Estimating potentially environmentally harmful subsidies and effective carbon rates with SEEA data

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Abstract

In 2020 Statistics Sweden did a pilot study on transactions related to fossil fuel for monitoring Agenda 2030 that uses SEEA as the frame. Between 2021-2023 Statistics Sweden was given EU grant for a pilot study on potentially environmentally harmful subsidies. Statistics Sweden recently developed a new methodology for industry allocation of environmental taxes, including mapping out tax abatements in different industries which is the starting point for the analysis.

This work is to be integrated in the pilot study on potentially environmentally harmful subsidies and some preliminary results are presented here. We compare our fossil fuel transfer results with an estimate using benchmark ECR of (the SEK equivalent of) 60 EURO per tonne of CO2 as a reference value, as this is a suggested lower band for 2030 (OECD, 2018) as well as benchmark of 1190 SEK per tonne. Results on indirect fossil fuel transfers vary depending on data sources and the chosen benchmarks.

With the data from tax abatements in different industries we can also presents effective carbon rates (ECR) in EURO/tonnes of emitted CO2, estimated with SEEA data. The estimates are based on the OECD method to calculate ECRs. By publishing the results in different bands of carbon costs, this method could allow for country comparisons and potentially be used to follow up on the sustainable development goals.

The main reason the ECRs differ between sectors is that some sectors receive indirect fossil fuel transfers through reduced tax rates. Furthermore, firms in the EU ETS are exempt from the carbon tax and face a reduced energy tax rate, as their emissions should be priced through the EU ETS.

Introduction

Data on fossil fuel subsidies are required to monitor Agenda 2030 goal 12 on Sustainable Consumption and Production. SDG target 12.c aims to "rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances, including by restructuring taxation and phasing out those harmful subsidies, where they exist, to reflect their environmental impacts". This is monitored through indicator 12.c.1 "Amount of fossil-fuel subsidies per unit of GDP (production and consumption) and as a proportion of total national expenditure on fossil fuels". Estimates of fossil fuel subsidies are thus needed for this indicator. There are several ways to estimate fossil fuel subsidies, by using the revenue forgone method and national tax norms or using an international benchmark rate.

The System of Environmental-Economic Accounting (SEEA) could facilitate the process of calculating such statistics as SEEA already have established methods for recording greenhouse gas emissions, fossil fuel use and environmental taxes by industry. In 2020 Statistics Sweden did a pilot study on transactions related to fossil fuel for monitoring Agenda 2030 that uses SEEA as the frame (Statistics Sweden, 2020)). One of the conclusions from this work, in a national context, was that further work was needed for aligning the data that was available then with the SEEA framework. Among other things, data from this pilot study could not be presented by industry or by fuel.

On a more general level the pilot study attempted to find a common method to report and present data by identifying three types of transfers:

- **Budget transfers**, i.e. direct transfers that can be found in national budgets
- **Indirect transfers** in the form of tax abatements
- **Other implicit support measures** for example, this can be export credits or preferential loans that reduces price of emitting greenhouse gas.

Between 2021-2023 Statistics Sweden is given EU grant for a pilot study on potentially environmentally damaging subsidies (PEDS) for developing the methodology. The aim of this study is to produce estimate of PEDS and report these estimates to Eurostat. In the manual for Environmental Subsidies and Similar Transfers (ESST) PEDS is

defined as: reductions and exemptions related to environmental taxes, transfers going to certain activities or industries which are considered particularly polluting (energy, transport or agriculture).

This paper presents the preliminary results from this work with a focus on **indirect transfers** and calculating so called **Effective Carbon Rates** (ECR), i.e. the price in Euro/tonne of emitted CO_2. By publishing the results in different bands of carbon costs, this method could allow for country comparisons and potentially be used to follow up on the sustainable development goals.

The background for being able to develop the methodology for calculating indirect transfers presented in this paper is that Statistics Sweden recently developed a new methodology for industry allocation of environmental taxes. This includes mapping out tax abatements in different industries and fuels. Therefore, it is now possible to calculate potentially environmentally harmful subsidies using the revenue foregone method, which was not the case when the first pilot study was done in 2020.

Since methodologies and data sources are developing rapidly in this field the data presented in this paper should be seen as preliminary. The aim, however, is that this statistics or parts of it should be published regularly as official statistics to facilitate international comparisons, environmental economic analyses and to follow up SDG target 12.c.1.

Data sources on indirect fossil fuel transfers

There are several data sources available in Sweden on foregone tax revenues. One is the Ministry of Finance's tax expenditure reports. The purpose of these reports is to forecast how tax reductions will affect the budget and to highlight what tax reductions are in place to support businesses and households. The Swedish Ministry of Finance calculates the revenues foregone through a method using tax norms, which differ between taxes and fuel types. The Swedish Ministry of Finance (2019) acknowledges that the tax norm for the carbon tax implicitly reflects upon the monetary valuation of the damage of a tonne of CO_2 emissions from fossil fuels. In 2020 the tax norm used for the carbon tax was 1190 SEK per tonne of carbon emissions, which is considerably higher than the 60 EURO per ton benchmark used by the OECD[1].

The second data source is the database FRIDA, hosted by Statistics Sweden, which contains data from the Swedish Tax Authority on company requests for tax refunds. Each tax base and the amount requested to be reimbursed is recorded in the database with a time

[1] 1 EUR ≈ 10,5 SEK

series stretching from 2008-2017. In Statistics Sweden's (2020) previous report on fossil fuel transfers, data from the database FRIDA covering 2013-2017 was used to estimate fossil fuel tax abatements. The tax abatements and repayments in FRIDA are coded by sector, but following a different sector classification than NACE. The initial test of the data from the database FRIDA showed that trade industries are receiving the largest tax abatements together with the energy industries and the transport industries (ibid.). The reason that the trade industries are receiving a large part of the tax abatements relates to them being the counterpart to the tax authority, and not necessarily the user of the fuel. If the aim is to estimate how much different industries are benefitting from the tax abatements, a method to allocate the tax abatements to the user of the fuel is required.

Data sources and methodology used for this paper

In this project, we have instead estimated indirect fossil fuel transfers bottom up using environmental accounts data. By using the energy use data used for the air emission statistics production, in combination with the tax rates and tax exemptions used in our environmental tax statistics production, we can estimate how much taxes that have been refunded (or not paid) due to the tax exemptions. Table 1 lists the tax abatements which are covered in the estimates. These are presented in more detail in a report by the Swedish Environmental Protection Agency (2017).

Table 1: Tax exemption rules covered in the indirect fossil fuel transfer estimates[2]

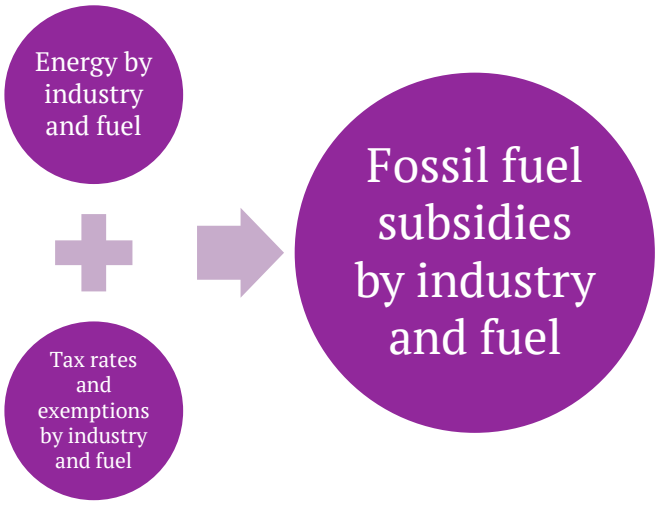
Energy tax abatements for fuel used in international waterway transportation
Manufacture privilege for producers of energy products
Energy tax abatements for fuel used in commercial aviation
No energy tax on peat used for heating
Reduced energy tax on fuels used for heating within industry
Reduced energy tax on electricity within manufacturing industry and data centres
Reduced carbon dioxide tax on fuels used for heating within industry outside EU-ETS and reduced carbon dioxide tax on district heating used within industry
No carbon dioxide tax on fuels used for electricity production outside EU-ETS
Reduced carbon dioxide tax on fuels used in combined heat and power plants outside EU-ETS
No carbon dioxide tax on peat as a fuel outside EU-ETS
Reduced energy tax on diesel within mining industry

[2] Reduced energy tax on diesel as fuel for vehicles was originally included in the table but are not included in the list since we do not estimate this in this study

Reduced carbon dioxide tax on diesel within mining industry
No energy and carbon dioxide tax on fuels used for railway
No energy and carbon dioxide tax on fuels used for domestic and international shipping
No energy and carbon dioxide tax on fuels used for domestic and international aviation
No energy tax on natural gas and liquefied petroleum gas used as fuel for vehicles
Reduced energy tax and carbon dioxide tax on fuels used for heating of greenhouses and within agriculture.
Reduced energy tax on electricity used for greenhouse and agriculture
Reduced carbon dioxide tax on diesel used in machinery within agriculture, forestry and aquaculture.
No energy and carbon dioxide tax on fuels used for professional fishing

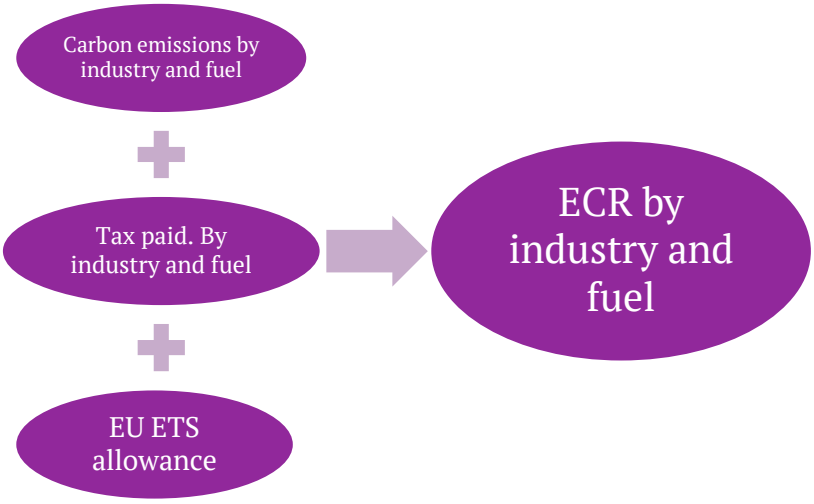
The method for estimating the indirect fossil fuel transfers in this study is to estimate loss in government income before and after tax exemptions by industry and by fuel. This assumption is called “with and without exemption” in this paper. Carbon and energy taxes in Sweden vary for different fuels and tax exemptions are different in different industries and when fuels are used for different purposes. These tax rates and exemptions have been mapped out with the SEEA energy/air emissions accounts and environmental taxes as a starting point, see Figure 1. It should be mentioned that tax exemptions and data structure do not always match one to one. Some exemption rules are difficult to capture even with this detailed level of energy use data and therefore some simplifications must be made.

Figure 1: Process for estimating fossil fuel subsidies



We have also estimated indirect fossil fuel transfers bottom up using ECRs and reference values of (the SEK equivalent of) 60 EURO per tonne of CO_2 as a reference value, as this is a suggested lower band for 2030 (OECD, 2018) that can be seen as a carbon pricing target. To calculate this CO_2 emissions by industry and fuel is combined with information on climate policy e.g. carbon tax, energy tax and EUA (European Union Allowance) price, see Figure 2. We also show the results using the carbon tax norm specified by the Swedish Ministry of Finance, 1190 SEK per tonne of carbon emissions. The results using these different method and reference prices are then compared.

Figure 2: Process for estimating ECR

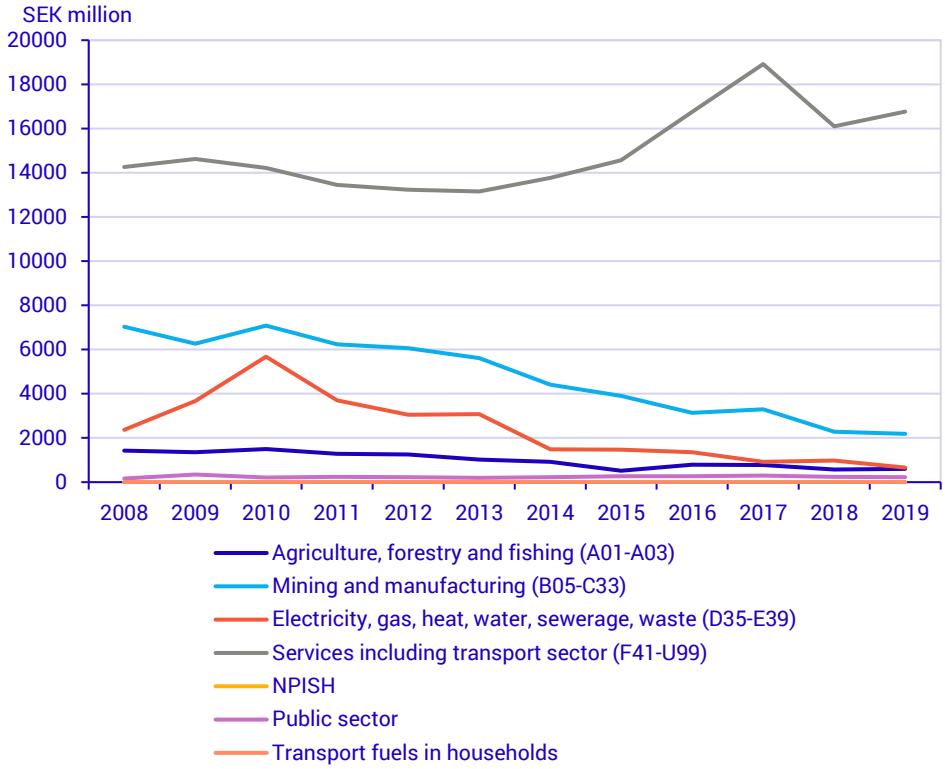


Some preliminary results

The results of estimating indirect fossil fuel transfers bottom up using environmental accounts data is presented in table 2.

Our preliminary results show that the largest indirect transfers are directed to the transport sector, which has several tax exemptions for fossil fuel use in aviation, shipping and railway. In falling order, the manufacturing and mining, energy, and the agriculture, forestry and fisheries sector receive indirect transfers. Public sector also receives some indirect transfers, which are related to aviation fuels. The estimated total does not show an increasing or decreasing trend. Figure 3 visualise these results.

Figure 3: Indirect fossil fuel transfers, by industry 2008-2019



Results differ with different benchmarks

So far, the results presented follow the "with and without exemption" assumption, i.e., using the actual tax rates and exemptions for different fuels. For purpose of comparison, we also estimate fossil fuel transfers using a benchmark of (the SEK equivalent of) 60 EURO per tonne of CO_2 as a reference value, as this is a suggested lower band for 2030 (OECD, 2018). Furthermore, we present results using the carbon tax norm specified by the Swedish Ministry of Finance, 1190 SEK (around 120 EUR) per tonne of carbon emissions. Table 2 presents these results.

Comparing a reference price equivalent to 60 euros and a reference price of 1190 SEK, the estimated indirect fossil fuels become smaller, than when comparing with the "with and without exemptions" i.e. tax rates before and after exemption rules are applied (see Figure 1). However, for most industries negative values are estimated (in light blue), which is due to that they are subject to carbon pricing levels above the reference price.

The sum of the positive values is the total indirect fossil fuel transfers estimated using the different benchmarks of 60 EUR per tonne and 1190 SEK per tonne. Naturally, a lower reference price will result in a lower

total indirect fossil fuel transfers estimate. An interpretation of the results using the reference price of 1190 SEK per tonne of carbon emissions (final row) is that in 2019 the price gap of emissions priced below this level summed to 12.9 billion SEK. This estimate is lower than the above results with and without tax exemption rules applied for the estimation which summed up to 20.4 billion SEK.

Table 2: Indirect fossil fuel transfers per NACE rev.2 sector in million SEK, estimated using ECRs and reference values

		2008	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*
Using a reference price equivalent to 60 euros	Agriculture, forestry and fishing (A01-A03)	-1 274	-1 283	-1 463	-1 784	-1 951	-2 100	-1 994	-2 490	-2 433	-2 431
	Mining and manufacturing (B05-C33)	4 184	3 579	4 211	3 110	2 653	2 596	2 628	2 506	1 835	1 665
	Electricity, gas, water,, waste (D35-E39)	3 793	4 325	4 953	3 469	3 068	3 004	2 736	2 800	2 732	2 921
	Services incl. transport sector (F41-U99)	-6 517	-6 011	-8 054	-8 930	-9 219	-8 492	-7 199	-6 692	-7 020	-7 548
	NPISH	-27	-26	-29	-27	-28	-28	-27	-28	-29	-29
	Public sector	-834	-725	-865	-802	-874	-822	-760	-767	-854	-833
	Transport fuels in households	-15 918	-16 171	-16 641	-15 581	-15 754	-15 515	-14 912	-15 603	-16 879	-16 661
	Total fossil fuel transfers (sum of positive values)[3]	**7977**	**8070**	**9164**	**6579**	**5722**	**5601**	**5364**	**5412**	**4953**	**4586**
		2008	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*
Using a reference price of 1190 SEK	Agriculture, forestry and fishing (A01-A03)	192	-16	44	-195	-368	-571	-587	-1 131	-1 159	-1 209
	Mining and manufacturing (B05-C33)	12 279	9 258	12 141	10 912	10 205	9 739	9 415	9 257	8 573	8 226
	Electricity, gas, water,, waste (D35-E39)	8 489	8 744	11 460	8 848	8 217	7 983	6 884	6 874	6 905	6 917
	Services incl. transport sector (F41-U99)	3 857	2 812	1 765	252	-512	553	1 617	2 732	2 363	760
	NPISH	-14	-15	-15	-14	-15	-15	-14	-16	-18	-18
	Public sector	-325	-233	-342	-287	-350	-347	-313	-323	-428	-427
	Transport fuels in households	-9 389	-10 300	-10 223	-9 295	-9 532	-9 334	-9 051	-9 775	-11 280	-11 227
	Total fossil fuel transfers (sum of positive values)[3]	**24 817**	**20 814**	**25 409**	**20 013**	**18 421**	**18 276**	**17 916**	**18 862**	**17 840**	**15 903**

Results compared to other sources on Swedish fossil fuel transfers

When comparing the results presented above with the total fossil fuel repayments and tax reductions in FRIDA, our methodology appears to

[3] Please note that the total fossil fuel transfers are calculated as the value of the positive values. Therefore they vary depending on the level of industry aggregation. Results should only be used in comparison in this study.

capture slightly lower transfers in total. There are still some uncertainties in how to correctly map out the data in FRIDA, so there might be some overestimations in this compilation. All results here are still preliminary and will be further investigated throughout this project. It is also possible that our estimation is a slight underestimation as some of the exemption rules are difficult to capture even with this detailed level of energy use data. One difference between the data from FRIDA and our method is that the energy use data suggest taxes were paid when the fuel was used, while the data from FRIDA shows when the taxes have been paid. Thus, the comparison over time is not identical, but still provides a picture of the levels and trends.

Table 4 compares the results for this study using the "with and without exemption" assumption. The indirect fossil fuel transfers appear higher using the FRIDA database than in this study. The time series in FRIDA also appears to be more volatile, especially in 2013.

Table 3: Total fossil fuel repayments and tax reductions in FRIDA, compared with this study ("with and without tax exemptions")

	2013	2014	2015	2016	2017
FRIDA, excluding exemptions and repayments not related to fuel use[4] (million SEK)	36117	27173	26186	27093	30019
Difference between our estimate and FRIDA total, in percent	- 36 %	- 23 %	- 21 %	- 18 %	- 19 %

We also compare our estimates to the tax expenditure reported by the Swedish Ministry of Finance which is used in the OECD Fossil fuel support inventory. In this comparison, our estimates are much higher, see Table 4.

This is due to a few methodological differences. The Ministry of Finance uses tax norms, rather than the rate tax before reductions are applied which is used in FRIDA and our method with the "with and without tax exemption" assumption. OECD include the lower tax on diesel than gasoline while we do not, accounting for 73% of the reported total fossil fuel support in 2019 (OECD, n.d.). But they exclude international aviation and international shipping which is included in our air emission/energy accounts after residence adjustment.

[4] Examples of these repayments include repayments for tax on fuels which have been exported or for which tax incidence is at producer stage and repayment is done to avoid double taxation.

Table 4: OECD Fossil fuel support inventory and Swedish ministry of Finance, totals and compared with this study ("with and without tax exemptions")

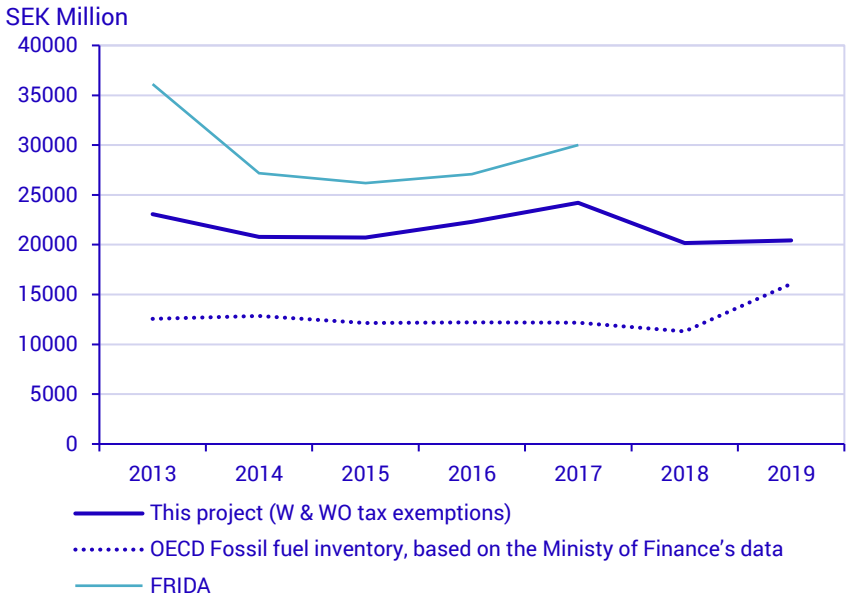
	2013	2014	2015	2016	2017	2018	2019
OECD Fossil fuel inventory, based on the Ministy of Finance's data (million SEK)	12 566	12 849	12 139	12 221	12 167	11 302	16 070
Difference between our estimate and the Ministry of Finance/OECD total, in percent	84%	62%	71%	82%	99%	78%	27%

Source: OECD fossil fuel support inventory[5] and Swedish Ministry of Finance (2019)

Figure 4 below illustrates the differences in estimates of indirect fossil fuel transfers between this project and other sources. There is a relatively small difference between the results of the two methods used in this project; comparing tax rates with and without exemptions applied and using a reference price of SEK 1190. These results however differ from what is reported in FRIDA and in the OECD fossil fuel support inventory. The size of tax exemptions and repayments is much higher in FRIDA than our estimates, while the OECD FFS inventory reports lower values partly due to the use of tax norms. To conclude, this comparison demonstrates the importance of what the real (reduced) tax rates are compared with, as this leads to widely different estimates of fossil fuel transfers. If international comparability of results is prioritised, harmonisation of reference prices (tax norms) is necessary.

[5] https://stats.oecd.org/viewhtml.aspx?datasetcode=FFS_SWE&lang=en

Figure 4: Comparing methods and sources for indirect fossil fuel transfers



The OECD methodology for calculating ECR

The OECD (2021) has estimated effective carbon rates for 44 OECD and G20 countries, accounting for 80% of global energy use and of CO2 emissions, to analyse the extent to which countries use carbon pricing policies. The analysis shows the distribution of effective carbon rates across all energy use and their composition by six economic sectors. However, most of the ECRs presented in their report include emissions from bioenergy. The aim here is to focus on fossil fuel use.

The OECD (2018) considers two benchmark rates: EUR 30, a low-end estimate of carbon costs today; and EUR 60, a midpoint estimates of the carbon costs in 2020 and a low-end estimate for 2030. In a more recent report, the OECD (2021) add another benchmark rate of EUR 120. EUR 120 is a central estimate of the carbon price needed in 2030 to decarbonise by mid-century under the assumption that carbon pricing plays a major role in the overall decarbonisation effort (Kaufman et al. 2020, via OECD 2021).

The carbon pricing gap indicates the extent to which polluters do not pay for the damage from carbon emissions. The marginal damage caused by one tonne of CO2 increases with the accumulation of CO2 in the atmosphere. Accordingly, integrated assessment models show carbon prices that increase significantly in real terms over time.

However, these benchmarks are lower than many of the observed ECRs in Sweden and in other countries. In 2019 Sweden had tax rates over

200 euro per cubic meter for oil products. As a result, a problem with the OECD carbon gap estimations is that fuels taxed above the benchmark rate are not included in the analysis. This is discussed further in our previous FFS report (Statistics Sweden 2020, p.23-24).

Calculating ECR using SEEA data – some preliminary results

Since the SEEA framework includes information on energy use, carbon emissions and environmental taxes it is suitable for combining this information with carbon pricing to calculate effective carbon rates. This study has done some preliminary calculations of ECR in Sweden using the SEEA framework. At the finest level, ECRs can be calculated per fuel, ECR component (e.g., different policies) and industry. This level of detail is unlikely to provide much value to users but can be presented as a table.

An overview of how ECRs vary between industries is provided by Figure 5. The main reason the ECRs differ between industries is that some industries receive indirect fossil fuel transfers through reduced tax rates. Furthermore, firms in the EU ETS are exempt from the carbon tax and face a reduced energy tax rate, as their emissions should be priced through the EU ETS. However, low EUA prices have led to lower ECRs for sectors with a high EU ETS coverage. The partly subsidised ECRs can be compared with households where ECRs were over four times higher than that of the manufacturing sector in 2018.

Figure 5: Average ECR per aggregated sector (2008-2019)

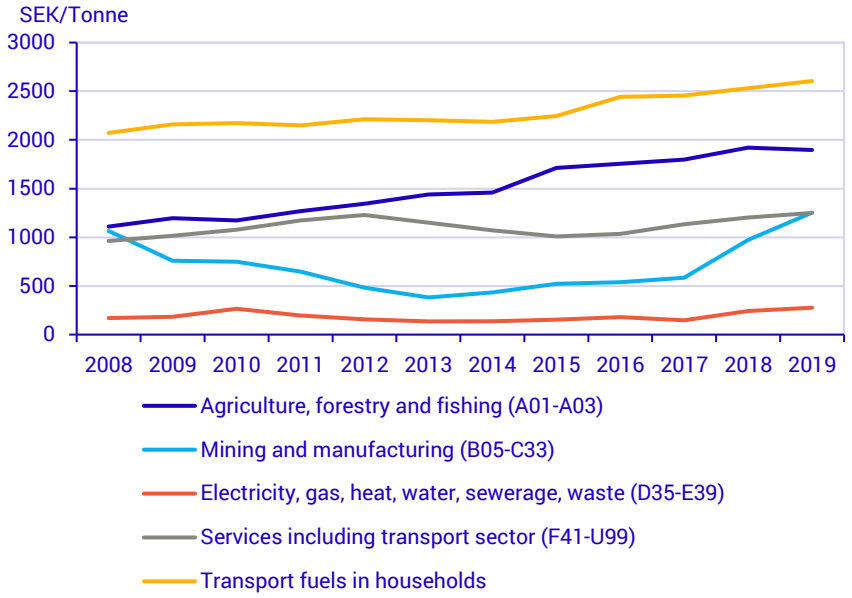
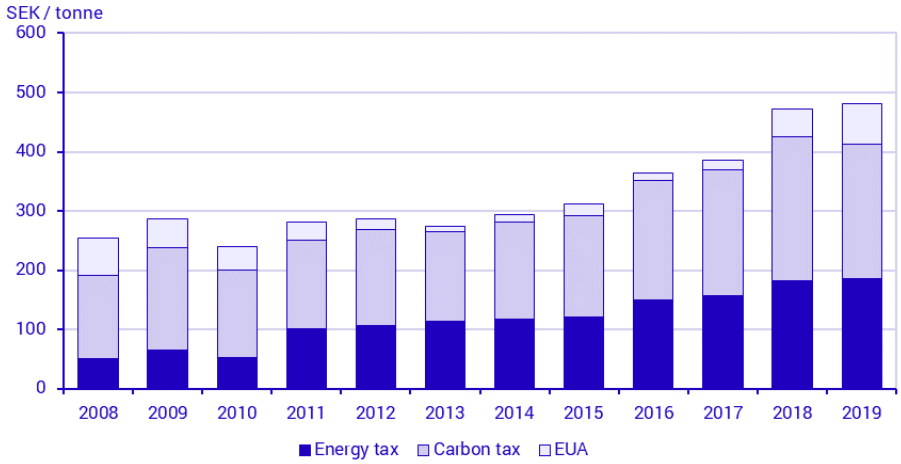


Figure 6 demonstrates another way of presenting ECRs – by component. In this example for the manufacturing sector between

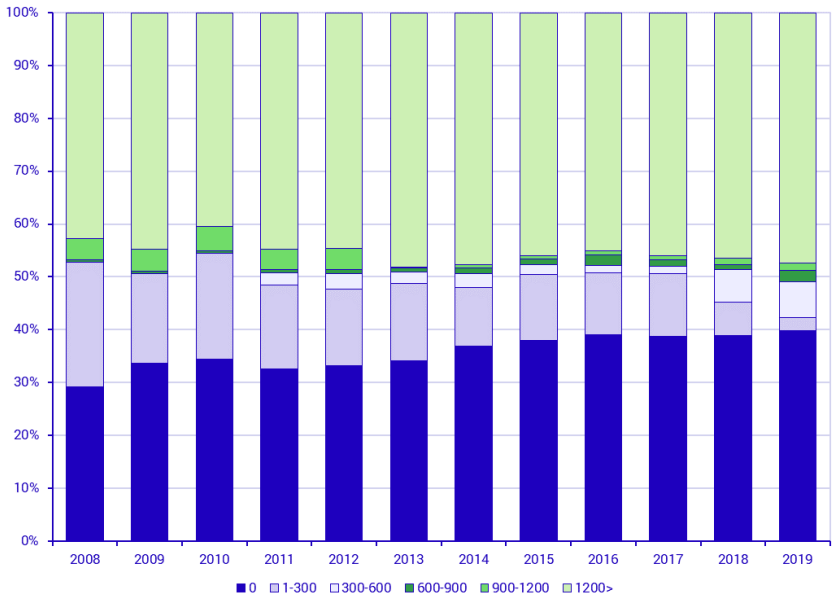
2008-2019. It shows that the vast majority of the carbon pricing per tonne of emissions firms from this sector on average face stems from the national policy tools, the carbon and energy taxes. By presenting ECRs over time, effects of changes in tax rates, tax exemption and EUA prices can be visualised. Between 2010 and 2011 for example, an energy tax exemption for the manufacturing sector was reduced leading to a higher average ECR in 2011.

Figure 6: Average ECR per component, for the manufacturing sector NACE C (2008-2019)



We suggest that it is possible to produce statistics that can show the whole range of ECRs, while remaining internationally comparable. Figure 7 shows the share of total CO2 emissions from fossil fuels priced at different ECR bands. The graph indicates that there is little structural change over the studied time period. In 2019, around 40 percent of Sweden's emissions are not exposed to any carbon pricing costs. This includes emissions from for example domestic and international aviation and shipping, metallurgical processes and peat used for heating. Meanwhile, 47 percent of total emissions in 2019 were priced above SEK 1200. A graph like this one could be adapted to any ECR ranges considered most useful for international comparison. This approach could complement the 12.c.1 SDG indicator.

Figure 7: Share of total CO2 emissions from fossil fuels in Sweden priced within ECR bands (2008-2019)



Discussion and future work on indirect fossil fuel transfers

Finding an internationally comparable method for estimating indirect fossil fuels is important. The comparison of estimates made with different methods that we have presented here clearly demonstrates how estimates depend heavily on what the actual reduced tax rates are compared with in a revenue forgone analysis. Using an internationally agreed upon reference price per tonne of emissions would be a way forward. This method would produce comparable estimates even if countries have different types of carbon pricing policies in place, and can be interpreted as the distance to the target carbon pricing level. However, this might result in negative numbers if the reference price is set below actual carbon pricing levels.

Therefore, to compare carbon pricing between countries it could be preferable to present data on carbon pricing in the share of emissions priced within different ECR bands, as shown in Figure 7. This focuses on the actual carbon pricing rather than the size of the tax reductions, but when comparing countries, it would be visible where fossil fuel use to a larger extent is exempt from carbon pricing. This can be combined with further information needed for different industries or fuels. By presenting data on carbon pricing in the share of emissions priced within ECR bands, the full picture of how carbon emissions are priced can be communicated in an easily understandable format.

The questions we have encountered for the revenue foregone method and that we would like to discuss with the London group are:

- Whether to count diesel and gasoline tax gap as an indirect subsidy?
- How to ensure harmonized coverage and benchmarks?
- Which type of indicators would be best to make cross country comparisons?
- How to report emission trading permits?
- Going beyond fossil fuels how to account for bio-based fuels when estimating indirect transfers?

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