



Can economic instruments promote a circular economy?

A case study of the Nordic region



Nordic Council
of Ministers

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Preface

This report has been commissioned by the Nordic Working Group on Environment and Economics (NME). The report has been prepared by IVL The Swedish Environmental Research Institute. The team responsible for drafting the report consisted of Flintull Annica Eriksson, Annacarin Karlsson, Viivi Rouhento, Susanna Sepponen, Heini Purho and Magnus Hennlock.

The report presents an overview of different economic policy instruments and their connection to the circular economy in the Nordics. Two sectors are put in focus, namely the textile and the construction industries with the aim to analyse which role these could have in the circular economy transition. Options to choose and implement economic instruments to promote such transition is studied. The report concludes that there are no simple solutions when creating incentives for circularity in complex and global value chains. Finding an effective combination of economic and other policy instruments is key for giving the right incentives to the markets.

Comments and inputs to the report have been provided by members of the Nordic Working Group for Environment and Economy during the preparation of the report. The authors of the report are responsible for the content as well as the assessments and recommendations, which do not necessarily reflect the views and the positions of the governments in the Nordic countries.

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Chair of the Nordic Working Group for Environment and Economics

Executive Summary

This report analyses the potential of developing new economic instruments or modifying existing ones to promote the transition towards a circular economy. Specifically, in the textile- and construction sector. Two sectors with extensive material flows and a prominent role in the Nordic countries.

The results are quite similar for the two sectors. Economic instruments that could promote circularity include environmental taxes, such as natural resource taxes, import taxes, waste taxes, as well as Extended Producer Responsibility, VAT, and subsidies. A more in-depth analysis of the implementation of environmental taxes in the respective sectors show that taxes can be used to affect the market and consumer behaviour. However, the results indicate that the tax level needs to be relatively high to boost a shift towards circular economy. The results also show that it is difficult to anticipate the environmental and socio-economic impacts of a tax, as the value-chains in both studied sectors are complex. Aspects that need to be considered when dealing with complex and often global value chains include:

1. the location of the production taking place throughout the value chain
2. the availability of sustainable substitutes
3. the value of the circulated material.

In many cases, climate and environmental impacts can be reduced by introducing more sustainable materials and methods of productions, as well as policies and regulations that promote production which eliminate pressure on resources such as water, energy, and chemicals.

In conclusion, a combination of economic instruments, other policy instruments and investments in resource efficient business models, is needed to achieve circular economy. For the textile sector an internalizing combination of economic instruments could be e.g., a textile import tax, consumption tax on textile products, and subsidies targeting reuse or recycling of textiles.

The report is divided into two parts where the first part provides an overview of different economic policy instruments and their connection to the circular economy in the Nordics, specifically with focus on Finland, Sweden, and Norway. The second part of the report focuses on how environmental taxes can be used to reduce environmental impacts. It contains an in-dept analysis on how an environmental tax affect the demanded quantities by using price elasticities of demand.

Sammanfattning

Den här rapporten analyserar potentialen i att utveckla nya ekonomiska instrument eller modifiera befintliga för att främja övergången till en cirkulär ekonomi i textil- och byggsektorn. Två sektorer med omfattande materialflöden och en framträdande roll i de nordiska länderna.

Resultaten är relativt lika för de två sektorerna. Ekonomiska styrmedel som kan främja cirkuläritet inkluderar miljöskatter, såsom naturresursskatter, importskatter, avfallsskatter, samt utökat producentansvar, moms och subventioner. En mer djupgående analys av införandet av miljöskatter inom respektive sektor visar att skatter kan användas för att påverka marknads och konsumentbeteende.

Resultaten tyder dock på att skattenivån behöver vara relativt hög för att främja en omställning mot cirkulär ekonomi. Resultaten visar också att det är svårt att förutse de miljömässiga och socioekonomiska effekterna av en skatt, eftersom värdekedjorna i båda sektorerna är komplexa. De aspekter som måste beaktas vid komplexa och globala värdekedjor inkluderar:

1. var varje steg i produktionen sker
2. tillgången på hållbara substitut
3. värdet av det cirkulerade materialet.

I många fall kan klimat- och miljöpåverkan minskas genom att införa mer hållbara material och produktionsmetoder, och genom att implementera policys och regleringar som främjar hållbar produktion.

Sammanfattningsvis behövs en kombination av ekonomiska styrmedel, andra styrmedel och investeringar i resurseffektiva affärsmodeller för att uppnå cirkulär ekonomi. För textilsektorn kan en kombination av ekonomiska styrmedel vara till exempel en importskatt och konsumtionsskatt på textilprodukter och subventioner riktade mot återanvändning eller återvinning.

Rapporten är uppdelad i två delar där den första delen ger en översikt över olika ekonomiska styrmedel och deras koppling till den cirkulära ekonomin i Norden, med fokus på Finland, Sverige och Norge. Den andra delen av rapporten fokuserar på hur miljöskatter kan användas för att minska miljöpåverkan. Den innehåller en fördjupad analys av hur en miljöskatt påverkar de efterfrågade kvantiteterna genom att använda priselasticiteter för efterfrågan.

Background and objectives

Climate change and environmental degradation call for global measures to decouple economic growth from the use of natural resources. The transition to a circular economy is one important means in turning environmental threats into opportunities and boost the wellbeing of our societies while battling climate change and biodiversity loss.

The Nordic countries wish to be at the forefront in EU and globally as a sustainable and integrated region. At the same time, the countries struggle to reach the Sustainable Development Goal for sustainable consumption and production (SDG 12)^[1]. Nordic countries share many common strategic interests and features when it comes to the circular transition. These include e.g., a high level of technology and innovation, digitalisation know-how, skilled work force, and favourable environments for new business models. On the other hand, circular economy development is hampered by the low price of virgin raw materials in comparison to recycled materials, relatively high labour costs and income taxes, as well as low waste costs. For instance, high income taxes can discourage individuals from buying circular products and services, as they tend to be more expensive than traditional non-circular options. In turn, this may lead to a decrease in demand for recycled and re-used goods and services. Thus, can lead to a decreased supply for circular economy practices. Current regulation and economic instruments are not always designed to incentivise circular practices. It stands clear that the transformation from linear to circular economy practices, needs a systemic change on many levels. This includes changes in economic policy, both on the EU and national levels.

Objectives

The project aims to analyse the potential of developing new economic instruments or modifying existing ones to promote the transition towards a circular economy in the Nordics.

- i. Analyse the potential of new economic instruments that can move the society in a circular direction by affecting e.g., the treatment of products and waste.
- ii. Assess to what extent existing environmental and energy-policy-motivated economic instruments and their costs for the society have positive and negative impacts on the circular transition.
- iii. Discuss how existing economic policy instruments could be strengthened to better support the circular transition in the Nordics.

1. <https://sdgs.un.org/goals/goal12>

Scope and delimitations

This study is divided into two main parts. The first part provides a broader overview of the use of economic instruments to support a circular economy, and their use across the EU and the Nordic countries, with focus on Finland, Sweden, and Norway. The overview is complemented with accounts of actual use of these instruments, in terms of lessons learned as well as need for further development. This overview is based on desk review and expert interviews conducted during the project, as well as learnings from the extensive "Circular Transition in the Nordics" - project^[2] of the Nordic Council of Ministers' Working Group for Circular Economy.

In the second part of the report, studies of the effects of a natural resource tax on products made of virgin materials are analysed in detail. Focus lies on the textile- and construction sectors because of their prominent role and extensive material flows in the Nordic countries. Furthermore, there are various possible circular substitutes to the most commonly used materials available both for textiles and for construction materials. The cases for in-depth analysis have been scoped in close dialogue with the Working Group for Environment and Economics of the Nordic Council of Ministries. It was decided to limit the scope of our study to polyester within the textile sector and cement within the construction sector. This scope is presented in more detail in chapter 4.

2. For key findings of the study see Sepponen, S. et al (2023). Low-Carbon Circular Transition in the Nordics: Actions needed to unleash the potential. Nordic Council of Ministers, 2023.

1 Introduction to economic policy instruments for a circular economy

This chapter provides an overview of different economic policy instruments and their connection to the circular economy in the Nordics. Current development in the EU is also briefly highlighted. Additionally, potential future developments in this area are explored.

1.1 Introduction to economic instruments for a circular economy

The Ellen McArthur Foundation (2023) has defined "the circular economy as a system where materials never become waste and nature is regenerated. In a circular economy, products and materials are kept in circulation through processes like maintenance, reuse, refurbishment, remanufacture, recycling and composting". Circular economy presents a transformative alternative to the linear "take-make-dispose" model by regenerating and restoring resources. Using the definition of Ellen McArthur Foundation (2023), circular economy can be described by three key principles:

1. Regenerate natural systems (narrowing the loop)
2. Keep products and materials in use (slowing the loop)
3. Design out waste and pollution (closing the loop)

As circular economy disrupts our traditional views on production value chains, transitioning to a circular economy requires measures that foster systemic change. One important means for national and local governments in supporting the circular transition is the use of economic instruments, including taxes, fees and incentives in relation to circular economy principles.

Economic instruments can be categorised in relation to their ability to support a circular economy as shown in Table 1 (Simons et al. 2018; Green Budget Europe, 2018).

Table 1. Economic instruments for a circular transition

Note: Economic instruments often more or less influence all three loop effects by value-chain effects from influenced price signals in the market. Their ability to support a circular economy should be seen as possibilities in a value-chain context that is complex.

Source: Adapted from Simons et al. (2018); Green Budget Europe (2018)

Economic policy instrument	Narrowing the loop	Slowing the loop	Closing the loop
Taxes	Natural resource tax	§ Reducing VAT and labour tax § Increasing VAT for unsustainable solutions § Waste tax	§ Waste tax § Natural resource tax
Fees and charges			§ Pay as you throw fees
Subsidies	§ Incentives for research and development § Investments	§ Incentives for research and development	
Other		§ EPR schemes ^[3]	§ EPR schemes

Taxes

Taxes play an important role in shaping the dynamics of the circular economy by influencing for example resource use, product design, and waste management practices.

Natural resource taxes are linked to the extraction or to the use of natural resources, i.e. activities that deplete natural resources, such as minerals or water reserves. They incentivise the efficient use of raw materials and promote sustainable sourcing practices, encouraging the substitution of virgin material resources with secondary materials. A raw material tax and an import tax are two examples of natural resource taxes, depending on where in the value-chain the tax is intended to influence the economic structure.

Waste taxes refer to taxes related to waste management, including collection, treatment, or disposal. By imposing a tax on waste generation, businesses are steered towards minimizing waste and adopting more efficient production processes. Waste taxes encourage companies to invest in waste reduction strategies, such as recycling and reusing materials, promoting circularity and resource conservation.

3. Extended Producer Responsibility (EPR)

Monitoring *Values Added Taxes (VAT)* means either increasing or decreasing the VAT for different products or services in order to steer consumer behaviour. For example, a decrease of VAT for resell can promote reuse of products, and an increased VAT for certain products can increase the attractiveness of alternative solutions.

Subsidies

Subsidies refer to positive incentives used to strengthen certain behaviour. A subsidy is a negative tax, as governments use tax money from consumers or companies, to provide subsidies to certain target groups. Subsidies are often provided by governments to encourage the production of specific goods and services such as clean energy, healthcare etc.

Research Development Incentives (RDI) are used to support innovation and technological development that will facilitate new solutions in the future, by providing grants or loans to research and innovation activities.

Other

Extended Producer Responsibility (EPR) schemes place the responsibility on producers to manage the entire lifecycle of their products, including collection, recycling, and appropriate disposal. Most EPR schemes relate to widely used groups of products, such as electronic goods and packaging.

1.2 Current development in the EU

The EU Green Deal has an overall goal of making Europe the first climate-neutral continent by 2050. It covers several main elements such as clean energy, climate action, biodiversity, buildings, and renovations (European Commission, 2019). The Green Deal aims to align national taxation systems with the EU's climate objectives by removing subsidies for fossil fuels, shifting the tax burden to the polluter (polluters pay principle), and considering social distributional aspects. Recent tax reform trend across the EU and EEA countries, including the Nordic countries, have mainly been related to energy and transport taxes (European Commission, 2022b).

Current environmental taxes are according to Eurostat classified into energy, transport, pollution, and resources categories. In 2021, environmental taxes contributed to 5,5% of the total tax revenue within the EU-27. Energy tax revenue is the largest category of environmental taxes across all EU Member States, accounting for 78% of EU-27 environmental tax revenue, followed by transport taxes. Figure 1 illustrates environmental tax revenue by category as percentage of total revenues from taxes and social contributions (excluding imputed social

contributions), as well as by GDP of each EU/EEA country. Among the Nordic countries, Denmark has the highest share of environmental taxes with (6%), followed by Finland (5,8%), Iceland (4,9%) Sweden (4,5%) and Norway (4,0%) (Eurostat, 2023a).

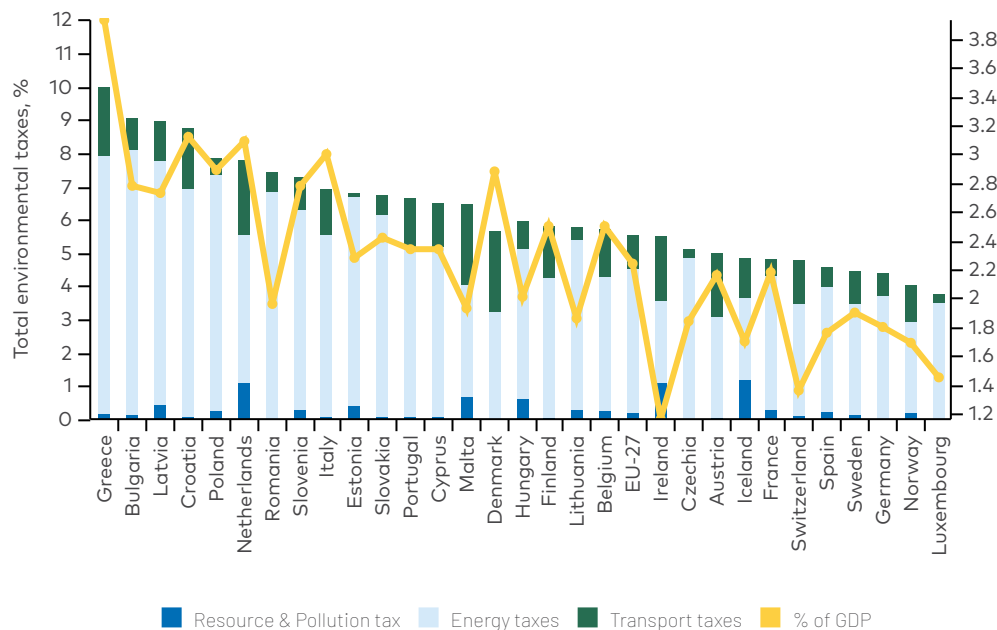


Figure 1: Environmental tax revenue by category as % of TSC and GDP of EU and EEA countries, 2021

Source: Eurostat, 2023

Note: TSC is abbreviation for taxes and social contributions

When planning the use of economic instruments for a circular economy, it is important to note that the current environmental taxes will not enable the needed systemic transformation, but a combination of different instruments will be needed to drive the development in a desired direction. According to an Ecopreneur study (2019), the root cause for the lack of demand for circular products and services at current prices is the greatest obstacle for implementing circular business models. Additional incentives are needed that make circular products and services cheaper than traditional linear items. The study calls for stronger incentives to remove this barrier and suggests a combination of the following economic related policy instruments to promote circularity in the textile sector: innovation policies such as investment support and other subsidies, economic incentives such as VAT and other tax shifts and Extended Producer Responsibility (EPR) in addition to other trade policies, regulation, and voluntary actions.

Furthermore, circular taxation, aimed at changing economic agents' behaviour towards circularity, will require a rethinking of the whole system of building blocks

currently used as economic instruments. The transformation will need to include at least a) a shift from labour taxes to resource/material taxes. This would balance out revenue from labour taxation and encourage reduced material extraction. Today it is common to tax labour more than materials, which provides incentives for continuous material extraction and the outsourcing of production to other countries. If materials are more taxed than labour, it encourages businesses to reduce its material extraction, thus provides incentives for more labour hours. b) strengthening the waste management taxes, c) a shift from taxation of services towards taxation of material intensive products d) introducing a tax on virgin raw materials e) reviewing the application of VAT within each national taxation systems (World Bank, 2022).

1.3 Current development in Finland

Finland has several economic instruments in use that aim to protect the environment, including taxes and subsidies. The total revenue generated by the environmental taxes and fees in 2021 was 6,4 billion EUR, where the largest revenue originated from energy related taxes, especially from households, transportation and storage, and service industries (Figure 2) (Statistics Finland, 2023a). Just under half of all greenhouse gas emissions in Finland is covered by the EU-ETS (Ministry of Economic Affairs and Employment of Finland, 2023).

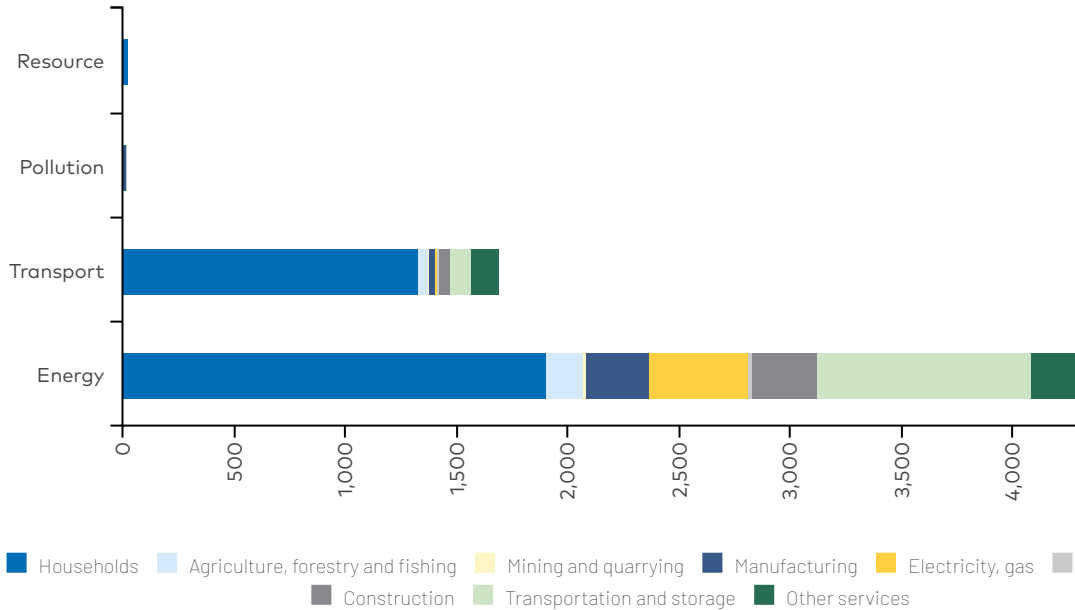


Figure 2: Environmental taxes by industry and tax type in Finland (year 2021)

Source: Statistics Finland, 2023a

Currently, the resource taxes in Finland include, for example, excise duty on beverage packaging, waste tax, oil waste duty and oil damage duty. Excise duty on beverage packaging refers to taxation on beverage packaging that is not included in the current deposit system. The waste tax comprises taxation of landfilled waste. In addition to taxes, there are also subsidies and other instruments, for example blending requirement for motor fuels, a feed-in tariff for renewable energy, as well as energy aid and investment aid for key energy projects that promote the production of renewable energy, energy savings or efficiency, utilization of waste heat or making energy systems low-carbon (Ministry of Economic Affairs and Employment of Finland, n.d.).

In 2021, Finland launched a new national strategic program, which aims at transforming the country's economy into a circular one by 2035 (Ministry of the Environment of Finland, 2021). The program includes measures related to economic instruments. One of these measures involves developing economic incentives that will reduce natural resource consumption and carbon dioxide emissions and promote circular economy service models.

The current economic instruments in use in Finland do not directly target raw materials, instead there is an interest towards developing energy-related taxes and waste taxes to promote circularity of materials. Finland has started the development towards an environmental tax reform by building a Sustainable Taxation Roadmap where the first wave focuses on energy and transportation related taxes. Notably, the second wave will most likely focus on changing the waste tax, by adding construction related plaster waste and green liquor precipitate into its scope. (Finnish Government, 2020). A proposal to add a tax for the mining sector has also been approved and will commence in 1.1.2024. Taxes are levied on minerals extracted in Finland, with the objective of securing societal compensation for the utilization of non-renewable resources. The responsibility for paying this tax falls upon the entity that has mined the mineral, and is subject to a mining permit, as mandated by the Mining Act. (Finnish Tax Administration, 2023)

However, in relation to the national circular economy strategy the Ministry of the Environment of Finland has conducted a study of the effects of increased waste taxes on the development of the circular economy in Finland (Savikko et al. 2022). The study concluded that the waste tax in Finland has already largely achieved its goals to reduce the amount of waste landfilled that could be utilized otherwise, and its current impact is turning fiscal. In the future, when new or more efficient waste treatment options are developed for broader number of waste fractions, the current tax base can be altered and expanded.

Tax as a driver for sustainability and circularity has also been studied in terms of connecting the tax to life-cycle emissions in Finland. Remes et al. (2023) studied life-cycle emissions-based consumption taxes in Finland, revealing a need for more accurate and consistent information on life-cycle emissions if one was to establish a reliable tax base. According to the study, a life-cycle emissions-based

consumption tax could be suitable for products that produce high emissions and are not subject to other relevant emission reduction instruments, and to product categories where emissions do not differ too much between producers, thus enabling fair and purposeful taxation. For example, if the same product from different producers were manufactured using renewable energy vs. fossil energy, these products might be taxed similarly although their emissions would differ. It might be better if all taxable products under the same category produce emissions of similar magnitude for fair and purposeful taxation.

1.4 Current development in Sweden

Sweden has a wide range of economic instruments in use to protect the environment and promote climate friendly behaviour. Generally, economic incentives can be beneficial to encourage more businesses to establish circular business models as well as promote behavioural change.

In 2021, Sweden's revenue generated by environmental taxes accounted for 10,0 billion Euros (103,6 million SEK). Thirty nine percent of Sweden's national climate emissions is covered by the EU-ETS (Naturvårdsverket, 2023b). Energy taxes accounted for the largest share of the total environmental taxes, 7,5 billion Euros (77 million SEK) in 2021.

Transport taxes are the second largest category and account for 2,2 billion Euros (23 million SEK). Pollution taxes accounted for 0,3 billion Euros (0,3 million SEK). Resource taxes are the smallest category and account for 0,12 billion Euros (13 million SEK). It is also the only category directly linked to the circular economy.

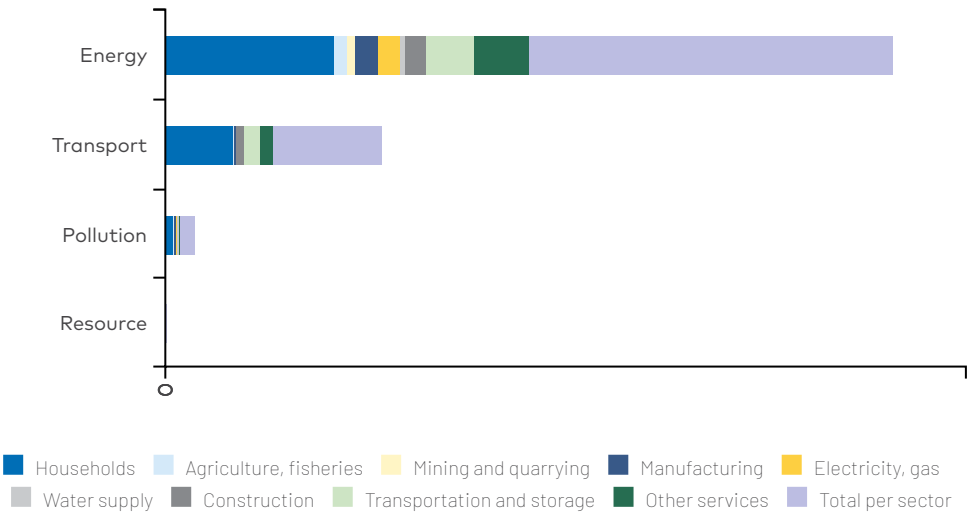


Figure 3: Total environmental taxes by industry and type, year 2021, Euros

Source: Statistics Sweden, 2023a

Households pay 50% of the total environmental taxes, where energy taxes are the largest category, accounting for 3,5 billion Euros (36 million SEK), transport taxes being the second largest category with 1,4 billion Euros (14 million SEK).

In 2020, Sweden adopted a new national strategy for a circular economy transition. Four focus areas were selected by the government:

- sustainable production and products design
- sustainable consumption and use of materials, products, and services
- toxic free and sustainable recycling loops
- driving force for businesses and other actors through measures that promote innovation and circular business models.

Complementary to the national strategy, action plans for plastics, waste management and waste prevention were also launched. The action plans were chosen for specific areas that are deemed to have the greatest potential in contributing to the circular economy transition and the UN Sustainable Development Goals. The prioritised material flows in Sweden's national strategy for a circular economy are plastics, textiles, food, the construction and property sector, renewable and bio-based raw materials, and innovation for critical metals and minerals (Swedish Government, 2021).

With its new strategy, Sweden implemented a circular policy element which relates to requirements to sort construction and demolition waste. A business or individual who produces construction or demolition waste is required to sort certain types of waste and store them separately from each other, and from other types of waste. The purpose of this action is to reach a higher level in the waste hierarchy and increase the incentives for accelerating circular flows within the construction sector (Naturvårdsverket, 2020).

Sweden has, during the period 2017–2022, implemented economic incentives to boost the circular economy, such as lowering tax rates for repairing textiles and for clothes rental. In 2017, the VAT for smaller repairs of bikes, shoes, clothes, and textiles decreased from 25% to 12%. In 2022, the VAT for repairs of shoes, clothing, bikes, and household linen was further reduced from 12% to 6% (Riksdagen, 2022). By the end of 2022, Sweden had a new government installed, and the VAT was again increased from 6% to 12% (by 1 April 2023), with the aim to increase the uniformity of the tax system (Riksdagen, 2023).

During the summer of 2022, the Swedish Government decided to appoint a national committee to investigate which material flows, product groups or services, that are the most appropriate to target by economic instruments aiming at promoting a circular economy. In addition, proposing specific instruments to support the transition. Economic instruments that may stimulate construction with recycled materials instead of raw materials is also examined. The committee aims to present its results by the end of April 2024 (Swedish Government, 2022a).

1.5 Current development in Norway

In 2021, Norway's revenue from environmental taxes, including taxation of CO₂ emissions, accounted for 7,3 billion Euros (74,6 million NOK). Like the other Nordic countries in this study, energy taxes were the largest category with 5,1 billion Euros (51,8 million NOK). Transport taxes were the second largest category with 1,9 billion Euros (19,5 million NOK), while pollution taxes accounted for 0,3 billion Euros (3,3 million NOK). Much like the situation in Sweden and Finland, resource taxes were the smallest category in Norway, and accounted for 0,01 billion Euros (140 million NOK). In 2022, approximately 85 percent of domestic greenhouse gas emissions were either covered by the EU-ETS, subject to a domestic tax, or both (International Energy Agency, 2022).

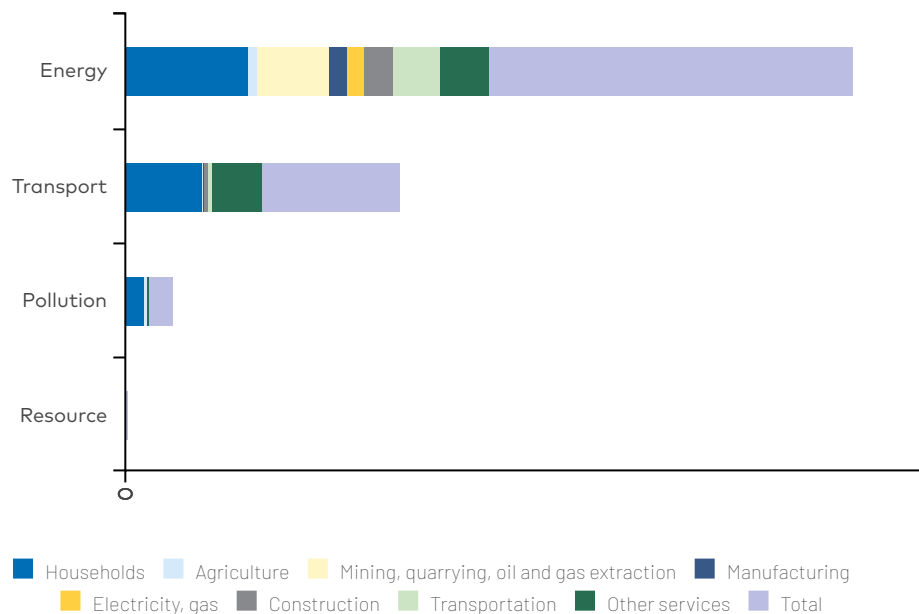


Figure 4: Total environmental taxes by industry and type, year 2021, Euros

Source: Statistics Norway, 2023

Households paid 42% of the total environmental taxes, and energy taxes was the largest category, accounting for 1,7 billion Euros (17,5 million NOK). Transport taxes was the second largest category for households, it accounted for 1,1 billion Euros (10,9 million NOK).

In June 2021, the Norwegian Government (2021) launched a strategy for developing a green, circular economy. EU policies (e.g. Circular Economy Action Plan, European Commission, 2023c) are the main drivers for development of circular economy policies in Norway. Norway closely monitors EU regulations in the area of waste

and circular economy. The national strategy focuses on actions within four sectors that have been identified as having the greatest potential for circularity and green competitiveness: agriculture, forestry, fisheries, process industry, construction and buildings, and trade. The Norwegian Government has acknowledged that counties and municipalities play a key role in terms of pushing initiative and action to promote a circular economy across stakeholders within businesses and civil society as well as different public sector levels. The strategy aims to make use of local and regional resources, combined with national industries to further develop a circular economy in Norway.

The business sector has during the latest years been working on preparing road maps to boost green competitiveness across various sectors such as e.g. waste management, process industry, retail and wholesale trade and the packaging industry. The national strategy will also strengthen consumer rights in terms of making it easier for consumers to adopt circular consumption patterns. Additionally, expanding the availability of sustainable and durable products, as well as improving consumer information. More support for Ecolabelling will also be provided. One of the new key areas are related to promoting circular solutions within bio-based sectors. This implies an increased focus on promoting industries that produces goods and services from renewable biological resources, with an overall aim to replace non-renewable options to support climate and environmental targets.

Within the public sector, green innovation and sustainable consumption will be promoted through the public procurement system. Norway will focus on making more use of digital tools to boost the shift to a circular economy. With national ICT ^[4] solutions such as product passports and digital marketplaces it will be possible to collect and analyse large amounts of data, and make these available for researchers, businesses, and authorities.

During the summer of 2021, the Norwegian government decided to appoint a committee that was given the task of scrutinizing the entire tax system in terms of assessing how economic instruments can be used to boost a circular transition (Norwegian Government, 2021). At the end of December 2022, the expert committee presented its results, concluding that the field of circular economy is relatively new within economics. To date, little research is available on how economic instruments such as environmental taxes may affect the development of a circular economy. The committee emphasised that more studies are needed in this field. The need to modify taxes should be assessed in relation to other policy instruments, such as legislation, and in relation to efficiency and administrative costs. The expert committee presented some examples of measures that do not specifically target the source of the external costs. These include e.g. taxes on plastic packages and new textiles, and reduced taxes on sales of goods and services

4. ICT is an abbreviation for Information and Communication Technology

that promote the circular transition. The committee found that the best option for Norway is to consider second-best solutions, such as taxes or subsidies that is targeted specific group of goods or services on a national scale. The committee further concluded that the greatest challenges are related to the high Norwegian consumption of imported goods and services, where the Norwegian Government has limited possibilities to impact the national legislations and their environmental burden. Targeting the source of the external cost is therefore not feasible. Furthermore, the committee suggests that a broader study should be launched, that examines in more detail the possibilities of using economic instruments to boost a circular transition. This study should also consider how any policy instrument affect distribution, revenues, and administrative costs (Norges Offentlige Utredninger, 2022).

2 Economic instruments to promote circular economy in the textile sector

In this chapter, we move from the general overview of the use of economic instruments into discussing the possible role of economic instruments in the textile sector to promote circular transition. First, the current developments of the sector in the Nordic region are investigated, and then options for economic instruments targeted to the textile sector are discussed.

2.1 The role of the sector in the circular transition

The textile value chain is estimated to account for approximately 10% of the global greenhouse gas emissions (European Parliament, 2020). The textile sector is a major user of fossil-based virgin materials and there is a lot of potential for circularity, and hence reducing the environmental impact of the sector.

Currently, the trend of consuming textiles is going upwards and since year 2000, the amount of used textiles from the EU has tripled from 550,000 tonnes to approximately 1.7 million tonnes in 2019. To add to the effects of overly produced amounts of textiles, textile waste creates environmental and social issues. Textiles used in 2019, were mainly exported from the EU region to Africa (46%) and Asia (41%). Annual export of used textiles from the EU region to non-EU European countries has been constant at a level of 10% throughout the past two decades. Textiles that are not reused or recycled are likely to end up in open landfills (European Environmental Agency, 2023a).

To address the challenges from the increased export of textile waste, the EU Member States agreed in March 2022 on a new strategy on sustainable and circular textiles. The strategy intends to increase sustainability patterns across the global trade of textile waste, thus promoting a circular economy (European Commission, 2022a).

Traditionally, when manufacturing a textile product, value is added throughout the value chain, where the highest value is gained from the finished product (Figure 5). Prolonging the lifespan of textiles and improving reuse and recycling activities across the value chain are key actions in moving towards circularity. Moreover, in the textile industry, key aspects in the circular transition relate to traceability of raw materials, design for longevity, sustainable production (e.g., resource efficiency,

production on-demand and local production), renting and leasing services, repair and maintenance services, take-back and resale of the product (second hand), collection, reuse and recycling of material (e.g., chemical and mechanical recycling).

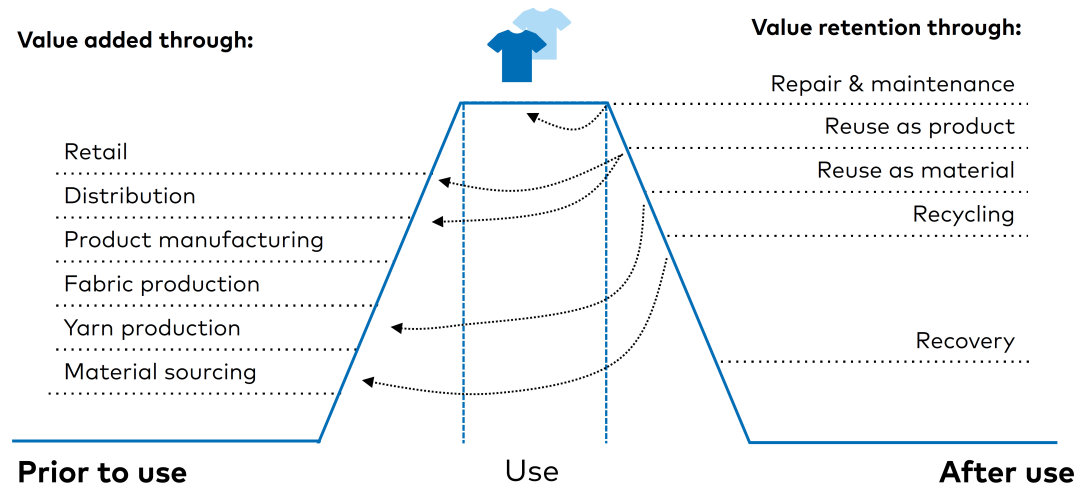


Figure 5: Value addition and retention in the circular value chain of textiles.

Source: Originally adapted from Achterberg, Hinfelaar, & Bocken (2016)

2.2 The textile sector in the Nordics

The textile sector is important in the economy of many European countries, including the Nordics. In 2021, the European textile and clothing industry turnover was 147 billion Euro, which is an increase with 11 percent since the year before. The sector has 1.3 million employees in Europe (EURATEX, 2022).

The selected Nordic countries in this study and their respective turnover within the textile and clothes industry for the year 2020 is shown in table 2 below.

Table 2: Overview of textile and clothes turnover, (year 2020), billion Euro.

Source: Finnish Textile and Fashion Association, 2020; Statistics Sweden, 2020

Unit: billion Euro	Finland	Sweden	Norway
Textile industry turnover	0.44	0.86	0.71
Clothing industry turnover	0.58	1.24	0.28

In 2019, around 62 kt of new textiles were imported to Finland and the total consumption of new textile products was 11,3 kilos per capita, household consumption having the largest share (83%) (Dahlbo et al. 2020). The Swedish total consumption of new textiles was 13,7 kilos per capita during 2019. A large share of used clothes and textiles, approximately 7,5 kilo per capita end up as waste and are sent directly to incineration. Thus, a large portion of textiles are not being reused or recycled (Naturvårdsverket, 2021). Norway's total consumption of new textiles and clothes was 15 kilos per capita during 2020. Approximately 50 percent of the used clothes and textiles end up as waste and then sent directly to incineration (Klima- og miljødepartementet, 2021).

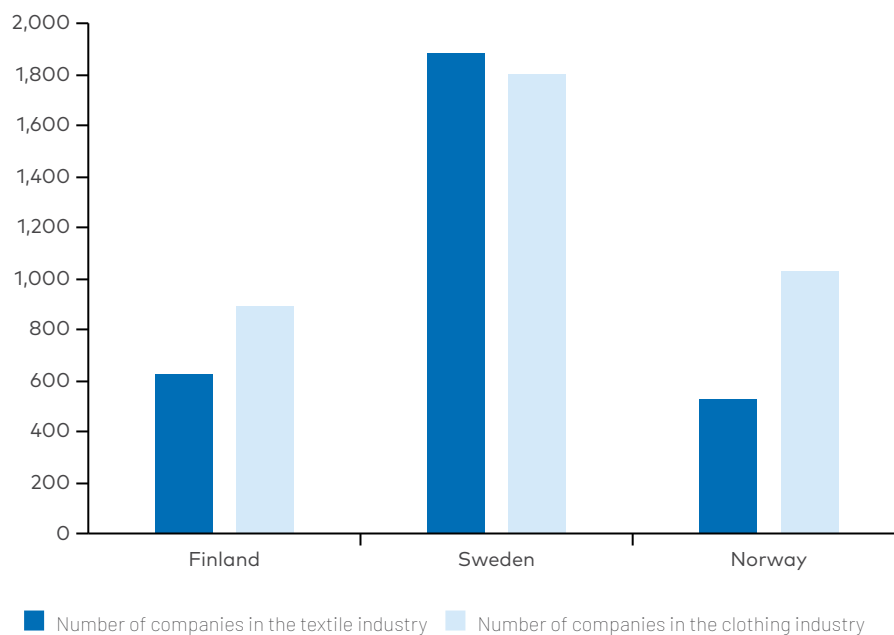


Figure 6: Number of companies in the textile and clothing industry in Finland, Sweden, and Norway (year 2020)

Source: Finnish Textile Fashion, 2022

The textile and clothing industry provides many employment opportunities and represents one of many gateways for young people access to the labour market. The number of companies in the textile and clothes industry in Finland, Sweden and Norway can be seen in figure 6.

The numbers of employees in the textile and clothing industry in Finland, Sweden and Norway related to year 2020 can be seen in figure 7 below.

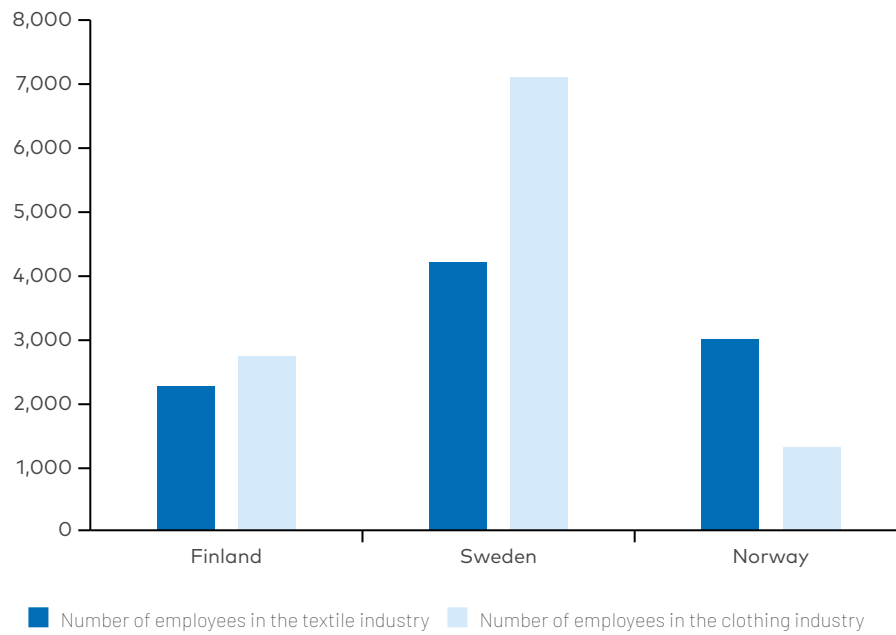


Figure 7: Overview of number of employees in the textile and clothing industry in Finland, Sweden and Norway (year 2020)

Source: Finnish Textile Fashion, 2022

In the light of the data in table 2, and figures 6 and 7, it is obvious that the value chain of textiles was one of the prioritised areas identified in the Nordic Council of Ministers' large study on circular transition potential, 2020–22 (Luoma et al., 2021) and subsequently also chosen as scope for the present work. Textiles are explicitly mentioned as focus areas of national priorities for Sweden, Finland, Denmark, Åland as well as for the European Union (See e.g., European Environmental Agency, 2023b). Joint Nordic processes have also been launched which aims to turn the textile industry towards more sustainability. It is also internationally acknowledged that the Nordics (in particular Finland and Sweden) host cutting-edge RDI activity on new biobased and circular textile solutions, such as man-made cellulose fibres. At the same time, the fashion industry in the Nordics has become increasingly aware of more sustainable consumer trends, forming a counterforce to disposable fast fashion.

The textile sector in the Nordics has shown notable development in promoting sustainability and circularity. There are several initiatives developing more sustainable production methods, design principles, material choices, collection, sorting and recycling methods, as well as consumption related initiatives (See e.g., the Nordic Council of Ministers, 2023). There are also some initiatives taken regarding economic instruments to promote circular economy in the textile sector. These initiatives are primarily targeted at implementing EPR for textiles.

A study commissioned by the Swedish Government in 2017, had the main task of

analysing and proposing economic instruments to promote a resource efficient and circular economy. The study proposed introducing a tax reduction of 50% of the labour cost for consumption of goods and services in connection to repairing textiles, maintenance of furniture, second-hand sales, or repair of consumer products (SOU, 2017).

The Royal Swedish Academy of Engineering Sciences (2020) studied how current policies need to shift to establishing a national movement towards resource efficiency and a circular economy. Within the textile sector, the study suggests promoting increased use of regenerated fibres from residual flows by promoting economic instruments that favour recycling of textiles. As an incentive, manufactures of new products based on recycled materials should be rewarded by a tax break, which in turn could potentially create new jobs, build a more competitive manufacturing industry, thus contributing to the national economy. Finally, the study suggests reviewing which kind of customer barriers that create obstacles to the trading of used clothes as well as difficulties for trading used materials between countries (IVA, 2020).

IVL Swedish Environmental Research Institute (2022) studied policy measures on behalf of Circular Sweden^[5] to boost the circular economy. The study highlights proposals related to reduced tax rates on repairs of textiles and on buying second-hand clothing. Obstacles that are mentioned in the study are related to linear design, low profitability during resale and circularity is not prioritized as high as climate issues. Another suggestion is related to introducing an EPR system with differentiated fees and incentives, that counteracts non sustainable and circular fashion. A third suggestion is to increase the quota obligation on the amount of recycled fibre raw material within new textile products. However, the study highlights a long list of obstacles to implement a quota obligation such as material composition, linear design, low traceability options, large investments required for a circular transformation, lack of harmonisation and flexibility and circular flows requires much coordination.

In 2020, the Swedish Government initiated an investigation with a focus to examine the EPR for textiles, to ensure separate collection of textiles for reuse and textiles for waste and recycling (SOU, 2020). The study showed that less than 1 percent of textiles are recycled, and fibre to fibre recycling occurs approximately at a rate of 2–3 percent on a global scale.

During September 2022, the Norwegian government decided to appoint a working group to investigate the possibilities of implementing EPR for textiles, with the aim to reduce their environmental impact. The working group will focus on mapping quantities, the portion of imports and how textiles are managed after use. Digital product passports will also be examined to evaluate if they can be designed for

5. Circular Sweden is a business forum that focuses on driving the development of circular product and material flows forward. <https://www.circularsweden.se/>

usage in the textile sector. National objectives thought to boost a circular economy, will also be presented by the working group in September 2023 (Klima- og miljødepartementet, 2022).

In Finland, there are currently ongoing discussions on how EPR will affect already established schemes for collecting waste textiles (Saarinen, 2023). It should also be noted that the European Union is proposing an EPR for textiles as part of the renewal of the Waste Framework Directive (EU Commission, 2023b).

2.3 Options for economic instruments in the textile sector

In the textile sector, economic instruments can play a crucial role in promoting a circular economy, as well as unlocking various opportunities. By implementing economic instruments, the market for more sustainable textiles can be boosted, creating a level playing field for environmentally friendly products. This, in turn, could encourage innovation in the sector, leading to the development of new technologies and practices that enhance the circular economy.

As discussed in the previous chapters, several economic instruments to support a circular textile sector have been attempted or studied in the Nordics. Figure 8 shows how different economic instruments could be placed into the value chain of textiles. Chosen economic instruments for further discussion are divided into resources taxes, import taxes, EPR schemes and increasing of VAT.

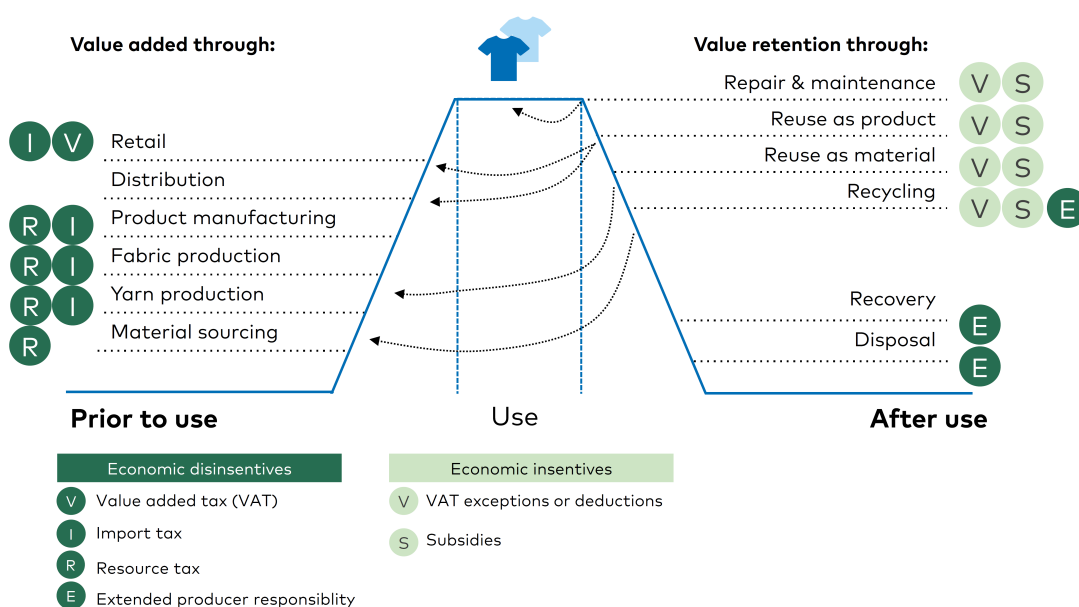


Figure 8: Outlook for possible economic instruments to promote the circular economy in the textile sector

Source: Originally adapted from Achterberg, Hinfelaar, & Bocken, 2016

For textiles, **natural resource taxes**, such as raw material tax could be targeted to the first stages of the value chain, where raw materials are purchased. Although a natural resource tax is already in use in certain sectors, the key challenge in the textile sector is linked to the fact that such a tax requires careful targeting to the early stages of the value chain in order to be effective. Whereas most textiles used in the Nordics are manufactured outside the region, natural resource tax would essentially target raw materials that are produced in the Nordic countries. Thus, the volumes, types and sustainability performance of textiles produced locally would need to be assessed firstly. In general, the tax should be targeted towards non-sustainable textile fibres, steering towards the use of sustainable ones. However, there is a notable risk that introducing tax to local textile production in the Nordics might only harm domestic textile production sector and steer the acquiring of fibre towards cheaper countries.

Import taxes, i.e. customs duty could be used to guide towards more sustainable material usage in the textile products and encourage local production and sourcing. A research study by Hennlock et al. (2021) indicate possibilities for the Nordic countries to let the *textile importer* of a specific good bear the environmental charges, fees or taxes corresponding to the external effects caused by the design and production. This is further discussed in chapter 4.4.6. However, effective implementation and enforcement across international supply chains poses challenges that need to be solved. Firstly, from an EU member state perspective, import tax is only targeted for non-EU imports. Additionally, such as WTO-rules would have to be taken account which might create challenges. Also, current global commodity codes that are used for import and export declarations isn't built to segregate sustainable and non-sustainable textiles from each other. The lack of alternative sustainable raw materials poses challenges also, similarly as with resource tax.

By implementing **EPR schemes**, the textile sector could steer producers to design products with recyclability in mind and establish effective recycling systems. Leading to reduced waste, resource conservation, and increased circularity in the industry.

By raising the **VAT** on textiles, consumers' purchasing decisions can be guided towards opting for durable and environmentally friendly products. In addition, the playing field between unsustainable and sustainable textiles could be levelled by targeting the prices of less sustainable textiles. Such an increase in the VAT could create a price differential that would incentivise the adoption of circular business models, such as product repair and reuse, while discouraging fast fashion and disposable consumption patterns. While increasing the VAT on textiles can promote sustainable consumption, it is crucial to find the right balance in order to not hamper the affordability and creating resistance from industry stakeholders. In addition, policy makers tend to be somewhat hesitant to create a complex sector-specific VAT system.

One potential possibility for economic instruments in the textile sector is the implementation of **VAT exceptions or deductions** for activities like reselling, or mending and repairing services, rather than imposing taxes on raw materials. Such measures could incentivize and support the growth of second-hand markets, prolonging the lifespan of textiles. Furthermore, a reduction of the VAT for repair services can be a powerful tool, incentivising consumers to make sustainable choices and prolonging the life of textiles. On the other hand, reducing the VAT requires careful consideration of the impacts on revenues and market dynamics. As highlighted in section 1.4, policymakers in Sweden reduced the exactly this VAT during 2022.

Subsidies can play a role in promoting a circular economy in the textile sector. One potential form of subsidy is investment support, which can help businesses in the sector to acquire and implement technologies that enable more sustainable practices. This could include financial assistance for the purchase of machinery and equipment for mechanical or chemical recycling, as well as support research and development activities aimed at advancing circular economy solutions. In addition to providing financial assistance, subsidies can also encourage collaboration and knowledge sharing among businesses, research institutions, and technology providers.

The implementation of economic instruments promoting a circular economy in the textile sector faces several challenges. In addition to the challenge of defining what constitutes a "sustainable fibre" (considering different perspectives and criteria), there is, to date, a limited availability of affordable substitutes for popular virgin materials like cotton or polyester. In the Nordic countries, most companies operating in the textile sector are SMEs. Companies that struggle to afford novel recycled and sustainable materials, as their availability is scarce, and mostly out of reach. New innovations are brought to the attention of the industry each year, (e.g. Spinnova and Infinited Fiber Company both from Finland), but most of the solutions are still in their scaling phase and the startups only have capacity to cooperate with larger companies in the industry, as the demand for their raw materials is significant.

As pointed out in the Low-Carbon Circular Transition in the Nordics study (Part II), promoting the use of recycled content for textiles is dependent on technologies to be scaled up, especially when it comes to novel materials. For example, the development of chemical recycling, a promising solution for textile waste, is still in its early stages and largely limited to pilot-scale initiatives. Scaling up this technology poses challenges in terms of infrastructure, investment, and technological advancements. There is a lack of incentives among brand-owners and investors to further drive the development of chemical recycling. Recycled fibres are more expensive than virgin fibres, and the infrastructure for chemical recycling plants is underdeveloped. For the future, chemical recycling can be promising especially because it can for instance separate blended cotton and polyester fibres without decreasing the value of the fibres (Hjelt et al. 2022).

3 Economic instruments to promote circular economy in the construction sector

This chapter discusses the possible role of the construction sector in the circular economy transition. First, the current developments of the sector in the Nordic region are highlighted. After that options for economic instruments to promote circular economy in the construction sector is elaborated.

3.1 The role of the sector in the circular transition

The construction sector is a complex sector containing a wide variety of materials and product groups. The lifetime of different products can vary significantly. A circular economy of products with long lifespans (decades or even centuries) is not seen as potential target group compared to products with shorter lifespans.

The implementation of circular practices in the construction sector has attracted a lot of interest since the EU's Circular Economy Action Plan identifies the construction sector as one of the priority areas for closing material loops (European Commission, 2023c).

Circular economy strategies and models for the construction sector aim to minimize the resource consumption by contributing to more sustainable design choices and by reducing the need for new buildings. Additionally, strategies like maintenance, repair, and renovation of buildings extend their lifespan, while exploring new ways to utilize existing infrastructure and reusing components from demolished constructions, prevents waste generation. Enabling a circular economy in the construction sector relies on effective recycling of waste materials through improved sorting and separating activities, as well as increasing the use of recycled content in construction components.

Value is added and retained during the life cycle of a construction project as Figure 9 demonstrates. In addition, the value chain's various stages contain features that promote circular economy adding to that value. For example, the planning and design phase plays a crucial role in enabling sustainable material use including recycled materials. This phase also effects to maintenance requirements, flexibility in changing the intended use of the structure, and the expected lifespan. As construction begins, focus on material efficiency and effective waste management becomes paramount. This ensures that resources are used efficiently, and waste

generation is minimised. Once the structure is in use, the duration of its lifespan is determined by the effective management and maintenance practices used. As the structure reaches its end-of-life stage, careful considerations must be made regarding the fate of the generated waste materials. This may involve recycling or other appropriate disposal methods (Wahlström et al., 2021).

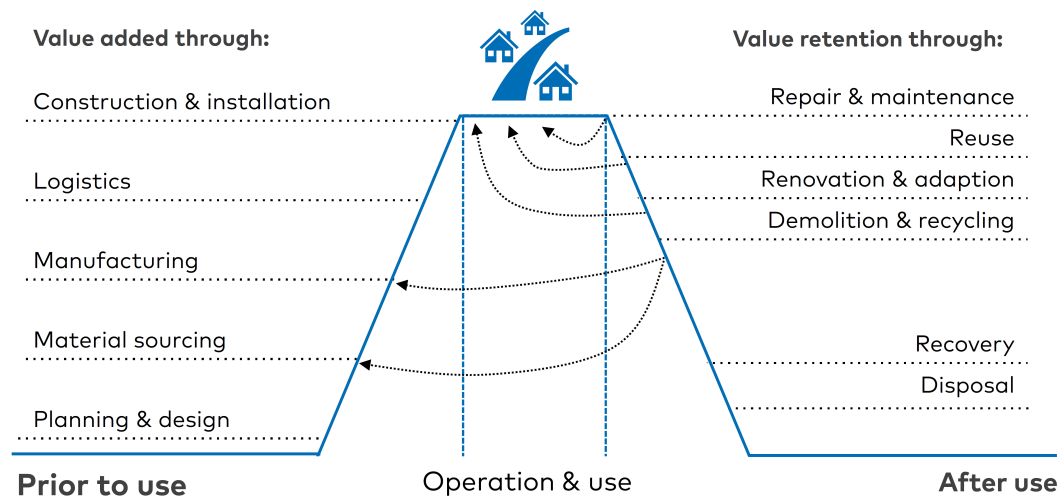


Figure 9: Value addition and retention in the circular value chain of the construction sector

Source: Originally adapted from Achterberg, Hinfelaar, & Bocken, 2016

A study by Karlsson et al (2020) shows that a successful decarbonization of the supply chain for buildings and infrastructure will require parallel emission abatement measures that includes a variety of policies and strategies to transform the sector. The analysis estimates that out of the total carbon impact from construction of buildings accounts 32 percent of the total building construction emissions originates from concrete and other cement-based products. To better support decision-makers on the climate transition, the authors suggest to further investigate possibilities for making use of negative emissions by making use of carbon capture storage (CCS) and carbon sinks such as making more use of long-lived wood-based construction materials in houses.

3.2 The construction sector in the Nordics

The construction sector is one of the largest economic sectors within EU and the Nordic countries. It is an energy- and material-intensive sector that produces significant amounts of air emissions and waste. Development tends to be slow but efforts to promote sustainability are becoming increasingly common and circular economy practices have begun to gain traction.

The selected Nordic countries in this study and their respective turnover in the construction sector for year 2021 is shown in Figure 10 below. In 2021, the total turnover for the entire construction sector in Finland was 43.2 billion Euros, in Sweden it was 92.8 billion Euros, and in Norway it was 66.6 billion Euros. Relative to each country's gross domestic product (GDP) value for Finland, the construction sector turnover accounts to 17 percent of the total GDP (250 billion Euros in 2021). For Sweden the share of the construction sector turnover is also 17 percent as GDP is estimated to 540 billion Euros. For Norway it accounts to 16 percent, as GDP is estimated to 414 billion Euro in the same year (Eurostat, 2023).

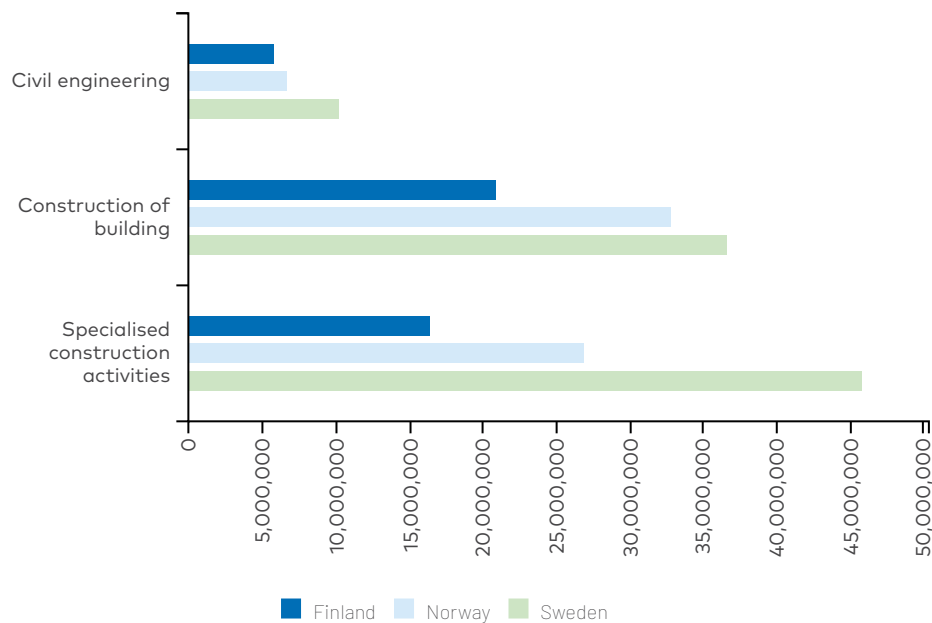


Figure 10: Turnover of enterprises in the construction sector in Finland, Norway and Sweden, 1000 Euros (Year 2021)

Source: Statistics Sweden (2021), Statistics Norway (2021), Statistics Finland (2021)

The construction sector provides many employment opportunities across Sweden, Norway and Finland. In 2021, the sector employed about 345 000 people in Sweden, it accounts to 12 percent of the total workforce. In Norway, the sector employs about 246 000 people, it accounts to 11 percent of the total workforce. In Finland the construction sector employs about 154 000 people, it accounts to about 11 percent of the total workforce. An overview of the total amount of employees within specialised construction activities^[6], construction of buildings and civil engineering is shown in Figure 11.

6. These activities usually require specialised skills or equipment such as foundation work, concrete work, brick laying, stone setting.

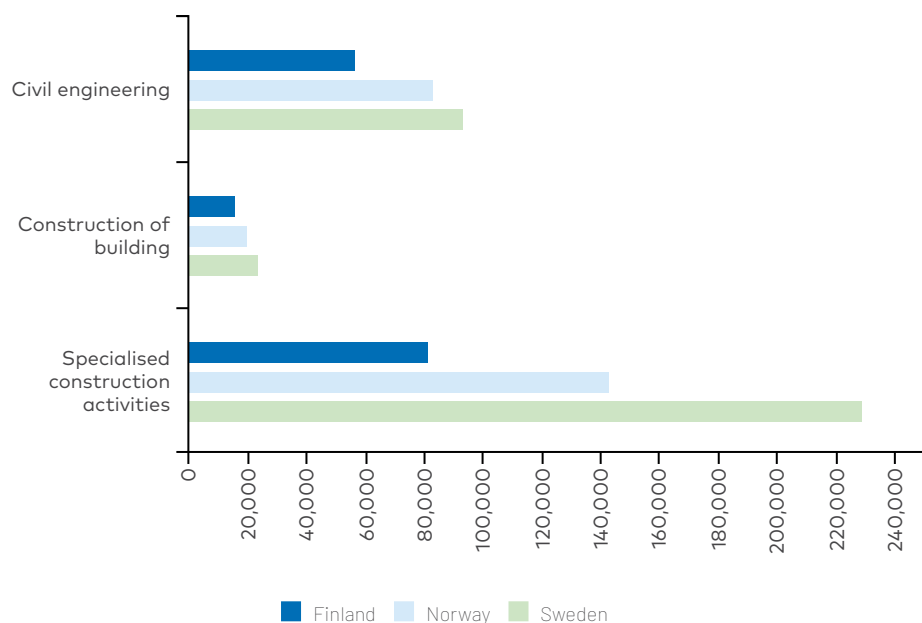


Figure 11: Overview of the number of employees in the construction industry in Finland, Norway and Sweden (year 2021)

Source: Statistics Sweden (2021), Statistics Norway (2021), Statistics Finland (2021)

Given the data in Figures 10 and 11, it is easy to understand that the building and construction sector was one of the key priorities identified in the large Nordic study on circular economy potential 2020–2022. It was recognised as a priority in all the Nordic countries (except no explicit mentioning in Faroe Islands and Greenland). The Nordic construction sector was shown to have a shared opportunity to build a common hierarchy framework for the reuse and repurposing of buildings, as well as to create digital marketplaces for the circulation of construction materials. The role of circular design as a key enabler was also recognised.

The Nordic countries have already launched several processes towards developing a sustainable and circular construction sector, among these the flagship programmes Nordic sustainable construction^[7] and the Nordic networks for circular construction^[8].

There are also several interesting national developments in the Nordic countries. For example, in 2022, the Swedish government decided to appoint a commission within the National Board of Housing, Building and Planning (Boverket) to further develop the work with circular transformation of the construction and real estate sector, with the aim to help achieving Sweden's environmental and climate goals. The working group was given the task of mapping and analysing the current

7. <https://nordicsustainableconstruction.com/>

8. <https://nordiccircularconstruction.com/>

operations in reuse and recycling of existing building materials, building parts and construction, as well as mapping and analysing the supply and demand of critical building materials. The work also includes examining potential indicators to monitor the circular development within the sector, launching outreach campaigns and increasing public awareness on the topic, and examining the digitalization potential. Results are expected by December 2024 (Swedish Government, 2022b).

In 2022, the Norwegian Agency for Public and Financial Management (DFÖ) conducted a joint study with Deloitte on how the circular economy could be improved within the construction and real estate sector. The report highlights the need for requirements of re-use and includes a mapping of existing re-use of materials. It also introduces shared economy concepts within the public sector, requirements for local suppliers providing bio-based construction materials, leasing options instead of consuming new goods, etc. To date, the marketplaces for building materials are insufficient and there are severe difficulties in calculating the emission savings stemming from sustainable choices (DFÖ, 2022). Regarding the marketplaces, the same concerns are shared across the Nordics (Hjelt, M et al. 2022).

As of today, Norway has a tax on commercial buildings (dokumentavgiften) which provides an incentive to demolish old and existing buildings, instead of renovating them. If the buyer demolishes the entire building, they only have to pay taxes on the land area, but if they decide to renovate the building, a document tax needs to be paid on the entire sales price. This is an example of a counterproductive economic instrument that creates barriers for the circular transition (Kartverket, 2023).

3.3 Options for economic instruments in the construction sector

Economic instruments offer a range of opportunities to incentivise positive change and drive the transition towards more resource-efficient construction and demolition processes. This chapter examines different economic instrument options that can be tailored to address specific circular economy challenges within the construction sector.

Policies play a crucial role in influencing recycling rates and promoting sustainable practices within the construction sector. Several economic instruments can be employed, including natural resource taxes, green public procurement (GPP), VAT, import taxes, Extended producer responsibility (EPR), waste taxes, in addition to different kind of subsidies. These instruments aim to incentivise the recycling and reuse of construction and demolition waste and enhance the incorporation of recycled content in new construction projects. Figure 12 shows how different economic instruments could be placed into the value chain of the construction sector.

Zu Castell-Rüdenhausen et al. (2021) identified economic barriers as the main obstacle to the reuse and recycling of construction and demolition waste. The high price of secondary raw materials and used products often surpasses that of virgin raw materials and new products like aggregates, wood, glass, and gypsum. In some cases, demolition companies may opt for landfilling due to perceived cost-effectiveness. Moreover, there are additional costs associated with sorting waste into fractions that meet the quality requirements of secondary raw material producers.

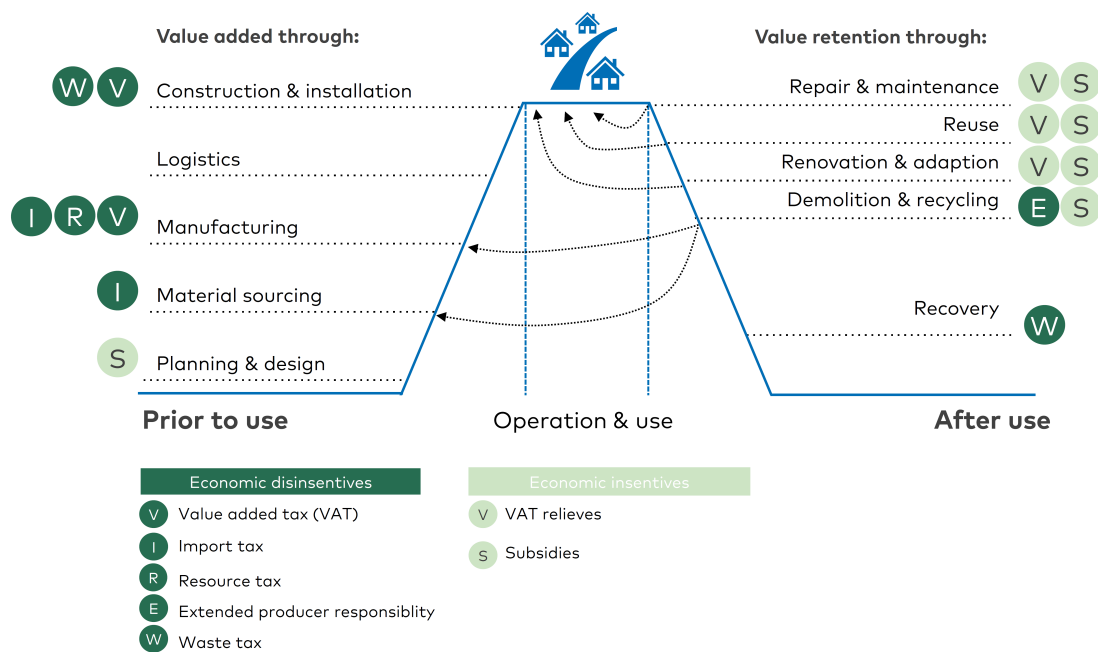


Figure 12: Outlook for possible economic instruments to promote circular economy in the construction sector

Source: Originally adapted from Achterberg, Hinfelaar, & Bocken, 2016

The construction sector is a significant consumer of natural resources, relying heavily on materials such as aggregates, minerals, and wood. **Natural resource taxes** for the construction sector could aim to reduce the extraction of natural resources by imposing a tax on the use of materials. However, it should be noted that the government and municipalities have major roles in many building projects. Natural resource tax might be passed on to the prices of end products, thus leading to unintended effects if the costs of the new taxes are mainly burdening the municipal budgets, instead of steering the industry's behavior.

A waste tax can be an efficient economic instrument in promoting circular economy practices, particularly in the manufacturing stage of the construction sector. By levying taxes on the generation and disposal of waste, companies are incentivized

to adopt sustainable practices, such as waste reduction, recycling, and resource recovery.

Savikko et al. (2022) estimate that in Finland, expanding the waste tax base and scope to include soil and rock waste fractions that are currently landfilled, would reduce the amount of waste landfilled by about 1.3 million tons. However, the study points out that an excessive waste tax could also lead to e.g., environmentally harmful alternatives, for example with transportation distances, and therefore suggests that further investigation is needed to explore the suitability of waste taxation as a means of directing the treatment of soil and rock materials that cannot be utilized. Also, the construction industry is hesitant as to whether a waste tax for soil and rock materials is a viable solution^[9]. The industry sees that as these virgin materials will always be needed in the construction sector to some extent, adding a tax would most likely only increase the costs without offering any reasonable alternatives. Furthermore, the quality requirements of soil-based construction materials in many applications can currently not be matched with recycled material options, and the availability of recycled materials living up to the quality requirements, cannot be guaranteed.

EPR is currently implemented for certain waste streams, such as packaging waste, but not extensively for the construction sector as a whole. Expanding this concept to cover the construction and demolition sector would encourage manufacturers and suppliers to take greater responsibility for the entire lifecycle of their products. However, as mentioned before, the construction sector is multifaceted and deals with various products that often are part of large, complex systems. Hence, the scoping of sensible target products for EPR might be difficult (CPA, 2022). Implementing EPR in the construction sector would require collaboration between various stakeholders and careful consideration of the specific challenges and dynamics of the industry.

Although **VAT** is not specifically designed to promote circular economy in the construction and demolition sector, it can indirectly influence sustainable practices. By adjusting VAT rates or offering reduced rates for environmentally friendly products and services, the construction sector can be encouraged to adopt circular economy principles, such as using recycled materials.

Import tax could be an option for construction sector, however further investigation is needed to see what kind of and how much in volumes materials or products for construction sector use are imported from regions subject to an import tax.

Subsidies could be targeted towards enhancing reuse activities.

There are some key characteristics and challenges that need to be considered when discussing circular economy in the construction sector and economic instruments. As mentioned, products in the construction sector often have a long lifespan such

9. Correspondence with the Confederation of Finnish Construction Industries RT 2/2023

as buildings, roads and bridges, thus economic instruments are likely to have a limited effect in the short run. Additionally, virgin materials are still largely needed in the construction sector, as the availability of recycled materials is not yet guaranteed. Especially reusing and recycling materials and components from older constructions is often complex. To get more recycled content into use in the construction industry, the industry needs more guidance and knowledge building, costs should be reasonable, value chains for recycled materials should be enforced and recycled content should be part of the building process already from early stages of design. Old buildings and other structures should be seen as material banks that which contents reused over and over. From economic instruments, such as waste tax could steer construction waste being directed through reuse or recycling activities back into use.

Estimating the impact of an economic instrument requires general equilibrium model analysis, due to the complexity of the value-chain perspective within the construction sector. The sector contains many different types of materials, several products groups and therefore many actors along the value-chain, which contributes further to its complexity. In the Nordics, both the industry and the policy makers are aware that the circularity of specific building materials is only a small part of the solution. Recycling solutions for concrete are for example already largely in use, but do not replace the need for virgin materials, as the circulated material cannot be reused as such for the same purposes. Instead, its typically used as filling material in new construction projects or aggregate in new concrete mixes. In the case of the Nordic construction sector, transforming the sector requires developing circular design and life-cycle models that enable the repurposing and reuse of whole buildings, their superstructures, and components. In addition, developing viable business models and markets for circular-economy products and services, including repair and renovation, are required (Sepponen et al. 2022).

Further circular opportunities in the sector can also be found e.g., in replacing single-use products and tools needed in construction activities with reusable products or leased products. Some examples include e.g., replacing single-used wooden scaffolds with reusable scaffolds, or leasing tools instead of owning them.

4 Environmental taxes to reduce environmental impacts

An environmental tax per unit of primary raw materials will increase the costs of using primary raw materials relative to the use of recycled raw materials. According to economic theory, this economic incentive will contribute to boost a shift of demand from primary raw materials to re-used virgin materials. This will in turn reduce the extraction of primary raw materials, thus reducing the negative environmental impact. As described in section 1.2, environmental taxes are classified into four categories, energy, transport, pollution, and resource taxes.

This chapter presents the results of the in-dept impact assessment for two case studies within the textile and construction sector, chosen to illustrate the impacts of a natural resource tax. The two cases are textile goods made of polyester and construction goods of cement. Moreover, the chapter also briefly discusses price elasticities and its differences between retail and e-commerce. Also, the environmental impact of women's apparel is presented and discussed for a variety of clothing. Initially, the chapter highlights the environmental and social costs of textile production and consumption. Furthermore, the chapter discusses how circular economy models can be used in combination with life cycle analysis, to design effective environmental policies. Lastly, limitations and disclaimers of the chosen methods, the available price elasticities as well as quantities are also highlighted within this chapter.

4.1 Scope and data collection – The textile sector

The case of polyester was chosen as an example of a broadly used, but environmentally rather unsustainable material. Polyester is a synthetic fibre derived from oil, and therefore non-biodegradable. It is internationally recognised to have a large environmental impact as the fibre is made through a chemical reaction which involves coal, petroleum, air, and water (Commonobjective, 2021). Since 2008, the proportion of polyester has increased from 31 to 58 percent in 2021 out of all fibres produced globally (Finnish Textile Fashion Association, 2021). The share of recycled polyester has increased from 8 to 15 percent during the same period (Finnish Textile Fashion Association, 2022). The process of producing polyester requires 125 MJ of energy, per kilogram produced fabric (Commonobjective, 2021). Thus, with the increased global demand for polyester the environmental burden is evident, and the need to apply circular economy strategies to promote sustainability is urgent.

4.1.1 The environmental and social costs of textile production and consumption

Significant negative environmental damages and climate impact within the textile sector occurs across the value-chain of all stages of the product- and material design, as well as during the use phase of a textile product. The textile and fashion industry are a resource intensive and polluting industry, as its production requires a large amount of raw materials, energy, water and chemicals. Inputs that cause air-, water- and soil emissions. The amount of water used depends on the type of fibre and its production method. However, it is of great concern that large parts of the product- and material design of textile products occur in developing countries, where there are already water shortages. Environmental damages on biodiversity losses occurring due to farming, and land use, and pressures from industries, is also an important aspect to consider. Furthermore, social issues, such as labour rights and gender equality are also significantly impacted by the textile value chain (Swedish Environmental Protection Agency, 2023; European Parliament, 2020 and 2019; United Nations Environment Programme, 2023).

Recently, a shift has started towards investing in circular business models with focus on circular textile designs within Europe, including the Nordic countries. These behavioural changes create opportunities for the Nordic countries to influence policies at EU level to include economic instruments in the design phase of a textile product. By imposing a natural resource tax, governments can steer production away from resources that are scarce or have a high negative environmental impact. As discussed in chapter 1.1, a natural resource tax could, e.g., be a raw material tax or an import tax.

A majority of the clothes and textiles that are sold in the Nordic countries are produced outside of the region and in many instances outside of the EU. It is therefore more reasonable to examine the implementation of a natural resource tax that is charged as an import tax within the textile sector. Thus, that a tax is applied for each gram of a certain material that is imported.

Production often takes place in low-wage countries, where environmental legislation is inadequate. Processing and garment production phases requires large amount of water and use of chemicals. Significant amounts of energy are further used for sewing, gluing, welding, and seam taping equipment. The energy used in the production process often originates from fossil energy sources such as coal. Moreover, chemicals are used at all stages of the textile production process (Swedish Environmental Protection Agency, 2023; European Parliament, 2020 and 2019). According to estimates, producing 1 kg of textiles requires 0.58 kg of harmful chemicals (United Nations Environment Programme, 2023). Furthermore, pesticides are used to grow raw materials such as cotton. As previously highlighted in chapter 2.2, only 2–3 percent of so-called fibre to fibre recycles occur on a global scale.

Figure 13 shows the carbon, water and waste footprint of clothing consumed in the EU during 2015. In terms of *per tonne of sold clothing*, it accounted to carbon emissions of 30 tonne CO₂ equivalents, 7 220 m³ of water use and 1.7 tonnes of waste.

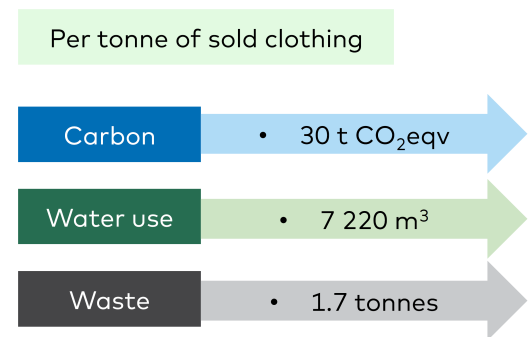


Figure 13: Carbon, water and waste footprint of clothing consumed in the EU (2015)

Source: Based on European Parliament, 2019

The textile production stages involve several actors. The largest negative external environmental effects can be seen among the fibre producers, textile manufactures, garment manufactures, as well as during the consumption use phase. During the agricultural production phase of textile fibres, large quantities of water is used. Combined with a global water scarcity it contributes negatively to earth's natural resources. When fibre and garment production occur, large quantities of fibre are lost due to the shredding of natural fibres. Additionally, large quantities of fabric waste are being produced throughout the garment processes. Large negative environmental effects can also be seen across the consumption use phase. Mainly because large amounts of electricity are being used to wash and dry garment. Another aspect to consider in this stage is the electricity mix^[10] of the textile producing country. Freshwater use is largest during the consumption use phase due to textile laundering (European Parliament, 2019; United Nations Environment Programme, 2023).

The textile sector includes several complex drivers and feedback loops, which includes many actors and various behaviors. By identifying the most effective solutions along the value chain, it may be possible to increase the circular economy in the sector, thus creating a systemic change.

Level of detail in the data

A data search was conducted for Finland, Sweden, and Norway in terms of finding data related to textile fibres, textile yarn and clothes made of polyester. This proved

10. Energy consumed across various fuels to produce electricity.

difficult, which is why the working group decided to make use of the Standard International Trade Classification (SITC) system, an international recognised classification of goods and services covering imports and exports (United Nations Statistics Division, 2006). The SITC classification provides data on general goods such as textile fibres, textile yarn, clothes, and shoes. However, it was not possible to find specific data on polyester. As the Nordic countries have limited national production of clothes and textiles (Naturvårdsverket, 2023a), it was decided that it is not relevant to include production data in this study. Instead, it was decided to focus the study on import data on volumes of textile fibres, textile yarn, clothing and footwear were collected for all three Nordic countries in this study.

For Norway, SITC data were collected from Statistics Norway into level 2. For Sweden, SITC data were collected from Statistics Sweden into level 2. For Finland SITC data were collected from the Finnish customs, into level 3. The closest relationship between clothes made from polyester and the import data found, is therefore data related to Finland and the sub-category of women's apparel.

4.2 Scope and data collection – The construction sector

The case of the effect of a tax on products made of cement within the construction sector was chosen as an example of a largely used material in a growth sector that faces increasing pressure to find less polluting and more sustainable alternatives.

To produce concrete, binders such as cement are needed to be used as glue, in combination with water, sand and gravel. Commonly, cement is used as a binder in concrete. However, when producing cement clinkers, there are also alternative binders such as clay, limestone, and volcanic ashes. Cement clinkers accounts for about 90 percent of concrete's total climate impact, why, using less clinker materials in concrete or replacing it with alternative, more sustainable materials, are two options to decrease the CO₂ intensity of cement production (Svensk betong, 2021).

The built environment is expected to grow due to urbanisation of several countries when new homes, schools, hospitals, and infrastructure is needed. Hence, cement is a key input to concrete, cement production follows a similar trend.

4.2.1 Cement production and carbon dioxide emissions

Reaching the overall goals of the EU Green Deal, to become the world's first climate-neutral continent by 2050, will require decarbonising the production of basic materials such as cement. The largest emissions trading system in the world, EU ETS, is a cornerstone of the EU policy to combat climate change. The EU's Carbon Border Adjustment Mechanism (CBAM) regulation will enter into force as of October 2023. It will include carbon dioxide emissions (CO₂) from intensive

production of goods such as cement, iron, steel, aluminum, fertilizers, electricity, and hydrogen (EU Commission, 2023a).

In 2021, the annual carbon dioxide emissions from cement accounted to 1051 million tonnes (Friedlingstein, P et al, 2022). This corresponds to the global cement production that accounts for approximately 8 percent of all global CO₂ emissions. On a global scale, it is the third largest industrial energy consumer. The global cement production accounted for 4270 Mt in 2021, where China is the largest consumer and producer, followed by India and the European Union (IEA, 2022a).

The annual carbon dioxide emissions from cement related to the years 2014, 2018 and 2021 in the Nordic countries in this study are shown in figure 14. The annual emissions peaked during 2018 across all three countries but have declined since the end of 2018.

As figure 14 shows, production of cement generates considerable emissions of carbon dioxide. Also, domestic cement production releases stored carbon dioxide from the limestone that is used as its raw material.

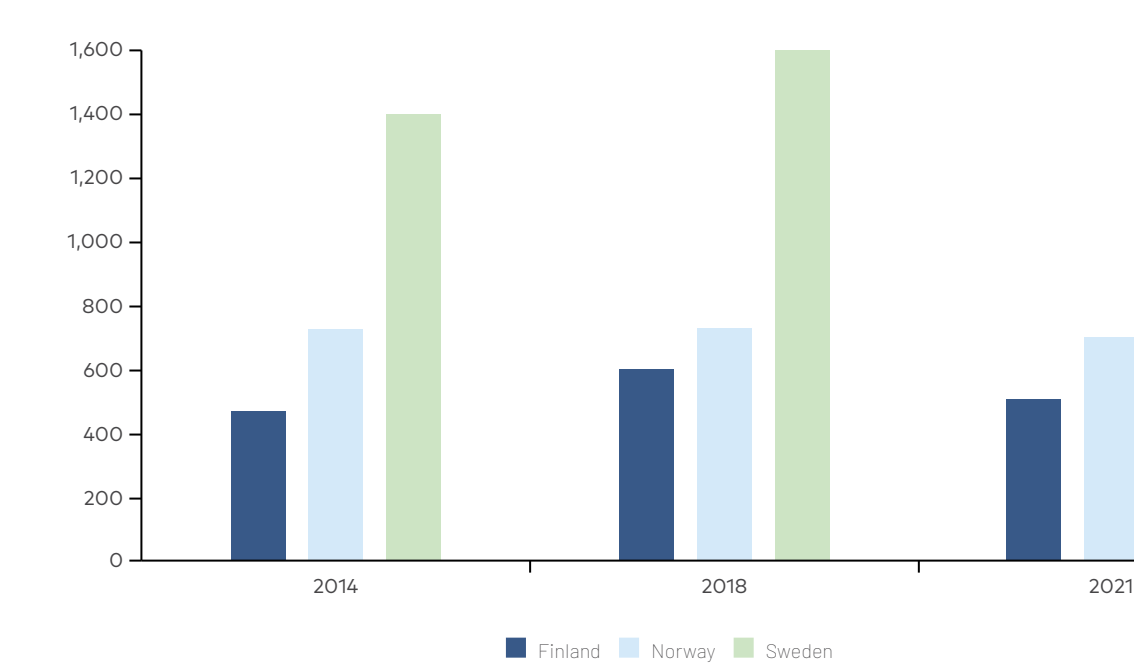


Figure 14: Annual carbon dioxide emissions from cement in Finland, Norway and Sweden (tonnes)

Source: Friedlingstein, P et al, 2022

A research study by Rootzén et al (2016) examined how the price increase in the cement industry affects prices throughout the cement supply chain. The results show that the expected price for emissions allowances for the cement industry under the EU ETS in the period until 2030 will not be enough to drive the required infrastructure and needed technological developments. According to the analysis the cost increases at multiple stages of the supply chain of cement. The result from this study indicates that complementary policy options are needed to influence the negative environmental impacts of cement.

Level of detail in the data

A data search was conducted for Finland, Sweden, and Norway in terms of finding data related to cement. It was decided to make use of the international classification of commodity codes (CN) of level 4, 6 and 8.

Production, import and export data on volumes of cement and cement clinkers were collected for all three Nordic countries included in the in-depth study.

4.3 Price elasticities of demand: Assessing the impact of a natural resource tax in the textile and construction sector

To be able to study the sensitivity or effect of a natural resource tax it is common to make use of the concept of price elasticities. According to economic theory, a negative elasticity of demand illustrates the Law of Demand, i.e. consumers tend to demand less quantity as the price increases of a specific good (Perloff, 2018). Price sensitivity of a certain good to which extent the consumer purchasing behaviour changes, is a complex area. It is determined by several factors such as the price of substitutes and complements, i.e., goods that can serve the same purpose or goods that add value when consumed together, the consumers income and future price expectations (Dwivedi, D N., 2016).

Price elasticity of demand measures how a change in the price of a good affects the quantity demanded of the good, meaning that a price elasticity gives the percentage change in quantity when the price is increased by one percent, holding everything else constant. Demand for a good is inelastic when the elasticity is less than one in absolute value, i.e. changes in price have a relatively small effect on quantity. The opposite applies when the elasticity is greater than one and the demand for a good is said to be elastic (Browning, Edgar K., 1992).

This analysis uses price elasticities to study how a natural resource tax in the textile- and construction sector would affect the demand, e.g. how a tax on imported polyester would change the demanded quantity of goods made of polyester.

The elasticity of demand varies along the demand curve. In this analysis, a general linear demand curve has been assumed, thus the higher the price, the more elastic the demand curve (larger negative number).

Price elasticity of demand can be written as:

$$\varepsilon = \frac{\text{percentage change in quantity demanded}}{\text{percentage change in price}} = \frac{\frac{\Delta Q}{Q}}{\frac{\Delta p}{p}}$$

Where ε is the price elasticity of demand, ΔQ equals the change in the demanded quantity Q and $\frac{\Delta Q}{Q}$ is the percentage change in the quantity demanded. Δp is the change in price and $\frac{\Delta p}{p}$ is the percentage change in price.

4.3.1 Calculating a natural resource tax

By using price elasticity of demand, it is possible to study how the quantity demanded, changes in response to a change in a natural resource tax. The tax is calculated using the following equation:

$$\text{percentage change in price} = \frac{\text{percentage change in quantity demanded}}{\text{price elasticity}} = \frac{\frac{\Delta Q}{Q}}{\varepsilon}$$

4.3.2 Price elasticities in the textile sector

To obtain price elasticities for the textile sector, a systematic literature review^[11] was conducted. It was not possible to find price elasticities for different types of materials, nor was it possible to find country-specific price elasticities for Finland, Norway, and Sweden. Additionally, as a second step, a systematic literature review was conducted with the aim to find relevant cross-price elasticities^[12]. However, no relevant cross-price elasticities could be found for this study.

The best option for the scope of this study was price elasticities for e-commerce specifically women's cardigans and men's footwear, as well as a price elasticity for clothes in e-commerce. The potential differences between price elasticities in physical stores and e-commerce are discussed in section 4.3.2.1. To closer capture the price elasticity of different types of materials a price elasticity for textile fibres is also included. The values and their corresponding standard errors used are presented in table 3. The elasticities in table 3 imply that a 1 percent price change decreases the demanded quantity by 1.5, 1.7, 1.62 or 1.27 percent, depending on which of the elasticities that is being interpreted.

11. The review included open access articles through google scholar as well as articles available through Science Direct covering price elasticities in the textile and construction sector, as well as specific price elasticities for different resources, materials and countries or regions.

12. Cross-price elasticities measure the effect of changes in the price of one good on the quantity demanded of another good.

Table 3: Elasticities used in the calculation of a tax, textile sector

Note: N/A is an acronym for not available

Type of elasticity	Value	Standard error	Source
Own-price, cardigans women e-commerce, mean effect	-1.5	N/A	Heuer, Brettel and Kemper (2015)
Own-price, sneakers men e-commerce, mean effect	-1.7	N/A	Heuer, Brettel and Kemper (2015)
Own-price e-commerce, mean	-1.62	0.02	Heuer, Brettel and Kemper (2015)
Price elasticity, textile fibres	-1.27	0.11	Schier, Morland, Dieter and Weier (2021)

To get robust results, 95-percent confidence intervals are presented in Appendix A for those cases where standard errors were available. This means that there is 95 percent certainty that the tax level needed is included in these intervals. For the elasticity values which do not have standard errors available, a confidence interval of +/- 30 percent is calculated. These estimates exhibit more uncertainty than those with 95-percent confidence intervals.

4.3.2.1 Differences between price elasticities and its implication

Three out of the four elasticities included are calculated using e-commerce. Previous studies indicate that when applying absolute values, price elasticities are higher within retails in physical stores compared to e-commerce (Zhang & Demirkan 2021; Chu, Chintagunta & Cebollada, 2008). Zhang and Demirkan (2021) estimated that price elasticities for packaged goods, e.g., toothbrushes, differ between -1.74 on average in physical stores and -0.87 on average in e-commerce.

The data in this study includes e-commerce as well as physical stores, indicating that it is probable that the price elasticities used, are lower than the true price elasticity. This implies that the results are overvalued, i.e., the tax level needed to decrease the demanded quantity, is lower than the results indicate.

4.3.3 Price elasticities in the construction sector

Just as for the textile sector, a systematic literature review was conducted to obtain price elasticities for the construction sector. Finding country-specific elasticities for Finland, Norway and Sweden proved difficult. This study uses elasticities calculated using the Norwegian cement industry (Röller and Steen, 2005). It is plausible to assume that the three Nordic countries have relatively

similar purchasing power and income structures. Thus, two price elasticities are included. One which account for short-run dynamics and one accounting for long run. The first considers that one or more factors of production is fixed in the short run, whereas the second one considers no factor of production is fixed in the long run. The elasticities are -0.46 and -1.47 respectively. This implies that a 1 percent change in the price of cement decreases the demanded quantity by 0.46 percent in the short run and 1.47 percent in the long run. A confidence interval of +/- 30 percent is presented in Appendix B.

Table 4: Elasticities used in the calculation of a tax, construction sector

Note: N/A is an acronym for not available

Type of elasticity	Value	Standard error	Source
Own-price elasticity in the short run, cement	-0.46	N/A	Röller and Steen (2005)
Own-price elasticity in the long run, cement	-1.47	N/A	Röller and Steen (2005)

Stede et al. (2021) examined carbon leakage risks and incentives across the product value chain by conducting input-output modelling and analysis on carbon pricing of basic materials, including cement. The study assumed a demand elasticity of -0.5, which is close to the short run elasticity presented in Table 4.

4.3.4 Limitations and disclaimers

There are limitations to the chosen method and the available price elasticities and quantities. This report examines the potential impact of a natural resource tax on imported polyester but when calculating for the textile sector, both elasticities and quantities applies to final products, i.e., clothes or textile fibres. In this context, textile fibres have the closest relation to the raw material used but includes more than polyester.

The results for the construction sector are closer since price elasticities and quantities for cement is used. Due to confidentiality the total quantity of demanded cement in Norway does not include production of all types of cement, e.g., the production of Portland cement is excluded in the Norwegian case study.

Applying a 95-percentage confidence interval in those instances where standard errors are available indicates uncertainties in the calculated tax levels. See appendix A and B for results including a 95-percentage confidence interval. It is important to note that although a natural resource tax leads to a decrease in quantity demanded of the taxed material, it is uncertain if the demanded quantity is shifted towards other materials, which may or may not be more environmentally sustainable.

4.4 Impacts of an import tax in the textile sector

With an overall purpose to tax the use of natural resources, this sub-chapter examines the impact of a natural resource tax that is charged at the border as an import tax. The study is making use of SITC 2 level data related to import of textile fibres and articles of apparel and clothing accessories, as well as footwear (Finnish Customs Agency, 2022a; Statistics Sweden, 2022a; Statistics Norway, 2022b). All data is related to 2022.

For Finland, it was possible to collect data at the SITC 3 level within the textile sector. Considering that one of the chosen price elasticities applies to women's cardigans in e-commerce data for women's or girl's clothes were therefore collected. This includes coats, capes, jackets, suits, trousers, shorts, shirts, dresses and skirts, underwear, nightwear, and similar articles of textile fabrics, not knitted or crocheted (Finnish Customs Agency, 2022a).

In the next sections, the results for Finland, Sweden and Norway are presented.

4.4.1 Finland

Table 5 presents the needed tax level to decrease quantity demanded by 500, 1 000 or 2 000 tonnes. In Finland, this corresponds to between 2 and 6 percent of all imported textile fibres. As for articles of apparel and footwear, it corresponds to a total quantity between 1 and 3 percent, and 4 and 14 percent respectively. For the item women's or girl's clothes not knitted, it corresponds to between 7 and 29 percent of the total quantity.

The results vary depending on which elasticity is used but are more dependent on the total quantity of the material, or item examined. For textile fibres, a tax of 1, 3 and 5 percent would decrease quantity demanded by 500, 1 000 and 2 000 tonnes respectively. For articles of apparel and clothing accessories the needed tax level is lower, approximately 1 to 2 percent. The needed tax level to decrease the quantity demanded of footwear is higher, 2 to 9 percent depending on which elasticity is used, and the desired decrease in quantity. These results highlight the difficulty in predicting the needed tax level to decrease quantities of textiles made of polyester, as the state of play involves behaviour changes of fibre producers, consumers, importers, and many other actors along the complex value-chain in the textile sector, as previously discussed in sub-chapter 4.1.1.

Table 5 also illustrates that a relatively high tax is needed to lower the demanded quantity of women's or girl's clothes. A 5, 10 or 19 percent tax is needed to decrease quantity demanded by 500, 1 000 or 2 000 tonnes. Table A4 in Appendix A illustrates the more extreme case of a decrease in the demanded quantity by 5 000 tonnes.

Table 5: Change in quantity demanded by 500, 1 000 and 2 000 tonnes, Finland

The table shows the tax level needed to decrease quantity demanded. Confidence-intervals is presented in Table A1-A3 in Appendix A.

Type of material or item	Decreased quantity	Used elasticity			Textile fibres
		Cardigans women e-commerce	Sneakers men e-commerce	E-commerce	
Textile fibres (other than combed wool) and their wastes	500 tonnes				1%
	1 000 tonnes				3%
	2 000 tonnes				5%
Articles of apparel & clothing accessories	500 tonnes	1%		<1%	
	1 000 tonnes	1%		1%	
	2 000 tonnes	2%		2%	
Footwear	500 tonnes		2%	2%	
	1 000 tonnes		4%	4%	
	2 000 tonnes		8%	9%	
Women's or girl's clothes, not knitted*	500 tonnes	5%		4%	
	1 000 tonnes	10%		9%	
	2 000 tonnes	19%		18%	

* Includes coats, capes, jackets, suits, trousers, shorts, shirts, dresses and skirts, underwear, nightwear and similar articles of textile fabrics, not knitted or crocheted.

4.4.2 Sweden

Table 6 presents the tax level needed to decrease quantity demanded by 500, 1 000 or 2 000 tonnes in Sweden. This corresponds to 1, 2 and 4 percent of all imported textile fibres. Around 1 percent of articles of clothes and 1, 3, and 5 percent of footwear.

The needed tax levels are lower than those of Finland. Less than 1 percent, 1 or 3 percent to decrease quantity demanded by 500, 1 000 and 2 000 tonnes for textile fibres. Sweden has a relatively high total quantity of articles of apparel and clothing accessories, which means that a relatively low tax, approximately 1 percent, decreases quantity demanded.

Table A8 in appendix A shows, that to decrease quantity demanded by 5 000 tonnes, a tax of 2 percent is needed. As for footwear, a tax of between 1 and 3 percent decreases quantity demanded by 500, 1 000 and 2 000 tonnes. Table A8 in Appendix A also presents a decrease in the demanded quantity by 5 000 tonnes for each of the materials or items in Table 6.

Table 6: Change in quantity demanded by 500, 1 000 and 2 000 tonnes, Sweden

The table shows the tax level needed to decrease quantity demanded. Confidence-intervals is presented in Table A5-A7 in Appendix A.

Type of material or item	Decreased quantity	Used elasticity			Textile fibres
		Cardigans women e-commerce	Sneakers men e-commerce	E-commerce	
Textile fibres (other than combed wool) and their wastes	500 tonnes				<1%
	1 000 tonnes				1%
	2 000 tonnes				3%
Articles of apparel & clothing accessories	500 tonnes	<1%		<1%	
	1 000 tonnes	<1%		<1%	
	2 000 tonnes	<1%		<1%	
Footwear	500 tonnes		<1%	<1%	
	1 000 tonnes		2%	2%	
	2 000 tonnes		3%	3%	

4.4.3 Norway

Table 7 presents the tax level needed to decrease quantity demanded by 500, 1 000 or 2 000 tonnes. In Norway, this corresponds to 7, 14 or 27 percent of all imported textile fibres. As for articles of clothes, it corresponds to approximately 1 to 3 percent, and for footwear 3, 5 and 10 percent, respectively.

The needed tax level to decrease quantity demanded by 500, 1 000 and 2 000 tonnes for textile fibres is 5, 11 and 21 percent. As for articles of apparel and clothing accessories the needed tax level is between 0 and 2 percent, and for footwear 2, 3 and 6 percent.

Table 7: Change in quantity demanded by 500, 1 000 and 2 000 tonnes, Norway

The table shows the tax level needed to decrease quantity demanded. Confidence-intervals is presented in Table A9-A11 in Appendix A.

Type of material or item	Decreased quantity	Used elasticity			Textile fibres
		Cardigans women e-commerce	Sneakers men e-commerce	E-commerce	
Textile fibres (other than combed wool) and their wastes	500 tonnes				5%
	1 000 tonnes				11%
	2 000 tonnes				21%
Articles of apparel & clothing accessories	500 tonnes	<1%		<1%	
	1 000 tonnes	<1%		<1%	
	2 000 tonnes	2%		2%	
Footwear	500 tonnes		2%	2%	
	1 000 tonnes		3%	3%	
	2 000 tonnes		6%	6%	

4.4.4 Change in quantity demanded by 10 percent

Table 8 presents the tax level needed to decrease quantity demanded by 10 percent. For Finland, this corresponds to approximately 3 100 tonnes of textile fibres, 6 400 tonnes of articles of apparel and 1 400 tonnes of footwear. For Sweden, it corresponds to approximately 5 600 tonnes of textile fibres, 19 000 tonnes of articles of apparel and 4 000 tonnes of footwear, and for Norway 700, 7 500 and 2 000 respectively.

The tax level needed to decrease the quantity in each country by 10 percent, is 8 percent for textile fibres. For articles of apparel the tax level is 6 to 7 percent, and for footwear 6 percent.

Table 8: Change in quantity demanded by 10 percent

The table shows the tax level needed to decrease quantity demanded by 10 percent. Confidence-intervals is presented in Table A13 in Appendix A.

Type of material or item	Used elasticity			Textile fibres
	Cardigans women e-commerce	Sneakers men e-commerce	E-commerce	
Textile fibres (other than combed wool) and their wastes				8%
Articles of apparel & clothing accessories	7%		6%	
Footwear		6%	6%	

4.4.5 Environmental impact of polyester in women's clothes

As previously discussed in sub-section 4.1.1, the textile and fashion industry's impact on the earth's resources is extensive and occurs throughout a long and complex supply chain. To illustrate this on an overall level, and to show how a tax on polyester might affect carbon dioxide emissions in the textile sector, the environmental impact of polyester in a variety of women's clothes is presented in Table 9. The purpose of this section is to provide an insight to the amount of carbon equivalents, as well as the complexity of the textile sector. This is a simplified analysis, which only takes certain textiles into consideration based on fibre type. Obviously other types of fibre than polyester such as cotton, silk or wool also has related carbon emissions, but they are left out of the scope in this study.

The estimates are based on a Mistra Future Fashion report where Sandin et al. (2019) use life cycle assessment (LCA) and a Swedish case study to evaluate the environmental impact of different garments. They conclude that a dress weighing 478 grams, made of 100 percent polyester has an environmental impact of approximately 14.5 kilograms CO₂ equivalents in the production of the dress^[13].

Based on this, the environmental impact of a variety of women's apparel is presented in Table 9. A pair of women's pants weighing 298 grams and containing 83 percent polyester has an impact of approximately 7.5 kg CO₂ equivalents. A summer dress weighing 176 grams and consisting of 100 percent polyester has an impact of approximately 5.3 CO₂ equivalents. The smallest impact (excluding those items which did not contain polyester) is found from the garment containing the

13. Includes the different steps needed when producing the dress as well as transports in production.

lowest amount of polyester. A cardigan weighing 231 grams and containing 23 percent polyester, which has an impact of 1.6 kg CO₂ equivalents.

In conclusion, clothes containing high amounts of polyester have a relatively high impact. This result indicates that imposing a natural resource tax on textile goods that are imported and made from polyester, can in theory have a positive impact on the circular transition.

Table 9: The environmental impact of polyester in women's clothes

Note: This table presents the environmental impact of polyester in a variety of women's clothes. The impact from other materials in clothes are excluded.

Type of women's apparel	Weight (in gram) ^[14]	Amount of polyester (%) ^[15]	Impact of polyester, kg CO ₂ equivalents
Jeans	320	32%	3.1
Blouse	124	100%	3.8
Dress, summer	176	100%	5.3
Cardigan, summer	231	23%	1.6
Cardigan, winter	293	0%	0
Skirt, summer	136	0%	0
Blazer	446	25%	3.4
Shirt	212	0%	0
Trousers	298	83%	7.5
Camisole	96	100%	2.9

4.4.6 The benefits of integrating circular economy models and life cycle analysis for policy analysis

Policy analysis based upon life-cycle perspective and general equilibrium, are not widely addressed in research literature to date. A research study by Hennlock et al. (2021) developed an integrated circular economy model with life cycle analysis (LCA). The aim of the research was to identify and analyse if policy combinations

14. These weights (in gram) are assumptions made for the various types of women's apparel.

15. The amount of polyester in each type of apparel is made of assumptions, and obviously does not represent all.

related to set goals, or socially efficient solutions that involve a transition from linear to circular flows, could efficiently be used to boost the transition to a circular economy. As the market for a specific product is interconnected via flows of materials, production, energy, waste treatment and consumption, a policy instrument targeting a specific actor is likely to affect behaviours of other actors along the value chain. Also, external effects come into play. All these effects can be both positive and negative.

LCA models compile the environmental impacts of a specific product and are supported by data from a larger number of actors on these markets, along the value chain. The LCA models also contain an assessment of a product's energy- and resource allocation and its related climate emissions.

The study by Hennlock et al. (2021) found that an interdisciplinary strategy that combines a circular economy model with LCA, could efficiently be used to identify the environmental impact, that each actor causes along the value chain. The authors suggests that in order to achieve a reduced environmental impact and close the loop, it is necessary to use a combinations of policy instruments which in turn requires to have knowledge of:

- a. What type of environmental impact category you want to reduce
- b. Identify the actors in the value chain that contributes the most to this impact
- c. Identify which of the flows within these life-cycle phases that produces this impact
- d. Identify how these flows are affected by policy instruments

Obviously, the Nordic countries cannot influence the production processes in other countries, in terms of imposing economic instruments for example in the textile sector in other countries. Even though the Nordic countries cannot influence the outcome of implementing taxes and/or subsidies at the raw material stage in specific countries, it is possible to advance policy instruments further along the value-chain, by moving from the material processing and sorting stage, towards production and textile imports.

The research results by Hennlock et al. (2021) show that it is possible for the Nordic countries to let the *textile importer* of a specific good bear the environmental charges, fees or taxes corresponding to the external effects caused by the design and production. As well as levy a *consumption tax*, that corresponds to the external effects caused by consumption. These economic variables often refer as differentiated upstream taxes on foreign production.

A *consumption tax on textile products* can be levied by the importer when the consumer buys the goods, if it is incorporated with the good, thus they are not already levied from other taxes on e.g. electricity consumption for washing clothes.

Additionally, a *subsidy* for reuse or recycling is needed when the textile product is returned by the consumer. This can be paid with a fee that is charged by the textile importer at the time of the purchase, i.e., via a deposit system.

By measuring the external effects from these actors, this recommended combination of economic instruments may provide full internalization^[16]. If the external effects from the linear flow are greater than the circular economy flow, the research result reveals that the taxes and subsidies will be so large, that the linear, traditional flows are replaced by circular flows. Nevertheless, this is an area for future studies.

4.5 Impacts of a natural resource tax in the construction sector

With an overall aim to reduce national consumption of cement, this study examines the effect of imposing a natural resource tax in the construction sector. For this purpose, production, import and export data related to concrete and cement, including clinkers, at level CN4, CN6 and CN8 within the construction sector were collected for all three countries (Finnish Customs Agency, 2022b; Statistics Finland, 2023b; Statistics Sweden, 2023c; Statistics Sweden, 2023d; Statistics Norway, 2023b; Statistics Norway, 2023c). However, as mentioned in section 4.4.3 price elasticities could only be found for cement. Therefore, the raw material tax in this section is focused on cement. More specifically products included in the CN4 level code for cement including cement clinkers, whether or not coloured was included in the analysis. This also includes e.g. Portland cement. All data is related to year 2021. As for Norway, some production data are excluded from the total quantity due to confidentiality.

In the next sections, the results for Finland, Sweden and Norway are presented.

4.5.1 Finland

Table 10 shows the needed tax level to decrease quantity demanded of cement by 50 000 or 100 000 tonnes in both the short- and long run. This corresponds to approximately 2 and 4 percent of total quantity.

To decrease quantity demanded by 50 000 tonnes in the long run an approximately 1 percent tax is needed. To instead decrease quantity by 100 000 tonnes a 3 percent tax is needed. In the short run a higher tax is needed. A 5 percent tax decreases quantity demanded with 50 000 tonnes in the short run, whereas a decrease of 100 000 tonnes requires a 9 percent tax.

16. Internationalization means taking the negative external effects into account, such as environmental degradation. Include external costs of environmental pollution in the total cost of the product.

In Table B3 and B4 in Appendix B, the tax levels needed to decrease quantity demanded by 200 000 tonnes and 500 000 tonnes are also presented.

Table 10: Change in quantity demanded by 50 000 and 100 000 tonnes, Finland

The table shows the tax level needed to decrease quantity demanded. Confidence-intervals of +/- 30 percent is presented in Table B1-B2 in Appendix B.

Type of material or item	Decreased quantity	Used elasticity	
		Own-price elasticity cement, short run	Own-price elasticity cement, long run
Cement, including cement clinkers, whether or not coloured	50 000 tonnes	5%	1%
	100 000 tonnes	9%	3%

4.5.2 Sweden

Table 11 shows the needed tax level to decrease quantity demanded of cement by 50 000 or 100 000 tonnes, which corresponds to approximately 1.5 and 3 percent of demanded quantity in Sweden. In the short run, a tax level of 3 or 7 percent would decrease quantity demanded by 50 000 and 100 000 tonnes respectively. In the long run, a lower tax level is needed, 1 to 2 percent.

Table B7 and B8 in Appendix B presents the tax levels needed to decrease quantity demanded by 200 000 tonnes and 500 000 tonnes.

Table 11: Change in quantity demanded by 50 000 and 100 000 tonnes, Sweden

The table shows the tax level needed to decrease quantity demanded. Confidence-intervals of +/- 30 percent is presented in Table B5-B6 in Appendix B.

Type of material or item	Decreased quantity	Used elasticity	
		Own-price elasticity cement, short run	Own-price elasticity cement, long run
Cement, including cement clinkers, whether or not coloured	50 000 tonnes	3%	1%
	100 000 tonnes	7%	2%

4.5.3 Norway

Table 12 shows the needed tax level to decrease quantity demanded of cement by 50 000 or 100 000 tonnes, which corresponds to approximately 4 and 8 percent of demanded quantity in Norway. In the short run, a tax level of 8 and 17 percent would decrease quantity by 50 000 and 100 000 tonnes. In the long run, a lower tax level is needed, 3 and 5 percent.

Table B11 in Appendix B presents the tax levels needed to decrease quantity demanded by 200 000 tonnes.

Table 12: Change in quantity demanded by 50 000 and 100 000 tonnes, Norway

The table shows the tax level needed to decrease quantity demanded. Confidence-intervals of +/- 30 percent is presented in Table B9-B10 in Appendix B.

Type of material or item	Decreased quantity	Used elasticity	
		Own-price elasticity cement, short run	Own-price elasticity cement, long run
Cement, including cement clinkers, whether or not coloured ^[17]	50 000 tonnes	8%	3%
	100 000 tonnes	17%	5%

4.5.4 Change in quantity demanded by 10 percent

Table 13 presents the tax level needed to decrease the demanded quantity of cement by 10 percent. For Finland, this corresponds to approximately 243 00 tonnes, for Sweden 325 000 tonnes and for Norway 131 000 tonnes.

To decrease the demanded quantity in the short run, a tax level of 22 percent is needed. A lower tax level, 7 percent, is needed in order to decrease demand in the long run.

17. *Some production data is excluded from the total quantity due to confidentiality, e.g., Portland cement.

Table 13: Change in quantity demanded by 10 percent

The table shows the tax level needed to decrease quantity demanded by 10 percent. Confidence-intervals of +/- 30 percent is presented in Table B12 in Appendix B.

Type of material or item	Used elasticity	
	Own-price elasticity cement, short run	Own-price elasticity cement, long run
Cement, including cement clinkers, whether or not coloured	22%	7%

4.6 Key findings

As for *the textile sector* the results indicate that, although there are cases where a relatively low tax would decrease the demanded quantity, the decrease would be percentage-wise small compared to the total quantity. Instead, a rather high import tax is needed to achieve any substantial decrease in the quantity of textiles made of polyester. Combined with the fact that a systemic transformation is needed across several actors, along a complex value-chain this makes a hard case to crack. In a perfect world implementing an import tax on *textile products* made of polyester could decrease the quantity demanded of *textile fibres* by 2 000 tonnes. In Finland a tax level of 5 percent is needed. For Sweden, the results for the same item indicate a tax level of 3 percent, and for Norway, the needed tax level is 21 percent.

The results from the *construction sector*, in terms of measuring the effect of implementing a natural resource tax on *cement*, show that to decrease the quantity demanded by 100 000 tonnes in the short run, a tax level of 9 percent is needed in Finland. In Sweden a tax level of 7 percent is needed, and in Norway, it is 17 percent. In the long run, all countries' results indicate lower tax levels. In conclusion, to decrease quantity demanded of cement in the short run, a relatively high natural resource tax is needed, and in the longer run a lower tax level is needed.

Even though the results reveal that a raw material tax leads to a decrease in the quantity of used virgin raw material, it is not certain that it will create a shift towards more sustainable substitutes. Likewise, the study of the effects of imposing a tax on one material might have complex effects that are not foreseen by the calculations.

Studying the price sensitivity of a certain good and its anticipated effects on consumer behaviour is a complex area, as it is determined by numerous circumstances such as reference price, ease of comparison and price unfairness. The textile related data in this study include both physical stores and e-commerce,

which most likely sheds light to the fact that the price elasticities used, are lower than the true price elasticity. This implies that the tax level needed to decrease demand quantities are lower than the presented results indicate. Presently, there is much ongoing research, but more research is needed in terms of Nordic price elasticities across different parts of the value-chains across the textile- and construction sectors.

This analysis shows that there are no simple solutions when creating incentives for circularity in complex and global value chains. Previous studies on the subject of economic instruments in a circular economy and value-chains (see e.g., Hennlock et al. 2021), indicate that a combination of policy instruments is needed to achieve behavioural change. The intricacy of the textile sector suggests that a combination of economic instruments along the value chain are needed for transforming the entire textile sector to a circular economy.

Similarly, the value chain in the construction sector involves many actors with different roles, such as investors, clients, consultants, and sub-contractors. Incentivising a behavioural change across all these actors by introducing a natural resource tax on certain construction materials and promoting sustainable sourcing practices, is complex.

To conclude, finding an effective combination of economic and other policy instruments is key, when the public sector aspires to incentivise the markets for sustainable textiles and sustainable construction materials. Previous studies on the subject of transforming the supply chain for the construction sector towards sustainability such as Sepponen et al. (2022), Karlsson et al. (2020) and Rootzén et al. (2016) indicate that a variety of policies and strategies are needed to transform the sector. The outcome of this study points to the same direction.

5 Conclusions and recommendations

This study has highlighted how economic policy instruments can play a crucial role in promoting a circular economy in the Nordic countries. It examined the role of the textile- and construction sector in the circular transition across Finland, Norway, and Sweden. The study used in-depth analysis of price elasticities to illustrate how a natural resource tax in the textile- and construction sector would affect the quantity demanded of goods made of polyester and cement. The analysis used in the study is based on linear changes which would be approximations with less validity for large changes in tax levels. In reality, both these sectors have complex value-chains that include many actors.

The results reveal that environmental taxes, such as natural resource taxes can be used to affect the markets and consumer behaviour. However, the findings indicate that the tax level needs to be quite high to incentivize a shift towards circular economy, thus putting some question marks on its viability as a politically feasible policy instrument. The findings also indicate that an environmental tax, such as a natural resource tax alone will not be an effective instrument in the two studied sectors. There are also difficulties in anticipating its environmental and socio-economic impacts without advanced modelling methods, as the value-chains in both studied sectors are complex.

Aspects that need to be considered when dealing with complex and often global value chains include:

1. the location of the production taking place throughout the value chain
2. the availability of sustainable substitutes
3. the value of the circulated material

In many cases, climate and environmental impacts can be reduced by introducing more sustainable materials and methods of production, as well as policies and regulations that promote production which eliminate pressure on water, energy, and chemicals.

A combination of economic instruments, other policy instruments and investments in resource efficient business models, is a prerequisite for achieving socially efficient higher-value material loops. For the textile sector an internalizing combination of economic instruments could be e.g., a textile import tax, consumption tax on textile products, and subsidies targeting reuse or recycling of textiles.

Economic policy instruments are then correcting market failures, maintaining a linear economy by making it unprofitable for business. As such, economic instruments can incentivize systemic change through the value-chain that is needed, especially to close material loops. It is essential that economic instruments are sufficiently stringent as traditional, linear value chains are challenging to change solely with low economic incentives, when they are upheld by various regulatory, market and cultural barriers.

Another challenge lies in effectively designing, modelling, monitoring, and measuring the impact of economic instruments. After implementation, it is essential to evaluate progress and ensure that the desired outcomes are achieved, as well as continuously identify and monitor unsought trade-offs and unintended consequences. For example, environmental considerations can lead to severe socio-economic challenges in some regions, or cost savings from labour practices may compromise social or ethical considerations.

Conclusively, this study identifies a need for continued analysis on what kind of combination of economic policy instruments would be most effective in incentivising the circular transition in the Nordics

- Specifically, we recommend looking into further possibilities of introducing and expanding combinations of waste taxes, VAT practices, and EPR schemes.
- With regard to both construction and textiles/clothing, the main priority should be on prolonging the life span of existing products, and investigating alternative ownership models, in order to decrease the overall need for new material.
- To better support the circular transition in the Nordics, a combination of economic instruments is needed, due to the complexity of the textile- and construction sectors respective value chains.

To be able to give more concise answers to when environmental taxes, such as natural resource taxes should be part of the solution, there is a need for more research on Nordic price elasticities across different parts of the value-chains in the textile and construction sector. As well as, in general, to make use of life-cycle analysis and circular economy models to design effective environmental policies.

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Appendix A – Results for the textile sector, import tax levels

Finland

Table A1: Change in quantity demanded by 500 tonnes

The table shows the tax level needed to decrease quantity demanded by 500 tonnes. Confidence-intervals is presented in parentheses.

Type of material or item	Used elasticity			
	Cardigans women e-commerce	Sneakers men e-commerce	E-commerce	Textile fibres
Textile fibres (other than combed wool) and their wastes				1% (0% - 2%)*** (-20% - 23%)**
Articles of apparel & clothing accessories	<1% (0% - 1%)***		<1% (0% - 1%)*** (-3% - 4%)**	
Footwear		2% (1% - 3%)***	2% (1% - 3%)*** (-2% - 7%)**	
Women's or girl's clothes, not knitted*	5% (3% - 7%)***		4% (3% - 6%)*** (0% - 9%)**	

* Includes coats, capes, jackets, suits, trousers, shorts, shirts, dresses and skirts, underwear, nightwear and similar articles of textile fabrics, not knitted or crocheted.

**95 percentage confidence intervals.

***Confidence-intervals of +/- 30 percent.

Table A2: Change in quantity demanded by 1 000 tonnes

The table shows the tax level needed to decrease quantity demanded by 1 000 tonnes. Confidence-intervals is presented in parentheses.

Type of material or item	Used elasticity			
	Cardigans women e-commerce	Sneakers men e-commerce	E-commerce	Textile fibres
Textile fibres (other than combed wool) and their wastes				3% (1% - 4%) ^{***} (-19% - 25%) ^{**}
Articles of apparel & clothing accessories	1% (0% - 2%) ^{***}		1% (0% - 2%) ^{***} (-3% - 5%) ^{**}	
Footwear		4% (2% - 6%) ^{***}	4% (3% - 6%) ^{***} (0% - 9%) ^{**}	
Women's or girl's clothes, not knitted*	10% (6% - 13%) ^{***}		9% (6% - 12%) ^{***} (4% - 13%) ^{**}	

* Includes coats, capes, jackets, suits, trousers, shorts, shirts, dresses and skirts, underwear, nightwear and similar articles of textile fabrics, not knitted or crocheted.

**95 percentage confidence intervals.

***Confidence-intervals of +/- 30 percent.

Table A3: Change in quantity demanded by 2 000 tonnes

The table shows the tax level needed to decrease quantity demanded by 2 000 tonnes. Confidence-intervals is presented in parentheses.

Type of material or item	Used elasticity			
	Cardigans women e-commerce	Sneakers men e-commerce	E-commerce	Textile fibres
Textile fibres (other than combed wool) and their wastes				5% (3% - 7%)***
Articles of apparel & clothing accessories	2% (1% - 3%)***		2% (1% - 3%)*** (-2% - 6%)**	
Footwear		8% (5% - 11%)***	9% (3% - 6%)*** (4% - 13%)**	
Women's or girl's clothes, not knitted*	19% (13% - 25%)***		18% (12% - 23%)*** (13% - 22%)**	

* Includes coats, capes, jackets, suits, trousers, shorts, shirts, dresses and skirts, underwear, nightwear and similar articles of textile fabrics, not knitted or crocheted.

**95 percentage confidence intervals.

***Confidence-intervals of +/- 30 percent.

Table A4: Change in quantity demanded by 5 000 tonnes

The table shows the tax level needed to decrease quantity demanded by 5 000 tonnes. Confidence-intervals is presented in parentheses.

Type of material or item	Used elasticity			
	Cardigans women e-commerce	Sneakers men e-commerce	E-commerce	Textile fibres
Textile fibres (other than combed wool) and their wastes				13% (8% - 17%) ^{***} (-8% - 35%) ^{**}
Articles of apparel & clothing accessories	5% (3% - 7%) ^{***}		5% (3% - 7%) ^{***} (0% - 9%) ^{**}	
Footwear		21% (13% - 27%) ^{***}	22% (15% - 29%) ^{***} (17% - 26%) ^{**}	
Women's or girl's clothes, not knitted*	48% (33% - 63%) ^{***}		44% (31% - 58%) ^{***} (40% - 49%) ^{**}	

* Includes coats, capes, jackets, suits, trousers, shorts, shirts, dresses and skirts, underwear, nightwear and similar articles of textile fabrics, not knitted or crocheted.

^{**}95 percentage confidence intervals.

^{***}Confidence-intervals of +/- 30 percent.

Sweden

Table A5: Change in quantity demanded by 500 tonnes

The table shows the tax level needed to decrease quantity demanded by 500 tonnes. Confidence-intervals is presented in parentheses.

Type of material or item	Used elasticity			
	Cardigans women e-commerce	Sneakers men e-commerce	E-commerce	Textile fibres
Textile fibres (other than combed wool) and their wastes				<1% (0% - 1%)*** (-20% - 23%)**
Articles of apparel & clothing accessories	<1% (0% - 1%)***		<1% (0% - 1%)*** (-3% - 4%)**	
Footwear		<1% (0% - 2%)***	<1% (0% - 1%)*** (-3% - 5%)**	

**95 percentage confidence intervals.

***Confidence-intervals of +/- 30 percent.

Table A6: Change in quantity demanded by 1 000 tonnes

The table shows the tax level needed to decrease quantity demanded by 1 000 tonnes. Confidence-intervals is presented in parentheses.

Type of material or item	Used elasticity			
	Cardigans women e-commerce	Sneakers men e-commerce	E-commerce	Textile fibres
Textile fibres (other than combed wool) and their wastes				1% (1% - 2%) ^{***} (-20% - 23%) ^{**}
Articles of apparel & clothing accessories	<1% (0% - 1%) ^{***}		<1% (0% - 1%) ^{***} (-3% - 5%) ^{**}	
Footwear		2% (1% - 2%) ^{***}	2% (1% - 2%) ^{***} (-2 % - 6%) ^{**}	

^{**}95 percentage confidence intervals.

^{***}Confidence-intervals of +/- 30 percent.

Table A7: Change in quantity demanded by 2 000 tonnes

The table shows the tax level needed to decrease quantity demanded by 2 000 tonnes. Confidence-intervals is presented in parentheses.

Type of material or item	Used elasticity			
	Cardigans women e-commerce	Sneakers men e-commerce	E-commerce	Textile fibres
Textile fibres (other than combed wool) and their wastes				3% (2% - 4%) ^{***} (-18% - 24%) ^{**}
Articles of apparel & clothing accessories	<1% (0% - 1%) ^{***}		<1% (0% - 1%) ^{***} (-3% - 5%) ^{**}	
Footwear		3% (2% - 4%) ^{***}	3% (2% - 5%) ^{***} (-1% - 8%) ^{**}	

^{**}95 percentage confidence intervals.

^{***}Confidence-intervals of +/- 30 percent.

Table A8: Change in quantity demanded by 5 000 tonnes

The table shows the tax level needed to decrease quantity demanded by 5 000 tonnes. Confidence-intervals is presented in parentheses.

Type of material or item	Used elasticity			
	Cardigans women e-commerce	Sneakers men e-commerce	E-commerce	Textile fibres
Textile fibres (other than combed wool) and their wastes				7% (5% - 10%) ^{***} (-18% - 25%) ^{**}
Articles of apparel & clothing accessories	2% (1% - 3%) ^{***}		2% (1% - 3%) ^{***} (-2% - 6%) ^{**}	
Footwear		8% (5% - 10%) ^{***}	8% (5% - 11%) ^{***} (4% - 12%) ^{**}	

^{**}95 percentage confidence intervals.

^{***}Confidence-intervals of +/- 30 percent.

Norway

Table A9: Change in quantity demanded by 500 tonnes

The table shows the tax level needed to decrease quantity demanded by 500 tonnes. Confidence-intervals is presented in parentheses.

Type of material or item	Used elasticity			
	Cardigans women e-commerce	Sneakers men e-commerce	E-commerce	Textile fibres
Textile fibres (other than combed wool) and their wastes				5% (3% - 7%)*** (-16% - 27%)**
Articles of apparel & clothing accessories	<1% (0% - 1%)***		<1% (0% - 1%)*** (-3% - 5%)**	
Footwear		2% (1% - 3%)***	2% (1% - 3%)*** (-2% - 6%)**	

**95 percentage confidence intervals.

***Confidence-intervals of +/- 30 percent.

Table A10: Change in quantity demanded by 1 000 tonnes

The table shows the tax level needed to decrease quantity demanded by 1 000 tonnes. Confidence-intervals is presented in parentheses.

Type of material or item	Used elasticity			
	Cardigans women e-commerce	Sneakers men e-commerce	E-commerce	Textile fibres
Textile fibres (other than combed wool) and their wastes				11% (7% - 14%) ^{***} (-10% - 33%) ^{**}
Articles of apparel & clothing accessories	<1% (0% - 2%) ^{***}		<1% (0% - 2%) ^{***} (-3% - 5%) ^{**}	
Footwear		3% (1% - 4%) ^{***}	3% (2% - 5%) ^{***} (-1% - 8%) ^{**}	

^{**}95 percentage confidence intervals.

^{***}Confidence-intervals of +/- 30 percent.

Table A11: Change in quantity demanded by 2 000 tonnes

The table shows the tax level needed to decrease quantity demanded by 2 000 tonnes. Confidence-intervals is presented in parentheses.

Type of material or item	Used elasticity			
	Cardigans women e-commerce	Sneakers men e-commerce	E-commerce	Textile fibres
Textile fibres (other than combed wool) and their wastes				21% (15% - 28%) ^{***} (-1% - 43%) ^{**}
Articles of apparel & clothing accessories	2% (1% - 3%) ^{***}		2% (1% - 3%) ^{***} (-2% - 6%) ^{**}	
Footwear		6% (4% - 8%) ^{***}	6% (4% - 9%) ^{***} (2% - 11%) ^{**}	

^{**}95 percentage confidence intervals.

^{***}Confidence-intervals of +/- 30 percent.

Table A12: Change in quantity demanded by 5 000 tonnes

The table shows the tax level needed to decrease quantity demanded by 5 000 tonnes. Confidence-intervals is presented in parentheses.

Type of material or item	Used elasticity			
	Cardigans women e-commerce	Sneakers men e-commerce	E-commerce	Textile fibres
Textile fibres (other than combed wool) and their wastes				54% (37% - 70%) ^{***} (32% - 76%) ^{**}
Articles of apparel & clothing accessories	4% (3% - 6%) ^{***}		4% (2% - 6%) ^{***} (0% - 8%) ^{**}	
Footwear		15% (10% - 20%) ^{***}	16% (11% - 21%) ^{***} (11% - 20%) ^{**}	

^{**}95 percentage confidence intervals.

^{***}Confidence-intervals of +/- 30 percent.

Change in demanded quantity by 10 percent

Table A13: Change in quantity demanded by 10 percent

The table shows the tax level needed to decrease quantity demanded by 10 percent. Confidence-intervals is presented in parentheses.

Type of material or item	Used elasticity			
	Cardigans women e-commerce	Sneakers men e-commerce	E-commerce	Textile fibres
Textile fibres (other than combed wool) and their wastes				8% (6% - 10%)*** (-14% - 29%)**
Articles of apparel & clothing accessories	7% (5% - 9%)***		6% (4% - 8%)*** (2% - 10%)**	
Footwear		6% (4% - 8%)***	6% (4% - 8%)*** (2% - 10%)**	

**95 percentage confidence intervals.

***Confidence-intervals of +/- 30 percent.

Appendix B – Results for the construction sector, natural resource tax levels

Finland

Table B1: Change in quantity demanded by 50 000 tonnes

The table shows the tax level needed to decrease quantity demanded by 50 000 tonnes, which corresponds to approximately 2 percent of total demanded quantity in Finland. Confidence-intervals of +/- 30 percent is presented in parentheses.

Type of material or item	Used elasticity	
	Own-price elasticity cement, short run	Own-price elasticity cement, long run
Cement, including cement clinkers, whether or not coloured	5% (3% - 6%)	1% (1% - 2%)

Table B2: Change in quantity demanded by 100 000 tonnes

The table shows the tax level needed to decrease quantity demanded by 100 000 tonnes, which corresponds to approximately 4 percent of total demanded quantity in Finland. Confidence-intervals of +/- 30 percent is presented in parentheses.

Type of material or item	Used elasticity	
	Own-price elasticity cement, short run	Own-price elasticity cement, long run
Cement, including cement clinkers, whether or not coloured	9% (6% - 12%)	3% (2% - 4%)

Table B3: Change in quantity demanded by 200 000 tonnes

The table shows the tax level needed to decrease quantity demanded by 200 000 tonnes, which corresponds to approximately 8 percent of total demanded quantity in Finland. Confidence-intervals of +/- 30 percent is presented in parentheses.

Type of material or item	Used elasticity	
	Own-price elasticity cement, short run	Own-price elasticity cement, long run
Cement, including cement clinkers, whether or not coloured	18% (12% - 24%)	6% (3% - 8%)

Table B4: Change in quantity demanded by 500 000 tonnes

The table shows the tax level needed to decrease quantity demanded by 500 000 tonnes, which corresponds to approximately 21 percent of total demanded quantity in Finland. Confidence-intervals of +/- 30 percent is presented in parentheses.

Type of material or item	Used elasticity	
	Own-price elasticity cement, short run	Own-price elasticity cement, long run
Cement, including cement clinkers, whether or not coloured	45% (31% - 59%)	14% (9% - 19%)

Sweden

Table B5: Change in quantity demanded by 50 000 tonnes

The table shows the tax level needed to decrease quantity demanded by 50 000 tonnes, which corresponds to approximately 1.5 percent of total demanded quantity in Sweden. Confidence-intervals of +/- 30 percent is presented in parentheses.

Type of material or item	Used elasticity	
	Own-price elasticity cement, short run	Own-price elasticity cement, long run
Cement, including cement clinkers, whether or not coloured	3% (2% - 5%)	1% (0% - 2%)

Table B6: Change in quantity demanded by 100 000 tonnes

The table shows the tax level needed to decrease quantity demanded by 100 000 tonnes, which corresponds to approximately 3 percent of total demanded quantity in Sweden. Confidence-intervals of +/- 30 percent is presented in parentheses.

Type of material or item	Used elasticity	
	Own-price elasticity cement, short run	Own-price elasticity cement, long run
Cement, including cement clinkers, whether or not coloured	7% (4% - 9%)	2% (1% - 3%)

Table B7: Change in quantity demanded by 200 000 tonnes

The table shows the tax level needed to decrease quantity demanded by 200 000 tonnes, which corresponds to approximately 6 percent of total demanded quantity in Sweden. Confidence-intervals of +/- 30 percent is presented in parentheses.

Type of material or item	Used elasticity	
	Own-price elasticity cement, short run	Own-price elasticity cement, long run
Cement, including cement clinkers, whether or not coloured	13% (9% - 18%)	4% (2% - 6%)

Table B8: Change in quantity demanded by 500 000 tonnes

The table shows the tax level needed to decrease quantity demanded by 500 000 tonnes, which corresponds to approximately 15 percent of total demanded quantity in Sweden. Confidence-intervals of +/- 30 percent is presented in parentheses.

Type of material or item	Used elasticity	
	Own-price elasticity cement, short run	Own-price elasticity cement, long run
Cement, including cement clinkers, whether or not coloured	33% (23% - 44%)	11% (7% - 14%)

Norway

Table B9: Change in quantity demanded by 50 000 tonnes

The table shows the tax level needed to decrease quantity demanded by 50 000 tonnes, which corresponds to approximately 4 percent of total demanded quantity in Norway. Confidence-intervals of +/- 30 percent is presented in parentheses.

Type of material or item	Used elasticity	
	Own-price elasticity cement, short run	Own-price elasticity cement, long run
Cement, including cement clinkers, whether or not coloured	8% (5% - 11%)	3% (1% - 4%)

Table B10: Change in quantity demanded by 100 000 tonnes

The table shows the tax level needed to decrease quantity demanded by 100 000 tonnes, which corresponds to approximately 8 percent of total demanded quantity in Norway. Confidence-intervals of +/- 30 percent is presented in parentheses.

Type of material or item	Used elasticity	
	Own-price elasticity cement, short run	Own-price elasticity cement, long run
Cement, including cement clinkers, whether or not coloured	17% (11% - 21%)	5% (3% - 7%)

Table B11: Change in quantity demanded by 200 000 tonnes

The table shows the tax level needed to decrease quantity demanded by 200 000 tonnes, which corresponds to approximately 15 percent of total demanded quantity in Norway. Confidence-intervals of +/- 30 percent is presented in parentheses.

Type of material or item	Used elasticity	
	Own-price elasticity cement, short run	Own-price elasticity cement, long run
Cement, including cement clinkers, whether or not coloured	33% (23% - 44%)	10% (7% - 14%)

The table showing a change in quantity demanded by 500 000 tonnes is not included for Norway because the results are non-feasible.

Change in demanded quantity by 10 percent

Table B12: Change in quantity demanded by 10 percent

The table shows the tax level needed to decrease quantity demanded by 10 percent. Confidence-intervals is presented in parentheses.

Type of material or item	Used elasticity	
	Own-price elasticity cement, short run	Own-price elasticity cement, long run
Cement, including cement clinkers, whether or not coloured	22% (15% - 28%)	7% (5% - 9%)

About this publication

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