ALIGNING FISCAL POLICY WITH THE CIRCULAR ECONOMY ROADMAP IN FINLAND
Aligning Fiscal Policy with the Circular Economy Roadmap in Finland

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This document is the final report on the findings and results of the project Best Practices in the Promotion of Circular Economy in Finland. The project was funded by the Finnish Innovation Fund (Sitra) and carried out by Green Budget Europe (GBE) as head of the consortium, in collaboration with the Institute for European Environmental Policy (IEEP) and the Ex'tax Project Foundation. The project started in December 2017 and was completed in December 2018.

The main goal of the project was to promote the implementation of the Finnish national road map to a circular economy by providing policy options and practical instruments on how to reach circular economy goals in Finland. The project was divided into two parts. Firstly, it identified tax options and other economic instruments together with best practices to promote circular economy goals. Secondly, it presented an ambitious scenario for green fiscal reform, which aligns fiscal policy with carbon-neutral circular economy objectives. In addition, it assessed through modelling some of the potential economic, environmental and social impacts of the particular green fiscal reform scenario. Finally, it provided concrete examples of best practice in other market-based instruments applied in Europe to achieve these goals.

The steering group of the project held two workshops and regular meetings to ensure the timely development of the scenario and appropriate instruments. It used the services of Cambridge Econometrics to evaluate the fiscal, macro-economic and environmental impacts of the proposed tax measures. The project held several meetings with Finnish ministries and industry groups to consult local experts and interest groups on the possible implications, such as sectoral competitiveness issues, of the proposed measures. Based on their feedback, some of the proposed measures were revised before modelling and presenting them in the final report.

The Finnish Government, together with the public and business sectors, is highly committed to moving towards a society based on circular economy. However, a major obstacle towards this transition is that the current regulatory system is in many cases promoting linear economy and prohibiting the change to circularity. Mainstreaming of the circular economy requires a regulatory system, which promotes the corresponding business models, such as service-based business, sustainable consumption patterns, recycling, and the promotion of recycling and sharing practices.

Taxation, and especially its structure, has a very strong steering impact on the whole society. The project proposes to use fiscal instruments to promote carbon-neutral circular economy goals. A green budget reform, which means shifting taxation from labour to resource use and pollution, could be one of the key drivers in achieving carbon neutrality and circular economy objectives.
**EXECUTIVE SUMMARY**

Many countries are considering new policies to support the transition to a low-carbon circular economy. This study was initiated to

- **a)** Identify best practices of market-based instruments in EU Member States to enhance the circular economy;
- **b)** Identify options for phasing out of environmentally harmful subsidies in Finland;
- **c)** Study the potential of environmental fiscal reform (shifting the tax burden from labour to natural resource use); and
- **d)** Provide an overview of potential measures and economic instruments in the Finnish context to promote the objectives of a carbon-neutral circular economy.

The study is based on the Finnish roadmap to a circular economy 2016-2025, published by Sitra in 2016 with relevant ministries and other stakeholders. Following the rationale of the road map, the following objectives were studied in further detail:

- **Sustainable food systems:** using sustainable crop production, organic farming, short supply chains, and nutrient recycling;
- **Forest-based loops:** recycling of the forest industry’s side streams, processed products other than pulp and paper, wood construction and wooden furniture, substituting fossil resources and using more wood-based textiles;
- **Technical loops:** minimising the need for virgin raw materials by lengthening product life cycles through redesign, reuse, recycling, repair and maintenance, promoting the use of secondary materials and remanufacturing by pricing the external costs of virgin raw materials; and
- **Carbon-neutral transport and logistics:** moving beyond fossil-fuels, improving service-based transport systems, ending fossil fuel use in private cars by 2040, promoting sustainable biofuels, replacing fossil fuels with renewable and non-fossil alternatives, optimising transport routes and material flows, and promoting public transport.

The study provides a series of fiscal and other instruments to promote these carbon-neutral circular economy objectives. The project also reviewed the Finnish tax system to define measures to improve resource and energy efficiency, while reducing labour taxes to ensure fiscal neutrality and boost employment.

Finland has relatively high labour taxation compared with other EU Member States and OECD countries. When comparing the tax wedge\(^1\), Finland occupied the second highest position among the OECD countries in 2016. The OECD has advised Finland to reduce the tax burden.

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\(^1\) The tax wedge is defined as the ratio between the amount of taxes paid by an average single worker and the corresponding total labour cost for the employer. The average tax wedge measures the extent to which tax on labour income discourages employment. (OECD)
on labour, increase environmentally-related taxes and phase out environmentally harmful subsidies. A reduction in labour taxes is crucial to enable labour and knowledge intensive business models, such as reuse, recycling, repair and maintenance, redesign of supply chains and products, needed for a circular economy.

The following measures were included in the scenario, which was modelled by Cambridge Econometrics in the E3ME model:

- **Air pollution**: A carbon price floor;
- **Fossil fuels**: Removal of the diesel subsidies (transport sector); removal of the light fuel oil subsidy; removal of the peat tax subsidy; taxation of non-energy use of fossil fuels (mineral oils and other fossil material used in plastics and other chemical industry);
- **Energy**: Electricity tax increase for bulk users and removal of the subsidy for energy-intensive industries;
- **Transport related taxes**: Air passengers and air freight taxes;
- **Waste related taxes**: Incineration of waste and a nuclear waste tax;
- **Natural resource taxes**: Water abstraction; extraction of metal ores and extraction of non-metallic minerals; and
- **Agricultural related taxes**: Pesticides tax.

In the scenario, the measures were phased in over the 2019-2025 period, with revenues amounting to €3.5 billion in 2025. Every year, the revenues were used to lower labour taxes (personal income tax, social contributions paid by employers and employees, as well as additional income support for the lowest two income quintiles) and towards investments in research and development (R&D) and renewables.

**Results**

The modelling results suggest that the scenario increases GDP and employment by 1.2% in 2025 compared to the business as usual scenario. Similarly, CO₂, SO₂ and NOₓ emissions would be reduced by 6.0%, 8.1% and 6.3% respectively. Exports and imports would be virtually unaffected, apart from energy imports, which would be reduced by 6.1%.

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Overall, the results from the scenario show that the energy and utilities sectors experience the biggest loss in output, while labour-intensive services sectors experience the largest gains. Over the course of seven years (2019-2025), compared to baseline, the scenario cumulatively reduces carbon emissions by 8.4 million tonnes, and saves €924 million on Finland’s energy import bill. Over the same period, 115,600 person years of employment are added as well as €12.9 billion in GDP.

The key message from the results is that it is possible to design policy measures that reduce final energy consumption and harmful emissions, while at the same time stimulating the Finnish economy and creating jobs.

Graph 1. Overall result: Decoupling (2019-2025, difference from baseline). Source: Cambridge Econometrics

This study is meant to provide directions on how fiscal systems can be rationalized in light of the circular economy goals and describe the potential impacts. The authors hope that the report will be used as a source of inspiration for further discussion and planning on environmental fiscal reform in Finland and Europe in general.

More studies will be required on the possibilities of aligning fiscal systems with circular economy goals. Cooperation among EU countries will be key to ensure a level-playing field.
1. **CIRCULAR ECONOMY GOALS IN FINLAND**

The Finnish government has a strong commitment to a circular economy. Prime Minister Juha Sipilä’s government has set a goal to make Finland a global circular economy leader by 2025. The bioeconomy and clean solutions as a part of a circular economy were some of the focus areas in the Government Programme approved in 2015. The Finnish Innovation Fund (Sitra) has played a key role in establishing the circular economy concept in the Finnish society, particularly by encouraging and implementing it in practice. The business sector has also been active in identifying opportunities for new circular economy-based business models, and in maximising the use and reuse of the products, components and materials that already exist in the economy.

What would the transformation from a linear economy towards a circular economy-based society require in Finland? The policy goals, measures and actions towards a circular economy have been defined in several processes and reports. The main report in this field is the national road map to circular economy prepared by Sitra: *Leading the cycle - Finnish road map to a circular economy 2016–2025*. The road map is currently being updated, and a new version, National roadmap to circular economy 2.0, will be published in early 2019. The main objective of this exercise is to increase the level of ambition of the circular economy goals, specify the contents, and to complement new measures and proposals to action.

In addition to the road map, policy goals, measures and actions for transition towards a circular economy have been defined in the Government Programme of Prime Minister Sipilä (2015), in the Circular economy action plan (2017) prepared by the Finnish Government, and in several sectoral reports and initiatives. In the next section, we will focus on the main objectives and policy goals set in the national road map to a circular economy.

### 1.1. National road map to a circular economy

The world’s first national road map to a circular economy was published in September 2016 in Finland. It was prepared jointly by the Finnish Innovation Fund (Sitra), the relevant ministries and other stakeholders to respond to the opportunities provided by circular economy.

The road map defines the steps required for a systemic change in the economy: in the future, the competitiveness of the Finnish economy and well-being will no longer require overconsumption of natural resources. Instead, the economy will be based on circularity, and closing the material and energy loops.

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A circular economy strives to maximise the circulation of products, components and materials, and the value bound to them. In a circular economy, production and consumption create the smallest possible amount of material loss and waste. Material efficiency leads to environmental, economic and social benefits as part of sustainable development. Added value is often created for products by means of services and digital solutions based on intelligence. The systemic change towards a circular economy means major changes in both production manners and consumer behaviour. The driving force for this work is to turn the circular economy into a driver of growth, investment and exports for Finland.

The national road map for a circular economy contains four focus areas with the following general description of the aim of the focus area followed by more specific policy actions:

**Sustainable food systems**

The vision of a sustainable food system emphasises that consumer choices will be more resource-wise than at present, and that they will be promoted through public food services. Emissions and resource consumption in food production will decrease and their formation will be transparent. The policy actions aim to:

- Create a market for organic recycled nutrients;
- Minimise food waste by eliminating obstacles and creating incentives; and
- Provide support for biogas systems and other renewable energy solutions in agriculture in order to replace fossil fuels.

**Forest-based loops**

The vision of circularity in forest-based loops relies on the use of side streams, increasing the manufacturing and added-value of products and services and other circular economy solutions derived from forest-based loops. In addition, the second-generation biofuels and the digital revolution are mentioned, as well as wood construction and wood-based products. The main objective of the national forest strategy should be to:

- Maximise the overall added-value of Finnish forest-based products and services rather than the amount of wood;
- Encourage through public procurement the selection of wood-based products and those made from other renewable raw materials when life-cycle analysis demonstrates that they are more sustainable overall;
- Provide support to investments aimed at demonstrating bioproducts and bioservices on a commercial basis; and
- Create incentives for developing Finnish wood construction and the design of wooden furniture and interior design sector.

**Technical loops**

In the technical loops focus area, the principle is sustainable use of non-renewable natural resources, lengthening the product life cycle via maintenance measures, and determining how the material at the end of products’ life-cycle can be returned to the loop. According to circular
Economy principles, material development and product design play a key role in this work. Eco-industrial parks are examples to enable side streams from one industry to be used as a raw material in other industrial processes. In addition, they aim to:

- Promote the use of secondary raw materials, including waste act interpretation and streamlining the environmental permit procedure;
- Make use of the side streams produced during the project, such as surplus spoil. These should be planned and described in the environmental impact assessment and environmental processes; and
- Include eco-design requirements in product design and construction and in the material development phase.

**Transport and logistics**

The vision in the transport and logistics focus area is a systemic change towards a carbon-neutral and service-based transport system. The idea is to raise the level of logistics capacity utilisation, replace fossil fuels with renewable and non-fossil alternatives, and optimise transport routes and material flows. Digitalisation is emphasised as a key enabler as passenger transport moves towards smart, easy-to-use transport that is based on:

- Sharing and services (MaaS, Mobility as a Service). This would require the development of incentives and policy instruments to accelerate a radical change towards a more service-based transport system; and
- Developing tax and other steering instruments to support the phase out of fossil fuels in private cars by 2040 and promote the implementation of sustainable production of biofuels.

In addition to these substance-related focus areas, the fifth focus area in the road map is common action. This refers to the notion that legislators, companies, universities and research institutes, consumers and citizens, and vibrant regions are all needed to achieve systemic change. Communication and diverse interaction are particularly important when implementing joint action with different stakeholders. The role of the public sector as a facilitator and supporter is emphasised together with research, development and innovation activities. Achieving systemic change requires a wide range of actions and many social changes.

**1.2. Government programme and action plan for a circular economy**

**Government programme: bioeconomy and clean solutions**

The transition towards a circular economy has an important role in the Government Programme of Prime Minister Sipilä (2015). *Bioeconomy and clean solutions* is one of the five strategic priorities in the Government Programme, and circular economy is treated as a key project under the title of “Breakthrough to a circular economy and adoption of clean solutions”.
In September 2015, an implementation plan was launched to put the key projects into action. The Government allocated to the key projects altogether €1 billion, of which €300 million was earmarked for Bioeconomy and clean technologies. Each circular economy project received €63 million according to the following topics:

1) Preparation of regulations and solutions to promote recycling;

2) Increase of nutrient recycling and promotion of good ecological status of the Baltic Sea and other water systems;

3) Experimental project for remediation of contaminated land and recycling of soil; and

4) Promotion of clean solutions and clean-tech business.

The objective of these projects was to exploit the growing potential of the circular economy and clean solutions. Actions to promote a good ecological status of the Baltic Sea were one of the priorities to be made in cooperation with domestic and international actors. The amount of nutrients and organic material leaching to the waters would be reduced, while the nutrient and energy self-sufficiency of agriculture would be enhanced. One of the objectives was that the circular economy and clean-tech business and exports would grow, and new jobs would be created.

In the implementation of the Government programme, e.g. the following actions have been made related to the promotion of a circular economy:

- **An action plan for a circular economy** was prepared together with Sitra based on the national road map to a circular economy.
- **Experimental programme of nutrient recycling** has been put into practice.
- **From recycling to a circular economy – The National Waste Plan 2030** was published in May 2018.
- **A government proposal on amending the Waste Act** has been submitted to Parliament in November 2018. One of the amendments is an obligation to create and develop an information platform for waste and by-products.
- **Experimental projects** on recycling municipal waste.
- New, internationally competitive **techniques for reconditioning contaminated soil** have been tested and areas have been reconditioned for use through the **Clean Soil programme** of Tekes and the Ministry of the Environment.
- New investments in bio-economy.
- Six business ecosystems with international market potential, Tekes’ business spearheads and ecosystems in the bio-economy programme.
- In order to encourage sustainable and innovative procurement, a network-based **centre of excellence** was to be set up in spring 2018.
- Preparation of an **action plan for sustainable urban development**.

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A green deal model has been piloted. The first Green Deal concerning plastic carrier bags was concluded in 2016, and has already successfully reduced the use of plastic bags. The Finnish automotive industry, the Ministry of Transport and Communications and the Ministry of the Environment concluded the second Green Deal on November 2018. The Green Deal for the benefit of the climate is part of the Finnish Society’s Commitment to Sustainable Development. The aim is to reduce carbon dioxide emissions in the transport sector.

Government action plan for a circular economy: experiments, public procurement and service innovations

In addition to the Government’s key projects and the National road map to a circular economy, the Government prepared a more concrete action plan on how to promote the realisation of the circular economy during the rest of the Government term\(^8\). The Ministry of Environment - together with other Ministries\(^9\) and Sitra - prepared an Action plan for a circular economy\(^{10}\), where the objectives, main actions and measures are defined.

The three priorities of the action plan and measures are:

- **Platforms for experimenting with and testing the circular economy**, 
- **Sustainable and innovative public procurement, and**
- **Support for new product and service innovations**.

There is a strong emphasis on experiments and pilot projects for testing new ideas for a circular economy and other policy objectives. Furthermore, public procurement has been raised as a key measure to promote sustainable solutions and environmentally friendly products, techniques and methods.

The main objectives of the plan were defined as follows: to generate internationally competitive solutions to circular economy; create substantial added-value for products; and to share best practices with other countries. The key aim to circular economy solutions was to make it possible to cut greenhouse gases and other atmospheric emissions in a decisive way, to promote the sustainable use of natural resources, and to increase well-being and thereby also improved competitiveness.

\(^8\) The next Parliamentary elections will be held in April 2019.
\(^9\) The Ministries involved in circular economy are: Ministry of Environment, Ministry of Economic Affairs and Employment and Ministry of Agriculture and Forestry.
1.3. Main goals in the transition towards a carbon-neutral circular economy

Circular economy is a framework for an economy that is restorative and regenerative by design. According to the Ellen MacArthur Foundation\textsuperscript{11}, circular economy aims to redefine growth, focusing on positive society-wide benefits. It entails gradually decoupling economic activity from the consumption of finite resources and designing waste and pollution out of the system. In addition, a transition to renewable energy sources is an important part of a carbon-neutral circular economy, which has been emphasised in the Finnish road map.

The system diagram of a circular economy by Ellen MacArthur Foundation illustrates the continuous flow of technical and biological materials through the “value circle” (Figure 1). The concept of circular economy is based on three principles\textsuperscript{12}:

1) Regenerate natural systems
2) Keep products and materials in use
3) Design out waste and pollution

\textsuperscript{11} https://www.ellenmacarthurfoundation.org/circular-economy/concept
\textsuperscript{12} https://www.ellenmacarthurfoundation.org/circular-economy/concept
In the project, we defined four main goals for the transition towards a carbon-neutral circular economy in Finland based on these three principles and the content of the Finnish road map and the Action Plan for a circular economy and other initiatives. These four goals have served as the general policy objectives of a carbon-neutral circular economy to which the following economic instruments have been identified:

1) Minimising the use of virgin natural resources
   - Instruments: Natural resource taxes
2) Reducing emissions
   - Pricing of CO₂ emissions
   - Incentives for investments in low carbon technology
3) Prolonging the lifetime of products
   - Cutting of labour taxes to boost service-based business models
- Incentives for research and development

4) Recycling of waste as material
- Waste related taxes

More detailed presentations on circular economy goals and instruments to promote them are presented in chapter 3 and its sub chapters.
2. ALIGNING TAX POLICY WITH THE INCLUSIVE CIRCULAR ECONOMY

As described in Chapter 1, Finland aims to become a global circular economy leader by 2025. In this chapter we will explore how shifting the tax burden from labour to natural resource use would align the Finnish tax system with the goals of the carbon-neutral, inclusive and circular economy.

First, we will briefly explore the difference between linear business models and circular models, illustrated by examples from the fashion industry.

2.1. Linear vs circular business models

Linear business models maximize materials throughput

In the linear, take-make-waste economy, resources are extracted, turned into products and – after a short lifetime – discarded as waste. Business models in the linear economy revolve around maximising resource extraction, throughput and product sales. The fashion industry for example, operates along linear processes. It is one of the most polluting sectors in the world, using harmful pesticides, dyes, solvents and large amounts of water. The sector emits more greenhouse gases than all international flights and maritime shipping combined. Less than 1% of material used to produce clothing is recycled into new clothing and every second, a garbage truck of textiles is landfilled or incinerated. On a global scale, more than $500 billion of value is lost every year due to underutilization and the lack of recycling\(^{13}\).

In Finland, around a total of 70 million kg of textiles are used and withdrawn annually which means 13 kg per person. According to a study on the textiles and textile waste flows in Finland, in 2012 roughly 20% of discarded textiles were collected separately by charity organisations and directed mainly towards reuse. Only a few percent of the overall flow was recycled. The majority of the discarded textiles were collected in municipal solid waste and incinerated with energy recovery.\(^{14}\) Since 2012, there has been development in the field towards reuse and recycling and also to sharing of clothes as renting business (eg Vaaterekki and Vaatepuu\(^{15}\)).

Circular business models are labour and knowledge-intensive

Compared to linear business models, circular business models are resource-efficient. They also tend to be more labour and knowledge-intensive. In the circular economy, companies recollect, repair and disassemble products and provide services with products. Examples of


\(^{15}\) Vaaterekki and Vaatepuu are companies which rent clothes for customers. More info in Finnish, see [https://www.vaaterekki.com/](https://www.vaaterekki.com/) and [https://vaatepuu.fi/](https://vaatepuu.fi/)
such new business models are emerging in every sector. In the garment industry, for example, companies offer lease services and customization (eg Mud Jeans), reselling of products (eg Patagonia) and sharing/subscription services (eg Ycloset).

Circular business models require a higher service level than simply selling products; they require handling, sorting, quality monitoring and cleaning. Such business models also require a redesign of products and supply chains (eg cradle-to-cradle clothing by C&A and reuse of materials by Ioniqa). Intensive research and development efforts are needed to develop bio-based materials (such as Earthcolours’ dyes made from agricultural waste) and new processes (eg Mistra Future Fashion’s ultrasound laser cutting).

Renewable energy

With regard to the carbon-neutrality component of the circular economy, it is important to note that low-carbon, renewable energy technologies create more jobs than fossil-fuel technologies; they are more labour-intensive. Solar Photovoltaics, for instance, creates more than twice the number of jobs per unit of electricity generation compared with coal or natural gas. The World Bank estimates that in the United States, wind and solar create about 13.5 jobs per million dollars of spending, and that building retrofits (energy efficiency) create 16.7 jobs per million dollars of spending. This is more than three times the 5.2 jobs per $1 million for oil and natural gas, and more than twice the 6.9 jobs per $1 million for coal.

Circular (and low-carbon) business models, compared to linear models, are relatively resource-efficient but require more human capital.

The next step in our analysis is to look at the role of taxation in the transition to an inclusive circular economy. EU governments (including Finland) tend to put a high tax burden on labour (including personal income tax, payroll taxes and social contributions) and low or no taxes on natural resource-use (‘environmentally related’ taxes, or ‘green’ taxes, which are based for example on fossil fuel use, carbon emissions and other pollution and water use). Because of these financial incentives, low-carbon, innovative and labour-intensive circular activities have a competitive disadvantage compared to linear business models. The societal cost of pollution and the way tax structures deal with these costs will be further explored in the next sections.

2.2. A low tax burden on natural resource use, inconsistent carbon pricing, substantial fossil fuel subsidies

The polluter doesn’t pay

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The global welfare losses from pollution have been estimated at $4.6 trillion a year, or 6.2% of global economic output.\(^{18}\) The long-term negative impacts on the global economy caused by the CO\(_2\) emissions in 2017 alone were $16 trillion.\(^{19}\) Such costs are ‘externalised’, meaning that they are passed on to society, individuals and future generations, rather than absorbed by the polluter. The notion of putting a price on externalities has been around since Arthur Pigou introduced the concept in 1920.\(^{20}\) In recent years, many studies have quantified external costs (or ‘negative externalities’), in particular related to carbon emissions, with prices ranging from $30 per tonne to more than $400 per tonne of CO\(_2\).\(^{21}\)

The OECD applies a minimum social cost of carbon of €30 per tonne, and has included in 2018 a benchmark of €60 per tonne to its analyses to reflect the estimated cost of carbon in the future.\(^{22}\) The OECD has noted that at the current pace of incremental annual growth in pricing emissions, carbon prices will reflect the real costs to the climate only in 2095.\(^{23}\)

**Inconsistent carbon pricing in Finland**

In 1990, Finland became the first country to tax CO\(_2\) emissions.\(^{24}\) Finland has since developed a complex system of energy and carbon taxes. In addition to energy taxation, the vehicle related taxation, both one-off car tax (registration tax) and annual vehicle tax are also based on CO\(_2\) emissions from 2008 onwards. Furthermore, the EU Emission Trading System (EU ETS) applies to large industrial and energy production plants since 2005.\(^{25}\) Approximately half of the greenhouse gas emissions in Finland are covered by the ETS.\(^{26}\) Altogether, a large proportion of the total CO\(_2\) emissions in the economy were not effectively taxed.\(^{27}\) Due to exceptions, rebates and reduced rates, the pricing levels per tonne of CO\(_2\) varied significantly per sector and the type of fuel used. From a climate perspective, there is no difference between carbon dioxide emitted from an exhaust pipe, a residential heater or a factory chimney; the impacts and, therefore, the external costs per tonne of carbon are the same. Still, the effective tax rate in Finland ranges from €0 per tonne of carbon emitted by biomass and waste sources to a benchmark of €60 per tonne to more than €400 per tonne of CO\(_2\).\(^{28}\)

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25. In addition, other policy instruments have been in use to tackle greenhouse gas emission. For example, different kind of subsidies to renewable energy sources, like feed-in-tariff scheme and Energy Aid Programmes for investment support for renewable energy and energy-saving projects have been used, as well as, regulation and voluntary schemes to promote energy efficiency and renewables.
27. Including taxes and emissions trading systems. OECD (2018), Taxing Energy Use 2018; Companion to the Taxing Energy Use Database, [http://dx.doi.org/10.1787/9789264289635-en](http://dx.doi.org/10.1787/9789264289635-en). Biomass related CO\(_2\) emissions (which do not have a tax) are included in the 58% figure.
combustion in industry to € 300 per tonne of carbon emitted in gasoline used in road transport (see graph 2).  

Graph 2. Effective tax rates on energy use in EUR per tonne of CO$_2$ in Finland, 2015

Low share of environmental taxes in Finland

In general, the European Commission defines environmental taxes as taxes on energy, transport, pollution and resource extraction. In 2016, some 7% of tax revenues in Finland were based on environmental taxes (close to the 6% EU weighted average). Just 0.1% of the Finnish tax revenues was based on natural resource-use and pollution (EU weighted average: 0.2%). The extraction of metals and minerals, for example, as well as water usage and the pollution from the combustion of aviation fuel, are free of tax in Finland.

Fossil fuel support

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28 The effective carbon tax rate is the price of carbon emissions resulting from taxes and emissions trading systems. Methodology on how the effective tax rate is calculated can be found here: OECD (2018), Taxing Energy Use 2018; Companion to the Taxing Energy Use Database, http://dx.doi.org/10.1787/9789264289635-en


Governments around the world, including Finland, provide active support to fossil fuel consumption, and thus to pollution, both through direct budgetary transfers and tax concessions that in some way provide a benefit or preference for fossil-fuel production or consumption, relative to alternatives. The IEA estimates the value of global fossil-fuel consumption subsidies at more than US$ 300 billion in 2017, up from US$ 270 billion in 2016. According to OECD data, Finland provided € 1.7 billion in fossil fuel support in 2016 (see table 1).

<table>
<thead>
<tr>
<th>Fossil Fuel Support in Finland</th>
<th>€ mln</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced Energy Tax Rate on Diesel Used in Transport</td>
<td>746</td>
</tr>
<tr>
<td>Reduced Energy Tax Rate for Light Fuel Oil Used in Mobile Machinery</td>
<td>444</td>
</tr>
<tr>
<td>Energy Tax Refund for Energy Intensive Enterprises</td>
<td>211</td>
</tr>
<tr>
<td>Reduced Energy Tax Rate on Peat Used in Heating</td>
<td>140</td>
</tr>
<tr>
<td>Reduced CO₂ Tax for Combined Heat and Power Production</td>
<td>107</td>
</tr>
<tr>
<td>Energy Tax Rebates for Certain Fuels Used in Agriculture</td>
<td>33</td>
</tr>
<tr>
<td>Energy Tax Exemption for LPG</td>
<td>10</td>
</tr>
<tr>
<td>Energy Tax Exemption for Fuels Used in Vessel Traffic</td>
<td>3</td>
</tr>
<tr>
<td>Reduced Energy Tax Rate on Natural Gas Used in Transport</td>
<td>1</td>
</tr>
<tr>
<td>Peat Storage Support Coverage</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,696</strong></td>
</tr>
</tbody>
</table>

In 2016, greenhouse gas emissions in Finland were 11.1 tonnes of CO₂ equivalent (‘tCO₂eq’) per capita, which was higher than the EU-average of 8.7tCO₂eq per capita. Two sectors, manufacturing and electricity, produced 50% of total greenhouse gas emissions in Finland. According to a (2016) OECD analysis:

“The longstanding use of economic instruments, especially taxation, to promote green growth in Finland, has reduced greenhouse gas emissions intensity considerably since 1990, but it is still the third highest in the OECD.”

The OECD recommended Finland to:

33 Eurostat (2018), Greenhouse gas emissions by source sector (source: EEA)
Finland is a member of the Friends of Fossil Fuel Subsidy Reform (FFFSR), established in 2010, which promotes the gradual phase-out of inefficient fossil fuel subsidies. The other members of FFFSR are Costa Rica, Denmark, Ethiopia, Norway, Sweden and Switzerland. The countries are committed to ‘act as first movers, serving as an example and supporting other countries’ participation in efforts to rationalise the use of fossil fuel subsidies’.

Finland high on SDG Index – but challenges remain

Three Scandinavian countries (Sweden, Denmark and Finland) top the 2018 SDG Index, which ranks 156 countries across the dimensions of the 17 Sustainable Development Goals (SDGs). This means that Finland is in a good position to meet the SDGs. According to the index, ‘major challenges’ remain across several indicators including electronic waste generated, net imported SO₂ emissions, non-recycled municipal solid waste, energy-related CO₂ emissions, imported CO₂ emissions and the annual change in forest area.

According to the Ministry of Environment of Finland:

“It is estimated that Finns consume their own share of the Earth’s natural resources approximately four months earlier than the global average. In Finland, the national Overshoot Day fell earlier than before, on 11 April. If everyone in the world consumed as much as the average Finn, 3.6 Earths would be needed to sustain them.”

Across the EU, in only five countries (Luxembourg, Belgium, Estonia, Sweden and Denmark) Earth Overshoot Day occurred earlier than in Finland.

A few additional observations with regard to pollution and resource use in Finland:

Metal ore consumption. In 2016, Finland’s consumption of metal ores was by far the highest in the EU (5.5 tonnes per capita).
Pesticides used in forestry. Sales of pesticides used in forestry have increased dramatically over the past 10 years. In 2003, sales of pesticides used in forestry accounted for less than one percent, while in 2015, they accounted for around 60% of total sales of pesticides.41

Energy import dependency. The consumption of energy in 2016 was 34.6 million tonnes of oil equivalent, 25.2 million tonnes of oil equivalent (73%) was imported.42 The total value of imports from Russia in 2016 was € 6.1 billion, 71% of which is energy products.43

Health impacts of air pollution. Estimates of the health impacts attributable to exposure to air pollution indicate that PM2.5 concentrations in 2015 were responsible for 1,540 premature deaths in Finland.44

Increasing the tax burden on pollution and resource use would not only benefit the circular economy but could also help protect the health of the population, reduce energy import dependency and boost innovation in sustainable products and processes. The OECD has specifically recommended Finland to increase green taxes and phase out harmful subsidies. At the same time, the OECD advises to reduce the tax burden on labour.45 The rationale for a reduction in labour taxes will be further explored below.

2.3. Taxes on labour are high

As in most EU countries, the bulk of tax revenues in Finland are based on the taxation of workers.46 On average, in the European Union, labour taxes (including personal income tax, social contributions and payroll taxes) provide 50% of total tax revenues; in Finland labour taxes provide a similar share (51%) of tax revenues.47 Other indicators of high labour taxation are the following:

- In 2016, Personal Income Tax was 13% of GDP; the third highest in the EU.48
- The ‘tax wedge’ (a measure of the tax burden on employment incomes; the difference between labour costs to the employer and the corresponding net take-home pay of the employee) is also high in Finland. In 2017, Finland had the fourth highest tax wedge in the OECD for an average married worker with two children, at 38.4% (compared to an

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42 Eurostat (2018), Simplified energy balances - annual data
46 In the European Union, only in Malta, Romania, Croatia, Bulgaria, Estonia and Cyprus consumption taxes provide a bigger share of total tax revenues than labour taxes.
OECD average of 26.1%). The average single worker in Finland faced a tax wedge as high as 42.9% (compared to an OECD average of 35.9%).

The impact of labour taxes on employment opportunities

The overall relation between labour taxes (including social contributions) and employment has been documented extensively, both in terms of labour supply and labour demand. See for example Nickell & Layard (1999), ECB (2008), Vermeend et al. (2008), Dolenc & Laporšek (2010) and Brys (2011). Researchers investigated the influence of taxation on employment and unemployment on the sample of 21 OECD countries between 1983 and 2003 and found that:

“(…) a 10 percentage points reduction of the tax wedge in an average OECD country would reduce equilibrium unemployment by 2.8 percentage points and increase the employment rate by a larger 3.7 percentage points (due to the positive impact on participation).”

Other researchers found even stronger correlations. Over the years, institutions such as the World Bank (World Bank, Bogetic et al. 2015; World Bank 2018), the OECD (OECD 2018; OECD, World Bank and ILO 2015; OECD 2011), the IMF (2014, 2015), the European

The business perspective on labour taxes

From a business perspective, it is clear that a high tax burden on labour incentivises companies to gain efficiency by reducing payroll costs. ACCA (2018) describes a range of strategies for entrepreneurs to minimise headcount, including:

- Reducing service levels provided to customers (e.g. in hotels)
- Replacing manual service with machines (e.g. self-checkout lanes in supermarkets)
- Shifting to mass production rather than bespoke, custom-made products (e.g. handmade shoes vs mass produced shoes)
- Hiring short-term, informal workers rather than workers on a permanent contract (hiring interns or operating in the gig economy)
- Understaffing (putting pressure on workers to produce more in less time)
- Outsourcing to lower-income countries.

Such strategies may make business sense, but they contribute directly and indirectly to unemployment and underemployment as well as informal and temporary employment.

Unemployment and underemployment

In 2017, unemployment in the European Union stood at 7.6%\textsuperscript{73}, meaning that 18.8 million people were unemployed. A closer look at unemployment statistics, however, reveals that the ‘underutilised labour potential’ was more than twice as high, at 38.2 million people.\textsuperscript{74} This number takes underemployment into account, including part-time workers who wish to work more hours, persons seeking work but who are not immediately available and persons available to work but not actively seeking.

In Finland, the 2017 unemployment rate was 8.6% (higher than the EU average of 7.6%) implying that 234,000 Finns were unemployed. The underutilised labour potential was more than twice as high, at 536,000.\textsuperscript{75} According to the IMF:

\begin{quote}
\textit{“There is substantial scope to increase labour utilisation in Finland, given relatively low participation of many groups and relatively high unemployment. While some of the existing labour market slack will be removed along the ongoing recovery, achieving substantially higher participation rates will require additional reforms.”}\textsuperscript{76}
\end{quote}

A few additional observations about the labour market in Finland:

- Finland has the highest social protection costs as a percentage of GDP in the EU28. In 2016, Finland spent € 55,286 million on social protection, which was 45.8% of total government expenditure.\textsuperscript{77}
- Employment in the manufacturing of furniture and other products of wood and cork (a sector the circular roadmap aims to enhance) has decreased 12.8% and 21.8% respectively in Finland during the 2010-2017 period.\textsuperscript{78}
- Finland’s employment rate is markedly lower than in the other Nordic countries.\textsuperscript{79} The combination of different working-age benefits, childcare costs and income taxation creates complexity, reduces work incentives and holds back employment.\textsuperscript{80} The European Commission recommends Finland to ‘improve incentives to accept work’.\textsuperscript{81}

Lowering the tax burden on labour would not only benefit the circular economy, but could also help to solve unemployment and underemployment in Finland. The rationale to shift the tax burden from labour to natural resource use will be further explored below.

\textsuperscript{73} Eurostat (2018), Unemployment by sex and age - annual average[une_rt_a]; Eurostat (2018), Supplementary indicators to unemployment - annual data.
\textsuperscript{74} Eurostat (2018), Supplementary indicators to unemployment - annual data.
\textsuperscript{75} Eurostat (2018), Unemployment by sex and age - annual average[une_rt_a]; Eurostat (2018), Supplementary indicators to unemployment - annual data.
\textsuperscript{76} IMF (2017), Finland; selected issues. https://www.imf.org/~/media/Files/Publications/CR/2017/cr17371.ashx
\textsuperscript{77} Eurostat (2018), General government expenditure by function (COFOG)[gov_10a_exp]
\textsuperscript{78} Eurostat (2018), Labour input in industry - annual data[sts_inlb_a]
\textsuperscript{80} Ibid.
2.4. Shifting the tax burden from labour to resource use

Green tax reform has been known under many different names

The proposal to shift taxation from labour to resource use (including pollution and carbon emissions) has been known as Environmental Tax Reform (ETR), Environmental Fiscal Reform (EFR), Green Fiscal Reform (GFR), Green Tax Swaps (GTS) and Value Extracted Tax. Throughout this report the term ‘tax shift’ will refer to such reform. The tax shift also includes the reform of environmentally harmful subsidies. Also, in this perspective, social benefits are equally important as environmental benefits.

Support has grown

The idea to shift the tax burden from labour to resource use has gained support over the last few years amongst academics, international institutions and business organisations as well as in politics. The rise of the circular economy principles has made the subject even more topical and tangible from a business perspective. Most studies on the circular economy conclude that reducing labour taxes and increasing green taxes will be key to achieving the circular ambitions set by governments and businesses. ACCA (2018) mentions for example Ellen MacArthur Foundation (2013); Ellen MacArthur Foundation et al. (2015); Stegeman (2015); Finnish Innovation Fund Sitra (2016); Wijkman and Skånberg (2016); Ministry of Environment, Portugal (2017); Ministry for the Environment, Land and Sea and Ministry of Economic Development Italy (2017).

Although budget neutral for governments, a tax shift fundamentally changes the margins within which business, consumers and governments operate. The impacts of a tax shift from labour to resource-use have been researched extensively, both in theory and in practice.

Tax shift in theory

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82 The term Value Extracted Tax (in short: ‘Ex’tax’) was coined in 1994 by the Dutch entrepreneur Eckart Wintzen in a more integrated approach, focussing on the role of taxes in enabling sustainable prosperity. Wintzen, Eckart (1994), Re-engineering the Planet. Three Steps to a Sustainable Free Market Economy.


85 Budget-neutral fiscal reform is defined as changes in the composition of government revenues and expenses, which are keeping the fiscal budget unchanged.
The UK Green Fiscal Commission modelled an ambitious tax shift in the UK, based largely on energy taxes and some taxes on water and materials. The impacts included that over the period 2006 to 2020 an increase of environmental tax revenues from 6% to 15% of total tax revenues enabled income tax to be cut by 10% and National Insurance Contributions by around one-third. Other impacts were that carbon dioxide emissions fell by 16% in 2020, employment was up by around 1.5% (450,000 jobs) and the effect on GDP was negligible, ‘as the negative effects of the energy price increase were almost completely offset by the positive effects of the increased employment and reduced labour taxes’.  

This study fits in a long range of modelling work finding similar impacts. 

In 2005, a review looked at 186 model simulations taken from 61 separate studies. On average, ‘all of the different groupings of studies predicted net job creation with significant reductions in CO₂ emissions’.  

In 2016, a working group led by The Ex'tax Project presented a tax shift scenario for 27 EU Member States with positive results. Economic modelling has shown that switching €554 billion of taxes from labour to pollution and resource use in the European Union could add €842 billion in GDP (2.0% compared to business as usual), enable 6.6 million more people to be in employment (2.9% compared to business as usual), cut carbon emissions by 8.2% by 2020 and save €27.7 billion on the EU energy import bill over a five-year period.  

Barriers for implementation

Although the basic principle is simple, rebalancing our tax system is not easy for a number of reasons. First of all, tax policy is driven by politics, and the relatively short cycles in politics makes it difficult to develop long-term tax strategies. Secondly, nobody really likes to pay for something that was previously free of charge. Also, industries with an interest in keeping the status quo often have a stronger voice than other interest groups such as non-governmental organisations (NGOs), healthcare organisations or small and medium-sized enterprises that may have an interest in a transition. Finally, there is the challenge of how to coordinate tax reform internationally, as shifting financial incentives will change trade patterns.  

Despite these barriers, the tax shift has been applied in at least nine countries in the past: Sweden (1990), Denmark (1993), the Netherlands (1996), Finland (1997), Slovenia (1997),

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87 Eunomia and IEEP (2014), Study on Environmental Fiscal Reform Potential in 12 EU Member States.  
http://knjznica.sabor.hr/pdf/E_publikacije/Study_on_environmental_fiscal_reform_potential.pdf  
http://www.neweranewplan.com/  
89 ACCA (2018), Tax as a force for good Rebalancing our tax systems to support a global economy fit for the future. Professional Insight Report by Femke Groothuis, The Ex'tax Project.  
Support for the tax shift

International organisations such as the OECD (2011, 2013, 2015a, 2015b, 2018), IMF (2012; 2015; 2016; Heine et al. 2012; Lagarde 2012), World Bank (2015), European Parliament (2012; 2013) and the ILO have all called for a change from labour-based taxation towards tax on resource-use and consumption. The ILO has stated, for example:

‘Taxing polluters generates revenues that can be leveraged to reduce other (distortionary) taxes, for example taxes on labour. These reductions can lead to higher labour demand and higher employment, while using less energy.’

Business groups such as the World Business Council for Sustainable Development and the Business and Sustainable Development Commission have also supported such a tax reform.
According to the European Commission, a tax shift from labour to green taxes is ‘a winning strategy’:

“One of the biggest tax policy challenges in Europe is that governments tend to rely too much on labour taxes. But overdependence on labour taxes can be a disadvantage when they make it too expensive to employ people. Passing some of the taxes to other things, such as pollution, could help to accelerate employment and economic growth. Smart taxation is a winning strategy.”

In 2018, OECD recommendations to Finland specifically included the advice to further reduce the tax burden on labour, increase environmentally-related taxes and phase out environmentally harmful subsidies.

Multiple measures – variety in impacts

Shifting the tax burden from labour to natural resource use consists of multiple policies; it is multi-faceted and so are the potential impacts. More than a hundred options for ‘green’ taxes are available to governments for applying the ‘polluter pays’ principle, including putting a price on air pollution (such as carbon emissions), fossil fuels, waste and water.

Raising taxes on natural resource-use (such as water, harmful emissions, metals and minerals) creates both challenges and opportunities for businesses. On one hand, it will be challenging to reduce water consumption and carbon footprints. On the other hand, when the price of natural resources goes up, the business case of resource efficient technologies improves.

In general, when taxes on labour go down, human resources (manpower, craftsmanship and ingenuity) will become more affordable. Business models can then shift to labour-intensive business models, repair and maintenance services, remanufacturing of products and R&D. A lower tax burden on labour also benefits sectors such as healthcare, education and scientific research. A tax shift has a fundamental impact on consumption patterns too, as pricing of products and services better reflects the external costs by applying the ‘polluter pays’ principles. Circular business models become more competitive if externalities would be priced into polluting products and labour costs would go down.

Any potential regressive effect can be balanced out by using (part of) the revenues to lowering the tax burden (or providing benefits) to low-income groups. As the High-level Commission on Carbon Prices concludes:

‘Taxing ‘bads’ (pollutants) rather than ‘goods’ (labor, capital) can allow for a less costly tax system... Revenues can also be used to reduce the social

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charges imposed on labor costs. This may reduce unemployment rates and help increase real wages. This would also serve to counteract the potentially regressive effects of higher carbon prices and help poor people deal with the higher price levels caused by carbon pricing. It also has positive distributional impacts because of the larger share of wages in the total income of poor households (higher-income households may have other sources of income – capital, interest, and rents). Moreover, mitigation options (eg, energy efficiency, renewables, and agricultural and forestry low-carbon practices) are generally more labor-intensive than economic activities based on fossil fuels. Therefore, recycling carbon tax revenues may generate a double dividend: fostering the transition toward decarbonization while simultaneously promoting economic growth and social development.\textsuperscript{103}

This study explores the potential of a tax shift in Finland. It aims to propose broad-based, budget-neutral policy measures that incentivise resource-efficiency and employment, while maintaining overall long-term competitiveness. The next chapter will explain how the research group developed the scenario under review.

3. **Developing a Circular Tax Scenario**

This chapter describes the methodologies used by the GBE, IEEP and Ex’tax research group to develop a circular tax scenario, which served as input to the modelling.

**The Ex’tax Methodology**

The research group has used the Ex’tax Methodology\textsuperscript{104} in Figure 2 to develop a tax shift scenario. Step 1 in the methodology is to define the overall goals of the policy measures. In step 2, data are collected on the geographic area under review; the economic and fiscal landscape as well as on environmental and labour market issues. In step 3, a focus group of policy areas is defined based on the overall goals defined in step 1. Step 4 entails the development of a scenario, which is explored in more detail in step 5, including a macro-economic impact analysis.

![Figure 2. The Ex’tax Methodology steps](image)

**Step 1: Defining the goals**

The goals in this study are based on the document ‘Leading the cycle – Finnish road map to a circular economy 2016–2025’:  

“The target of the Finnish government and the road map is to make Finland a global leader in the circular economy by 2025.”\textsuperscript{105}

A circular economy is regenerative, and carbon neutral by design and the policy proposals should serve the four themes and the goals identified in the roadmap:

**Theme 1: A sustainable food system**

Goals: *The use of sustainable resources; Sustainable crops production; Short supply chains (local food); Nutrient recycling and waste management systems.*


Theme 2: Forest-based loops

Goals: Recycling of forest industry’s side streams; More refined products than pulp & paper; Wood construction & wooden furniture; Substituting fossil resources and using more wood-based textiles.

Theme 3: Technical loops

Goals: All industrial sectors minimise the need for virgin raw materials by lengthening product life cycles through redesign, reuse, recycling, repair & maintenance, use of secondary materials and remanufacturing.

Theme 4: Transport and logistics

Goals: Moving beyond fossil-fuelled transport; More 'service-based' transport system; Ending fossil fuel use in private cars by 2040; Promoting sustainable biofuels; Replacement of fossil fuels with renewable and non-fossil alternatives; Optimisation of transport routes and material flows and boost public transport.

Overarching themes are inclusive growth and a fair transition by increasing employment and wellbeing (including health and social benefits) as well as improving competitiveness of the Finnish economy through the development of new circular business models. Figure 3 provides a schematic overview of themes in the circular roadmap.

Step 2: Data collection

The research team has collected a large amount of data to support the analysis, mainly from Eurostat, the OECD and Finnish government sources. Such data are included throughout this report.

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106 Based on Sitra (2016)
Data limitations were also identified, for example with regard to mining waste per type of material, recent water data (after 2010) and details of wastewater. Data limitations restrict the number of policy options that can be modelled.

**Step 3: Defining a focus group of policy areas**

**The Ex’tax Policy Toolkit**

The ‘Ex’tax Policy Toolkit’ provides an overview of options to shift the tax burden from labour to natural resource use. Figure 4 shows policy options to lower labour taxes (personal income tax, social contributions and payroll tax) and more generally to use revenues for the good of society (e.g. social assistance, environmental protection, and investments). Each category includes several sub-categories.

Figure 5 provides policy options to apply the ‘polluter pays’ principle and raise revenues based on natural resource use and consumption (e.g. air pollution, energy, food production inputs, fossil fuels, metals and minerals). Again, each category includes several sub-categories. Within the waste category, for example, one of the sub-categories is electronic waste.

**Focus on specific options**

In order to create a workable scope, the research group identified a focus group of policy areas that could help advance the circular roadmap themes by (a) broadening the tax base of environmental taxes, (b) increasing the rates of environmental taxes, (c) abolishing or reducing environmentally harmful subsidies (EHS), and (d) lowering labour taxes.

For each theme and goal, the inputs and outputs were assessed (e.g. industrial loops are linked to inputs such as metals, electricity, water and fossil fuels and outputs such as solid waste, waste water and air pollution). The focus group of policy areas was chosen based on criteria such as urgency and (mid- to long-term) attainability. Each policy option is also intended to be a significant contributor, which means smaller measures are not (yet) included. The overall goal was a fair transition with progressive impacts on income. The current tax system, cultural preferences, geographic issues and the climate zone of Finland were also taken into account to the extent possible.

In building the scenario, there were limitations due to lack of data for some parameters, as well as limitations to the dimensions in the E3ME model. In sustainable transport, for example, a Helsinki area congestion charge could not be included, since the model does not allow for regional assessments. The tax bases this study focuses on are highlighted in pink in Figures 4 and 5. The scenario focuses on tax measures; potential other (non-fiscal) market-based instruments are discussed in Chapter 5.

**Consultations**

On 14 June 2018, a workshop was organised in Helsinki to discuss a preliminary scenario, and the comments and discussion have been taken into account as much as possible. Further
meetings and discussions with stakeholders and interest groups took place in August and September 2018, which have enriched the analysis.

Figure 4. Policy options for use of revenues

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The next section provides a brief overview of the scenario under review.

**Step 4: Defining the scenario (overview)**

Based on the focus group of policy areas above, 21 policy measures were selected to serve as input in the modelling:

**Revenue-raising measures:**

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108 Based on The Ex'tax Project et al. (2016), New era. New plan. Europe. [www.neweranewplan.com](http://www.neweranewplan.com)
- **Air pollution taxes**
  1) CO₂ (non-road sectors, bulk users): Carbon Price Floor

- **Fossil fuels**
  2) Removal of the diesel subsidies (transport sector)
  3) Removal of the light fuel oil subsidy
  4) Removal of the peat subsidy
  5) Non-energy use of fossil fuels (mineral oils and other fossil material used in plastics and other chemical industry)

- **Energy**
  6) Electricity (bulk users)
  7) Removal of the subsidy for energy-intensive industries

- **Transport related taxes**
  8) Air passengers
  9) Air freight

- **Waste related taxes**
  10) Incineration of waste
  11) Nuclear waste

- **Water**
  12) Water abstraction

- **Metals and minerals**
  13) Extraction of metal ores
  14) Extraction of non-metallic minerals

- **Agriculture related taxes**
  15) Pesticides

The revenues are used as follows in the scenario:

- **Personal Income Tax (PIT) and Social Security Contributions (SSC)**
  1) PIT and employee SSC reduction
  2) Employers’ SSC reduction (for new employment)
  3) Employers’ SSC reduction (general)

- **Income support**
  4) Income support for specific groups

- **Investments**
  5) R&D subsidy (labour cost reduction)
  6) Subsidy for renewable energy.

Figures 6 and 7 provide a brief overview of the tax bases, the measures, pricing level per unit and the revenues raised and used by each measure.
**Figure 6.** Estimated use of revenues in the scenario in 2025 in real prices *(Cambridge Econometrics 2018).*

<table>
<thead>
<tr>
<th>Tax base</th>
<th>Measure</th>
<th>% of total</th>
<th>€ mln (in 2025)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Personal Income Tax (PIT) &amp; social security contributions (SSC)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PIT &amp; employee SSC</td>
<td>General reduction</td>
<td>50%</td>
<td>(1,751)</td>
</tr>
<tr>
<td>Employers’ SSC</td>
<td>Employers benefit from reduction if labour demand is increased structurally</td>
<td>30%</td>
<td>(1,051)</td>
</tr>
<tr>
<td>Employers’ SSC</td>
<td>General reduction</td>
<td>5%</td>
<td>(175)</td>
</tr>
<tr>
<td><strong>Income support</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income support</td>
<td>Support for the lowest two income quintiles</td>
<td>5%</td>
<td>(175)</td>
</tr>
<tr>
<td><strong>Investments</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R&amp;D</td>
<td>R&amp;D subsidy (labour cost reduction)</td>
<td>5%</td>
<td>(175)</td>
</tr>
<tr>
<td>Renewable energy</td>
<td>Subsidy for renewable energy production</td>
<td>5%</td>
<td>(175)</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td><strong>(3,502)</strong></td>
</tr>
</tbody>
</table>
Figure 7. Estimated revenues of the scenario in 2025 in real prices (Cambridge Econometrics 2018).

Figure 8 shows how the measures contribute to a budget-neutral shift from labour to natural resource use in 2025. On the right are measures that, compared to the baseline, raise an additional € 3.5 billion of revenues for the treasuries in Finland (at current prices). On the left is shown how the costs of labour can potentially be lowered by the same amount.
Figure 8. €3.5 billion tax shift scenario from labour to natural resource-use in Finland (2025) (Cambridge Econometrics 2018).

Clearly, tax systems are not static; they will evolve with new circumstances. When the updated system works properly, the tax base can be extended to other categories within the Toolkit, in order to guarantee a stable government income. Rates and tariffs can also be raised or lowered; just like the current system of labour taxes, the future system will also be adapted periodically.

It should be emphasised that the scenario is not a blueprint for implementation. It is meant to provide directions on how the fiscal system can be rationalised in light of the circular economy roadmap and what the potential impacts are. Any implementation pathway should be researched and then monitored by the designated Finnish institutions with full access to national statistics.

In the following sections, the measures are described in terms of the national context in Finland, the scope of the measures, their rationale, potential revenue, and examples of best practices in the EU, which may serve as a source of inspiration.
Revenue-raising measures

Carbon Price Floor (non-road sectors, bulk users)

Context

In 1990, Finland became the first country to introduce a carbon tax for fossil fuels. The tax originally covered fuel oil, natural gas, coal and peat at a rate of € 1.12/tonne of CO\(_2\), and has since undergone several changes. The current excise tax on fossil fuels consists of three components: an energy content component, a CO\(_2\) emissions component (CO\(_2\) tax) and a strategic stockpile fee for certain fuels. The energy and CO\(_2\) tax rates have been significantly increased in the 2000s. At the start of 2018, the carbon tax rate was increased to € 62/tonne of CO\(_2\) emissions\(^{109}\). According to the state budget, energy taxes would accrue total revenues of around €4.683 billion in 2018, including the revenues from the CO\(_2\) tax component\(^{110}\).

In addition to carbon taxation, other economic instruments\(^{111}\) have been used in Finland to tackle CO\(_2\) emissions and to promote low carbon solutions. The main instruments have been the EU Emission Trading System (EU ETS) and different kind of subsidies to renewable energy sources, like feed-in-tariff scheme and Energy Aid Programmes for investment support for renewable energy and energy-saving projects. The EU ETS applies to large industrial and energy production plants and covers approximately half of the greenhouse gas emissions in Finland\(^{112}\). For a long time after the start of the ETS in 2005, the allowance price remained low because of a surplus of emission allowances. Consequently, the incentive to reduce emissions was not strong. However, it is estimated that in Europe the ETS has had a significant effect on the emissions of the firms participating in it. In Finland, emissions in the EU ETS sectors have decreased by 24% between 2005 and 2017.\(^{113}\) Nevertheless, the role of the ETS to the reduction is uncertain, because at the same time other instruments have been introduced. For example, the feed-in-tariff scheme for renewable energy has affected the ETS sectors' emission as well. In 2018, the price of the emission allowance has increased significantly, from approximately 8 euros in January to 21 euros per tonne of carbon dioxide (CO\(_2\) eq.) in August 2018.\(^{114}\)

The total Finnish emissions of greenhouse gases in 2017 corresponded to 56.1 million tonnes of carbon dioxide (CO\(_2\) eq.), excluding land use, land-use change and forestry (LULUCF).


\(^{111}\) In addition to economic instruments, various regulations and voluntary programmes have been used, as well. Ministry of Economic Affairs and Employment (2018), Emission Trading. https://tem.fi/en/emissions-trading


Since 1990, Finnish emissions have reduced by one fifth (21%). Nevertheless, the full implementation of a carbon-neutral circular economy needs more effective economic instruments and other policy tools.

According to the OECD:

“The longstanding use of economic instruments [in Finland], especially taxation, to promote green growth, has reduced greenhouse gas emissions intensity considerably since 1990, but it is still the third highest in the OECD.”

In Finland, like in other European countries, the greenhouse gas emission targets and related instruments have been divided into two sectors: the emissions trading sector, and the effort sharing sector. The latter covers the sectors of the economy that fall outside the scope of the EU Emissions Trading System (EU ETS), such as construction, building-specific heating, housing, agriculture, transport and waste management, and industrial F-gases. These sectors account for a little more than a half of the EU's greenhouse gas emissions. Emissions in sectors not covered by the ETS are regulated under the Effort Sharing Decision.

In October 2014, EU leaders set a binding economy-wide domestic emission reductions target for 2021-2030 of at least 40% by 2030 compared to 1990. It was specified that the effort sharing sector must reduce emissions by 30% by 2030 compared to 2005 as their contribution to the overall target. The Effort Sharing Regulation translates this commitment into binding annual greenhouse gas emission targets for each Member State for the period 2021–2030, based on the principles of fairness, cost-effectiveness and environmental integrity. The Regulation was adopted on 14 May 2018. Accordingly, Finland's individual target is to reduce greenhouse gas emissions by 39% compared to 2005 in the effort sharing sector.

According to World Bank (2018) data, around 40% of all greenhouse gas emissions (including other than CO₂ emissions) in Finland are covered by a carbon tax. Taxation is used as a main instrument in the effort sharing sector. However, it should be kept in mind that about half of the greenhouse gas emissions in Finland are covered by the ETS. If we are looking only at the carbon taxation, 49 million tonnes of CO₂ emissions (incl. biomass & waste) were not

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under carbon taxation in 2015 (see graph 2 on page 19 for an overview of how the effective carbon tax rates differ by sector and by energy resource).121

The social cost of carbon

A wide variety of estimates exist of the so-called social cost of carbon (i.e. the damage that results from emitting one tonne of CO₂). The OECD applies a minimum social cost of carbon of €30 per tonne, and in 2018 added a benchmark of €60 per tonne to their analyses to reflect the estimated cost of carbon in the future.122 Other estimates do not take into account the external costs to society, but the price range needed to achieve certain reduction targets. The High-level Commission on Carbon Pricing, for example, concluded that a $40–$80 range in 2020, rising to $50–$100 by 2030, would be consistent with the core objective of the Paris Agreement of keeping the average temperature rise below 2 degrees Celsius.123

The role of biomass

In Finland, the role of biomass as energy source has increased in recent years. In 2017, wood fuels reached a new record and became the most important energy source in Finland. They accounted for 27% of the total energy consumption.124 Biomass in Finland consists mainly of wood fuels, which are forest industry side-streams and wood residues. In addition, biogas is produced from organic waste or compostable waste from industrial, municipal or agricultural waste. Only a very marginal share comes from field biomasses consisting of energy plants or their parts.

Wood fuels sources and their energy production capacity are divided as follows:

- solid wood fuels used at power and heating plants accounted for 38 terawatt-hours,
- the burning of black liquor made up 43 terawatt-hours,
- the small-scale combustion of wood comprised 17 terawatt-hours, and
- other wood fuels covered 2 terawatt-hours.125

The consumption of different wood fuels as part of the total energy consumption is shown in figure 9.

122 The first, EUR 30 is a low-end estimate of the damage that carbon emissions currently cause. Pricing emissions above EUR 30 does not guarantee that polluters pay for the full damage they cause, or that prices are sufficiently high to decarbonise economies. A price below EUR 30 does mean, however, that emitters are not directly confronted with the cost of emissions to society and that incentives for cost effective abatement are too weak. The second benchmark, EUR 60 per tonne of CO₂, is a midpoint estimate of carbon costs in 2020, as well as a forward-looking low-end estimate of carbon costs in 2030. Rising benchmark values over time for carbon costs reflect that the marginal damage caused by one tonne of CO₂ increases with the accumulation of CO₂ in the atmosphere’ (OECD (2018), *Taxing Energy Use* 2018. [https://read.oecd-ilibrary.org/taxation/taxing-energy-use-2018_9789264289635-en#page43](https://read.oecd-ilibrary.org/taxation/taxing-energy-use-2018_9789264289635-en#page43)).
125 Ibid.
Biomass, which has been defined technically as a renewable energy source, has offered an alternative for unrenewable fossil fuels. This has been the case in Finland where the use of biomass has been encouraged by different subsidy schemes such as energy aid and investment programmes. For example, since 2011, Finland has maintained a feed-in tariff scheme to support the introduction of more renewable energy. Under this scheme, in addition to wind power, new biogas power plants (gas produced by digestion), new wood-fuelled power plants (that also produce heat for use) and forest chip power plants have been able to apply for support.

Nevertheless, there is a growing debate on the CO\textsubscript{2} emissions of biomass in Finland and internationally. At the moment, these emissions are not under any kind of pricing mechanism according to their CO\textsubscript{2} content even though they are included in the land-use, land-use change and forestry sector (LULUCF).

The increasing use of biomass produces CO\textsubscript{2} emissions as well. Consequently, a re-evaluation of the existing approach may be necessary even if the carbon sink is not significantly reduced by the use of biomass. In Finland, the use of biomass consists mainly of the residues and side streams produced by the pulp and paper industry, thus trees are not cut to burn as biomass. In addition, the carbon stock in Finland has been quite stable. However, the role of biomass,

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its emissions and calculation basis should be reconsidered based on open and thorough reflection.

Internationally, burning wood and wood by-products for electricity generation is the subject of much debate:

"Biomass is technically a “renewable” energy source, in that trees can be replanted after they're harvested. And some lawmakers have argued that because trees store carbon as they grow, replacement forests will gradually remove the carbon dioxide emitted when the previous trees were burned for energy, making the whole process carbon neutral—that is, putting no net emissions into the atmosphere. But there are some serious flaws in that argument, many scientists suggest. One of the biggest issues is the matter of timing. Burning biomass for energy releases large amounts of carbon into the atmosphere all at once. But depending on the type of tree, forests may take decades or even a century to draw the same amount of carbon back out of the air.”129

In 2018, more than 800 scientists sent a letter to European policymakers sounding the alarm about the burning of wood pellets for electricity generation.130

In Finland, CO₂ emissions from biomass and waste are currently free of charge, even though biomass causes 44% of carbon emissions in the country.131 It is important to note that the use of wood and wood by-products for heat and energy generation is deeply engrained in Finnish culture and economy.

The measure

The scenario under review includes:

- A carbon price floor of € 10 per tonne of CO₂ emitted from biomass (e.g. wood and wood by-products);
- A carbon price floor of € 60 per tonne of CO₂ emitted by all other energy resources used across all industries (e.g. coal, peat, fossil fuels and CHP).

These measures target industrial users (not households). In the modelling, in ETS sectors it is applied as a mark-up to the ETS price.132 The cost of heat generation in the modelling is

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131 Looking at industrial emissions alone, 74.5 million tonnes of CO₂ were emitted in 2015, of which 33 million tonnes CO₂ emissions (44%) were from biomass used as fuel. The combined emissions by industries and households were 86.4 million tonnes of CO₂ in 2015, of which 38.7 million tonnes CO₂ emissions (45%) were from biomass used as fuel. Eurostat (2018), Air emissions accounts by NACE Rev. 2 activity [env_ac_ainah_r2]. Accessed November 19, 2018.

132 The state aid under the ETS remains unchanged. The European Commission has approved a Finnish support scheme to partially compensate energy-intensive companies in certain sectors for higher electricity prices resulting from indirect emission costs under the EU Emission Trading Scheme (ETS). This benefits companies in
increased only depending on the type of fuel used. Aviation remains exempt until an EU-wide approach is found.

Rationale
This measure ties in with the circular roadmap goal of carbon neutrality, industrial loops, sustainable food, forest loops & sustainable transport by:

- Putting an effective price on CO₂ emissions;
- Creating a level playing field between fuels with regard to carbon contents (the “polluter pays” principle);
- Directing Finland towards an emissions trajectory consistent with the Paris Agreement;
- Creating fiscal space to reduce labour taxes.

Potential revenue
The revenue of this measure would be € 869 million for the high rate in 2025, and € 284 million for the low rate, totalling € 1,153 million in 2025 (33% of the revenues raised in the scenario).

Best practices
See the box below. The UK Carbon Price Floor has been highly effective:

> ‘the drop in the European Union (EU) Emissions Trading System (ETS) emissions (by 2.4 percent in 2016) was primarily driven by the carbon-price floor introduced in the United Kingdom, where a £18/tCO₂ top-up on the EU ETS price resulted in the coal power plants reducing their emissions by 58 percent in 2016.’

Box 1: Carbon Price Floor, UK

The UK introduced a carbon price floor in in 2013 to complement the EU ETS. It is administered via a levy on fossil fuels used to generate electricity, taking into account their average carbon content. The carbon price floor applies to fossil fuel-based electricity generators, including electricity that is also subject to the Climate Change Levy regime. The covered fossil fuels are natural gas, liquified petroleum gas (LPG), coal and other taxable solid fossil fuels, gas oil, fuel oil and other heavy oil.

specific sectors that are especially exposed to international competition: The state aid aims to avoid an increase in global greenhouse gas emissions due to shifts of production outside the European Union, where they may face less environmental regulation. The scheme will cover the period from 2016 to 2020. Finland will grant to relevant companies compensation of 40% of the eligible costs for the period in 2016-2018 and 37.5% of the eligible costs for the period 2019-2020. Beneficiaries will still bear part of the ETS costs, so they have an incentive to limit their electricity consumption. The budget of the scheme is approximately €149 million. European Commission (April 2017). http://europa.eu/rapid/press-release_MEX-17-864_en.htm


Fossil Fuels

Removal of the diesel subsidy (transport sector)

Context

In Finland, the effective tax rate per tonne of CO₂ emitted is significantly lower for diesel (€190.1 per tonne) than petrol (€301.6 per tonne) (see Table 2). The difference in pricing represents an effective subsidy for diesel and increases the demand for diesel and diesel driven vehicles. The diesel subsidy represented a tax expenditure of €746 m in 2016. Since the diesel subsidy is targeted towards the transport industry rather than household use of diesel, the vehicle tax on driving power (€388 million 2017) partly offsets the diesel subsidy. According to the OECD:

"raising diesel taxation to the level applied on gasoline would spur the development of alternative fuels and transport modes."

Table 2. Duty and effective carbon tax on diesel and petrol for Finland 2018

<table>
<thead>
<tr>
<th></th>
<th>Diesel</th>
<th>Petrol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duty on fuel (€/1,000 litres)</td>
<td>530</td>
<td>703</td>
</tr>
<tr>
<td>Effective tax rate (€/tonne of CO₂)</td>
<td>190.1</td>
<td>301.6</td>
</tr>
</tbody>
</table>

The measure

The scenario under review includes the removal of the Reduced Energy Tax Rate on Diesel Used in Transport minus the driving power vehicle tax.

Rationale

This measure ties in with the circular roadmap goals of sustainable transport, industrial loops, sustainable food and forest loops by:

- Phasing out fossil fuel subsidies in line with the Finnish commitment to the Friends of Fossil Fuel Subsidy Reform (FFFSR);
- Creating a level playing field between fuels (the “polluter pays” principle);

https://www.ieta.org/resources/Resources/Case_Studies_Worlds_Carbon_Markets/2015/uk_case_study_may2015.pdf

135 This does not consider indirect subsidies for diesel, such as those included in the vehicles taxation system.


140 OECD 2018, Taxing energy use – companion to taxing energy use database
- Aligning tax policy with climate and health goals;
- Creating fiscal space to reduce labour taxes.

The measure is expected to contribute to national goals including 1) ending fossil fuel use in private cars by 2045; 2) promoting sustainable biofuels; 3) replacing fossil fuels with renewable & non-fossil alternatives; 4) optimisation of transport routes and material flows.

As the removal of the reduced rate on diesel will have substantial economic impacts on the transport sector, there should be additional measures to help investments on low-carbon vehicles and to boost the transition towards carbon-neutral transportation.

**Potential revenue**

The estimated revenue would be € 461 million in 2025 (13% of the revenues raised in the scenario).

**Best practices**

**Box 2: Diesel taxation, UK**

The UK is the only EU Member State to have equalised the “at pump” fuel rates for diesel and petrol, as of 1994. The rate for both petrol and diesel in the UK was €661 per 1,000 litres of fuel in 2018. Prior to 1994 diesel was charged a lower rate. The revenues from fuel duties were €31.8 billion for 2017/2018. Fuel rates overall in the UK have gradually increased between 1993 and 1999 as part of the “duty escalator” policy. In 1999, the tax on fuel represented 85% of the price, compared to 64% in 2018. Since then, the escalator concept persists but specific policies have defined rate increases, including those linking fuel prices to inflation and freezes in prices at various points. Other factors have also increased the cost of fuels in the UK, including the increase of the VAT rate to 20% and the decline in the value of GBP.

The 2018 UK rate is the highest rate applied for diesel in the EU. However, this is not the highest rate for fuels overall in the EU; several Member States have higher rates for petrol but lower rates for diesel. For example, the Netherlands charges a higher rate for petrol of € 778 per 1,000 litres, compared with € 490 for diesel. Other Member States with high rates for fuels include Sweden, Italy and Denmark.

The UK’s 2017 Autumn Budget statement complemented fuel rates with specific measures on diesel vehicles. This included increasing the Vehicle Excise Duty (VED) rates for diesel vehicles by one

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band and increasing the company car tax on diesels by 1%\textsuperscript{144}. In 2017, 42% of new cars registered in the UK were diesels, compared to an EU-15 average of around 45%, just over 30% in Finland and 17.5% in the Netherlands (the lowest). Historically, UK diesel sales peaked in 2012 at around 51%, having increased steadily prior to this from 6.4% in 1990\textsuperscript{145}. As this is around the same time the diesel rates were equalised, this implies that the measure was not effective at reducing the purchase of diesel vehicles and the consumption of diesel overall. This suggests that other factors than simply closing the diesel gap may help to determine fuel type consumption and the share of diesel in vehicle fleets.

**Box 3: Integrated vehicle taxation, Netherlands**

Evidence based on existing practice suggests that a combination of fiscal and regulatory measures is most effective in reducing the carbon intensity of vehicle fleets. In the EU, the Netherlands has the lowest CO\textsubscript{2} emissions from new vehicle registrations – 105.9 gCO\textsubscript{2} / km in 2016, compared to an EU-28 average of 118.8 gCO\textsubscript{2} / km and 120 gCO\textsubscript{2} per km in Finland\textsuperscript{146}. The Netherlands also has the lowest number of new diesel vehicles as a percentage of new registrations at 19% in 2016. Likewise, the Netherlands had the highest share of electric chargeable (BEV, PHEV) vehicles in the EU-28 with 6% and was second only to Norway globally with 29%\textsuperscript{147}.

In the Netherlands, the car registration tax (Belasting Personenauto’s Motorrijwielen, BPM) increases rapidly with every additional gram of CO\textsubscript{2}. Under the Dutch system after 175 gCO\textsubscript{2}/km and every additional gram costs €478, with an additional surcharge of €86.43 per gram above 67g/km for diesel cars. High-emitting vehicles over 400g gCO\textsubscript{2}/km pay up to €120,000.

Previously diesel cars with EURO 6 engines received a rebate in the BPM, however this has since been removed. On the other hand, plug in hybrids (PHEV) are exempt when they produce zero emissions and pay lower rates compared to other vehicles; additionally, they do not pay a fixed €356 surcharge charged to all other vehicle types\textsuperscript{148}. The signal is strengthened by the road tax in the Netherlands (motorrijtuigenbelasting, MRB). Annual road tax is based on vehicle weight and the EURO classification of the vehicle, with a surcharge payable for diesel vehicles. Although the Netherlands does not have an equal fuel rate for diesel and petrol, the system heavily penalises diesels and high emitting vehicles in general. This gives low emissions vehicles, and particularly PHEVs, a significant price advantage. The effects of these measures are reflected in purchasing behaviour in the Dutch car fleet.


\textsuperscript{146} T&E, Forum Ökologisch-Soziale Marktwirtschaft (FÖS) / Green Budget Germany (GBG) (2018 forthcoming) A comparison of CO\textsubscript{2}-based car taxation in EU-28, Norway and Switzerland

\textsuperscript{147} Ibid.

Removal of the light fuel oil subsidy

Context
In Finland, a reduced energy tax rate is applied for light fuel oil used in mobile machinery, meaning off road agricultural, construction, gardening and municipal use. Light fuel oil is also used for heating purposes in households. The light fuel oil subsidy represented a tax expenditure of € 444 million in 2017.

The measure
The scenario under review includes the removal of the light fuel oil subsidy.

Rationale
This measure ties in with the circular roadmap goals of industrial loops, sustainable food, forest loops and carbon-neutral transport by:

- Phasing out fossil fuel subsidies in line with the Finnish commitment to the FFFSR; thereby applying the “polluter pays” principle;
- Creating a level playing field between fuels;
- Driving energy efficiency;
- Creating fiscal space to reduce labour taxes.

The removal of the light fuel oil subsidy will have economic impacts on agriculture, construction and public sector, as well as, on households. Therefore, additional measures to help investments on low-carbon machinery and to boost transition towards carbon-neutral heating should be implemented at the same time. The removal of light fuel oil subsidy should be implemented as gradually rising and having the biggest increases only in the last years when actors could have been able to adapt to the forthcoming changes.

Potential revenue
The estimated revenue would be € 442 million in 2025 (13% of the revenues raised in the scenario).

Removal of the peat subsidy

Context

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Peat is the only fossil-like energy material extracted in Finland.\textsuperscript{151} Finland applies a reduced carbon tax rate on fuel peat used in heating, which represented a tax expenditure of € 148 million in 2017.\textsuperscript{152}

The measure

The scenario under review includes the removal of the peat subsidy.

Rationale

This measure ties in with the circular roadmap goal of \textbf{carbon neutrality} by levelling the playing field between fuels with regard to carbon contents (the “polluter pays” principle). Phasing out fossil fuel subsidies is in line with the Finnish commitment to the FFFSR and creates fiscal space to reduce labour taxes.

Potential revenue

The revenue of this measure would be € 140 million in 2025 (4\% of the revenues raised in the scenario).

\textbf{Non-energy use of fossil fuels}

Context

In 2016, non-energy use of fossil fuels in industry in Finland (including petroleum products and natural gas) was around 65.53 petajoules or 1,565,000 tonnes of oil equivalent (toe).\textsuperscript{153}

According to the Netherlands Environmental Assessment Agency (PBL), the external costs of non-energy use of fossil fuels in the Netherlands are € 9.59 million per PJ. If the same value per PJ were applied in Finland, the external cost of non-energy use of fossil fuels in Finland would amount to € 628 million.\textsuperscript{154}

In the case of plastics, production is heavily dependent on fossil fuels, with 90\% of the plastics produced globally derived from fossil fuels.\textsuperscript{155} Of the 7-8\% of global oil production used to produce plastics, 4\% is used as feedstock for plastics, with the remaining 3-4\% used to provide energy for plastics manufacture.\textsuperscript{156} \textsuperscript{157}

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\textsuperscript{153} Eurostat (2018), Simplified energy balances - annual data [nrg_100a]. Accessed November 19 2018.
There is currently no tax on the non-energy use of fossil fuels in Finland.

The measure

The scenario under review includes a tax of € 10 per tonnes of oil equivalent (toe) (the parameter used in the E3ME model) applied to mineral oil and other fossil raw material used in plastics, rubber, painting and other chemical industries.

It is recommended to create an analysis similar to that undertaken by PBL in the Netherlands, to arrive at an external cost calculation specifically for Finland, in order to assess the appropriate pricing level.

Rationale

This measure supports the circular roadmap goal of *industrial loops* by:

- Internalizing external costs (applying the ‘polluter pays’ principle);
- Applying a price for the use of finite resources;
- Driving efficiency, incentivising recycling and substituting fossil-based materials with recycled materials and renewable resources;
- Creating fiscal space to reduce labour taxes.

Potential revenue

The revenue of this measure would be € 16 million in 2025 (0.5% of the new revenues in the scenario).

Best practices

No best practices have been identified.

Energy

*Electricity (bulk users)*

Context

Since the energy tax reform of 1997, electricity is taxed at the point of end use, not according to the fuels used to produce it. Electricity producers in Finland are mostly included in the EU ETS, which should drive the selection of fuels for electricity production.

Electricity tax is divided into two categories according to the user:

- A higher rate of € 0.02253/kWh (category I) is levied on electricity used by private households, as well as the agriculture, forestry, construction, public administration and service sectors.
- An excise duty of € 0.00703/kWh (category II) is levied on electricity used in industry and professional greenhouse cultivation, and in recent years also server rooms and
In the 2018 state budget, the lower rate represents a tax expenditure of € 614 million. During the first half of 2017, Finland had the second lowest electricity price for non-household consumers (including taxes and levies excluding VAT) in the European Union, after Sweden. The average electricity price in the EU is € 0.114/kWh. The average tax rate on electricity in the EU is € 0.035/kWh.

According to the IEA, saving energy is one of the keys to achieving the goals of the Paris Agreement:

"Although end-use energy efficiency alone is not sufficient to meet the temperature goals of the Paris Agreement, it can deliver 35% of the cumulative CO₂ savings required by 2050."

The measure

The scenario under review includes the reduction of the tax expenditure on the reduced (II) rate on electricity by 50%.

Rationale

This measure ties in with the circular roadmap goals of industrial loops, sustainable food, forest loops by:

- Driving energy efficiency (regardless of the source of energy);
- Levelling the playing field between different electricity users;
- Creating fiscal space to reduce labour taxes.

Potential revenue

The estimated revenue would be € 309 million in 2025 (9% of the revenues raised in the scenario).

Best practices

160 Eurostat (November 2017) Electricity price statistics. Accessed November 19, 2018. This is the average rate for industry with annual electricity consumption between 500 and 2 000 MWh.
Germany currently applies an electricity tax rate of € 0.076/kWh for bulk users, whilst in Denmark the rate is € 0.023/kWh. These rates are higher than the category I rate (the highest rate) applied to households in Finland.

**Removal of the subsidy for energy-intensive industry**

**Context**

In 1998, Finland introduced a tax refund system for energy-intensive industry, at the same time as energy tax reform and a substantial increase of energy tax rates. According to the energy tax refund system, companies paying energy taxes exceeding 0.5% of the company’s value added are allowed to apply for a refund of 85% of the amount of the energy taxes paid on the exceeding amount.

According to a 2016 study, a change in the calculation basis at the beginning of 2012 resulted in significant increases in the amount of refunds paid and in the number of firms receiving them, increasing from 13 companies in 2010 to over 140 in 2014. The amount of energy tax refunds for energy-intensive industry increased respectively from € 7 million to over € 200 million, with the amount of refunds estimated at € 230 million in 2018. Close to 85% of all refunds are paid to paper, chemical and forestry companies.

According to the study, energy tax refunds may distort competition because they only apply to certain fields of activity and only to the largest companies within these fields. While large corporations may recoup over 80 per cent of the energy taxes paid, small companies in the same line of business receive much less or nothing. Close to 85 per cent of all refunds go to paper, chemical and forestry companies. Many of them are large international corporations.

Finland is member of the Friends of Fossil Fuel Subsidy Reform working internationally within forums such as the G20, APEC, OECD, World Bank, UNFCCC and the UN Sustainable Development Agenda to convince governments of the benefits of subsidy reform.

**The measure**

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162 For non-household consumers, for the Band IC: 500 MWh <Consumption <2,000 MWh). Eurostat (2018), Electricity prices for non-household consumers - bi-annual data (from 2007 onwards) [nrg_pc_205].


165 Ibid.

166 See website of Friends of Fossil Fuel Subsidy Reform (FFFSR): http://fffsr.org/about/.
The scenario under review includes the removal of the Energy Tax Refund for Energy Intensive Enterprises. (Note: the energy tax rebates for certain agricultural fuels (€ 33 m in 2016) remain unchanged.)

Rationale

This measure ties in with the circular roadmap themes of industrial loops, sustainable food, forest loops and sustainable transport by:

- Phasing out fossil fuel subsidies in line with the Finnish commitment to the FFFSR;
- Creating a level playing field between fuels (the “polluter pays” principle);
- Creating fiscal space to reduce labour taxes.

Potential revenue

The revenue of this measure would be € 201 million in 2025 (6% of the revenues raised in the scenario).

Transport & logistics

Air passengers

Context

In Finland, 18.1 million air passengers were transported in 2016, not including transit passengers (see Table 3).

In general, the environmental impacts of aviation include carbon and air pollutant emissions, noise pollution and local land use change. There is no VAT on ticket prices and international agreements and EU law prevent aviation fuel for international flights being taxed. In a bid to still put a price on the negative impacts of air travel, several countries (including the UK, Germany and Norway) have introduced a passenger aviation tax, as a proxy for kerosene use.  

Table 3. Air transport passenger data Finland 2016

<table>
<thead>
<tr>
<th>Type of journey</th>
<th>Number of passengers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic travel</td>
<td>2,688,880</td>
</tr>
<tr>
<td>International intra-EU travel</td>
<td>11,265,168</td>
</tr>
<tr>
<td>International extra-EU travel</td>
<td>4,145,906</td>
</tr>
<tr>
<td>TOTAL</td>
<td>18,099,954</td>
</tr>
</tbody>
</table>

The measure

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The scenario under review includes a €15 fee per passenger per flight (arrivals and departures, but excluding transit passengers). The rate is based on the lowest rate applied per passenger in the UK (see box 4).

Rationale

This measure ties in with the circular roadmap goal of sustainable transport by:

- Applying the ‘polluter pays’ principle in the absence of (EU-wide) excise duties on kerosene
- Creating a level playing field between transport modes in the absence of VAT on plane tickets;
- Creating fiscal space to reduce labour taxes.

Potential revenue

The estimated combined revenue of this measure and the air freight tax (see section below) would be € 274 million in 2025 (8% of the revenues raised in the scenario).

Best practices

**Box 4: Air passenger duty, United Kingdom**

The UK air passenger duty (APD) is charged to passengers departing from UK airports. The measure was introduced in 1994. Planes with a capacity of less than 20 or a maximum take-off weight (MTOW) of less than 10 tonnes (5.7 tonnes for business jets) are exempt.

Table 4. UK Air passenger duty rates (€) correct from 1 April 2019

<table>
<thead>
<tr>
<th>Destination Band</th>
<th>Reduced Rate</th>
<th>Standard Rate</th>
<th>Higher Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Band A</td>
<td>15</td>
<td>29</td>
<td>88</td>
</tr>
<tr>
<td>Band B</td>
<td>88</td>
<td>195</td>
<td>583</td>
</tr>
</tbody>
</table>

The rate charged per passenger is determined by the nature of the aircraft (MTOW, seat pitch and seating capacity) as well as the distance travelled (capital city to London). In total there are six rates of duty, between €15 and €583 – see Table 4. A different set of rates are applied in Northern Ireland.
The revenues from the APD have increased steadily over time, reaching over €4 billion in 2016. Although the share is growing, it should be said that the APD is still a small share of total environmental tax revenues in the UK.

When the APD was introduced it was not initially envisaged as an environmental tax, indeed the environment was not explicitly referred to in the Budget Speech that launched the measure\textsuperscript{170}. More recently, the measure has been referred to as an environmental tax, particularly as a measure that can address aircraft emissions. For example, in the 2006 Pre-Budget report it was estimated that the measure would deliver carbon emission savings of 0.3 million tonnes of carbon by 2010-2011\textsuperscript{171}.

Currently, the Highlands and Scottish Islands have exemptions from the tax\textsuperscript{172}.

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**Air freight**

**Context**

Eurostat provides data on all freight and mail on board an aircraft either landing or taking off from a national airport (see Table 5):

\[\text{Graph 3. Government revenue from the UK air passenger duty (APD) 1997 - 2016 (EUR millions)\textsuperscript{169}}\]

\[\text{The revenues from the APD have increased steadily over time, reaching over €4 billion in 2016. Although the share is growing, it should be said that the APD is still a small share of total environmental tax revenues in the UK.}\]

\[\text{When the APD was introduced it was not initially envisaged as an environmental tax, indeed the environment was not explicitly referred to in the Budget Speech that launched the measure\textsuperscript{170}. More recently, the measure has been referred to as an environmental tax, particularly as a measure that can address aircraft emissions. For example, in the 2006 Pre-Budget report it was estimated that the measure would deliver carbon emission savings of 0.3 million tonnes of carbon by 2010-2011\textsuperscript{171}.}\]

\[\text{Currently, the Highlands and Scottish Islands have exemptions from the tax\textsuperscript{172}.}\]

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\textsuperscript{172} Revenue Scotland (2018) *Air Departure Tax*. https://www.revenue.scot/air-departure-tax
Table 5. Air freight volumes Finland 2016 (tonnes)

<table>
<thead>
<tr>
<th>Type of air freight</th>
<th>Volume (tonnes) 2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>National transport</td>
<td>2,864</td>
</tr>
<tr>
<td>International intra-EU</td>
<td>68,958</td>
</tr>
<tr>
<td>International extra-EU</td>
<td>114,649</td>
</tr>
<tr>
<td>TOTAL</td>
<td>186,471</td>
</tr>
</tbody>
</table>

Compared to other means of transporting goods (e.g. rail, road and sea), air freight is significantly more polluting. Two tonnes of freight carried 1,000 km produces 4,138 kg CO₂ by air, compared to 42 kg by diesel train, 30 kg by container ship. Other externalities of air transportation are emissions of NOx (causing smog and acid rain), SO₂ (deteriorating soil and water quality) and volatile organic compounds (VOCs), and noise pollution.

Air freight fuel (kerosene) is not subject to excise duties with respect to international and EU law and no EU countries currently operate air freight taxes, which represents a significant effective subsidy to this form of freight compared to other modes of transport.

The measure

The scenario under review includes a flat rate of € 20 per tonne of air freight (excluding passenger baggage).

Rationale

This measure ties in with the circular roadmap goal of sustainable transport by applying the ‘polluter pays’ principle in the absence of (EU-wide) excise duties on kerosene. Also, the measure creates fiscal space to reduce labour taxes.

Potential revenue

The estimated combined revenue of this measure and the air passenger tax (see section above) would be € 274 million in 2025 (8% of the revenues raised in the scenario).

Best practices

**Box 5: Tonnage tax, United Kingdom**

The UK tonnage tax, introduced in 2000, is a kind of Corporation Tax specifically designed for the maritime shipping industry in the UK. The objective of the measure was to support the development of the UK shipping sector and increase the level of training of personnel working for shipping companies.

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175 Ibid
operators. The measure may help to promote the maritime movement of freight, rather than use of more environmentally polluting or heavily-emitting modes such as air and rail.

The measure allows shippers to pay a tonnage tax on a fixed notional profit based on the tonnage of their ships, rather than directly on their profits earned. Taxable profits are calculated based on the net tonnage per vessel and the following guidance:

Table 6. Calculation of tonnage tax profits UK tonnage tax

<table>
<thead>
<tr>
<th>Net tonnage of ship (tonnes)</th>
<th>Daily profit rate per 100 tonnes (GBP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 1,000</td>
<td>0.60</td>
</tr>
<tr>
<td>1,000 – 10,000</td>
<td>0.45</td>
</tr>
<tr>
<td>10,000 – 25,000</td>
<td>0.30</td>
</tr>
<tr>
<td>25,000 +</td>
<td>0.15</td>
</tr>
</tbody>
</table>

The rate of the tonnage tax is favourable compared to the general Corporation Tax. In this sense, the tax can be interpreted as a subsidy to the shipping industry – and has been approved as EU State Aid. Shipping operators must choose whether or not they wish to be part of the tonnage tax scheme and have to be enrolled for a minimum of 10 years. Entry into the scheme places the following requirements on ships:

- The size of the ship – greater than 100 gross tons
- Flag of the vessel – must be flagged under an EU flag
- Training requirements for ship officers

Analysis of the impact of the tonnage tax suggests that in 2015 the measure supported 37,000 jobs, €463 million in tax contributions, an additional 73% of gross added value (GVA) from the UK shipping industry, and €4.18 billion in sea-based transport export services.

Waste

Nuclear waste

Context

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177 Ibid
In 2017, around 33% of total electricity supply in Finland (totalling 21.5 million MWh) was generated from nuclear energy. In 2017, the largest share of electricity produced by nuclear energy in the 14 EU Member States that have nuclear facilities to produce electricity were observed in France (71.5 %), followed by Slovakia (56.6 %), Belgium (49.9 %), Hungary (49.6 %), Sweden (39.6 %), Slovenia (39.1 %), Bulgaria (36.1 %) and Finland (33.2 %). Across OECD countries the average share of nuclear energy is 18.5% of total energy supply.\(^{179}\)

Between 1990 and 2016, Finland increased its production of nuclear-generated electricity by almost 21%.\(^{181}\)

There is currently no nuclear waste tax in Finland, but a payment for management of nuclear waste. An operator holding a licence to run a nuclear facility is responsible for the management of nuclear waste and all the related costs. To guarantee that outstanding nuclear waste management interventions can be carried out in all circumstances, licensees under a waste management obligation make payments to the Nuclear Waste Management Fund.\(^{182}\) The size of the payments is decided annually by the Ministry of Economic Affairs and Employment based mainly on the amount of waste produced and the overall situation of waste management. There is currently € 2.6 billion in the nuclear waste management fund. The payments totalled € 73.1 million in 2017. The production of nuclear energy (electricity) was 22,280 GWh, thus the nuclear waste management payment was about € 3.28/MWh.\(^{183}\)

Nuclear waste from energy production can remain dangerous for decades or even up to millions of years.\(^{184}\) Closing the loop on nuclear waste is not currently possible.

The measure

The scenario under review includes a tax on the production of nuclear waste of € 4 per MWh of energy generated by nuclear power\(^{185}\) in addition to the payments to the Nuclear Waste Management Fund. The rate is based on the example in Spain (€ 7/MWh, see box 7), reduced to € 4/MWh because of the existing Finnish license fee of € 3.28/MWh.

Rationale

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\(^{183}\) Financial statement of NWMF (in Finnish) [https://tem.fi/paatos?decisionId=0900908f80593a72](https://tem.fi/paatos?decisionId=0900908f80593a72)


\(^{184}\) Ulrik Kautsky, Peter Saetre, Sten Berglund, et al. (2016), The impact of low and intermediate-level radioactive waste on humans and the environment over the next one hundred thousand years. Journal of Environmental Radioactivity, Volume 151, Part 2, January 2016, Pages 395-403. [https://doi.org/10.1016/j.jenvrad.2015.06.025](https://doi.org/10.1016/j.jenvrad.2015.06.025);


\(^{185}\) At present, the units of electricity produced is used as a proxy due to the structure of the E3ME model.
This measure ties in with the circular roadmap goal of **industrial loops** by applying the 'polluter pays' principle and (indirectly) putting a price on the extraction of non-renewable resources. Also, the measure creates fiscal space to reduce labour taxes.

**Potential revenue**

The estimated revenue of this measure would be € 134 million in 2025 (4% of the revenues raised in the scenario).

**Best practices**

**Box 6: German tax on nuclear fuel**

Germany had in place a tax on nuclear fuel (fissile uranium and plutonium) between 2011 and 2016. The tax was introduced to make extensions to the lives of nuclear power plants less profitable for operators in the face of the planned postponement of the phase-out of nuclear power in the country (i.e. to reduce windfall profits). An additional motivation was to obtain revenue to cover the cost of decommissioning and decontaminating the Asse II mine, which had been used as a test site for the long-term storage of radioactive waste. The tax rate was € 145/g of nuclear fuel, which translates to a tax of approximately € 7.3 to € 15.8 per MWh of electricity generated. The revenues (which amounted to a total of around € 5.8 billion for the period 2011-2015) were paid into the general budget. The tax is no longer in place since 2017.

**Box 7: Spanish tax on nuclear waste generation and storage**

Spain introduced a tax on nuclear waste generation and storage in 1997. The tax is levied on nuclear power plant operators. The rate is € 6.60 - € 7.80 per MWh. Revenues accrue to a dedicated fund to finance decommissioning and nuclear waste storage. In addition, in 2012, Spain introduced two new nuclear waste taxes, with revenues accruing to general budgets at the federal level.

**Incineration**

**Context**

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188 Ibid
Of the total amount of all waste generated in Finland (around 93 million tonnes annually), 4.5 million tonnes are incinerated with energy recovery, and 0.5 million tonnes are incinerated without energy recovery.\footnote{Eurostat (2014), \textit{Treatment of waste by waste category, hazardousness and waste operations [env_wastrt]}, \url{http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_wastrt&lang=en}}

The EU’s waste hierarchy, as established by the Waste Framework Directive, places incineration as the second least desirable option, above only landfilling. Incineration with energy recovery can therefore be seen as downcycling, and incineration without energy recovery as disposal.

There is currently no incineration tax in Finland.

**The measure**

The scenario under review includes an incineration tax of € 20 per tonne of waste incinerated. A best practice example of such measure is found in Denmark (see Box 8).

**Rationale**

This measure ties in with the circular roadmap goal of \textit{industrial loops, sustainable food and forest loops} as incineration is downcycling of materials. Increasing the cost of incineration increases the value of secondary materials versus virgin materials. This improves the business case for salvaging and reusing waste streams (such as metals, minerals, biomass from food waste and wood) that would otherwise be incinerated. Also, the measure creates fiscal space to reduce labour taxes.

**Potential revenue**

The estimated revenue of this measure would be € 100 million in 2025 (3% of the revenues raised in the scenario).

**Best practices**

\begin{box8}

\textbf{Box 8: Waste disposal taxes, Denmark}

Denmark introduced landfill and incineration taxes in 1987 and became the first country to completely ban the landfilling of combustible waste in 1997. When first introduced in 1987, the incineration tax was set at DKK 40 per tonne (€ 5.4). In 2014, the tax for incineration was DKK 261 per tonne (€ 35) and the tax for landfill DKK 470 per tonne (€ 63) (Legislative Council Secretariat, 2014). The introduction of landfill tax and incineration tax in Denmark has not resulted in a reduction in the quantity of waste generated. Instead, it has provided a strong economic incentive for
\end{box8}
recycling. Private markets for compost products and recycled construction and demolition waste have been developed as a result.

Water

Water abstraction

Context

The latest available data in Eurostat on abstraction of fresh surface and ground water is from 2006.\(^{191}\) Salminen et al. (2018) published more recent data, indicating that total abstraction by Finnish industry was around 1,960 million m\(^3\) of fresh water in 2010 for purposes other than cooling. Around 1,643 million m\(^3\) of this came from surface water and around 316 million m\(^3\) from ground water. In addition, around 1,891 million m\(^3\) of surface water and 3.7 million m\(^3\) of ground water were abstracted for cooling. The amount of brackish water abstracted for various purposes was around 6,280 million m\(^3\) per year.\(^{192}\)

Although Finland has the second highest volumes of freshwater resources per inhabitant in the EU (around 20,000 m\(^3\))\(^{193}\), a more efficient and circular use of water is important to improve the resilience of the system, manage future risks and reduce associated energy use.\(^{194}\)

There is currently no Finnish tax on water abstraction (other than locally applied fees).

The measure

The scenario under review includes a water abstraction tax of € 0.04 per m\(^3\) of water intake (including ground water and surface water, excluding sea water). This rate only applies for bulk users.

Rationale

This measure supports the circular roadmap themes industrial loops and sustainable food by driving water efficiency and energy efficiency (as energy and water use are interconnected). A reduction in water use (through efficiency gains, reuse and recycling) could also lessen the


\(^{192}\) Jani M. Salminen, Pekka J. Veiste, Jari T. Koskiaho, Sarianne Tikkanen (2018), Improving data quality, applicability and transparency of national water accounts – A case study for Finland, https://doi.org/10.1016/j.wre.2018.05.001


\(^{194}\) California’s water conservation between June 2015 and February 2016 simultaneously saved enough electricity to power 135,000 houses for a year. This energy saving translated into a reduction in greenhouse gas emissions equivalent of removing 50,000 cars from the road for a year. UC Davis Center for Water-Energy Efficiency (Accessed June 2016), website.
level of emissions and biochemical oxygen demand (BOD) in wastewater from certain industries and help reduce pressure on wastewater treatment plants. Incentivising water recycling technologies could benefit Finland and its long history of technological entrepreneurship. Also, the measure creates fiscal space to reduce labour taxes.

Potential revenue
The revenue of this measure would be € 133 million in 2025 (4% of the revenues raised in the scenario).

Best practices

**Box 9: Water abstraction charges, Bulgaria**

A water abstraction charge was adopted in Bulgaria in 2001 with the aim of preserving water resources to achieve sustainable water usage in the long-term. Since its introduction, the charges have been updated twice, in 2012 and 2017, and increased to fulfil the EU Water Framework Directive. The charges are applied to all aspects of abstraction. The revenue is collected by the Enterprise for Management of Environmental Protection Activities (EMEPA) and used for environmental projects and initiatives.

**Table 7. Water charges in 2012**

<table>
<thead>
<tr>
<th>Usage type</th>
<th>Charge in 2012 (BGN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drinking and household needs</td>
<td>0.02 (EUR 0.01)</td>
</tr>
<tr>
<td>Irrigation, livestock, fish breeding</td>
<td>0.001 (EUR 0.0005)</td>
</tr>
<tr>
<td>From surface and spring waters</td>
<td>*</td>
</tr>
<tr>
<td>From groundwater</td>
<td>*</td>
</tr>
<tr>
<td>For cooling</td>
<td>0.0003 (EUR 0.00015)</td>
</tr>
<tr>
<td>For recreation and water sport</td>
<td>none</td>
</tr>
<tr>
<td>For industrial purposes</td>
<td>0.045 (EUR 0.023)</td>
</tr>
<tr>
<td>For other purposes</td>
<td>(EUR 0.033)</td>
</tr>
<tr>
<td>For production of energy</td>
<td>0.0016 (EUR 0.0008)</td>
</tr>
</tbody>
</table>

*Not available

Annual revenue from the enactment of the Water Act in Bulgaria has increased over time and it is argued that the amendment of the water abstraction charges in 2012 contributed significantly to this – from EUR 14 million in 2012 to EUR 26 million the following year. The adoption of the water

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Box 10: Water abstraction charges, Luxembourg

A reform of the water allocation regime was undertaken in Luxembourg in 2008 with the 2008 Water Law, passed by the Government to implement the EU Water Framework Directive and the Floods Directive. The Water Law includes a charge on surface and groundwater abstraction for all categories of water users: agriculture, domestic, industrial, energy production (excluding hydropower), and hydropower. The charge is based on the volume of water drawn and set at € 0.10/m³.

The aim of the tax is to prevent water wastage and to reduce the risk of droughts due to future climatic changes. In addition to a water abstraction tax, the Water Act sets a pollution tax to ensure compliance with the EU Water Framework Directive standards for water quality. The revenue obtained from these taxes goes to the Water Management Fund.

Metals and minerals

Extraction of metal ores

Context

In Finland, around 27 million tonnes of metal ores were extracted in 2016. There is currently no tax on mining or other extraction of minerals. However, royalties are paid to land owners. The Mining Act of 2011 requires mining permit holders to pay an annual compensation, an excavation fee, to the land owners of the mining area. The annual amount of the excavation fee per property is 50 euros per hectare. In addition, there is an additional compensation fee differentiated according to metallic mineral mines, and other mining minerals, as follows:

- on metallic mineral mines: 0.15 per cent of the calculated value of metallic mining minerals, excavated and exploited during the year, considering the average price of the exploited metals included in the ore during the year, and the average value of other products exploited from the ore during the year.

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201 OECD (2012) OECD Economic Surveys: Luxembourg
203 Eurostat (2018), Material flow accounts [env_ac_mfa]
- on other mining minerals than metallic minerals: reasonable compensation for excavated and exploited mining mineral, taking into consideration grounds influencing the financial value of the mining mineral.²⁰⁴

The measure

The scenario under review includes a tax rate of € 2 per tonne of metal ores extracted.

Rationale

This measure supports the circular roadmap theme *industrial loops* by:

- Internalising the external environmental costs (e.g. damage to water, biodiversity and landscapes) caused by metal ore mining.
- Putting a price on the extraction of non-renewable natural resources, thereby improving the business case of secondary raw materials versus virgin material;

The measure provides an opportunity to use revenues from resource extraction to the benefit of Finnish society in general.

Potential revenue

The combined revenue of this measure and the tax on non-metallic minerals (see next section) would be € 97 million in 2025 (3% of the revenues raised in the scenario).

Best practices

Taxes directly comparable to the measure have not been identified. Nevertheless, the examples below offer some support to the rationale for applying the instrument in Finland.

**Box 11: Examples in the EU**

In Sweden, for the concession of minerals, 0.15% of the value of minerals extracted is paid to the landowner, and 0.05% to the Government.

In Norway, for state-owned minerals NOK 100 (around €10.6) is paid to the Government per hectare per year, with 0.5% of sales value paid to the landowner (0.75% in the county of Finnmark).

In Greenland, a sales royalty of 2.5% of the value of minerals is payable to the Government of Greenland, rising to 5% for rare earth elements and uranium. An additional 15% surplus royalty is payable on gross profit exceeding 40%.²⁰⁵

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Box 12: Examples from outside the EU

In India, a ‘deadrent’ is paid on the land area of a mine at the following rates, whether or not active extraction is taking place: around €37/ha for copper, around €50/ha for gold and around €12/ha for iron ore. In addition, royalties are paid at the following rates: 4.2% of the units produced for copper, 2% for gold and 10% for iron ore.

In Ukraine, a tax of around €0.50 is applied per tonne of gold extracted, and around €0.03-€0.35 per tonne of iron ore, depending on the ore quality.

In China, a resource tax is charged at the following rates: €0.64-€0.90 per tonne produced of copper, €0.19-€0.90 for gold, and €1.29-€3.22 for iron ore. In addition, royalty fees are paid per km² of mining area (€12.87 for the first three years, then an additional (€12.87 from the fourth year, with a ceiling of around €65/km²/year).206

Extraction of non-metallic minerals

Context

In 2016, a total of around 85 million tonnes of non-metallic minerals were extracted in Finland, the majority (82%) of which was sand, gravel and clay (70 million tonnes); 13% chemical and fertiliser minerals (11 million tonnes); 4% stone (such as limestone, gypsum and chalk) (3.3 million tonnes); and other non-metallic minerals (just over 1 million tonnes)207. Total turnover in 2016 was € 635 million, including these minerals plus the extraction of peat, but not including mining support service activities.

Discussions on non-metallic minerals in Finland have focussed on sand and gravel, which are typically extracted in fresh water areas in the south of the country, with associated impacts on those environments. The turnover for stone, sand and clay was around € 300 million in 2016208.

There is currently no tax on the extraction of aggregates or non-metallic minerals in Finland. In 2012, a report from the Ministry of Finance suggested that an aggregate tax would have a positive impact on the recycling of construction materials and reduce the use of natural gravel, thereby protecting the quality of groundwater209. It also noted, however, that such a tax would increase the cost of the public sector, as it is the biggest player in infrastructure and housing.

The measure

The scenario under review includes a tax of € 0.50 per tonne of non-metallic minerals extracted (including stone, sand, gravel and minerals for chemical and fertiliser use).

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207 Eurostat (2018), Material flow accounts [env_ac_mfa]
208 Eurostat (2018), Annual detailed enterprise statistics for industry (NACE Rev. 2, B-E) [sbs_na_ind_r2]
Rationale

This measure supports the circular roadmap theme **industrial loops** by:

- Internalizing external costs (e.g. damage to water, biodiversity and landscapes) caused by the extraction of minerals;
- Putting price on the extraction of non-renewable natural resources;
- Promoting recycling of materials (e.g. construction and demolition waste) versus the use of virgin materials;
- Encouraging a move towards renewable alternatives, such as wood.

The measure provides an opportunity to use revenues from resource extraction to the benefit of the Finnish society in general.

Potential revenue

The combined revenue of this measure and the tax on metallic minerals would be € 97 million in 2025 (3% of the revenues raised in the scenario).

Best practices

**Box 13: Aggregates tax, Sweden**

Sweden introduced a tax on gravel extraction in 1996. At its introduction, the tax rate was set at SEK 5 (around € 0.50) per tonne to mirror the price of recycled material and was then gradually increased to SEK 15 per tonne (around € 1.40). The objectives for the introduction of the tax were to protect groundwater quality by promoting the recycling of construction materials and the use of alternatives to virgin gravel, and to internalise in pricing the environmental impacts of gravel extraction. In addition, there were goals to reduce the use of natural gravel from over 40 million tonnes to 12 million tonnes per year, and to ensure that recycled material accounted for 15% of all materials used. These goals were achieved in 2012, and between 1994 and 2014 the use of natural gravel decreased from almost 44 million tonnes to just under 11 million tonnes per year. The revenue from the tax amounted to SEK 167 (around € 19 million) in 2013.

**Box 14: Aggregates levy, UK**

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An aggregates levy was introduced in the UK in 2002. When introduced, the rate was GBP 1.60, rising to GBP 2 per tonne (around € 2.25) in 2009. It is applied at the point of commercial exploitation of sand, gravel and rock. The rationale for the levy was to reduce the negative environmental impacts of aggregate extraction and to incentivise the recycling of aggregates. Initially, the levy contributed to a minor tax shift of a 0.1% reduction in employers’ National Insurance (i.e. social security) contributions. The tax amounts to around 20% of the average price for sand, rock and gravel.\textsuperscript{214}

The UK has a high recycling rate for aggregates, accounting for almost 25% of the UK aggregates market; this is the largest recycled market share for any European country. In 2013, revenue from the tax was around GBP 275 million (€ 324 million), and revenue amounted to GBP 407 million (€ 477 million) in 2016-17.\textsuperscript{215} The tax increased the costs of virgin aggregates, incentivising the construction sector to use recycled aggregates.\textsuperscript{216} Whilst the use of virgin aggregate in the construction sector has reduced significantly, it is difficult to attribute this solely or specifically to the levy; the falling trend began prior to the levy’s introduction and has also been linked to the landfill tax (imposed from 1997 onwards). Nevertheless, a decoupling of the use of aggregates from construction output can be observed between 1995 and 2010.\textsuperscript{217} From 2002 to 2011, GBP 35 million (€57 million) per year was ringfenced into the Aggregate Levy Sustainability Fund, to finance projects to mitigate the local environmental impacts of quarrying.

**Box 15: Tax on raw materials, Denmark**

A tax on raw materials extraction was introduced in Denmark in 1990, together with a waste tax, with the aim of moving up the waste hierarchy and reducing resource-use. The tax is fixed at DKK 5 (€0.67) for each m\textsuperscript{3} of raw material extracted: stone, gravel, sand, clay, limestone, chalk, peat, topsoil and similar deposits. The tax primarily affects the construction and cement production sectors. The effect of the tax on raw material extraction has been relatively small, as both the elasticity of demand and the tax rate are low. Revenues are received by the State. In general, the tax revenue has increased, from EUR 18.2 million in 1995 to EUR 25 million in 1999.\textsuperscript{218} The tax, in conjunction with the waste tax, has increased the demand for recycled substitutes – from 12% of construction and demolition waste recycled in 1985 to 94% in 2004.\textsuperscript{219}


Food production inputs

Pesticides

Context

In 2016, total sales of plant protection products reached 13,223 tonnes. Sales of plant protection products for agricultural and horticultural use was 4,335 tonnes, including 1,575 tonnes of active substances. Sales of plant protection products for use in forestry was 8,878 tonnes, including 3,017 tonnes of active substances.220 In 2014-2015, Finland had the greatest increase in pesticide sales in the EU, compared to 2011-2013 sales.221

The 7th EU Environment Action Programme sets the objective that by 2020, the use of plant protection products does not have any harmful effects on human health or unacceptable influence on the environment, and that such products are used sustainably.222 A tax on pesticides may help reduce and/or prevent the use of the most harmful pesticides.223

There is currently no pesticides tax in Finland. A pesticide registration fee was in place between 1988 and 2006, which applied to the pesticides industry.224, 225 Since 2009, there has been a fee for the approval of new plant protection products if they needed an evaluation. The fee covers the evaluation cost made by the Finnish Safety and Chemicals Agency (Tukes).

The measure

The scenario under review includes a tax of € 10 per kg of active ingredients used.

Rationale

This measure ties in with the circular roadmap sustainable food theme by:

- Internalising the external costs of the use of these substances on society and on the environment;
- Incentivising closing the loop on mineral resource-use, thereby reducing pollution. It may also incentivise the adoption of alternative pest control measures that do not contribute to further extraction of virgin mineral resources.

Potential revenue

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221 [source]
223 UNDP (2017) Taxes on Pesticides and Chemical Fertilizers. UNDP.
225 Ibid.
The estimated revenue of this measure would be € 43 million in 2025 (1% of the revenues raised in the scenario).

Best practices

Based on the experience of applying a pesticides tax in other EU Member States, a banded tax rate according to the potential effects of different active ingredients is considered to be the most effective. Eunomia (2016) advise a rate of € 10/kg active ingredient.226

**Box 16: Pesticide tax, Denmark**

Denmark introduced a tax on pesticides in 1996, applying to all types of consumption (including agriculture). A key aim was to reduce the spraying intensity of pesticides in Danish agriculture (the Treatment Frequency Index, TFI). A fee had previously been imposed on the agrochemical industry (since 1986), with the same objective. The initial tax rate was set on retail price (excl. VAT) as follows: 37% on insecticides and 15% on fungicides, herbicides and growth regulators. In 1998, the tax rate on insecticides was increased to 54%, and 33% respectively on the other three product categories227.

The system was reformed in 2013, moving from a consumption-based tax to a tax with rates differentiated according to the relative environmental and health impacts of individual pesticides. Average tax rates were also increased. The pesticides with the highest impact are most heavily taxed to provide the strongest economic incentive to use pesticides with the least negative impact. This aspect of the tax was positively received by industry228.

In the first ten years of the tax, annual revenues ranged between DKK 235 and 500 million (€31.5-67.1 million). This increased to DKK 659 million (€88.5 million) in 2013, or 0.07% of total Danish tax revenue. Since 2010, farmers were partly compensated for increased expenses by a reduction in land taxes of DKK 62-72 (€8.3-9.7) per hectare, which also helped to ease resistance from industry. Part of the revenues are returned to fund agricultural R&D activities, and another part is used to fund the administration of the Danish Pesticide Action Plan229.

The Danish pesticide tax has had small effects on pesticide use over the years, but more significant reductions are expected following the reformed tax (it will be evaluated in 2017-18), as the pesticides with largest environmental load now face substantially higher price levels230.

Finally, the tax has some distributional effects. For instance, as land prices differ across Denmark, different farmers receive different levels of reimbursements through the reduced land value tax mechanism231. For example, following the 2013 reform of the tax, strawberry producers could be

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229 Ibid.
230 Ibid.  
231 Ibid.
expected to experience decreasing pesticide prices while potato producers might experience increasing prices, due to the differing environmental load of the pesticides used by the respective types of farmers.  

*June 2018 exchange rate

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**Box 17: Pesticides tax, Sweden**

In 1984, Sweden was the first country in the world to introduce a flat tax on pesticides based on volume sold. The objective was to reduce pesticide use and thereby its environmental and health impacts. The initial rate of SEK 4 (€0.39) /kg active substance has been gradually raised, and since 2015 is SEK 34 (€3.32) /kg. The tax applies to both pesticides produced in Sweden and imported pesticides.

SEK 122 million (€11.9 million) were raised in revenue from the tax in 2017 (preliminary figures). Until 1995 and Sweden’s accession to the EU, the revenues were used for agri-environmental programmes aiming to reduce pesticide application and to promote integrated pest management. Since then, the revenues have been directly allocated to the national treasury.

Since the introduction of the tax, the sales of active pesticides substances have gone down and the aggregated environmental risk index calculated for pesticides has remained relatively stable. However, the pesticide tax cannot be interpreted as the only determinant for these trends.

Updated statistics of pesticide sales in Sweden is expected in mid-2018.

*June 2018 exchange rate

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234 The Swedish Tax Agency (2018) *Skatt på bekämpningsmedel* [Pesticides tax]. [https://www.skatteverket.se/foretagochorganisationer/skatte/punktsskatter/bekampningsmedel.4.18e1b10334ebe8bc80005054.html](https://www.skatteverket.se/foretagochorganisationer/skatte/punktsskatter/bekampningsmedel.4.18e1b10334ebe8bc80005054.html) Accessed 180618

235 Ibid.

236 Ecotec Research & Consulting, Centre for Social Science Research on the Environment (CESAM), Centre for Agriculture and Environment (CLM), University of Gothenburg, University College Dublin (UCD) and Institute for European Environmental Policy (IEEP) (2001) *Study on the economic and environmental implications of the use of environmental taxes and charges in the European Union and its Member States*. Ecotec Research & Consulting, Brussels.

237 Ibid.


Use of revenues

Personal income tax (PIT) and social security contributions (SSC) reduction

PIT and employee SSC reduction

National context

In Finland, labour taxes raised € 48.8 billion in revenues (or 51% of total tax revenues) in 2016, consisting of:

- € 23.6 billion paid by employees (25% of total tax revenue)
- € 18.8 billion paid by employers (20% of total tax revenue)
- € 6.4 billion paid by non-employed (7% of total tax revenue)

Finland has no payroll taxes.

The “tax wedge” is a measure of the tax burden on employment incomes. It is the difference between labour costs to the employer and the corresponding net take-home pay of the employee. In 2017, Finland had the fourth highest tax wedge (after France, Greece and Italy) in the OECD for an average married worker with two children, at 38.4% (compared to an OECD average of 26.1%). The average single worker in Finland faced a tax wedge of 42.9% (compared to an OECD average of 35.9%).

As a share of GDP, Personal Income Tax was 13% of total tax revenues in Finland in 2016; the third highest in the EU (after Denmark and Sweden).

The measure

In the modelling, 50% of the net increases in government revenues are used to reduce personal income tax and employee social security contributions. In practice, these reductions can take many forms, ranging from benefits and allowances (in tax credits or cash transfers) to adapting income tax rates to obtain the desired fair distribution. Specific attention needs to go to the fact that currently, private pensions are deferred wages and are based on gross income. Lowering income tax rates and social contributions should not affect pension rights.

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243 The modelling assumption for this measure is that all income tax rates are decreased equally. A separate income support measure is specifically designed to reduce inequality.
Rationale

The measure supports the circular roadmap goals of inclusive growth and a fair transition. By lowering personal income tax and employee social contributions, households have more disposable income. This compensates for an increase in living expenses.

Estimated cost

€ 1,751 million in 2025. This amount represents 4.7% of the combined personal income tax revenues and employee social contributions in 2016244.

Best practices

Spain reduced the share of the combined personal income tax revenues and employee social contributions in total tax revenue by 2.9% during the period 2010-2016, the highest reduction in the EU.245

Employers’ SSC reduction (for new employment)

National context

Employers’ social contributions provided € 18.8 billion, or 20% of total tax revenues in Finland in 2016. At 8.7% of GDP, these employers’ social contributions are the fourth highest in the EU (after France, Estonia and Czech Republic).246

The Finnish employment target for 2020 is 78%; in 2016, the employment rate was 73%. In 2016, 235,600 people were unemployed (8.8% of the labour force). However, according to Eurostat, the potential additional labour force in 2016 was more than twice as high as the number of unemployed, at 553,600247, consisting of:

- 235,600 unemployed (8.8% of labour force)
- 102,000 underemployed part-time workers248
- 64,000 seeking work but not immediately available for work
- 152,000 available but not actively seeking work.

According to the OECD:

“Raising the employment rate, which is lower than in all the other Nordic countries, is crucial to address the long-term fiscal challenges posed by ageing and foster inclusive growth. The Competitiveness Pact which

---

244 Eurostat (Accessed November 2018), Main national accounts tax aggregates[gov_10a_taxag]
245 Ibid
247 Eurostat (Accessed June 2018a), Supplementary indicators to unemployment - annual data
248 An underemployed part-time worker is a person aged 15-74 working part-time who would like to work additional hours and is available to do so. See also Eurostat (2018), Glossary: Underemployed part-time worker, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Underemployed_part-time_worker
entered into force this year is helping contain labour costs and strengthen demand for labour. Recent measures to enhance work incentives, notably the cut in the duration of unemployment benefits, will lift labour supply. However, further reforms to boost employment are needed, as high tax rates upon return to work and complex benefit rules still undermine work incentives.”

“Work incentives could be further strengthened by reducing the tax burden on labour while further increasing indirect and property taxes and reducing tax expenditures.”

The measure

30% of the net increases in government revenues are used to reduce labour costs for employers through a reduction in employers’ social contributions. The scenario assumes that the cost reduction is tied to an effective employment increase. This means that employers only benefit if they actually increase their workforce structurally.

Rationale

The measure reduces labour costs, which enables a shift towards labour-intensive circular activities. It ties in with business models for each of the themes of the study: industrial loops, sustainable foods, forest loops, sustainable transport & logistics.

Through its impact on labour demand, the measure supports the circular roadmap goals of inclusive growth and a fair transition.

Estimated cost

€1,051 million in 2025.

Best practices

In 2014, Spain adopted a similar measure to promote employment creation and indefinite hiring. This involved a cut in employers’ social contributions to a flat rate of €100/month for two years on new permanent contracts, conditional on the upkeep of the labour contract over 3 years.

Box 18: Measures to promote employment, Spain

In March 2014, the Spanish Government adopted the Royal Decree-Law (RDL) 3/2014, on urgent measures to promote employment creation and indefinite hiring. The Spanish decree contains one

250 OECD Economics Department (March 1, 2018), Finland: growing and reforming, but no time for complacency, https://oecdecoscope.blog/2018/03/01/finland-growing-and-reforming-but-no-time-for-complacency/
measure: a cut in employers’ social security contributions to a flat rate of €100 per month for two years on all permanent contracts signed until the end of the year. This flat rate is conditional on the labour contract being maintained over the three following years by the hiring company. The specifics are as follows:\(^{251}\):

- It applies to either new indefinite contracts or the conversion of temporary into indefinite contracts.
- Micro firms may benefit of an additional reduction of 50% of the standard social security contribution after the end of the first two years of the application of the flat rate.
- For part-time contracts, the flat rate will be proportional to the working hours.
- The new regulation does not affect the employer’s or worker’s contribution for other contingencies such as unemployment insurance, professional training, and contribution to the wage guarantee fund (FOGASA).
- The job must be maintained for at least three years; otherwise, the amounts saved by the company shall be recovered, totally or partially (recapturing is 100% if the employment contract is terminated during the first year, 50% if terminated during the second year and 33% if terminated during the third year).
- The new measure will have no impact on the benefits to which workers are entitled, which are calculated applying the full contribution base.
- According to the Ministry of Labour and Social Security, the scheme will reduce by 75% the current total social security contributions. Indeed, the flat rate replaces the 23.6% contribution to social security for common contingencies (basically, related to pensions and health and safety).

The downside of this scheme is that the flat rate implies that the higher the salary, the higher the savings on the social security contributions for the company and, consequently, the revenue loss for the social security system. Still, the advisory commission on this matter states: “While the flat rate implies a greater subsidy for higher paid workers, the higher labour demand and supply elasticities could still lead to a bigger impact on low-skilled jobs.”

Another issue may be that the measure could result mainly in a conversion of temporary contracts into permanent ones, thus meeting one of its stated objectives, while its potential to stimulate additional employment creation is more uncertain\(^{252}\).

**Employers’ SSC reduction (general)**

**National context**

In Finland in 2016, employers’ social contributions raised €18,800 million, or 20% of total tax revenue. Employers’ social contributions accounted for 8.7% of GDP, the 4th highest in the EU (after France, Estonia and Czech Republic)\(^{253}\).

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\(^{252}\) Ibid

The measure

5% of the net increases in government revenues are used to reduce employers’ social security contributions in general.

Rationale

The measure reduces labour costs, which enables a shift towards labour-intensive circular activities. It therefore ties in with business models for each of the themes of the study: industrial loops, sustainable foods, forest loops, sustainable transport & logistics. By increasing labour demand, the measure supports the circular roadmap goals of inclusive growth and a fair transition.

Estimated cost

€ 175 million in 2025. To put this into perspective: this amount is comparable to 1.0% of the employers’ social security revenues in 2016.254

Best practices

Hungary reduced the share of employers’ social contributions in total tax revenue by 5.9% during the period 2006-2016, which was the highest reduction in the EU in that period.255

Income support for specific groups

National context

Compared to other EU28 member states, Finland has one of the lowest inequality rates and low at-risk-of-poverty rates in every population category. For employed persons the at-risk-of-poverty rate is the lowest in the EU28 (3.1%). 37.2% of the unemployed had an income below the at-risk-of-poverty threshold, which is again below the EU-average of 48.6%. Pensioners also have a lower than average at-risk-of-poverty rate (at 12%, which is below the 13.8% EU28 average). The 'other inactive' group shows a higher at-risk-of-poverty rate (albeit still lower than EU average); at 28.8%. Single persons have a higher than EU average risk at 28.6%, which is also much higher than the rate for two adults at least one aged 65 and older (4%) and two or more adults (6.4%).256

Finland has a complex system of income support.257 The OECD Economic Survey 2018 notes the following:

254 Ibid
255 Ibid
256 ‘The at-risk-of-poverty rate is the share of people with an equivalised disposable income (after social transfer) below the at-risk-of-poverty threshold, which is set at 60 % of the national median equivalised disposable income after social transfers. This indicator does not measure wealth or poverty, but low income in comparison to other residents in that country, which does not necessarily imply a low standard of living.’ Eurostat (2018), Glossary: At-risk-of-poverty rate. https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:At-risk-of-poverty_rate
“The combination of different working-age benefits, childcare costs and income taxation creates complexity, reduces work incentives and holds back employment. Coordinating the tapering of various working-age benefits against earnings could drastically improve work incentives and transparency, while preserving the current level of social protection.”

The measure

5% of the net increases in government revenues in the scenario are used to compensate the two lowest income quintiles in Finland.

Rationale

The measure supports the circular roadmap goals of inclusive growth and a fair transition by providing vulnerable households with support to compensate for an increase in living expenses.

Estimated cost

The estimated cost of the measure is € 175 million in 2025.

Best practices

Due to the complexity and wide range of indicators for the risk of poverty and inequality, no best practices have been identified.

Investments

R&D subsidy (labour cost reduction)

National context

Finland is a major investor in R&D. Spending on R&D as a percentage of GDP was 2.8% in 2016; higher than the EU average of 2.0% of GDP. The Finnish 2020 target in this respect is 4% of GDP, significantly higher than the EU 2020 target of 3% of GDP. According to the OECD:

“Notwithstanding a recent pick-up, total investment in R&D is now below 3% of GDP compared to close to 3.5% before the 2007 crisis – largely because of a large drop in Nokia and the electronics industry more generally.”  

---


The measure

5% of the net increases in government revenues in the scenario are used to reduce costs associated with high-skilled employment in R&D. Such a facility exists in the Netherlands’ Research & Development Promotion Act (WBSO), which is a wage cost reduction for R&D in general (see Box). The facility in Finland could potentially be targeted specifically at innovative circular resource use, including resource efficiency, closing the loop in supply chains and new (e.g. bio-based) materials. The technical details are to be determined at implementation; the E3ME model generically treats such measures as a cost reduction that is distributed among sectors based on their R&D expenditures.

Rationale

Depending on the details of implementation the measure serves the themes industrial loops, Sustainable foods, Forest loops, Sustainable transport & logistics and carbon neutrality by:

- Reducing the tax burden on labour for R&D employers (which enables job creation in innovative sectors);
- Promoting sustainable innovation, potentially in each of the themes.

Estimated cost

The estimated cost of the measure is € 175 million in 2025.

Best practices

Box 19: The Research & Development Promotion Act, the Netherlands

In the Netherlands, the Research & Development Promotion Act is a measure of about €0.8 billion (2014) per year aimed at lowering wage costs for R&D. An evaluation commissioned by the Dutch Ministry of Economic Affairs, Agriculture and Innovation showed that, thanks to the Act, private sector wages paid for R&D effectively went up in the period from 2006 to 2010262. In 2014, almost 23,000 Dutch companies, including self-employed entrepreneurs, used the facility263.

Subsidy for renewable energy production

National context

In Finland, renewable energy sources represented about 40 per cent of energy end-consumption in 2017. The aim set in the National Energy and Climate Strategy to 2030 is to

increase the share of renewable energy up to more than 50 per cent during the 2020s. The most important forms of renewable energy used in Finland are bioenergy, fuels from forest industry side streams and other renewable energy sources, such as hydropower, wind power and ground heat. Bioenergy is also generated from biodegradable waste and side streams of agriculture and industrial production and from municipal waste. Solar electricity has a growing role especially in on-site energy generation.

The main objective in promoting renewable energy is to reduce greenhouse gas emissions and move away from the energy system that is based on fossil fuels. Another objective is to improve energy self-sufficiency and employment and support the development of technologies in the sector.264 Finland has used different policy instruments to achieve the target share of renewable sources on energy end-consumption. The main drivers for investments and use of renewables have been a feed-in tariff programme, a biofuel blending requirement for motor fuels and subsidies for investments for renewable energy production (see appendix 1).

Energy aid and investment aid for key energy projects, managed by the Ministry of Economic Affairs and Employment has been one of the drivers to promote investments and technology in renewables. Energy aid can be granted to investment projects and studies that:

- promote the production or use of renewable energy;
- promote energy savings or increase the efficiency of energy generation or use; or
- otherwise promote the transition towards a low-carbon energy system.

Investment Aid for Key Energy Project programme is intended to subsidize investments on renewable energy and new energy technology.265 Annually, the subsidies under the Energy Aid and Investment Aid for Key Energy Projects account around € 60-70 million.266 In addition, investments in the construction of a national LNG terminals network have been supported with a total of approximately € 93 million.267

The measure

5% of the net increases in government revenues in the scenario are used to subsidise the production of solar, wind, biogas and geothermal energy (within the power sectors).

Rationale

Depending on the details of implementation the measure serves the theme of carbon neutrality by promoting renewable energy use.

The estimated cost of the measure is € 175 million in 2025.

Step 5: Detailed exploration

In this study, Cambridge Econometrics modelled the scenario. The results are discussed in the next chapter.
4. MODELLING RESULTS – E3ME

This chapter provides estimates of macroeconomic impacts of the tax reform policies in Finland as described in the previous chapter. The analysis is carried out using the E3ME macroeconomic model, which will be briefly introduced in section 5.1. Section 5.2 explains some of the assumptions, and 5.3 provides some of the key results. 5.4 provides an overview of the macro-economic impacts, 5.5 includes impacts per sector. A conclusion is drawn in the final section.

4.1. Introduction to the E3ME model

E3ME is a computer-based model of global economies, used for analysing the detailed linkages between the economy, materials, environment and energy. The model was originally developed through the European Commission’s research framework programmes and is now widely used in collaboration with a range of European institutions for policy assessment, forecasting and research purposes (see Ekins et al, 2012; Pollitt, 2011; European Commission, 2014, 2016, Cambridge Econometrics, 2013; Lee et al, 2016; European Commission, 2018; New Climate Economy, 2018; Mercure et al, 2018).

The key features of E3ME include:

- the close integration of the economy, energy and raw materials systems and the environment, with two-way linkages between each component
- the detailed sectoral disaggregation in the model’s classifications, allowing for the analysis of similarly detailed scenarios

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272 European Commission (2014), Study on modelling of the economic and environmental impacts of raw material consumption.
its global coverage (59 regions), while still allowing for analysis at the national level for large economies and EU Member States.

- the econometric approach, which provides a strong empirical basis for the model and means it is not reliant on some of the restrictive assumptions common to CGE models.
- the econometric specification of the model, making it suitable for short and medium-term assessment, as well as longer-term trends.

Appendix 2 includes a description of the model. The main dimensions covered by the model are listed in the E3ME manual (available online) at http://www.e3me.com. The manual also explains the theories behind the model as well as econometric specifications for each equation. A full list of model equations is available in Mercure et al. (2018).

4.2. Assumptions and limitations

The E3ME model is based on a post-Keynesian economic framework and its assumptions are consistent with this branch of economics. The approach is generally an empirical one, with behavioural parameters determined by relationships in the data. It is assumed that these relationships are maintained in the projection period, i.e. that behavioural responses remain consistent with those in the past.

There are several important assumptions specific to this analysis:

Baseline projections. The E3ME baseline (‘business as usual’) is consistent with the future trends published by the European Commission. All policies that were agreed at either EU or national level before the end of 2014 are incorporated. Final energy demand decreases by between 0.5% and 1.0% pa, and greenhouse gas emissions decrease by between 1.0% and 2.0% pa up to 2030. The modelling results are presented as differences from the baseline.

National policy. The measures are introduced in the model on a national level in Finland, rather than in a coordinated effort across the European Union. The results in this report are therefore presented as results for Finland.

Brexit. Due to the unsure character of the pending withdrawal of the United Kingdom from the European Union (‘Brexit’) as well as any potential impacts of such withdrawal on the UK, European and global economies, these impacts are not included in the baseline projections, nor in the scenario results.

Phasing in. The tax shift scenario assumes a gradual introduction of policy measures from 2019 to reach the full measures by 2025 and remain the same beyond 2025. A linear path of introduction is applied over the seven-year period 2019-2025, so the initial tax rates in 2019 are in general quite low.

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282 Note that in 2016, exports from Finland to the UK accounted for 4.5% and 5.6% of total Finnish exports of goods and services respectively. Imports from the UK accounted for 3% and 7% of total Finnish imports of goods and services respectively (source: UN Comtrade for goods, Statistics Finland for services).
**Budget-neutrality.** Each year, all revenues are used (‘recycled’) in accordance with the scenario (this means there is no impact on the public deficit).

**Price effects.** The E3ME model captures price effects and does not include any awareness or signalling effects from the green taxes. This means that the responses to changes in tax rates should be attributed to the financial effects, rather than any publicity or virtue-signalling that accompanies the reforms.

**Prices.** All euro-values in the results are in 2015 prices, unless specified differently.

**The level of disaggregation.** Although relatively detailed there are still limitations to E3ME in terms of sectors, regional breakdown and temporal periods. Probably most important here is that some sectors (e.g. ‘other mining’) combine things (here aggregates and mineral ores) that would be useful to have split up.

**Modelling the circular economy.** E3ME is based around a representation of the national accounting system which incorporates a detailed ‘input-output’ table that outlines linkages between sectors. The economic data are linked to physical indicators of energy consumption and material use. A circular economy is achieved through a reduction in physical consumption of virgin materials and fossil fuels, which is represented in the economy by changing patterns of purchases between industry sectors (e.g. less from mining and more from recycling).

**4.3. Key results**

As indicated in Chapter 3, the measures in the scenario are expected to raise around €3.5bn in the year 2025 (current prices). Every year, the revenues are fully recycled in the form of labour tax reductions and subsidies for renewable energy. The results of this revenue-neutral tax shift are presented in this paragraph.

The key message from the results is that it is possible to design policy measures that reduce final energy consumption and harmful emissions, while at the same time stimulating the Finnish economy and creating jobs. Graph 4 provides key results over the 2019-2025 period, demonstrating the effective decoupling of GDP and employment and resource use.

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283 In general, revenue-neutral means that the revenues from new tax rates introduced are used to offset something else. Budget neutral means that the overall government budget position is unchanged, which in a modelling exercise would only be possible if the model covered every source of tax and expenditure.
Overall result: decoupling
(Finland, 2019-2025, % difference from baseline)

Graph 4. Overall result: decoupling (2019–2025, difference from baseline). Source(s): E3ME, Cambridge Econometrics

Table 8. Key modelling results in 2025, difference from baseline. Source(s): E3ME, Cambridge Econometrics.

<table>
<thead>
<tr>
<th></th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
<th>2025</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP</td>
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<tr>
<td>Employment</td>
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<tr>
<td>CO₂ emissions</td>
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<tr>
<td>Final energy consumption</td>
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</tbody>
</table>

Impact beyond 2025

The tax shift scenario assumes a gradual introduction of policy measures from 2019 to reach the full measures by 2025 and remain the same beyond 2025. Since the E3ME model doesn’t assume return to equilibrium, GDP and employment continue to increase after 2025 in the scenario, albeit at lower rates than the period between 2019 and 2025.

In the sections below the macro-economic results are discussed in more detail.

4.4. Macro-economic impacts

Table 9 provides details for each result. The figures represent the difference on top of any changes that occur in the baseline. The next sections will give an explanation for the main line items.
<table>
<thead>
<tr>
<th>Economic indicators</th>
<th>2025 (%)</th>
<th>2025 (various)</th>
<th>Cumulative 2019-2025*</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP (€ mln)*</td>
<td>1.2%</td>
<td>3,513</td>
<td>12,913</td>
</tr>
<tr>
<td>Output (€ mln)*</td>
<td>0.8%</td>
<td>4,679</td>
<td>16,799</td>
</tr>
<tr>
<td>Household expenditure</td>
<td>1.7%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumer prices</td>
<td>0.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Investment</td>
<td>1.2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exports</td>
<td>0.01%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Imports</td>
<td>0.2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy imports (€ mln)*</td>
<td>-6.1%</td>
<td>-274</td>
<td>-924</td>
</tr>
<tr>
<td>Social indicators</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employment (persons in employment)</td>
<td>1.2%</td>
<td>30,600</td>
<td>115,600</td>
</tr>
<tr>
<td>Change in household incomes for lowest quintiles</td>
<td>2.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental indicators</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electricity Generation (MWh)</td>
<td>-3.1%</td>
<td>-2,640</td>
<td>-10,393</td>
</tr>
<tr>
<td>Final energy consumption (ktoe)</td>
<td>-2.6%</td>
<td>-636</td>
<td>-2,609</td>
</tr>
<tr>
<td>Material consumption (thousands of tonnes)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction Minerals</td>
<td>-0.6%</td>
<td>-1,129</td>
<td>-4,584</td>
</tr>
<tr>
<td>Non-ferrous ores</td>
<td>-0.8%</td>
<td>-196</td>
<td>-817</td>
</tr>
<tr>
<td>Ferrous ores</td>
<td>-0.7%</td>
<td>-49</td>
<td>-203</td>
</tr>
<tr>
<td>Industrial minerals</td>
<td>-0.1%</td>
<td>-1</td>
<td>-5</td>
</tr>
<tr>
<td>Air pollution (x1,000 tonnes)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO₂</td>
<td>-6.0%</td>
<td>-2,349</td>
<td>-8,358</td>
</tr>
<tr>
<td>SO₂</td>
<td>-8.1%</td>
<td>-14</td>
<td>-50</td>
</tr>
<tr>
<td>NOₓ</td>
<td>-6.3%</td>
<td>-11</td>
<td>-39</td>
</tr>
<tr>
<td>PM10</td>
<td>-5.8%</td>
<td>-5</td>
<td>-17</td>
</tr>
<tr>
<td>PM2.5</td>
<td>-3.9%</td>
<td>-2</td>
<td>-7</td>
</tr>
</tbody>
</table>

* Non-discounted
The reductions in labour taxes are the main driver of positive macroeconomic impacts in the scenario. By lowering personal income tax, households have more disposable income to spend, which more than offsets the higher prices of certain products. There is also a higher number of people in employment, driven by the direct reductions in labour costs. A growth in incomes, both in terms of people already employed and people becoming employed, leads to higher demands for goods and services in the economy. In real terms, GDP increases by 1.2% in the scenario compared to the baseline.

**Output**

While GDP represents the value added in the economy, output is a gross measure that includes input material and energy (but not labour) costs.

Although output increases in the scenario, the relative increase is smaller than for GDP. The reason is that companies become more efficient in their use of material and energy inputs because of the tax shift. So, the increase in GDP is due to both higher production levels and greater efficiency.

**Consumption and Household expenditure**

Consumption (household expenditure) goes up in the scenario. This is primarily due to a combination of higher employment levels and reductions in income tax rates, which boost household average incomes. In the scenario, average prices increase due to resource and consumption taxes. These price increases affect both consumers and industries but are not large enough to offset boosts in income.

For industries, resource taxes add to unit production costs. With the exception of commoditised industries, most of these costs are passed on to final consumers in the long run. The final impact on consumers depends on the interaction of higher product prices and lower income taxes, plus the net change in employment. The results show that the overall impact is positive.

**Investment**

There are no measures in the scenario that directly affect investment. However, some of the measures could lead to investment in new production methods. Furthermore, if the Finnish economy grows faster there will be higher rates of investment, due to a requirement for additional production capacity.

**Imports and Exports**

Overall, imports go slightly up (0.2%) and exports (0.01%) show almost no effect. The small changes in exports as imports can be explained by the fact that the additional resource taxes are compensated by lower labour costs. The impacts of these two factors vary across sectors, but broadly cancel out in aggregates.

At the same time, the trade balance is helped by reduction in fossil fuel imports of 6.1%. This is a result of several of the measures that are designed to reduce energy consumption and, to a lesser extent, switching to renewables. However, due to the higher rates of consumption (i.e. some of the displaced expenditure on fuels is used to buy other imported goods), overall imports still increase.
Employment

Employment goes up by 1.2% in the scenario compared to baseline. A large part of the increase in employment demand in the modelling results is driven by the tax credit for new employment. The remaining share is a direct result of the other employment related measures and indirect results from higher economic activity. The employment-related measures lower the cost of labour to industries, making labour more attractive as a factor of production, and in turn generating higher employment demand.

Electricity generation

Total electricity generation goes down by 3.1%. This is mainly the result of reduced consumption by energy-intensive industries.

Out of the different generation technologies, only solar and wind show positive effects; these are caused by the energy-related measures, notably the subsidy for renewable technologies (see Table 10).

Table 10. Electricity generation per technology in 2025, difference from baseline

<table>
<thead>
<tr>
<th>Source of electricity generation</th>
<th>Difference from baseline (%)</th>
<th>Difference from baseline (MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar</td>
<td>8.0%</td>
<td>2</td>
</tr>
<tr>
<td>Wind</td>
<td>0.6%</td>
<td>42</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>-2.0%</td>
<td>-348</td>
</tr>
<tr>
<td>Nuclear</td>
<td>-2.1%</td>
<td>-622</td>
</tr>
<tr>
<td>Biomass</td>
<td>-2.3%</td>
<td>-333</td>
</tr>
<tr>
<td>Oil</td>
<td>-4.1%</td>
<td>-10</td>
</tr>
<tr>
<td>Gas</td>
<td>-4.5%</td>
<td>-315</td>
</tr>
<tr>
<td>Coal</td>
<td>-10.8%</td>
<td>-1,056</td>
</tr>
</tbody>
</table>

Energy consumption

The total final energy consumption is reduced by 2.6%. This is the result of several of the measures included in the overall package.\textsuperscript{284} Table 11 provides the reductions per fuel type.

\textsuperscript{284} The following measures contribute to the reduction of final energy consumption: Carbon price floor, removal of the subsidy for energy-intensive industries, removal of the diesel subsidies, removing light fuel oil subsidy, electricity tax (bulk users) and removing the peat subsidy.
The reduction of the electricity consumption (-2.8%) is driven by a combination of the direct tax on electricity consumption but also the passing on of costs from the carbon price floor, water and nuclear waste taxes.\textsuperscript{285}

Energy-related taxes lower energy consumption directly, mostly of road transport and aviation fuels but also consumption of electricity.

Table 11. Final energy consumption per fuel type (in 2025, difference from baseline)

<table>
<thead>
<tr>
<th>Final energy consumption per fuel type</th>
<th>Difference from baseline (%)</th>
<th>Difference from baseline (ktoe)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline and diesel</td>
<td>-1.3%</td>
<td>-72.2</td>
</tr>
<tr>
<td>Bioenergy</td>
<td>-1.9%</td>
<td>-161.9</td>
</tr>
<tr>
<td>Heavy fuel oil</td>
<td>-2.9%</td>
<td>-42.3</td>
</tr>
<tr>
<td>Natural gas</td>
<td>-6.1%</td>
<td>-173.7</td>
</tr>
<tr>
<td>Crude oil</td>
<td>-6.2%</td>
<td>-78.1</td>
</tr>
<tr>
<td>Combustible waste</td>
<td>-7.0%</td>
<td>-6.0</td>
</tr>
<tr>
<td>Derived gas</td>
<td>-7.3%</td>
<td>-29.1</td>
</tr>
<tr>
<td>Hard coal</td>
<td>-10.6%</td>
<td>-152.5</td>
</tr>
<tr>
<td>Other coal</td>
<td>-12.1%</td>
<td>-136.2</td>
</tr>
</tbody>
</table>

**Material consumption**

Because of the taxes on materials extraction, the material consumption is brought down. All types of materials (construction minerals, industrial minerals, ferrous ores and non-ferrous ores) show a decline, while economic growth is higher than in the baseline. This demonstrates an effective decoupling of economic growth and resource use and shows a combination of improvements in material efficiency and a shift towards production of less material-intensive goods.

**CO\textsubscript{2} emissions**

In 2025, the policy measures in the scenario reduce CO\textsubscript{2} emissions by 6.0% compared to the baseline, mainly due to a combination of direct taxation on carbon and other measures that reduce energy consumption. Emissions from biomass are included in this figure. If only emissions from fossil fuels are included, the reduction in 2025 is 6.3%.

\textsuperscript{285} Electricity consumption is primary energy consumption, so not included in the final energy consumption to avoid double counting.
Localised air pollution

Four types of air pollution emissions are included in E3ME: SOx, NOx, PM10 and PM2.5. Although none of the measures in the scenario directly target air pollution, several of them aim to reduce the combustion of polluting energy products (e.g. coal or road transport fuels). There are therefore modest falls in all four types of emissions, compared to the baseline.

Real incomes

Real incomes are determined by a combination of changes in wage rates, taxation and prices across the economy. Rich and poor households spend their incomes in different ways and have different effective taxation rates; so the impacts may vary across household groups. Even without any measures to explicitly address income distribution, the tax shift is slightly progressive because of these different relative effects. When we account for the measure to boost incomes in the lowest two quintiles, the effect is more pronounced (see Graph 5). However, the average household in each group would still see an increase in real incomes of more than 1%.

![Graph 5. Overall result: decoupling (2019–2025, difference from baseline). Source(s): E3ME, Cambridge Econometrics](image)

Personal income tax and social contributions

In 2025, the average personal income tax rate goes down from 38.5% (baseline) to 36.9% (scenario). The employers' social contribution rate goes down from 20.2% (baseline) to 20.1% (scenario). By lowering personal income tax and social contributions, households have more disposable income to spend. This leads to the higher households demands for goods and services in the economy that are described above. By lowering social contributions paid by employers, employers can afford to hire more staff. In general, previous model-based analyses have demonstrated that when comparing the two options:

- Reducing income tax and employees' contributions gives a larger boost to household expenditure and GDP.
- Reducing employers' contributions gives a smaller boost to GDP but sometimes a larger boost to employment.

The next sections will look at the impacts per sector.
Overall, the results from the scenario show that the energy and utilities sectors experience the biggest loss in output, while labour-intensive services sectors experience the largest gains. More details on the macro-economic results per sector are further discussed below.

**Output**

The scenario represents a shift from an energy and material-intensive means of economic production to a more labour-intensive economy. The sectoral results reflect this pattern (see Table 12 and Graph 6).

The largest increases in output, both in relative and absolute terms, are in services sectors. These sectors benefit both from lower labour costs and boosts to household expenditure from lower income tax rates. The main exception is the engineering sector, which plays a role in developing new infrastructure in the scenario. Some of the manufacturing companies in its supply chain also benefit. Output falls in the energy and utilities sectors because of reduced demand for energy products.

Table 12. Output by sector (In 2025, difference from baseline in % and mln €).

<table>
<thead>
<tr>
<th>Output (difference from baseline)</th>
<th>In 2025 (%)</th>
<th>In 2025 (€ mln)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering etc.</td>
<td>1.5%</td>
<td>978</td>
</tr>
<tr>
<td>Other Services</td>
<td>1.5%</td>
<td>705</td>
</tr>
<tr>
<td>Wholesale and Retail</td>
<td>1.0%</td>
<td>484</td>
</tr>
<tr>
<td>Business Services</td>
<td>1.0%</td>
<td>1,375</td>
</tr>
<tr>
<td>Basic Manufacturing</td>
<td>0.8%</td>
<td>722</td>
</tr>
<tr>
<td>Transport and communications</td>
<td>0.8%</td>
<td>338</td>
</tr>
<tr>
<td>Agriculture</td>
<td>0.4%</td>
<td>46</td>
</tr>
<tr>
<td>Public Services</td>
<td>0.3%</td>
<td>203</td>
</tr>
<tr>
<td>Construction</td>
<td>0.3%</td>
<td>123</td>
</tr>
<tr>
<td>Energy and Utilities</td>
<td>-1.0%</td>
<td>-295</td>
</tr>
</tbody>
</table>

* E3ME includes 69 industry sectors based on Eurostat classification (see Appendix 2).
The impacts on the forestry sector are unclear and depend on how the measures in the scenario are implemented in practice. Although the scenario aims to reduce resource consumption, including of forestry products, there is an opportunity to use wood in different ways, for example in replacing mineral-based materials in long-life applications. The modelling is unable to go into this level of detail and relies largely on the relationships in the sectoral economic data (input-output tables) to estimate the demand for forestry products. Overall the scenario shows a change in output that is close to zero for the sector, which reflects a balancing between a small shift away from forestry products but in a larger economy.

**Employment**

A feature of the scenario is an increase in employment across almost all sectors (see Table 13 and Graph 7). Employment increases because of both higher levels of production and reductions in labour costs for employers from the revenues that are raised. The pattern across sectors broadly mirrors that for output. The largest increases in employment are services sectors, which are also large employers in absolute terms. However, there are smaller increases in employment in manufacturing. The only reduction in employment is in the energy and utilities sector.

**Table 13. Employment per sector**

<table>
<thead>
<tr>
<th>Employment per sector (difference from baseline)</th>
<th>2025 (%)</th>
<th>2025 (Employed persons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering etc.</td>
<td>2.0%</td>
<td>3,800</td>
</tr>
<tr>
<td>Wholesale and Retail</td>
<td>1.9%</td>
<td>5,900</td>
</tr>
<tr>
<td>Basic Manufacturing</td>
<td>1.4%</td>
<td>2,200</td>
</tr>
<tr>
<td>Other Services</td>
<td>1.3%</td>
<td>5,500</td>
</tr>
<tr>
<td>Business Services</td>
<td>1.2%</td>
<td>5,700</td>
</tr>
<tr>
<td>Public Services</td>
<td>1.0%</td>
<td>4,800</td>
</tr>
</tbody>
</table>
Construction | 0.7% | 1,400
Agriculture | 0.6% | 600
Transport and communications | 0.5% | 900
Energy and Utilities | -0.3% | -100

Graph 7. Employment per sector (2025, difference from baseline, number of employed persons)

CO₂

All of the measures have impacts on CO₂ emissions. Increasing effective carbon tax rates has a direct impact and changes to tax rates on energy consumption have similar effects. However, other measures can have indirect effects (either positive or negative) on sectoral emissions. The impacts on emissions from the different sectors vary according to their fuel mix, existing fuel prices (including tax rates) and whether they are included in the new measures.

The largest impact on CO₂ emissions (both in relative and absolute terms) is in the power sector. The power sector both faces higher carbon charges and incentives to shift to renewable technologies. A combination of these measures allows for a substantial reduction in emissions. The fall in emissions from transport is less. As drivers already pay high fuel prices in Finland, further increases to liquid fuel prices have a relatively small impact, although it is noted that higher gasoline and diesel prices help to promote the take-up of non-conventional vehicles. The transport sector is also excluded from any direct carbon pricing measures.²⁸⁶

²⁸⁶ The carbon price floor is lower than the current effective tax rates in the transport sector, whereby the proposed measure would have no impact in this sector.
Final energy consumption

The patterns in changes to final energy consumption broadly follow those for emissions. The changes to energy consumption broadly reflect the fuel mix used by the sector (e.g. carbon-intensive fuels are penalised more by carbon taxation) and changes from existing energy prices.
Conclusion

The modelling exercise has described the potential macroeconomic impacts of a shift in taxation from labour to resources in Finland. A detailed set of measures was designed and implemented in the E3ME macroeconomic model.

The results from the model show that it would be possible to implement a set of measures that reduce resource consumption in Finland while simultaneously boosting economic prospects and reducing economic inequality.

A key factor in the positive outcomes is a shift from a reliance on imported products (particularly of energy products) to using domestic labour resources (thereby reducing unemployment). Such a shift can be achieved through changes to the taxation system and would create a small stimulus effect that would boost the wider economy in Finland.

As with any taxation shift, the benefits and costs will not be spread evenly. The sectors that supply energy are likely to lose out from a lower demand, but this effect will be offset by higher levels of production in labour-intensive sectors. The model results suggest that poor and rich households alike could benefit, with a slightly higher benefit (in relative terms) for lower income households.
5. BEST PRACTICES IN THE PROMOTION OF CIRCULAR ECONOMY

In addition to the major tax shifts proposed in the previous chapters of this report, there are numerous other types of market-based instruments (MBIs) that can be used to promote circular economy. This chapter outlines some of the key types of MBIs that can contribute to achieving circular economy objectives, together with illustrative examples from other Member States that could provide inspiration for the introduction of new MBIs in Finland to complement the proposed broader tax shifts.

With regards to creating a more sustainable food system, it is particularly important to address the high level of wastage/lack of efficiency in the system, aiming to close the loops on nutrients and other materials. This might help reduce the associated negative impacts generated in production and end-of-life. Meanwhile, there is a need to create stronger incentives for the use of sustainable resources in food production, which in turn implies a need for more sustainable agricultural production and shorter supply chains (local food).

For technical loops, it is crucial to ensure that the valuable materials are kept in the economy and not lost as waste. MBIs can contribute by making the use of secondary raw materials and recycled materials financially viable in order to achieve market shifts. Waste electrical and electronic equipment (WEEE) contains many valuable materials, including metals (aluminum, cobalt, copper, tungsten, silver and cold), rare earth elements and plastics that can be recycled if products are collected and carefully disassembled. In addition, in many cases products that consumers no longer want or need, and are therefore seen as waste, can in fact be reused and resold, thereby extending their useful lifetime and reducing the need for new products.

Meanwhile, the textiles industry still operates an almost entirely linear system – a traditional way of doing business, focusing on minimising price and maximising volume. Less than 1% of the waste is currently recycled into new textile; 87% is landfilled or incinerated. For clothes, the use per garment has dropped 36% over the last 15 years while overall textile production has doubled over the same time (Ellen MacArthur Foundation, 2017). Similarly, few existing policy measures – in Europe or in Finland – go beyond reducing the impacts of the linear system and address the root causes of the challenge. Overall, the industry therefore offers significant potential in terms of improving circularity. Greater circularity in the textiles value chain would imply recyclable products, an available recycling system, and the use of recycled materials and fibres in the production of new textiles (Dutch Circular Textiles Platform, 2017). Importantly, in accordance with the waste hierarchy, the main priority should be to reduce consumption and encourage reuse/product longevity, e.g. through re-sale/second-hand and various new business models and servicing.

A variety of instruments can be used in addition to taxes with the aim of supporting a circular transition in the transport sector. Instruments can aim to promote more sustainable and service-based transportation, and to promote a modal shift from conventional transport towards soft mobility (for instance, cycling, walking and other non-motorised transport), public transport and low/zero emission vehicles (e.g. electric vehicles). They can also be used to send financial signals to consumers – either through a monetary reward or reduced cost – to trigger behavioural change.
5.1. Extended producer responsibility (EPR)

Extended producer responsibility (EPR) is a widely used MBI in the EU, following the implementation of several EU Directives, which require its introduction to contribute to the management of specific waste streams (WEEE, batteries, packaging and end-of-life vehicles). Several EU Member States have also introduced EPR for other waste streams, such as paper/cardboard, textiles, furniture and agricultural plastics. Typically, within EPR schemes, producers of products pay a fee based on the amount of product they place on the market (e.g. per item for EEE, or per tonne for packaging material). These fees are then used to contribute to, or in some cases completely cover, the cost of collection and environmentally sound treatment of the products once they become waste.

Some EPR schemes are now going further and introducing fees that vary, or are 'modulated', based on specific product features which have environmental impacts, e.g. making products that are not recyclable or repairable, or contain toxic additives that disrupt recycling processes, more expensive for producers to place on the market. Such schemes with modulated fees are particularly promising in promoting greater circularity and therefore sustainability of products.

EPR is widely applied to WEEE in EU countries, according to the requirements of the EU WEEE Directive (2012/19/EU), with all 28 EU Member States having an EPR scheme in place for WEEE. Implementation of EPR for food waste might be possible in order to internalise external costs. However, other policy priorities may intervene and impede implementation (Dubois et al., 2016). Well-designed EPR schemes for textiles can achieve more efficient collection and increase recycling rates, but also help foster waste prevention and textile reuse by encouraging design changes.

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**Box 20: Extended Producer Responsibility (EPR) for WEEE (France)**

*Finnish roadmap theme: Technical loops (electronics recycling)*

In France, there are three competing EPR schemes for WEEE (the producer responsibility organisations (PROs) Eco-systèmes, Ecologic and ERP, plus Recylcum which deals only with lamps). According to Eurostat, over 650,000 tonnes of WEEE were recovered in France in 2016, accounting for just over 90% of the amount placed on the market. Over 591,000 tonnes were recycled/reused (almost 82% of the amount treated). Just over 9,000 tonnes were reused. The fees paid by producers to French PROs cover 100% of collection, transport and net treatment costs. Within the Eco-systèmes scheme, the fees paid by producers are modulated according to a set of environmental criteria, including reusability, recyclability, lifetime, presence of hazardous substances, etc. Examples include:

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- A 100% increase in the fee for tablets and phones for software updates essential to the operation of the device are not provided
- A 100% increase in the fee for mobile phones which do not use a universal charger (once an international technical norm is published)
- A 20% increase in the fee for vacuum cleaners, personal computers and TVs that include plastic components weighing over 25g that contain brominated flame retardants
- A 20% increase in the fee for fridges/freezers, vacuum cleaners, electric screwdrivers/drills and games consoles that do not have technical documentation to assist with their repair
- A 20% increase in the fee for fridges/freezers and vacuum cleaners for which spare parts essential for the use of the equipment are not available
- A 20% reduction in the fee for lamps that only use LEDs
- A 20% reduction in the fee for washing machines, dishwashers, computers/notebooks and TVs that include at least 10% post-consumer recycled plastic

In an attempt to assess the cost-effectiveness of schemes, one report found that producers paid a total of around EUR 181 million of fees for household EEE into EPR schemes in a year, meaning that the average fees paid by producers in terms of per inhabitant per year were EUR 2.80. Waste collection and treatment is subcontracted to professional operators, and municipalities receive compensation from the PROs. Stakeholder dialogue is assured via a consultation committee, which includes all relevant stakeholders such as producers, retailers, PROs, local authorities, consumers, and environmental NGOs.

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295 Ibid
296 Ibid
More than 9 kg of textiles per inhabitant are put on the French market each year. Since 2008, France has implemented EPR with take back targets on textiles, domestic linen and shoes*. The target is to increase selective collection from 30 to 50% of the volumes placed on the market by 2019, to recycle more than 20% of the collected material and to ensure more than 95% is valorised (i.e. used for either recycling or energy recovery). Currently, Eco TLC represents more than 93% of the industry. In 2016, the consultancy EY noted that the targets for recycling and valorisation had been ‘easily met’, although the target for collection had not yet been met (Dubois et al., 2016).

Each company pays an equal fee based on the amount of items sold. In order to create a financial incentive to increase the recycled content in textiles, textiles with over 15% recycled content receive a fee reduction. However, introducing more than one threshold might make the incentive more dynamic, allowing those who use more than 15% recycled content to receive a higher financial incentive (Dubois et al., 2016).

The Eco TLC EPR fees create a fund of €15 million per year. Beyond covering the costs of waste management, the funds are used for R&D projects, e.g. a study on the use of recycled post-consumer polyester, and communication campaigns to stimulate collection (Eco TLC, 2018). An example is the development of a national app and website that guide citizens to nearby textile collection points (Dubois et al., 2016).

In addition to the single threshold for recycled content in the fee modulation, drawbacks with the French scheme include complicated administration and lack of transparency for citizens (Dubois et al., 2016).

* Eco TLC was formed following the law of the 21st of December 2006 (Article L-541-10-3 of the Code de l'Environnement; ratified on the 27th June 2008).

See more information at: [http://www.ecotlc.fr/](http://www.ecotlc.fr/)

### Subsidies/fiscal incentives

In addition to taxes, instruments of fiscal nature to support circular economy transition also include various targeted **subsidies and fiscal incentives**. This can include simple subsidies to support certain activities/behaviour, financial investments in certain types of infrastructure that supports the transition to a circular economy, funding for innovative start-ups, VAT exemptions or variable VAT rates, and payments for ecosystem services (PES). Importantly, subsidies should be applied to shift environmentally harmful activities to more sustainable alternatives. Depending on the type of instrument, subsidies could contribute to the circular economy transition by sending market signals in support of material substitution, promoting service-based solutions as opposed to material consumption, supporting business models that generate or maintain (rather than degrade) ecological process, and so on.

In relation to **sustainable food**, relevant instruments include feed-in tariffs, biogas subsidies, PES, subsidies for off-grid sewage treatment/waste water, and subsidies for plant-based foods.
VAT differentiation, such as zero or lower VAT on second-hand products or on the cost of labour for maintenance and repair, can help to reduce waste within technical loops (including textiles and electronics waste), increase utilisation and encourage service provision (leasing, sharing, etc.) rather than consumption of new products (ten Wolde, 2018).

Some countries (such as France and Denmark) have wage subsidy mechanisms in place targeting for instance youth (to tackle youth unemployment) or people who are not able to work full time due to impairments. In these schemes, businesses can be offered percentage subsidies of minimum wages or lump-sum payments for hiring a particular group. Similarly, wage subsidies could be applied to lower the personnel costs for businesses providing services which encourage circularity, such as repair and reuse (Watson D et al., 2017).

In the transport sector, examples include rebates to return old vehicles, tax reductions or exemptions for bike commuters, use of low emission company cars, or electric vehicles. These can in some cases be accompanied by urban spatial planning measures, investments in public transport, and the provision of charging infrastructure for electric vehicles, all of which aim at supporting a modal shift from conventional transport towards soft mobility, public transport and low/zero emission vehicles (e.g. electric vehicles).

Box 22: Government-funded Payments for Ecosystem Services (PES), Naturschützgerechte Bewirtschaftung von Grünland in der nordrhein-westfälischen Eifel (Germany)

Finnish roadmap theme: Sustainable food system

Since the mid-1980s, farmers in the Eifel region of North Rhine-Westphalia have been paid to maintain and extensively cultivate environmentally valuable land. Following the promising small-scale and privately funded project – initiated by a committed university professor to protect natural meadows and pastures – the government took over the funding and expanded the programme, which currently has a budget of about €1.5 million annually. The scheme has now been in operation for 30 years and is coordinated by the biological stations in cooperation with the district landscape agencies.

Payments are input-based and the level of payment is based on opportunity and production costs. In many cases farmers also enjoy a reduced lease payment for the managed area. The individual farmer can receive up to €600-700 per hectare, which is financially attractive to many farmers in the region.

The scheme has resulted in a significant increase in biodiversity and populations of rare species exclusively in the managed areas, and similar schemes have been adopted in other German states.

Source(s): [http://www.civiland-zalf.org/download/PayingforGreen_PESinpractice.pdf](http://www.civiland-zalf.org/download/PayingforGreen_PESinpractice.pdf)

Box 23: Tax incentives for the donation of food surplus (Italy)

Finnish roadmap theme: Sustainable food system
Since 1972 (and based on subsequent legislation/revisions), Italian legislation provides two fiscal incentives to encourage donation of food surpluses. Food business operators can:

1) recover VAT on surplus food donated to non-profit organisations; and
2) exclude the economic value of donated surplus food from their income and thereby avoid paying the related income tax.

To be eligible, both the donating company and the beneficiary need to comply with certain conditions.

Following the work under the National Food Waste Prevention Plan (PINPAS), including a review of the efficiency of existing instruments, the Italian Parliament adopted a new law on food waste prevention in 2016. Unlike the comparable French legislation which in 2016 made it mandatory for large supermarkets to donate their unsold items that are still fit for consumption, the new Italian law (166/2016) focused on simplifying and clarifying existing instruments.

Remaining challenges/criticism of the legislation include a lack of national food waste reduction targets, lack of scope (main focus is food donation for charitable purposes) and a lack of integration between green public procurement policies and food waste prevention.

Source(s): http://www.eu-fusions.org/phocadownload/country-report/FUSIONS%20IT%20Country%20Report%2030.06.pdf

Box 24: Start-up and transition funding (UK)

Finnish roadmap theme: Industrial loops (textiles)

To try to remedy the often high upfront costs for start-ups improving textile circularity, governments can provide access to funding and financing options with generous terms to allow start-up solutions to reach sufficient scale and finances. In the UK, for instance, the government set up a two-year Innovation in Waste Prevention Fund (starting in 2014 and with total value of £800,000) to encourage creative ideas for preventing the waste of certain priority materials (including textiles). Grants of up to £50,000 were offered to local businesses, councils, charities and voluntary groups.

More information about the fund is available here: http://www.wrap.org.uk/IWPFundPR.

Box 25: CO₂ based bonus/malus scheme (France)

Finnish roadmap theme: Transport

France introduced a CO₂ based bonus-malus system in 2008. Based on this instrument, the car buyer is subject to a fee (malus) if the vehicle’s CO₂ emissions are above a certain level, and receives a rebate (bonus) if the emissions are below a certain level.
Until 2017, the French feebate system was based on step functions to set levels of fees and rebates, which allowed manufacturers to take advantage by designing cars with CO₂ emissions just below the step function levels during the type-approval test. This initially led to increases in the rebates paid for small changes in CO₂ emissions. In 2017, the French government moved from this stepwise approach to a continuous function, allowing a continuous fee rate line to be established for vehicles with CO₂ emissions between 126 and 190 g/km. The malus fee for vehicles within that range is reduced for every gram by which CO₂ emissions are reduced (ICCT, 2018)²⁹⁷.

From January 2018, the malus fee is set between €50 (from 120 CO₂ g/km) to €10,500 (for 185 CO₂ g/km or more). The bonus fee of €6,000 is only applicable to vehicles emitting 20 CO₂ g/km or less (ACEA, 2018)²⁹⁸ (Ministère de la Transition, 2017)²⁹⁹.

The aim of this feebate system is to reduce CO₂ emissions and fuel consumption, while increasing vehicles’ efficiency. By providing a monetary advantage, the system incentivises more eco-friendly cars which emit less CO₂ per kilometre.

Since its first introduction, the system has been continuously adjusting and the level of CO₂ emissions at which the penalty fees and rebates are applied has decreased. As a result of the system, vehicle emissions fell significantly in France and the market has transitioned towards lower CO₂ emission vehicles (ICCT, 2018).

The bonus-malus system is expected to change further in 2019. The average penalty fee is expected to increase from the current €50 to €145 and the CO₂ emissions threshold to be lowered by 3 grams, from 120 g/km to 117 g/km (The Local France, 2018)³⁰⁰.

Box 26: Incentives to reduce the use of company cars (Belgium)

_Finnish roadmap theme: Transport_

_Compensation scheme for bike commuters_

Belgium introduced a cycling compensation scheme in 1999. Employers may adopt the scheme on a voluntary basis, as a way to financially reward employees who use a bike for all or part of their commute between their home and place of work. The scheme grants a tax-free compensation of €0.23 per kilometre travelled by bike.

The aim of the scheme is to promote eco-friendly transportation while providing alternatives to the common practice of using company cars. The adoption of the scheme is associated

with a number of important benefits in terms of public health, air quality, reduction in CO\textsubscript{2} emissions and congestion (SPF, 2018)\textsuperscript{301} (ECF, 2017)\textsuperscript{302}.

Between 2011 and 2015, the number of beneficiaries of the compensation scheme increased by 30%. In 2015, 406,000 employees (9% of Belgium’s workforce) received the cycling compensation. Such compensation has a cost of €93 million on Belgium’s public budget.

**“Cash for car” and “Mobility budget”**

In 2018, the Belgian government agreed to the introduction of a mobility allowance or “cash for car” scheme. The system allows employees to refuse the company car in exchange for a monetary value calculated as follows:

- Catalogue value of the company car $\times \frac{6}{7} \times 20\%$ (in case no fuel card was available)
- Catalogue value of the company car $\times \frac{6}{7} \times 24\%$ (in case a fuel card was available)

The aim of the system is to reduce the incentives to use company cars and promote alternative, more sustainable forms of transport.

In addition to this scheme, a “mobility budget” has been proposed which would allow employees who return their company car to create their own mobility package with the money received in exchange:

<table>
<thead>
<tr>
<th>Pillar 1</th>
<th>The company car at the employee’s disposal is exchanged with a more ecological vehicle.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pillar 2</td>
<td>The funds obtained following pillar 1 are used for sustainable transportation options – soft mobility (cycling) or service-based (public transportation, car sharing systems etc.)</td>
</tr>
<tr>
<td>Pillar 3</td>
<td>The remaining funds are made available to the employee in cash</td>
</tr>
</tbody>
</table>

Introducing the mobility budget, if formally accepted, would reduce traffic congestion in Belgium and promote more eco-friendly/service-based commutes as an alternative to company cars (EY, 2018)\textsuperscript{303}.

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**Box 27: Fiscal incentives for vehicles fuelled by alternative energy (Spain)**

**Finnish roadmap theme: Transport**
Spain introduced the MOVEA plan (Movilidad con Vehículos de Energías Alternativas – Mobility with Alternative Energy Vehicles) in 2012.

The scheme offers €14,260 million in incentives to make the transition towards sustainable mobility. The grants provided depend on the type of vehicle:

<table>
<thead>
<tr>
<th>Type of vehicle</th>
<th>Grants (€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas Liquefied from Petroleum Vehicles (GLP)</td>
<td>Between 500 and 15,000</td>
</tr>
<tr>
<td>Natural gas vehicles</td>
<td>Between 1,000 and 18,000</td>
</tr>
<tr>
<td>Fuel cell vehicles (hydrogen)</td>
<td>5,500</td>
</tr>
<tr>
<td>All-electric Vehicles, Plug-In Hybrids and Extended-Range Vehicles</td>
<td>Between 1,100 and 15,000</td>
</tr>
<tr>
<td>Electric quadricycles</td>
<td>Between 1,950 and 2,350</td>
</tr>
<tr>
<td>Electric motorbikes</td>
<td>Between 1,000 and 2,000</td>
</tr>
</tbody>
</table>

From 2017, the MOVEA plan also includes grants for charging stations: EUR 1,000 for conventional charging points and €15,000 for fast charge points. These grants are directed only to natural persons and freelancers, while the rest are available also to private companies, local and public entities, and autonomous regions.

The aim of the scheme is to promote the shift to more sustainable transportation, favouring fuel-efficient vehicles from renewable sources and discouraging conventional cars. Thanks to the benefits associated with the diversification of energy, reduced dependence on petroleum products and lower CO₂ emissions, the scheme provides a way to improve air quality, diminish noise pollution, and promote renewable energy sources (LiveBarcelona, 2017)³⁰⁴ (Ministerio de Industria, Comercio y Turismo, 2017)³⁰⁵ (Autovista Group, 2017)³⁰⁶.

Between 2012 and 2016, Spain also had the PIVE (Programa de Incentivos al Vehículo Eficiente – Program to incentivise efficient vehicles) car scrappage programme in place. The scheme allowed people who scrapped a car that was at least 10 years old to replace it with a new fuel-efficient vehicle and be entitled to a rebate of up to EUR 2,000.

Over the years, the plan led to the replacement of 890,000 vehicles and an associated energy saving of 308 million litres of fuel per year (Ministerio de Industria, Comercio y Turismo, 2015)³⁰⁷ (Mueller, 2015)³⁰⁸.

5.3. Fees/charges/payment schemes

Different payment schemes and charges/fees are examples of MBIs that are directly linked to the cost of maintaining a service and the revenues generated are generally used to provide the service in question. Such fees/charges are often applied to consumers, with the intention of providing a financial incentive to shift towards more sustainable behaviours.

³⁰⁸ http://europe.autonews.com/article/20150513/ANE/150519953/spain-renews-scrappage-program-for-the-last-time
Examples include pay-as-you throw (PAYT) schemes for municipal waste, which aim to change household behaviour, reduce waste generation and encourage recycling. PAYT schemes with variable rates (based on weight, volume, type or frequency) have been shown to be more cost-effective than fixed rate schemes. Further, to be effective, PAYT charges need to be relatively high and combined with supporting policies, such as free separate collection of recyclable waste (OECD, 2017).

In the transport sector, instruments include road pricing for conventional cars, such as the implementation of congestion charges to limit private vehicle use, and/or the use of the most polluting vehicles, in urban areas. In some cases, such instruments may be coupled with regulatory instruments such as the regulation of CO₂ emissions per capita.

Box 28: Pay-as-you-throw (PAYT) scheme in County of Aschaffenburg (Germany)

Finnish roadmap theme: Sustainable food system

The German County of Aschaffenburg comprises 32 municipalities and 173,000 inhabitants. It has had a PAYT scheme in place since 1997, making it an interesting example of impacts of PAYT schemes over time. Bio waste is collected separately and sent for anaerobic digestion. Subsidies are also offered to households which compost biowaste at home. The collection scheme is weight-based, and all containers and bins are coded. Collection trucks are equipped with a reading and a weighing device, and real-time information is distributed to a central billing facility. For biowaste, bins (60 or 120 litre capacity) are collected every 14 days (every 7 days in the months of June, July, and August). Graph 13 below illustrates the evolution over time of waste fees for consumers, comparing the total annual fee without a bin for organic waste and the fee with such a bin.

The graph shows that the fee is now lower than before the PAYT scheme, despite additional activities and equipment associated with PAYT implementation.
Today, the County has one of the highest rates of recyclables collection in Germany (86%) and one of the lowest rates of residual waste generation (55 kg/capita/year). Morlok et al. (2017) conservatively estimate that the scheme has led to a 91 kg CO$_2$e/capita/year reduction in greenhouse gas emissions.

One interesting observation from Aschaffenburg is that – in the case of high-rise buildings in cities – residents produce significantly less waste if they have smaller individual bins compared to big communal bins. Another is that socio-economic factors and environmental awareness appear to be important for PAYT success. PAYT schemes increase the risk of illegal dumping, but this has generally not occurred in Aschaffenburg. While the PAYT scheme clearly has contributed to the good results in terms of residual waste reduction, the case of Aschaffenburg also illustrates the importance of adopting supporting activities, including awareness raising and investments in better infrastructure for waste sorting and recycling.

Source: (Morlok et al., 2017)

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**Box 29: Milan Congestion charge (Italy)**

**Finnish roadmap theme: Transport**

The municipality of Milan introduced a congestion charge in 2012, with the aim of reducing traffic congestion, discouraging the use of private cars, and reducing pollution by imposing a cost on access to an area of the city.

The charge covers a Limited Traffic Zone (LTZ) called Cerchia dei Bastioni of 8.2 km$^2$, 4.5% of the city’s area, located in the centre. Vehicles which enter the area between 7.30am and
7.30pm from Monday to Friday (6pm on Thursday) must buy a daily entrance ticket at the cost of €5.

Certain types of vehicles are exempt from the charge, including mopeds, motorcycles, electric cars, vehicles for disabled people, public utility and public transport service vehicles, taxis. From 2017, hybrid, methane-powered, LPG and biofuel cars have been subject to the normal entrance fee (C40 cities, 2015)\(^\text{309}\) (Cleanair Europe, 2015)\(^\text{310}\). From October 2019, hybrid vehicles with CO\(_2\) emissions greater than 75 g/km will also be subject to the daily ticket (Comune di Milano, 2018)\(^\text{311}\).

Within the first week of implementation of the charge, traffic in Area-C fell considerably, from 122,000 to 77,000 cars (Canets, 2014)\(^\text{312}\).

By 2015, the congestion charge had led to a 28% reduction in road congestion since its first implementation. The charge has also led to a 6% increase in the share of clean vehicles and a 49% reduction in polluting vehicles. Such improvements have contributed to a reduction in several pollutants: total PM10 (-18%); exhaust PM10 (-10%); ammonia (-42%); nitrogen oxides (-18%); and CO\(_2\) (-35%) (C40 cities, 2015)\(^\text{313}\).

In addition, between 2012 and 2015, Area-C witnessed an increase in public transport usage by 12 and 17% for surface and underground transport respectively. A 26% reduction in road accidents was also observed in the same period (Amat, 2017)\(^\text{314}\).

In 2016, the revenue obtained from the Area C congestion charge was approximately €28 million. This amount was reinvested in sustainable mobility projects (Amat, 2017)\(^\text{315}\):

- Strengthening of public transport (62%)
- Development of sustainable mobility projects (22%)
- IT and software management (16%)

### 5.4. Public procurement guidelines and requirements

**Public procurement guidelines and requirements** are another category of (usually voluntary) MBIs that can help to promote a transition to a circular economy. Public bodies and institutions such as governments (national, regional and local), schools and hospitals are responsible for public procurement worth many millions of euros every year, providing significant potential for them to drive demand for, and provision of, more circular solutions for products.

For EEE, upgrades of equipment can result in significant amounts of ‘waste’ EEE which could in many cases, with the correct reconditioning, be reused by other organisations, thereby extending their lifespan. In the case of food, such measures can promote a reduction in food waste or promote shifts from meat-based to vegetarian diets. Public procurement guidelines generally apply to food served in schools, hospitals and public administrations, offering public

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\(^\text{311}\) [http://www.comune.milano.it/wps/portal/istit/it/servizi/mobilita/Area_C/novita_area_c](http://www.comune.milano.it/wps/portal/istit/it/servizi/mobilita/Area_C/novita_area_c)


authorities the opportunity to influence the types and quantities of food purchased, for example promoting zero waste (Schweitzer et al., 2018). Creating a strong enough demand for recycled textile materials is essential to increase circularity for non-wearable items (Ellen MacArthur Foundation, 2017). The textile industry has expressed that they experience a lack of demand for circularity in textiles, particularly from public and private procurement, and that mandatory public procurement criteria can be important to stimulate market demand (ten Wolde, 2018).

**Box 30: Public procurement guidelines to minimise food waste (Italy, Spain, Germany)**

*Finnish roadmap theme: Sustainable food system*

Several European cities have introduced public procurement criteria and guidelines to help minimise food waste. In 2013, the City of Turin introduced waste reduction criteria in school catering contracts, supporting for instance separate collection and redistribution of food waste for social projects (European Commission, 2014a). The same year, Barcelona’s Municipal Education Institute (IMEB) issued public procurement guidelines for the city’s 49 kindergartens, requiring bidders to train their staff on waste reduction and separate waste collection (European Commission, 2014b). The City of Hamburg encourages organic, local and seasonal food produced through green procurement criteria. Further, food packaging should contain over 45% recycled material or be produced from renewable raw materials, and food should not be supplied in individual portion packaging. Reusable cutlery, tableware, glasses and tablecloths must be used. The criteria also includes a ‘negative list’ of products that the administration may no longer purchase or use, including capsule-based coffee machines, mineral water in non-returnable bottles and disposable dishes (Hamburg, 2016).

*Source(s):* (Schweitzer et al., 2018)

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**Box 31: Circular public procurement of computers, Utrecht (The Netherlands)**

*Finnish roadmap theme: Technical loops (electronics recycling)*

Utrecht Provincial Council employs around 800 staff and has been aiming to achieve more circular procurement for some time. The Council was one of the first to join the Dutch Green Deal on Circular Procurement and has a target for at least 10% of its total procurement budget to be spent on circular procurement by 2020. In a pilot starting in 2015, the Council aimed to purchase laptops for 1,000 workplaces on a circular basis, i.e. by supplying refurbished ICT hardware for reuse after it reaches the end of its useful life at the Council. The pilot involved two workshops. The first was with the Dutch waterways, public works and environment agency Rijkswaterstaat (RWS) and explored the general principles of circular procurement and the selection and award criteria to achieve it. The second, held with MVO Netherlands, aimed to identify how to extend the life of aging ICT equipment in Utrecht Province. In January 2017, an ICT procurement exercise was held and SISO, a Dutch IT solutions company, was awarded a contract to reuse the laptops within a project to provide

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elderly people with lessons in how to use ICT. The ultimate aim is for the Council to award a single contract for circular services, a model which it hopes to achieve in the coming years.

Whilst the Council anticipates that circular procurement will become the norm over the next decade, this is not currently the case. Lessons learned through the pilot include the need to keep track of any changes to procurement rules, to ensure that they are taken into account in the design of procurement processes. Realism is also needed in terms of the market opportunities for circular procurement, and how circular purchasing fits or does not fit with manufacturers’ own product distribution models. There are also legal implications of ‘pay-per-use’ models, notably that the organisation becomes a ‘user’ rather than an ‘owner’ of a product. In addition, consultation (e.g. with key market players) is critical to the success of circular procurement. Finally, like any change in approach, shifting towards circular procurement takes time and requires support and buy-in from those involved, meaning that barriers such as existing attitudes/mindsets need to be effectively tackled. One way to do this is to embed change in personal performance targets, to provide a direct incentive for change.

Box 32: Public procurement guidelines for work wear, Herning Municipality (Denmark)

Finnish roadmap theme: Industrial loops (textiles)

In 2013, Herning Municipality developed specifications and contract performance clauses on maintenance, repair and recycling for purchasing contracts on work wear. The aim was to extend the lifetime of the uniforms of the technical operations department and improve the efficiency of their use. Through the establishment in 2015 of a service model for uniforms, including reuse and recycling contract provisions, the municipality saved €6,700 and over 1,000 tonnes of CO₂ emissions in four years (European Commission, 2016).

Information for consideration as examples of business models in the tax chapters:

For electrical and electronic equipment (EEE), greater circularity can be achieved in various ways through business models. This includes, for example:\n
- promoting recovery and recycling – to ensure that valuable materials are collected and reused/recycled at the end of a product’s life;
- extending product life – for example by ensuring that products are durable, and/or can be repaired, maintained, upgraded and/or remanufactured during their lifetime;
- product sharing platforms – to promote shared use of, access to and ownership of products; and
- promoting products as a service – offering the use of products as a service (essentially producers/manufacturers hiring out products to users).

**Box 33: Apple – Daisy the disassembling robot**

*Finnish roadmap theme: Technical loops (electronics recycling)*

In 2018, Apple announced its new robot named ‘Daisy’ which can disassemble nine different iPhone models at a rate of up to 200 phones per hour, to recover the valuable materials contained in them. Apple claims that Daisy can recover more materials than ‘traditional recyclers’, and at a higher quality.\(^{318}\) Daisy is currently running in Austin, Texas (US), with another due to be installed in Europe. Daisy follows in the footsteps of the previous incarnation named ‘Liam’, launched by Apple in 2016, and was created with some of Liam’s old parts.

For every 100,000 phones, Daisy could potentially recover: 1,900 kg of aluminium, 770 kg of cobalt, 710 kg of copper, 93 kg of tungsten, 42 kg of tin, 11 kg of rare earth elements, 7.5 kg of silver, 1.8 kg of tantalum, 0.97 kg of gold and 0.10 kg of palladium.\(^{319}\) One recent report estimates that the total potential value of secondary raw materials in EEE per year is EUR 55 billion globally, with the value of raw materials in waste mobile phones alone estimated at EUR 9.4 billion in 2016.\(^{320}\)

In addition to these disassembling robots, Apple has announced that it now uses 100% renewable energy in its supply chain and physical infrastructure, through purchasing green energy bonds and investing in renewables.\(^{321}\)

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**Box 34: Argos Gadget Trade-in, UK\(^{322}\)**

*Finnish roadmap theme: Technical loops (electronics recycling)*

Argos is the largest high street online retailer in the UK, selling a range of over 50,000 products both online and in its physical shops. In 2014, the company ran a 5-month pilot in 10 stores, supported by WRAP (the Waste and Resources Action Programme, which works with WRAP works with partners including governments, businesses, local authorities, trade associations and charities), to explore the potential to incentivise customers to return their unwanted electrical products by offering them a voucher with monetary value. The aim was to facilitate end-of-life products’ collection, recycling, refurbishment and reuse. Following the pilot, in 2015 Argos launched its ‘Gadget Trade-in’ service both online and in almost 800 UK stores, focussing on mobile phones and tablets (but with possible extension in the future to sat nav systems, cameras and laptops). Customers returning their old products receive a gift voucher. This business model is deemed to be scalable and commercially viable, whilst also providing extra environmental credibility to the Argos brand.

The scheme is convenient for customers, avoids the need for shipping/return packaging, and in 2016 was unique on the UK high street. Once the value of the item being traded in is determined (prices are regularly checked to remain competitive), a voucher is issued and can be spent immediately on anything purchased from Argos. All personal data is securely

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removed from devices before reuse/resale to another customer. By 2016 Gadget Trade-in had already prevented thousands of phones and tablets from being sent to landfill and provided quality second-hand products for resale and reuse.

In terms of functioning of the business model, Argos point out that it is crucial to have cross-term collaboration within the business for such a model to be successful. The range of expertise available amongst staff should be drawn upon from an early stage of the business model development, including sales, marketing, customer engagement and so on.

Argos also provides a take-back service for white consumer goods and packaging for home delivery.

**Box 35: Intelligent lighting: Philips ‘Lighting as a Service (LaaS)’, the Netherlands**

_Finnish roadmap theme: Technical loops (electronics recycling)_

Major lighting company Philips has developed the ‘Lighting as a Service (LaaS)’ concept, designed to deliver lighting through an intelligent, energy-saving system developed specifically for the needs of business clients. Within LaaS, Philips undertakes an assessment of the existing lighting system and potential savings, proposes a solution, then delivers, installs and commissions the new lighting system, and disposes of the old luminaires. Maintenance and repairs are also taken care of throughout the lifetime of the contract, with a fixed monthly rate charged to the customer. Essentially the concept sees lighting treated as another utility, such as water, gas or broadband.

Philips claims that the LaaS approach can reduce energy consumption for lighting by up to 80%, through a combination of energy efficient light sources and intelligent control systems (e.g. collection and use of data on building/room occupancy).

One example is InterAct Office, a connected lighting system provided for principal tenants OVG Real Estate and Deloitte at The Edge office building in Amsterdam. InterAct Office uses smart technology, apps and dashboards to provide insights into the use of office space and energy. Over 3,000 sensors in the connected lighting system receive anonymised data on lighting performance and space usage. This allows the optimisation of lighting, heating, ventilation, cooling, cleaning and use of space in the building, reducing energy usage and associated costs. In terms of hardware, Ethernet cables are used to send both power and data to the luminaires, which means that separate power cables are not required. Employees also use an app to tailor the lighting and temperature in their own workspace (wherever they work within the building).

Compared with previously-occupied offices, it is estimated that the InterAct Office system has resulted in €3.6m savings in office space and €100,000 reduction in energy costs per year. Along with desk-sharing, this has contributed to reducing the annual cost of space per employee by over €1,800.

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324 [http://images.philips.com/is/content/PhilipsConsumer/PDFDownloads/United%20Kingdom/Case-Study/CSLI20171222_001_UPD_en_GB_the_Edge.pdf](http://images.philips.com/is/content/PhilipsConsumer/PDFDownloads/United%20Kingdom/Case-Study/CSLI20171222_001_UPD_en_GB_the_Edge.pdf)
The Edge has been awarded the highest ever sustainable building score within the BREEAM (Building Research Establishment Environmental Assessment Method) sustainability assessment method, of 98.36%.

Voluntary approaches by firms and industries or innovative business models or technologies could also help stimulate more sustainable and circular food systems. Examples include various digital software to track food waste in homes or commercial kitchens, industry or community-led food redistribution programmes, urban and/or indoor farming schemes, smartphone applications enabling consumers to purchase local produce or food that is going to waste, and so on. Government strategies or policies can support these initiatives, for instance by providing access to funding for scaling up successful pilot schemes.

**Box 36: Business models in support of a more circular food system (France, UK, Finland)**

*Finnish roadmap theme: Sustainable food system*

The Eqoshère digital platform start-up, created in 2012, connects public and private sector bodies to reuse food waste. The team also helps customers reduce the generation of food waste throughout their value chains by auditing waste flows, suggest process improvements and train staff. In 2017, the start-up helped Leader Price to recycle of 500 tonnes of food, saving 200,000 m$^3$ of water.


Another similar example is the ‘Too good to go’ app, which allows restaurants to sell any food they have left at the end of the day to consumers. Consumers place an order via the app and can pick up their meal an hour before closure, at a reduced rate.

**Source:** [https://toogoodtogo.co.uk/en-gb](https://toogoodtogo.co.uk/en-gb)

Other businesses have innovated the production of food in support of increased circularity, for instance by producing fertilizers and other soil improvement products from recycled by-products from conventional agricultural, forestry and bioenergy industry. One example is the Finnish company Soilfood, established in 2015. Soilfood’s revenue comes from the acceptance fees paid for industrial by-products as well as products and services sold to farmers (at a lower rate than synthetic fertilizers). This type of solution reduces the need for virgin phosphorus, for instance, and can also help reduce the overall energy used to produce fertilizers.


With regards to textiles, while policy-makers have been moving slowly with regard to promoting textile circularity, the market has been more active in innovating and closing the loop on textiles. This is arguably a reflection of the profit opportunities for early movers in markets where sustainability has been a key trend in recent years. Examples of private sector
Innovation in support of a circular textile economy include, for instance, bespoke take-back schemes or digital solutions providing new ways of accessing quality textiles (such as rental and subscription-based models, etc.). The Ellen MacArthur Foundation (2015) categorises six types of action that business (and governments) can take to support a transition towards a circular economy:

- Regenerate: shifting to renewable energy and materials;
- Share: the sharing and recycling economy, and prolonging the life of products;
- Optimise: increased efficiency, waste minimisation and use of information and communications technology (ICT);
- Loop: closing the technical and biological material cycles;
- Virtualise: direct and indirect dematerialisation; and
- Exchange: the use of novel materials and technologies.

Box 37: I Collect; textile collection points

Finnish roadmap theme: Industrial loops (textiles)

I:Collect, or I:CO, offers a textiles take-back solution to fashion houses and retailers. I:CO provides in-store collection bins that can be designed to fit the respective company. It collects the bins and transports them to the nearest recycling facility, where all items are sorted by hand into three categories: garments for rewear (sold as second-hand), reuse (turned into other products) and recycling (turned into textile fibres). At present, the majority of the latter are made into insulation material for the automotive and construction industries. More information about I:CO is available on their website: https://www.ico-spirit.com/en/

C&A (The Netherlands) – In 2012, C&A was the first fashion retailer in the Netherlands to open textile collection points in its stores, in collaboration with I:CO. In exchange for a voucher of 5% reduction on their next purchase, customers can hand in their old clothes. Today, all 133 Dutch stores have a collection point and about 250 customers per week hand in used garments. C&A is now exploring how to expand the scheme beyond the Netherlands (Dubois et al., 2016).

H&M Group Garment Collection Program (global) – Swedish brand H&M also offers vouchers towards next purchase in return for customers handing in unwanted textiles. Claiming to have been the first brand to roll out the concept on a large scale, H&M introduced the scheme in 2013 for all its stores worldwide. The used textiles are collected, sorted and distributed by I:CO (H&M, 2018). Since the launch, over 55,000 tonnes of garments have been collected, and the target is to increase collection to 25,000 tonnes per year by 2020 (Gould, 2017, Lehmann et al., 2018).

Other companies offering similar services include Levi’s, Nike, Zara and Marks & Spencer, some of them through I:CO, or via other similar solutions.

While providing an often previously non-existent avenue for disposing of used textiles, it is important to note that these schemes have been criticised, for example for encouraging a guilt-free consumption attitude in favour of linear, fast fashion consumption (Gould, 2017).
Box 38: Circular business model initiatives for textiles

Finnish roadmap theme: Industrial loops (textiles)

Example 1 – Product service system for textiles: Leasing clothes, i.e. providing clothing as a service rather than selling products, is one solution supporting circularity in the textiles industry. One example is VIGGA™, a Danish clothes brand and product service system, which enables parents to lease organic maternity and children’s wear for a monthly fee. Once the child has grown out of one age batch of garments, the next is sent via post. Used garments are washed and mended if necessary and sent to another family in an attempt to close the loop on materials and provide an alternative to so-called fast fashion and linear business models. The initiative has won a number of design awards and is one illustration that rethinking the design of products and services has large potential beyond electrical appliances and energy efficiency.

Source: https://vigga.us/

Example 2 – Digital solutions for material traceability: Reverse Resources have developed a ‘Software as a Service (SaaS)’ platform to allow fabric and garment factories to map and measure leftover fabrics and scraps from production, making them traceable throughout their lifecycles. The aim is to close the loop of spilled fabrics and fibres from garment production. Although textile manufacturing is a relatively small industry in Finland, solutions for connecting garment factories with potential buyers of scraps can provide additional income streams, while providing mechanisms for ensuring high quality streams of scraps for the benefit of recyclers and secondary raw material markets. Individual brands can trace the origins of recycled fibres used in production, on which they can base sustainability claims made to consumers.

Source: http://reverseresources.net/en

Example 3 – Product repair services: Several brands offer repair services of their products in an attempt to increase product longevity. Customers can for instance bring their damaged jeans back to Nudie Jeans’ repair shops for free mending. In 2017, Nudie repaired almost 50,000 pairs of jeans, claiming to save an equivalent of 40,000 kg of garments being disposed of, and saving 345 million litres of water. Patagonia is another example, offering customers advice on how to best treat their clothes for longevity and how to mend broken items.


The transport sector has also seen the development of new business models which aim at promoting service provision instead of product consumption (service over ownership). Models include introducing car sharing, car clubs and fare sharing deliver a service which is paid based on the time consumed. Such models aim at reducing car ownership and potentially reduce CO₂ emissions. Evidence shows that the introduction of these circular models has been successful in several cities (Acea, 2018)\(^{325}\) (OECD, 2002)\(^{326}\).

6. CONCLUSIONS AND PROPOSALS FOR NEXT STEPS TO ACHIEVE CIRCULAR ECONOMY OBJECTIVES

The project looked into fiscal incentives and other mechanisms, which could eventually lead to the decoupling of economic growth and its environmental impacts in Finland. Following a detailed study, which covered all major sectors, including industry, transport and agriculture, the economic modelling produced a tax shift of 3.5 billion euros from labour taxation to energy and resource use by the year 2025. In addition, it suggested an increase of GDP and employment of 1.2 % and a reduction of emissions of 6.0–8.1 % compared to baseline levels without affecting external trade other than energy imports, which would be reduced by 6.1 %.

The results indicate that it is possible to design policy measures that reduce final energy consumption and harmful emissions, while at the same time stimulating the Finnish economy and creating jobs. Consequently, it would seem appropriate to open national discussions on the possibilities to introduce similar measures, and to check whether there are some aspects that may not have been raised during the project. Such incentives could be promoted also at European level, as Finland will be chairing the European Council during the latter part of 2019.

At the Paris Climate Summit, the European Union together with the other signatory states pledged to restrict global warming to less than two degrees Celsius and to pursue efforts to limit it to 1.5 degrees Celsius by the end of this century. Achieving these goals will be difficult without a major change in fiscal and other policies, whereby the external costs of economic growth should be internalised in market prices while reducing labour taxation.

The authors of this report hope that Finland would continue its active work in promoting low-carbon and circular economy objectives by introducing the necessary measures that would help to materialise these goals. Without the proper incentives, this may be difficult, if not impossible.
APPENDIX 1: ENVIRONMENTAL AND LABOUR TAXATION AND SUBSIDIES IN FINLAND

Total tax ratio and tax structure

In Finland, the tax burden is among the highest in the OECD countries. The share of taxes and tax-like payments (charges comparable to a tax) out of the total tax ratio was 44% in 2016 according to OECD Revenue Statistics Database\textsuperscript{327}, being the fourth highest total tax ratio of the OECD countries (see Graph 14).

![Graph 13. The tax burden in Finland and other OECD countries according to OECD Revenue Statistics Database.](http://www.oecd.org/finland/economic-survey-finland.htm)

The trend of tax ratio to gross domestic production (GDP) of taxes and compulsory social security contributions has been growing in long-term (see Graph 15). The ratio was in its highest in the late 1990 and went down after that period until the recession in 2008 when it grew again. The accrual of these tax and tax-like payments amounted to €95.2 billion in 2016. The tax ratio grew from the previous year by 0.2 percentage points to 44.1%.

Graph 14. Taxes and tax-like payments in Finland in years 1975 – 2016. The tax ratio describes the ratio of taxes and compulsory social security contributions to gross domestic product (GDP)

Labour Taxation

Finland has high labour taxation, and over half of all tax revenues, to be precise 51.3%, come from labour taxes in 2016\textsuperscript{328}. Especially the tax wedge\textsuperscript{329} is high compared to other EU member states and OECD countries. Finland had the 9\textsuperscript{th} highest tax wedge among the 35 OECD member countries in 2017. The average single worker in Finland faced a tax wedge of 42.9\% in 2017 compared with the OECD average of 35.9\%. In Finland, income tax and employer social security contributions combine to account for 82\% of the total tax wedge, compared with 77\% of the total OECD average tax wedge. The tax wedge for a worker with children is slightly lower than for a worker with the same income without children since benefits to families with children through cash transfers and preferential tax provisions affect the tax wedge. For an average married worker with two children, the tax wedge was the 4\textsuperscript{th} highest in the OECD at 38.4\% in 2017, which compares with the OECD average of 26.1\%. In 2016, the position was even higher as Finland occupied the 2\textsuperscript{nd} highest position. Child related benefits and tax provisions tend to reduce the tax wedge for workers with children compared with the average

\textsuperscript{328} Eurostat data (2018), \textit{Shares of environmental and labour taxes in total tax revenues} 
http://ec.europa.eu/eurostat/web/products-datasets/-/sdg_17_50

\textsuperscript{329} The tax wedge is a measure of the tax on labour income, which includes the tax paid by both the employee and the employer.
single worker. In Finland, this reduction (4.5 percentage points) was less than the OECD average (9.8 percentage points) in 2017\textsuperscript{330}.

### Environmental Taxes

In Finland, the share of environmental tax revenues of GDP was 3.1 percent in 2016, which is higher than the average for EU member states. The share of environmental taxes of entire tax revenues was over 7%, which is slightly higher than the average for EU member states\textsuperscript{331} (see Graph 16).

![Graph 15. Share of environmental tax revenues of GDP in Finland and other EU member states, 2016](image)

The accrual of the environmental tax revenues was € 6.7 billion in 2016. The revenues from environmental taxes have increased slowly and stayed nearly the same in the last decade (see Graph 17). Environmental tax revenues grew in 2016 by 10 per cent in average and taxes paid by households grew by 14 per cent from the previous year. The households’ share of paid environmental taxes increased to 51 per cent.\textsuperscript{332} The trend is that the households’ share has increased every year during the last decade.


The increase in environmental tax revenues was most significant for transport taxes, which grew by 14 per cent year-on-year to €2.1 billion. Transport taxes paid by households increased by 15 per cent, and represented 73 per cent of all transport taxes. The growth was mostly caused by the rise in vehicle tax. In addition, energy tax revenues increased by nine per cent to €4.5 billion. Energy taxes paid by households and energy supply grew most, by 14 per cent. Households were the biggest payers of energy taxes, paying 41 per cent of all energy taxes. Increases in taxes on fuel oil, coal and natural gas contributed to the growth.  

Emission taxes continued their decline in 2016. The falling trend is influenced by the continuous increase in the incineration of municipal waste that reduces the accrual of waste tax and by the ending of the temporary increase in oil protection fee that was in force from 2010 to 2015. As a result, emission taxes paid by water and waste management went down by 34 per cent and those paid by industry by 56 per cent.

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334 ibid.
In Finland, environmental taxes include energy taxes, vehicle-related taxes, waste and packaging taxes, oil spill payments and license fees for hunting and fishing. The majority of environmental tax revenues accrues from energy taxes on electricity and fuels used in transportation, heating, industry and in other purposes. In Finland CO\(_2\) tax is a part of energy taxation and included in energy tax revenues, thus its share of environmental taxes is not shown these statistics. One-third of environmental taxes are vehicle-related taxes, which comprise car tax, vehicle tax and motor vehicle tax. The car tax and vehicle tax are differentiated according to carbon dioxide emissions. As the CO\(_2\) tax is incorporated into the energy taxes and vehicle taxes, we do not have specific emission taxes in Finland. In statistics emission taxes are referred to waste tax, beverage packaging tax and oil spill payments. In addition, there are no actual natural resource taxes in Finland, apart from license fees for hunting and fishing.
Environmental taxes by tax payer, industry and households, and tax type are shown in Graph 20. The households’ share of all paid environmental taxes is over one half. One reason is that industry gets several tax reductions from energy taxes, and they pay electricity tax according to a lower tax rate. The other reason is that households are liable for the main part of energy taxes on fuels. The tax burden to households is also increased by transport, i.e. vehicle related taxes.  

Graph 19. Environmental taxes by tax payer (industry and households) and tax type in 2015, EUR million  

Energy and Carbon Taxation  

In 1990, Finland became the first country to introduce a carbon tax for fossil fuels. The tax originally covered fuel oil, natural gas, coal and peat at a rate of €1.12/tonne of CO$_2$ and has since undergone several changes. Energy taxes are levied under two different acts: one for heating fuels (coal, natural gas, fuel peat, tall oil and liquid fuels) and electricity, which is taxed as an end-product, and another one for transport fuels. The tax rate has been increased many times, whereby its structure has been changed and refund systems included.  

Since the 2011 energy tax reform, the taxation of heating and transport fuels has been based mainly on the carbon dioxide emissions from their combustion. The current excise tax on fossil fuels consists of three components: an energy content component, a carbon dioxide emissions component (CO$_2$ tax) and a strategic stockpile fee for certain fuels. At the start of 2018, the

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rate was increased to €62/tonne of CO₂ emissions. According to the state budget, energy taxes would accrue total revenues of around €4.683 billion in the year 2018, including revenues from the CO₂ tax component.

There are many tax refund systems incorporated in the Finnish energy taxation. According to the state budget, the total amount of altogether 11 tax refunds was estimated to cut energy tax revenues by about €2.3 billion in 2016. The main refund systems and their estimated value in 2017 are:

- a reduced tax rate for diesel (€775 million);
- a reduced tax rate for electricity (category II) for certain industry sectors (€614 million);
- a reduced tax rate of carbon tax for fuel peat (€148 million);
- a tax refund system for energy-intensive industry (€230 million in 2018).

The excise taxation of electricity has been graded into two categories since 1997. Electricity used in industry and greenhouse cultivation and in recent years also server rooms and mining, is subject to the lower (II) tax category. Excise duty of the higher (I) tax category is collected on electricity used by private households as well as agriculture, forestry, construction, public administration and service sector. The difference between categories is quite high as the lower rate is only 0.703 cent/kWh whereas the higher tax rate is 2.253 cent/kWh. According to this estimate, potential tax revenues of about €614 million are lost because of the lower rate for category II electricity in 2018.

**EU Emission Trading System**

The EU Emission Trading System (EU ETS) applies for large industrial and energy production plants and covers approximately half of the greenhouse gas emissions in Finland. The price for allowances has been quite low for many years diminishing the effectiveness of ETS as a climate change instrument. In 2018 the price has started to increase from approximately €10 per tonne of carbon dioxide (CO₂ eq.) close to €20.

In order to compensate the indirect emission costs due to ETS, there is established compensation measure, which rules are laid down in the Act (138/2017) on aid for indirect emission costs due to the Emissions Trading System entering into force in June 2017. It is possible to grant the aid for indirect emission costs under the Emissions Trading Directive, and

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340 This reduced rate for diesel is compensated by an extra tax for private diesel cars. Vehicles that operate with power or fuel other than motor petrol are subject to the tax on driving power (käyttööimavero).


about 10 EU member states or EEA countries have used the aid to compensate operators for indirect emission costs.

The compensation measure was adopted in Finland in 2017, when it accounted for €43 million. The amount of compensation is related to the price of allowances, thus the increase in prices has an impact on the compensation.\textsuperscript{343} The rates used in the calculation are defined by the Commission annually. The compensation is calculated individually to all industrial plants according to the amount of electricity they have used annually. In Finland, the compensation is only a half of the maximum level allowed.\textsuperscript{344}

**Carbon Tax Component in Vehicle Related Taxes**

Since 2008, the CO\textsubscript{2} component was introduced also to the vehicle related taxation: the annual motor vehicle tax and the car tax (paid once the vehicle is registered for the first time, the so-called registration tax) are levied according to the CO\textsubscript{2} emissions of the vehicle type. The main objective in implementing such an environmentally based taxation was technological neutrality: the aim was not to promote any specific vehicular technology via taxation, but instead to promote the more widespread use of all low-emission vehicle and fuel technologies.

The basic tax for passenger cars and vans is based on the levels of carbon dioxide emissions or on the basis of the total mass of the vehicle. In the case of new vehicles, the tax levied is based on CO\textsubscript{2} data stated by the car's manufacturer in the Vehicular and Driver Data Register. In case of older vehicles, and if the car does not have emission data, tax is levied on the basis on the total mass of the vehicle. The annual limits for CO\textsubscript{2} and mass are generated in view of the method for measurement of CO\textsubscript{2} emissions that has been standardised at EU level and the time when the emission data became mandatory for the vehicle's type approval\textsuperscript{345}.

According to state budget estimates the revenues from car tax will amount to €896 million in 2018, and from the motor vehicle tax about to €1.174 billion\textsuperscript{346}. At the moment, the focus in developing road traffic taxation is on levying taxes on usage not so much on buying a new vehicle.

**Tax and Other Business Subsidies**

In Finland, tax and other subsidies influencing all kind of business activities amount altogether to around €6 billion annually. Reduced rates for VAT account for about €3 billion annually. According to a report\textsuperscript{347} made by Ministry of Economic Affairs and Employment, tax and direct

\textsuperscript{343} http://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/79863/TEMrap_22_2017_verkkojulkaisu.pdf


\textsuperscript{346} Ministry of Finance (2017), State budget for 2018.

business subsidies account for over €4 billion. Of these, direct business subsidies accounts for €1.1 billion and tax subsidies for around €2.9 billion. However, this estimate does not cover VAT reduced rates, nor EU financed or partly EU financed subsidies for agriculture.\footnote{Ibid.}

According the report by the Ministry, only 11% of the €4 billion of subsidies promote the development of business sector or companies. Thus, the most part of the subsidies are supporting the linear economy-based status quo and the existing technology and business models. It is mainly the research and development tax subsidies and some direct subsidies that seem to have a positive impact on companies’ innovation activities. According to a study\footnote{Rauhanen, T., Grönberg, S., Harju, J. & Matikka, T. 2015. *Yritystukien arviointi ja vaikuttavuus* (The Assessment and effectiveness of business subsidies). Government’s Analysis, Assessment and Research Activities 8/2015, Prime Minister’s Office.} by the VATT Institute for Economic Research the effects of research and development subsidies, for small businesses in particular, are significant. However, most of the subsidy funds go to large companies. According to the study, correctly targeted subsidies can promote economic growth effectively. However, many of the subsidies are not effective. On the contrary, they are detrimental to sustainable development and innovation or even environmentally harmful while blocking reform and renewal of the business sector.

Consequently, there is a strong case for reforming current practices of business subsidies and for removing the ineffective and environmentally harmful subsidies. From a point of view of promoting circular economy, the business subsidies should be reformed as most of them are environmentally harmful or harmful also for circular economy business models and goals.

**Environmentally Harmful Subsidies**

There are many environmentally harmful subsidies (EHS) in Finland, which are working against the commitments and intentions of Finland related to e.g. the greenhouse gas emissions, biodiversity, circular economy goals and the fiscal needs of the state budget. In addition, Finland has committed to become a carbon-free society by 2045, at the latest. This carbon-neutral intension can be substantially hindered by the subsidies to the use of fossil fuels exists. According to the report by the Ministry of Environment, most of the EHS are tax subsidies, which exist mainly in the energy, transport and agricultural sectors.\footnote{Hyyrynen, M. (2013), *Ympäristön kannalta haitalliset tue* (Environmentally harmful subsidies) Ympäristöministeriön raportteja (Report of Ministry of Environment) 13/2013.}

**Energy sector**

The most significant environmentally harmful subsidies in the energy sectors are the same mentioned in the energy taxation chapter:

- a reduced tax rate for diesel (€769 million, 2019);
- a reduced tax rate for electricity (category II) for certain industry (€603 million, 2019);
- a reduced tax rate of carbon tax for fuel peat (€178 million, 2019);
Transport sector

The transport sector accounts for approximately 20% of greenhouse gas emissions in Finland, of which road traffic is responsible for 95%. Furthermore, road traffic causes other emissions, such as fine particles (PM$_{10}$, PM$_{2.5}$), nitrogen dioxide (NO$_2$) and sulfur dioxide (SO$_2$). Even if these emissions have decreased, they still have health impacts especially in the cities. The most significant subsidies in the transport sector are partly the same as mentioned in the energy taxation chapter (2014 and estimated values for 2019):

- a reduced tax rate for diesel (€769 million, 2019);
- a reduced tax rate for light fuel oil for machinery use (€426 million, 2019);
- a mileage allowance (the amount of excess compensation) (€170 million, 2014); and
- the commuting cost deduction (€630 million, 2014).

In addition, company car and parking benefits are significant incentives (administrative support) for private car use. The estimated amount of the company car benefit is €300 – 800 million in 2014.

Agriculture sector

In Finland, agriculture is the largest single contributor to nutrient loads on lakes, rivers and the Baltic Sea. It accounts for approximately 55% of the total nitrogen load and for 65% of the total phosphorus load on water bodies. In addition, agriculture affects biodiversity. According to the report by the Ministry of the Environment, the amount of the EHS in the agricultural sector is more than EUR 1.1 billion in 2014. The most significant of these subsidies are:

- national subsidies for agriculture and horticulture (€559 million);
- natural handicap payments (LFA) (€422 million); and
- structural subsidies for agriculture (€96 million).

Environmentally harmful subsidies are working against the achievement of many environmental commitments in Finland. They are supporting the old fossil fuel-based and linear economy, and thus preventing the transition towards a sustainable circular economy. In addition, the Finnish government has intentions to gradually remove or reallocate them, but

355 The objective of some of these subsidies is to cut emissions from farming and forestry. However, reductions in CO$_2$ have been modest until now.
356 These figures are now according to the report of Ministry of Environment (Hyyrynen, 2013). They will be updated and checked the situation and new figures later.
there is a lack of clear commitment, priorities for taking action, no action plan with a schedule nor a road map.

**Subsidies for Renewable Energy Production**

In Finland, renewable energy sources represent about 40 per cent of energy end-consumption in 2017. The aim set in the National Energy and Climate Strategy to 2030 is to increase the share of renewable energy up to more than 50 per cent during the 2020s. The most important forms of renewable energy used in Finland are bioenergy, fuels from forest industry side streams and other wood-based fuels in particular, hydropower, wind power and ground heat. Bioenergy is also generated from biodegradable waste and side streams of agriculture and industrial production and from municipal waste. Solar electricity has a growing role especially in on-site energy generation.

The main objective in promoting renewable energy is to reduce greenhouse gas emissions and move away from the energy system that is based on fossil fuels. Another objective is to improve energy self-sufficiency and employment and support the development of technologies in the sector.  

Finland has used different policy instruments to achieve the target share of renewable sources on energy end-consumption. The main drivers for investments and use of renewables have been a feed-in programme, a biofuel blending requirement for motor fuels and subsidies for investments for renewable energy production.

Since 2011, a feed-in tariff scheme for electricity has been in use to increase the renewable energy sources in electricity production. A feed-in tariff is available for 1) new wind power plants; 2) new biogas power plants (gas produced by digestion); 3) new wood-fuelled power plants with heat production; and 4) forest chip power plants. In the feed-in tariff system, an electricity producer can receive a production subsidy (feed-in tariff) for a maximum of twelve years. The subsidy varies on the basis of a three-month electricity market price or the market price of emission allowances. The fiscal effect of the feed-in tariff has varied from around €11 million in 2011 to €170 million in 2016.

Finland has a biofuel blending requirement for motor fuels. This obligation of mixing biofuels with fossil motor fuels started in 2008 as a small percentage, and has been increased since.

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The latest plans are to extend the biofuel blending requirement gradually to 30% by 2030 for transport fuels and to 10% for heating and machinery fuels.\(^{361}\)

Energy aid and investment aid for key energy projects, managed by the Ministry of Economic Affairs and Employment, has been one of the drivers to promote investments and technology in renewables. Energy aid can be granted to investment projects and studies that:

- promote the production or use of renewable energy;
- promote energy savings or increase the efficiency of energy generation or use; or
- otherwise promote the transition towards a low-carbon energy system.

Investment Aid for Key Energy Project programme is intended to subsidy investments on renewable energy and new energy technology.\(^{362}\) Annually, the subsidies under the Energy Aid and Investment Aid for Key Energy Projects amount to around € 60-70 million.\(^{363}\) In addition, investments in the construction of a national LNG terminals network have been supported with a total of approximately € 93 million.\(^{364}\)

\(^{361}\) ibid.


APPENDIX 2: E3ME

Introduction

E3ME is a computer-based model of the world’s economic and energy systems and the environment. It was originally developed through the European Commission's research framework programmes and is now widely used in Europe and beyond for policy assessment, for forecasting and for research purposes. Recent applications of E3ME include:

- Input to the EU’s 2050 long-term strategy on decarbonisation
- The modelling underpinning the 2018 New Climate Economy report
- Modelling used in the New Era New Plan report published by The Ex'tax Project
- Contribution to the EU’s Impact Assessment of its 2030 climate and energy package and Clean Energy for all Europeans package
- Analysis of future energy systems, environmental tax reform and trade deals in East Asia

This section provides a short summary of the E3ME model. For further details, the reader is referred to the full model manual available online from www.e3me.com.

E3ME’s basic structure and data

The structure of E3ME is based on the system of national accounts, with further linkages to energy demand and environmental emissions. The labour market is also covered in detail, including both voluntary and involuntary unemployment. In total there are 33 sets of econometrically estimated equations, also including the components of GDP (consumption, investment, international trade), prices, energy demand and materials demand. Each equation set is disaggregated by country and by sector. In this report the focus of the analysis is Finland, but the whole model is solved.

The main dimensions of E3ME are:

- 59 countries – all major world economies, the EU28 and candidate countries plus other countries’ economies grouped
- 69 industry sectors for European countries, based on the Eurostat classification (the final page of this Appendix provides a detailed overview)
- 43 categories of household expenditure
- 22 different users of 12 different fuel types
- 14 types of air-borne emission (where data are available) including the six greenhouse gases monitored under the Kyoto protocol.

E3ME’s historical database covers the period 1970-2016 and the model projects forward on an annual basis. The main data sources for European countries are the Eurostat national
accounts data\textsuperscript{365} and the IEA energy balances\textsuperscript{366}. These are supplemented by the OECD’s STAN database\textsuperscript{367} and other sources where appropriate. Most of the data provided by Eurostat are ‘complete’ and do not require further manipulation. Any remaining gaps in the data are estimated using customised software algorithms.

The econometric techniques used to specify the functional form of the equations are the concepts of cointegration and error-correction methodology, particularly as promoted by Engle and Granger (1987)\textsuperscript{368} and Hendry et al (1984)\textsuperscript{369}. In brief, the process involves two stages. The first stage is a levels relationship, whereby an attempt is made to identify the existence of a cointegrating relationship between the chosen variables, selected on the basis of economic theory and a priori reasoning, e.g. for employment demand the list of variables contains real output, real wage costs, hours-worked, energy prices and the two measures of technological progress.

If a cointegrating relationship exists then the second stage regression is known as the error-correction representation, and involves a dynamic, first-difference, regression of all the variables from the first stage, along with lags of the dependent variable, lagged differences of the exogenous variables, and the error-correction term (the lagged residual from the first stage regression). Due to limitations of data size, however, only one lag of each variable is included in the second stage.

It is noted that the structure of the Finnish economy has changed considerably over the historical time period. To test the validity of the econometric parameters over time, we assessed how key trade price elasticities vary over the period back to 1970, using ‘rolling’ regressions. This analysis found that there were some sectors where elasticities changed, but the elasticities in the key sectors were generally quite stable.

Figure 10 below shows how the three components (modules) of the model - energy, environment and economy - fit together. Each component is shown in its own box. Each data set has been constructed by statistical offices to conform with accounting conventions. Exogenous factors coming from outside the modelling framework are shown on the outside edge of the chart as inputs into each component.

For each region’s economy the exogenous factors are economic policies (including tax rates, growth in government expenditures, interest rates and exchange rates). For the energy system, the outside factors are the world oil prices and energy policy (including regulation of the energy industries). The linkages between the components of the model are shown explicitly by the arrows that indicate which values are transmitted between components. These linkages are one of the key strengths of the model, as they ensure consistency between each component.

\textsuperscript{365} See economy and finance branch at https://ec.europa.eu/eurostat/data/database
\textsuperscript{366} https://www.iea.org/statistics/balances/
\textsuperscript{367} http://www.oecd.org/industry/ind/stanstructuralanalysisdatabase.htm
\textsuperscript{368} Engle, R F and C W J Granger (1987), ‘Cointegration and error correction: representation, estimation and testing’, Econometrica, 55, 251-76.
The economy module provides measures of economic activity and general price levels to the energy module; the energy module provides measures of emissions of the main air pollutants to the environment module, which in turn can give measures of damage to health and buildings. The energy module provides detailed price levels for energy carriers distinguished in the economy module and the overall price of energy as well as energy use in the economy.

Technological progress plays an important role in the E3ME model, affecting all three Es: economy, energy and environment. The model’s endogenous technical progress indicators (TPIs), a function of R&D and gross investment, appear in nine of E3ME’s econometric equation sets including trade, the labour market and prices. Investment and R&D in new technologies also appears in the E3ME’s energy and material demand equations to capture energy/resource savings technologies as well as pollution abatement equipment. In addition, E3ME also captures low carbon technologies in the power sector through the FTT power sector model (see below).

An important part of the modelling concerns international trade. E3ME solves for detailed bilateral trade between regions (similar to a two-tier Armington model). Trade is modelled in three stages:

- econometric estimation of regions’ sectoral import demand
- econometric estimation of regions’ bilateral imports from each partner
- forming exports from other regions’ import demands

Trade volumes are determined by a combination of economic activity indicators, relative prices and technology.

Treatment of the labour market is an area that distinguishes E3ME from other macroeconomic models. E3ME includes econometric equation sets for employment, average working hours, wage rates and participation rates. The first three of these are disaggregated by economic sector while participation rates are disaggregated by gender and five-year age band.

The labour force is determined by multiplying labour market participation rates by population. Unemployment (including both voluntary and involuntary unemployment) is determined by taking the difference between the labour force and employment. This is typically a key variable of interest for policy makers.
The version of E3ME used included FTT (Future Technology Transformations) sub-models for the power, car and household heating sectors. The basic approach in each FTT model is similar. As the power sector was the most impacted in the scenario in this report, we focus the description here on that sector.

FTT represents a family of technology diffusion models. The model uses a decision-making core for investors wanting to build new electrical capacity, facing several options. In the power sector, the resulting diffusion of competing technologies is constrained by a global database of renewable and non-renewable resources. The decision-making core takes place by pairwise levelised cost (LCOE) comparisons, conceptually equivalent to a binary logit model, parameterised by measured technology cost distributions. Costs include reductions originating from learning curves, as well as increasing marginal costs of renewable natural resources (for renewable technologies) using cost-supply curves. The diffusion of technology follows a set of coupled non-linear differential equations, sometimes called ‘Lotka-Volterra’ or ‘replicator dynamics’, which represent the better ability of larger or well-established industries to capture the market, and the life expectancy of technologies. Due to learning-by-doing and increasing returns to adoption, it results in path-dependent technology scenarios that arise from electricity sector policies.

The FTT sub-models are fully hard-linked to the wider E3ME model, with two-way linkages in each direction. FTT provides a much higher degree of technological detail than is available
from using the econometric equations alone. The basic model is described in Mercure (2012)\textsuperscript{370}.

**Comparison with CGE models**

E3ME is often compared to Computable General Equilibrium (CGE) models. In many ways the modelling approaches are similar; they are used to answer similar questions and use similar inputs and outputs. However, underlying this there are important theoretical differences between the modelling approaches.

In a typical CGE framework, optimal behaviour is assumed, output is determined by supply-side constraints and prices adjust fully so that all the available capacity is used. In E3ME the determination of output comes from a post-Keynesian framework and it is possible to have spare capacity. The model is more demand-driven and it is not assumed that prices always adjust to market clearing levels.

The differences have important practical implications, as they mean that in E3ME regulation and other policy may lead to increases in output if they are able to draw upon spare economic capacity. This is described in more detail in the model manual.

The econometric specification of E3ME gives the model a strong empirical grounding. E3ME uses a system of error correction, allowing short-term dynamic (or transition) outcomes, moving towards a long-term trend. The dynamic specification is important when considering short and medium-term analysis (e.g. up to 2020) and rebound effects, which are included as standard in the model's results.

**The baseline projections**

Although results in the scenario are presented as (percentage) difference from baseline, the baseline projections themselves are important. If the baseline is unrealistic then it could introduce bias into the model results.

It is possible to use the econometric equations in the E3ME model to form baseline projections, but these would not account for expected future trends that vary from historical patterns. The baseline is therefore instead matched to a published set of projections that has already been validated externally.

The current baseline used is the EU’s 2016 reference case that is developed using the PRIMES energy system model\textsuperscript{371}. This in turn builds on long-term projections of economic growth from the European Commission\textsuperscript{372} and Eurostat population projections\textsuperscript{373}.

By matching to published projections, the analysis is consistent with other studies that are carried out at European level.

**How the scenario was implemented**

Fitting all of the taxation measures into the structure provided by the macroeconomic model represents a considerable challenge. This sub-section summarises the steps that were taken.

\textsuperscript{370} [https://www.sciencedirect.com//science/article/pii/S0301421512005356]


\textsuperscript{373} [https://ec.europa.eu/eurostat/web/population-demography-migration-projections/population-projections-data]
In most cases the changes are phased in gradually over the period up to 2025. The rates are held constant after 2025.

We start with the revenue-raising measures:

- Carbon Price Floor – implemented as a carbon tax rate (€60/tCO₂) for all sectors that have lower rates in the baseline, such that the total rate paid by the sector is equal to the value given. A lower rate (€10/tCO₂) was applied to the use of bioenergy.
- A phase-out of the aid scheme for indirect emission trading costs compensation.
- Removal of the Reduced Energy Tax Rate on Diesel – implemented as an increase in the cost of diesel for road transport.
- Removal of the light fuel oil subsidy – as above, implemented as an increase in the price of light fuel oil. Road and air transport are excluded.
- Removal of the peat subsidy – peat falls into the category ‘other solid fuel’ in E3ME. It was verified that the model data for this category represented peat (all cases except iron and steel, where a weighting was applied). The price of this fuel group was then increased.
- Non-energy use of fossil fuels – the tax is applied to the chemicals sector, at a rate such that the expected revenues are achieved.
- Electricity (bulk users) – the cost of electricity is increased for the sectors that are subjected to the lower tax rate (industry, greenhouse cultivation and data centres). These include sectors covered by the EU ETS (mostly large installations) plus the food and agriculture sectors.
- Removal of the subsidy for energy-intensive industries – the cost of energy is increased for the EU ETS sectors, with the amount determined by the value of the subsidy divided by energy consumption.
- Air passengers and air freight – it is not possible to split these two measures, given the data in the modelling framework. A charge is therefore added to domestic production (a proxy for number of flights) in the sector.
- Incineration of waste – the E3ME model does not have a detailed treatment of waste (mainly due to a lack of data). It was determined that the charge would be passed on to households that use district heating systems that are powered by incineration. The cost is therefore passed on to households, on the assumption that they cannot change their heating system.
- Nuclear waste – nuclear power is one of the technologies in the FTT:Power model. A charge per MWh is added to the levelised costs in the model, which help to determine the choice of future capacity.
- Water abstraction (bulk users) – a charge was added to industries that self-abstracted water, based on a €/m³ rate. Gaps in the data make this measure challenging to model and it was not possible to reconcile the expected revenues with the physical consumption data.
- Extraction of metal ores and extraction of non-metallic minerals – a charge is added to the cost of production of the ‘other mining’ sector in E3ME. It is not possible to differentiate between metal and non-metal ores here in the economic data.
- Pesticides – a charge was added to the consumption of ‘other chemicals’ by the agriculture sector, represented in E3ME by an input-output coefficient. It was assumed
that consumption falls by around 5% as a result, which is broadly in line with other studies.\textsuperscript{374}

Where sectors face higher costs, it is assumed that, in the long run at least, most of the higher costs are passed on to consumers. Estimated parameters determine how much of the cost increase is passed on initially.

The scenario is 'revenue neutral', meaning that all tax increases are exactly matched by reductions in other taxes. How the measures to do this are modelled are described below:

- **Personal income tax and Employee social security tax reduction** – both of these measures are represented as a subtraction of gross wage income. When the rates are reduced, households therefore have a higher domestic income for expenditure.
- **Employers’ social security tax reduction (for new employment)** – this measure is important for generating new employment. It is assumed that new jobs have the same wage rates as the existing sectoral average. The number of jobs created is therefore equal to the revenues available divided by the average wage rate.
- **Employers’ social security tax reduction (general)** – a reduction in employers’ labour taxes reduces the difference between labour costs and wage rates.
- **Income support for specific groups** – in the formal modelling, this measure is treated as a lump-sum payment to households. In a subsequent off-model calculation, the amount is allocated to low-income households.
- **R&D subsidy (labour cost reduction)** – it is assumed that R&D increases by the amount raised. The share of R&D across sectors matches existing patterns.
- **Subsidy for renewable energy** – subsidies are added to renewable technologies in the FTT:Power model. As a result, there is slightly faster uptake of wind and solar power.

\textsuperscript{374} The implied elasticity is -0.37. See e.g. Pearce and Koundouri (2003), where they report a value of -0.39. [http://siteresources.worldbank.org/INTWRD/903845-1112344347411/20424145/31203ARDenoteWRMEIPearceKoundouri.pdf](http://siteresources.worldbank.org/INTWRD/903845-1112344347411/20424145/31203ARDenoteWRMEIPearceKoundouri.pdf)
Conversion of 69 industry sectors to 10 sectors (Eurostat classification)

1) **Agriculture**: Crop production, Forestry and Fishing.
2) **Energy and Utilities**: Coal, Oil and Gas, Manufactured fuels, Electricity, Gas, steam and Air conditioning, Water supply, Sewerage and waste.
3) **Basic Manufacturing**: Other mining, Food, drinks and tobacco, Textiles and leather, wood and wood products, Paper and pulp, Printing, Chemicals, Pharmaceuticals, Rubber and plastic, Non-metallic mineral products, Basic metals.
4) **Engineering etc.**: Metal products, Electronics, Electrical equipment, Machinery, Equipment, Motor vehicles, Other transport equipment, Manufacturing, Repair and installation.
5) **Construction**: Construction.
6) **Wholesale and retail**: Sale of cars, Other wholesale, Other retail.
7) **Transport and communications**: Land transport, Water transport, Air transport, Warehousing, Postal and courier activities.
8) **Business services**: Publishing activities, Broadcasting and movies, Telecommunications, Computer services, Financial services, Insurance, Auxiliary to finance, Real estate, Legal, account. etc, Architect & engineer, R&D activities, Advertising, Other professional, Rental and leasing, Employment activities, Travel agency, tours, Security and administration.
9) **Public services**: Public admin, Education, Human health activities.
10) **Other services**: Hotel & catering, Residential care, Arts and entertainment activities, Sports activities, Memberships organizations, Repair household goods, Other personal services, Household employers, Extraterritorial organizations.