Article

Eelis Paukku*

Carbon Pricing in Finland: Balancing policy goals

https://doi.org/10.2478/ntaxj-2023-0006
Received Mar 21, 2022; accepted Jun 13, 2023

Abstract: This study discusses the role and development of carbon pricing via taxation by using Finland as a case example of several issues with carbon taxation. Carbon taxation and carbon pricing face some major problems, mainly competitiveness and social issues. Although Finland was one of the first countries to adopt carbon-based energy taxation, these problems shaped the tax system in a way that could even be described as "avoiding carbon pricing". This study provides new insights on how to develop carbon taxation and how to overcome major problems related to commonly known problems with carbon pricing.

Keywords: Carbon tax, environmental tax, carbon pricing, energy tax, tax policy

1 Introduction

The major tools for an energy transition from fossil fuels to renewable energy are carbon pricing, increasing energy efficiency standards, removing fossil fuel subsidies, and subsidizing renewable energy (Tsai 2020). Carbon pricing can be done via two competing tools: carbon taxation and emission trading (Chiu et al. 2015). Carbon taxation was the first major tool to be used to cut down greenhouse gas emissions (Andersen 2009, p. 3). Carbon pricing is seen as a necessary tool to achieve a carbon-neutral society (Rabe 2018, p. 26-27). In the 1990s, Finland was the first country in Europe to introduce a CO2 tax (Speck and Jilkova 2009, p. 32). In the 2020s, other policy instruments, mainly subsidy schemes, became more and more popular in order to promote renewable energy production further without harmful effects on the economy (Iliopoulos 2020). At the same time, the role of the polluter pays principle was reduced in the EU policy, which allowed increasing amounts of state aid to energy production (Paukku 2021a).

This study aims to analyze the Finnish carbon taxation system and analyze the actual role of energy transition goals of Finnish carbon taxation. This study aims to analyze whether and how the carbon taxation system in Finland is aimed to take into account energy transition goals and how it balances those and the fiscal goals of taxation. In addition to these, this study aims to systemize and also analyze the role of other policy goals in the Finnish carbon taxation policy system. There are two research questions in this study:

1. How has Finland solved the economic and policy obstacles in carbon pricing?
2. How have fiscal and environmental motivations affected Finnish carbon pricing legislation?

In order to recognize the goal and common problems and policies of carbon pricing, it is necessary to conduct a literature review. This literature review is based on a vast amount of economic and energy policy literature on the subject. As the goal of this study is not to find a consensus about different issues or to present the most developed and modern research on the subject but to present a framework that can be used to analyze the Finnish carbon taxation policies, the method for literature review used in chapter 2 is a narrative literature review instead of a systematic literature review (Jahan et al. 2016). In chapter 3, I will answer research questions 1 and 2. The method in this chapter is the positive theory of regulation, which is used to explore and systematize the policy goals behind the regulation (Määttä 2002). The legal dogmatic method is used to discover and systematize current legislation that is affecting carbon taxation (Aarnio 2011). The regulation to be analyzed will cover carbon taxation regulation, but in addition to this, also other regulations that affect energy transition and energy policy can be used to compare policy goals. The regulation to be analyzed will be mostly from the 2010s, but it will also cover older regulation when comparing the policy changes is necessary to pinpoint important aspects. Chapter 4 of this study covers the conclusions and discussion.

This study aims to conduct a case study on how different common problems in carbon pricing have been solved in one country and what the outcome has been. There are some earlier studies focusing on Finnish carbon

***Corresponding Author: Eelis Paukku:** University of Lapland: Lapin Yliopisto, Finland; Email: eelis.paukku@ulapland.fi

taxation, but they do not cover recent major developments and do not go deeply into tax legislation (Sairinen 2012). In addition to that, there are some studies written in English about the Finnish energy policy, which focus on energy transition (Pilpola and Lund 2018; Paukku 2021a; Similä et al. 2021; Farsaei et al. 2020). In addition to that, there are a number of studies written in Finnish that focus on the Finnish energy policy (Paukku 2021b, 2019; Paukku and Similä 2020; Paukku 2020b). However, none of these focuses on carbon taxation. For carbon taxation theory, this study extends the previous literature by providing new information on how to adjust carbon taxation with other policy instruments and policy goals. This study provides new information on what have been problems in carbon pricing and how those have been solved.

2 The social cost of carbon, carbon taxes, and energy transition

Pricing carbon is seen as a necessary requirement in order to achieve carbon neutrality (Rabe 2018, p. 26-27). A carbon tax is one possible tool for breaking the link between economic growth and greenhouse gas emissions (He et al. 2021). Pricing carbon has become one major focal point in national and international policies (Rey and Thierry 2020). A carbon tax can be approached as a *Pigouvian* environmental tax that should equal marginal damages and which is levied directly on the source of emissions (Heine et al. 2012). In this case, the users would internalize the

externality, which would lead to an economically optimal outcome (Golosov et al. 2014). Correctly set carbon tax with productive revenue usage enables lower carbon reduction costs for the economy (Parry 2015, p. 233). If carbon pricing is set too low, it might have negative outcomes due to the adverse effects on welfare and inadequacy to cause positive environmental effects (Ermolieva et al. 2010).

One proposition for environmental policy is that carbon taxes should be linked to the social cost of carbon (Rabe 2018, p. 30). This social cost is theoretically easy to define: monetary damage caused per additional specific amount of carbon dioxide in the atmosphere (Ackerman and Stanton 2012). However, calculating this depends on several factors, for example, assumptions about societal preferences, the climate system, economic technologies, and the feedback between them (Okullo 2019). In addition to this, the social cost of carbon is not stable, but it might change over time and reach several tipping points (Taconet et al. 2021). There are several estimates for social costs ranging from 21 $/ton to 1500 $/ton. OECD has estimated that 30 €/t would be a conservative low-end estimate of the social costs of carbon emissions in 2015, while 60 €/t would be enough to reach commitments from the Paris agreement, and even higher rates are needed in order to achieve the net zero carbon intensity of GDP (OECD 2018). There has been little movement towards the consensus number (Pindyck 2017). This makes defining the optimal carbon tax near impossible.

Although carbon pricing is seen as a preferable option when compared to any other economic instrument, there are disputes about whether carbon taxes or emission trading schemes are the preferable solution (Rabe 2018, p. 27-28). Several features of carbon taxation and emission trading are analogous to each other (Parry 2015, p. 233). Carbon taxes are a more cost-efficient solution to administrate, and they are especially useful in the case of small emitters, for example, consumers (Neuhoff 2011, p. 93-95). However, as optimal carbon tax has been quite difficult to define, climate policies have been more focused on emission targets (Pindyck 2017). This has favoured emission trading schemes as they provide sure results on how much emissions will be reduced, while carbon tax can only provide sure results on how much emitting would cost.

The basic idea of carbon pricing is to mitigate the damages caused by an externality, not to extract wealth from citizens (Rabe 2018, p. 26-27). Carbon taxes have little effect on the economy as long as revenues are used productively, for example, by lowering taxes on labour and capital (Parry 2015, p. 233). Even if carbon taxes are used to cover the deficit and not to boost the economy and green investment, there are some positive aspects. The consumption reduction effect caused by introducing a new consumption tax is not completely negative as it reduces the consumption of other goods outside carbon taxation and thus decreases carbon emissions in those sectors, which is called *negative carbon leakage* (Baylis et al. 2013).

Another problem related to using carbon tax revenues to boost the economy by lowering other taxes is the inequality issue. The welfare effect does not distribute equally between different income levels, as carbon taxes affect energy prices, including energy and transportation costs, heavily. However, the welfare effects differ widely from one country to another. Despite this, it is often

recommended to make changes to the fiscal system in order to limit the tax burden, especially for low-income households that use a significant portion of their wealth for energy (Heine et al. 2012). These changes should not be made by undercharging carbon as it is a highly inefficient way to help low-income households as the majority of benefits leak away to groups of higher-income (Parry 2015, p. 235). Another issue of the carbon tax is that it has heavy intergenerational effects. It can increase the welfare of future generations by reducing deficits and reducing greenhouse gas emissions (Rausch 2013).

Environmental taxes, especially carbon taxes, can be seen as an alternative to other consumption taxes, although both might be necessary from a fiscal standpoint (Heine et al. 2012). Carbon taxes have several features common to consumption taxes, as they reduce the consumption of several goods with no easily available low-carbon substitutes (Lawley and Thivierge 2018). Different environmental taxes have been efficient from a fiscal viewpoint, as they have accrued the treasury quite well in several different countries (Heine et al. 2012). The reality in the majority of countries has been that there has been little or no scope to adjust other taxes due to fiscal deficits, which has led to carbon taxes increasing overall consumption taxes (Parry 2015, p. 248). This is not an entirely bad thing as it can increase the welfare of future generations, as well as cutting greenhouse gas emissions (Rausch 2013).

Due to seeing carbon tax as a consumption tax, there are cases where a carbon tax is adjusted because of the changes in the market price of the taxed commodity, for example, gasoline (Zhao et al. 2018). If carbon tax had been set based on the social cost of carbon or other *Pigouvian* factors, these kinds of adjustments would not be necessary. However, the emission reduction targets require considering the price of the commodity, which has several other determining factors than a carbon tax, especially in the case of commodities with global markets, such as gasoline (Mori 2012). Other emission reduction policies might reduce energy prices, which has a controversial effect on carbon pricing as they might actually increase the energy demand due to a boost in economic growth and an increase in energy demand (Vera and Sauma 2015).

For effective results, it is recommended to use carbon taxes without exemptions, meaning emission trading schemes (Heine et al. 2012). For the last decades, carbon-free energy production methods have been more expensive than carbon-based energy production technologies, and although renewables are catching up, there would be significant challenges in achieving energy transition without subsidies or carbon pricing (Khatib and Difiglio 2016). As subsidies are an expensive long-term solution, they are not as preferable as carbon pricing for permanently solving the externality-related problem.

Reduction of carbon dependency is politically quite difficult as carbon is a part of all areas of life, carbon damages are indirect, and carbon industries are a formidable political force in several Western states (Rabe 2018, p. 23-36). However, light and postponed carbon taxation are not preferable from a global warming or welfare point of view, even if they consume less political capital (van der Ploeg 2016). Another possible disadvantage of carbon pricing is the [*positive*] *carbon leakage*, meaning that when carbon is priced, industries suffering from the pricing decrease their production, and production increases in areas where carbon pricing has not been introduced, reducing welfare and emission reductions in the area which introduced carbon pricing (Branger and Quirion 2014). Carbon leakage and international competitiveness are major factors affecting the acceptability of carbon pricing (Rey and Thierry 2020).

The previous international climate treaties, which only include developed countries, might have led to carbon leakage to some extent as trade with countries that had not adopted emission reduction grew after climate measures (Aichele and Felbermayr 2015). However, the amount of leakage is disputed as there are several effects and factors to reduce carbon leakage, for example, increased technology development and decreased consumption (Gerlagh and Kuik 2014; Baylis et al. 2013). Currently, carbon policies are not heavily affecting prices and investments (Rey and Thierry 2020). Carbon leakage tends to increase demands for different kinds of border carbon adjustments, which pose high risks of triggering trade wars as they are often seen as "green" protectionism (Branger and Quirion 2014). As current climate treaties include more and more parties, this problem is diminishing even further in the future (Rey and Thierry 2020).

One advantage that emission trading has when compared to carbon taxes is that it is politically much less costly and faces less opposition (Rabe 2018, p. 28-29). In the case of the *cap-and-trade* emission trading system, it is also possible to be sure that emission reductions are achieved, and there is an industry signal that carbon prices will rise until the emission targets are met (Neuhoff 2011, p. 52-54). In emission trading schemes, instead of a regulator, the markets define the abatement cost, which is more likely to fare better under several uncertainties related to markets and technology (Ermolieva et al. 2010). One significant disadvantage of the carbon

tax is that if it is set too low, global warming increases in the short term and the carbon tax is expected to rise in the future, which also creates more significant negative welfare effects (van der Ploeg 2016).

The effects of carbon pricing on economic growth are unclear (Neuhoff 2011, p. 52-54). There are several cases where carbon taxes have successfully reduced emissions without causing much damage to the economy. The earliest results are from Nordic states and the Netherlands from the 1990s (Rabe 2018, p. 98). Controversially, it is also possible to achieve economic growth in the long term by enforcing environmental taxes (He et al. 2021). It is even estimated to be possible to achieve significant economic growth if revenues are recycled in order to promote investment (McKibbin et al. 2015). There are studies implying that environmental taxes would have positive effects on the economy if tax revenues are used to reduce tax distortions from other taxes (Barker et al. 2009, 183).

It is clear that large-scale emission reductions require either stopping some economic actions or large-scale investments and technology development (Neuhoff 2011, p. 129-130). Some improvements, for example in energy efficiency might lack, as technology that becomes commercially mature will be implemented during following years or decades, depending on investment schedules. Fuel-shifting is another steady-improving field that provides emission reductions, but that does also require major investments in fuel production. As the first one is often not a preferable option, policies should be developed in a way that they promote investments and technological development. Carbon pricing might not be a suitable tool for energy transition if alternative technologies are immature, as it would require an extremely high carbon price to trigger investment, which would have a significant negative economic effect (Pahle et al. 2013). Carbon pricing is an effective tool to reduce emissions, but there are other more effective tools for investment promotion (Kök et al. 2018). Carbon pricing increases the competitiveness of new technologies, but it does not address other market failures effectively. Subsidies are another major tool that is especially good for reducing uncertainty and developing technologies that are not yet commercially mature (Paukku 2021a).

However, as several carbon reduction policies are costly, it is often recommended to use carbon pricing in order to finance other carbon reduction policies (Rausch and Reilly 2015). Investment subsidies can overcome some negative effects of steadily rising carbon taxing in the long term (van der Ploeg 2016). Investment subsidies and other supply-side grants are less likely to create carbon leakage and are thus more easily politically justified (Ye et al. 2020).

In addition to investment triggering, several energy production methods are likely to require production subsidies in order to compete with carbon if there are no significant carbon charges (Khatib and Difiglio 2016). Investment subsidies are not enough to boost investments as they do not ensure commercial success, and operating aids have been used in addition. Several renewable energy production investments have required and still require operating subsidies, like feed-in-tariffs, in order to ensure competitiveness against more mature technologies in the long term (Zhang et al. 2014). Currently, in Finland, only biomass burning, hydropower and onshore wind power are commercially viable renewable energy technologies without operating subsidies (Similä et al. 2021). However, achieving this requires a long-term and expensive feed-in-tariff -system, which will generate costs until the 2030s (Paukku and Similä 2020). However, feed-in-tariffs can be lowered significantly when technological maturity has increased enough to ensure commercial viability.[1]

One advantage of carbon taxes compared to emission trading schemes is that they are predictable and not volatile (Rabe 2018, p. 29-30). Emission allowance trading is influenced by several factors that are not dependent on carbon reduction prices, which makes them more volatile and significantly more difficult to predict (Feng et al. 2011). There is also some evidence that the EU ETS failed to affect energy prices despite what was planned in previous phases due to economic slowdown and too many emission allowances being in circulation (Chen et al. 2019). There are still several effects that make carbon markets unstable, creating risks for financial systems and the real economy (Liu et al. 2020). Carbon markets are especially sensitive to economic development and energy prices, which makes them even harder to predict and, thus, harder to plan future investments for emissions reductions (Tang et al. 2015). There is some evidence that the free allocation of EU ETS units is currently used in an inefficient way and does not promote economy or emission reductions as designed (European court of auditors 2020, 40-41).

1 Directive of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (Text with EEA relevance.) PE/48/2018/REV/1 OJ L 328, 21.12.2018.

3 Carbon taxes and other energy policy instruments in Finland

3.1 Development of carbon taxation in Finland

3.1.1 The beginning – 1990s and early 20s

Taxation is considered to have a significant impact on energy production and demand, and because of this, it has been used as one key tool in the Finnish energy and climate policy.[2] Although it is possible to create a somewhat economically ideal environmental tax, in practice, there have been several exceptions from political reasons in Finland during the early decades of environmental taxation (Vehmas 2005). One major problem in the Finnish energy policy was and is the high energy consumption of the Finnish industry (Teir 1999, p. 303).

It is not possible to discuss the Finnish energy policies without mentioning the EU, as both emission trading and carbon pricing in Finland are currently based or heavily adjusted based on EU regulation (Paukku 2021a). However, carbon taxation started in Finland before the EU membership, as Finland was one of the first countries, alongside the Netherlands, Sweden, Norway and Denmark, to adopt cross-cutting carbon taxes instead of taxes for individual fuels (Rabe 2018, p. 98). Finland was actually the first country to implement carbon tax. In Finland, these changes were implemented by law by changing the fuel tax law temporarily (1119/1989).[3] This was the first phase of energy taxation changes during the years 1989-1990 (Sairinen 2012, p. 426). Before this, these fuels had been outside fuel taxation.[4] This change was stated to be based on environmental viewpoints, especially reductions in carbon dioxide emissions.[5] On the other hand, the legislator knew that those new taxes that would be implemented would not have major environmental effects due to the low elasticity of energy demand, and the effect of taxes was estimated to *slow down* energy consumption and carbon emissions by 1%.[6] In addition to that, no systematic follow-up of those taxes was carried out (Vehmas 2005). However, there are some studies suggesting that even these taxes led to major carbon reductions in the long term (Tamminen et al. 2018, p. 27). These taxes had a major budgetary effect as their revenue was 700 million Finnish marks, which was about 1% of all tax revenue and 40% of budget deficits.[7]

The second phase of Finnish environmental taxation was between 1991 and 1994, when economic difficulties arising from the collapse of the Soviet Union led to the need to increase taxes, and carbon taxes were seen to be a suitable tool for that (Sairinen 2012, p. 428). In 1992 energy-intensive users got their first tax-subsidy, which only covered a small number of companies until 2012 (Tamminen et al. 2018, p. 9). Finnish energy taxation was changed again in the year 1994 when Finland abolished the electricity tax on other energy sources than nuclear and hydro and implemented a new primary energy sources tax, which was based 60% on the carbon intensity of the fuel and 40% of the energy content of the fuel and increased all carbon taxation.[8] This reform was stated to promote environmental viewpoints as taxing fuels was seen to reduce carbon emissions more than taxing the end results, namely electricity or heat.[9] However, electricity from hydro and nuclear power was included in the taxation due to fiscal reasons.[10] Nuclear power also had extra tax due to political discussion about building more nuclear power, which was a hot topic at the time of tax reform and caused some political crises due to some parties wanting to promote domestic energy sources (Sairinen 2012, p. 428). It is generally approved that Finnish energy taxes increased GDP due to decreasing import fuels (Barker et al. 2009, 187).

For imported electricity, the tax was set to correspond to the average tax burden on electricity in the Finnish markets.[11] The electricity tax was abolished in

2 HE 130/2002 vp Hallituksen esitys eduskunnalle laeiksi sähkön ja eräiden polttoaineiden valmisteverosta annetun lain ja nestemäisten polttoaineiden valmisteverosta annetun lain muuttamisesta, p. 6 [Government bill] (Fin.)

3 Laki polttoaineverosta annetun lain väliaikaisesta muuttamisesta 1119/1989. [Act on the Temporary Amendment of the Fuel Tax Act] (Fin.).

4 HE 237/1994 vp Hallituksen esitys eduskunnalle valmisteverotusta koskevaksi lainsäädännöksi, p. 5 [Government bill] (Fin.).

5 HE 122/1989 vp Hallituksen esitys Eduskunnalle laiksi polttoaineverosta annetun lain väliaikaisesta muuttamisesta, p. 1. [Government bill] (Fin.).

6 HE 122/1989 vp, p. 3.

7 Financial statement of Finland 1990.

8 HE 89/1993 vp Hallituksen esitys Eduskunnalle laiksi polttoaineverosta annetun lain muuttamisesta, p. 1. [Government bill] (Fin.).

9 HE 225/1996 vp Hallituksen esitys eduskunnalle energiaverotusta koskevan lainsäädännön uudistamiseksi, p. 4. [Government bill] (Fin.).

10 HE 89/1993 vp, p. 3.

11 HE 225/1996 vp, p. 4.

1986, and it was returned in 1993 (Linnakangas and Juanto 2016). This carbon tax component was even classified as an "environmental policy tax".[12] Energy contents were included in the taxation based on fiscal reasons. Otherwise, the tax changes would have led to unbearable tax revenue losses in the deepest modern recession in Finland in the '90s.[13]

When changing the structure of the taxation, the legislator directly mentioned that environmental viewpoints have recently been viewed *besides* fiscal goals of energy taxation and that in addition to fiscal goals of energy taxation, they might have some effect on *reducing the growth* of energy consumption and emissions.[14] A decade later, this viewpoint still persisted as environmental taxes were still seen as mainly fiscal, and their secondary role was to promote environmental goals.[15] In the 1990s, fuel taxes were about 10% of all tax revenue.[16] There were trade policy goals: domestic fuels, mainly wood and peat, were given significant tax advantages in order to promote their usage despite their emissions.[17]

However, the next phase of energy taxation began when Finland joined the European union (Sairinen 2012, p. 429). Previous changes did not last long due to Finland joining the European Union. There was a major excise tax reform in 1994 that was conducted in order to prepare the Finnish EU membership, and the new fuel tax law entered into force at the end of 1994.[18] At that time and after that, political tensions prevented changing harmonized EU energy taxation in a way that would take into account environmental viewpoints, for example, the carbon intensity of the fuel (Rocchi et al. 2014). At the same time, Finland opened electricity markets and became part of the Nordic energy market, which rase some competitiveness issues (Sairinen 2012, p. 430). Some Finnish coal- fired plants were closed due to taxation and competition from other Nordic countries with lower energy taxation (Vehmas et al. 1999).

At this point, Finland made a major environmental tax decision as it decided to keep taxing some fuels with national tax due to environmental reasons, even despite that they were outside the harmonized EU energy taxation (Linnakangas and Juanto 2016). However, the fiscal reasons were also present as fuel taxes were raised due to financial reasons as joining the EU required abolishing some taxes, like sugar and fat tax.[19] This was done by increasing both energy content and carbon taxes in a way that increased fuel tax revenue by almost 20% from previous years in a time when fuel taxes were about 10% of all tax revenue.[20] As Finnish energy tax levels exceed the minimum harmonization from the EU, there was no need to increase energy taxes due to the EU (Paukku 2021a). Fiscal reasons were later used when balancing competitiveness and fiscal reasons, as it was stated that the tax level would not be increased in the future if international competitiveness would require not increasing the levels.[21] It is important to note that based on recent studies, Finnish energy taxes *increased* competitiveness (Barker et al. 2009, 184). There was also some political pressure from the Green party, which was a significant factor in increasing the tax levels. (Sairinen 2012, p. 429) This is one implication of ad hoc changes in the energy taxation system in Finland (Vehmas 2005).

However, in the year 1994, there was one backlash with possible major consequences for emission reduction goals, as biofuels were included in the fuel taxation in a way that caused their energy contents to be taxed more heavily than their fossil counterparts. (Lampinen 2008) This was based on the idea that biofuels were and would be only used by mixing them with fossil fuels.[22] In the '80s and '90s, it was assumed that fossil fuel usage could only be lowered by reducing traffic and average car fuel consumption (Lampinen 2008).

At the end of the 90s, Finland was also one of the first countries to adopt the third stage of environmental policy, environmental tax reform changing the focus of the whole tax system (Sairinen 2012, p. 425). In the year 1996, the tax for gasoline was significantly increased by over 10% for fiscal reasons.[23] In 1997 energy tax system was reformed due to concerns related to the international competitiveness of environmental taxes (Linnakangas and Juanto 2016). In this change, the electricity tax was widely brought back in use, and all fuels used for electricity generation were left outside the

12 HE 237/1994 vp, p. 2.
13 HE 89/1993 vp, p. 3.
14 HE 89/1993 vp, p. 1.
15 HE 152/2010 vp Hallituksen esitys eduskunnalle laiksi uusiutuvilla energialähteillä tuotetun sähkön tuotantotuesta, p. 7. [Government bill] (Fin.).
16 HE 89/1993 vp, p. 2.
17 HE 89/1993 vp, p. 2-3.
18 HE 237/1994 vp, p. 1.
19 HE 237/1994 vp, p. 1.
20 HE 237/1994 vp, p. 30.
21 HE 225/1996 vp, p. 9.
22 HE 237/1994 vp, p. 27.
23 HE 65/1995 vp Hallituksen esitys eduskunnalle laiksi nestemäisten polttoaineiden valmisteverosta annetun lain liitteenä olevan verotaulukon muuttamisesta. [Government bill] (Fin.).

electricity taxation. In this reform, the carbon tax was increased, and the energy component of the tax was lowered.[24] This tax reform was carried out assuming that the Commission would soon propose an energy tax directive that would include a carbon tax.[25] This has not happened so far.

In this reform, Finland backed down on environmental taxes due to international competitiveness (Vehmas et al. 1999). It was stated that in most countries that were competing with Finland, the energy taxation level was significantly lower; they either had no carbon-based taxes or those taxes were refunded to the industry.[26] Although it was also known that carbon taxes themselves were not higher than in many other Nordic countries, due to their significantly lower carbon intensity of energy production, their effective tax burden was also significantly lower.[27]

Changing the taxation meant that carbon-intensive fuels got a significant advantage in energy production, which led to the weaker competitiveness of renewable energy sources.[28] It was stated that rising carbon taxes failed to increase renewable energy production, as the only commercially available energy was bioenergy, which was too expensive to use commercially, and due to this, the rising tax levels just led to a decrease in investment and increased electricity imports.[29]

The energy taxation was changed to be based on the user. The industry had a significantly lower electricity tax level than other consumers.[30] Now the carbon taxes were retained and doubled in heat production, but the energy tax component of fuels used in heat production was removed. In traffic fuels, the energy tax was also abolished, but the carbon tax was increased in a way that kept the total tax level the same.[31]

It was stated that this reform was likely to increase carbon emissions, but it was unavoidable unless other countries would adopt environmental-based energy taxation in the future.[32] Fiscal reasons were heavily present in this reform. Energy tax for other than industry users was increased in order to cover deficits from cuts in income taxes.[33] Some economic literature promotes this kind of action as it benefits the environment and general economic actions.

In the year 1998, there were some minor changes in energy taxation. It was noticed that the previous tax change made several renewable energy production methods have a competitive disadvantage, which was tried to correct by giving them new tax subsidies. It was stated that Finnish sustainable development goals required increased usage of renewable energy production and using less carbon- intensive fuels, like natural gas.[34] The main renewable energy production this tax reform promoted was wind power.[35] This tax subsidy was financed by increasing carbon taxes and electricity tax, and tax levels were increased even further to significantly increase tax revenue by 670 million Finnish marks.[36] This increase in revenue was 2% of all tax revenue in the year 1998.[37] There were no clear emission goals in this reform, only a statement that renewable energy competitiveness would increase, which would lower carbon emissions in the long term.[38] This reform succeeded at some level as wind power generation sevenfold in three years.[39] This year the fuel taxes for leisure and fishing boats were abolished due to EU legislation. Also, subsidizing the fishing industry was abolished.[40] Also, greenhouses used for farming got a new tax subsidy due to competitiveness reasons.[41]

The next environmental tax increase was made in 1999. At this time, the environmental taxes were heavily raised in order to cut down labour taxes due to negotiation results of the state budget, in which some parties threatened to walk away if environmental taxes would not be increased (Sairinen 2012, p. 430-431). This was done by increasing carbon taxes on those fuels which were still within carbon taxation and increasing electricity taxes by the same proportion. Some exceptions to this were peat, which had a small increase in tax level but

24 HE 225/1996 vp, p. 1.
25 HE 225/1996 vp, p. 6.
26 HE 225/1996 vp, p. 7.
27 HE 225/1996 vp, p. 7.
28 HE 194/1997 vp, p. 1-2.
29 HE 225/1996 vp, p. 8.
30 HE 225/1996 vp, p. 10-12.
31 HE 225/1996 vp, p. 11-12.
32 HE 225/1996 vp, p. 15.
33 HE 225/1996 vp, p. 9.
34 HE 194/1997 vp, p. 1-3.
35 HE 131/2001 vp Hallituksen esitys eduskunnalle sähkön ja eräiden polttoaineiden valmisteverosta annetun lain 28 §:n muuttamisesta, p. 1. [Government bill] (Fin.).
36 HE 194/1997 vp, p. 1.
37 Financial statement of Finland 1998.
38 HE 194/1997 vp, p. 6.
39 HE 131/2001 vp, p. 3.
40 HE 84/1997 vp Hallituksen esitys eduskunnalle laiksi nestemäisten polttoaineiden valmisteverosta annetun lain muuttamisesta. [Government bill] (Fin.).
41 HE 206/1998 vp Hallituksen esitys eduskunnalle laiksi nestemäisten polttoaineiden valmisteverosta annetun lain muuttamisesta. [Government bill] (Fin.).

still kept its tax subsidy, and traffic fuels, which faced no tax increase. In addition to these, wind power and district heating got new tax subsidies.[42] In this reform, Finland did also present a new tax subsidy to energy-intensive industries to increase their competitiveness despite increasing energy taxes.

One significant factor affecting energy policy in Finland is that the economy is quite energy-intensive, which affects the tax burden of fossil fuels (Vehmas et al. 1999). The 1999 change was estimated to increase the production of renewable energy in the long term.[43] The next minor change in the year 2002 was only technical due to a currency change. In the year 2000, there was also an extension of tax subsidy for small-scale renewable energy production.[44]

New subsidies for renewable energy production were introduced in 2002. The tax increase was done in order to meet national and EU climate goals.[45] Another need for change was to include waste incineration and biomass usage for tax subsidies on energy production methods as they were seen as beneficial for climate goals.[46] In this change, it was clearly stated that carbon pricing was not anymore the primary tool for emission reduction, as tax subsidies replaced them as a primary tool.[47]

3.1.2 Energy taxation in EU ETS era 2005–2011

The next major reform was made in the year 2005 due to the new energy tax directive[48] and the new EU emission trading scheme.[49] When EU ETS entered force, the whole focus of the energy tax system changed (Vehmas 2005). The EU ETS threatened to significantly reduce the usage of high carbon- content fuels, especially peat, which would increase the burning of wood in the short term, which would have had significant negative impacts on the important forest and paper industry in Finland. In order to keep peat competitive despite the EU ETS, all carbon and energy taxes for peat were removed.[50] The EU ETS had been a common justification to give subsidies to fossil fuels in Finland, as the regulator could say that due to the ETS, the emissions would not rise, even if taxes were cut (Paukku 2021b). It was stated that this tax subsidy would not significantly affect carbon emissions, but it would increase the security of energy supply and the use of nationally produced fuels.[51] However, this estimation proved to be extremely wrong, as the current usage of peat covers 10% of Finnish carbon emissions (Soimakallio et al. 2021). The political importance of peat was notable, as this was the first energy tax change since 1989, when energy tax revenue actually decreased.

As the EU ETS came into force in 2005, a new energy tax reform was needed due to the EU ETS succeeding in its goal: putting a price on carbon emissions.[52] In the Nordic electricity market, the price was mostly defined by Finnish and Danish coal power plants, which became significantly more expensive due to the ETS. This led to windfall profits for hydro and nuclear power. In this reform, electricity taxes were cut to half in order to maintain industry competitiveness.[53] In the year 2006, agriculture received a new energy tax subsidy just to subsidize agriculture.[54]

The next tax raise was done in 2007. Energy taxes were raised by almost 10%. The raise was focused on energy products outside the EU ETS. Biofuels got an energy tax exemption in this raise.[55] This was the first tax change where it was stated that slowing down climate change was an extremely important policy goal. In the year 2009, the energy tax subsidy for agriculture was increased again to subsidize agriculture due to its low profitability.[56]

The next major reforms were carried out in the year 2010. This reform was based on national and EU climate goals.[57] In this reform, fuel taxation was changed to be

42 HE 55/1998 vp Hallituksen esitys eduskunnalle energiaverotusta koskevan lainsäädännön muuttamisesta, p. 2-4. [Government bill] (Fin.).
43 HE 55/1998 vp, p- 5-8.
44 HE 131/2001 vp, p. 2.
45 HE 130/2002 vp, p. 7.
46 HE 130/2002 vp, p. 8-10.
47 HE 130/2002 vp, p. 11.
48 Council Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity OJ L 283, 31.10.2003.
49 HE 37/2005 vp Hallituksen esitys eduskunnalle laiksi sähkön ja eräiden polttoaineiden valmisteverosta annetun lain muuttamisesta, p. 1-3. [Government bill] (Fin.).
50 HE 37/2005 vp, p. 2-4.
51 HE 37/2005 vp, p. 4.
52 HE 120/2006 vp, p. 1-4.
53 HE 120/2006 vp, p. 5-6.
54 HE 56/2006 vp Hallituksen esitys eduskunnalle laiksi maataloudessa käytettyjen eräiden energiatuotteiden valmisteveron palautuksesta ja laiksi nestemäisten polttoaineiden valmisteverosta annetun lain 10 a §:n muuttamisesta, p. 7-8. [Government bill] (Fin.).
55 HE 61/2007 vp, p. 15-16.
56 HE 185/2008 vp, p. 3.
57 HE 152/2010 vp, p. 4.

even more carbon-based, as almost all other taxes were abolished in order to make fuel taxation based almost completely on carbon and energy content.[58] In addition to this, the carbon component of the total tax was increased in order to promote using less carbon-intensive fuels. It was also stated that different renewable energy subsidies were required in order to promote renewable energy production.[59] It was argued that energy taxes were suitable tools for achieving several environmental policy goals: reducing greenhouse gas emissions, increasing renewable energy production outside ETS, and increasing energy efficiency.[60] After this tax reform, the carbon taxes for traffic fuels were raised from 20 €/t to 50 €/t, although other taxes were abolished, and the tax level remained almost the same for some fuels.[61] In heating fuels, the carbon taxes were raised from 20 €/t to 30 €/t.[62] After this, tax levels for different fuels differed, which is an important political decision not based on economic recommendations.

At the same time, biogas and wind power received more subsidies.[63] Agriculture was left outside of these tax increases, and agriculture even received more tax subsidies to compensate for rising energy prices.[64] Peat was also left completely outside carbon taxation in this reform, although its taxes were increased by other means. In this reform, the EU ETS increased carbon pricing in combined heat and electricity production, which received new tax subsidies and a 50% decrease in carbon taxes in order to keep it competitive, which made coal more competitive.[65] One key policy point here was that the *environmental impact of carbon taxes was not assessed in numbers, as it was stated that carbon usage depends too much on the market prices of fossil fuels.*[66] This is one major policy implication that carbon taxes are not treated as *Pigouvian* taxes but more like consumption taxes that are used to raise the commodity price in order to cut down usage.

In addition to this, feed-in-tariffs for renewable energy production were established due to RES- directive[67] and national climate goals.[68] Additionally, small-scale energy production received tax advantages.[69] One goal of this reform was to promote wind power so that it would have a capacity of 2000 MW in the year 2020.[70]

This was the first reform with clearly and numerically stated environmental goals, but these goals were related to increasing renewable energy production, not cutting down carbon emissions.[71] The trend in the 2010s was that decrease in the carbon intensity of GDP offset the economic growth, which meant that raises in energy taxes or increases in renewable energy production would actually lower emissions. (Parry and Wingender 2021, p. 8) It was stated that carbon emissions would be lowered as renewable energy production would be increased.[72] This was a common view for energy policy at this time (Sokka et al. 2016). The EU had partially abolished the polluter pays principle a few years earlier and adopted a subsidy policy for renewable energy promotion (Paukku 2020a). The polluter pays principle was heavily present in EU ETS. At this time, the subsidy system was not very expensive, as it was tied to the price of electricity, which was high at the time.[73] However, as electricity prices came significantly down a few years later, the subsidy system had to be shutdown.[74]

3.1.3 The modern era in energy taxation - post-2011

In 2011 these carbon taxes were increased again in order to cover fiscal deficits and increase biofuel.[75] In addition to this, tax subsidies for energy-intensive industries were increased.[76] This tax increase was done in three ways: 1) a 5% total tax increase done by increasing the carbon component of the tax, 2) removing agricultural tax

58 HE 147/2010 vp, p. 1.
59 HE 152/2010 vp, p. 7.
60 HE 147/2010 vp, p. 22.
61 HE 147/2010 vp, p. 24.
62 HE 147/2010 vp, p. 29.
63 HE 152/2010 vp, p. 6-7.
64 HE 147/2010 vp, p. 33-34, 43.
65 HE 147/2010 vp, p. 29-30.
66 HE 147/2010 vp, p. 42.
67 Directive of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (Text with EEA relevance.) PE/48/2018/REV/1 OJ L 328, 21.12.2018, p. 82–209.
68 HE 152/2010 vp, p. 1.
69 HE 147/2010 vp, p. 32.
70 HE 152/2010 vp, p. 4.
71 HE 152/2010 vp, p. 19-20.
72 HE 152/2010 vp, p. 30-31.
73 HE 152/2010 vp, p. 7.
74 HE 15/2015 vp Hallituksen esitys eduskunnalle laiksi uusiutuvilla energialähteillä tuotetun sähkön tuotantotuesta annetun lain muuttamisesta, p. 2-3. [Government bill] (Fin.).
75 HE 53/2011 vp Hallituksen esitys eduskunnalle energiaverotusta koskevan lainsäädännön muuttamiseksi, p. 5-7. [Government bill] (Fin.).
76 HE 129/2011 vp Hallituksen esitys eduskunnalle laiksi sähkön ja eräiden polttoaineiden valmisteverosta annetun lain 8 a §:n muuttamisesta, p. 1. [Government bill] (Fin.).

refund from the carbon component of the fuel and 3) moderately increasing taxation of peat. One interesting point was that in the year 2010, the energy taxes were increased in order to compensate for removing the KELA payment paid by employers, and now the tax subsidies were increased in order to compensate for the increase in energy taxation, which effectively meant that the removal of this payment was transferred from companies to private persons.[77]

In 2013, there was another small energy tax increase. The carbon tax component for some heating fuels was increased, and the energy tax component was reduced so that the tax level remained the same, and the carbon price was raised from 30 €/t to 35 €/t.[78] The change was stated to slightly increase the competitiveness of renewable energy, as peat was not included in a tax increase, and the majority of fuels included in this reform were mostly consumed in the ETS sector.[79]

In 2013, the government planned to implement a new power installation tax. This tax would have been used for renewable energy and nuclear power installations as they got windfall profits from electricity prices increased by the EU ETS, as the prices for electricity were based on the most expensive energy production method.[80] However, this tax was not ever used due to difficulties with the EU state aid regulation (Linnakangas and Juanto 2016, p. 162).

In 2014, there was another small tax increase, taxation of carbon component in traffic fuels was increased from 50 €/t to 58 €/t. Electricity tax for consumers was also increased. This was the first reform where it was noticed that an increase in energy taxation hits the lower income brackets heavier. In the same year, new tax subsidies were also given for data centres. This was the first time when the legislator noted that the connection between energy usage and carbon emissions might be broken. This change in paradigm could later challenge the role of electricity taxation as an environmental tax.

Tax levels were increased again in 2015 the tax levels were increased. This increase was done in order to cover the fiscal deficits of the state. In this reform, the energy component of traffic fuels was increased instead of the carbon component in order to "keep the tax base broader", but it was still argued that there are positive environmental impacts due to an increase in saving energy. In heating fuels, the carbon component was increased from 35 €/t to 44 €/t, but in first-generation biofuels, the carbon tax was still half of the other fuels with the same carbon intensity, and for the second- generation biofuels, it was still absent due to carbon being released anyways in case of materials for these biofuels. In addition to those, the tax on peat was decreased again in order to promote its and wood's competitiveness against coal in combined heat and electricity generation.[81] This tax cut was even increased later in the same year to promote the competitiveness of peat even more.[82] Before the year had ended, one more tax cut was decided in order to promote burning peat and renewable biomass.[83] In these tax cuts, the tax was cut from 5,9 €/MWh to 1,9 €/MWh. In 2015 there were other changes. The first of them was increasing the power limit of taxable electricity generation from 50 kVA to 100 kVA for small-scale electricity production.[84] The other change was removing tax subsidies that were given to LPG and taxing it as other fossil fuels.[85]

In 2016 energy taxes were raised again. This time carbon tax for heating fuels rose from 44 €/t to 54 €/t. Other goals were to increase the competitiveness of peat and renewable fuels.[86] The energy taxes were raised again in 2017, this time for both traffic fuels and heating fuels, this time by increasing the carbon tax from 58 €/t to 62 €/t and the energy tax by 2%. Heating fuel taxes were increased from 54 €/t to 58 €/t, and energy tax by 7,5%. In this reform, energy taxes were again seen as

77 HE 129/2011 vp, p. 2-4.

78 HE 91/2012 vp Hallituksen esitys eduskunnalle laeiksi nestemäisten polttoaineiden valmisteverosta annetun lain liitteen sekä sähkön ja eräiden polttoaineiden valmisteverosta annetun lain muuttamisesta, p. 1. [Government bill] (Fin.).

79 HE 91/2012 vp, p. 3.

80 HE 140/2013 vp Hallituksen esitys eduskunnalle voimalaitosverolaiksi sekä laeiksi elinkeinotulon verottamisesta annetun lain 16 §:n muuttamisesta ja verotilistä annetun lain 1 §:n muuttamisesta, p. 4. [Government bill] (Fin.).

81 HE 178/2013 vp, p. 11-13, 19.

82 HE234/2014 vp Hallituksen esitys eduskunnalle energiaverotusta koskevan lainsäädännön muuttamiseksi annetun hallituksen esityksen (HE 128/2014 vp) täydentämisestä. [Government bill] (Fin.).

83 HE 359/2014 vp Hallituksen esitys eduskunnalle laiksi sähkön ja eräiden polttoaineiden valmisteverosta annetun lain liitteen muuttamisesta. [Government bill] (Fin.).

84 HE 349/2014 vp Hallituksen esitys eduskunnalle laiksi sähkön ja eräiden polttoaineiden valmisteverosta annetun lain muuttamisesta, p. 7-8. [Government bill] (Fin.).

85 HE 350/2014 vp Hallituksen esitys eduskunnalle laiksi nestemäisten polttoaineiden valmisteverosta annetun lain muuttamisesta. [Government bill] (Fin.).

86 HE 34/2015 vp Hallituksen esitys eduskunnalle energiaverotusta koskevan lainsäädännön muuttamiseksi, p. 6-7. [Government bill] (Fin.).

consumption taxes, as it was stated that tax increases would be reassessed if the market price of oil rose too high.[87] In 2018, the taxes for heating fuels were raised, the carbon tax was raised from 58 €/t to 62 €/t, which was now the same as in traffic fuels, and energy taxes were raised by 4,5%.[88] This reform was again stated to increase the competitive position of peat and renewable energy production.[89] In 2018 there was a small change in the calculation basis of emissions with no tax effect.[90]

Fuel taxes were raised again in 2020 by increasing energy tax by 3% and carbon tax from 62 €/t to 77 €/t. Now it was estimated that due to the bio-obligation in traffic fuels, tax increases would not increase the competitiveness of renewable fuels but only reduce fuel consumption.[91] In 2021 tax subsidies for paraffin diesel were removed, as they were no longer required to achieve environmental goals in particle emissions.[92] Tax levels were much lower than required to meet 2030 climate goals, which might even need to be 125€/t by 2030 (Parry and Wingender 2021, p. 4).

In 2021 there was a major reform in energy taxation. There were three major changes: 1) increasing energy taxes, 2) decreasing electricity tax to EU minimum and 3) removing subsidies for energy- intensive industries. The goal of this reform was to increase carbon pricing and meet climate goals. However, it was also mentioned that one goal of these changes was to increase tax revenue. It is known that carbon pricing is currently the most effective strategy for achieving climate goals in the EU and Finland (Parry and Wingender 2021, p. 4).

One major change was that it was finally, after 25 years of tax subsidies, taxation was increased in order to cut down the usage of peat.[93] However, peat still retained a major tax advantage. This reform aimed to achieve climate goals, and the most effective reform was estimated to be removing subsidies for energy-intensive industries. This reform was stated to increase the electrification of the industries and, due to that, reduce the usage of fossil fuels. This reform was later adjusted by creating a tax floor to peat taxation in order to prevent its price from dropping too low if the EU ETS price dropped under 21,20 €/t. However, as the EU ETS and the tax increase would hit the peat industry hard, another tax subsidy was given to peat by making the usage of peat tax-free in small installations under 10 000 MWh during the years 2022– 2026 and usage in under 8000 MWh installations tax-free in years 2027–2029. The goal of this reform was to split the usage of peat before 2030.[94]

3.2 Some remarks on trends in carbon taxation

3.2.1 Taxation of traffic fuels

In Finland, energy taxation has, in recent years, focused on sectors outside the EU ETS, especially the traffic sector has been a focal point of taxation (Niskakangas 2011, p. 50). Taxing traffic fuels has a limited environmental impact as their demand is quite inelastic, and it has been stated that taxation is not an effective way to decrease carbon emissions in traffic (Paukku 2020c). It has also been recognized in policymaking that taxing traffic fuels is not likely to significantly reduce their usage due to a lack of feasible alternatives.[95] This is also controversial to the idea that emissions should be reduced where they can be reduced in the most cost-effective way (Paukku 2021b). In the Finnish tax policy, this is stated to be due to that emission reduction costs in traffic are higher than in other sectors, and because of this, carbon taxes should be higher.[96] It could also be argued that taxing traffic is important for national budgets and exceeding the costs that traffic causes (Niskakangas 2011, p. 125).

87 HE 136/2016 vp Hallituksen esitys eduskunnalle laeiksi nestemäisten polttoaineiden valmisteverosta sekä sähkön ja eräiden polttoaineiden valmisteverosta annettujen lakien liitteiden muuttamisesta, p. 7-10. [Government bill] (Fin.).

88 HE 138/2017 vp Hallituksen esitys eduskunnalle laeiksi nestemäisten polttoaineiden valmisteverosta sekä sähkön ja eräiden polttoaineiden valmisteverosta annettujen lakien liitteiden muuttamisesta. p. 6. [Government bill] (Fin.).

89 HE 138/2017 vp, p. 9.

90 HE 191/2018 vp Hallituksen esitys eduskunnalle energiaverotusta koskevan lainsäädännön muuttamiseksi, p. 15-16. [Government bill] (Fin.).

91 HE 66/2019 vp Hallituksen esitys eduskunnalle laeiksi nestemäisten polttoaineiden valmisteverosta annetun lain liitteen ja valmisteverotuslain 5 §:n muuttamisesta, p. 10. [Government bill] (Fin.).

92 HE 144/2020 vp Hallituksen esitys eduskunnalle laiksi nestemäisten polttoaineiden valmisteverosta annetun lain liitteen muuttamisesta. [Government bill] (Fin.).

93 HE 167/2020 vp Hallituksen esitys eduskunnalle laeiksi energiaverotusta koskevan lainsäädännön muuttamisesta, p. 1, 3, 8. [Government bill] (Fin.).

94 HE 144/2021 vp Hallituksen esitys eduskunnalle laeiksi sähkön ja eräiden polttoaineiden valmisteverosta annetun lain sekä oma-aloitteisten verojen verotusmenettelystä annetun lain 11 §:n muuttamisesta, p. 8. [Government bill] (Fin.).

95 HE 66/2019 vp, p. 12.

96 HE 147/2010 vp, p. 24.

During this century, traffic taxation has focused even more on fuel taxes than taxes related to owning and using a car.[97] This had been stated to be an ineffective way to change fuel usage as it is often more effective to tax buying or owning a car based on the carbon intensity of car usage than taxing the usage of fuel (Paukku 2020c). However, from an administrative viewpoint, taxing fuel usage is a quite cost-effective way to reduce emissions from traffic, and it does not hit the lower-income brackets harder (Palanne and Sahari 2018, p. 3-5).

It is also known that as fuel taxes are consumption taxes, their revenue is relatively easy to adjust based on the fiscal needs of the state, and due to this, it has often been quickly adjusted based on the fiscal situation (Juanto et al. 2018, p. 3-5). The energy taxes were increased several times based on fiscal reasons, to cover deficits or to cut other taxes.[98] Energy taxes were sometimes used directly to cover tax cuts from other sectors as a rise in energy taxes.[99] It was also stated that fuel taxes had an environmental component, meaning carbon tax, and a fiscal component, meaning energy tax.[100]

3.2.2 Taxation of heating fuels

One interesting point in the Finnish carbon taxation has been the taxation of fuels used in district heating. One significant factor in the Finnish energy policy is the great need for heating due to the cold climate (Teir 1999, p. 303). There has been a long-term policy goal to subsidize this to keep it competitive when compared to local heating solutions.[101] These subsidies grew over time via changes in tax systems.[102] One reasoning for this was that district heating is more environmentally friendly as it combines electricity and heat production and thus reduces the loss of energy.[103] Later, when the EU ETS increased carbon pricing, the carbon taxes for combined heat and electricity production were cut by 50% to keep these sources of energy competitive.[104] This tax advantage was later assessed in 2016, but the tax subsidies were kept in order to promote district heating due to its assessed positive environmental impacts.[105] In 2019, the taxation of these fuels was changed in order to promote carbon steering. In this change, all energy taxes were removed, but the previously halved carbon tax was now carried out fully.[106] In 2021, another tax subsidy was removed from district heating, as the previously used calculation rule for fuel usage, which gave district heating tax advantages, was removed.[107]

3.2.3 Taxation of peat

Another interesting point has been the tax advantages given to peat. Currently, peat usage is responsible for 10% of Finnish carbon emissions, and it is as harmful as using coal (Soimakallio et al. 2021, p. 3). Just 15 years ago, the tax advantages were reasoned with a claim that using peat would not significantly affect carbon emissions.[108] Trade and regional policy goals had led to promoting using peat due to lower tax levels.[109] Another goal has been to prevent burning wood in order to secure material supply for the paper and wood industries.[110] In addition to this, all subsidies for several wood product side streams were removed.[111] The same reasoning was used in the 2010s when pressure for increasing carbon taxation for peat increased.[112]

The competitiveness of peat-generated heat and electricity has been improved in several reforms.[113] During the 90s, the tax level of peat was only $1/6^{th}$ of the tax that other fuels with similar carbon intensity had.[114] At the beginning of the century, the tax level was raised to $¼^{th}$ of the fuels with the same carbon intensity.[115] Only in the 2010s was it recognized and stated that peat is as harmful to the climate as fossil fuels, and it should be taxed similarly to fossil fuels.[116]

Later the tax advantages given to peat were stated to be due to it being a domestic fuel and mainly used

97 HE 61/2007 vp, p. 15.
98 HE 61/2007 vp, p. 2-3; HE 225/1996 vp, p. 9.
99 HE 61/2007 vp, p. 29.
100 HE 61/2007 vp, p. 2.
101 HE 225/1996 vp, p. 14.
102 HE 55/1998 vp, p. 2-3.
103 HE 37/2005 vp, p. 4.
104 HE 147/2010 vp, p. 30.
105 HE 136/2016 vp, p. 9.
106 HE 191/2018 vp, p. 17-19.
107 HE 167/2020 vp, p. 5.
108 HE 37/2005 vp, p. 4.
109 HE 89/1993 vp, p. 2-3.
110 HE 37/2005 vp, p. 2-3.
111 HE 120/2006 vp, p. 1.
112 HE 53/2011 vp, p. 4-5.
113 HE 225/1996 vp, p. 14.
114 HE 130/2002 vp, p. 1-2.
115 HE 130/2002 vp, p. 3.
116 HE 53/2011 vp, p. 4-5.

Table 1: Fuel taxes and their revenue in Finland

Fuel	Estimated revenue, M€	% of all budget revenue	Carbon tax % of total tax	Estimated carbon tax revenue	% of all budget revenue, carbon tax
Petrol	1298	2,2%	23%	300	0,5%
Diesel	1462	2,5%	42%	607	1,0%
EU ETS	450	0,8%	100%	450	0,8%

for CHP.[117] Later advantages given to peat were reasoned with it being a nationally produced fuel, which increased the security of the energy supply.[118] This reasoning was reused in the 2010s.[119] The EU energy tax directive did not require taxing the usage of peat for heat production.[120] Subsidies for peat were increased even higher in the year 2006 when all energy taxes for peat were abolished in order to protect it from the EU ETS putting a price on carbon.[121] Finland has an earlier history of focusing energy taxes on fuels and sectors that were not facing international competition, but peat was the exception in this protectionist policy (Vehmas et al. 1999).

Later on, in 2010, giving tax advantages for peat were reasoned by encouraging investments for district heating that could burn biomass, which could later make an easy transition to renewable energy usage.[122] In 2011 taxes for peat were increased in order to promote burning wood and decrease carbon emissions. It was stated that peat needed some tax advantages due to its significance to regional economies.[123] In 2014 the energy tax for peat was cut down as its usage decreased while using coal increased. It was even stated that burning more peat would reduce carbon emissions as more renewable biomass would be burned with it instead of burning coal.[124] These tax advantages were increased even more in the same year in order to promote the. [125] Later on, the carbon taxes for other heating fuels were increased in order to promote the competitiveness of peat and renewable fuels.[126]

In 2017, the same reasoning to decrease the usage of coal was used again in order to not increase the taxation of peat.[127] In 2019, these taxes were increased as tax increases on other fuels made it possible to raise taxes and keep peat competitive.[128] In 2019, one goal of the government program was to cut the use of peat in energy production down by 50% before 2030.[129] It was speculated whether these additional policies to reduce the usage of peat and coal were necessary due to the effectiveness of the EU ETS (Paukku 2021b). In 2021, the energy tax on peat was raised in order to reduce the usage of peat, and future tax increases were conditional on whether the burning of wood would increase, as the supply for paper and wood industries needed to be ensured.[130]

3.2.4 Subsidy system

Finland had suffered from decreased energy production due to increased carbon taxation.[131] This has later been taken into account, and there have been several production subsidy systems for renewable energy, which has led to increased renewable energy production in the 2010s (Paukku 2021a). The first major energy subsidies were granted in 1997 for small-scale energy production, meaning bioenergy and the first wind power installations in Finland for all 20 of them.[132] The subsidies were sig-

117 HE 131/2001 vp, p. 2-4.
118 HE 37/2005 vp, p. 4.
119 HE 53/2011 vp, p. 4-5.
120 HE 61/2007 vp, p. 11.
121 HE 37/2005 vp, p. 1-3.
122 HE 147/2010 vp, p. 41-42.
123 HE 53/2011 vp, p. 7.
124 HE 128/2014 vp Hallituksen esitys eduskunnalle energiaverotusta koskevan lainsäädännön muuttamiseksi, p. 12-13, 19. [Government bill] (Fin.).
125 HE234/2014 vp.
126 HE 34/2015 vp, p. 6-7.
127 HE 136/2016 vp, p. 9.
128 HE 191/2018 vp, p. 17.
129 Programme of Prime Minister Sanna Marin's Government 10 December 2019. Inclusive and competent Finland: a socially, economically and ecologically sustainable society. Publications of the Finnish Government, 37.
130 HE 167/2020 vp, p. 3.
131 HE 225/1996 vp, p. 8.
132 HE 225/1996 vp, p. 10-11.

nificantly increased in the year 2003.[133] However, this system has started to turn from production subsidies to investment subsidies for new energy technologies.[134] Operating subsidies have been necessary to promote several energy technologies in Finland, especially wind power (Paukku and Similä 2020). In the 2010s, the feed-in-tariff system was established in order to increase renewable energy production and meet 20-20-20-goals.[135]

The EU ETS led to several tax subsidies in Finland as major cost rises for the industry were to be avoided. The first subsidy was tax exemptions given to peat.[136] The second was significantly cutting down electricity taxes when electricity costs were rising in the Nordic energy markets due to the EU ETS.[137] In 2011, tax advantages for energy-intensive industries were significantly increased due to the EU ETS making electricity more expensive.[138] In 2012, it was clearly stated that states should avoid overlapping actions with the EU ETS.[139] In the next year, energy taxation was focused more on the ETS sector than other sectors.[140] The EU ETS has been fiscally quite effective in Finland as it is estimated to provide a revenue of 450 M€ in the year 2022, which is 0,8% of all budgetary income in Finland.[141] On the other hand, fuel taxes are still significantly higher[142], as shown in Table 1 above.

It has to be noted that a portion of the carbon tax is actually lower as biofuels without carbon taxes are counted into the total estimated revenue, thus making the carbon tax revenue actually lower. However, as the portion of these biofuels is still relatively low, some estimated carbon tax revenue can be made.

4 Conclusions

There first research question in this study was: How has Finland solved the economic and policy obstacles in carbon pricing??" The second research question was: " How have fiscal and environmental motivations affected Finnish carbon pricing legislation?" These research questions are best answered individually. The traditional *Pigouvian* approach to environmental taxes has been that the polluter should pay the cost of pollution in order to reduce pollution. This approach is the foundation of several environmental policies, but there are several obstacles in order to creating effective carbon taxation.

If it is not possible to put a price on carbon, it can be asked whether it is possible to follow another traditional environmental policy principle: *the polluter pays*. In the EU, the principle lost its key role in the environment at the beginning of the 21st century as several other environmental policy principles were also used, and renewable energy subsidies increased their significance. Finland was one of the first countries to test environmental taxes, which indeed led to revealing several possible

problems in environmental tax policies (Sairinen 2012). In Finland, at the beginning of the '90s, there was an attempt to implement the polluter pays principle as carbon taxation. However, international competitiveness issues, lack of electricity production, and compatibility issues with the EU state aid law led to partially abolishing this policy. After this, carbon pricing was watered down with several exceptions and tax subsidies for energy products that had important policy aspects behind them. Especially energy-intensive industries, peat and agriculture, received different tax subsidies for various policy reasons.

After this, electricity taxation did not include any carbon taxes but only taxes based on electricity consumption. There were some attempts to reason this with positive effects of energy saving, but in the 2010s, those attempts seemed much weaker as renewable energy production was subsidized rapidly and electrification was seen as a way to solve the climate crisis, and electricity taxation for the industry was cut to a minimum. This is not due to the successful Finnish environmental policy but the success of the EU ETS, which Finland has tried to prevent pricing carbon effectively. When the EU ETS was implemented, Finland adopted many tax subsidies in order to prevent energy prices from rising for industries. When the ETS price finally rose in the late 2010s, the usage of peat was protected with new tax subsidies in order to ensure an easier transition for peat producers.

In the 2010s, there was a change in paradigm, as the increase in energy usage was not eventually seen to lead to an increase in GHG emissions as energy production was becoming greener. From that on, the goal of carbon

133 HE 130/2002 vp, p. 6.
134 Programme of Prime Minister Sanna Marin's Government 10 December 2019.
135 HE 152/2010 vp, p. 1.
136 HE 37/2005 vp, p. 3-4.
137 HE 120/2006 vp, p. 5-6.
138 HE 129/2011 vp, p. 3-4.
139 HE 91/2012 vp, p. 4.
140 HE 110/2013 vp, p. 13.
141 National budget of Finland 2022, chapter 12.32.99.
142 National budget of Finland 2022, chapter 11.08.07; Laki nestemäisten polttoaineiden valmisteverosta (1472/1994). [The Law on Excise Duty on Liquid Fuel] [Law] (Fin.).

Table 2: Energy tax reforms in Finland

Year	Government bill	Goal	Significant changes	Effect on total tax revenue	Estimated environmental effect
1989	HE 122/1989 vp	Environmental goals, slowing down emission growth.	Introducing fuel tax.	Significant tax revenue increase.	Reducing fuel usage growth by 1%.
1994	HE 89/1993 vp	Environmental goals, slowing down emission growth.	Introducing fuel tax based on the carbon content of the fuel.	A small increase in tax revenue.	Small environmental impact on the short term, possible long-term investment impact.
1995	HE 237/1994 vp	Adjusting the Finnish tax system to EU membership.	Continuing national taxes on some energy products.	Significant increase in energy taxes, compensating abolishment of some taxes.	Not estimated.
1996	HE 65/1995 vp	Increasing tax revenue.	Increasing the gasoline tax.	Significant revenue increase.	Not estimated.
1997	HE 225/1996 vp	Decreasing the energy costs of industry and increasing competitiveness.	Abolishing carbon taxes for electricity production, introducing electricity tax.	Significant increase in tax revenue.	Increase in carbon emissions. The increase was not estimated to be significant.
1998	HE 194/1997 vp	Subsidy renewable energy and energy with lower carbon intensity.	Tax subsidy for renewable energy production.	Significant increase in tax revenue despite new tax subsidies.	Increased competitiveness of renewable energy production and natural gas. Possible long-term reduction in carbon emissions.
1998	HE 84/1997 vp	Increasing the competitiveness of the fishing industry.	Abolishing fuel taxes for fishing boats.	Small loss of tax revenue.	Only small negative environmental impact.
1998	HE 206/1998 vp	Increasing the competitiveness of greenhouse farming.	New tax subsidy for greenhouse farming.	Small loss of tax revenue.	Not estimated.
1999	HE 55/1998 vp	Increasing energy taxes in order to finance cutting down revenue taxes.	Increase in all tax levels. New tax subsidies for district heating and wind power. New tax subsidies for the energy-intensive industry.	Significant increase in tax revenue.	Possible long-term reduction in carbon emissions due to their increased competitiveness.
2003	HE 130/2002 vp	Increase energy tax subsidies to cover deficits.	Increased renewable energy tax subsidies. Significant tax level increases.	Significant increase in tax revenue.	Possible reduction in energy demand growth and carbon emission growth. Increase in renewable energy production.
2005	HE 37/2005 vp	Keep peat competitive despite EU ETS.	Removing all taxes from peat.	Small loss of tax revenue.	A small increase in carbon emissions. (Disputed at the time, peat emissions are extremely significant in the 2020s).
2006	HE 56/2006 vp	Subsidizing agriculture.	New energy tax subsidy for agriculture.	Small loss of tax revenue.	Small negative environmental impact.
2006	HE 120/2006 vp	Increasing industry competitiveness despite the EU ETS.	Decreasing industry energy taxes, removing tax subsidies from competitive renewable energy sources.	Medium-sized loss of tax revenue.	No significant environmental impact as the EU ETS had just increased electricity prices. Smaller decrease of carbon emissions than in the base scenario.
2007	HE 61/2007 vp	To raise tax levels.	Increasing tax levels.	Significant increase in tax revenue.	Small positive environmental impact as emissions would grow slower.
2009	HE 185/2008 vp	Subsidize agriculture.	Increase in tax subsidies.	Small loss of tax revenue.	The small negative environmental impact that was compensated in other sectors.
2010	HE 147/2010 vp	Increasing energy taxation to be more carbon-based.	Abolishing base tax and taxing only energy and carbon contents.	Significant increase in tax revenue.	Significant greenhouse gas emission reduction in traffic and heating. No change in agriculture.
2010	HE 152/2010 vp	Promoting renewable energy production.	Starting new feed-in tariffs for renewable energy production.	Moderate costs to the state.	Possibility to achieve 20-20- 20 goals.
2011	HE 53/2011 vp	Increasing taxes, decreasing carbon emissions, and increasing the use of sustainable biofuels.	Taxes were increased, and tax subsidies from carbon components of tax were abolished. New tax subsidy for sustainable biofuels.	A moderate increase in tax revenue.	Decrease in carbon emissions.
2011	HE 129/2011 vp	Increasing the competitiveness of energy-intensive industries.	Increasing tax subsidies by making more industries eligible for aid.	Moderate costs to the state.	No estimated increase in carbon emissions as most of the subsidy receivers were already within EU ETS.
2012	HE 26/2012 vp	Making biofuel tax subsidies compatible with the EU state aid regulation	Taking account life-cycle emissions in carbon taxation.	No effect.	No effect.
2013	HE 91/2012 vp	Increasing the significance of carbon components in energy taxation.	Increasing carbon tax component and decreasing energy tax component.	Small loss of tax revenue due to tax subsidies.	Making carbon more costly and thus decreasing its usage in other than ETS sectors.
2014	HE 110/2013 vp	Increasing tax revenue.	Increasing taxes on traffic fuels and electricity.	A moderate increase in tax revenue.	Increasing competitiveness of biofuels and decrease in energy usage.
2013	HE 178/2013 vp	Increasing data centre competitiveness.	Making more industries eligible for electricity tax subsidies.	Small loss of tax revenue.	Increasing energy usage and a possible increase in carbon emissions if renewable energy capacity growth would not enough.
2015	HE 128/2014 vp	Increasing tax revenue, increasing peat and biomass usage in heating. Subsidize agriculture.	Increasing carbon taxes. Decreasing peat energy taxation. Removing mining industries from energy tax subsidies.	A small increase in tax revenue.	Increasing competitiveness of renewable energies and especially energy usage. Possible decrease in energy usage.
2015	HE234/2014 vp	Increasing peat competitiveness.	Increasing tax subsidy given to peat.	Small loss of tax revenue.	Estimated carbon emission reduction (disputed).
2015	HE 349/2014 vp	Promoting small-scale electricity production.	Leaving bigger installations outside the electricity taxation. Making the administrative process easier.	Very small loss of tax revenue. Possibly bigger losses in the future as small-scale production become more common.	A small increase in small- scale renewable energy production.
2015	HE 350/2014 vp	Removing tax subsidies from fossil fuels.	Removing tax advantages given to LPG.	A small increase in tax revenue.	No major environmental impact due to lack of alternatives.
2016	HE 359/2014 vp	Increasing peat competitiveness. (even more)	Increase tax subsidy given to peat.	Small loss of tax revenue.	Estimated carbon emission reduction (disputed).
2016	HE 34/2015 vp	Increasing tax revenue. Subsidize the mining industry.	Increasing carbon component of heating fuels. Giving mining industries eligibility for lower electricity taxes and electricity tax subsidies.	A moderate increase in tax revenue.	Increase in the competitiveness of biofuels. Increased carbon steering.
2017	HE 136/2016 vp	Covering deficits and financing tax cuts.	Increase in carbon and energy taxation.	A large increase in tax revenue.	Decrease in carbon emissions. Increase in the competitiveness of renewable energy.
2018	HE 138/2017 vp	Increasing tax revenue.	Increase in carbon and energy taxation.	A moderate increase in tax revenue.	Decrease in energy usage and carbon emissions. Increase in the competitiveness of renewable energy.
2019	HE 191/2018 vp	Making the whole system more compatible with EU state aid legislation. Increasing carbon steering in heating. Subsidizing agriculture. Increasing electricity storages.	Taking life-cycle emissions in carbon taxation into account. Taxing only the carbon contents of combined heating and electricity.	A small increase in tax revenue.	Minor carbon emission reductions in district heating.
2020	HE 66/2019 vp	Increasing tax revenue.	Increase in carbon and taxation on traffic fuels.	Major increase in tax revenue.	About 1,2 to 1,4% reduction in fuel usage from base scenario, meaning 0,7% decrease. Possibly promote electric cars.
2021	HE 144/2020 vp	Removing some environmental subsidies not related to GHG emissions	Removing tax subsidies from paraffin diesel.	Major increase in tax revenue.	About 0,2 to 0,9 reduction to fuel usage from base scenario, meaning 0,1 to 0,3 reduction in fuel usage.
2021	HE 167/2020 vp	Increasing competitiveness, increasing tax revenue and decreasing GHG emissions.	Removing tax subsidies from energy-intensive industries, decreasing industry electricity tax to EU minimum and increasing energy taxes on certain heating fuels.	A moderate increase in tax revenue.	Increase electrification in industry. Increase the competitiveness of renewable energy products. Decrease usage of fossil fuels.
2021	HE 144/2021 vp	Creating a price floor mechanism for peat due to taxation. Subsidizing peat usage in order to make the transition easier.	Price adjustments by taxation for peat if EU ETS price would be too low. Making usage of peat in small installations tax-free.	Small loss of tax revenue if ETS price would not lower.	A small increase in carbon emissions in the future compared to the base scenario. A small decrease in carbon emissions in the scenario where the EU ETS price drops.

tax increases has not been reducing GHG emissions or energy consumption but promoting renewable energy competitiveness. In addition to pricing carbon, Finland approached the climate crisis by promoting renewable energy usage with different subsidies. These subsidies included grants and tax subsidies. The goal of these subsidies had been to increase renewable energy generation and left carbon pricing for the EU ETS. In sectors outside carbon taxation, the carbon pricing between 1997 and the mid-2010s was mostly in the form of increased taxation in order to fulfil the financial needs of the state. In recent years, carbon taxation, other than in the ETS sector, has been increased in order to decrease carbon emissions and achieve climate goals. This was not a directly mentioned policy goal for nearly 15 years. Although climate goals were mentioned often in recent reforms, carbon taxes were not raised without also increasing energy taxes, as increasing tax revenue was also an important factor.

Another factor was that environmental taxes are also treated as consumption taxes in the Finnish energy policy, and other price factors and the total price of commodities were taken into account when planning tax increases. Market prices for commodities were taken into account when planning tax increases so that the prices would not go too high. Increasing these environmental taxes on fuels

used by consumers was not heavily based on increasing renewable energy production like in industry fuels, as there were no viable substitutes, for example, for traffic fuels at the time. Therefore the environmental impact was mostly based on a decrease in consumption. In recent years, instead of rising carbon taxation, also energy taxation has been increased in order to decrease consumption and increase tax revenue. In the late 2010s, it was mentioned that due to biofuel obligation, increasing carbon taxes would not increase renewable energy share in traffic fuels. Despite that, fuel taxes were increased.

Although these environmental taxes were mostly used in order to cover fiscal deficits, sometimes, these environmental/consumption taxes were increased to cut down labour taxes. This is one aspect recommended in economic literature, as it is possible to maximize carbon taxation benefits with these kinds of policies. Another interesting point has been that the increase in energy taxation mostly hit consumers, and tax cuts from industries have often been financed in order to raise carbon taxation for consumers. Only in the late 2010s the social effects of the energy tax increase were evaluated. There is some evidence that carbon taxes do not hit the lowest income bracket hardest, as middle-income brackets bear the largest burden of some energy taxes.

These carbon taxation results were aligned with previous policy studies about the Finnish energy policy. Industrial competitiveness in the '90s and agricultural focus in the 2000s was already known in previous studies (Salo 2014, p. 204-205). However, there were several new findings on how carbon taxation is viewed in the Finnish energy policy and what kind of results it has produced in Finland. In addition to this, the factors affecting Finnish carbon taxation were analyzed in recent studies. For international energy policy literature, this article provided new results on how carbon taxes can be implemented in order to reach certain policy goals. In addition to this, Finland has provided a case study on how industrial policy interests have watered down carbon taxation and prevented effective emission reductions. Another research result has been confirming the previous research results that emission reductions are politically much easier to achieve through the EU ETS than via carbon pricing, as putting a price on carbon after a political decision might be costly in terms of political capital.

References

Aarnio, Aulis. 2011. Luentoja lainopillisen tutkimuksen teoriasta. Helsingin yliopiston oikeustieteellinen tiedekunta.

Ackerman, Frank, and Stanton, Elizabeth A. 2012. "Climate Risks and Carbon Prices: Revising the Social Cost of Carbon." *Economics* 6(1).

Aichele, Rachel, and Felbermayr, Gabriel. 2015. "Kyoto and Carbon Leakage: An Empirical Analysis of the Carbon Content of Bilateral Trade." *The Review of Economics and Statistics* 97(1): 104-115.

Andersen, Mikael Skou. 2009. "Pricing of Carbon in Europe." In *Carbon-energy taxation: lessons from Europe*, edited by Andersen, Skou, Mikael, and Ekins, Paul. OUP Oxford, 2009.

Barker, T., Junankar, S., Pollitt, H., & Summerton, P. (2009). The effects of environmental tax reform on international competitiveness in the European Union: Modelling with E3ME. Carbon-energy taxation: Lessons from Europe, 147-214.

Baylis, Kathy, Fullerton, Don, and Karney, Daniel H. 2013. "Leakage, Welfare, and Cost-Effectiveness of Carbon Policy." *The American Economic Review* 103(3): 332-337.

Branger, Frédéric, and Quirion, Phillippe. 2014. "Would Border Carbon Adjustments Prevent Carbon Leakage and Heavy Industry Competitiveness Losses? Insights from a Meta-analysis of Recent Economic Studies." *Ecological Economics* 99: 29-39.

Chen, Y., Qu, F., Li, W., and Chen, M. 2019. "Volatility Spillover and Dynamic Correlation Between the Carbon Market and Energy Markets." *Journal of Business Economics and Management* 20(5): 979-999.

Chiu, Fan-Ping, Kuo, Hsiao-I., Chen, Chi-Chung, and Hsu, Chia-Sheng. 2015. "The energy price equivalence of carbon taxes and emissions trading—Theory and evidence." *Applied energy* 160: 164- 171.

COM(2001)547 – Communication Alternative fuels for road transportation and on a set of measures to promote the use of biofuels.

COM(2011) 169 final Proposal for a Council directive amending Directive 2003/96/EC restructuring the Community framework for the taxation of energy products and electricity.

Council Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity OJ L 283, 31.10.2003.

Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (Text with EEA relevance.) PE/48/2018/REV/1 OJ L 328, 21.12.2018.

Ermolieva, Tatiana, Ermoliev, Yyri, Fischer, Günther, Jonas, Matthias, Makowski, Marek, and Wagner, Fabian. 2010. "Carbon Emission Trading and Carbon Taxes Under Uncertainties." *Climatic Change* 103(1-2): 277-289.

European court of auditors. (2020). Special Report 18/2020: The EU's Emissions Trading System: free allocation of allowances needed better targeting.

Farsaei, Anahita, Syri, Sanna, Olkkonen, Ville, and Khosravi, Ali. 2020. "Unintended Consequences of National Climate Policy on International Electricity Markets—Case Finland's Ban on Coal-Fired Generation." *Energies* 13(8): 1930.

Feng, Zhen-Hua, Zou, Le-Le, Wei, Yi-Ming. 2011. "Carbon Price Volatility: Evidence from EU ETS." *Applied Energy* 88(3): 590-598.

Financial statement of Finland 1990.

Financial statement of Finland 1998.

Finnish Wind Power Association. Tuulivoimalla katettiin noin 10% Suomen sähkönkulutuksesta vuonna 2020. Tiedote 2.2.2021. Available < https://tuulivoimayhdistys.fi/ajankohtaista/tiedotteet/tuulivoimalla-katettiin-noin-10-suomen-sahkonkulutuksesta-vuonna-2020> Last access 17.12.2021.

Gerlagh, Reyer, and Kuik, Onno. 2014. "Spill or Leak? Carbon Leakage with International Technology Spillovers: A CGE Analysis." *Energy Economics* 45: 381-388.

Golosov, Mikhail, Hassler, John, Krusell, Per, and Tsyvinski, Aleh. 2014. "Optimal taxes on fossil fuel in general equilibrium." *Econometrica* 82(1): 41-88.

Gonand, Frédéric. 2015. "The Carbon Tax, Ageing and Pension Deficits." *Environmental Modeling & Assessment* 21(3): 307-322.

Harju, Jarkko, Hokkanen, Topi, Laukkanen, Marita, Ollikka, Kimmo, and Tamminen, Saara. 2016. Vuoden 2011 energiaverouudistuksen arviointia. Valtioneuvoston selvitys- ja tutkimustoiminnan julkaisusarja 2016:61.

HE 15/2015 vp Hallituksen esitys eduskunnalle laiksi uusiutuvilla energialähteillä tuotetun sähkön tuotantotuesta annetun lain muuttamisesta. [Government bill] (Fin.).HE 110/2013 vp Hallituksen esitys eduskunnalle energiaverotusta koskevan lainsäädännön muuttamiseksi. [Government bill] (Fin.).

HE 120/2006 vp Hallituksen esitys eduskunnalle laiksi sähkön ja eräiden polttoaineiden valmisteverosta annetun lain muuttamisesta. [Government bill] (Fin.).

HE 121/2009 vp Hallituksen esitys eduskunnalle laeiksi maataloudessa käytettyjen eräiden energiatuotteiden valmisteveron palautuksesta annetun lain muuttamisesta annetun lain voimaantulosäännöksen ja nestemäisten polttoaineiden valmisteverosta annetun lain 10 a:n muuttamisesta annetun lain voimaantulosäännöksen muuttamisesta. [Government bill] (Fin.).

HE 122/1989 vp Hallituksen esitys Eduskunnalle laiksi polttoaineverosta annetun lain väliaikaisesta muuttamisesta. [Government bill] (Fin.).

HE 128/2014 vp Hallituksen esitys eduskunnalle energiaverotusta koskevan lainsäädännön muuttamiseksi. [Government bill] (Fin.).

HE 129/2011 vp Hallituksen esitys eduskunnalle laiksi sähkön ja eräiden polttoaineiden valmisteverosta annetun lain 8 a §:n muuttamisesta. [Government bill] (Fin.).

HE 130/2002 vp Hallituksen esitys eduskunnalle laeiksi sähkön ja eräiden polttoaineiden valmisteverosta annetun lain ja nestemäisten polttoaineiden valmisteverosta annetun lain muuttamisesta. [Government bill] (Fin.).

HE 131/2001 vp Hallituksen esitys eduskunnalle sähkön ja eräiden polttoaineiden valmisteverosta annetun lain 28 §:n muuttamisesta. [Government bill] (Fin.).

HE 136/2016 vp Hallituksen esitys eduskunnalle laeiksi nestemäisten polttoaineiden valmisteverosta sekä sähkön ja eräiden polttoaineiden valmisteverosta annettujen lakien liitteiden muuttamisesta. [Government bill] (Fin.).

HE 138/2017 vp Hallituksen esitys eduskunnalle laeiksi nestemäisten polttoaineiden valmisteverosta sekä sähkön ja eräiden polttoaineiden valmisteverosta annettujen lakien liitteiden muuttamisesta. [Government bill] (Fin.).

HE 140/2013 vp Hallituksen esitys eduskunnalle voimalaitosverolaiksi sekä laeiksi elinkeinotulon verottamisesta annetun lain 16 §:n muuttamisesta ja verotilistä annetun lain 1 §:n muuttamisesta. [Government bill] (Fin.).

HE 144/2020 vp Hallituksen esitys eduskunnalle laiksi nestemäisten polttoaineiden valmisteverosta annetun lain liitteen muuttamisesta. [Government bill] (Fin.).

HE 144/2021 vp Hallituksen esitys eduskunnalle laeiksi sähkön ja eräiden polttoaineiden valmisteverosta annetun lain sekä omaaloitteisten verojen verotusmenettelystä annetun lain 11 §:n muuttamisesta. [Government bill] (Fin.).

HE 147/2010 vp Hallituksen esitys eduskunnalle energiaverotusta koskevan lainsäädännön muuttamiseksi. [Government bill] (Fin.).

HE 152/2010 vp Hallituksen esitys eduskunnalle laiksi uusiutuvilla energialähteillä tuotetun sähkön tuotantotuesta. [Government bill] (Fin.).

HE 167/2020 vp Hallituksen esitys eduskunnalle laeiksi energiaverotusta koskevan lainsäädännön muuttamisesta. [Government bill] (Fin.).

HE 178/2013 vp Hallituksen esitys eduskunnalle laiksi sähkön ja eräiden polttoaineiden valmisteverosta annetun lain 2 ja 4 §:n muuttamisesta. [Government bill] (Fin.).

HE234/2014 vp Hallituksen esitys eduskunnalle energiaverotusta koskevan lainsäädännön muuttamiseksi annetun hallituksen esityksen (HE 128/2014 vp) täydentämisestä. [Government bill] (Fin.).

HE 185/2008 vp Hallituksen esitys eduskunnalle laeiksi maataloudessa käytettyjen eräiden energiatuotteiden valmisteveron palautuksesta annetun lain ja nestemäisten polttoaineiden valmisteverosta annetun lain 10 a §:n muuttamisesta. [Government bill] (Fin.).

HE 191/2018 vp Hallituksen esitys eduskunnalle energiaverotusta koskevan lainsäädännön muuttamiseksi. [Government bill] (Fin.).
HE 194/1997 vp Hallituksen esitys eduskunnalle energiaverotusta koskevan lainsäädännön muuttamisesta. [Government bill] (Fin.).
HE 206/1998 vp Hallituksen esitys eduskunnalle laiksi nestemäisten polttoaineiden valmisteverosta annetun lain muuttamisesta. [Government bill] (Fin.).
HE 225/1996 vp Hallituksen esitys eduskunnalle energiaverotusta koskevan lainsäädännön uudistamiseksi. [Government bill] (Fin.).
HE 237/1994 vp Hallituksen esitys eduskunnalle valmisteverotusta koskevaksi lainsäädännöksi. [Government bill] (Fin.).
HE 26/2012 vp Hallituksen esitys eduskunnalle laiksi nestemäisten polttoaineiden valmisteverosta annetun lain 1 §:n muuttamisesta. [Government bill] (Fin.).
HE 34/2015 vp Hallituksen esitys eduskunnalle energiaverotusta koskevan lainsäädännön muuttamiseksi. [Government bill] (Fin.).
HE 349/2014 vp Hallituksen esitys eduskunnalle laiksi sähkön ja eräiden polttoaineiden valmisteverosta annetun lain muuttamisesta. [Government bill] (Fin.).
HE 350/2014 vp Hallituksen esitys eduskunnalle laiksi nestemäisten polttoaineiden valmisteverosta annetun lain muuttamisesta. [Government bill] (Fin.).
HE 359/2014 vp Hallituksen esitys eduskunnalle laiksi sähkön ja eräiden polttoaineiden valmisteverosta annetun lain liitteen muuttamisesta. [Government bill] (Fin.).
HE 37/2005 vp Hallituksen esitys eduskunnalle laiksi sähkön ja eräiden polttoaineiden valmisteverosta annetun lain muuttamisesta. [Government bill] (Fin.).
HE 53/2011 vp Hallituksen esitys eduskunnalle energiaverotusta koskevan lainsäädännön muuttamiseksi. [Government bill] (Fin.).
HE 55/1998 vp Hallituksen esitys eduskunnalle energiaverotusta koskevan lainsäädännön muuttamisesta. [Government bill] (Fin.).
HE 56/2006 vp Hallituksen esitys eduskunnalle laiksi maataloudessa käytettyjen eräiden energiatuotteiden valmisteveron palautuksesta ja laiksi nestemäisten polttoaineiden valmisteverosta annetun lain 10 a §:n muuttamisesta. [Government bill] (Fin.).
HE 56/2016 vp Hallituksen esitys eduskunnalle laeiksi eräiden valtion tukea koskevien Euroopan unionin säännösten soveltamisesta annetun lain, valmisteverotuslain, sähkön ja eräiden polttoaineiden valmisteverosta sekä verotustietojen julkisuudesta ja salassapidosta annetun lain 6 §:n muuttamisesta. [Government bill] (Fin).
HE 61/2007 vp Hallituksen esitys eduskunnalle laeiksi nestemäisten polttoaineiden valmisteverosta sekä sähkön ja eräiden polttoaineiden valmisteverosta annettujen lakien muuttamisesta sekä laiksi yksityisestä huvialuksesta suoritettavasta polttoainemaksusta. [Government bill] (Fin.).
HE 65/1995 vp Hallituksen esitys eduskunnalle laiksi nestemäisten polttoaineiden valmisteverosta annetun lain liitteenä olevan verotaulukon muuttamisesta. [Government bill] (Fin.).
HE 66/2019 vp Hallituksen esitys eduskunnalle laeiksi nestemäisten polttoaineiden valmisteverosta annetun lain liitteen ja valmisteverotuslain 5 §:n muuttamisesta. [Government bill] (Fin.).
HE 84/1997 vp Hallituksen esitys eduskunnalle laiksi nestemäisten polttoaineiden valmisteverosta annetun lain muuttamisesta. [Government bill] (Fin.).
HE 89/1993 vp Hallituksen esitys Eduskunnalle laiksi polttoaineverosta annetun lain muuttamisesta. [Government bill] (Fin.).
HE 91/2012 vp Hallituksen esitys eduskunnalle laeiksi nestemäisten polttoaineiden valmisteverosta annetun lain liitteen sekä sähkön ja eräiden polttoaineiden valmisteverosta annetun lain muuttamisesta. [Government bill] (Fin.).
He, Pinglin, Ya, Qiao, Chengfeng, Long, Yuan, Yuan, and Xiao, Chen. 2021. "Nexus Between Environmental Tax, Economic Growth, Energy Consumption, and Carbon Dioxide Emissions: Evidence from China, Finland, and Malaysia Based on a Panel-ARDL Approach." *Emerging Markets Finance & Trade* 57(3): 698-712.
Heine, Dirk, Parry, Ian W.H., and Norregaard, John. 2012. Environmental Tax Reform: Principles from Theory and Practice to Date. International Monetary Fund.
Iliopoulos, Theodoros. 2020. "Price support schemes in the service of the EU's low-carbon energy transition." In Economic Instruments for a Low-carbon Future. Edward Elgar Publishing.
Jahan, Nusrat, Naveed, Sadiq, Zeshan, Muhammad, and Tahir, Muhammad A. 2016. "How to conduct a systematic review: a narrative literature review." *Cureus* 8(11).
Juanto, Leila, Punavaara, Anu, and Saukko, Petri. 2018. Arvonlisäverotus ja muu kulutusverotus. Helsinki: Alma Talent.
Khatib, Hisham, and Difiglio, Carmine. 2016. "Economics of Nuclear and Renewables." *Energy Policy* 96: 740-750.
Kök, Gürhan A., Shang, Kevin, and Yücel, Şafak. 2018. "Impact of Electricity Pricing Policies on Renewable Energy Investments and Carbon Emissions." *Management Science* 64(1): 131-148.
Laki nestemäisten polttoaineiden valmisteverosta (1472/1994). [The Law on Excise Duty on Liquid Fuel] (Fin.).
Laki polttoaineverosta annetun lain väliaikaisesta muuttamisesta 1119/1989. [Act on the Temporary Amendment of the Fuel Tax Act] (Fin.).
Lampinen, Ari. 2008. "Fossiilisten liikennepolttoaineiden tukimekanismien kehitys Suomen lainsäädännössä." *Oikeus* 4(37): 453-473.
Lawley, Chad, and Thivierge, Vincent. 2018. "Refining the Evidence: British Columbia's Carbon Tax and Household Gasoline Consumption." *The Energy Journal* 39(2).
Linnakangas, Esko, and Juanto, Leila. 2016. Verojen historia: synty, kehitys, kuolema, ylösnousemus, reinkarnaatio. Helsinki.
Liu, Jian, Tang, Shuai, and Chang, Chun-Ping. 2020. "Spillover Effect Between Carbon Spot and Futures Market: Evidence from EU ETS." *Environmental Science and Pollution Research International* 28(12): 15223-15235.
Määttä, Kalle. 2002. Oikeudellisen sääntelyn tutkimus – lastuja sääntelyteoriasta. Oikeus, 2:132-142.
McKibbin, Warwick J., Morris, Adele C., Wilcoxen, Peter J., and Cai, Yiyong. 2015. "Carbon Taxes and U.S. Fiscal Reform." *National Tax Journal* 68(1): 139-155.
Mori, Keibun. 2012. "Modeling the Impact of a Carbon Tax: A Trial Analysis for Washington State." Energy Policy 48: 627-639.
National budget of Finland 2022.
Neuhoff, Karsten. 2011. Climate Policy After Copenhagen: The Role of Carbon Pricing. Cambridge University Press.
Niskakangas, Heikki. 2011. Veropolitiikka. Helsinki:Talentum Media.
Okonkwo, Jennifer Uju. 2012. "Welfare Effects of Carbon Taxation on South African Households." *Energy Economics* 96: 104903.
Okullo, Samuel Jovan. 2019. "Determining the Social Cost of Carbon: Under Damage and Climate Sensitivity Uncertainty." *Environmental & Resource Economics* 75(1): 79-103.
Organization for Economic Co-operation and Development. 2018. Effective Carbon Rates 2018: Pricing Carbon Emissions Through Taxes and Emissions Trading. Paris, France: OECD Publishing.
Pahle, Michael, Lessmann, Kai, Edenhofer, Ottmar, and Bauer, Nico. 2013. "Investments in Imperfect Power Markets Under Carbon

Pricing: A Case Study Based Analysis." *The Energy Journal* 34(4): 199-227.

Palanne, Kimmo, and Sahari, Anna. 2021. Henkilöautoliikenteen CO2-päästöt ja päästöjen vero-ohjaus. VATT-muistiot 63.

Parry, Ian. 2015. "Carbon Tax burdens on Low-Income Households: A Reason For Delaying Climate Policy?" In Inequality and Fiscal Policy, edited by Clements, Benedict, de Mooij, Ruud, Gupta, Sanjeev, and Keen, Michael. Washington DC: International Monetary Fund.

Parry, Ian, and Mr Philippe Wingender. 2021. "Fiscal Policies for Achieving Finland's Emission Neutrality Target." International Monetary Fund.

Paukku, Eelis, and Similä, Jukka. 2020. "Merituulivoiman käyttöönoton edistäminen." Ympäristöjuridiikka 2/2020: 7-35.

Paukku, Eelis. 2019. "Luonnonvara- ja ympäristöpolitiikan eurooppalaistuminen: mahdollistaako EU:n valtiontukisääntely sinisen kasvun tukemisen Suomessa." Ympäristöpolitiikan ja -oikeuden vuosikirja 187-230.

Paukku, Eelis. 2020. "Maatalouden biokaasuvoimaloiden sääntely—markkinahäiriöistä potentiaalin hyödyntämiseen." *Ympäristöjuridiikka* 1/2020:68-97. (Paukku 2020b)

Paukku, Eelis. 2020. Euroopan unionin politiikan ja tukikilpailun vaikutus valtiontukisääntelyyn. Doctoral thesis. Acta electronica Universitatis Lapponiensis. (Paukku 2020a)

Paukku, Eelis. 2020. Markkinahäiriöt ja ajoneuvot – vaihtoehtoisten polttoaineiden liikenteen infrastruktuurin edistäminen Suomessa. Ympäristöpolitiikan ja -oikeuden vuosikirja 127-188. (Paukku 2020c)

Paukku, Eelis. 2021. "How could Finland promote renewable energy technology innovation and implementation?" *Clean Energy* 3/5: 447-463. (Paukku 2021a)

Paukku, Eelis. 2021. "Päästökauppa ympäristöpolitiikan kiihdyttäjänä ja rajoittajana." Ympäristöpolitiikan ja -oikeuden vuosikirja XIV, Itä-Suomen LYY-instituutti 117-165. (Paukku 2021b)

Pilpola, Sannamari, and Lund, Peter D. 2018. "Effect of major policy disruptions in energy system transition: Case Finland." *Energy Policy* 116: 323-336.

Pindyck, Robert S. 2017. "Coase Lecture—Taxes, Targets and the Social Cost of Carbon." *Economica* 84(335): 345-364.

Programme of Prime Minister Sanna Marin's Government 10 December 2019. Inclusive and competent Finland: a socially, economically and ecologically sustainable society. Publications of the Finnish Government, 2019:33.

Rabe, Barry G. 2018. Can We Price Carbon? MIT Press.

Rausch, Sebastian, and Reilly, John. 2015. "Carbon Taxes, Deficits, and Energy Policy Interactions." *National Tax Journal* 68(1): 157-177.

Rausch, Sebastian. 2013. "Fiscal Consolidation and Climate Policy: An Overlapping Generations Perspective." *Energy Economics* 40: S134-S148.

Rey, Florian, and Thierry, Madiès. 2020. "Addressing the Concerns About Carbon Leakage in the Implementation of Carbon Pricing Policies: A Focus on the Issue of Competitiveness." *Economia E Politica Industriale* 48(1): 53-75.

Rocchi, Paola, Serrano, Mònica, and Roca, Jordi. 2014. "The reform of the European Energy Tax Directive: exploring potential economic impacts in the EU27." *Energy Policy* 75: 341–353.

Sairinen, Rauno. 2012. Regulatory reform and development of environmental taxation: The case of carbon taxation and ecological tax reform in Finland. In Handbook of research on environmental taxation. Edward Elgar Publishing.

Salo, Miikka. 2014. Uusiutuva energia ja energiajärjestelmän konsensus: mekanisminen näkökulma liikenteen biopolttoaineiden ja syöttötariffin käyttöönottoon Suomessa. Doctoral Thesis. Jyväskylä studies in education, psychology and social research 499: 1-238.

Similä, Jukka, Soininen, Niko, and Paukku, Eelis. 2021. "Towards Sustainable Blue Energy Production: An analysis of legal transformative and adaptive capacity." *Journal of Energy & Natural Resources Law* 1- 21.

Soimakallio, Sampo, Sankelo, Paula, Kopsakangas-Savolainen, Maria, Sederholm, Camilla, Auvinen, Karoliina, Heinonen, Tero, Johansson, Annika, Judl, Jáchym, Karhinen, Santtu, Lehtoranta, Suvi, Räsänen, Satu, and Savolainen, Hannu. 2020. Turpeen rooli ja sen käytöstä luopumisen vaikutukset Suomessa. Sitra, tekninen raportti. Suomen Luontopaneelin julkaisuja 2(2021), 2737-0062.

Sokka, Laura, Sinkko, Taija, Holma, Anne, Manninen, Kaisa, Pasanen, Karri, Rantala, Mirja, and Leskinen, Pekka. 2016. "Environmental Impacts of the National Renewable Energy Targets – A Case Study from Finland." Renewable & Sustainable Energy Reviews 59: 1599-1610.

Speck, Stefan, and Jilkova, Jirina. 2009. "Design of Environmental Tax Reforms in Europe." In Carbon- energy taxation: lessons from Europe. Edited by Andersen, Skou, Mikael, and Ekins, Paul. OUP Oxford, 2009.

Taconet, Nicolas, Guivarch, Céline, and Pottier, Antonin. 2021. "Social Cost of Carbon Under Stochastic Tipping Points: When Does Risk Play a Role?" *Environmental & Resource Economics* 78(4): 709-737.

Tang, Bao-jun, Gong, Pi-qin, and Shen, Cheng. 2015. "Factors of Carbon Price Volatility in a Comparative Analysis of the EUA and SCER." *Annals of Operations Research* 255(1-2): 157-168.

Tamminen, Saara, Haanperä, Outi, and Hietaniemi, Tuuli. 2018. Harnessing economic instruments to tackle the climate crisis - Finland's experiences with economic instruments applied in climate policy. Sitra memorandum.

Teir, Gustav. (1999). (Environmental) Energy Taxes: The Experience of Finland. pp.303-308 in Barde, J. P.. Environmental taxes in OECD countries: ANOVERVIEW. China in the Global Economy Environmental Taxes Recent Developments in China and OECD Countries: Recent Developments in China and OECD Countries, 19.

Tsai, Wen-Hsien. 2020. "Carbon emission reduction—Carbon tax, carbon trading, and carbon offset." *Energies* 13(22): 6128.

van der Ploeg, Frederick. 2016. "Second-best Carbon Taxation in the Global Economy: The Green Paradox and Carbon Leakage Revisited." *Journal of Environmental Economics and Management* 78: 85-105.

Vehmas, Jarmo, Jari Kaivo-oja, Jyrki Luukkanen, ja Pentti Malaska. 1999. "Environmental Taxes on Fuels and Electricity — Some Experiences from the Nordic Countries." *Energy Policy* 27(6): 343-355.

Vehmas, Jarmo. 2005 Energy-related Taxation as an Environmental Policy Tool—the Finnish Experience 1990–2003. *Energy Policy* 33(17): 2175-2182.

Vera, Sonia, and Sauma, Enzo. 2015. "Does a Carbon Tax Make Sense in Countries with Still a High Potential for Energy Efficiency? Comparison Between the Reducing-emissions Effects of Carbon Tax and Energy Efficiency Measures in the Chilean Case." *Energy* 88: 478-488.

Ye, Huiying, Zhang, Qi, Pan, Xunzhang, and Farnoosh, Arash. 2020. "Market-induced Carbon Leakage in China's Certified Emission Reduction Projects." *Mitigation and Adaptation Strategies for Global Change* 25(6): 987-1012.

Zhang, H. L, Van Gerven, T., Baeyens, J., and Degrève, J. 2014. "Photovoltaics: Reviewing the European Feed-in-Tariffs and Changing PV Efficiencies and Costs." *The Scientific World Journal*.

Zhao, Lu-Tao, He, Ling-Yun, Cheng, Lei, Zeng, Guan-Rong, and Huang, Zhimin. 2018. "The Effect of Gasoline Consumption Tax on Consumption and Carbon Emissions During a Period of Low Oil Prices." *Journal of Cleaner Production* 171: 1429-1436.