based on the principles of Circular Economy.

The policy instruments according to type of resource(s)

All resources in a building.

The policy instrument according to building component type

All building components.

The policy instrument according to the value chain (and how, when and to whom is it a barrier?)

Primarily the design phase (b) where the choice of materials is made as lower VAT will affect the price and thereby lower the construction costs. It also has an effect during the product design (phase a) as the building materials must include recycled resources or be made of reused resources.

The remaining phases will also be affected e.g. the dismantling (end-of-life phase) where design-for-disassembly solutions will be one effective instrument to increase the resource efficiency.

The policy instrument according to legislation, taxation and fees

Taxation (VAT).

The policy instrument according to the opportunities, benefits, costs and trade-offs.

The national VAT system – a lower VAT on CE-based building products will create a lower VAT revenue on building products.

Please also specify the effect of a change in the policy instrument by giving a -5 to +5 indication for each of the seven below listed aspects. Where -5 is a very negative effect, 0 (zero) is a neutral effect and +5 is a very high positive effect

- Environmental impact (e.g. CO₂ emissions) from the estimated and quantified savings in resources.
 - The market is expected to respond fast to lower VAT on building materials that are based on the principles of Circular Economy. The lower the VAT, the faster the market will respond. A significant VAT reduction will instantly create a growing demand for such materials and product. In the short run, the producers and constructors might not be able to fully respond to this demand – therefore 2 in short run and 4 in the long run as the whole construction sector will learn how to design, build and operate building based on CE-principles. It will impact the CO₂ footprint and the use of secondary resources in the production of materials. The VAT reduction is expected to be adjusted to the demand (see b).
- Estimated effect on the economy for the public authorities
 - 2 in the short run, -3 in the long run. A significant VAT reduction will significantly affect the public VAT revenue. It is therefore expected that the VAT reduction will be adjusted to the demand and will most likely mainly be used to start the market for CE-marked building materials. A growing production will create economy of scale and thereby more competitive prices. Higher administrative costs are also expected due to time spent on supervision and verification.
- Estimated effect on the economy for the private companies.
 - The companies that succeed in transforming their business model to the principles of Circular Economy may benefit from the policy instrument, and thereby be able to obtain a positive effect.
 - Estimated effect in total: a large plus (3). For some companies, which are innovative etc., the effect may be very positive. For other companies which do not engage in the transition, the effect may be negative. Summing all this up, the effect is 3 due to the expected adjustment of the VAT reduction (see b).
- Estimated effect on the exportation of goods and thus also the competitiveness of the companies in the Nordic countries.
 - First-mover advantages can be obtained by the Danish companies. When the market becomes effective, the advantages become smaller.
 - Estimated effect: Long term of 4 to 5. Short term: 0 (zero) (as models and products have to be developed).

- Estimated effect on the export of knowledge concerning circular economy, new technical solutions etc.
 - Short term: 0. Knowledge must be generated and collected before we can utilise the potential gains.
 - Long term: 4 to 5 when we utilise the potentials fully.
- Benefits generated due to a higher degree of collaboration between the Nordic countries toward a Nordic circular economy.
 - Distribution of knowledge is very important. Quite unsure and a slow start.
 - Short term: 0 (zero) because it may be difficult to comply with the requirements and utilise the knowledge fully at the beginning. Long term: 1–3 due to the fact that cooperation can in fact strengthen the benefits when knowledge sharing becomes more effective.

The level of uncertainty on the above information

High: up to 60% uncertainty as it depends on how the market will respond.

The Centre for Management and Recycling of Construction Waste: Anke Oberender

Attendees:

- Anke Oberender – AO, The Centre for Management and Recycling of Construction Waste.
- Henrik Sand – HESA, COWI A/S Denmark.
- Linda Højbye – LAN, COWI A/S Denmark.

The interview was performed on March 29, 2017.

AO is Managing Director at The Centre for Management and Recycling of Construction Waste (VHGB – Videncenter for Håndtering og Genanvendelse af Byggeaffald). VHGB is a Danish initiative that was initiated in April 2016. The centre's primary task is to collect, develop and disseminate impartial and concrete knowledge about the management and recycling of construction waste.

After the first interview, AO and LAN had a follow-up meeting on 7 April 2017 to discuss the remaining aspects to finish the two fact sheets.

The goal for circular economy in Denmark is expressed through:

- The work performed by the Advisory Board for Circular Economy.
- The Danish waste policy which has specific focus on resource use and which is supported by waste strategies:
 - Denmark without waste – A resource strategy for waste management.
 - Denmark without waste II – A waste prevention strategy.

The waste prevention strategy is a continuation of the resource strategy, and with these two strategies, the Government's ambition is to contribute to the decoupling of the link between economic growth and environmental impact from waste generation.

The waste prevention strategy describes a number of initiatives for the construction sector which aim at waste prevention in the sector and efficient use of resources.

Overskrift til afsnittet

The policy instrument (characteristics)

The first policy instrument focuses on the design and construction of buildings in combination with related aspects – the motivation of and/or setting requirements to the private and public building owners in order to promote construction that supports the principles of the Circular Economy. This may especially include:

- Requirements on the use of building products without hazardous substances.
- Focus on Design for Disassembly – Repair – Maintenance.
- Incorporating minimum requirements in the national building regulation for reuse/recycling of building materials from renovation/demolition.
- Incorporating minimum requirements in the national building regulation for the use of secondary building materials in new construction (recycling).
- Alternatively, voluntary systems (e.g. certification schemes) or tax structure where the use of secondary building materials in new construction is rewarded.
- Altered methods for tendering and procurement processes that i.e. ensure involvement of relevant stakeholders and promote closer dialogue between them in the early stages of the process.
- Revised tax structure of waste (making reused/recycled building materials more competitive compared to new building materials/virgin raw materials by making it more expensive to lower the degree of recyclability and reuse).
- Requirements to documentation and traceability of the materials and their technical/environmental quality so that reuse and recycling can be optimised.
- One way of motivating the construction sector to reuse and recycle building materials to a larger degree is to include lifecycle assessment (LCA) and lifecycle costing (LCC) of the entire lifecycle of a construction (including the end-of life phase) in the planning and design phases. In this way, the environmental consequences and overall economics can be considered by the project decision-makers.

The policy instruments according to type of resource(s)

All resources in a building.

The policy instrument according to building component type

All building components.

The policy instrument according to the value chain (and how, when and to whom is it a barrier?)

The policy instrument focuses on the design and construction of the building (b in the interview guide) as it has the potential to influence all of the other phases of a building's lifecycle as the choice of building products affects the manufacturer's product design, the construction of the building, the use of the building, need for refurbishment, ease of demolition including reuse and recycling of the resources. It will also generate a need for innovative products, investments in new business models, products, verification of products etc.

The policy instrument according to legislation, taxation and fees

The building legislation. Especially the national building regulation ("Byggeloven" and "Byggningsreglementet"). Voluntary schemes.

There are two ways to reach the goals:

- By incorporating additional mandatory requirements into the building regulation or
- To include supplementary and optional "green" criteria and requirements to the building regulation.

This can be supplemented by economic incentives to motivate the building owners.

The policy instrument according to the opportunities, benefits, costs and trade-offs.

There will be a transition where principles of Circular Economy need to be further developed and implemented in the construction sector. The policy instrument can be positive if the market adjusts to the changed needs.

The policy instrument will increase the responsibility of the building owners.

Please also specify the effect of a change in the policy instrument by giving a -5 to +5 indication for each of the seven aspects listed below. Where -5 is a very negative effect, 0 (zero) is a neutral effect and +5 is a very high positive effect

Zero, 0, is the baseline which must be linked to data to estimate the potential amount of resources as we did not focus on a percentage change (we should consider changing this in the interview guide – 5 to +5 means 10 % per 1 so that -5 is the same as 50% reduction and +5 is an increase of 50%).

The following quantifications are estimated for the three instruments in combination:

- Increased degree of disassembly.
- Less degree/content of hazardous substances.
- Increased use of recycled and reused materials.

- Environmental impact (e.g. CO₂ emissions) from the estimated and quantified savings in resources.
 - 2–3 at medium to long term if more materials are recycled and reused. This score can be translated into the use of 20–30% reused and recycled materials in buildings in total (the gain must be calculated on the basis of the difference between the current use of reused and recycled materials and the projected use of 20–30% reused and recycled materials). The current use of recycled and reused materials in buildings is unknown – might be at approximately 10%.
 - 0–1 in the short term since older constructions typically do not allow for a high degree of disassembly and typically contain hazardous substances.
- Estimated effect on the economy for the public authorities
 - The effect on administration and taxes cannot be quantified.
 - May increase costs to the building owners (private and public) in the short term since the reuse and recycling of building materials are often hindered by the presence of hazardous substance and a low degree of disassembly of older buildings. This in combination with relatively low costs for new building materials will typically imply higher costs when reusing/recycling building materials in new construction (-1). If the full life cycle costs of a project are considered, there might be smaller positive gains (+1) (in the long term).
- Estimated effect on the economy for the private companies
 - Not a cost – but an opportunity for a positive transition. Moving business and turnover from some companies to new companies. Thus there will be winners and losers. The winners will gain by redeveloping their business models and creating new products. The losers will continue with their existing products and business model.
 - Total estimation: +1 as there are more processes and a need for more manpower/man hours to handle the secondary materials in the improved and strengthened circular economy.
- Estimated effect on the export of goods and thus also the competitiveness of the companies in the Nordic countries.
 - Gains to be obtained for the producers of building materials which do transform into the circular economy e.g. by providing products without hazardous substances, use of secondary materials etc. As Denmark is not at the forefront and more proactive than other European countries, the effect is estimated to be 0 (zero).
- Estimated effect on the export of knowledge concerning circular economy, new technical solutions etc.
 - The cooperation across the value chain and also between countries can benefit the export of knowledge transfer. Denmark can also import knowledge (estimated effect: +2 as the knowledge export is estimated to be positive for Danish companies).

- Benefits generated due to a higher degree of collaboration between the Nordic countries toward a Nordic circular economy.
 - Minor benefits due to some differences between the countries (+2) that Denmark could learn from.

The level of uncertainty on the above information

Medium uncertainty.

Overskrift til afsnittet

The policy instrument (characteristics)

Regulations concerning the responsibility of the building owner: the building owner is responsible for carrying out screening (and mapping) of the building materials prior to certain types of construction/renovation work or demolition to determine whether PCB-containing material may have been used in the construction or any previous renovation of the building. Furthermore, the building owner is responsible for submitting a written notification to the local authorities covering (among other) the expected waste quantities and types as well as expected use or treatment of the waste or the expected waste recipient.

There is a need to promote the understanding, interpretation and implementation of the legislation concerning waste.

This includes:

- Guideline and/or requirements on the registration of hazardous substances/environmental pollutants other than PCB during screening and mapping.
- Clear specifications of the responsibilities of the involved stakeholders/parties (building owners, consultants, contractors and authorities).
- Inspection and supervision of the methodologies and practices of handling and sorting waste when demolishing a building (ensuring the correct handling of the materials from demolition and increasing the quality of reuse).
- Increased need for cooperation between legislation/policy makers – e.g. the waste legislation, environmental legislation, the building regulation, requirements for demolition of buildings, the health and safety regulation etc.
- Formulation and understanding of the legislation creating a better understanding and reducing misunderstandings – especially concerning the responsibilities of stakeholders throughout the value chain.
- Increased cooperation between parties, e.g. demolishers, building owners, municipalities etc.
- Expanded use of selective dismantling of buildings from comprising public building project only to comprising all kinds of building projects (all sizes of projects and all types of building owners).

The policy instruments according to type of resource(s)

All resources in a building.

The policy instrument according to building component type

All building components.

The policy instrument according to the value chain (and how, when and to whom is it a barrier?)

Phase f: from waste to resources (demolition).

The policy instrument according to legislation, taxation and fees

The building and waste legislation primarily which are important to make the transition. It can also be combined with certification of building materials containing secondary materials, insurance premium etc.

The policy instrument according to the opportunities, benefits, costs and trade-offs.

This policy instrument can have the following consequences:

- The municipalities need to spend more time on inspection and supervision of demolition projects, which entails increased costs for the municipalities.
- The building owner may face increased costs for selective deconstruction as compared with demolition.
- The building owner can gain financial benefits from the sale of the building materials which can be reused or recycled.
- The policy instrument can provide larger incentives for increased cooperation during the value chain.

Please also specify the effect of a change in the policy instrument by giving a -5 to +5 indication for each of the seven below listed aspects. Where -5 is a very negative effect, 0 (zero) is a neutral effect and +5 is a very high positive effect

Zero, 0, is the baseline which must be linked to data to estimate the potential amount of resources as we did not focus on a percentage change (we should consider changing this in the interview guide – 5 to +5 means 10 % per 1 so that -5 is the same as 50% reduction and +5 is an increase of 50%):

- Environmental impact (e.g. CO₂ emissions) from the estimated and quantified savings in resources + the estimated effect on space efficiency (m² space).
 - The use of primary resources can be reduced. The energy consumption for handling the materials will probably increase.
 - In the short term, the score is estimated to be 0-1 as the work processes and technologies for handling the materials are not ready/fully developed and the

amounts of reusable materials and materials suitable for upcycling are relatively low.

- In the long term, when work processes and technologies are ready and the amounts of high-quality waste from demolition of buildings increase, the score is estimated to be +2.
- Estimated effect on the economy for the public authorities.
 - The estimated effect on the economy is anticipated to be -1 due to the increased administration and time consumed for inspection/supervision of the demolitions. It is difficult to estimate the typical time consumption for this, since that may be influenced by the size and complexity of a demolition project. The estimation is 1 day per demolition.
- Estimated effect on the economy for the private companies.
 - The income and ownership of the materials typically go hand in hand. So if the building owner owns the materials after the building have been demolished, the building owner also benefits from the gains when selling the materials.
 - The estimated effect is 0 (zero) to 1 from the beginning due to the time needed for the transition of the companies and due to the need for more man hours to create lean work processes etc.
 - The estimated effect is 1 in the long term when the companies have adapted to the new requirements, working processes and the new business model.
- Estimated effect on the export of goods and thus also the competitiveness of the companies in the Nordic countries.
 - The estimated effect on the export of goods is neutral (0) as it is not expected that it will be financially feasible to export reused/recycled materials. It is assumed that the good business case relies on local reuse/recycling of materials derived from demolition.
 - The competitiveness of the companies is estimated to be 1 as new methods and business models are developed – but the countries around Denmark also work intensively with circular economy, so the effect is considered positive – but not large.
- Estimated effect on the export of knowledge concerning circular economy, new technical solutions etc.
 - The export of knowledge is estimated to be 1 as knowledge can be exported – but the countries around Denmark also work intensively with circular economy, so the effect is considered positive – but not large.
 - If the market becomes effective, the prices of reused and recycled materials also rise.
- Benefits generated due to a higher degree of collaboration between the Nordic countries toward a Nordic circular economy.

- The estimated effect is assumed to be 1 as knowledge sharing can be very beneficial.

The level of uncertainty on the above information

Medium: Up to 30% uncertainty.

The Confederation of Danish Industry: Elly Kjems Hove and Jakob Orbesen

Attendees:

- Elly Kjems Hove – EKH, DI Byg.
- Jakob Orbesen – JAOR, DI Byg.
- Henrik Sand – HESA, COWI A/S Denmark.
- Linda Høibye – LAN, COWI A/S Denmark.

The interview was performed on 20 April 2017.

EKH is director and JAOR is consultant at DI Byg.

The goals for increased circular economy in the building sector was not discussed during the interview.

The answers in this interview are directed at the whole building sector.

The most important policy instruments for DI Byg are:

- Removal of the obligation to use the municipal waste handling solution as the most important starting point to accelerate an effective market with recycled and reused building products and resources.
- Having optimal regulatory conditions for the companies to sell and buy reused and recycled materials – in Denmark and across the borders e.g. by declaration of technical performance of reused building products to ensure equal requirements for new and reused products. This must also be possible across branches. The resources must be available in sufficient amounts (a collective collection of resources is needed to scale up the quantities and the potentials).

DI Byg expresses a need to investigate the regulatory instruments for barriers.

De-regulation is needed! Set the market free.

One of the main problems to increase the transition to increased circular economy is that focus is on the value of building materials (e.g. kg or tonnes) – rather than the volume of building materials and the resource scarcity related to the building products.

Overskrift til afsnittet

The policy instrument (characteristics)

Removal of the obligation to use the municipal waste handling solution as the most important starting point to accelerate an effective market with recycled and reused building products and resources.

To support this, it must be agreed how potential problematic aspects related to hazardous substances in the existing building products can be phased out – rather than recycled to the next life cycle.

Another important aspect is to ensure the quality of reused and recycled building products. The technical criteria for the reused building products or building products including recycled materials must be developed (e.g. strength, pureness, content of hazardous substances etc.)

The policy barrier concerns the entire Danish market – the building sector must not be isolated – the policy barrier must be removed for all branches, materials, geographic regions etc.

The policy instruments according to type of resource(s)

All resources in a building.

The policy instrument according to building component type

All building components.

The policy instrument according to the value chain (and how, when and to whom is it a barrier?)

The policy instrument is focused on the production of building products. But still the policy instrument concerns the entire market – including all branches, resources etc.

The policy instrument according to legislation, taxation and fees

The obligation is described in the current Danish regulation concerning waste (Afmeldingsbekendtgørelsen).

Today, the waste regulation includes the obligation to:

- use a collection or allocation scheme described in (local) regulation
- comply with the specific municipal direction concerning the waste handling regulation that are not described in a collection or allocation scheme.

The policy instrument according to the opportunities, benefits, costs and trade-offs.

There are some important aspects to be considering before the market is truly working:

- Avoid recycling of building products and resources which contains hazardous substances.

- Certification/verification of reused building products and recycled resources, so that the technical performance and quality can be documented. These aspects must be taken care of at EU level to ensure full compliance with other requirements, improve the export and ensure compliance with the EU Commission's requirements concerning equal and fair competition in EU.

Please also specify the effect of a change in the policy instrument by giving a -5 to +5 indication for each of the seven aspects listed below. Where -5 is a very negative effect, 0 (zero) is a neutral effect and +5 is a very high positive effect

- Environmental impact (e.g. CO₂ emissions) from the estimated and quantified savings in resources.
 - Zero, 0, due to the fact that the building sector is already very good at recycling and because the amount of recycled and reused materials is very low compared to the amount of new building materials. So, the gain from an environmental point of view is insignificant.
- Estimated effect on the economy for the public authorities.
 - For some municipalities, there will be gains due to the potential income when selling the resources – but for some municipalities, there can be increased expenses due to more competition in the market and decreased income from the waste producers.
 - JAOR has sent a link to the report: "Forsyningssektorens effektiviseringspotentiale" of August 2016 developed by McKinsey & Company, which describes the potential financial gains if the waste sector becomes more effective by removing the barriers:
 - Realization of a fully competitive waste market including removal of the obligation to use the municipal waste handling solution.
 - Incorporation of standards for board members.
 - Ensuring the transition of the public waste companies to private (A/S) companies.
 - The gain of removing these policy barriers is estimated to be 517 million DKK (related to the three barriers mentioned above). The potential gain for the building sector in isolation is not included in the report.
 - This potential gain of 517 million DKK has not been split between the public and private sectors due to lack of data.
- Estimated effect on the economy for the private companies
 - Many costs will be removed from the companies if the current policy instrument is removed – thus the market can become more effective. The collection of waste will be more effective and cheaper – due an open market where private companies can start collecting waste. By setting the market free, private companies are likely to develop new businesses with new profit opportunities. Market failures must be removed so that the real values of the resources will be effective.

- It is estimated that the gains can be rated at +2 to +3. The score is based on an assumption about considerable effects causing significant increases in turnover. This positive effect can be realized for the majority of Danish companies which manage to reuse building products – because the majority of producers of building products can use secondary materials as input. This is the case for companies which reuse building products and also producers of building products with secondary materials. The largest volume is expected to be realized for the producers which use secondary resources as input to new production materials (thus substituting primary materials).
- The calculation of the monetized effect must be based on the profit margin due to the fact that the expenses are decreasing.
- The market in Denmark is very small and often driven by very few producers (e.g. production of stone wool, glass wool and gypsum plates involving very few producers). Thus the data on production, degree of recycled resources, turnover etc. are not public for competitive reasons.
- Copenhagen Economics has published a report where it is estimated, that the production companies in Denmark use 45% of the expenses in average for input resources. Thus only a few percentages in savings can contribute to great savings.
- Data for the turnover of production companies in Denmark are available as an aggregated number – however, due to the fact that the Danish companies produced only very small amounts of products for the Danish market, it is not correct to use the profit margin of the Danish companies for this assessment/quantification of the effect.
- Danish Statistics does not collect and publish data on produced and sold building products in Denmark, so data availability is very poor.
- Estimated effect on the export of goods and thus also the competitiveness of the companies in the Nordic countries.
 - The estimated effect is estimated to be 0 (zero). According to DI Byg a positive effect occurs only if there is a market demand for reused products or products with recycled resources – but as there is no market demand, the effect is 0 (zero).
 - Furthermore, as the building products are voluminous and heavy, the transport of building products often means significant expenses. This fact makes it less profitable to export (and thus transport) building products.
- Estimated effect on the export of knowledge concerning circular economy, new technical solutions etc.
 - The estimated effect is 0 (zero) as the Research & Development activities at large production companies are often located in countries other than Denmark due to the less advantageous tax system in Denmark.
- Benefits generated due to a higher degree of collaboration between the Nordic countries toward a Nordic circular economy.

- The effect is estimate to be 0 (zero) – again due to costly transportation of building materials.
- It is advantageous with a higher degree of collaboration concerning the transport of resources across borders.

The level of uncertainty on the above information

This aspect was not assessed at the interview.

Overskrift til afsnit

The policy instrument (characteristics)

The policy instrument is the lack of requirements for the technical performance and quality of the reused products or the products including recycled resources in the Construction Products Regulation.

A declaration of the technical performance (quality, durability, strength, content of hazardous substances etc.) is needed to ensure the quality level of buildings.

The responsibility for the reused building products and the products containing recycled resources must be clarified to ensure the legal position of building owners and producers. There is a risk of building scandals if the reused materials do not live up to the expected quality and cause damage.

The policy instrument affects the requirements in the national building regulation as the Danish building regulation requires that building materials shall be CE-marked. As the reused products cannot obtain a CE-marking, dispensations from the building regulation must be granted to use reused products in buildings. The risk is that buildings with dispensations will have a considerable reduced life time. So one very important aspect is risk minimization.

The policy instruments according to type of resource(s)

Cannot be answered according to type of resource – but only by building component (see no. 3).

The policy instrument according to building component type

All building components that can be reused directly e.g. bricks, windows etc.

The policy instrument according to the value chain (and how, when and to whom is it a barrier?)

The policy instrument focuses on the design of the building (b) in the interview guide) as it has the potential to influence all of the other phases of a building as the choice of building products affects the manufacturer's product design, the construction of the building, the use of the building, need for refurbishment, demolition including reuse and recycling of the resources. It will also generate a need for certification/verification of products etc.

The policy instrument according to legislation, taxation and fees

The (EU) building legislation (Construction Products Regulation) is important for the transition. It must be combined with certification/verification of building materials containing recycled materials etc.

The policy instrument according to the opportunities, benefits, costs and trade-offs.

There are opportunities in reusing building materials and recycled resources in new building products – but certification/verification is needed to minimize the risk of buildings with decreased quality and life time due to the use of building products which do not comply with the technical requirements.

The producers of building products can use the gain positively for marketing purposes as the documentation describes the specific technical performance of the building products.

Please also specify the effect of a change in the policy instrument by giving a -5 to +5 indication for each of the seven below listed aspects. Where -5 is a very negative effect, 0 (zero) is a neutral effect and +5 is a very high positive effect

- Environmental impact (e.g. CO₂ emissions) from the estimated and quantified savings in resources + the estimated effect on space efficiency (m² space).
 - Estimated effect: 3 under the circumstance that the recycled and reused products and materials are certified/verified to ensure quality. The effect is related to the value of the resources, which makes the data baseline the turnover for the companies transforming the waste to a resource. So, the effect of 3 when the effect is measured in terms of saved resources – isolated around the small part of the market that concerns reused building products (the effect is close to 0 (zero) for the total market for building products).
 - The effect is 0 (zero) if the effect is measured in terms of the amount of reused building products in tonnes.
 - The documentation of the technical performance of the reused products created confidence for the sellers and the buyers of the reused products.
 - The scarce resources can create a large commercial value when reusing (contrary to the building products which do not contain scarce resources e.g. concrete, wood etc.).
 - The value can be high – but the quantity of the reused materials is relatively low, e.g. less than 0.1%.
 - Weight is a misleading KPI – the KPI must be centred around the value of the products.
- Estimated effect on the economy for the public authorities.
 - Effect: 0. As the market drives the activities without any obligations for the public authorities.
- Estimated effect on the economy for the private companies.

- For some companies the market has expanded – and for other companies the product range has expanded. In total, the estimated effect is o (zero).
- Estimated effect on the export of goods and thus also the competitiveness of the companies in the Nordic countries.
 - Effect: o. The reasoning is described in the first fact sheet.
- Estimated effect on the export of knowledge concerning circular economy, new technical solutions etc.
 - Effect: o. The reasoning is described in the first fact sheet.
- Benefits generated due to a higher degree of collaboration between the Nordic countries towards a Nordic circular economy.
 - Effect: o (zero). It only has an effect for the companies that have a market in more than one of the Nordic countries. Further reasoning is described in the first fact sheet.

The level of uncertainty on the above information

The uncertainty was not discussed during the interview.

The Danish interviewees have provided the following replies to the questions asked

Table 17: Denmark

Organisation	1	2	3	4	5	6	7						8
							a	b	c	d	e	f	
The Danish Environmental Protection Agency (a)	1a	All ⁴	All ²	f	L	-	2-3	o	2-3	1/2	o	1-2	N/A
	2a	All ²	All ²	b (+a-f)	L	-	3-4	o	0-1	1/2	3-4	2-3	N/A
Danish Waste Association (b)	1b:	All	All	b (+a-f)	O	-	4-5 ¹² 0-1 ¹³	-1 ¹² -3 ¹³	4-5 ¹² 0 ¹³	4-5 ¹² 0 ¹³	4-5 ¹² 0 ¹³	1-3 ¹² 0 ¹³	N/A
	2b:	All	All	b (+a-f)	T	-	4	-3	3	o	4-5	1-3	High
The Centre for Management and Recycling of Construction Waste (c)	1c:	All	All	b (+a-f)	L	-	2-3 ⁵ 0-1 ⁶	1 ³ -1 ⁴	1	o	2	2	Medium
	2c:	All	All	f	L	-	2 ¹² 0-1 ¹³	-1 1 ¹³	0-1 ¹² 1 ¹³	0 ¹² 1 ¹³	1	1	Medium
The Confederation of Danish Industry (d)	1d:	All	All	a	L	-	o	N/A	2-3	o	o	o	N/A
	2d:	N/A	All	b	L	-	3	o	o	o	o	o	N/A

⁴ All resources in the building – but maybe including a de minimis limit so that the main resources related to the environmental and economic impact and consequences are included.

⁵ Medium to long term.

⁶ Short term.

Finland

In Finland the following stakeholders were interviewed.

Table 18: The interviewees from Finland

Organisation	Interviewee
Finnish Environmental Industries	Riikka Kinnunen
Helsinki Region Environmental Services Authority	Nea Metsänranta
Confederation of Finnish Construction Industries	Pekka Vuorinen
Finnish Environment Institute	Petrus Kautto

Finnish Environmental Industries (YTP): Riikka Kinnunen

Attendees:

- Riikka Kinnunen – RK, Finnish Environmental Industries.
- Aino Taskinen – AT, SYKE.

The interview was performed on 19 April 2017.

Notes:

- Riikka Kinnunen highlights that the evaluations are based on very rough estimations, since the statistics about waste in construction sector are not explicit, and no studies about the impacts of these suggestions have been conducted.

Overskrift til afsnittet

The policy instrument (characteristics)

There is a need to develop and implement regulations concerning end-of-waste in Finland. Currently, decisions are made on a case-by-case basis. Development and implementation of end-of-waste regulations would facilitate the development of secondary raw materials markets as it would reduce the current uncertainty, and environmental permission process, over what waste materials can be recycled; which could also stimulate the development of novel waste treatment technologies.

For example, at the moment to recycle waste wood from construction and demolition sites one must through permission procedure, even if it was pure wood.

End-of-waste criteria could be based on a risk assessment approach to materials, with standardisation to develop criteria for specific waste streams. If criteria are developed this could also remove the negative associations around using waste from some materials, increase perceptions of material quality and the chances of recycling and re-using materials.

The policy instruments according to type of resource(s)

- Concrete.
- Tiles, bricks and masonry.
- Wood.
- Insulation material.

Currently the conversation runs mostly around concrete due to its volume, but all materials are related to this.

The policy instrument according to building component type

- Façade.
- Foundation.
- Windows.
- Insulation.

The policy instrument according to the value chain (and how, when and to whom is it a barrier?)

Mostly f) From waste to resources (demolition), and g) Innovation, investment and other crosscutting issues

Better information and clearer regulations can reduce the uncertainty and accelerate the market formulation. This could help innovation and investment in all phases of value chain.

The policy instrument according to legislation, taxation and fees

a) Waste legislation. Also f) Other: Chemical legislation and Public procurements.

Current chemical legislation has been made from different view point: too old to support circular economy goals.

The policy instrument according to the opportunities, benefits, costs and trade-offs.

- Potential impact on whole construction sector, as well as waste sector.
- Risk based evaluation is criticized, but it might make the process of investing the materials faster and decrease the costs.
- More streamlined regulatory procedures (i.e., moving away from a case-by-case process) should entail dangerous substances are overlooked; the benefit is in the increased efficiency of the process.
- Better knowledge about materials in the design and building phase also makes the demolition easier. However, in the current situation is that there is a lack of knowledge concerning the material properties of waste that would prohibit them from being used in recycled products.

Please also specify the effect of a change in the policy instrument by giving a -5 to +5 indication for each of the seven below listed aspects. Where -5 is a very negative effect, 0 is a neutral effect and +5 is a very high positive effect

The evaluation of percentile changes is compared to current situation:

- Environmental impact (e.g. CO₂ emissions) from the estimated and quantified savings in resources
 - +4: Significant impact. If most of the materials circulate and the market attracts new innovations, the amount of recycling and reusing materials could increase.

Supplementary information (collected after the interview)

Baseline: Official statistics on the treatment of waste do not specify the economic activity in where the waste is produced. In 2013, Statistics Finland a "snapshot" or waste treatment from housing construction for 2011 (figures do not include soil waste or dredging spoils): 2.2 million tonnes of construction waste generated; over 1.7 million tonnes of waste generated in construction utilised or transported to pre-processing; 1.3 million tonnes of mineral waste used or treated for utilisation; 100,000 tonnes of metal waste used or treated for utilisation; 250,000 tonnes of wood waste went to energy production; 250,000 tonnes of construction went to landfill

- Increase of 20% from the current amount of waste being recycled.
- Estimated effect on the economy for the public authorities
 - +3 in the long term. In general, end-of-waste criteria that is not over burdensome to industry, would reduce the costs of current case-by-case decision-making processes. There is the potential of reduced landfill tax if waste is diverted to recycling.
- Estimated effect on the economy for the private companies.
 - +3. On short term (and currently), uncertainty about new regulations can slow down the positive impact. New investments concerning construction and demolition recycling made by the private sector could increase by 50%. On the long term, private sector revenue could increase approximately 10%, due to the lower costs of regulatory processes (applying for case-by-case decisions), the lower costs of processing waste material closer to construction sites, reduced landfill tax and gate fees.
- Estimated effect on the export of goods and thus also the competitiveness of the companies in the Nordic countries.
 - 0, neutral impact. Might be positive, if significant new innovations are developed in Finland.
- Estimated effect on the export of knowledge concerning circular economy, new technical solutions etc.

- +4, very positive impact. Increased information and knowledge is a prerequisite for the market to develop, creates a positive cycle.
- Benefits generated due to a higher degree of collaboration between the Nordic countries toward a Nordic circular economy.
 - +2 or +3 bigger than the export of goods. There are a lot of companies working in many Nordic countries and the collaboration is most likely to increase.

The level of uncertainty on the above information

Medium: Up to 30% uncertainty.

Overskrift til afsnittet

The policy instrument (characteristics)

In general, policies should help to make the exploitation and reproduction of recycled materials easier, not to make it more complicated. For example, current EU current chemical, energy, waste and product regulations are not entirely coherent. (Incineration of waste wood contributes to renewable energy GHG emission reduction targets but is in conflict with the waste hierarchy). This does encourage towards circular economy; coherence in legislation is needed for market to develop.

The forthcoming MARA Act and the potential MASA Act is a good case of streamlining policy processes. Extending the scope of materials that do not require an environmental permit to be recycled would have a large effect on the whole construction sector. Recycled material quality would be covered by broad regulation, and not set on a case-by case basis

The policy instruments according to type of resource(s)

Mostly c) Wood, but also related to a) Concrete, and b) Tiles, bricks and masonry.

The policy instrument according to building component type

- Façade.
- Foundation.
- Windows.
- Insulation..

The policy instrument according to the value chain (and how, when and to whom is it a barrier?)

From waste to resources.

The policy instrument according to legislation, taxation and fees

a) Waste legislation, b) Building regulation, d) Environmental legislation
Also f) Other: Chemical legislation.

The policy instrument according to the opportunities, benefits, costs and trade-offs.

Streamlining is needed to achieve the existing circular economy goals. On larger scale the benefits are that the circular economy activities become a part of demolition processes.

Time of processing the materials decreases, costs decrease and hence the impact on economy would be positive.

Streamlining regulation could also lead to new innovations which could deliver higher quality materials.

Please also specify the effect of a change in the policy instrument by giving a -5 to +5 indication for each of the seven below listed aspects. Where -5 is a very negative effect, 0 is a neutral effect and +5 is a very high positive effect

The evaluation of percentile changes is compared to current situation:

- Environmental impact (e.g. CO₂ emissions) from the estimated and quantified savings in resources.
 - At least +2 or +3. If high-quality materials are produced and exploited, the amount material reuse and recycling could increase.

Supplementary information (collected after the interview)

Baseline: Official statistics on the treatment of waste do not specify the economic activity in where the waste is produced. In 2013, Statistics Finland a “snapshot” or waste treatment from housing construction for 2011 (figures do not include soil waste or dredging spoils): 2.2 million tonnes of construction waste generated; over 1.7 million tonnes of waste generated in construction utilised or transported to pre-processing; 1.3 million tonnes of mineral waste used or treated for utilisation; 100,000 tonnes of metal waste used or treated for utilisation; 250,000 tonnes of wood waste went to energy production; 250,000 tonnes of construction went to land-fill.

- Increase of 10–15% from the current amount of waste being recycled.
- Estimated effect on the economy for the public authorities.
 - +2. The impact of simplifying the bureaucracy is significant, when different actors start to collaborate more. The operating costs of public authorities are not known to Finnish Environmental Industries (YTP), but streamlining existing regulations and simplification of bureaucracy could lead to a drop in administrative costs up to 10%.
- Estimated effect on the economy for the private companies
 - +3. If regulation simplifies, more materials are processed and higher in quality, thus higher in value. The turnover of waste processing companies could increase 10–15%.

- Estimated effect on the export of goods and thus also the competitiveness of the companies in the Nordic countries.
 - +1, Positive impact, if the end of waste regulation is functional and the regulations about waste transportation are changed. Transportation costs hinder the positive impact. The prerequisite is that new innovations emerge, materials are upgraded and they are competitive at the market.
- Estimated effect on the export of knowledge concerning circular economy, new technical solutions etc.
 - +3, Simplifying has a strong positive effect on this.
- Benefits generated due to a higher degree of collaboration between the Nordic countries toward a Nordic circular economy.
 - 0, since the legislation is mostly national.

The level of uncertainty on the above information

High: Up to 60% uncertainty.

Helsinki Region Environmental Services Authority HSY: Nea Metsänranta

Attendees:

- Nea Metsänranta – NM, Helsinki Region Environmental Services Authority.
- Aino Taskinen – AT, SYKE.

The interview was performed via telephone on the 18th of April, 2017.

Note: Nea Metsänranta noted that it was difficult to choose separate instruments, since most of them strongly affect each other. She also noted that the views presented here are her own.

Overskrift til afsnittet

The policy instrument (characteristics)

At the moment there are no regulations that address resource (material and energy) efficiency in old buildings and no regulation that address material efficiency in new buildings. There are voluntary energy efficiency classification schemes, and green building certification systems. The introduction for regulations for resource efficiency in renovation and construction would be a way to promote the reuse and recycling of construction and demolition waste.

Resource efficiency criteria would need to be developed in a consultative manner which would encourage growth in the sector. Criteria could include quotas for recycled content in building materials, and/or standards related to the recyclability of building materials. Clear instructions for calculations are required to be developed and implemented. Minimum level for criteria could be national, obligatory and set quite low.

However, they could be set higher, at a regional level through municipal regulations in certain neighbourhoods.

Requiring such certification through regulation would give clear and simple instructions and set a minimum level for the material efficiency in all construction and renovation processes.

The policy instruments according to type of resource(s)

- Concrete.
- Tiles, bricks and masonry.
- Wood.
- Insulation material.
- Space.

The policy instrument according to building component type

- Façade.
- Foundation.
- Windows.
- Insulation.

The policy instrument according to the value chain (and how, when and to whom is it a barrier?)

All. a) Product design (including choice of raw materials for the products), b) Design of building, c) Production process (construction), d) Consumption/use (operation and maintenance), e) Refurbishment (renovation), f) From waste to resources (demolition), g) Innovation, investment and other crosscutting issues.

Especially e) b) c)

The policy instrument according to legislation, taxation and fees

b) Building regulation.

The policy instrument according to the opportunities, benefits, costs and trade-offs.

Costs to public authorities associated with the development and implementation of such a certification scheme.

This instrument could have a wide impact, but would need to be developed in line with existing and planned regulations

Disagreement about e.g. which materials are the most efficient is slowing down the process of making such wide regulations.

Please also specify the effect of a change in the policy instrument by giving a -5 to +5 indication for each of the seven below listed aspects. Where -5 is a very negative effect, 0 is a neutral effect and +5 is a very high positive effect

- Environmental impact (e.g. CO₂ emissions) from the estimated and quantified savings in resources.
 - +4. Strong impact (i.e. decreased resource used) in long term, since the regulation would cover new and old buildings.
 - May also increase space efficiency and the variability in the use of spaces.

Supplement information (collected after the interview)

Current resource efficiency (amount of reused and recycled materials) for Finnish buildings is not known.

A baseline in waste produced by the construction sector is available, in the table below. Official statistics on the treatment of waste do not specify the economic activity in where the waste is produced. In 2013, Statistics Finland a "snapshot" or waste treatment from housing construction for 2011 (figures do not include soil waste or dredging spoils): 2.2 million tonnes of construction waste generated; over 1.7 million tonnes of waste generated in construction utilised or transported to pre-processing; 1.3 million tonnes of mineral waste used or treated for utilisation; 100,000 tonnes of metal waste used or treated for utilisation; 250,000 tonnes of wood waste went to energy production; 250,000 tonnes of construction went to landfill.

Table 19: Waste in construction sector in 2013, tonnes

	Chemical	Metal	Paper & cardboard	Wood	Animal & plant	Mixed	Glass, plastic etc.
Construction Sector	8	1,178	1,426	141,585	94	94	30,753

Source: http://www.stat.fi/til/jate/2013/jate_2013_2015-05-28_tau_002_fi.html

- Estimated effect on the economy for the public authorities.
 - +2. There will be economic savings to public authorities in the long term, in terms of reduced landfilling costs. Short term impacts would be the costs associated with developing and implementing a certification scheme.
- Estimated effect on the economy for the private companies.
 - +1. Can have a negative impact in the short term, but in the long term neutral or positive, if companies adapt to the new situation and start exploiting recycled materials. Benefits are significant especially for spanning companies and recycling companies.
- Estimated effect on the export of goods and thus also the competitiveness of the companies in the Nordic countries.
 - 0. No impact, unless some indirect effects. Policy instruments in question are very local.

- Estimated effect on the export of knowledge concerning circular economy, new technical solutions etc.
 - +3. Positive, especially the export of know-how. Usually norms and rules accelerate the development of new solutions and increase knowledge. The role of forerunners expands.
- Benefits generated due to a higher degree of collaboration between the Nordic countries toward a Nordic circular economy.
 - 0. No impact due to locality.

The level of uncertainty on the above information

Medium: Up to 30% uncertainty.

Overskrift til afsnit

The policy instrument (characteristics)

Removing the need for case-by-case decisions on environmental permits for waste management activities for earth construction waste. The amendments to the MARA and MASA intend to reduce the regulatory burden of environmental permit procedures.

There are some restrictions on the use of materials under the proposed MARA and MASA; recycled concrete is not allowed to be used in water shed areas (due to the risk of ground contamination). However, updating the MARA Act, and the proposed MASA act, has also raised some criticism due to risk of contamination since more materials can bypass the permission procedure.

The policy instruments according to type of resource(s)

- Concrete.
- Tiles, bricks and masonry.

The policy instrument according to building component type

a) Façade, b) Foundation, e) Other: Materials used in earthwork (question 2) also impacts others than the building construction sector.

The policy instrument according to the value chain (and how, when and to whom is it a barrier?)

a) Product design (including choice of raw materials for the products), b) Design of building, c) Production process (construction), f) From waste to resources (demolition).

The policy instrument according to legislation, taxation and fees

a) Waste legislation, d) Environmental legislation, also mentioned in c) Transport legislation.

The policy instrument according to the opportunities, benefits, costs and trade-offs.

Including more materials under MARA Act, materials can be used without separate permission procedure and exploited in earth construction.

Please also specify the effect of a change in the policy instrument by giving a -5 to +5 indication for each of the seven below listed aspects. Where -5 is a very negative effect, 0 is a neutral effect and +5 is a very high positive effect

- Environmental impact (e.g. CO₂ emissions) from the estimated and quantified savings in resources.
 - +3. Demolition waste could be recycled and used more efficiently, which would decrease the need of new resource materials in construction.
- Estimated effect on the economy for the public authorities.
 - +1. Saving materials has some impact on savings for the public authorities, but the costs/benefits for the simplification of the environmental permitting system is not known.
- Estimated effect on the economy for the private companies.
 - +3: Positive impact mostly on companies that process waste into new materials. New products can enter the market easier, thus also new companies potentially born.
- Estimated effect on the export of goods and thus also the competitiveness of the companies in the Nordic countries.
 - 0. MARA Act is local, thus the impact is mostly local. Waste from construction and demolition activities are not exported.
- Estimated effect on the export of knowledge concerning circular economy, new technical solutions etc.
 - 0. No significant impact seen on the export of knowledge.
- Benefits generated due to a higher degree of collaboration between the Nordic countries toward a Nordic circular economy.
 - 0. No significant impact.

The level of uncertainty on the above information

Medium: Up to 30% uncertainty.

Confederation of Finnish Construction Industries RT, Pekka Vuorinen

Attendees:

- Pekka Vuorinen – PV, Confederation of Finnish Construction Industries.
- Aino Taskinen – AT, SYKE.

The interview was performed via telephone on the 6th of April, 2017.

Notes: Pekka Vuorinen noted that it is a difficult task to discuss each policy instrument and their impacts separately, as policies related to circular economy in construction sector are strongly linked to each other. Furthermore, the Confederation of Finnish Construction Industries does not have the expertise to predict the estimate effect on the economic conditions of private firms or public authorities.

Overskrift til afsnittet

The policy instrument (characteristics)

Two regulatory policy instruments in the process of being amended developed that concern the management of waste from earth construction; the MARA and MASA Acts. In Finland, the definition of construction and demolition waste includes “waste from new construction and repairs and demolition of buildings or other fixed structure, civil engineering work or other corresponding construction”. Hence, waste from earth construction makes up a fraction of construction and demolition waste.

Waste treatment activities generally require environmental permits, the purpose of these regulatory policy instrument amendments and proposals is to simplify the environmental permitting procedures by allowing the recycling of certain wastes (under certain conditions) to take place without the need to apply for an environmental permit. The acts apply to waste fractions over a certain threshold, and set out specific technical standards related to the material qualities and applications for the use waste. Environmental criteria are set for recycled materials from earth works, fulfilling these criteria would allow the waste fractions to be recycled without having to apply for an environmental permit on a case-by-case basis. Thus helping to reduce waste from going to landfill by implying the regulatory permission process for recycling activities. The intention is to promote the use of waste generated from earth construction especially for smaller firms that do not currently have environmental permits.

The upcoming amendment to the existing MARA Act (Government Decree 591/2006 concerning the recovery of certain wastes in earth construction). This act covers earth construction defined as 1) public roads, streets, bicycle lanes, pavements and areas directly connected to these, necessary for road maintenance or traffic, 2) parking areas, 3) sports grounds and routes in recreational and sports areas, and 4) railway yards as well as storage fields and roads in industrial areas, waste processing areas and air traffic areas. The original scope of the act included concrete and some energy industry wastes. The scope of this regulation has been amended to include more construction and demolition waste fractions including bricks, blacktop, lime, impurities from waste incineration, sand, crushed tyres. This act is currently awaiting adoption.

The upcoming amendment to the existing in the MASA Act Government Decree concerning the recovery of certain soil waste in earth construction is currently being prepared and not in its final form. Soil materials from earth construction that may be covered in the new act include:

- unspoilt soil waste

- soil waste with harmful matters
- soil waste that includes small amounts of mineral construction waste
- recycled materials that are used to stabilize soft soils
- stabilized soil (mined)
- stabilized structure materials (mined)
- sediments (prepared)
- macadam (sanding, trails).

The policy instruments according to type of resource(s)

- Concrete.
- Tiles, bricks and masonry.

The policy instrument according to building component type

a) Façade, b) Foundation, e) Other: Materials used in earthwork

The policy instrument according to the value chain (and how, when and to whom is it a barrier?)

From waste to resources.

The policy instrument according to legislation, taxation and fees

a) Waste legislation, d) Environmental legislation

The policy instrument according to the opportunities, benefits, costs and trade-offs.

Benefits include a reduction in regulatory burden (to regulators and industry) concerning case-by-case environmental permitting procedures.

This has the potential to increased recycling, reduce the time for waste processing, reduce costs and storage space, and remove the cumbersome environmental permitting system which is a barrier to the development of new business and innovations.

Transportation distances and related emissions would decrease as waste could be recycled closer to construction site and not only at sites that have environmental permits:

- A current limitation of this new regulatory procedure is that the temporary storage period for waste (3–4 years) is too short, at the moment, to allow business to make use of the material.
- New business ideas are born only if reusing the materials is made simple and the legislation is unambiguous, hence this new procedure could stimulate companies to use more recycled materials and innovate materials that use recycled materials.

Please also specify the effect of a change in the policy instrument by giving a -5 to +5 indication for each of the seven below listed aspects. Where -5 is a very negative effect, 0 is a neutral effect and +5 is a very high positive effect

- Environmental impact (e.g. CO₂ emissions) from the estimated and quantified savings in resources.
 - +2 to +3 In terms of the coordination of waste, the biggest effects would be in reduced need of transportation and temporary storage of waste soils.

Supplementary information (collected after the interview)

In 2013, proximally 15 million tonnes of mineral waste was generated (Statistics Finland). Official statistics on the treatment of waste do not specify the economic activity in where the waste is produced. In 2013, Statistics Finland produced a "snapshot" of waste treatment from housing construction for 2011, yet these figures did not include soil waste.

Example given with the City of Helsinki:

The City of Helsinki has pursued a strategy to recycle more soil waste and to decrease transportation distances of soil. Thus, these could be used as an example of the potential impact of the proposed MASA act, if put into operation and if municipalities take advantage of this streamlined regulatory process. This was a City of Helsinki initiative, hence data is only available for Helsinki. Savings in 2015 included:

- ~5300 tons of CO₂-emissions.
- ~2.1 million litres of fuel.
- ~0.46 million tonnes of waste from the construction sites was recycled and reused, and
- 0 tonnes went to soil landfills.

Supplementary information (collected after the interview)

A rough extrapolation for all Finnish municipalities could be made on the basis of population (0.63 million Helsinki, 5,482 million Finland):

- ~46,000 tons of CO₂-emissions.
- ~18.2 million litres of fuel.
- ~4 million tonnes of waste recycled the construction sector.

- Estimated effect on the economy for the public authorities.
 - +1 to +2: Reduced regulatory burden for public authorities in terms of processing applications. Also, public authorities undertake a significant amount of earth work activities thus the potential impact to public authorities would not be unsubstantial.

Case Helsinki savings:

- ~ 10 million Euros.

Supplementary information (collected after the interview)

A rough extrapolation for all Finnish municipalities could be made on the basis of population (0.63 million Helsinki, 5.482 million Finland):

- ~ 87 million euros.

- Estimated effect on the economy for the private companies
 - +2 A positive effect on the financial performance of private companies if those companies adapt to the situation and take advantage of the possibilities to reuse the waste materials concerned. Novel technological innovation may be developed.
- Estimated effect on the export of goods and thus also the competitiveness of the companies in the Nordic countries.
 - 0, neutral:
 - Construction companies are very local; hence there would be minimal effect on the export of secondary raw materials. If technologies would be transported, the effect could be positive.
 - Transporting construction and demolition waste is too expensive to be economic.
- Estimated effect on the export of knowledge concerning circular economy, new technical solutions etc.
 - +2: There is large potential for the development of new technologies and companies, if the regulations for the reuse and recycling of waste are made unambiguous. Also, changes in attitudes are needed, e.g. public projects should be exemplary.
- Benefits generated due to a higher degree of collaboration between the Nordic countries toward a Nordic circular economy.
 - 0: hard to evaluate, not remarkable.

The level of uncertainty on the above information

On question 7 the uncertainty is very high 50%.

Overskrift til afsnit

The policy instrument (characteristics)

Currently, European waste policy and chemical policy (REACH) and its application in Finland creates uncertainty over when waste cease to be waste and can be sold on a market (and therefore REACH should be applied) or when waste management and waste material reuse falls under waste legislation and its regulatory processes (e.g. environmental permitting procedures).

Current EU regulation needs to be better integrated with each other so that it does not act as a barriers to the reuse and recycling of building materials:

- Chemical legislation (REACH) and waste legislation are not entirely integrated, and there are a lot of grey areas between the legislation.
- The aim is to get dangerous materials out of the cycle. However, when different standards apply to waste materials and virgin materials, this prevents recycling and the entry of new actors to the market.
- In a buildings lifetime, chemical legislation changes multiple times, so future requirements of materials are hard to predict.

The policy instruments according to type of resource(s)

All resources:

- Concrete.
- Tiles, bricks and masonry.
- Wood.
- Insulation material.
- Space.

The policy instrument according to building component type

- Façade.
- Foundation.
- Windows.
- Insulation.

Especially façade and windows mentioned.

The policy instrument according to the value chain (and how, when and to whom is it a barrier?)

a) Product design (including choice of raw materials for the products), b) Design of building, c) Production process (construction), e) Refurbishment (renovation), f) From waste to resources (demolition), g) Innovation, investment and other crosscutting issues.

The policy instrument according to legislation, taxation and fees

f) Other: Product legislation and chemical legislation.

Waste materials, for example concrete, are not easily integrated into new products due to national legislation; for example the use of recycled concrete materials has limitations in terms of its use in water shed areas.

The policy instrument according to the opportunities, benefits, costs and trade-offs.

If chemical legislation and product legislation can “fit together” and be clear enough, reusing the materials offers companies the potential to explore new opportunities.

Government sets the boundaries, but still local actors (e.g. cities and municipalities) need to have a will to use the recycled resources and improve efficiency.

Please also specify the effect of a change in the policy instrument by giving a -5 to +5 indication for each of the seven below listed aspects. Where -5 is a very negative effect, 0 is a neutral effect and +5 is a very high positive effect

- Environmental impact (e.g. CO₂ emissions) from the estimated and quantified savings in resources.
 - +5: Removing the uncertainty of when waste ceases to be waste (and hence when to apply chemical or waste regulations) could lead to many potentials for new recycling solutions. If the legislation is simple and clear and not open to differing interpretations, new technologies and companies around waste can evolve and materials previously impossible to reuse can be exploited.

Supplementary information (collected after the interview)

Baseline: As this is a general suggestion to clarify the operation of current policy instruments, it may influence all construction and demolition waste.

Table 20: Waste in construction sector in 2013, in tonnes

Chemical	Metal	Paper & cardboard	Wood	Animal & plant	Mixed	Mineral	Sludge	Glass, plastic etc.
8	1,178	1,426	141,585	94	94	14,960, 946	1,088	30,753

Source: http://www.stat.fi/til/jate/2013/jate_2013_2015-05-28_tau_002_fi.html

- Estimated effect on the economy for the public authorities.
 - +2: Public authorities may benefit from less legislative uncertainty
- Estimated effect on the economy for the private companies.
 - +2: There is a broad potential to increase the economic outlook of firms if more integrated legislation leads to increased market certainty. This may spur the development of new businesses and lead to business model innovation in incumbent firms.
- Estimated effect on the export of goods and thus also the competitiveness of the companies in the Nordic countries.
 - 0: Due to the nature of construction and demolition waste and their reuse/recycling markets (only very small amounts of construction and demolition are imported and exported), there is little potential of this policy instrument to influence the export of goods.

- Estimated effect on the export of knowledge concerning circular economy, new technical solutions etc.
 - +1: Clear and unambiguous legislation is more approachable. If attitudes change to the perception of waste, there may be a greater potential for the export of recycling technologies and products that incorporate secondary raw materials.
- Benefits generated due to a higher degree of collaboration between the Nordic countries toward a Nordic circular economy.
 - 0: hard to evaluate. Might increase but not remarkably.

The level of uncertainty on the above information

On question 7 the uncertainty is very high 50%.

Finnish Environment Institute, Petrus Kautto

Attendees:

- Petrus Kautto – PK, Finnish Environment Institute, The Environmental Policy Centre.
- Aino Taskinen – AT, SYKE.

The interview was performed in person on the 19th of April, 2017.

Overskrift til afsnit

The policy instrument (characteristics)

The quality of construction and demolition waste statistics in Finland is poor. The current state of waste statistics is a systematic barrier to the reuse and recycling of waste from construction and demolition activities, as such basic hinders future planning for end-of-life treatment options.

Two examples were given that could improve construction and demolition waste statistics:

1. Currently, waste holders are required to provide a "shipping document" (in accordance with the Waste Act: Section 121) to the consignee. These shipping documents are not currently exploited for statistical purposes (as they are currently only in paper format). The digitisation of this process by public authorities (i.e. the creation of electronic shipping documents), could allow this data to be used for statistical purposes.
2. Currently, there is a lack of information concerning the potential for material recovery in the demolition sector. A requirement for firms undertaking demolition works, in large demolition projects, to complete a pre-demolition audit would in-

creases the knowledge about what material fractions could potentially be recovered and to determine the material efficiency of demolition processes (the amount of waste that has the potential to be reused or recycled versus the amount of waste that is actually reused or recycled).

The policy instruments according to type of resource(s)

- Concrete.
- Tiles, bricks and masonry.
- Wood.
- Insulation material.
- Space.

The policy instrument according to building component type

- Façade.
- Foundation.
- Windows.
- Insulation.

The policy instrument according to the value chain (and how, when and to whom is it a barrier?)

a) Product design (including choice of raw materials for the products), b) Design of building, c) Production process (construction), d) Consumption/use (operation and maintenance), e) Refurbishment (renovation), f) From waste to resources (demolition), g) Innovation, investment and other crosscutting issues.

The policy instrument according to legislation, taxation and fees

- Waste legislation.
- Building regulation.

The policy instrument according to the opportunities, benefits, costs and trade-offs.

In general, the potential benefits of improved construction and demolition waste statistics would outweigh the costs. For example, there is an existing requirement for shipping documents. Hence, one would expect the costs associated with digitisation would be outweighed by more streamlined statistical reporting. The indirect benefits may include increased reuse and recycling due to better knowledge of the content, local and volume of waste streams.

The direct cost of conducting a pre-demolition audit would cost approximately 3,000–5,000 € per construction site. Whilst this does not pose a large cost in the context of large demolition projects, the market value of secondary raw materials from demolition waste is often low. Hence, a cost-benefit analysis would be required to determine the economic benefit of such an instrument.

Please also specify the effect of a change in the policy instrument by giving a -5 to +5 indication for each of the seven below listed aspects. Where -5 is a very negative effect, 0 is a neutral effect and +5 is a very high positive effect

- Environmental impact (e.g. CO₂ emissions) from the estimated and quantified savings in resources.
 - There would be no direct impact due to the requirement for increased information on waste volumes and materials.
 - Indirectly +1 to +2: the instrument could have resource saving potential (in terms of the increased amount of construction and demolition waste reused or recycled) if tools for increasing information and knowledge are put into operation.
 - Possibly a 5–10% increase in the reuse of recycling of construction and demolition waste.
 - Baseline: Information instrument, hence difficult to put a quantity of resource savings
 - Possibly a 10% increase.
- Estimated effect on the economy for the public authorities.
 - +1/+2 If increased information results in reusing materials and components (not only recycling).
 - Baseline: It is not possible at this point in time to attribute the estimated economic costs and/or benefits to public authorities as a result of the need to develop new process to improve construction and demolition waste statistics. There could be a small increase (+5 to 10%) or decrease (-5 to 10%) in the costs to public authorities depending on the system implemented. This is based on a very rough estimate.

Supplement information (collected after the interview)

Baseline: The aim of this instrument targets improving the quality of statistics for all construction and demolition waste streams. Data is available on waste stream for all economic activities under the construction sector.

Table 21: Waste in construction sector in 2013, in tonnes

Chemical	Metal	Paper & cardboard	Wood	Animal & plant	Mixed	Mineral	Sludge	Glass, plastic etc.
8	1,178	1,426	141,585	94	94	14,960, 946	1,088	30,753

Source: http://www.stat.fi/til/jate/2013/jate_2013_2015-05-28_tau_002_fi.html

- Estimated effect on the economy for the private companies.

- +1 to +2 For some companies, the need to conduct a pre-demolition audit may entail expenses. If companies adapt to situation, new opportunities are available, but volumes are hard to evaluate.
- Baseline: It is not possible at this point in time to attribute the estimated economic costs and/or benefits to private companies as a result of the need to develop new process to improve construction and demolition waste statistics.
- There could be a small increase (+5 to 10%) or decrease (-5 to 10%) in the costs to private companies depending on the system implemented. This is based on a very rough estimate.
- Estimated effect on the export of goods and thus also the competitiveness of the companies in the Nordic countries.
 - o: Knowledge and information problem is very national, thus the solutions are required to match the same level.
- Estimated effect on the export of knowledge concerning circular economy, new technical solutions etc.
 - +4: If solutions can be developed to streamline the collection of data for the statistical reporting of construction and demolition waste, the export of such process may have the potential to reduce the costs of data collection.
- Benefits generated due to a higher degree of collaboration between the Nordic countries toward a Nordic circular economy.
 - o to +1: if good examples and success cases are shared.

The level of uncertainty on the above information

Up to 50% uncertainty.

Overskrift til afsnit

The policy instrument (characteristics)

Extending the eco-design and standardisation requirements for prefabricated modular wooden elements in the construction sector. There is a growth of the multi-storey wood buildings (structural wood frame buildings over 3 floors) in some European countries: for example Sweden, Finland, Germany and Austria. The standardization and labelling of structural elements (e.g., Cross-laminated timber panels and elements, laminated veneer lumber, glue-laminated timber) and modular components (e.g., walls, floors and even rooms) may increase the potential for modular components to be reused at the end of their life.

Modular components (e.g., rooms) could have standards that extend to energy efficiency criteria. Such an approach could echo the work that is currently being undertaken at the EU level concerning the labelling requirements for window products.

Impregnated wood becomes an issue. Impregnated timber is more durable than non-impregnated timber, but is considered a hazardous waste at the end-of-life and cannot be reused under the current regulatory environment. Developing product eco-

design standards that aim at facilitating the reuse of wooden components could be a soft measure in order to stimulate the development of non-hazardous timber impregnation solutions.

Due to the growing rate of multi-storey timber buildings in Finland, standardisation would promote the growth of the emerging national business ecosystem.

The policy instruments according to type of resource(s)

Wood.

The policy instrument according to building component type

- Façade.
- Foundation.
- Windows.
- Insulation.

The policy instrument according to the value chain (and how, when and to whom is it a barrier?)

Especially a) Product design (including choice of raw materials for the products) and b) Design of building: the beginning stages, in time also the other phases of value chain.

The policy instrument according to legislation, taxation and fees

- f) Other: Product legislation and chemical legislation.
- b) Building regulation, or f) Other: Energy regulation.

The policy instrument according to the opportunities, benefits, costs and trade-offs.

Due to wood construction making up a large proportion of the detached housing building stock (90%), and the current growth of multi-storey wooden buildings (6% of new multi storey buildings per year), there is significant potential to reuse modular wooden components and elements.

It is not technically challenge to reuse wooden building components. There a lacking demand for reused wood, caused there to me no market value for reused wooden material.

There is a strong tradition of concrete buildings in Finland, which creates system lock-in. However, there are much greater potential for the circular bio-economy when using wood as a structural building element compared to concrete. Also, Finland would benefits from a renewal of its forests product industries.

Please also specify the effect of a change in the policy instrument by giving a -5 to +5 indication for each of the seven below listed aspects. Where -5 is a very negative effect, 0 is a neutral effect and +5 is a very high positive effect

- Environmental impact (e.g. CO₂ emissions) from the estimated and quantified savings in resources.

- +3: Due to impregnated wood used in building structures, large amount of construction wood is currently being used in energy production as this prevents reuse. Eco-design criteria may see this wood diverted from incineration to reuse or recycling.

Supplementary information (collected after the interview)

Baseline:

- Approx. 141 585 tonnes of wood waste was generated from the construction sector in 2013.
- There are no statistics available for the treatment of wood wastes from construction and demolition activities.
- Possibly a 20% increase in the reuse or recycling of wood due to eco-design and standardisation requirements

- Estimated effect on the economy for the public authorities
 - +2: For public authorities, this mostly a question of governance. There may be a slight benefit for public authorities in the future in terms of lower building costs due to the cheaper cost of wood construction and possibilities to reuse building elements within the public sector.
 - Baseline: There would be a cost to implement and maintain compliance this instrument. An economic effect on public authorities cannot be calculated at this time.
- Estimated effect on the economy for the private companies
 - +2: Very much depends of what type of firms. Potential, for both existing and new companies evolving around producing standardised modular wooden building elements; especially due to the current growth in multi-storey buildings. Although this may negatively affect incumbent actors building with concrete frames.
 - Baseline: Difficult to attribute an economic value. Currently waste there is no market for wood reusing wooden building elements; hence at the moment it is impossible to foresee the potential market effects of such an instrument.
 - Possibly 20% increase in turnover of firms producing wooden building components and modular elements.
- Estimated effect on the export of goods and thus also the competitiveness of the companies in the Nordic countries.
 - +2: If wooden components and elements could be standardized successfully, there is potential for these to be exported to Nordic countries which have markets for multi-storey wood buildings.
- Estimated effect on the export of knowledge concerning circular economy, new technical solutions etc.

- +1: As an EU directive the effect on Finland in terms of knowledge would be minimal as the each member state would be required to implement the directive.
- Benefits generated due to a higher degree of collaboration between the Nordic countries toward a Nordic circular economy.
 - 0: as above.

The level of uncertainty on the above information

Up to 70% uncertainty.

The Finnish interviewees have provided the following replies to the questions asked

Table 22: Finland

Organisation	1	2	3	4	5	6	7						8
							a	b	c	d	e	f	
Finnish Environmental Industries (YTP) (e)	1e	All	a-d	All	L	-	0 ¹⁴	1-2	1-2	0	4	0-1	H
	2e	c	a-d	a+b	L	-	3	2	2	2	1	0	H
Helsinki Region Environmental Services Authority HSY (f)	1f	All	a-d	All	L	-	4	2	1	0	3	0	M
	2f	a+b	a+b and materials for earthworks	a,b,c,f	L	-	3	1	3	0	0	0	M
	3f	a,b,d	a-d	f	T	-	3	-2-2	1	0	2	0	
The Confederation of Finnish Construction Industries RT (g)	1g	a+b	a, b and materials for earthworks	f (+a and b)	L	-	2-3	1-2	2	0	2	0	H
	2g	All	a+c	a-g	L	-	5	2	2	0	1	0	H
The Finnish Environment Institute (h)	1h	All	a-d	a-g	L	-	0 ⁷	1-2	1-2	0	4	0-1	M
	2h	c	a-d	a+b	L	-	3	2	2	2	1	0	H

⁷ 0 for the direct savings, but 1-2 for the indirect savings.

Norway

In Norway, the following stakeholders were interviewed.

Table 23: Norway

Organisation	Interviewee
The Federation of Norwegian Industries	Gunnar Grini
The Federation of Norwegian Construction Industries	Rannveig Ravnanger Landet
The trade organisation Bygg uten Grenser	Jan Eldegard
Norwegian Association of Heavy Equipment Contractors	Sverre Huuse Fagerlie

The Federation of Norwegian Industries: Gunnar Grini

Attendees:

- Gunnar Grini – GG, The Federation of Norwegian Industries.
- Benedicte Kaspersen – BEKA, COWI.
- Tore Methlie Hagen – TMEH, COWI.

The interview was performed on 21 April 2017.

GG is the chief at the Federation of Norwegian Industries representing the majority of the private recycling industry in Norway.

During the interview, GG highlighted the product development/design phase as a phase with potential to increase the circular economy and resource efficiency. He emphasized that regulations in this area have to be developed at a European level, and that it was important that both industry and authorities in the Nordic countries co-operate and are active in the European legislation processes.

Further, GG mentioned different policy instruments, two of the most important, which are described in more detail, are increased materials recycling rate and expanding the requirement for a waste plan in the building regulation to apply for all buildings larger than 100 m² (Technical regulation (TEK) § 9–6). Today the regulation (TEK § 9–6) requires a waste management plan if the building area is larger than 100 m² for existing buildings, and 300 m² for new buildings, or if the refurbishment/dismantling will generate more than 10 tonnes of waste.

Overskrift til afsnit

The policy instrument (characteristics)

Increase the recycling rate demand from building and construction waste. This implies imposing stricter recycle goals in the waste legislation, which again has to be implemented in the building legislation.

The policy instruments according to type of resource(s)

All building components.

The policy instrument according to building component type

All building components.

The policy instrument according to the value chain (and how, when and to whom is it a barrier?)

Phase f: From waste to resources (demolition). Recycling of waste from production.

The policy instrument according to legislation, taxation and fees

Primarily the waste legislation, which further has to be implemented in the building legislation.

The policy instrument according to the opportunities, benefits, costs and trade-offs.

- More available waste, which can substitute other products.
- Reducing the CO₂ emissions.
- Substitute other resources with waste.
- Increased costs for the building owner. This is due to more manpower etc.

Please also specify the effect of a change in the policy instrument by giving a -5 to +5 indication for each of the seven below listed aspects. Where -5 is a very negative effect, 0 (zero) is a neutral effect and +5 is a very high positive effect

- Environmental impact (e.g. CO₂ emissions) from the estimated and quantified savings in resources.
 - The score is estimated to be +3. This score is estimated based on the assumption on a recycling rate that is increasing from 60 to 80 % and assuming that the waste amount in Norway today is 2.5 million tonnes. The latter number is based on appendix to the Norwegian waste strategy compiled by Miljødirektoratet (Miljødirektoratet, 2017). The CO₂ emission saving is estimated to be approximately 90,000 tonnes. This is calculated based on the assumption shown in Table 1. Here the assumptions such as the emission factors are listed.
 - By dividing the savings with the total emission from the construction and building industry, which is 854,000 tonnes of CO₂ emissions (SSB, 2016), one can see that this correspond to approximately 10 %.
- Estimated effect on the economy for the public authorities
 - Not a cost. The effect is estimated to be 0 (zero).
- Estimated effect on the economy for the private companies
 - Assuming a cost of 200 NOK/tonnes waste due to additional costs associated with more manpower/hour in order to recycle the materials and building

products at the site, etc. This will, with a recycled waste amount of 0.5 million tonnes, lead to an additional cost of 100 million NOK.

- Assuming a turnover of 200 billion NOK from the construction and building sector, the costs on the private companies are estimated to have an effect of -1. The turnover is based on SSB (2017a), which is 437,3 billion NOK, and assuming a share of 45% of this turnover for construction and demolition of buildings (based on the numbers from Table "Omsetningsstatistikk for bygge- og anleggsvirksomhet, etter næring¹" in SSB (2017b).
- Other socioeconomic values: for instance generating 0.5 million tonnes recycled materials will lead to an additional 12,500 workplaces. This number is based on numbers prepared by LOOP (2016). (+3).
- Estimated effect on the export of goods and thus also the competitiveness of the companies in the Nordic countries.
 - Limited effect (0). Norway imports 3 to 4 times more building materials than we export (Byggevarerindustrien, 2015).
- Estimated effect on the export of knowledge concerning circular economy, new technical solutions etc.
 - The score is estimated to be +1, as more efficient dissemination of knowledge and information will be beneficial. For instance knowledge regarding marketing opportunities, technologies and different treatment methods in order to increase the recycling rate.
- Benefits generated due to a higher degree of collaboration between the Nordic countries toward a Nordic circular economy.
 - The estimated effect is assumed to be +1. The cooperation between countries can benefit the circular economy; cooperation regarding exploitation of technology etc.

The level of uncertainty on the above information

High: Up to 30 % uncertainty.

Assumptions to calculation in 7 a can be seen in Table 24

Table 24: Calculations of CO₂ emission in 7a

Building material	Savings [tonnes of CO ₂]	% share of the 0.5 mill. tonnes of waste
Concrete	3,000 ⁸	60
Gypsum	1,199 ⁹	15
Wood	2,250 ¹⁰	15
Mineral wool	8,250 ¹¹	5
Metal ¹²	72,100 ¹³	5
Total savings in CO ₂	86,799	

Assumptions regarding emission factors:

- Concrete: 0.1 kg CO₂-eq./kg.
- Wood: 0.03 kg CO₂-eq./kg.
- Mineral wool: 3.32 kg CO₂-eq./kg.
- Gypsum: 0.08 kg CO₂-eq./kg.

Overskrift til afsnit

The policy instrument (characteristics)

Expanding the requirement for a waste plan in the building legislation to apply for all buildings larger than 100 m² (Technical building regulation (TEK) § 9–6).

The policy instruments according to type of resource(s):

All resources in a building.

The policy instrument according to building component type

All building components.

The policy instrument according to the value chain (and how, when and to whom is it a barrier?)

Phase f: From waste to resources (demolition).

The policy instrument according to legislation, taxation and fees

The building legislation, primarily the building regulation.

⁸ Assuming 10% is going to concrete production.

⁹ Assuming 20% is going to gypsum production.

¹⁰ Assuming 100% is going to wood production.

¹¹ Assuming 10% is going to mineral wool production.

¹² Assuming 20% alu. and 80% steel.

¹³ Assuming 100% is going to metal production.

Need to incorporate the policy instrument as a mandatory requirement into the building regulation.

The policy instrument according to the opportunities, benefits, costs and trade-offs.

There are several costs and consequences associated with the policy instrument:

- In some cases, the building owner incurs increased costs associated with dismantling or refurbishment.
- The municipalities need to spend more time on supervision/going through waste plans for demolition and refurbishment projects.
- Large amounts of the waste are sorted. Even small building projects generate large amounts of waste.

Please also specify the effect of a change in the policy instrument by giving a -5 to +5 indication for each of the seven below listed aspects. Where -5 is a very negative effect, 0 is a neutral effect and +5 is a very high positive effect

- Environmental impact (e.g. CO₂ emissions) from the estimated and quantified savings in resources + the estimated effect on space efficiency (m² space).
 - The effect in environmental impact is estimated to be +1. This is based on the assumption that 10,00 new buildings under 300 m² are built each year and 15,000 buildings in the form of cottage etc. (SSB, 2017). By using experience data from TA-2357/2007 it is approximated that the waste generated will be approximately 250,000 tonnes. This has to be accounted for in the building and construction statistics.
 - By dividing the savings with the total emission from the construction and building industry, which is 854,000 tonnes of CO₂ emissions (SSB, 2016), one can see that this correspond to approximately 5 % of the total emission.
- Estimated effect on the economy for the public authorities.
 - The estimated effect on the economy is assumed to be 0 (zero). This is due to the increased administrative work and time spent on supervision.
- Estimated effect on the economy for the private companies.
 - The effect for the builder is estimated to be -1 due to the need of more manpower to prepare waste plans. Today, most of the building projects concern apartment buildings and commercial buildings. However, there is a large share of single-family residences and cottages, which will be included with this policy instrument. Private waste/demolition companies will, most likely, take care of the waste in a better way than before.
- Estimated effect on the export of goods and thus also the competitiveness of the companies in the Nordic countries.

- This effect is estimated to be o (zero). Maybe some gains from transformation of building materials into the circular economy, resulting in a higher amount of recycled materials in new building products.
- Estimated effect on the export of knowledge concerning circular economy, new technical solutions etc.
 - The export of knowledge is estimated to be o (zero). The other Nordic countries have also developed waste strategies that are embedded in the legislation.
- Benefits generated due to a higher degree of collaboration between the Nordic countries toward a Nordic circular economy.
 - The score is estimated to be o (zero).

The level of uncertainty on the above information

Medium: Up to 30 % uncertainty.

Reference

SSB (2017). Bygningsmassen, 1. januar 2017 Accessed from: <https://ssb.no/bygg-bolig-og-eiendom/statistikker/bygningsmasse> (04.05.2017)

The Federation of Norwegian Construction Industries: Rannveig Ravnanger Landet

Attendees:

- Rannveig Ravnanger Landet – RRL, The Federation of Norwegian Construction Industries.
- Tore Methlie Hagen – TMEH, COWI.

The interview was performed on 19 April 2017.

RRL is Director of Environment and Energy at the Federation of Norwegian Construction Industries (BNL). BNL is a business and employer policy organisation for companies in the construction industry. BNL is an umbrella organisation for 15 trade organisations and has more than 4,000 member companies with 75,000 employees. BNL was established in 1997 and is currently the second largest association in The Confederation of Norwegian Enterprise (NHO).

BNL organises both manufacturing companies, plumbers, carpenters, landscape gardeners, masons, painters, entrepreneurs and real estate owners.

BNL is also a member of the Confederation of Norwegian Enterprise (NHO). NHO is Norway's major organisation for employers and the leading business lobby. Their current membership of 23,000 companies range from small family-owned businesses to multinational companies in most sectors, with more than 550,000 employees. NHO is the leading voice of business and industry in Norway. Having expert knowledge and an

extensive business network, NHO plays an important and constructive role in the Norwegian society.

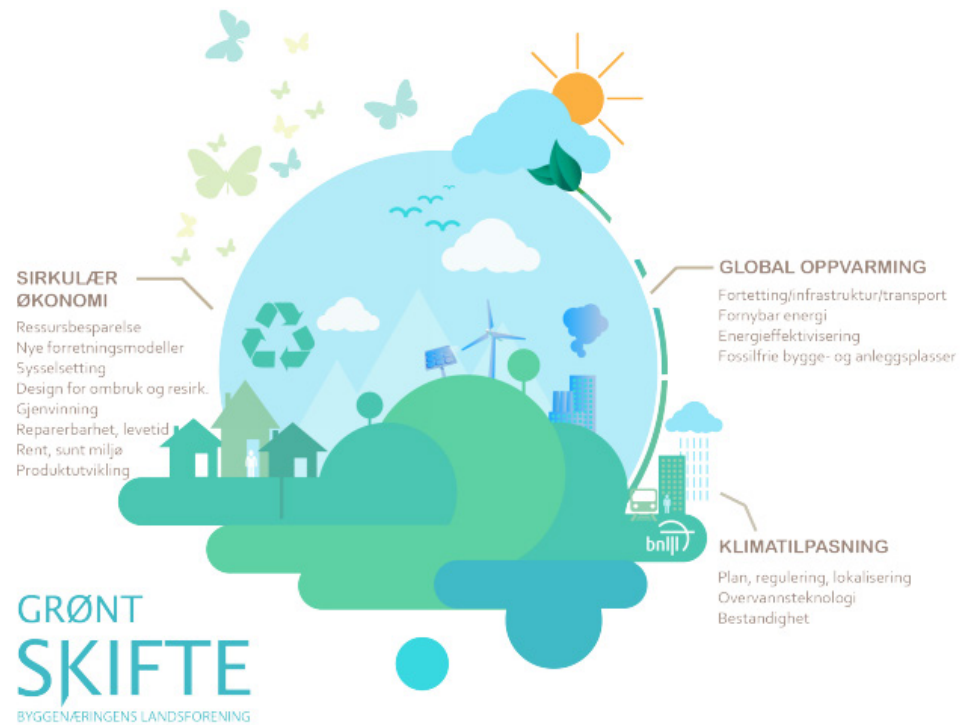
The building and construction sector comprises the construction and renovation/refurbishment of houses and commercial buildings, and the development of roads, airports and facilities related to defence, energy, oil, gas, railways and tramlines. This sector has many small companies. The large companies account for a smaller share of the construction output in Norway than in other countries. However, building contractors are constantly restructuring. (Ref: <http://www.bnl.no/dette-er-bnl/english/>). The public sector, through the local authorities and the Public Roads Administration, also accounts for a considerable share of the activities in the building and construction sector.

The building and construction industry is extremely sensitive to fluctuations in the market, and often the building and construction industry are the first to register the first signs of major changes in the economy. This industry accounts for a considerable share of the total energy and materials consumed in Norway and generates a correspondingly large share of its overall waste. Increased focus on the lifetime of buildings, such as management, operations, maintenance and development, has given rise to new business areas.

BNL has focused on improved waste management for years and took the initiative to establish the first national action plan for construction and demolition waste in 2001 (NHP1). The plan has been revised several times, and a fourth version of the action plan for the period 2017 to 2020 is now being prepared (NHP4).

As an input to the governmental organised work "Green competitiveness"(ref. MOM from interview with MEF), BNL produced a document describing BNLs environment- and energy politic towards 2030. The figure below shows the three target areas; 1. Global Warming, 2. Circular Economy 3. Climate changes.

Figure 2: The three target areas



Source: From BNLs policy document

The document (<https://bnl.no/globalassets/dokumenter/rapporter/bnls-politikk-gront-skifte.pdf>) describes the three target areas and the relevant policy instruments to BNL

As mentioned, BNL took the initiative to create the first national action plan (NHP1) on construction waste in 2001. Back then approximately 80 % of the construction waste ended at a landfill whereas now more than 80 % are recycled. An overall goal in NHP3 is that all construction waste should be minimized to the extent possible, recycled to the extent possible and handled properly. A lot has happened during recent years, but various policy instruments to achieve a greater degree of circular economy and improved resource efficiency were discussed initially and also which of these could be the most effective.

In certain areas of Norway, there is still less control and construction waste goes to uncontrolled dumpsites. The lifetime and flexibility of a building is, of course, also very important for safeguarding resource efficiency and a circular economy. The market for construction waste is not functioning well enough and RRL focused specifically on two policy instruments which she meant could be the most effective. These are described in the fact sheets.

Overskrift til afsnit

The policy instrument (characteristics)

Requires a certain content of secondary resources in new products.

This will:

- Widen the market for waste from the construction sector.
- Ensure that new products with a certain mixture of waste as secondary resources fulfil requirements to new products.
- Facilitate a higher degree of recycling of construction waste.

The policy instruments according to type of resource(s):

All resources in a building which are free from dangerous substances.

The policy instrument according to building component type

All building components.

The policy instrument according to the value chain (and how, when and to whom is it a barrier?)

Products must be tested and fulfil certain criteria to be used as a product in new buildings. This can be a bottleneck today. Claiming that products must contain a certain amount of secondary resources in the product will increase the demand, but it is also important to determine how high the amount of secondary resources can be without compromising the technical requirements of the product. The policy instrument is focused on product design and possibilities. This means that it is easier for those who design and describe solutions to prescribe the use of secondary materials in new building products.

It has to be considered which requirements must be applicable to the waste that can be included in new products or reused for certain purposes. This will clarify what processes the waste must undergo and improve the market situation for recovered waste.

The proposed policy instrument can be a barrier both to the producers and the waste industry, but also an instrument to clarify the limits to the same actors.

The policy instrument according to legislation, taxation and fees

The national building legislation.

To comply with the requirements, new products must fulfil the building requirements (CE-marking of construction products). An assessment of what product waste could be mixed and to what level has to be carried out. The authorities must verify that the rules are complied with.

The proposed changes in the building regulation can be supplemented by economic incentives, a higher score when using waste-based products in a certification system (such as BREEAM or similar) to motivate the building owners or constructors to specify these products.

Building products are regulated at EU level and are therefore governed by the Construction Products Regulation.

The policy instrument according to the opportunities, benefits, costs and trade-offs.

In the long term, the policy instrument will improve the market situation for recovered waste and products including secondary resources. Some products may involve more long-term tests and comprehensive analyses, product declarations etc. and thus be more long-term, whereas other products or uses for waste-based products have a more short-term perspective.

The proposed policy instrument may lead to some development work and costs for manufacturers of various building products where secondary resources is included, but it may also increase sales and result in higher profits for producers.

Please also specify the effect of a change in the policy instrument by giving a -5 to +5 indication for each of the seven aspects listed below. Where -5 is a very negative effect, 0 (zero) is a neutral effect and +5 is a very high positive effect

- Environmental impact (e.g. CO₂ emissions) from the estimated and quantified savings in resources.
 - The effect is estimated to be +4 to +5 in the long term. More materials will be in the loop for a longer period and thus reduce the loss of resources. Another effect is that emissions will be reduced as the withdrawal of virgin raw materials usually generates much higher emissions. The possible mixture of recycled waste as a secondary resource varies between the different products/components and the effect will thereby also vary. It can probably be translated into the use of 20–60% reused and recycled materials in buildings in total. The current use of recycled and reused materials in buildings is unknown, but in general very low (<10 %). However, some products, for instance Rebar, can be produced with nearly 100 % recycled materials.
 - The effect is supposed to gradually increase, but in the short term, the effect is estimated to +1 to +2.
 - The baseline is based on calculated effects when replacing the use of virgin materials with recycled waste feedstock (secondary resources). In most cases, there is a significant reduction in energy consumption and greenhouse gas emissions.
- Estimated effect on the economy for the public authorities.
 - In the short term, there will be more work associated with the use of waste as a secondary resource in building products and construction materials and controlling new product declarations. The effect on administration is most

likely very low and is estimated to 0 (zero), since the authorities normally cover their extra costs through increased taxes.

- Estimated effect on the economy for the private companies.
 - In the short term, there will be a cost to develop (-1 to -3), test and obtain permission to use the new products. In the long term, there is an opportunity for a positive transition and estimated to +2 to +4. It is, however, hard to find a directly comparable baseline to this estimation. In general, it is costly to develop and get new products certified. However, development support is often provided and compared to the potential upside of increased sales, the costs are considered low.
- Estimated effect on the export of goods and thus also the competitiveness of the companies in the Nordic countries.
 - Products must satisfy EU regulations in order to be able to enter the market. Developing costs and documentation requirements might be higher, but the market potential will also be higher. Norway is importing three times more than they are exporting and thus the effect is estimated to +1 to 2 as circular economy and use of secondary resources is a focus area in all of the European Member States and could thus have a positive effect on the products and quantities that are exported.
- Estimated effect on the export of knowledge concerning circular economy, new technical solutions etc.
 - The good Norwegian economy can be a contributing factor to Norway's opportunities, being a driving force in developing new solutions. Abundant access to virgin raw materials for both concrete and wood can, however, be a limiting factor for Norway in becoming a spearhead in this work. The effect is probably quite low and estimated to 0 to +1.
- Benefits generated due to a higher degree of collaboration between the Nordic countries toward a Nordic circular economy.
 - A better cooperation between the Nordic countries will most likely have a positive effect assumed to +1.

The level of uncertainty on the above information

Medium to high uncertainty.

Overskrift til afsnit

The policy instrument (characteristics)

Introduce stricter documentation requirements for all materials used for new construction using a model similar to for example BREEAM.

This includes:

- Registration of the chemical substances used in the building.
- Registration of all solid materials/components used in the building.

- The documentation should follow the building owner and be supplemented when the building is renovated/changes to the building are made. Today, only a few large builders want BREEAM certification, and only a small number of large contractors can meet these requirements. Implementing similar requirements in the building regulation could give the building “a passport” when built, and would make it much easier to recover components and materials.

The policy instruments according to type of resource(s):

All resources in a building.

The policy instrument according to building component type

All building components.

The policy instrument according to the value chain (and how, when and to whom is it a barrier?)

The proposed instrument will influence the whole value chain as developer, constructor, builder, building company, the building operator as well as be very helpful when renovating and demolishing a building. The instrument will force constructors to think more consciously of material choices under design, which will lead to increased awareness of circular economy and resource efficiency. It will also be an important instrument to be able to increase the possibilities to reuse components and recover/recycle more waste to secondary resources. The documentation concerning compound products consisting of several different materials and recyclability will be a part of this.

The proposed policy instrument will primarily be a barrier to the constructors and the builder since it implies more work during construction and building.

The policy instrument according to legislation, taxation and fees

The building legislation primarily. Today BREEAM buildings have a certificate according to the relevant BREEAM standard. Something similar could be useful, but it might be an idea to introduce the instrument stepwise, dependent on the size of the project.

Substitution obligation for environmentally hazardous substances is regulated through the Control Product Act, but is also a part of the building regulation (TEK §9.2). This obligation is complicated to follow, especially for small companies with no experts on chemicals (which means a greater part of the construction sector). Control of the use of environmentally hazardous substances is therefore inadequate and probably means that such substances are used as long as they are legal to use. Regulation requiring documentation of substances and products that will be used will result in building products without any hazardous substances which makes it easier for reuse and recycling. Better substitution obligation which is suited for all building industries should be developed. The existing obligation is made/fit for normal industry companies (on fixed plants), which use a limited amount of products for longer periods.

ProductXchange, a digital tool developed by the construction industry itself, is a useful tool to i.e. assess different substances and to document what is used in a project, but it is normally not used by small companies. ProductXchange is, however, a good

example of a technology which makes it much easier to store documentation about a building, which will be helpful during the lifetime of a building.

The policy instrument according to the opportunities, benefits, costs and trade-offs.

This policy instrument can have the following consequences:

- The building owner incurs increased costs when designing and building a new building because more resources have to be used to follow up on documentation and ensure that it is actually the chosen products that are being used.
- The policy instrument will provide incentives for increased cooperation during the value chain.
- Rental of certified buildings may be easier as “green buildings” seem to be more attractive in the rental market.
- The building owner can gain economic benefits from the sale of the building materials which can be reused or recycled.
- The building owner will probably have reduced costs of dismantling/ demolishing.
- The policy instrument can reduce the insurance costs of certified buildings as there is less uncertainty associated with the consequences of events in the building.

Please also specify the effect of a change in the policy instrument by giving a -5 to +5 indication for each of the seven aspects listed below. Where -5 is a very negative effect, 0 (zero) is a neutral effect and +5 is a very high positive effect

- The use of primary resources will most likely be reduced and there will be less pollutants in the building. Less costs to depollution and increased recovery rate of components and construction waste will be a result. In the short term, the score is estimated to be 1–2 and mainly tied to improved awareness of resource use and cleaner materials. The lifetime of new buildings are long and on a longer term, when the building will be demolished, the chance to reuse components and an increased recycling of waste from demolition of buildings will increase, the score is estimated to be +3–4. The baseline for this is the experienced effect of building a BREEAM certified building where it is rated dependent on the chosen solutions, giving more environmental friendly solutions a higher score. A calculation of the climate effect when building the new terminal at Gardermoen Airport, which is BREEAM excellent certified, showed a reduction of 34% compared to a “normal” terminal.
- Estimated effect on the economy for the public authorities.
 - The work involved in following up on compliance with the building regulations will require some additional work. Since the public authorities normally cover their costs through fees, it will just imply that the building application fee will

increase slightly. The effect on the economy for public authorities is thereby estimated to be 0 (zero).

- Estimated effect on the economy for the private companies.
 - There will be some increased workload both in the construction and the building face. Compared to the total costs of a project they are low and estimated to be 0 to -1. The trade-offs are uncertain, but the demolishing costs will most likely be reduced and an increased recovery rate will most likely also reduce the costs considerably. In the long run, the effects are estimated to be + 3 to 4.
 - A baseline to estimate the effects is hard to find when it comes to the possible income and is based on an assumption of the reduced quantity of waste and increased reuse of secondary resources. The costs, however, are based on experienced costs from BREEAM-certified projects. These will most likely be reduced when technological tools are more developed and the number of projects increase.
- Estimated effect on the export of goods and thus also the competitiveness of the companies in the Nordic countries.
 - The estimated effect on the export of goods is estimated as very low (0) since it is not supposed to effect the export of goods. If Norway will be at the forefront compared to the other Nordic countries it could have a positive effect on the competitiveness of these companies. The value is, though, estimated to be quite low and the effect estimated to +1.
- Estimated effect on the export of knowledge concerning circular economy, new technical solutions etc.
 - The export of knowledge is estimated to be +1. Norway introduced requirements to environmental and waste management plans early, as well as creating action plans for construction waste. It is therefore probable that this expertise will benefit other Nordic countries and the companies operating in other Nordic countries. The knowledge can be exported – but the effect in other Nordic countries is dependent on how far the work on policies to circular economy and resource efficiency will develop. The effect is thus considered positive – but not large.
- Benefits generated due to a higher degree of collaboration between the Nordic countries toward a Nordic circular economy.
 - The estimated effect is assumed to be +1 as knowledge sharing can be very beneficial both to public authorities and private enterprises.

The level of uncertainty on the above information

Medium: Up to 30% uncertainty.

The trade organisation Bygg uten Grenser: Jan Eldegard

Attendees:

- Jan Eldegard – JE, the trade organisation Bygg uten Grenser.
- Benedicte Kaspersen – BEKA, COWI.
- Tore Methlie Hagen – TMEH, COWI.

The interview was performed on 20 April 2017.

JE is director at Bygg Uten Grenser, which is a trade organisation for manufacturers of bricks and concrete. In addition to being director at Bygg Uten Grenser, JE is also director at the Norwegian Factory Concrete Association.

JE emphasized the importance of working in cooperation with sectors in order to increase circular economy in the construction sector. Today, the industries work too much within their own sector. In some cases, this could lead to bottlenecks in the circular economy. One solution to this problem could be to generate incentives in the different sectors.

JE highlights different policy instruments, two of the most important, which are described in more details below, are traceability and knowledge.

Overskrift til afsnit

The policy instrument (characteristics)

Traceability for building materials/products in order to make it easier to reuse and recycle. Traceability in the form of CO₂ emission, composition of chemical substances in the material/product, alternative end-of-life treatment options etc. This can be done through:

- Environmental Product Declarations (EPDs).
- Linking the materials/products in the building with their respective EPD in BIM models.
- Developing Apps, such as a database, where the EPDs can be stored and traced back to the different building materials/products in the building.

By making it a requirement for building owners to have traceable materials and products it will make it easier to reuse the materials, especially in order to meet future building requirements.

The policy instruments according to type of resource(s):

All resources in a building.

The policy instrument according to building component type

All building components.

The policy instrument according to the value chain (and how, when and to whom is it a barrier?)

Phases a, d and e. The policy instruments will be a barrier in the construction and the renovation phases. This is due to the need of making the environmental labelling of the building materials in these phases. By making the building materials traceable it will make it easier to reuse and recycle materials (in the demolition phase), as information regarding the end-of-life options, production and the associated CO₂-emissions will be accessible. This is especially important if the materials are to be used in future buildings. Today's standards and requirements may not be the same in 60 years. Future building legislation is not yet known and by making the information regarding the building materials accessible, it will be easier to reuse the materials.

The policy instrument according to legislation, taxation and fees

The building legislation. Making environmental-labelling of all building materials and products mandatory.

Today, the use of Building Information Modelling (BIM) is common practice in building projects. However, labelling the materials with more than name, family and quantity in the BIM models are not that common. More and more building projects require strict demands regarding environmental documentation of the different building materials/products used in the projects. This information could be further incorporated into the BIM model, making it easy to trace the different materials.

Moreover, impose mandatory standards on producers for higher focus on the end-of-life phase in the EPDs. Today, the focus is almost exclusively on global warming potential (GWP). For instance by focusing more on the demolition phase, one could calculate the savings in CO₂-emissions from different types of end-of-life treatments.

The policy instrument according to the opportunities, benefits, costs and trade-offs.

- The policy instruments will give opportunities for a larger amount of recycled materials in buildings.
- The building owners can gain financial benefits from the sale of the building materials which can be reused or recycled.

Please also specify the effect of a change in the policy instrument by giving a -5 to +5 indication for each of the seven below listed aspects. Where -5 is a very negative effect, 0 (zero) is a neutral effect and +5 is a very high positive effect

- Environmental impact (e.g. CO₂ emissions) from the estimated and quantified savings in resources.
 - 1–2 in the short term. This is due to more awareness on the building products and components to be more environmental friendly.
 - 2–3 in the long term. The use of primary resources is likely to be reduced in future buildings, this is due to an increased recovery rate and reuse of components and construction waste.

- The baseline for this estimation is the experience from the environmental effect of building the new terminal at Gardermoen Airport. This terminal is BREEAM-certified as “excellent”. The building had a 34% reduction in CO₂ emissions due to the use of environmentally friendly solutions, including building materials and products, compared to a reference scenario, where there was no environmental focus. Future buildings may in addition to a CO₂ emissions reduction, due to more focus on environmentally friendly products and materials, also gain from being more traceable, hence more materials and products may be reused. The score is therefore set to 2–3. In the short term, the emission reduction is set to 1–2 as this reflects the CO₂ emission reduction for certified buildings and other “green” buildings (not set as high as for BREEAM “excellent” buildings).
- Estimated effect on the economy for the public authorities.
 - The effect is estimated to be 0 (zero). Today, EPDs are not required in the building legislation. Therefore, there will be no additional costs for the public authorities. However, if this is implemented as an requirement in future building legislation there will be some additional administrative costs associated with management and monitoring (-1).
- Estimated effect on the economy for the private companies.
 - Higher costs for the building owners in the short term, as more manpower/man hours are needed in order to prepare environmental documentations for all building materials and linking this documentation to the BIM model/database. However, compared to the total costs of a building project, the additional costs are low (-2).
 - A baseline to estimate the effect on the economy for the private companies is hard to retrieve, especially when it comes to the possible income. The costs, however, are based on experienced costs from BREEAM-certified projects. Furthermore, it is important to emphasize that the costs are likely to be reduced in future due to more experiences and development of new technologies, strategies and methods.
- Estimated effect on the export of goods and thus also the competitiveness of the companies in the Nordic countries.
 - 1–2 in the long term. This could benefit building owners across the Nordic countries. A traceable system makes it easier to reuse building materials, especially if new requirements regarding production/emissions are set. This may potentially benefit the circular economy by increasing the amount of secondary materials in the construction sector. However, the export of goods across the Nordic countries will not be preferable from an environmental perspective. The materials should be used locally, in order to reduce the environmental impacts from transportation.
- Estimated effect on the export of knowledge concerning circular economy, new technical solutions etc.

- The estimated effect is assumed to be +1 as knowledge sharing can be very beneficial. Both BIM and EPDs are common practice in all Nordic countries. Sharing and collaborating across Nordic countries can affect the development of better and smarter ways to do environmental labelling and incorporating this into BIM models or other databases/programs.
- Benefits generated due to a higher degree of collaboration between the Nordic countries toward a Nordic circular economy.
 - The estimated effect due to a higher degree of collaboration between Nordic countries is assumed to be +1. Knowledge sharing can be very beneficial.

The level of uncertainty on the above information

High: Up to 60% uncertainty.

Overskrift til afsnit

The policy instrument (characteristics)

Increase the knowledge of circular economy by focusing more on industrial symbiosis between industries, not just within the construction sector. This could be done through:

- Own study direction for circular economy at the University. Focusing on interdisciplinary; connection between industries. How can the industries work together to optimize the circular economy in all sectors.

The policy instruments according to type of resource(s):

All resources in a building.

The policy instrument according to building component type

All building components.

The policy instrument according to the value chain (and how, when and to whom is it a barrier?)

The policy instrument is focusing on innovation (item g) in the interview guide). This policy instrument will influence all phases of the life-cycle of the building. More focus on circular economy across sectors; materials/products circulating between different sectors. For instance, the concrete industry produces washing water as a waste product. This water could potentially be used as a product in the agricultural sector.

The policy instrument according to legislation, taxation and fees

Other (item f) in the interview guide).

The policy instrument according to the opportunities, benefits, costs and trade-offs.

- The policy instrument will provide more opportunities as increased knowledge regarding industrial symbiosis in the construction sector may lead to new and smart methods to increase circular economy.
- The policy instrument may benefit cooperation throughout the value chain.

Please also specify the effect of a change in the policy instrument by giving a -5 to +5 indication for each of the seven below listed aspects. Where -5 is a very negative effect, 0 is a neutral effect and +5 is a very high positive effect

- Environmental impact (e.g. CO₂ emissions) from the estimated and quantified savings in resources and the estimated effect on space efficiency (m² space).
 - In the long term, the score is estimated to be 1–2 as better knowledge regarding industrial symbioses could lead to better business models for handling of waste products; waste products in one industry could benefit another industry. In addition, better knowledge regarding utilization of different waste products etc. may also lead to improved technologies.
- Estimated effect on the economy for the public authorities.
 - -1 in the long term. There will be a negative effect on the economy for the public authorities as creating a new study program at the University will be an additional expense. However, the public authorities may also benefit from the study program due to increased knowledge of circular economy.
- Estimated effect on the economy for the private companies.
 - +1 in the long term. There will not be an additional cost, on the contrary, this will benefit the private companies due to increased knowledge; improved technologies, business models, exploration of building materials and products etc.
- Estimated effect on the export of goods and thus also the competitiveness of the companies in the Nordic countries.
 - The estimated effect on the export of goods is 0 (zero) as the intention of industrial symbiosis is to use the by-products/waste products locally.
 - The competitiveness of the companies is estimated to be 1 as new and smarter business models could be developed.
 - The intention is to work together, one industry supplies another industry with their waste products.
- Estimated effect on the export of knowledge concerning circular economy, new technical solutions etc.
 - The export of knowledge is estimated to be 1 as knowledge can be exported, however, the other Nordic countries also work with circular economy, so the effect is considered positive, but small.

- Benefits generated due to a higher degree of collaboration between the Nordic countries toward a Nordic circular economy.
 - The estimated effect is assumed to be 2 as knowledge sharing on industrial symbiosis can be very beneficial.

The level of uncertainty on the above information

High: Up to 80 % uncertainty.

Norwegian Association of Heavy Equipment Contractors: Sverre Huuse Fagerlie

Attendees:

- Sverre Huuse Fagerlie – SHF, Norwegian Association of Heavy Equipment Contractors.
- Tore Methlie Hagen – TMEH, COWI.

The interview was performed on 24 April 2017.

SHF is head of the department waste recycling and treatment at the Machine Contractors' Association in Norway (MEF). MEF is the largest independent trade and employers' organisation, representing approximately 2,030 small, medium-sized and large businesses in the construction trade. MEF also has three associated industries; mechanical deforestation, waste recycling and treatment and well drilling. There are 55 members within waste recycling and treatment.

In all, MEF member companies have approximately 30,000 employees and generate approximately 70 billion NOK in annual revenues.

The goals for circular economy in Norway is expressed through:

The Norwegian waste strategy "From Waste to resources" containing the following goals:

- The total quantity of waste shall be considerably lower than the growth in the economy.
- The quantity of waste to recycling (75 % in 2010) shall gradually rise to 80% based on increasing the amount of waste for recycling in line with what is economically and environmentally sound.
- All hazardous waste should be taken care of properly.
- The generation of hazardous waste shall be reduced before 2020 (compared to 2005 level).
- A newly prepared Annex (Waste Prevention Program) to the Strategy.

The document is in consultation with the deadline for commenting at 30 June, but states that it is a need to implement new policy instruments/actions to reach the goal of 70 % recovery of building and construction waste.

A new report; “Green competitiveness” from a government-appointed committee had, in addition to the EU’s circular economy strategy, been an important basis document when Norwegian Waste Management and Recycling Association recently produced a Roadmap to Circular economy within the waste management and recycling industry. They point out the importance of developing industry standards and common quality requirements. A national strategy for resource efficiency that contains targets for waste reduction, reuse and materials recycling as well as clear framework conditions for actors is requested from the authorities. The authorities should also consider a producer liability scheme to increase the demand for increased use of secondary raw materials for among other things some building materials, fertilizers etc. In addition, public procurement should require prioritization of recycled raw materials and resource-efficient solutions. In order to stimulate the market, green fees should also be considered and a work to simplify the import and export regulations of recycled raw materials and waste for recycling.

So far, there are no direct goals for increased circular economy in the building sector. Norway has, however, adopted requirements in the Building Regulation (TEK) for the preparation of waste plans when building a new building when buildings are renovated and when buildings are demolished. There is also a requirement for the preparation of an environmental assessment plan prior to demolition to identify and remove hazardous waste separately. Further it is required that at least 60% of the construction waste has to be sorted at the site of construction. Sorted combustible does not count as a separate fraction and mixed residual waste cannot exceed 40% of the total amount. In exceptional cases, acceptance may be given to sort the waste at a sorting plant instead of at the building site.

Overskrift til afsnit

The policy instrument (characteristics)

Include all buildings in the requirements in the building regulation for the preparation of a waste plan, environmental management description and sorting requirements when building a new buildings, refurbishing a building and demolishing a building.

This will:

- Increase the control of more waste from the building sector.
- Ensure proper handling of hazardous waste from the building sector.
- Facilitate a higher degree of recycling of building and construction waste.

The policy instruments according to type of resource(s):

All resources in a building.

The policy instrument according to building component type

All building components.

The policy instrument according to the value chain (and how, when and to whom is it a barrier?)

The policy instrument focuses both on the design of new buildings as it makes the developer aware of generated waste and waste types in the preparation of waste plans, and at how demolition waste could be handled when hazardous components are removed. The requirements to a high degree of source separation also facilitates a higher degree of reuse of construction waste for the production of new building materials and a higher recovery rate.

Today, only new buildings >300 m² have to make a waste plan and buildings to be demolished or renovated >100 m² have to conduct an environmental management description. When all buildings have to conform with the same requirements the amount of construction and demolition waste to be recovered will increase considerably.

The policy instrument will be a barrier to those who will be affected by the requirement, i.e. all owners of buildings that are smaller than the area limit applicable in the current regulation.

The policy instrument according to legislation, taxation and fees

The building legislation.

To reach the goals, the following must be done:

- Incorporating additional mandatory requirements into the building regulation (TEK), Chapter 9, § 9.6
- The authorities must verify that the rules are complied with.

The proposed changes in the building regulation (TEK) can be supplemented by economic incentives to motivate the building owners to better source separation.

The policy instrument according to the opportunities, benefits, costs and trade-offs.

A transition period in which especially small and medium-sized actors have to adjust to the new regulation is expected while the municipality as a building agency must employ more staff to cope with an increased workload.

The proposed changes will lead to more paperwork and bureaucracy and might cause political discussions since simplification of the building rules has been a political issue the last years.

The proposed policy instrument will increase the responsibility of the building owners and medium and small-scale construction companies.

Please also specify the effect of a change in the policy instrument by giving a -5 to +5 indication for each of the seven below listed aspects. Where -5 is a very negative effect, 0 (zero) is a neutral effect and +5 is a very high positive effect

The following quantifications are estimated for the proposed policy instrument:

- *Increased recovery rate of construction waste.*

- *Less degree/content of hazardous substances.*
- *Increased use of recycled and reused materials.*
- Environmental impact (e.g. CO₂ emissions) from the estimated and quantified savings in resources
 - The current use of reused and recycled materials are low and assumed to be <10 %. According to calculation, the proposed policy instrument will increase the controlled handling of waste from the building sector by 250,000 tonnes/year. Based on the same assumption as described in the interview with Gunnar Grini that more waste will be used as a secondary resource producing new building products, it estimated that the reduction in CO₂ emissions will be approximately 45,000 tonnes/year.
 - The effect is estimated to +2 at medium to long term and to 0 (zero) to +1 in the short term.
- Estimated effect on the economy for the public authorities.
 - More bureaucracy and more work has to be done by the authorities. This increased bureaucracy often results in additional costs – thus being embedded into the current economical frame to avoid any extra costs.
 - The effect is estimated to be 0 (zero).
- Estimated effect on the economy for the private companies.
 - MEF Waste has a turnover of approximately 3 billion NOK. Approximately 1 billion NOK from new buildings, 1 billion NOK from refurbishment and approximately 1 billion NOK from demolition, where heavy masses such as concrete, bricks and wood make up 80–90%.
 - If we calculate an extra cost (compared to what is paid today) for improved sorting and handling of the 250,000 tonnes to 400 NOK/tonne it means an extra cost to building owners of 100 million NOK/year and a similar increase in turnover to the private companies.
 - Dependent on other policy instruments it might cause a change in the market position and turnover for the specific companies – some businesses will gain and some may lose market share, turnover and profit. The winners will gain by redeveloping their business models and creating new products. The losers will continue with their existing products and business model. Extra income from producing secondary resources compared to the cost of handling the waste today is likely, but hard to estimate.
 - The effect is estimated to an opportunity for a positive transition and estimated to +2 based on the arguments above.
- Estimated effect on the export of goods and thus also the competitiveness of the companies in the Nordic countries.
 - The proposed policy instrument will probably not influence the export market of goods (effect 0), but it might have a positive effect on the competitiveness of some companies (effect +1).

- Estimated effect on the export of knowledge concerning circular economy, new technical solutions etc.
- Experiences from practicing the Norwegian rules may be useful to other Nordic and European countries. It is difficult to estimate the effect since MEF does not know how the regulations are in the other Nordic countries, but assumed to be +1 as the knowledge export is estimated to be positive for Norwegian companies and authorities.
- Benefits generated due to a higher degree of collaboration between the Nordic countries toward a Nordic circular economy.
 - A better cooperation between the Nordic countries will most likely have a positive effect, assumed to be +1.

The level of uncertainty on the above information

Medium uncertainty.

Overskrift til afsnit

The policy instrument (characteristics)

Introduce stricter documentation requirements for all materials used for new buildings using the same model as for example BREEAM.

This includes:

- Registering the chemical substances used in the building.
- Registration of all building products used in the building.

The documentation should follow the building owner as a “building passport” and be supplemented when the building is renovated/changes to the building are made.

The policy instruments according to type of resource(s):

All resources in a building.

The policy instrument according to building component type

All building components.

The policy instrument according to the value chain (and how, when and to whom is it a barrier?)

The proposed instrument will influence the whole value chain, the builder and the building operator as well as be very helpful when renovating and demolishing a building. The instrument will force designers to think more consciously about the material choices under design, which may in turn lead to increased awareness of circular economy and resource efficiency. It will also be an important instrument to increase the possibilities

of reusing components and recover/recycling more waste to resources. The documentation concerning compound products (different types of materials in one product) and recyclability will be a part of this.

The policy instrument according to legislation, taxation and fees

The building legislation primarily.

The policy instrument according to the opportunities, benefits, costs and trade-offs.

This policy instrument can have the following consequences:

- The building owner incurs an increased cost when designing and building a new building.
- The policy instrument will provide incentives for increased cooperation throughout the value chain.
- Rental of certified buildings may be easier because "green buildings" are more attractive in the rental market.
- The building owner can gain financial benefits from the sale of the building materials which can be reused or recycled.
- The building owner will probably have reduced costs for dismantling/demolishing.
- The policy instrument may reduce the insurance cost of certified buildings as there is less uncertainty associated with the consequences of incidents such as fire in the building.

Please also specify the effect of a change in the policy instrument by giving a -5 to +5 indication for each of the seven aspects listed below. Where -5 is a very negative effect, 0 (zero) is a neutral effect and +5 is a very high positive effect

- The use of primary resources will most likely be reduced and there will be less pollutants in the building. Less costs to depollution and an increased recovery rate of components and construction waste. It is also likely that the principals in circular economy will be implemented. In the short term, the score is estimated to be 1–2 and mainly tied to improved awareness of resource use and cleaner materials. The lifetime of new buildings is long and in the long term, when the building will be demolished the chance to reuse components and an increased recycling of waste from demolition of buildings has increased, the score is estimated to be +3–4. Comparing the CO₂ emissions from BREEAM-certified building, we see that the emissions are significantly lower. These are calculated to be 34 % lower at the new terminal at Gardermoen Airport (BREEAM excellent) compared to a "normal" terminal. A comparison of this baseline has been used when estimating the effects.
- Estimated effect on the economy for the public authorities.

- The work involved in following up on compliance with the building regulation will require some additional work. The effect on the economy for public authorities, however, will be reflected in higher costs for building permits which will be paid by the builder. Therefore the effect is estimated to be 0 (zero).
- Estimated effect on the economy for the private companies.
 - There will be increased workload both in the construction and the building phases. Compared to the total costs of a building project, they are low and estimated to 0 (zero) to -1-. The trade-offs are uncertain, but the demolishing costs will most likely be reduced and an increased recovery rate will most likely also reduce the costs considerably. In the long run, the effects are estimated to be as high as + 3 to 4 due to the reduced amount of waste and increased possibilities to use more of the building as secondary resources.
- Estimated effect on the export of goods and thus also the competitiveness of the companies in the Nordic countries.
 - The estimated effect on the export of goods is assessed to be neutral (0).
- Estimated effect on the export of knowledge concerning circular economy, new technical solutions etc.
 - The export of knowledge is estimated to be +1. Norway introduced requirements to environmental and waste management plans early, as well as created action plans for construction waste. It is therefore probable that this expertise will benefit other Nordic countries and the companies working in other Nordic countries. The knowledge can be exported – but the effect in other Nordic countries is dependent on how far the work on policies to circular economy and resource efficiency will develop. The effect is thus considered positive – but not large.
- Benefits generated due to a higher degree of collaboration between the Nordic countries toward a Nordic circular economy.
 - The estimated effect is assumed to be +1 as knowledge sharing can be very beneficial both to public authorities and private enterprises.

The level of uncertainty on the above information

Medium: Up to 30% uncertainty.

The Norwegian interviewees has provided the following replies to the questions asked

Table 25: Norway

Organisation	1	2	3	4	5	6	7						8
							a	b	c	d	e	f	
The Federation of Norwegian Industries (i)	1e	All	All	f	L	-	2 ¹² 1 ¹³	N/A	0	1-2	1	1	H
	2e	All	All	f	L	-	2	-1	-1	TBC	1	1	H
The Federation of Norwegian Construction Industries (j)	1f	All	All	a	L	-	4-5 ¹² 1-2 ¹³	-1	2-4 ¹² -3 to -2 ¹³	1-2	1	1	M-H
	2f	All	All	f	L	-	3-4 ¹² 1-2 ¹³	-1	3-4 ¹² 0-1 ¹³	0	1	1	M
The trade organisation Bygg uten Grenser (k)	1g	All	All	d+e	L	-	2 ¹² 0 ¹³	N/A	-2	1-2 ¹²	1	1	H
	2g	All	All	g	O	-	1-2	N/A	N/A	0 1 ¹⁴	1	2	H
Norwegian Association of Heavy Equipment Contractors (l)	1h	All	All	b (+a)	L	-	2 ¹² 0-1 ¹³	-2	2	0	1	1	M
	2h	All	All	a-f	L	-	3-4 ¹² 1-2 ¹³	-1	3-4 ¹² -1-0 ¹³	0	1	1	M

Sweden

In Sweden, the following stakeholders were interviewed.

Table 26: Sweden

Organisation	Interviewee
Svensk Byggindustri	Marianne Hedberg
The Swedish Recycling Industries' Association	Britt Sahleström
Avfall Sverige	Jon Nilsson-Djerf
IVL Svenska Miljöinstitutet	Martin Erlandsson

¹⁴ Impact on the competitiveness.

Svensk Byggindustri: Marianne Hedberg

Attendees:

- Marianne Hedberg – MH, Svensk Byggindustri.
- Peter Stigson – PESG, COWI.

The interview was performed on 7 April 2017.

Marianne Hedberg is an environmental expert at the organisation for environmental aspects such as resources, wastes, material choices and hazardous substances.

A general comment by the respondent is that a key to resource efficiency and circularity of resource flows in the construction sector is to decrease knowledge asymmetries. This should target three main areas:

- Improved statistics on resource flows to understand the system and its losses and potentials.
- Potential actions and the value creation thereof.
- Improved terminology to make sure that there is an understanding of what a resource actually is, what it thus consists of and how it should be sorted etc.

According to the members of the organisation, the respondent highlighted that the responses should be interpreted from a contractor perspective. A central part in this is that contractors typically do as they are told to do in the call for tender. Hence, the buyers of their services, such as property owners and developers, are key stakeholder groups in setting parts of the framework conditions that determine the system's efficiency.

In general, there is a lack of policy instruments in this area and in the view of the respondent, the policymakers have repeatedly identified that there is little need for policy interventions. This is seen as partly due to the sector having taken significant measures for self-regulation. While in a sense voluntary, it is, however, rooted in a policy threat to intervene should the sector not have reached sufficient self-regulation in moving toward the established policy goals (see policy background paper).

The policy initiatives highlighted by the respondent are existing initiatives. However, they are continuously updated to reflect changed conditions, such as availability of new materials, recycling technologies and changes in the policy framework. Moreover, as there is a constant policy threat of policy measures if self-regulation does not reach the desired levels regarded as sufficient by policymakers.

Overskrift til afsnit

The policy instrument (characteristics)

Resource and waste guidelines for the construction sector.

The policy instrument is an existing informative and private policy instrument, i.e. the Resource and waste guidelines for the construction sector. Its intention is to self-regulate on certain matters and thus avoid public policy interventions. The guidelines are continuously updated to be relevant according to current standards (technologies, practice, materials etc.). The goal of the policy instrument is to make resources out of waste. This is targeted through the guidelines on:

- Audits/identification ahead of demolition as well as procurement of audit.
- Reuse, sorting and waste management as well as procurement of demolition contractors.
- Sorting and waste management as well as procurement of construction contractors.

It thus aims to identify potentials for materials recycling. A key part in the policy's target is the focus on chemicals and identifying hazardous waste. The policy instrument encompasses the entire construction and demolition sector.

Moreover, there is a gap in Sweden, where more resource efficient practices are not seen as viable, whereas this is the case in Germany. Consequently, a business model development that increases the economic case in this area is needed.

A main context that should be remembered in the debate and analyses in this field, is the long life-cycles, which emphasise information. Both in terms of doing it right from the start, but also in terms of measures to keep track of the resources used and their material (chemical) contents.

The policy instruments according to type of resource(s):

All resources as part of construction waste.

The policy instrument according to building component type

All parts are targeted.

Demolition: The inner structures is where most information is needed about the materials contents, as these building parts typically have a more complex content.

Construction: The main aspect is to reduce waste. Large savings in material use could be made through enhanced cooperation between architects and contractors, e.g. by using standard measurements so that plasterboards do not need to be cut as often and thus produces waste from almost every board.

The policy instrument according to the value chain (and how, when and to whom is it a barrier?)

Mainly targets items f) and e). However, it provides information to items a) and b) in terms of design for circularity.

The policy instrument according to legislation, taxation and fees

The guidelines are an informative and private policy instrument.

The policy instrument according to the opportunities, benefits, costs and trade-offs.

The benefits of the policy instrument is mainly two-fold.

Firstly, in terms of providing a relatively conform understanding and categorisation of material contents and their environmental impact, which to a high degree determines the recycling and reuse opportunities. The level of conformity is naturally determined by how broadly the guidelines are implemented by the business. A relative consensus in the business on these matters may in turn make important contributions to better and more conform statistics. In other words, the benefits thus largely lies in the fact that the guidelines and agreements decreases knowledge asymmetries and thus increases the share of the sector that acts in a "correct" way (as per the definition in this project). This is partly due to the information and knowledge sharing in itself, but also due to harmonisation of different aspects that provides a more well-functioning market. As the guidelines and agreements also relate to regulatory policies, providing guidance on how these can be met, they promote an understanding of these regulations from a sector perspective.

Secondly, resource efficiency can also reduce costs along the value chains and nets. However, the costs are not necessarily high. Implementing the best environmental choice raises costs by about 0.5-1.0 %. But, the property owner or developer needs to provide a correct/good call for tenders. However, this often does not occur due to a perception that "it is known that the costs are much too high". There are no obvious trade-offs.

Please also specify the effect of a change in the policy instrument by giving a -5 to +5 indication for each of the seven below listed aspects. Where -5 is a very negative effect, 0 is a neutral effect and +5 is a very high positive effect

- Environmental impact (e.g. CO₂ emissions) from the estimated and quantified savings in resources.
 - +2/3 in terms of reduced use of virgin resources. The environmental gains stem from better practice identifying possible recycling and reuse in demolition, sorting and waste management practices.
 - A general quantification is difficult as many materials and products are covered by the guidelines. However, looking at the overall statistics by weight (which do not necessarily correspond to environmental impact), the construction and demolition waste amounted to 9.4 Mtonnes during 2014, of which 0.8 Mtonnes was represented by hazardous wastes.
- Estimated effect on the economy for the public authorities.
 - +/- 0.
- Estimated effect on the economy for the private companies.

- +2. It benefits both those who “produce” construction wastes (contractors) and those receiving such wastes (recycling industry) through highlighting that wastes are actually a resource.
- The costs of better sorting is very low in comparison to the materials costs. Hence, any increased cost of resource efficiency has a direct positive payoff, where the rate of payoff differs largely depending on the material costs, meaning that a specific number cannot be quantified. No specific data at this level are available.
- Estimated effect on the export of goods and thus also the competitiveness of the companies in the Nordic countries.
 - +/- 0. There is in general a low rate of exports. However, some incentives for innovation should occur as a result of the policy, and thus also some first-mover advantages (as the risks of moving first is reduced through the business themselves setting the rules and standards that seem viable).
- Estimated effect on the export of knowledge concerning circular economy, new technical solutions etc.
 - +3/4. Because it provides producers with information on what is upcoming.
- Benefits generated due to a higher degree of collaboration between the Nordic countries toward a Nordic circular economy.
 - +/- 0. Denmark has shown an interest in the guidelines. Finland has something similar in the pipeline in the form of information material. Norway applies “coBuilder” to some extent. In general, the Nordic countries are an appropriate scale as a single country is typically too small to argue for any large-scale efficiency gains from a systems perspective. The problem is a lack of harmonisation as each country has its own perspective and understanding of system solutions.

The level of uncertainty on the above information

Low uncertainty on this level of detail.

Overskrift til afsnit

The policy instrument (characteristics)

Information and guideline systems and agreements.

This concerns a set of private and informative policy instruments. The key systems raised were BASTA, Byggvarubedomningen and Sunda Hus. The intentions of these systems can be summarised as providing guidance on material contents in construction resources and publish (easy accessible) information on used materials through different databases (a requirement in many environmental certification schemes, such as Miljöbyggnad, where the Gold level also requires that location and amount in the building is documented). The aim is to reduce the chemical and hazardous contents of building products and thus support reuse or materials recycling in future (and improve

healthy living conditions). In essence, it is also a way for the sector to show that they take these aspects seriously and to define a “good standard”. Due to their broad use in the sector, they serve as a policy framework, establishing a set of information that the sector arguably must adhere to or explain why not followed. The systems provide a set of tools for procurement to set a “standard” for consideration of these aspects, aiding both the procurer and the contractor to set/agree/understand an appropriate scope. The entire construction sector is included or affected.

The policy instruments according to type of resource(s)

All resources as part of construction waste.

A key part is the focus on chemicals and hazardous contents in building materials.

The policy instrument according to building component type

All parts are targeted.

The policy instrument according to the value chain (and how, when and to whom is it a barrier?)

Mainly targets item a). They provide information toward agreed standards. They also impact the sector providing property owners and developers with a tool to establish demands on contractors (e.g. being a member of..., following...).

The policy instrument according to legislation, taxation and fees

The systems are a set of informative and private policy instrument.

The policy instrument according to the opportunities, benefits, costs and trade-offs.

A key benefit for resource efficiency and related environmental aspects is that these initiatives establish a system for documenting material contents, which is important for harmonising references to material types and to document specific material contents. The latter is important due to the long lifespan of buildings. This knowledge makes it feasible to document a track the presence of hazardous contents, benefitting a higher and safer rate of possible recycling and reuse.

The systems mean a large step in the right direction, by being instructive and market/user relevant, especially compared to the “black lists” of materials previously used. Through setting standards and evaluation/documentation systems, they decrease knowledge asymmetries and thus increase the share of the sector that acts in a “correct” way (as per the definition in this project). This is partly due to the information and knowledge sharing in itself, but also due to harmonisation of different aspects that provide a more well-functioning market.

A main context that should be remembered in the debate and analyses in this field is the long life cycles, which emphasises the need for preserving information about the materials used and their specific contents.

Importantly, resource efficiency can reduce costs along the supply chains and nets (i.e. an acknowledgment that supply networks are increasingly complex and intertwined, meaning that larger system perspectives must be used for robust efficiency

gains). Also, the costs of choosing better and more recyclable and reusable materials are not necessarily high. Implementing the best environmental choice raises costs by about 0.5–1.0%. However, the property owner or developer needs to provide a correct/good call for tenders. However, this often does not occur due to a perception that “it is known that the costs are much too high”.

Please also specify the effect of a change in the policy instrument by giving a -5 to +5 indication for each of the seven below listed aspects. Where -5 is a very negative effect, 0 (zero) is a neutral effect and +5 is a very high positive effect

- Environmental impact (e.g. CO₂ emissions) from the estimated and quantified savings in resources.
 - +4. The systems benefits a lower use of hazardous substances in general, which in the specific context of resource efficiency means improved conditions for recycling and reuse. Adding to this, the documentation means that the information on material contents of different products are easily available. Quantifying the effects is not possible due to the very large number of materials and products covered.
- Estimated effect on the economy for the public authorities.
 - +/- 0. The systems have incentivised innovation in standards, documentation and building materials. No baseline is available.
- Estimated effect on the economy for the private companies
 - +1. They have spurred innovation, however, this results in an initial cost for the companies. Quantifying a baseline or effects is not possible due to a lack of studies analysing the investments and gains from innovations in this specific area. Better materials from the systems’ perspectives, i.e. less hazardous materials, have low additional costs and increasingly the use of log books on used materials is a precondition on the market.
- Estimated effect on the export of goods and thus also the competitiveness of the companies in the Nordic countries.
 - +/- 0. There is in general a low rate of exports. However, some incentives for innovation should occur as a result of the systems, and thus also some first-mover advantages as the risks of moving first is reduced through the businesses themselves setting the rules and standards that they consider viable.
- Estimated effect on the export of knowledge concerning circular economy, new technical solutions etc.
 - +3/4. Because it provides producers with information on standards, which increases credibility and lowers perceived risks for customers.
- Benefits generated due to a higher degree of collaboration between the Nordic countries toward a Nordic circular economy.
 - +/- 0. There have been talks about collaboration between the countries, but nothing has been decided yet. Sweden is ahead on these system initiatives.

For example BASTA was considered too far reaching in the other Nordic countries.

The level of uncertainty on the above information

Low uncertainty on this level of detail.

The Swedish Recycling Industries' Association: Britt Sahleström

Attendees:

- Britt Sahleström – BS, The Swedish Recycling Industries' Association.
- Peter Stigson – PESG, COWI.

The interview was mainly performed on 11 May 2017, and was conducted on the phone. *The interview was preceded by phone and e-mail correspondence to identify correct focus and prepare for the interview.*

Britt Sahleström is CEO of the Swedish Recycling Industries' Association, which is an organisation of Swedish companies working within the recycling field.

The key policy goal mentioned was the goal of materials recycling in the construction industry reaching 70 % of non-hazardous materials by 2020.¹⁵ This goal is seen as problematic as it results in the recycling industries receiving large fractions of low-value material so that the goal is reached, however, due to a low material value these fractions are difficult to return to the market compared to "better" and more valuable resources.

The baseline is that Sweden is positioned well behind several other countries in the EU in terms of efficient materials recycling in the construction sector. Hence, there should be significant room for cost-efficient improvements.

A key strategy to stimulate a circular economy must have a much broader scope than the studies typically performed on circular economy under the Nordic Council of Ministers and other organisations, such as this one. It is not possible to analyse and establish an efficient resource system if looking at one sector, resource, product, stakeholder group or policy. It is a systems understanding and efficient market creation in-between these various and complex contexts that should be the focus moving forward in research and policy-making as well as market actions. The work to improve the efficiency in each of these individual contexts has been going on for some time and while there is much room for additional improvements, the key focus now must be efficiency gains across the value chain. This is, after all, the main concept of a circular economy. Hence, the responses below reflect this position.

In this, three aspects are central elements to provide conditions where a higher rate of materials recycling is profitable or demanded from a legislation perspective (e.g. through a quota system):

¹⁵ <http://www.naturvardsverket.se/Miljoarbete-i-samhallet/Sveriges-miljomal/Etappmal/>

- Create a market demand for recycled and reusable resources.
- Make sure the logistics are efficient, which includes improved statistical knowledge.
- Effective supervision by supervisory authority to make sure that new policy instruments, such as quotas, are followed.

Overskrift til afsnit

The policy instrument (characteristics)

Requirements on sorting of recyclable and reusable resources .

This concerns a suggestion for a new public regulatory policy instrument that improves the responsibilities of contractors to sort recyclable and reusable resources. The policy change would affect the whole sector and value chains as a systems perspective along the value chains should be applied, as stated above. For example, either the contractor or a recycling company could handle the sorting. Hence, it is the practise of sorting that should be targeted rather than a specific stakeholder. The intention is to improve the recycling and reuse market through more homogenous fractions and to increase the level of policy initiatives connected to the 70%-goal, which currently lacks a stringent connection to policy instruments that can be used to pursue the goal. The policy change could be entered into the Environmental Code or the Waste Ordinance.

The policy instruments according to type of resource(s):

All resources as part of the supply and value chains.

The policy instrument according to building component type

All parts are targeted as the system must be viewed as interconnected.

The policy instrument according to the value chain (and how, when and to whom is it a barrier?)

Affects all areas considering the interconnectedness between all stakeholders and resource flows (e.g. replacement effects).

The policy instrument according to legislation, taxation and fees

The suggested policy changes target the Environmental Code or the Waste Ordinance as public and legislative policy instruments connected to the overall goal for resource efficiency in the sector.

The policy instrument according to the opportunities, benefits, costs and trade-offs.

Sweden has a low rate of materials recycling compared to several EU-countries. There are thus significant opportunities to improve the system efficiency. The benefits of the policy initiative are stimulation of circular thinking, highlighting of the costs of resource use and cost savings of circular practises, improved statistics and knowledge of the resource system, and a more clear path towards the 70%-goal. Through stimulating of

more homogenous fractions of recycled and reusable materials and products it would improve the market.

Please also specify the effect of a change in the policy instrument by giving a -5 to +5 indication for each of the seven below listed aspects. Where -5 is a very negative effect, 0 (zero) is a neutral effect and +5 is a very high positive effect

Because of the interlinked systems interactions and the fact that a single point of analysis does not provide an accurate picture of the actual changes in environmental impacts, resource savings, economic effects etc. Hence, quantifying this is not possible other than from the rough estimates provided below:

- Environmental impact (e.g. CO₂ emissions) from the estimated and quantified savings in resources.
 - +4 from a resource efficiency perspective. The high rating is based on a strong and clear demand on the sector, should the policy be implemented. However, to reach this figure, a policy initiative on improved sorting must be accompanied by appropriate supervisory efforts to make sure that the sorting is carried out.
 - In 2014, the pre-handling (in Swedish: förbehandling, which includes sorting and disassembling) of mixed non-hazardous construction and demolition wastes was 0.48 Mtonnes. In comparison, the total volume from the construction and demolition waste amounted of 9.4 Mtonnes of which 0.8 Mtonnes was represented by hazardous wastes. The rest undergoes various treatments, such as biological treatment, energy production, landfilling etc. (see p 78).
- Estimated effect on the economy for the public authorities.
 - +/- 0. The supervisory activities are associated with a cost, which can be financed through introducing a fee in the policy instrument. A baseline is not available and the 0 (zero) should be considered as a relative change due to changes in costs and incomes.
- Estimated effect on the economy for the private companies.
 - +4. The companies would be made aware of the costs and better understanding of the economic effects of adopting, or not, more efficient and circular practices. Recycling companies would benefit from better fractions. A baseline is difficult to establish as the costs and benefits are diffuse along the supply and value chains. As described below, see question e, the better fractions would improve earning possibilities in new markets based on the sorted materials. Should a fee be introduced through the policy, it would imply an increased cost for the companies.
- Estimated effect on the export of goods and thus also the competitiveness of the companies in the Nordic countries.
 - +/- 0. However, not a key question for the organisation.

- Estimated effect on the export of knowledge concerning circular economy, new technical solutions etc.
 - +4. It would make very large contributions to stimulating an interest in innovation as it would produce new and better fractions as a basis for recycling and reuse, providing new economic opportunities. No baseline is available.
- Benefits generated due to a higher degree of collaboration between the Nordic countries toward a Nordic circular economy.
 - Cannot be estimated even on a rough scale. A Nordic market should be the goal to reap the benefits of a larger system with more potential synergies between sectors, stakeholders and resources. Hence, a value chain perspective should be used.

The level of uncertainty on the above information

Medium level of uncertainty on this level of detail due to complex systems interactions.

Overskrift til afsnit

The policy instrument (characteristics)

Quota for use of recycled/reused resources in construction.

This concerns a suggestion for a new public administrative policy instrument. The aim is to make significant contributions to developing the market for recycled and reusable materials and products in the construction sector. The intention is to put demands on the use of recycled resources and reusable building materials in construction to increase the rate of materials recycling instead of energy recycling and landfills. The intention is also to increase the level of policy initiatives connected to the 70%-goal, which currently lacks a stringent connection to policy instruments that can be used to achieve the goal. The policy change could be implemented in the Planning and Building Act or the Environmental Code.

Additionally, quota systems are used in several other policy areas (such as renewable energy) and should be similarly applicable in this area.

The policy instruments according to type of resource(s):

All resources as part of the supply and value chains.

The policy instrument according to building component type

All parts are targeted as the system must be viewed as interconnected.

The policy instrument according to the value chain (and how, when and to whom is it a barrier?)

Affects all areas considering the interconnectedness of all stakeholders and resources (e.g. replacement effects). It does not target a barrier rather a lack of sufficient economic incentives and practices in the sector to use recycled materials.

The policy instrument according to legislation, taxation and fees

The suggested policy changes to the Planning and Building Act or the Environmental Code as a public and legislative policy instrument connected to the overall goal for resource efficiency in the sector.

The policy instrument according to the opportunities, benefits, costs and trade-offs.

The key benefit is to increase the market demand, which affects the whole value chain. The trade-off is that economic instruments are preferable in general; however, this legislative policy would be very effective under the current circumstances. Additionally, the instrument would strongly promote better statistical knowledge of resource flows, which is a key barrier to systems understanding and improvements today. Through stimulating more recycled and reusable materials and products, price dynamics in this market would improve.

Please also specify the effect of a change in the policy instrument by giving a -5 to +5 indication for each of the seven below listed aspects. Where -5 is a very negative effect, 0 (zero) is a neutral effect and +5 is a very high positive effect

Because of the interlinked systems interactions and the fact that that a single point of analysis does not provide an accurate picture of the actual changes in environmental impact, resource savings, economic effects etc. Hence, quantifying this is not possible other than from the rough estimates provided below:

- Environmental impact (e.g. CO₂ emissions) from the estimated and quantified savings in resources.
 - +5 from a resource efficiency perspective. Currently, the 70%-goal is not associated with specific policy instruments and a quota system would make a significant change. The quality of data on materials recycling and reuse of construction and demolition wastes in the construction sector is of too low quality to provide a baseline.
- Estimated effect on the economy for the public authorities.
 - +/- 0. The supervisory activities are associated with a cost, which can be financed through a introducing a fee in the policy instrument. A baseline is not available, and the 0 (zero) should be seen as a relative change due to changes in costs and incomes.
- Estimated effect on the economy for the private companies.
 - +4. The system would make significant contributions to better knowledge of the resource use, which would enhance resource efficiency and thus lower costs. Moreover, the market for recycled and reused resources would be significantly improved with better market access. Should a fee be introduced through the policy, it would imply a cost for companies. No baseline is available.

- Estimated effect on the export of goods and thus also the competitiveness of the companies in the Nordic countries.
 - +/- 0. However, not a key question for organisations.
- Estimated effect on the export of knowledge concerning circular economy, new technical solutions etc.
 - +4. It would, similarly to a policy instrument on sorting of wastes, stimulate better sorting and provide better fractions from which new business models and products can be developed, hence spurring innovation in different areas that can be exported. No baseline is available.
- Benefits generated due to a higher degree of collaboration between the Nordic countries toward a Nordic circular economy.
 - Cannot be estimated even on a rough scale. A Nordic market should be the goal to reap the benefits of a larger system with more potential synergies between sectors, stakeholders and resources. Hence, a value chain perspective should be used. No baseline is available.

The level of uncertainty on the above information

Medium level of uncertainty on this level of detail due to complex systems interactions.

Avfall Sverige: Jon Nilsson-Djerf

Attendees:

- Jon Nilsson-Djerf – JND, Avfall Sverige.
- Peter Stigson – PESG, COWI.

The interview was performed on 25 April 2017.

Jon Nilsson-Djerf is advisor for materials recycling and reuse, collection and transport of wastes at The Swedish Waste Management Association.

The organisation represent households and small businesses as well as some municipal stakeholders and thus not waste management etc. of larger companies. As such, their work encompasses private household refurbishments and knowledge about how municipalities act, and may act, in terms of promoting more circular practices. Hence, they work with:

- Construction wastes from private households at recycling centres (Återvinningscentraler, ÅVC), mostly from refurbishments and mostly wood and plasterboards, but also some plastics and insulation materials.
- Construction waste from smaller companies (which pay the ÅVC), predominantly wood.
- Municipal collection, small share of special fractions.

There are large differences in what type of construction wastes that may provide a sufficient economic profit to be of interest. While the answer that this includes plastic, iron and paper may seem inherent, the very large number of other materials and material composites that exists as past and present building materials should be borne in mind.

Overskrift til afsnit

The policy instrument (characteristics)

The goal of materials recycling in the construction industry is to reach 70% of non-hazardous materials by 2020.

This is a public policy target, which is not established as a legal requirement on single policy subjects and thus to be considered an informative policy. It has a direct impact on the whole of the construction sector through setting an overarching target for the industry. The intentions of the goal is to provide guidance both to public and private stakeholders and groups. What is required is a change in statistical data quality to make it possible to distinguish whether the goal is met or not.

The policy instruments according to type of resource(s):

All resources as part of construction waste.

However, for the organisation's customers this means wood, plasterboards, plastics and insulation material.

A key part in the policy's target is the focus on chemicals and identifying hazardous waste as parts/content of the resources.

The policy instrument according to building component type

All parts are targeted.

For the organisation's members, the key component types are kitchens (wood, often in good shape and reusable), bathrooms (tiles, mostly broken and may be used in different forms), outdoor constructions (pressure-impregnated wood, which is considered hazardous material).

The policy instrument according to the value chain (and how, when and to whom is it a barrier?)

Mainly targets item e.

The policy instrument according to legislation, taxation and fees

The guidelines represent a policy goal, and as such an informative policy initiative (although not necessarily a policy instrument per se).

The policy instrument according to the opportunities, benefits, costs and trade-offs.

The key benefits of the goal are the environmental improvements that can be achieved with lowered use and better recycling of hazardous wastes.

Moreover, one of the major opportunities of the policy is that it may emphasise resource efficiency in the sector and related value chains, and contribute to improved statistics. A barrier for the policy's efficiency and effectiveness is that the knowledge about the goal is low.

Please also specify the effect of a change in the policy instrument by giving a -5 to +5 indication for each of the seven below listed aspects. Where -5 is a very negative effect, 0 (zero) is a neutral effect and +5 is a very high positive effect

- Environmental impact (e.g. CO₂ emissions) from the estimated and quantified savings in resources.
 - +4 in relation to resource efficiency. An estimated increase is 5% in resource efficiency. The effects of increasing recycling in absolute numbers are somewhat marginal as there are many complementary drivers. A key value is the increased emphasis and knowledge about resource efficiency.
 - Construction and demolition waste from the household sector was 147 Ktonnes in 2014 and non-hazardous wood wastes totalled 410 Ktonnes.
 - Evaluations are difficult due to a lack of reports providing statistics and analyses.
- Estimated effect on the economy for the public authorities.
 - +1. Somewhat positive, but more as a saving than a revenue. Gains could be offset by a slight loss in VAT revenue. A baseline is not possible.
- Estimated effect on the economy for the private companies.
 - Cannot say, private companies is not our focus.
- Estimated effect on the export of goods and thus also the competitiveness of the companies in the Nordic countries.
 - +1. There is no export to speak of from this category. Perhaps along the recycling value chain some plastics and metals, but not wood, and the rate is quite marginal. There is an increased interest in and production of insulation from recycled paper, which should be a national system and could result in some exports.
- Estimated effect on the export of knowledge concerning circular economy, new technical solutions etc.
 - +5. Yes, absolutely. It provides knowledge about materials and technologies for sorting, both know-how and technological (machines).
- Benefits generated due to a higher degree of collaboration between the Nordic countries toward a Nordic circular economy.
 - +5. Large-scale benefits when waste stops being wastes and is treated as a resource commodity that can be traded.

The level of uncertainty on the above information

Low to medium.

Overskrift til afsnit

The policy instrument (characteristics)

Improved possibilities for municipalities to work with reuse at recycling centres (ÅVC).

This concerns a suggested change to an administrative (regulatory) public policy instrument. The change is suggested in the recent Government Report on circular economy. The aim is to resolve a situation where there has been a legal impediment (or arguably a legal void) for municipalities to significantly engage in reuse at their ÅVCs. This has resulted in different interpretations of the degree that the municipalities can prepare what can be legally regarded as waste for reuse. The obstacle partly lies in, and is emphasised by the fact that there are different interpretations of the municipalities' possibilities in this areas. Hence, the rules need to be clarified and the municipalities given a clear mandate to contribute to reuse. The suggested changes imply that the municipalities should be allowed to finance the work to prepare resources (or wastes, depending on definition) for reuse by means of the waste charge, which is important as an efficient and effective reuse function requires staff. For example for sorting, cleaning and other handling of re-useable resources. This is required to ensure sufficient quality in order to maintain an interest in the function.

The policy instruments according to type of resource(s):

All resources as part of construction waste.

Key focus can be argued on reusable resources, however, sorting out these fractions also benefits lower volumes in non-reusable fractions.

The policy instrument according to building component type

All parts are targeted.

Some special types can be mentioned due to their occurrence in the resource flow, for instance bricks (walls and roofs), doors, windows, sinks, kitchens/cupboards, etc.

The policy instrument according to the value chain (and how, when and to whom is it a barrier?)

Mainly targets item e. They provide information towards agreed standards. They also affect the sector providing property owners and developers with a tool to establish demands on contractors (e.g. being a member of..., following...), which affects the value chain.

The policy instrument according to legislation, taxation and fees

A change to an administrative (regulatory) public policy instrument.

The policy instrument according to the opportunities, benefits, costs and trade-offs.

This makes the mandate for the municipalities to take a forefront position on circular economy significantly stronger, which could spur other stakeholders to do more. In ad-

dition, the ÅVCs now receives more than they can sell, meaning that improved conditions for establishing a better market at the ÅVCs would have large benefits. These effects will mainly occur at the larger ÅVCs.

Moreover, the benefits of a better market would mean that statistics would improve due to economic incentives and reporting requirements.

It should be noted that very old (i.e. antiques) and old materials are typically much more valuable as they are more in demand than less old materials from 1970's and onwards.

Please also specify the effect of a change in the policy instrument by giving a -5 to +5 indication for each of the seven below listed aspects. Where -5 is a very negative effect, 0 (zero) is a neutral effect and +5 is a very high positive effect

- Environmental impact (e.g. CO₂ emissions) from the estimated and quantified savings in resources.
 - +5. The changes are low in absolute numbers, in comparison to the overall waste statistics, but the change would be significant compared to the present status (i.e. specific changes).
 - Data for reuse is not included in the statistics and a data baseline is therefore not possible.
- Estimated effect on the economy for the public authorities.
 - +5. The change means a crucial step toward a functional reuse system at ÅVCs.
 - Data for reuse is not included in the statistics and a data baseline is therefore not possible.
- Estimated effect on the economy for the private companies.
 - +5. Cannot say really, as private companies is not our focus, but this could spur a new type of business which would be a huge change from the baseline.
 - Data for reuse is not included in the statistics and a data baseline is therefore not possible.
- Estimated effect on the export of goods and thus also the competitiveness of the companies in the Nordic countries.
 - +/- 0. There is a low rate of exports.
- Estimated effect on the export of knowledge concerning circular economy, new technical solutions etc.
 - +5. As answered under item c, this may spur new business models.
- Benefits generated due to a higher degree of collaboration between the Nordic countries toward a Nordic circular economy.
 - +/- 0. The reuse typically occurs locally.

The level of uncertainty on the above information

Low to medium.

IVL Svenska Miljöinstitutet: Martin Erlandsson

Attendees:

- Martin Erlandsson – ME, IVL Svenska Miljöinstitutet.
- Peter Stigson – PESG, COWI.

The interview was performed on 27 April 2017 and updated on 5 May 2017.

Martin Erlandsson is a senior researcher at IVL Swedish Environmental Research Institute and a leading expert on life cycle assessments for the construction sector.

The key policy goal discussed was the overarching goal on resource efficiency in the construction and demolition sectors of a 70 %-weight by 2020 (more information in policy background). More on this is discussed below.

Several reports on the subject by Martin et al are available at: <http://www.ivl.se/sidor/kontakt/medarbetare/martinerlandsson.4.756107b1150d43d7591d8f.html>

Overskrift til afsnit

The policy instrument (characteristics)

Changing the waste legislation to acknowledge environmental relevance.

These changes concern a development of both public informative policies and public administrative policy instruments that informs and controls the function of the waste system. The intention is to replace the current 70% recycling goal (see above) initiated by the framework directive on waste, which emphasises weight, with a goal that acknowledges the environmental benefits.

While weight is a valuable indicator for resource efficiency, it is only one of several indicators that can be used. The problem with measuring weight is that it acknowledges neither the value of the recycled resource in its continued use, nor its environmental benefits. For example, we may recycle a large share of a waste in terms of weight, but recycling/reusing another type of waste with less weight may possibly have larger environmental benefits and provide larger values (e.g. recycling high- quality steel in basic steel products may have a high weight, but recycles a very small share of the potential market value). Through such changes, the goal would move away from potential goal conflicts between resource efficiency goals on the one hand and other environmental goals on the other hand. An arguably negative incentive caused by the current goal formulation is that reclassifying a large ballast fraction through minor treatment (e.g. cleaning) may contribute a lion's share to the goal, while little change and small environmental benefits have actually occurred. The current goal also excludes energy recycling and the benefits and trade-offs that this may have on other policy goals.

The policy instruments according to type of resource(s):

All resources as part of construction waste. From a baseline perspective, the change would especially affect heavy fractions, such as concrete, stone and dirt. Through this, it would also affect lighter fractions, if the changes are applied.

The policy instrument according to building component type

All parts are targeted. As per above, especially heavy density materials from a present state scenario. However, in a dynamic perspective it will also affect lighter materials and especially those with a high environmental values. This is due to resulting changes in the resource systems, where a replacement effect would occur.

The policy instrument according to the value chain (and how, when and to whom is it a barrier?)

Mainly targets items a and f. However, from a perspective broader than demolition, it also affects items b, c, d, e and g. This broad scope is due to the focus on a policy goal with broad sectoral influence, rather than targeting a specific action, material or product. I.e., it targets the entire construction sector through highlighting a policy goal. The effects on recycling and reuse should be similar considering that both are included in the goal in its present version.

The policy instrument according to legislation, taxation and fees

The suggested policy changes target the waste plan (see policy background paper) as a public policy instrument, stemming from the EU Waste Directive. As an overarching and sectoral policy goal, it is primarily an informative policy instrument (whereas the waste plan also points out more specific actions, these are primarily highlighted as good examples).

The policy instrument according to the opportunities, benefits, costs and trade-offs.

The policy change is expected to generate a higher environmental efficiency in the resource system. This would also benefit the efficacy of the policy system as policy trade-offs between resource efficiency and environmental goals could potentially be mitigated. A potential trade-off could be that less emphasis is put on large fractions in terms of mass and volume.

Please also specify the effect of a change in the policy instrument by giving a -5 to +5 indication for each of the seven below listed aspects. Where -5 is a very negative effect, 0 (zero) is a neutral effect and +5 is a very high positive effect

- a) Environmental impact (e.g. CO₂ emissions) from the estimated and quantified savings in resources.
- Approx. a 10 % reduction in environmental impact if the circular economy transition is strengthened, about +1 or +2. Quantifying the savings is difficult considering the very broad range of products affected as well as a general target on broad environmental impacts.
- In terms of statistics, out of the total of 9.4 Mtonnes of wastes from construction and demolition, 5.1 Mtonnes was soil, 1.7 Mtonne mixed fraction, 1.2 Mtonne dredge, 0.33 Mtonne metals and 0.2 Mtonne wood.
- b) Estimated effect on the economy for the public authorities.

- These are low-cost materials and fractions, so there is little change. There is furthermore no large incomes from mining activities etc. that would be displaced. +/-0.
- c) Estimated effect on the economy for the private companies.
- Due to a low change and low costs, the effects would be insignificant. +/-0.
- d) Estimated effect on the export of goods and thus also the competitiveness of the companies in the Nordic countries.
- Heavy and low-cost materials are typically not imported or exported and must be acquired locally. +/-0.
- e) Estimated effect on the export of knowledge concerning circular economy, new technical solutions etc.
- Moving in the direction that would be incentivised by the policy change does not require innovations etc. All technology and knowledge is available. The problem is that it is not financially feasible, e.g. due to the costs. +/-0.
- f) Benefits generated due to a higher degree of collaboration between the Nordic countries toward a Nordic circular economy.
- There could be some benefits in connection with standards on new materials such as technical standards for products based on products and materials from recycled resources. +1.

The level of uncertainty on the above information

Low uncertainty (very certain).

Overskrift til afsnit

The policy instrument (characteristics)

Regulations that move away from the use of fossil waste as fuels, when usable as a recyclable resource.

This concerns changes to public administrative and economic policy instruments that regulate and affects the market for energy (combustion) and materials recycling of wastes. It would thus, among other, affect energy and carbon dioxide taxes as well as waste regulations depending on how such a change would be introduced into the policy framework. The aim is to increase materials recycling through changing the economic incentives of energy versus materials recycling, where the former is seen as favourable by some market actors mostly due to economic considerations. The intention is to stimulate a markets development and innovation towards materials recycling of fossil waste resources. It affects a majority of the construction sector, excluding only the stakeholders that exclusively deal with non-fossil construction resources.

A key consideration, which is generally applicable in the development of more efficient materials recycling, is that the quality of the products based on recycled materials must match those based on virgin materials. Hence, such aspects need to be on the

agenda. A key part in changes is the producer responsibility, where packaging is covered, but buildings products are not. This also raises pedagogic issue, e.g. in the public and other stakeholder's understanding – for instance why a glass bottle should and typically is recycled whereas a glass window is not. The problem is that the current system, including the producer responsibility, but also other policies, makes it cheaper to sell recyclable fossil fractions as fuels, rather than recyclable materials.

The policy instruments according to type of resource(s):

All construction materials based on fossil resources and fossil wastes from other sectors that can be used as recycled materials in the construction sector. Consequently, especially plastics are affected.

The policy instrument according to building component type

All parts are targeted in terms of their inclusion of fossil materials.

The policy instrument according to the value chain (and how, when and to whom is it a barrier?)

Mainly targets items a and f, however, from a broader perspective than demolition, also affects items b, c, d, e and g. This broad scope is due to the focus on a materials category in the resource system, rather than a specific product or service.

The policy instrument according to legislation, taxation and fees

The changes would most likely primarily affect taxes such as economic public policy instruments.

The policy instrument according to the opportunities, benefits, costs and trade-offs.

Materials recycling should be seen as preferable by the market actors along the resource chain, such as contractors and recycling companies, which would benefit the resource system through changing the existing system in terms of business models and practices, as well as facilitating and guiding innovation both in terms of business models and technical system components. The opportunity is strengthened by the fact that costs of separation at constructions sites are low. On the contrary, there may be problems in dense urban areas when sorting of several fractions due to space restriction.

Please also specify the effect of a change in the policy instrument by giving a -5 to +5 indication for each of the seven below listed aspects. Where -5 is a very negative effect, 0 (zero) is a neutral effect and +5 is a very high positive effect

- Environmental impact (e.g. CO₂ emissions) from the estimated and quantified savings in resources.
 - In the sense that you would replace production of virgin plastics, the effect is 100 %. +5.

- As of 2010, it has been estimated that 150 tonnes, out of a total of 43,000 tonnes of plastic wastes in the construction sector was sent to materials recycling.
- A case study has noted that the climate impact of construction is predominately caused (84%) by the upstream life cycle phases, such as production of the materials, compared to transport (3%) and the construction process (13%). The same study's results, however, indicate that plastics has a relatively low impact overall compared to the other fractions.
- Nonetheless, increasing materials recycling would primarily provide environmental benefits in the plastics production rather than other life cycle stages. Hence, the environmental value lies in the avoidance of producing 43,000 tonnes of plastics, minus the emissions associated with collection, treatment and production of non-virgin plastic products. However, we are rapidly moving toward an increased use of bio-based plastics, meaning that in a medium-term future, the saving are not possible to estimate. Notwithstanding, the production of 43, 000 tonnes of plastic resin from fossil raw products, emit approximately 64,500 CO₂ per year at a rate of 1.5 tonnes of CO₂ per tonnes of plastic resin. It should be noted, however, that the emission rate is a very rough estimate as there are differences in emissions of the plastic products, variations in plastic compounds (such as inclusion or recycled or bio-based resources) and qualities as well as production sites.
- However, from a systems perspective concerning quantifying the saving, one would need to look at the replacement effects that could occur between plastics and other materials, such as biogenic fibre based products, as a result of changed market conditions, such as market availability and price dynamics.
- Estimated effect on the economy for the public authorities.
 - This should probably not result in any large changes, however, acknowledging that it depends on how the changes are made to policies outside of the resource efficiency policy framework (e.g. combustion taxes). +/-0.
- Estimated effect on the economy for the private companies.
 - The effects are insignificant as it would affect the whole sector and thus not affect competition. +/-0.
- Estimated effect on the export of goods and thus also the competitiveness of the companies in the Nordic countries.
 - No effects. +/-0.
- Estimated effect on the export of knowledge concerning circular economy, new technical solutions etc.
 - This is likely to have a significant impact on innovation and new products. If the boost in recycled materials becomes a fact, various actors will find a use for it. +3.

- Benefits generated due to a higher degree of collaboration between the Nordic countries toward a Nordic circular economy.
 - Such a change could make large contributions to a Nordic market and stimulate collaborations on waste flows and innovation. +3.

The level of uncertainty on the above information

Low uncertainty (very certain).

The Swedish interviewees have provided the following replies to the questions asked