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Developing a Methodology for Measuring Fossil Fuel Subsidies

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Abstract:

Guidance for national statistical institutes that produce environment accounts is based on the UN System of Environmental Accounting, which does not address measurement of fossil fuel subsidies. Ireland's Central Statistics Office has developed an annual statistical release on fossil fuel subsidies and effective carbon rates. Here we describe our methodology and provide examples of both measures. Our approach is based on OECD work on fossil fuel supports and effective carbon rates but prioritises coherence with environment-economic accounting classifications and definitions where possible. This allows comparisons with other environmental accounts and with national accounts, and demonstrates that these quantities can be estimated using widely available tax, energy and other official statistics. We found that measures of fossil fuel subsidies and effective carbon rates both provide useful information. An inventory of fossil fuel subsidies allows policy makers to track and evaluate individual supports while effective carbon rates allow for interesting comparisons between the rates paid by different sectors of the economy, as well as between countries.

Keywords:

Tax Expenditures; Revenue Foregone; Effective Carbon Rates; Energy Taxes

1. Introduction:

Sustainable Development Goal (SDG) indicator 12.c.1 is a measure of the 'Amount of fossil fuel subsidies per unit of GDP (production and consumption)' and will entail national monitoring of fossil fuel subsidies across the globe. The EU, in the European Green Deal acknowledges that "fossil fuel subsidies should end" and that the "Commission will look closely at the current tax exemptions including for aviation and maritime fuels.

Nonetheless, there is no internationally agreed methodology for measuring fossil fuel subsidies, as the System of Environmental-Economic Accounting (SEEA) does not define potentially environmentally damaging subsidies (UN 2014). The Organisation for Economic Co-operation and Development (OECD), the International Energy Agency and the International Monetary Fund all produce estimates of fossil fuel subsidies. Their methods include identifying individual supports (OECD 2021), using the price-gap approach and measuring pre-tax and post-tax consumption subsidies. The OECD also publishes data on effective carbon rates (ECRs) (OECD 2021). UN Environment, the custodian agency for SDG indicator 12.c.1, proposes a combination of these methods in its guidance on compiling data for the indicator.

To complement its work on other environment accounts such as environment taxes and environmental subsidies the Central Statistics Office (CSO), Ireland's national statistical institute, has developed an annual statistical release on fossil fuel subsidies and ECRs. The latest CSO statistical release contains data on fossil fuel subsidies and ECRs for 2000-2019.

2. Methodology:

This section describes the methodology developed by the CSO. We outline the steps involved in defining and measuring fossil fuel subsidies and ECRs, and provide examples.

2.1 Definition of a Fossil Fuel Subsidy

To produce estimates of fossil fuel subsidies, we used definitions and classifications from the SEEA and extended them as required using the OECD's methodology for compiling its Inventory of Fossil Fuel Supports.

Eurostat has developed a series of environmental accounts modules based on the SEEA, and the CSO has produced statistical releases on a number of these, including environmental subsidies and environment taxes. By aligning our work on fossil fuel subsidies with these modules we built in coherence with our other environmental accounts.

Environmental subsidies include direct subsidies, capital grants and social transfers, as well as tax expenditures. Although tax expenditures are not part of the SEEA classification of transactions, they are included as a voluntary reporting item in the Eurostat module on environmental subsidies.

The OECD definition of fossil fuel supports includes budgetary transfers and tax expenditures that provide a benefit or preference for fossil fuel production or consumption (OECD 2021). We adopted this definition in principle, although we did not identify specific instances of all types of subsidy. We found that tax expenditures are by far the dominant type of fossil fuel subsidy and our efforts have thus far been focused on this area.

Table 1: Types of Fossil Fuel Subsidy

Type of Subsidy	UN SEEA	Eurostat Environmental Subsidies	OECD	CSO - in scope	CSO - identified
Direct subsidies	✓	✓	✓	✓	✓
Social transfers	✓	✓	✓	✓	✓
Transfers within govt./to rest of world	✓	✓	✓	✓	
Capital grants	✓	✓	✓	✓	✓
Tax expenditures		✓	✓	✓	✓
Induced transfers/Price support			✓	✓	
Provision of goods or services			✓	✓	
Govt. ownership of energy enterprises			✓	✓	
Government loans/loan guarantees			✓	✓	

We defined fossil fuel activities as exploration for, and extraction, manufacturing, refining and distribution of fossil fuels; research and development supporting any of these activities; and fossil fuel consumption. We defined a fossil fuel subsidy as any of the "in scope" financial instruments in Table 1 that directly support fossil fuel activities. Many transport subsidies indirectly cause an increase in fossil fuel consumption. While these are not fossil fuel subsidies according to our definition, we identified them in the background notes to the release. We included subsidies to primary fossil fuels and to electricity and heat generated from fossil fuels.

2.2 Measurement of Fossil Fuel Subsidies

Data on direct subsidies, capital grants and social transfers supporting fossil fuel activities were readily available from accounts and reports of government departments and public bodies. Compiling data on tax expenditures involved defining the relevant benchmark rates of the Irish tax system and measuring tax expenditures as deviations from these rates.

Table 2: Benchmark Tax Rates in Ireland, 2019

Type of Tax	Specific Tax from Irish Regime	Unit	Benchmark Rate 2019
Excise Duty/Carbon Tax on Hydrocarbon Oils for Transport	Mineral Oil Tax on Petrol (Excise and Carbon Tax)	€ per 1,000 litres	587.71
Excise Duty/Carbon Tax on Hydrocarbon Oils for Heating	Mineral Oil Tax on Marked Gas Oil (Excise and Carbon Tax)	€ per 1,000 litres	102.28
Excise Duty on Electricity	Electricity Tax: Non-Business Use	€ per MWh	1.00
VAT on Energy Products	Standard VAT Rate	% of price	23

We obtained data on some tax expenditures directly from the Office of the Revenue Commissioners (Revenue). We estimated others using the revenue foregone approach which measures the reduction in tax revenue due to the reduced rate, assuming no behavioural change:

$$\text{Revenue foregone on fuel A} = (\text{benchmark rate} - \text{tax rate on fuel A}) \times \text{volume of Fuel A}$$

2.3 Examples of Fossil Fuel Subsidies

Table 3 shows the different kinds of subsidy identified in Ireland. Most are tax expenditures.

Table 3: Examples of Fossil Fuel Subsidies identified in Ireland

Fossil Fuel Subsidy	Type	Data Source
Electricity generation from fossil fuels	Direct subsidy	Electricity market regulator reports
Fuel poverty supports	Social transfers	Government accounts
Fuel grant for drivers with disabilities	Social transfers	Government accounts
Research and development funding	Capital grant	Direct requests to universities and government departments
Repayments of Excise/Carbon Tax on fossil fuels	Tax expenditure	Revenue data
Repayments of VAT on fossil fuels	Tax expenditure	Revenue data & CSO Estimates
Revenue foregone: fossil fuel Excise duty	Tax expenditure	Estimated using Revenue data
Revenue foregone on VAT on fossil fuels	Tax expenditure	Not yet estimated
Carbon Tax exemptions and reliefs	Tax expenditure	Not yet estimated
Revenue foregone on Electricity Tax	Tax expenditure	Estimated using Revenue data
Gas and oil royalty revenue foregone	Tax expenditure	Estimated using industry accounts
Revenue foregone: free emission permits	Tax expenditure	Estimated using EU ETS data
Expensing of exploration costs	Tax expenditure	No data available

2.4 Definition of Effective Carbon Rates

The OECD defines ECRs as the total price that applies to carbon dioxide emissions from energy use as a result of market-based instruments (fuel excise taxes, carbon taxes and carbon emissions permit prices) (OECD 2021). We largely based our work on OECD methods but built in coherence with the SEEA where possible.

We defined average ECRs as net energy tax receipts divided by carbon dioxide emissions from fuel combustion, for a given fuel and sector. Energy taxes are those included in the Eurostat environment taxes module. VAT was not included. Biofuels and non-energy use of fossil fuels were not included. The ten sectors covered were Road transport, Aviation, Water transport, Rail transport, Electricity generation, Industry, Services, Agriculture and Fishing, Household heating and Electricity consumption. ECRs are measured in units of euro per tonne of carbon dioxide emitted from combustion of the fuel.

Table 4: Energy Taxes included in the Eurostat module on Environment Taxes

Name of Energy Tax	Fossil Fuels subject to Energy Tax	Sectors liable for Energy Tax
Excise Duty	Hydrocarbon oils	All (but most electricity generation, aviation, water transport exempt)
Carbon Tax	Hydrocarbon oils, Natural Gas, Coal, Peat	All (but most electricity generation, aviation, water transport exempt)
Electricity Tax	Electricity from fossil fuels	Electricity consumption
Public Service Obligation (PSO) Levy	Electricity from fossil fuels	Electricity consumption
National Oil Reserves Agency (NORA) Levy	Petrol, diesel/gasoil, kerosene, fuel oil	All (but most electricity generation, aviation, water transport exempt)
EU ETS Emission Permit Purchases	All primary fossil fuels	Electricity generation, industry, services, aviation

2.5 Calculating Effective Carbon Rates

Average ECRs were calculated using data from the Office of the Revenue Commissioners (Revenue) on net energy tax receipts and fuel volumes wherever possible. When net receipts or fuel volumes for a specific fuel or sector were not available, information on energy tax rates and reliefs was used along with verified emissions data from the EU Emissions Trading Scheme (ETS) and energy use statistics from the Energy Balance to produce estimates. Emissions were calculated by applying emission factors to energy use.

2.6 Example Calculations of Effective Carbon Rates

Example 1: Average Effective Carbon Rate on Petrol

The ECR on petrol can be considered very reliable due to the quality of the data on tax receipts and volumes from Revenue, and on petrol volumes subject to the NORA Levy.

$$\text{ECR}(\text{petrol}) = \frac{\text{Net Excise Duty receipts} + \text{Net Carbon Tax receipts} + (\text{NORA Levy volume} \times \text{NORA Levy rate})}{\text{Revenue petrol volumes} \times \text{Energy conversion factor} \times \text{Emission factor}}$$

Example 2: Average Effective Carbon Rate on Natural Gas

Natural gas is used by the electricity generation, industry, services, road transport and household heating sectors. Natural gas supplies in Ireland are subject to the Natural Gas Carbon Tax (NGCT). Natural gas consumption is also subject to EU ETS permit purchases, receipts from which are treated as a tax in National Accounts. Annual data on net NGCT receipts and tax receipts from EU ETS permit purchases are available, though the latter cannot be linked to specific fuels.

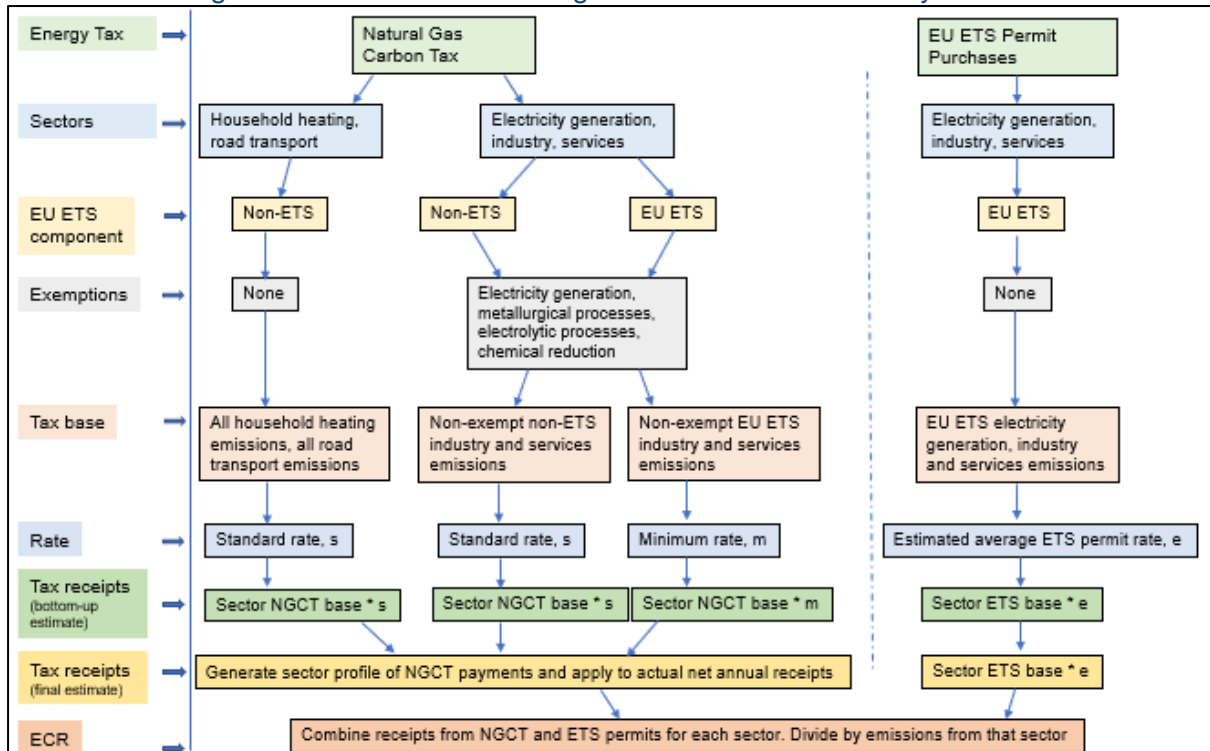
NGCT exemptions apply to natural gas used for electricity generation and certain industrial uses, while a minimum rate applies to fuel use under the EU ETS. By linking exemptions to sectors or subsectors we can estimate the amount of fuel use liable for NGCT in each sector. For example, we can link the exemption for metallurgical processes to manufacture of basic metals (NACE Division 24). Data from the EU ETS on emissions from natural gas by large emitters in the electricity generation, industry and services sectors are available.

NGCT rates can change mid-year. The CSO publishes data on quarterly networked gas consumption by different sectors, allowing us to assign accurate estimates of consumption to different rates within a year. Net NGCT receipts are controlled so bottom-up estimates are used to generate an average profile of taxes paid by sector.

Tax receipts from purchases of EU ETS emission permits at auction were used to calculate average emission permit rates by sector over each phase of the EU ETS. Although it is not known which sectors purchased permits, we have data on free allowances and verified emissions in each sector. By comparing emissions with free allowances, we assigned purchases to each sector. This provided a first order estimate for average permit rates,

accounting for free emission allowances. (Note these are not marginal rates which could be obtained from auction data.)

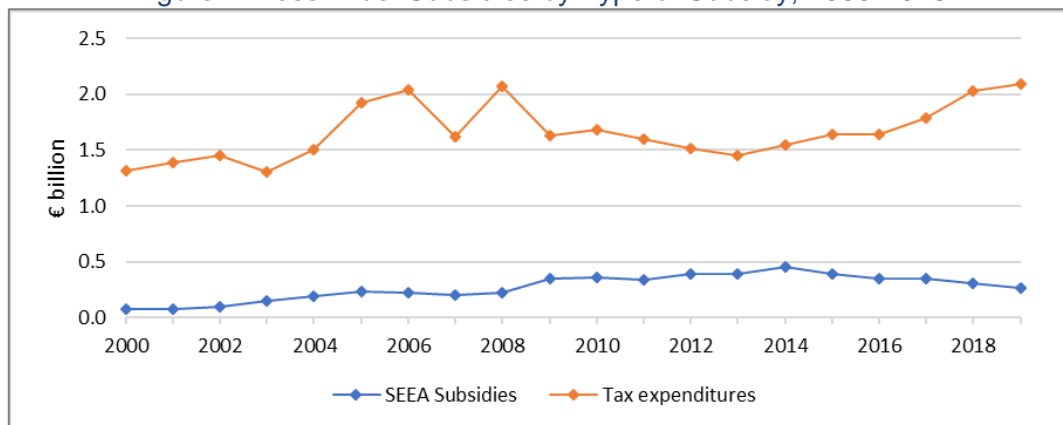
Figure 1: Calculation of Average ECRs on Natural Gas by Sector



3. Results:

We found that we were able to produce estimates of fossil fuel subsidies using available data sources such as tax statistics and government accounts. Tax expenditures dominated (see Figure 2) and were 89% of fossil fuel subsidies in 2019.

Figure 2: Fossil Fuel Subsidies by Type of Subsidy, 2000-2019



Fossil fuel subsidies in Ireland were €2.4 billion in 2019, 1% higher than 2018 and 60% higher than 2000. For comparison, CSO Environment’s releases on environment taxes and environmental subsidies showed that in 2019 energy taxes were €3 billion and €0.4 billion was spent on environmental energy subsidies. The largest fossil fuel subsidy in 2019 was due to the Excise and Carbon Tax exemption for jet kerosene used for commercial aviation. Using the revenue foregone approach, we estimated this as €634 million in 2019.

ECRs for selected fuels are shown in Table 5.

Table 5: Average Effective Carbon Rate (€ per t CO₂) on Selected Fuels, 2015-2019

Fuel	2015	2016	2017	2018	2019
Petrol	256.99	255.97	238.99	257.96	258.57
Autodiesel	182.96	183.88	171.88	183.89	183.47
Jet Kerosene	0.09	0.09	0.08	0.08	0.08
Residual Fuel Oil for Maritime Transport	0.00	0.00	0.00	0.00	0.00
Marked Gas Oil for Agriculture and Fishing	35.23	35.77	35.23	34.71	35.36
Household Heating Fuels	24.32	25.04	24.47	24.33	24.73
Fuels used in Industry	8.71	8.50	8.42	8.17	8.33
Fuels used in Electricity Generation	3.92	3.69	4.01	4.59	5.20

4. Discussion and Conclusion:

Main findings:

- The combination of an inventory of fossil fuel supports and a table of ECRs by sector and fuel provides the fullest picture of national support to fossil fuels
- An inventory allows policy makers to evaluate and track individual supports
- The inventory approach shows the extent of direct subsidies and tax expenditures
- Tax expenditures dominate fossil fuel subsidies
- Focus on budgetary (SEEA) supports and tax expenditures allows coherence with the Eurostat Environmental Subsidies module
- An advantage of ECRs is that they allow clear comparisons between sector rates
- ECRs are ideally suited to cross-country comparisons, unlike tax expenditures
- ECRs can be compared to a reference carbon rate to measure fossil fuel subsidies
- Defining ECRs in terms of energy taxes from the Eurostat Environment Taxes module results in coherence and potential efficiencies
- It was possible to produce estimates of ECRs using mainly tax and energy statistics

We hope to develop our work on fossil fuel subsidies by producing estimates for more fossil fuel subsidies and by providing a fuel breakdown of fossil fuel subsidies. We plan to calculate ECRs for NACE Rev. 2 divisions and may calculate ECRs net of direct subsidies. ECRs are already net of tax expenditures as they are calculated using net tax receipts. It is possible that effective carbon rates could be negative in this scenario. For example, combustion of peat for electricity generation in Ireland is exempt from most taxes, but was directly subsidised until 2019. Incorporating direct subsidies into ECRs would give a single figure for how much a sector is charged or paid for emitting each tonne of carbon dioxide from a particular fuel.

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