

REGULATORY ASSISTANCE PROJECT

Levelling the playing field: Aligning heating energy taxes and levies in Europe with climate goals

Jan Rosenow, Samuel Thomas, Duncan Gibb (RAP), Ruben Baetens, Andries De Brouwer,
Jan Cornillie (3E)



Executive summary

How much tax should governments add to the prices of the energy that we consume? This question has come sharply into focus, as the reality of the need to decarbonise the buildings sector has become more urgent.

Adding taxes and levies to energy prices encourages energy efficiency and raises revenues for governments, which can be dedicated to energy transition projects. But adding them disproportionately to electricity discourages us from investing in electrically powered heat pumps, a key technology in the buildings sector decarbonisation jigsaw. This paper¹ shines a light on the imbalance in energy taxation across almost all European markets and makes the case for reform.

To meet national and European climate targets, buildings must completely decarbonise by 2050, with greenhouse gas emissions from the sector falling by 60% across the EU by 2030 compared with 2015 levels.² Delivering this reduction will require a complete shift away from the use of fossil fuels for space and water heating, which account for more than two-thirds of residential energy consumption.³ A combination of regulation, investment support and price reform will be needed to deliver on these goals. Getting pricing right is not a silver bullet but, if reformed along with support for vulnerable households, it can align incentives with societal goals, drive compliance with regulations and reduce the need for subsidies among those able to invest.⁴

The two main approaches for reducing emissions in the sector are to reduce energy demand through improvements in the thermal efficiency of building fabric; and to decarbonise heat supply by switching away from fossil fuels to clean heating. Electrically powered heat pumps, whether in individually heated homes or as part of district heating supply, are likely to be the key heating system technology enabling this change. Now, in 2022, with the drive to move away from Russian fossil fuel imports, the need for heat electrification has never been stronger.

Yet, when we assess the state of play in European countries, we find that environmental costs are rarely well reflected in energy prices; and that the costs of energy transition programmes – and occasionally broader social policies – are overwhelmingly borne by electricity consumers.⁵

¹ The authors would like to acknowledge and express their appreciation to the following people who provided helpful information and insights into drafts of this paper: Renée Bruel, Bram Claeys, Richard Cowart and Louise Sunderland. Tim Simard provided editorial assistance.

² European Commission. (2020a). *Impact assessment accompanying the document COM(2020) 562 final: Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of The Regions – Stepping up Europe's 2030 climate ambition. Investing in a climate-neutral future for the benefit of our people [Commission staff working document]. SWD(2020) 176 final. Part 1.* <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020SC0176>

³ European Commission. (n.d.). *EU Buildings Factsheet.* https://ec.europa.eu/energy/eu-buildings-factsheets_en

⁴ The way that energy is priced is only one of many factors underpinning the decarbonisation of the buildings sector, albeit an important one. There are many non-financial barriers that need to be addressed too, and a robust policy package will need to go beyond fixing the economics. This paper provides a deep dive into the issue of taxes and levies, while fully recognising the limitations of focusing solely on pricing. We have discussed the merits of a well-aligned policy mix elsewhere using the example of heat pumps. See: Lowes, R., Rosenow, J. Scott, D., Sunderland, L., Thomas, S., Graf, A., Baton, M et al. (2022). *The perfect fit: Shaping the Fit for 55 package to drive a climate-compatible heat pump market.* Regulatory Assistance Project. <https://www.raonline.org/knowledge-center/the-perfect-fit-shaping-the-fit-for-55-package-to-drive-a-climate-compatible-heat-pump-market>

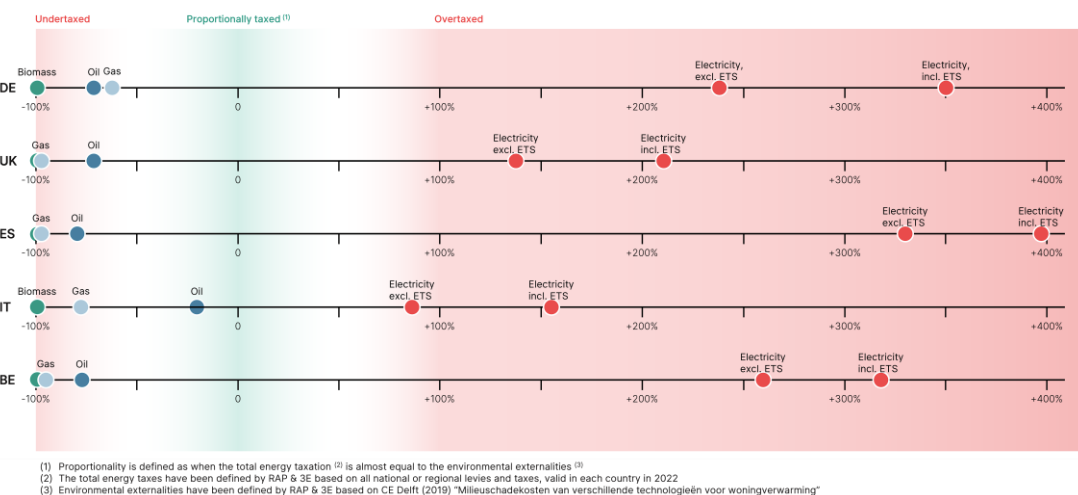
⁵ Some countries have temporarily reduced energy taxes or capped prices in 2022 in response to the high prices caused by the war in Ukraine and the recovery from depressed demand during the COVID pandemic. We do not include these temporary policy interventions in our analysis.

In this paper we explain the current structure of energy taxes and levies in five key European countries where reform would be beneficial, and set out four ways to rebalance energy taxes and levies, drawing on examples from around the continent.

Status quo in key markets does not encourage clean heating

We compared the taxes and levies on fossil gas, heating oil and electricity used by households in Germany, the United Kingdom, Spain, Italy and Belgium with estimates of the environmental costs associated with emissions of greenhouse gases, nitrogen oxides and particulate matter. In all five countries electricity is overtaxed, in three cases by more than 200%, and oil and fossil gas are undertaxed. Only in Italy is the tax rate on heating oil close to the value of the environmental costs caused by its use.

Summary figure 1. Taxes and levies compared to environmental externalities in Germany, the United Kingdom, Spain, Italy and Belgium



Meanwhile, electricity production is also covered by the EU Emissions Trading System (ETS), adding costs to the production of fossil-fuelled electricity, which are passed through to consumers. By contrast, the use of oil and gas in buildings is not covered by the ETS, except in district heating systems with large enough facilities to qualify.

The European Commission's proposals in the Fit for 55 Package, if implemented, would go a long way towards addressing the taxation issue. The proposal to rebalance energy excise taxation through a reform of the Energy Taxation Directive (ETD) would require electricity taxes to be lower than those on other fuels,⁶ while the extension of emissions trading to the buildings and road transport sectors (ETS 2) would add a carbon price to fossil heat.⁷ These are important developments that may or may not survive the negotiating processes around the Fit for 55 Package. Attempts to reform energy taxation at EU level have failed in the past.⁸ Either way, the analysis underpinning the Commission's proposals is good. Member States wishing to align

⁶ European Commission. (2021a). *Proposal for a Council Directive restructuring the Union framework for the taxation of energy products and electricity (recast) COM/2021/563 final*. <https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX:52021PC0563>

⁷ European Commission. (2021b). *Revision of the EU Emission Trading System*. https://ec.europa.eu/info/files/revision-eu-emission-trading-system_en

⁸ European Parliament. (2021). *Review of the Energy Taxation Directive*. [https://www.europarl.europa.eu/RegData/etudes/BRIE/2021/662636/EPRS_BRI\(2021\)662636_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/BRIE/2021/662636/EPRS_BRI(2021)662636_EN.pdf)

their taxation policy with their climate targets can act now to begin the process of rebalancing.

Even if the European Commission's proposals do become law, the excessive burden of levies on electricity consumers would remain. Levies are national tax measures where the revenues are hypothecated to fund specific programme spending. In some cases, electricity consumers subsidise social programmes where there is no direct justification, such as a subsidy for the railway sector in Italy, but by far the largest levies are used to fund energy transition subsidies, such as feed-in tariffs for renewables and carbon capture and storage (CCS) pilots.

Adding the costs of paying feed-in tariffs to electricity bills may have had relatively benign impacts in the past. However, now that the achievement of 2030 climate targets depends on switching away from fossil fuel-based heating, in particular through the rapid deployment of heat pumps and low-temperature district heating, the recovery of energy transition costs through electricity bills only serves to obstruct the fuel switching we need. It is like trying to accelerate with the handbrake on.

Options for reform – lessons from leading European countries

We highlight four approaches to rebalancing taxes and levies between electricity and the heating fuels that governments would like people to switch from. All four would have redistributive effects – there will always be winners and losers from tax reform – and all four would affect consumption and investment, with longer-term economic consequences. Ultimately, speeding up the electrification of heat will reduce the costs of the energy transition, as it is in line with the cost-effective meeting of 2030 targets and trajectories to net zero in 2050, as highlighted in the European Commission's Climate Target Plan.⁹

The options are not mutually exclusive. Indeed, from an economic perspective, an optimal mix of reforms would see higher fossil fuel taxes and lower electricity taxes, reflecting their respective environmental costs, along with a redistribution of levy costs from electricity consumers to the government, i.e., to taxpayers. This would be in line with the basic principle of efficient taxation, i.e., allowing prices to reflect their marginal costs of production (including environmental costs), while paying for social spending, including energy transition subsidies, through general taxation.

Option 1: Lower tax on electricity for heating

Perhaps the most straightforward and clearest example of tax reform in recent years was in Denmark, where the tax rate on electricity for heating was reduced to the minimum level allowed under EU law in 2021. This approach provides a clear signal that can be amplified through information campaigns and other incentives such as grants and loans aimed at driving investment in electrically powered heating. It also imposes no direct costs on low-income, fossil-fuel consuming households, although lost tax revenues would have impacts on broader tax and spending decisions.

Denmark also has environmental taxes on a variety of environmentally damaging emissions associated with energy use. However, its carbon tax is relatively modest (at

⁹ European Commission. (n.d.). *2030 Climate Target Plan*. https://ec.europa.eu/clima/eu-action/european-green-deal/2030-climate-target-plan_en

around €20-25) compared to Sweden, which has a carbon tax on heating fuels of over €110. The introduction and subsequent escalation in value of the Swedish carbon tax has coincided with the removal of heating oil from the fuel mix and the significant take-up of heat pumps (Sweden has the highest rate of heat pump ownership in Europe).

Option 2: Environmental taxation

Carbon taxation, while beneficial to the cost-effective meeting of climate goals, also comes with significant distributional implications, owing to the necessity of energy consumption and its higher share in the budgets of low-income households, necessitating compensatory measures among vulnerable groups. Carbon taxation does not only support electrification (in jurisdictions where electricity is relatively less carbon-intensive), it can also lead to the greater use of biomass in heating if biomass is not taxed to the same degree. Indeed, this was also seen in Sweden, where wood products are used in district heating systems and individual boilers. To the extent that the use of biomass in heating is undesirable from an environmental perspective, additional policy safeguards are likely to be needed to avoid negative outcomes.

Options 3 and 4: Shift levies to public budget or fossil fuels

Different ways of redistributing the energy tax burden have been applied in the Netherlands, where taxes have been shifted to fossil fuels, and Germany, where costs have been shifted to taxpayers.¹⁰ From an economic perspective, the Dutch levy on fossil fuels acts as a proxy for a carbon tax (the Netherlands does not have an official carbon tax), whereas in Germany the shift to general taxation has been accompanied by the introduction of a carbon tax on heating fuels (to become an emissions trading system in 2026).


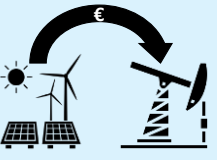
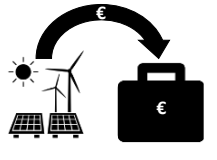

All four of these examples show what can be done if policymakers take seriously the need to align incentives with the actions that will be required if 2030 climate targets are to be met cost-effectively. Each example comes with side effects that need to be taken into account when designing policy portfolios. Reductions in electricity taxes and levies reduce the incentive to use electricity more efficiently, make inefficient electric resistive heating more affordable, and increase the payback period for building fabric efficiency improvements in electrically heated buildings. Where equivalent increases in taxes and levies are not put on other fuels, public finances see a reduction in revenues, and where they are, the distributional implications will likely necessitate financial compensation, particularly for low-income groups. Nevertheless, these side-effects should not obstruct the rebalancing of energy taxes and levies in a way that better aligns with the 'polluter pays' principle and the EU's environmental policy goals.

The European Commission's Fit for 55 Package proposes changes that would put the bloc on a path towards a more rational approach to heating fuel pricing. Now, at a time of unusually high energy prices, Member States can take actions to pre-empt changes to, and go further than, the Energy Taxation Directive, by reducing their tax rates on electricity for heating, and by removing the costs of social programmes and energy transition spending from electricity bills. It's time to release the fiscal handbrake and let the energy transition accelerate.

¹⁰ Belastingdienst. (n.d.). *Tabellen tarieven milieubelastingen*.

https://www.belastingdienst.nl/wps/wcm/connect/bldcontentnl/belastingdienst/zakelijk/overige_belastingen/belastingen_op_milieugrondslag/tarieven_milieubelastingen/tabellen_tarieven_milieubelastingen

Summary table 1. Options for reform of taxes and levies

	Option	Description	Examples	Advantages	Disadvantages	Key considerations
	Lower tax on electricity for heating	Lowering the tax rate applied to electricity that is used for heating	Denmark	Simplicity No negative impact on low-income customers	Loss in revenue If tax rate is low to start with, impact is limited	Potential for incentivising excessive electric resistive heating
	Shift levies to fossil fuels	Levies are shifted from electricity to fossil fuels	Netherlands Considered in UK	Simultaneously lowers cost of clean heating and increases cost of fossil heating	Impact on low-income customers using fossil fuels	Need to ensure low-income customers are not disadvantaged, and protected from impact
	Shift levies to public budget	Levies are shifted to the public budget	Germany	No negative impact on low-income customers	Additional cost item in public budget	Potentially less stable funding for clean energy programmes previously funded through levies
	Environmental taxation	Fossil fuels are taxed based on environmental impacts	Swedish carbon tax	Simplicity Source of additional revenue to support heat decarbonisation	Impact on low-income customers using fossil fuels	Need to ensure low-income customers are not disadvantaged, and protected from impact

Introduction

The EU27 and the UK have ambitious goals for decarbonising residential heating. In the EU27 greenhouse gas emissions from heating buildings will have to fall by 60% by 2030 based on 2015 levels in order to meet the economy-wide greenhouse gas reduction goals for 2030.¹¹ The UK government assumes that carbon emissions from homes need to drop by 47-62% by 2035.¹² A reduction of this scale in such a short amount of time has never been achieved before and requires an accelerated phase-out of fossil fuel-based heating.

Experts widely acknowledge that heat pumps and district heating are key solutions for decarbonising heating, alongside fabric efficiency upgrades. The International Energy Agency believes that by 2050 about 55% of all buildings in the world will need to have a heat pump to meet the climate goals: this equates to about 1.8 billion heat pumps across the entire building sector.¹³ National governments in Europe have put in place targets for heat pump deployment. For example, the new German government recently announced that it aims to install 4-6 million heat pumps by 2030.¹⁴ In the UK, the government set a target to deploy 600,000 heat pumps per year by 2028 and committed itself to no longer instal oil boilers after 2026 and fossil gas boilers after 2035.¹⁵

But in Europe, too often consumers face higher running costs if they decide to switch to clean heating technologies, despite the fact that fossil fuel boilers require around four times as much final energy to operate. This is partly because governments have attributed energy taxes and levies disproportionately to electricity rather than heating oil, fossil gas, coal and biomass. Unless the economics of clean heating improve it is difficult to see how governments can either persuade sufficient numbers of building owners to invest in technologies such as heat pumps or rely on regulation to mandate their deployment, without significant subsidies to offset the artificially high running costs.

Policymakers are increasingly aware of this significant barrier to clean heating technology adoption and the achievement of cost-effective pathways to net zero. Uneven energy taxes and levies have been identified as an area for urgent policy

¹¹ European Commission. (2020b). *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Stepping up Europe's 2030 climate ambition; Investing in a climate-neutral future for the benefit of our people*. Commission staff working document, impact assessment. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020SC0177>

¹² BEIS. (2021). *Net Zero Strategy: Build back greener*. Presented to Parliament pursuant to Section 14 of the Climate Change Act 2008. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1033990/net-zero-strategy-beis.pdf

¹³ IEA. (2021). *Net Zero by 2050: A Roadmap for the Global Energy Sector*. IEA, Paris. <https://www.iea.org/reports/net-zero-by-2050>

¹⁴ BWP. (2022, January 11). *Habeck Kündigt "Wärmepumpen-Rollout" An* [Press Release]. <https://www.waermepumpe.de/presse/news/details/habeck-kuendigt-rollout-von-waermepumpen-an>

¹⁵ BEIS, 2021.

reform, for example by the European Commission,¹⁶ the UK's Committee on Climate Change,¹⁷ and the German Advisory Council on the Environment.¹⁸

So far, most pan-European analyses of taxes and levies were carried out at a high level, only drawing on Eurostat data and similar sources. What this analysis does not reveal is exactly what kind of taxes and levies European countries apply and for what purpose. Furthermore, a systematic comparison of existing taxes and levies with the environmental externalities of different heating fuels is absent.

We also note that several countries have already reformed energy taxes and levies to improve the economics of switching to low-carbon heating, or are in the process of doing so. In this report we share some of these examples to illustrate the different options for reform.¹⁹

At a time where significant acceleration in clean heating is required and policies are under review at European and national level, this report takes stock of the existing taxes and levies that apply to heating fuels. It serves three important purposes:

- First, to collate the best available data on taxes and levies applied to heating fuels in selected countries in Europe.
- Second, to identify good practices in reforming taxes and levies to encourage heat decarbonisation.
- Third, to develop policy recommendations based on the evidence reviewed that can be adopted and adapted by other countries.

The first chapter provides an overview of the overall context of energy taxation and levies in Europe. This is followed by a number of case studies of countries where existing taxes and levies are problematic in that they disincentivise clean heating uptake. The third chapter provides specific options for policy and regulatory reform, again using country case studies to illustrate how this could work in practice.

With the recent increase in gas prices, clean heating solutions such as heat pumps have become cheaper to run in some countries compared to gas boilers, as analysis for the UK demonstrates.²⁰ It is unclear if, when and by how much gas prices could decrease in the future.²¹

¹⁶ European Commission. (2021c). *Revision of the Energy Taxation Directive (ETD): Questions and Answers*. https://ec.europa.eu/commission/presscorner/detail/en/qanda_21_3662

¹⁷ Committee on Climate Change. (2020). *The Sixth Carbon Budget. The UK's path to Net Zero*. <https://www.theccc.org.uk/wp-content/uploads/2020/12/The-Sixth-Carbon-Budget-The-UKs-path-to-Net-Zero.pdf>

¹⁸ Sachverständigenrat für Umweltfragen. (2020). *Für eine entschlossene Umweltpolitik in Deutschland und Europa*. Umweltgutachten 2020. https://www.umweltrat.de/SharedDocs/Downloads/DE/01_Umweltgutachten/2016_2020/2020_Umweltgutachten_Entschlossene_Umweltpolitik.pdf;jsessionid=C65026B0895E4DE542C680873ABE1AF1.1_cid292?_blob=publicationFile&v=31

¹⁹ This does not include any temporary tax reductions offered in response to the recent energy price rises.

²⁰ Rosenow, J. (2022). *Analysis: Running costs of heat pumps versus gas boilers*. Regulatory Assistance Project. <https://www.raponline.org/knowledge-center/analysis-running-costs-of-heat-pumps-versus-gas-boilers/>

²¹ EEX. (2022). *Futures market data* [obtained 22 February 2022]. <https://www.powernext.com/futures-market-data>

Taxes and levies on energy

Energy taxes and levies on energy in principle serve important purposes:

- They encourage investment in energy-efficient goods and services as well as energy-efficient lifestyles and behaviour.
- They play a directional role to encourage a shift towards more sustainable alternatives, provided they reflect the non-market environmental costs of energy production and consumption.
- They provide a source of revenue for governments that should be used to fund clean energy programmes including renewable energy and energy efficiency, particularly for low-income households.

However, if calibrated incorrectly they can misdirect people away from low-carbon solutions such as clean heating. This may not be intentional: it is often the outcome of historic policy decisions made at a time when the context was different and clean heating was not a primary consideration.²²

Taxes and levies on energy in Europe

Energy taxes have existed for a long time in Europe. As more products and services were covered by value added tax (VAT), energy used for heating also attracted VAT. For example, the UK started to tax domestic heating fuels in 1994.²³

Some countries also implemented specific energy taxes. For example, Germany implemented a tax on heating oil in 1960.²⁴ Until 2003 energy taxation for most heating fuels was a matter for EU Member States to decide, but in 1992 the European Union adopted the Energy Taxation Directive (ETD) which covered heating oil, among other non-heating fuels, but not gas and electricity. In 2003 the ETD was revised and now stipulates minimum tax levels for all of the main heating fuels and electricity, although most countries have higher taxes in place than the minimum levels required. The ETD is currently under review as the European Commission recognises that it is no longer fit for purpose in terms of providing the right directional incentives in the context of decarbonising the economy and addressing broader environmental concerns.²⁵

Environmental taxation goes back almost 90 years and is a well-established policy instrument.²⁶ Environmental taxes on resources, products, goods and services are a means of attaching a price to environmentally harmful activities. Economic theory suggests that when polluters take account only of the private costs of their activities, ignoring the environmental costs, they will pollute more than is socially efficient. Taxes

²² The impacts of increases in the costs on the demand for one fuel (e.g., fossil gas) and its substitutes (e.g., electricity) can be captured in elasticity analysis (for more details see Annex 2).

²³ Seely, A. & Twigger, R. (1997). *VAT on fuel & power*. House of Commons Library. <https://researchbriefings.files.parliament.uk/documents/RP97-87/RP97-87.pdf>

²⁴ Bundestag. (1970). *Kleine Anfrage der Abgeordneten Rollmann, Spilker, Gewandt und Genossen - Drucksache VI/ 1463 – [Memo]*. <https://dsserver.bundestag.de/btd/06/016/0601629.pdf>

²⁵ European Commission, 2021c.

²⁶ Markandya, A. (2012). Environmental taxation: What have we learnt in the last 30 years? *Environmental Taxes and Fiscal Reform*. Castellucci, L., Markandya, A., Eds. (2012). *Central Issues in Contemporary Economic Theory and Policy*. Palgrave Macmillan, London.

change the prices faced by polluters and they change their behaviour in response, but they need to be sufficiently high to encourage investments in clean heating technology (see Annex 2, which looks at the evidence on price elasticities).

For heating fuels this means that an environmental tax could internalise some or all of the environmental costs resulting from their use. This includes, for example, the impact on global warming of CO₂ emissions from heating and air pollution.

Carbon taxes are not required under EU law. To date, only nine EU Member States have placed a carbon tax on fossil heating fuels. On the other hand, the EU Emissions Trading System (ETS) ensures that a carbon price is passed through to all electricity consumers (and customers of district heating systems fed by installations large enough to be regulated through the ETS). Even where carbon taxes are in place, the EU ETS price (around €80/tonne in the first four months of 2022)²⁷ is higher than the prevailing carbon tax rate in all but one country. Figure 1 shows that heating fuels used for combustion in buildings, such as fossil gas, coal and oil, are subject to carbon taxes per tonne of €115 in Sweden, €62 in Finland, €45 in France, €41 in Ireland, €30 in Germany and Austria,^{28, 29, 30} €25 in Luxembourg,³¹ €23 in Denmark³² and Portugal,³³ €17 euros in Slovenia, and zero elsewhere in the EU.³⁴

Looking forward, the price of EU ETS allowances is uncertain. The average of independent forecasts, polled in April 2022, put the EU ETS allowance price at €100 in 2025 and €122 in 2030.³⁵ Carbon tax rates are more certain and are also expected to rise. Luxembourg's carbon tax is planned to rise to €30 in 2023 and Germany's carbon price trajectory is scheduled to reach €55-65 in 2026, after which the price will be determined through a national emissions trading system.^{36, 37} Ireland's Climate Action Committee has recommended that its carbon tax rise to €80 in 2030.³⁸ France's carbon

²⁷ The EU ETS price was stable at around €20-25/tonne during 2019 and 2020, rising to €32 at the start of 2021 to €80 by the start of 2022.

²⁸ The carbon price in Germany is set by the federal government but will be allowed to vary in a price corridor as part of a hybrid cap-and-trade mechanism from 2026. See Hansen, H. (2019). Germany to raise carbon price to 25 euros in 2021 after pressure. *Reuters*. <https://www.reuters.com/article/us-germany-climate-idUSKBN1YK0IF>

²⁹ Schulz, F. (2020, May). German cabinet agrees CO₂ price of €25 from January 2021. *Euractiv*. <https://www.euractiv.com/section/energy-environment/news/german-cabinet-agrees-to-a-co2-price-of-e25-from-january-2021/>

³⁰ Government of Austria. (2022). *Nationales Emissionszertifikatehandelsgesetz 2022*. https://www.ris.bka.gv.at/Dokumente/Begut/BEGUT_COO_2026_100_2_1908302/BEGUT_COO_2026_100_2_1908302.html

³¹ JCA. (2020). STATEC expects CO₂ tax to reduce emissions but not enough to meet climate objectives. *Luxembourg Chronicle*. <https://chronicle.lu/category/environment/34736-statec-expects-co2-tax-to-reduce-emissions-but-not-enough-to-meet-climate-objectives>

³² Exchange rate as of 21 March 2021 is 1 SEK = 0.099 euros. Government Offices of Sweden. (2021). *Sweden's carbon tax*. <https://www.government.se/government-policy/swedens-carbon-tax/swedens-carbon-tax/>

³³ Government of Ireland. (2021). *Budget 2022*. <https://www.gov.ie/en/campaigns/0020e-budget-2021/>

³⁴ World Bank Group. (2020). *State and trends of carbon pricing 2020*. <https://openknowledge.worldbank.org/bitstream/handle/10986/33809/9781464815867.pdf?sequence=4&isAllowed=y>

³⁵ Carbon Pulse. (2021). *Poll: Big boost for EU carbon price forecasts as several analysts see EUAs topping €100 this decade*. <https://carbon-pulse.com/125815/>

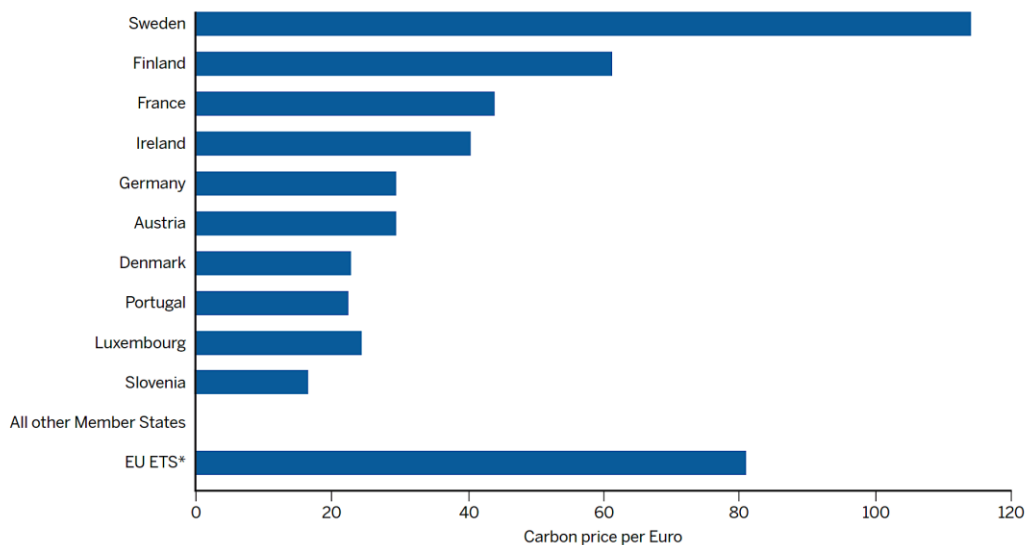
³⁶ Ember. (2021). *Carbon pricing - The latest data on EU ETS carbon prices*. <https://ember-climate.org/data/carbon-price-viewer/>

³⁷ Hansen, 2019.

³⁸ O'Sullivan, K. (2019). CO₂ and you: The carbon tax explained. *Irish Times*. <https://www.irishtimes.com/news/environment/co2-and-you-the-carbon-tax-explained-1.3839345>

tax was expected to increase on an annual basis to €86 euros by 2022, but has in fact been kept at 2018 levels in the face of public protests by the *gilets jaunes*.³⁹

Figure 1. Range of carbon prices on fossil fuels combusted in buildings (national measures) and used in electricity generation (EU ETS)



* EU ETS allowance market price 22 June 2022.

This uneven coverage of carbon pricing would be addressed through the adoption of the European Commission's proposal to extend emissions trading to the buildings and road transport sectors, which recognises the need to align price incentives with the energy transition investments required of building owners.⁴⁰ Correcting this distortion would improve the economics of building renovation and fuel switching in particular.

In addition to energy and carbon **taxes**, countries have increasingly added **levies** to energy bills for a variety of purposes, including supporting renewable energy deployment, energy efficiency programmes, and – in many of the cases examined in this report – social welfare schemes. Unlike taxes, levies are not funds collected for the public budget, but funds allocated to specific programmes and obligations. Levies are not regulated at European level directly, although European policy requires Member States to implement programmes to meet targets for renewable energy and energy efficiency, some of which have resulted in levy-funded policies.

The best-known example of a levy is probably the German Renewable Energy Sources Act from the year 2000 (preceded by the Electricity Feed-in Act which entered into force on 1 January 1991). This law initiated the first green electricity feed-in tariff scheme in the world to encourage the generation of renewable electricity. The scheme was funded by a surcharge on electricity consumers but with generous exemptions for industry.

³⁹ Savolainen, A. (2020). A low ineffective French carbon tax lies frozen at 2018 level. *Climate Scorecard*. <https://www.climate-scorecard.org/2020/03/the-dysfunctional-french-carbon-tax-is-frozen-at-2018-level/>

⁴⁰ European Commission. (2021d). *Questions and Answers - Emissions Trading – Putting a Price on carbon*. https://ec.europa.eu/commission/presscorner/detail/en/qanda_21_3542

Existing taxes and levies on heating fuels often directionally incorrect

In many countries, taxes and levies on energy are not applied to all heating fuels in the same manner; this can lead to distortions which provide misleading incentives. As a result, cleaner heating options often attract higher taxes and levies than more carbon-intensive fuels.

In particular, levies and taxes have been disproportionately applied to electricity, and in 2016 analysis on behalf of the European Commission concluded that “since 2008, the taxes and levies component has increased for electricity.”⁴¹

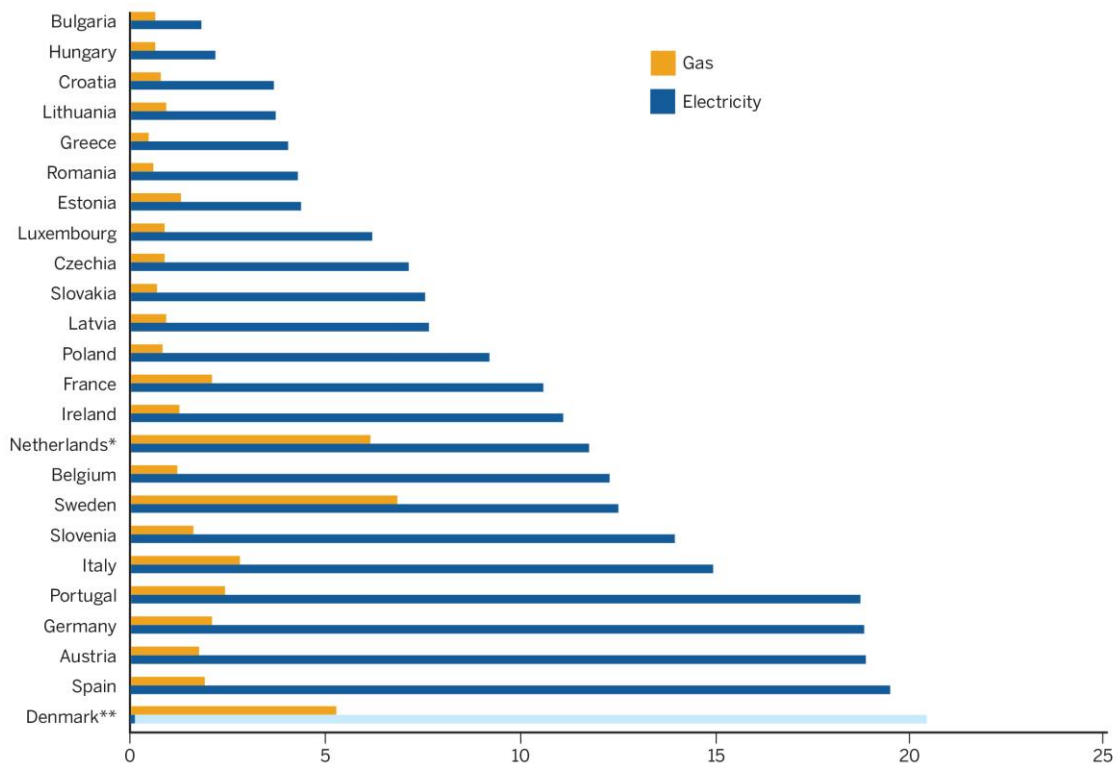
It is now clear that electricity in Europe will need to be fully decarbonised in the mid-2030s, and direct electrification via heat pumps is an important pathway to decarbonising heating. But the price ratio of electricity to gas (the most common fossil fuel used for heating in Europe) in many countries is unfavourable and discourages households with a gas boiler from switching to a heat pump. A significant portion of the disparity in price is driven by taxes and levies, fundamentally skewing the economics of space heating away from electrification at the very time that we would like people to invest in electrically powered heating technologies.

Figure 2 illustrates the disparities between fossil gas and electricity taxes and levies across Europe in 2020. The ratio of electricity taxes and levies to those on fossil gas is at least 1.8 in all EU countries and as high as 10.9 in Poland. The lowest ratios can be found in Sweden (which consumes virtually no fossil gas for space heating) and the Netherlands, where tax and levy reform has partly levelled up the burden of taxation.⁴² Only in Denmark do residential consumers registered as using electricity for space heating pay a lower tax rate than fossil gas consumers. The low tax rate is charged on consumption over 4,000 kWh per year for these consumers. This threshold represents the expected average electricity consumption of households for non-space heating services. While this helps to make the total costs of ownership of a heat pump more attractive than a fossil gas boiler, charging a lower rate for the first portion of a household’s electricity consumption (rather than the second) would provide a better incentive for the energy efficient use of electricity. As far as we are aware, there are no taxes or levies on biomass heating fuels.

⁴¹ Graves, K., Breitschopf, B., Ordonez, J., Wachsmuth, J., Boeve, S., Smith, M., Schubert, T., et al. (2016). *Prices and costs of EU energy*. Ecofys. https://www.isi.fraunhofer.de/content/dam/isi/dokumente/ccx/2016/report_ecofys2016.pdf

⁴² Electricity consumers in the Netherlands also receive a lump sum rebate to compensate for higher taxes and levies on fossil gas, however, this is not related to electricity consumption.

Figure 2. Levies and taxes (including VAT) on residential gas and electricity (euro cents per kWh) in EU Member States, average in 2021



* The taxes and levies on electricity in the Netherlands do not include the lump sum rebate given to residential electricity consumers, as this is not directly related to electricity consumption.

** The taxes and levies on residential electricity consumption over 4 000 kWh per year for residential consumers registered as using electricity for space heating in Denmark is the lowest in the EU. All other residential electricity consumption is subject to the highest rate in the EU.

Energy Taxation Directive a necessary first step for Member States to build upon

The current Energy Taxation Directive (ETD) exists to ensure that there are minimum tax levels across Member States on electricity and fuels when they are used as motor fuel, in aviation or heating in order to avoid competitive distortions and contribute to a low-carbon and energy-efficient economy.

However, the ETD does not contribute to heat decarbonisation, as the minimum rates are low and relate to neither energy nor carbon content. Furthermore, Member States are free to increase any energy tax above the minimum levels prescribed by the ETD. In practice, many Member States have set tax rates and levies and surcharges in such a way that they effectively subsidise fossil fuels by disproportionately burdening electricity consumption relative to other energy products and leaving taxes for fossil heating fuels at a relatively low rate.

The current proposals for the revisions of the ETD⁴³ look to ensure that, at least to some degree, the energy content and environmental impact of fuels is reflected in taxation (see Box 1). However, the proposed new minimum taxation levels for fossil heating fuels, and the exemptions envisaged, mean that only some countries (mostly in

⁴³ European Commission, 2021a.

Eastern and Southern Europe) with very low current tax rates would be affected, and only to a limited extent. The most significantly affected countries would be those that currently have a zero effective tax rate, such as Bulgaria, Czechia, Croatia, Hungary, Lithuania, Poland, Romania and Slovakia.⁴⁴ The impact on heat pump deployment would be likely to be marginal.

The proposed new ranking rule could have a more fundamental impact on price rebalancing, particularly in those Member States that currently have relatively high excise taxes on electricity, including large Member States such as France, Germany, Italy, Poland and Spain.⁴⁵ The new rule, if implemented, would ensure that fossil heat and biomass are always more highly taxed than electricity, although it would not mean that the differences in tax rates would need to fully reflect the differences in their environmental impacts.

Box 1. Proposals for the ETD

The ETD proposals would complement the extension of EU emissions trading to road transport and heating, which focuses on CO₂ emissions, by ensuring that Member States' energy taxation rates respect their relative environmental costs. The key implications are:

- Fossil fuels and unsustainable biomass would have increased minimum rates owing to their associated environmental damages, albeit not at sufficient levels to correct existing imbalances.
- Transitional rates on certain fuels and for certain groups (e.g., low income) would mean some tax increases would come in from 2023 and higher rates would be reached by 2033.
- A proposed ranking rule would ensure that in each Member State, the ranking of fuels by environmental performance would be maintained at higher tax rates. Electricity would always have the lowest rate, regardless of its use.⁴⁶

This is not the first time that ETD reform has been proposed. In 2011, the Commission also proposed to bring the Directive in line with climate and energy policy goals. However, opposition from some Member States and the need for unanimity in the Council on taxation matters meant that the proposals were not adopted. The unanimity requirement is the main barrier to the adoption of even a relatively modest reform of the ETD. However, 11 years have passed since the last attempt to revise the ETD, and the EU now has challenging 2030 and 2050 emissions reduction targets. A better alignment of the ETD with environmental policy requirements would make it easier for national policymakers to drive the needed energy transition to clean heating.

The Commission also proposed, in its Fit for 55 Package, a revision to the ETS Directive, extending emissions trading to the buildings and road transport sectors,

⁴⁴ Belgium, Bulgaria, Greece, Croatia, Hungary, Lithuania, Luxembourg, Latvia, Poland, Romania and Slovakia would be required to increase their tax rates on fossil gas to the proposed new minimum level. See: Gore, T. (2022). *Can Polluter Pays policies in the buildings and transport sectors be progressive? Assessing the distributional impacts on households of the proposed reform of the Energy Taxation Directive and extension of the Emissions Trading Scheme*. Research report, Institute for European Environmental Policy. [https://ieep.eu/uploads/articles/attachments/7a9ac44a-fa75-4caf-9db5-76d55110217c/Can%20polluter%20pays%20policies%20in%20buildings%20and%20transport%20be%20progressive_IEEP%20\(2022\).pdf?v=63813977582](https://ieep.eu/uploads/articles/attachments/7a9ac44a-fa75-4caf-9db5-76d55110217c/Can%20polluter%20pays%20policies%20in%20buildings%20and%20transport%20be%20progressive_IEEP%20(2022).pdf?v=63813977582)

⁴⁵ Austria, Cyprus, Germany, Denmark, Spain, Finland, France, Italy, Poland and Sweden would need to reduce their electricity taxes, raise fossil gas taxes, or some combination of both to meet the proposed ranking rule. See: Gore, 2022.

⁴⁶ Gore, T. (2021). *The revision of the Energy Taxation Directive could underpin a fair and green tax reform in Europe*. Heinrich Boll Stiftung. <https://eu.boell.org/en/2021/09/13/revision-energy-taxation-directive-could-underpin-fair-and-green-tax-reform-europe>

through the institution of a second trading system (ETS 2).⁴⁷ While not ensuring the same carbon price across fuels combusted in buildings and those used in the production of electricity, it would put in place the mechanism for a future joining of the two ETSS and provide policymakers with the flexibility to introduce social safeguards in its initial phase(s). For example, a price cap could be used to limit increases in the costs of fossil fuels, which make up a relatively large share of outgoings for many households in the lower income deciles in many EU countries. Meanwhile, the revenues from the auctioning of ETS allowances, and indeed energy taxation, can be used to make good the incomes after energy of the lowest income deciles, and form part of the funds needed for decarbonisation projects among those households least able to afford low-carbon investments.⁴⁸

The next section will zoom in on selected countries where significant imbalances between tax rates have been identified. This allows for a better understanding of the types of taxes and levies in place, their purpose and their effect on the final prices of different heating fuels. The chapter that follows will then offer a range of potential solutions that can be tailored to national circumstances.

⁴⁷ European Commission, 2021b.

⁴⁸ For more details see: Thomas, S, Sunderland, L. & Santini, M. (2021). *Pricing is just the icing: The role of carbon pricing in a comprehensive policy framework to decarbonise the EU buildings sector*. Regulatory Assistance Project. <https://www.raponline.org/knowledge-center/pricing-just-icing-role-carbon-pricing-comprehensive-policy-framework-decarbonise-eu-buildings-sector>

Country case studies of existing tax and levy regimes

This chapter provides five country case studies where the existing energy taxes and levies regime is problematic in that it hinders or slows down the uptake of clean heating technologies. The countries selected are Italy, Spain, the UK, Belgium and Germany – all countries with significant imbalances in terms of the apportioning of taxes and levies, and all countries among those with the highest levels of gas use for heating.

For each country we calculate the level of taxes and levies for different heating fuels including gas, oil, coal, wood and electricity.⁴⁹ We did not include those taxes and levies that are generic such as value-added tax, or fuel-specific levies (e.g., to finance the distribution infrastructure), and we focus only on the volumetric taxes and levies applied on the marginal energy consumption (per kWh). All levies and taxes have been evaluated in two ways:

- We calculate an implicit carbon tax for each country for each energy carrier. An implicit carbon tax can be defined as the sum of the current volumetric duties and levies, expressed in euros per tonne of CO₂. We present the implicit carbon tax including and excluding the EU ETS so that the non-ETS component is clearly visible.
- We compare the taxes and levies with the environmental externalities of heating fuels to determine whether fuels seem under- or overtaxed. Environmental externalities represent the negative environmental effects of the production and consumption of heating fuels, such as the damage costs of global warming (CO₂eq) and air pollution (NO_x, PM_{2.5} and PM₁₀). Damage costs have been calculated using the methodology and parameters of CE Delft (2019) on the environmental damage costs of different residential heating technologies.⁵⁰ For further detail on how taxes, levies and externalities have been calculated see the methodology in the Annex of this report.

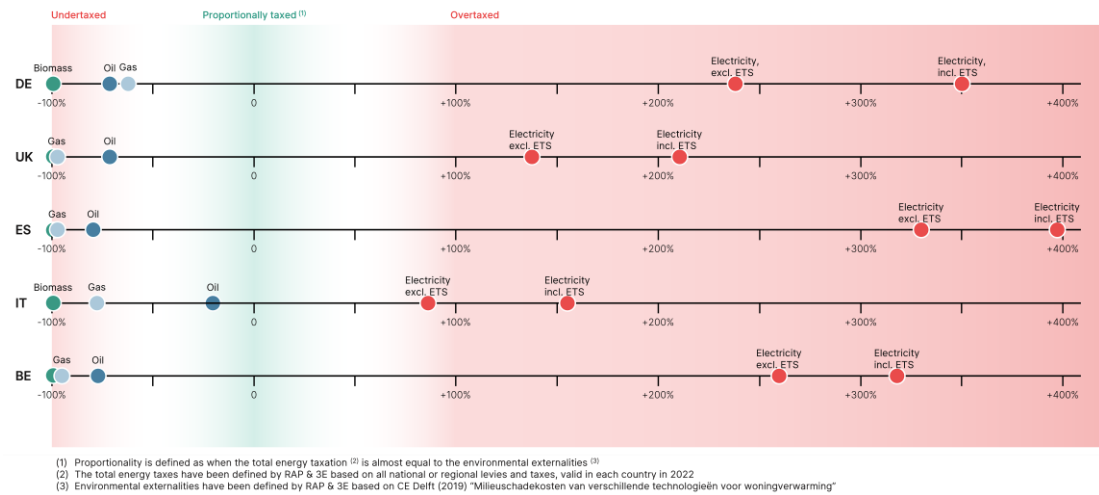
The summary of our analysis is presented in Figure 3. In all five countries electricity is overtaxed, i.e., the level of taxes and levies exceeds the environmental externalities per unit of energy, whereas oil, coal and gas are significantly undertaxed (with the exception of oil in Italy, which is closer to the optimal tax level). This has a direct effect on the relative running costs of heating systems and in the five countries analysed results in heating systems relying on electricity being more costly than other options.

⁴⁹ All presented taxes and levies are the taxes and levies that were in place in 01/2022 in the different countries.

⁵⁰ CE Delft. (2019). *Milieuschadeposten van verschillende technologieën voor woningverwarming*.

<https://www.vmm.be/publicaties/milieuschadeposten-van-verschillende-technologieen-voor-woningverwarming>

Figure 3. Taxes and levies compared to environmental externalities in Germany, the United Kingdom, Spain, Italy and Belgium



Below we present the data for each country in more detail. For further information and the sources used, we also provide detailed country reports.⁵¹

Italy

In 2018, Italy had an annual final energy demand of 735 TWh for heating and cooling, of which 61% relates to space heating and domestic hot water.

The residential heating and cooling demand averages 13.9 MWh per household, mainly covered by fossil gas (57%), biomass (19%) and gas oil (7%). Also 94% of new heating installations are fossil boilers, and only 4% of new heaters are electric heat pumps.

Energy taxation

Taxes and levies in Italy consist of two different types, i.e., excise duties on electricity, gas and other fossil fuels, and system levies on electricity and gas only. Both types of taxes favour the use of natural gas over gas oil and electricity.

- The excise duties are split in a duty on electricity and a duty on fossil fuels. The tax rate for electricity amounts to €22.70 per MWh, while gas oil is taxed at €38.90 per MWh. The rate for natural gas ranges from €3.70 to €15.60 per MWh depending on the annual volume and region.
- The system levies cover a wide range of policy costs. On electricity, a rate of €23.40 per MWh is applied to cover subsidies for renewable energy, nuclear safety, social measures and the railway sector. On gas, a levy of €3.80 per MWh applies to cover for energy efficiency and district heating subsidies. Both levies also finance an energy poverty fund.

In combination, excise duties and system levies result in overall taxes and levies of €7.50 per MWh on gas, €38.90 per MWh on gas oil, and €46.10 per MWh on electricity.

⁵¹ Country reports will be published on the RAP website later in 2022.

At €80 per ton CO₂eq and with an average carbon emission intensity of 0.234 tonnes CO₂eq per MWh electricity in 2019,⁵² the current EU ETS adds approximately another €18.70 per MWh to electricity in Italy.

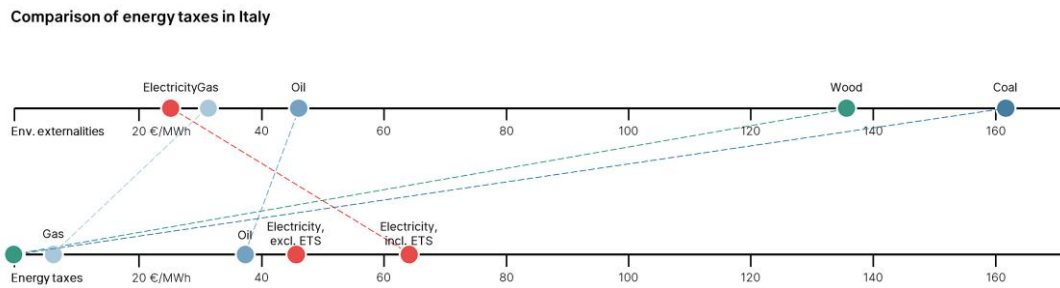
Additionally, a reduced VAT rate of 10% is applied to the domestic use of electricity, gas oil and the use up to 480 m³ of gas per year. Above this usage, the standard rate of 22% applies.

Evaluation

When recalculating all excise duties and levies into an implicit carbon tax, Italy levies an implicit carbon tax of €37 per tonne on gas, €150 per tonne on gas oil, and an additional €177 per tonne on electricity on top of the explicit carbon price of €80 in the EU ETS.

When a shadow cost for NO_x, PM_{2.5} and PM₁₀ is also included in the comparison, Italy seems to undertax gas and gas oil by 78% and 17% respectively, while overtaxing electricity by 82% excluding the EU ETS and 157% including the EU ETS (Figure 4).

Figure 4. Comparison of the energy tax and levies in Italy with the average environmental externalities of each energy vector, in euros per MWh excluding VAT



Spain

In 2018, Spain had an annual final energy demand of 384 TWh for heating and cooling, of which 57% relates to space heating and domestic hot water.

The residential heating and cooling demand averages 7.2 MWh per household, mainly covered by gas (38%), gas oil (24%) and biomass (22%). Ninety-three per cent of new heating installations are gas boilers, and only 5% of new heaters are electric heat pumps.

Energy taxation

In Spain there are three types of taxes and levies, i.e., excise duties on electricity, gas and other fossil fuels, levies on electricity and gas only, and an extra value added tax on the production of electricity.

- The excise duties consist of a duty on electricity, a duty on fossil fuels, and a duty on coal. The excise duty on electricity is an ad valorem tax of 5.11%, while

⁵² Eurostat. (2021). *Energy balances – early estimates*. Accessed 28 October 2021. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Energy_balances_-_early_estimates

coal and gas are taxed at €2.34 per MWh. The rate for gas oil equals €9.34 per MWh.

- The system levies cover a wide range of policy costs. On electricity, the levy is used to introduce a time-of-use component and the rate varies between €6 per MWh in the off-peak period to €133.10 per MWh in the peak-period. The levy mainly covers subsidies for renewable energy and energy-related compensations for the Spanish non-peninsular territories. On gas, an ad valorem tax of 0.14% is levied to cover for regulatory costs.
- A specific additional value added tax of 7% on the production value of electricity generation was introduced in 2012, an equivalent of approximately €2.8 per MWh.

Together, the three types of taxes and levies result in an equivalent average tax of €2.50 per MWh on gas, €9.30 per MWh on gas oil, and €113 per MWh on electricity.

At €80 per tonne CO₂eq and with an average carbon emission intensity of 0.210 tonnes CO₂eq per MWh electricity in 2019;⁵³ the current EU ETS approximately another €16.80 per MWh of taxes to electricity in Spain.

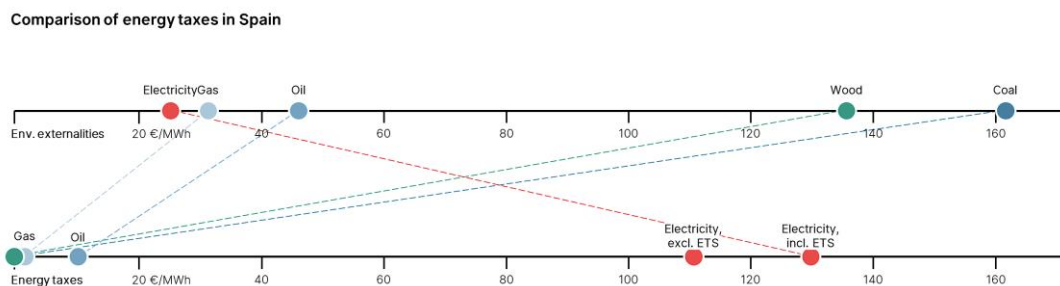
Additionally, the standard VAT rate of 21% is applied to all domestic use of energy, on top of all levies and taxes – significantly exacerbating the differences in taxation levels.

Evaluation

When recalculating all excise duties and levies into an implicit carbon tax, Spain levies an implicit carbon tax of €13 per tonne on gas, €36 per tonne on gas oil, and an additional €427 per tonne on electricity on top of the explicit carbon tax of €80 in the EU ETS.

When a shadow cost for NO_x, PM_{2.5} and PM₁₀ is also included in the comparison, Spain seems to undertax gas and gas oil by 92% and 80% respectively, while overtaxing electricity by 330% excluding the EU ETS and 397% including the EU ETS (Figure 5).

Figure 5. Comparison of the energy tax and levies in Spain with the average environmental externalities of each energy vector, in euros per MWh excluding VAT



The United Kingdom

In 2018, the UK had an annual final energy demand of 673 TWh for heating and cooling, of which 60% relates to space heating and domestic hot water.

⁵³ Eurostat, 2021.

The residential heating and cooling demand averages 12.8 MWh per household, mainly covered by gas (75%), gas oil (9%) and electricity (10%). Also 93% of new heating installations are gas boilers, and only 1% of new heaters are electric heat pumps.

Energy taxation

In the UK there are three different types of taxes and levies, i.e., excise duties on gas oil, a climate change levy for companies, and a set of environmental and social levies on electricity and gas only.

- The hydrocarbon oil duty is levied on gas oil and amounts to €12.10 per MWh.
- A set of environmental and social levies are levied on electricity and gas only. Around 70% of these levies fund clean energy projects, the remaining 30% cover social policies. The tax rates amount to an equivalent of €57.60 per MWh for electricity and €1.24 per MWh for gas.

Adding both together results in an equivalent tax of €1.20 per MWh on gas, €12.10 per MWh on gas oil, and €57.60 per MWh on electricity.

At €80 per tonne CO₂eq and with an average carbon emission intensity of 0.225 tonnes CO₂eq per MWh electricity in 2019,⁵⁴ the current UK ETS approximately adds another €18 per MWh to electricity in the UK.

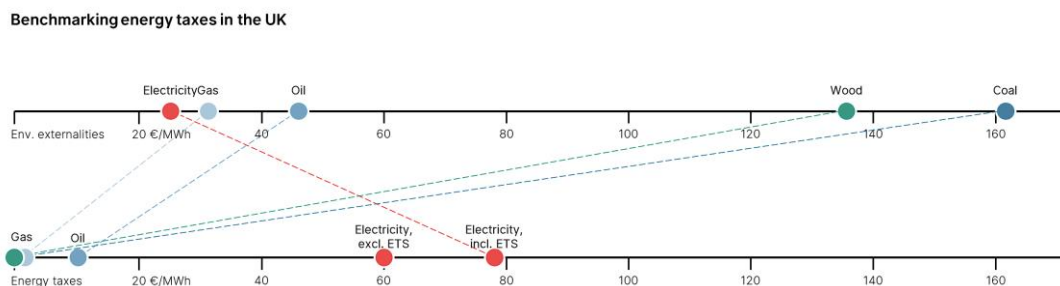
Additionally, a reduced VAT rate of 5% is applied to all domestic use of energy.

Evaluation

When recalculating all excise duties and levies into an implicit carbon tax, the UK levies an implicit carbon tax of €6 per tonne on gas, €49 per tonne on gas oil, and an additional €233 per tonne on electricity on top of the explicit carbon price of €80 in the UK ETS.

When a shadow cost for NO_x, PM_{2.5} and PM₁₀ is also included in the comparison, the UK seems to undertax gas and gas oil by 96% and 73% respectively, while overtaxing electricity by 140% excluding the EU ETS and 212% including the EU ETS (Figure 6).

Figure 6. Comparison of the energy tax and levies in the UK with the average environmental externalities of each energy vector, in euros per MWh excluding VAT



Belgium

In 2018, Belgium had an annual final energy demand of 165 TWh for heating and cooling, of which 59% relates to space heating and domestic hot water.

⁵⁴ Eurostat, 2021.

The residential heating and cooling demand averages 17.2 MWh per household, mainly covered by gas (46%), gas oil (36%) and electricity (10%). Also 95% of new heating installations are gas boilers, and only 5% of new heaters are electric heat pumps.

Energy taxation

In Belgium there are two types of taxes and levies: a federal excise duty on all energy vectors, and a wide set of regional social and environmental levies. The latter differs strongly among the three regions: Flanders, Wallonia and Brussels.

- The federal excise duty amounts to €1.50 per MWh on pipeline gas, €6.70 per MWh on gas oil, and €18.90 per MWh on electricity. The excise duty on electricity is a de facto environmental levy, financing the subsidies for offshore wind energy.
- Flanders adds three regional levies on top of the federal excise duty: a fixed energy fund contribution on electricity use, a surcharge for green power and cogeneration on the supply of electricity, and an additional public service obligation to the distribution grid operators for electricity and gas to cover the remaining costs for renewable energy subsidies and social energy policies. Altogether, these levies amount to €0.80 per MWh on gas and €72.40 per MWh on electricity.
- Wallonia adds four regional levies on top of the federal duty: a grid connection fee on electricity and gas to finance the Walloon energy fund, a surcharge for green power and cogeneration on the supply of electricity, a retribution for the using of public land charged to the distribution grid operators for gas and electricity, and an additional public service obligation to the distribution grid operators for electricity and gas to cover the remaining costs for renewable energy subsidies and social energy policies. Altogether, these levies amount to €4 per MWh on gas and €43 per MWh on electricity.
- Brussels adds three regional levies on top of the federal duty: a surcharge for green power and cogeneration on the supply of electricity and gas, a retribution for the use of public land charged to the distribution grid operators for gas and electricity, and an additional public service obligation to the distribution grid operators for electricity and gas to cover the remaining costs for renewable energy subsidies and social energy policies. Altogether, these levies amount to €2.60 per MWh on gas and €17.80 per MWh on electricity.

For Flanders this results in an overall equivalent taxes and levies level of €2.30 per MWh on gas, €9.40 per MWh on gas oil, and €91.20 per MWh on electricity.

At €80 euros per tonne CO₂eq and with an average carbon emission intensity of 0.174 tonnes CO₂eq per MWh electricity in 2019,⁵⁵ the current EU ETS approximately adds another €13.90 per MWh of taxes to electricity in Belgium.

Additionally, the standard VAT rate of 21% is applied to all domestic use of energy and on top of all levies and taxes – significantly exacerbating the differences in taxation levels.

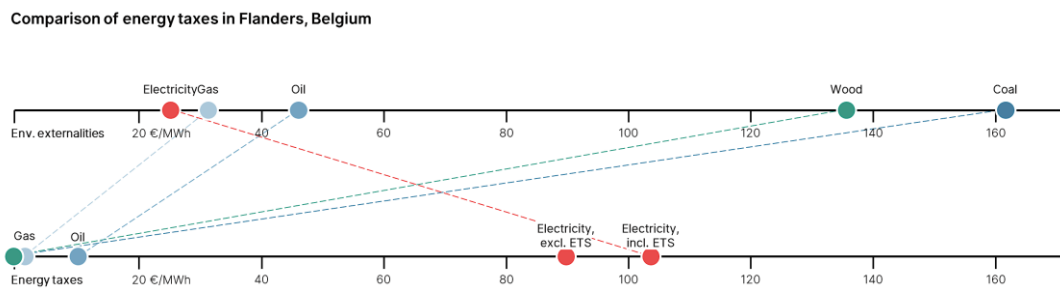
⁵⁵ Eurostat, 2021.

Evaluation

When recalculating all excise duties and levies into an implicit carbon tax, Flanders levies an implicit carbon tax of €12 per tonne on gas, €36 per tonne on gas oil, and an additional €351 per tonne on electricity on top of the explicit carbon tax of €80 of the EU ETS.

When a shadow cost for NO_x, PM_{2.5} and PM₁₀ is also included in the comparison, Flanders seems to undertax gas and gas oil by 93% and 80% respectively, while overtaxing electricity by 260% excluding the EU ETS and 316% including the EU ETS (Figure 7).

Figure 7. Comparison of the energy tax and levies in Belgium with the average environmental externalities of each energy vector, in euros per MWh excluding VAT



Germany

Germany has an annual final energy demand of 1,384 TWh for heating and cooling, of which 64% relates to space heating and domestic hot water.

The residential heating and cooling demand averages 13.6 MWh per household, mainly covered by gas (42%), gas oil (26%), biomass (11%) and district heating (10%). Also 84% of new heating installations are gas boilers, and only 13% of new heaters are electric heat pumps.

Energy taxation

Taxes and levies in Germany consist of three different types: excise duties on fossil fuels and electricity, a carbon tax, and a set of environmental and social levies on electricity and gas only.

- The excise duties are split into an energy fuel tax and an electricity tax. The former amounts to €5.92 per MWh for gas oil and €5.51 per MWh for gas, while the latter equals €20.50 per MWh on electricity.
- A federal carbon tax on gas and gas oil was introduced in 2021 and is currently set at €30 per tonne.
- Five different levies are added on top of the excise duty and carbon tax: a concession fee is charged to the distribution operators of gas and electricity for the use of public space, a renewable energy surcharge (no longer applicable after 1 July 2022, see note below), heat and power surcharge and offshore grid levy finance the green transition through the electricity bill, and the StromNEV surcharge covers the costs linked to the partial exemption from grid charges of

large power consumers. Together, these levies amount to €3 per MWh on gas and €66.20 per MWh on electricity.

This results in an equivalent tax of €14.50 per MWh on gas, €13.70 per MWh on gas oil, and €86.70 per MWh on electricity.

At €80 per tonne CO₂eq and with an average carbon emission intensity of 0.344 tonnes CO₂eq per MWh electricity in 2019,⁵⁶ the current EU ETS approximately adds another €27.50 per MWh of taxes to electricity in Germany.

Additionally, the standard VAT rate of 19% is applied to all domestic use of energy (except on biomass heating) on top of all levies and taxes, and thus exacerbates the differences in taxation levels.

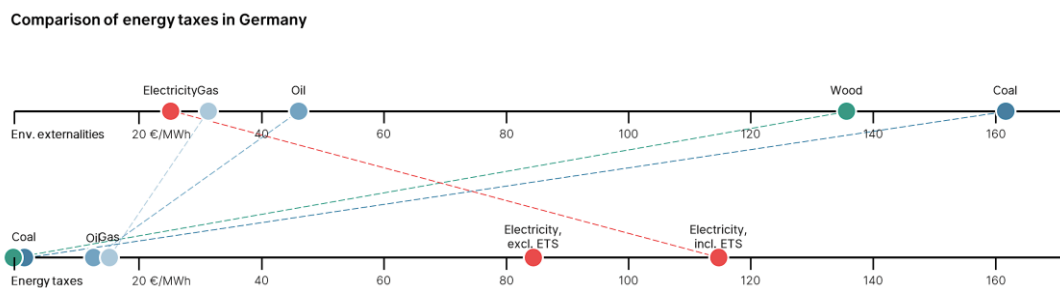
Over the course of this research the new German government has legislated for shifting all of the renewable energy surcharge to general taxation from 1 July 2022, which will result in a reduction of levies on electricity of €37.20 per MWh.⁵⁷

Evaluation

When recalculating all excise duties and levies, Germany levies an implicit carbon tax of €72 per tonne on gas, €53 per tonne on gas oil, and an additional €333 per tonne on electricity on top of the explicit carbon tax of €80 in the EU ETS.

When a shadow cost for NO_x, PM_{2.5} and PM₁₀ is also included in the comparison, Germany seems to undertax gas and gas oil by 57% and 71% respectively, while overtaxing electricity by 240% excluding the EU ETS and 350% including the EU ETS (Figure 8).

Figure 8. Comparison of the energy taxes and levies in Germany with the average environmental externalities of each energy vector, in euros per MWh (not including recent shift of the renewable energy surcharge)



⁵⁶ Eurostat, 2021.

⁵⁷ Bundesregierung. (2022). *Stromkunden werden entlastet*. <https://www.bundesregierung.de/breg-de/suche/eeq-umlage-faellt-weg-2011728>

Reforming taxes and levies: policy recommendations

As the analysis in the previous chapter shows, current taxes and levies on heating fuels are not well aligned with decarbonisation goals, and provide a disincentive for those considering a switch from fossil to clean heating. In all our five focus countries, taxes on fossil gas, heating oil and biomass are significantly lower than the cost of the environmental damage they cause. Polluters are not paying. Meanwhile, electricity consumers are burdened with national tax rates that are double or more than triple their environmental damage costs, while also paying a carbon price through the EU (and UK) ETSS.

While reform may partly be facilitated through forthcoming EU legislation, in EU Member States it is uncertain to what extent and exactly when this will require significant change in the way taxes and levies are put on heating fuels. National governments have the opportunity to reform taxes and levies early and give direction to the heating market to accelerate the uptake of clean heating in advance of potential EU legislation. So too does the UK.

An important consideration of any reform of taxes and levies is the impact this will have on the poorest in society. Heating with electricity is often used in poorer households, as evidence from the UK⁵⁸ and Austria⁵⁹ shows. Reducing levies and taxes on electricity would help with energy poverty in that segment. However, the majority of low-income households heat with fossil fuels and more often live in poorly insulated homes, unable to keep warm. Reforms of taxes and levies that will increase the costs of heating oil and gas need to be carefully evaluated in the context of the wider policy and regulatory framework.

Options for reforming taxes and levies

This section assesses the options for reform, presenting case studies of countries which have taken steps towards rebalancing the prices facing consumers. We show what is possible, presenting ideas that other countries could adapt for their circumstances.

Although the options for reform set out below are positive directional changes, even in those countries in which they taken place (with the exception of Denmark), electricity is still overtaxed compared to other fuels.

⁵⁸ BEIS. (2019). *National statistics: Fuel poverty detailed tables 2019*. <https://www.gov.uk/government/statistics/fuel-poverty-detailed-tables-2019>

⁵⁹ Lechinger, V. & Matzner, S. (2020). *So heizt Österreich – Heizungsarten und Energieträger in österreichischen Haushalten im sozialen Kontext*. AK-Wein. https://emedien.arbeiterkammer.at/viewer/rest/pdf/mets/AC12370441_2020_36.xml/LOG_0007/So_heizt_sterreich_Heizungsarten_und_Energietrger_in_sterreichischen_Haushalten_im_sozialen_Kontext.pdf



Lower tax on electricity for heating

Lowering the taxes applied to electricity used for heating is a simple option to make clean heating using electricity more attractive. Minimum tax rates, required by the Energy Taxation Directive, are applicable, but they are currently at very low levels (0.1 eurocent per kWh of electricity⁶⁰).

Assessment:

- **Shift towards sustainable heating:** Reduces the running costs for heat pumps; supports neither fossil fuel nor biomass heating.
- **Efficiency:** Makes inefficient electric resistive heating more attractive as well as efficient heat pumps; reduces incentive for building fabric improvements for electrically heated homes.
- **Public budget:** Leads to a loss in revenues for the public budget; however, focus on heating has less impact than reduction in electricity taxation for all end-uses.
- **Equity:** A key advantage of this option is that it does not have any negative impact on low-income customers as it reduces the cost of electricity.

Denmark has applied this approach, as described in the box below, focusing on electricity consumption over a threshold that broadly distinguishes between households that use electricity for heating and those that do not (Box 2).

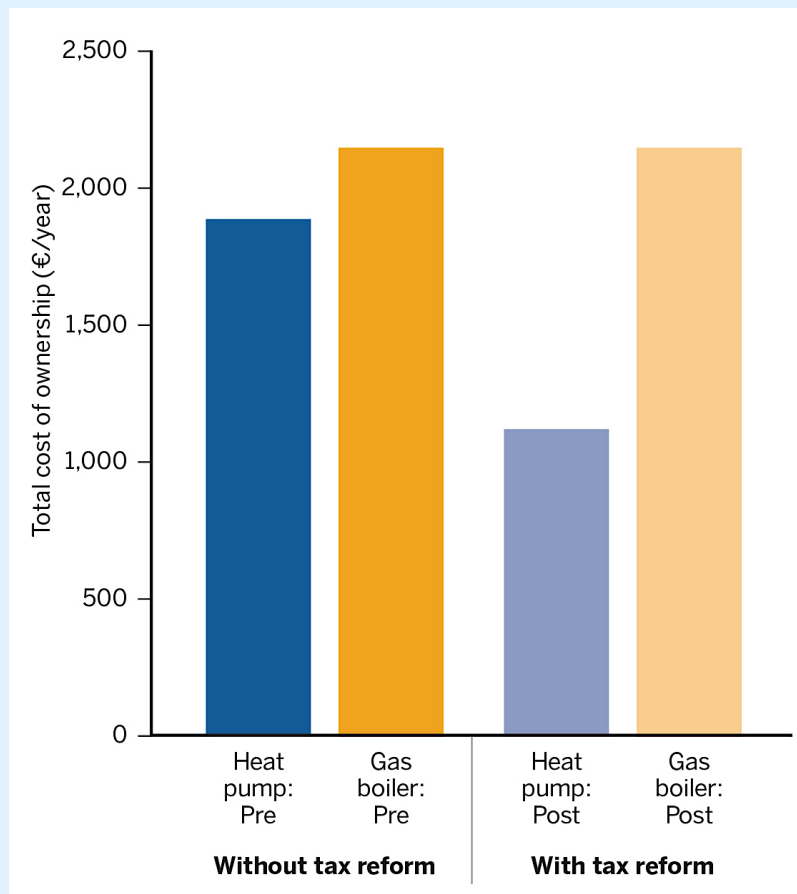
⁶⁰ European Commission. (2003). *Council Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity*. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02003L0096-20180915>

Box 2: Lower taxes on electricity for heating in Denmark

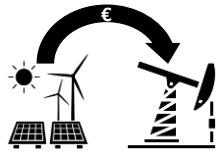
Electricity for heating was already taxed at a lower level than electricity for other uses.⁶¹ This tax benefit may have been a factor in the significant increase in sales of heat pumps, which have grown significantly in recent years. In 2020, 52% more heat pumps were sold than the year before. The country has recently taken a significant measure to support electricity for the heating of homes by lowering the energy tax on electricity used for heating from 2 eurocents / kWh to 0.05 eurocents / kWh, the minimum allowable tax rate under the ETD. This applies to the part of the consumption that exceeds 4 MWh annually in year-round dwellings and holiday homes heated by electricity. The Danish government is hoping that this incentive will help it roll out heat pumps more quickly and at a larger scale.

Denmark's tax reform improved the cost-competitiveness of electric heat pumps compared to the minimum efficiency fossil gas boilers (Figure 9). Prior to the reform, the annual cost of owning of an electric heat pump in Denmark was estimated to already be 18% cheaper than a gas boiler, at €1,900 and €2,150 per year respectively. Taxes and levies accounted for about 50% of the annual running cost of the heat pump. Minimising the Energy Tax on electricity reduced running costs by half, leading to an annual cost of ownership of just over €1,100.

Figure 9. Total cost of ownership of a heat pump and gas boiler before and after reform, Denmark



⁶¹ OECD. (2019). *Taxing Energy Use 2019: Country Note – Denmark*. <https://www.oecd.org/tax/tax-policy/taxing-energy-use-denmark.pdf>



Shift levies to fossil fuels

In Europe, the majority of environmental levies are currently attributed to electricity. One way of changing the relative running costs of heating systems is to shift these levies from electricity to other heating fuels. How they are apportioned could, for example, reflect environmental externalities. An advantage of this policy option is that it simultaneously lowers the cost of clean heating and increases the cost of fossil heating, making clean heating more attractive.

Assessment:

- **Shift towards sustainable heating:** Reduces the running costs of heat pumps; increases the running costs of fossil heating systems; makes biomass heating more economic compared to heating with oil and gas.
- **Efficiency:** Improves incentives for building fabric improvements in fossil-heated buildings; reduces incentives for efficiency in electrically heated buildings (both fabric and heating system).
- **Public budget:** No direct impact; equity considerations likely imply the need for increased public spending to offset distributional impacts .
- **Equity:** Households using fossil fuel for heating would be worse off unless they switch away from fossil heating systems, implying compensation payments, at least until low-income households have been able to adapt, and support for investment in low- carbon heating systems.

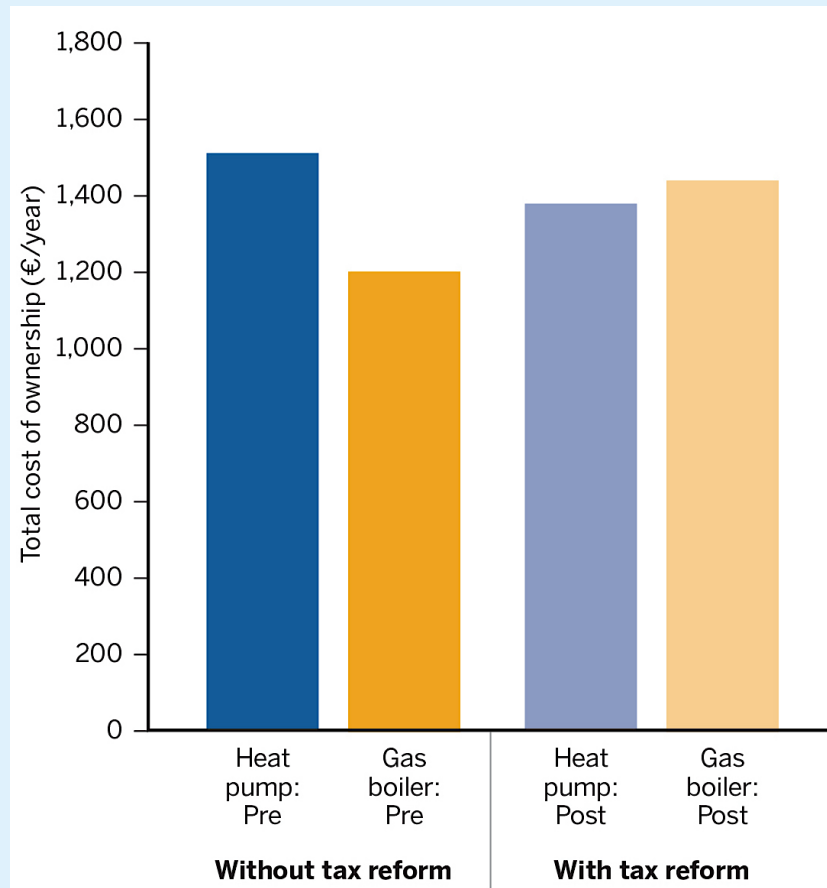
An example of a country where taxes and levies are increasingly shifted from electricity to other fuels is the Netherlands, alongside lump sum compensation (Box).

Box 3: Shifting taxes and levies to fossil fuels in the Netherlands

With its energy taxation system, the Dutch government aims to stimulate energy efficiency and enable the transition to sustainable energy. It has steadily increased its energy tax on gas while decreasing the energy tax on electricity: tax rates for an average household consumer have increased by 84% for gas and decreased by 25% for electricity since 2013.⁶² The high energy taxes are countered by a lump sum tax reduction per household. Of all the heating technologies, heat pumps have seen the biggest growth. In six years, the number of heat pumps has increased almost tenfold.⁶³ The changes in tax rates may have played a role in this success, for example by making it easier to implement the ban on gas connections for new buildings (imposed in 2018).

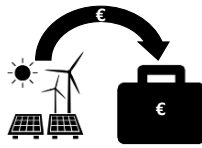
The Dutch tax reform is estimated to have caused heat pumps to become more cost-effective than fossil gas boilers (Figure 10). Prior to the reform, the annual total cost of operation (TCO) for an electric heat pump in the Netherlands was estimated at around €1,500, or about 26% more expensive than a gas boiler. Decreasing taxes on electricity and increasing them on fossil gas caused movement in both directions, leading the heat pump TCO to fall about 10%, while the gas boiler TCO rose some 17%. Post-reform, an electric heat pump was 4% cheaper per year than a fossil gas boiler.

Figure 10. Total cost of ownership of a heat pump and gas boiler before and after reform, Netherlands



⁶² Rijksoverheid. (2021). *Energiebelasting*.

<https://www.rijksoverheid.nl/onderwerpen/milieubelastingen/energiebelasting#:~:text=Het%20kabinet%20verhoogt%20de%20energiebelasting,voor%20duurzame%20warmteopties%2C%20zoals%20aardwarmte>



Shift levies to public budget

Rather than shifting levies to fossil heating fuels there is also the option of shifting to shift levies into the public budget. This lowers the cost of those fuels with a disproportionate share of levies. The advantage of this option is that it does not negatively affect low-income customers in the same way that other options such as environmental taxation might do if not accompanied by mitigating measures such as revenue recycling (provided general taxation is progressive, which it is in most European countries).

It is important to note that many clean energy programmes benefited from a stable funding source through levies for many years. If programme funding is shifted to the public budget, not only does it add another cost item in the public budget that needs to be funded, but once such programmes are funded through general taxation there is a risk of annual budget cycles affecting the funding stability.

Assessment:

- **Shift towards sustainable heating:** Reduces the running costs of heat pumps; no change in costs of fossil or biomass heating systems.
- **Efficiency:** Reduces incentives for efficiency in electrically heated buildings (both fabric and heating systems).
- **Public budget:** Adds a cost item to the public budget which can be significant.
- **Equity:** A key advantage of this option is that it does not have any negative impact on low-income customers, as it reduces the cost of electricity.

Germany is currently in the process of implementing this approach (Box 4).

⁶³ van der Zee, T. (2021). Warmtepompen onverminderd in de lift. *Installatie*. <https://www.installatie.nl/nieuws/warmtepompen-onverminderd-in-de-lift/>

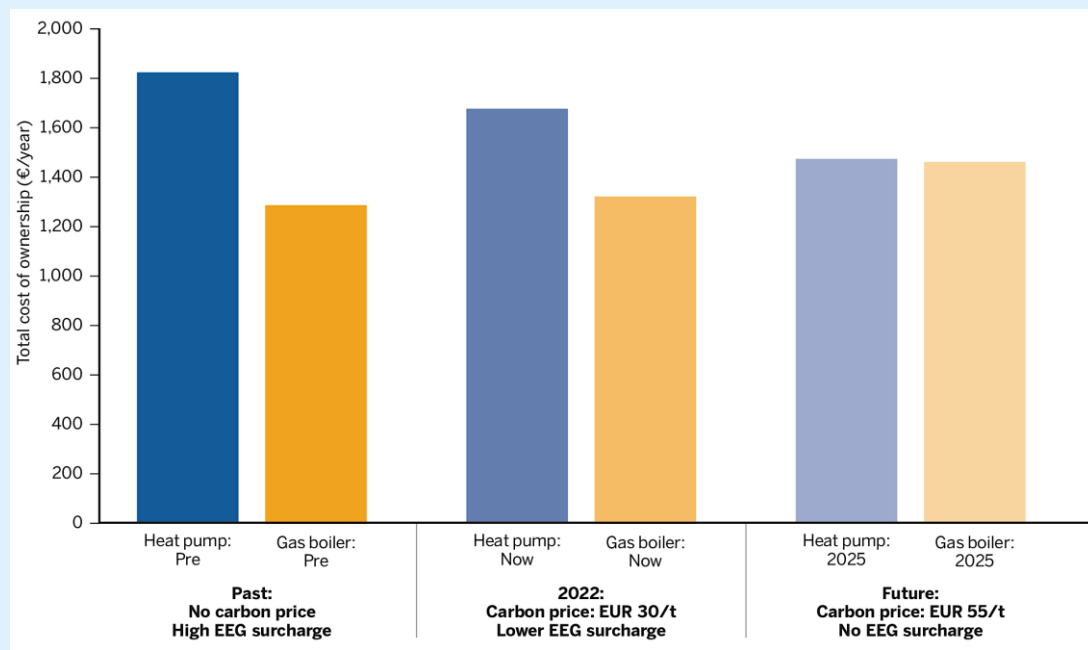
Box 4: Shifting levies to the public budget in Germany

The new German government has committed to shifting the renewable energy levy to general taxation. In a new piece of legislation to be passed next year, the government commits to “end the financing of the Renewable Energy Surcharge (EEG) levy via the electricity price as quickly as possible.”⁶⁴

Germany’s EEG reform and the introduction of a national ETS both have significant impacts on the TCO of an electric heat pump versus a natural gas boiler (Figure 11). Prior to 2021, under a German policy regime with an EEG levy of 6.5 ct/kWh and no carbon price, the yearly TCO of an electric heat pump was estimated at €1,800 – 42% more expensive than a fossil gas boiler.

As of 2022, the balance has shifted. The EEG levy was lowered to 3.7 ct/kWh and a carbon price was introduced, equivalent to €5/kWh on fossil gas. In this current scenario, the TCO of an electric heat pump has fallen to €1,700 per year, still 27% pricier than a fossil gas boiler (the TCO of which increased 3%). In a future scenario, the shifting of the EEG levy to general taxation (effectively reducing it to zero) and increasing the carbon price to €10/kWh would improve the cost-competitiveness of heat pumps even further, making it equivalent to a fossil gas boiler on a TCO basis at €1,500.

Figure 11. Total cost of ownership of a heat pump and gas boiler prior to, during, and after 2022, Germany



⁶⁴ Reuters. (2022). *German finance minister backs early end to green energy levy*. <https://www.reuters.com/business/sustainable-business/german-finmin-adds-his-voice-calls-early-end-green-energy-levy-2022-01-30/>



Environmental taxation

Energy production and consumption have environmental costs that are not factored into the prices faced by end-users, unless policymakers introduce environmental taxes (or cap and trade mechanisms). Including the external costs of environmental damage (or the marginal costs of meeting environmental targets) into energy prices aligns energy users' incentives with societal goals. In Europe, the environmental impacts of heating fuels have rarely been factored into end-user prices, while the EU ETS has at least ensured that electricity prices include a cost of carbon.

Assessment:

- **Shift towards sustainable heating:** Increases the costs of fossil and biomass (if taxed) heating systems (depending on type of tax).
- **Efficiency:** Improves incentives for efficiency in fossil and biomass (if taxed) heated buildings.
- **Public budget:** Increases revenues, enabling equity considerations to be addressed.
- **Equity:** Increases the costs of fossil and biomass (if taxed) heating, implying the need for compensation payments, at least until low-income households have been able to adapt, and support for investment in low- carbon heating systems.

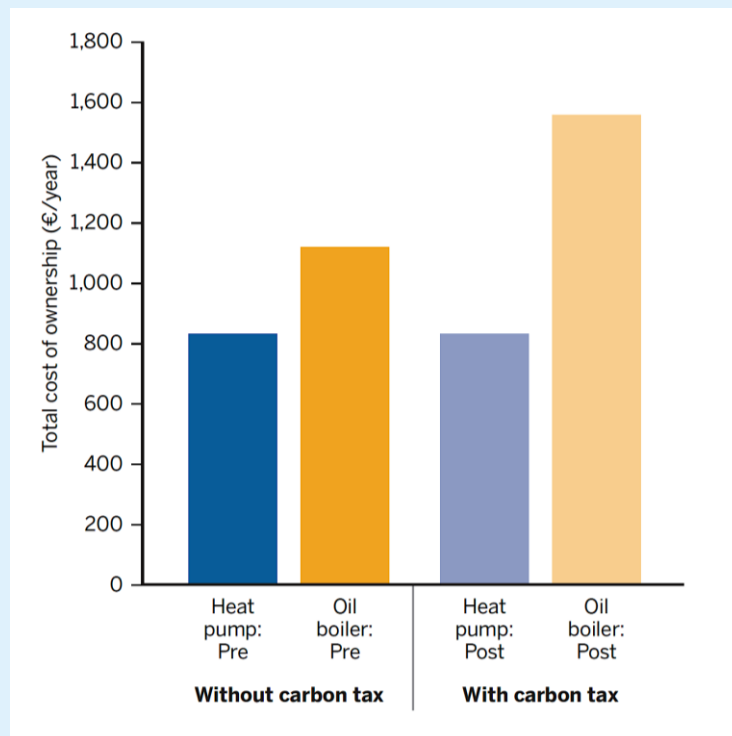
One of the countries in Europe with a long-standing carbon tax on heating fuels is Sweden, where this has been an important driver of the uptake of clean heating technologies (Box 5).

Box 5: Carbon tax in Sweden

Sweden was one of the first EU countries to introduce a carbon tax, in the early 1990s.⁶⁵ Many energy carriers are subject to both the carbon tax and a generic energy tax that excludes electricity. The carbon tax provides incentives to reduce energy consumption, improve energy efficiency and increase the use of renewable energy alternatives. The carbon tax rate steadily increased over time, and currently amounts to €115 per tonne⁶⁶ – nudging households and businesses to switch to renewable forms of heating. The sale of heat pumps has more than doubled in Sweden in the last 14 years: there are now 1.7 million heat pumps installed in the country of 10 million inhabitants.⁶⁷ However, high carbon taxes in Sweden have also resulted in an expansion of biomass heating, particularly as a fuel source for district heating.⁶⁸

Sweden's carbon tax has caused a shift away from residential heating oil to heat pumps and district heating, often fed by biomass boilers. The use of light heating oil in Swedish households collapsed 92% between 2005 and 2020, from 24.5 to 1.9 petajoules.⁶⁹ Based on 2021 technology and fuel/electricity prices, the estimated TCO for heat pumps and oil boilers were €850 and €1,100 respectively (Figure 12). Adding a carbon tax of 2.8 ct/kWh increases the oil boiler TCO to €1,600, around twice as expensive as an electric air-air heat pump. Low equipment costs of electric air-air heat pumps in Sweden (around €2,500⁷⁰) contribute to their competitive TCO.⁷¹

Figure 12. Total cost of ownership of a heat pump and heating oil boiler before and after carbon tax, Sweden



⁶⁵ Holmberg, R. (2021). *How are the Swedish taxes on energy and carbon dioxide related to energy efficiency?*

Odyssey-Mure. <https://www.odyssey-mure.eu/publications/policy-brief/swedish-taxes-energy-carbon.html>

⁶⁶ Sveriges Riksdag. (1994). *Lag (1994:1776) om skatt på energi*. <http://extwprlegs1.fao.org/docs/html/swe131806.htm>

⁶⁷ European Heating Industry. (2021). *Heating Market Report 2020*. <http://www.ehi.eu/heating-market-report/heating-market-report-2020/>

⁶⁸ Werner, S. (2017). District heating and cooling in Sweden. *Energy* 126, pp. 419-429

Summary

This chapter presented four options for reforming taxes and levies at the national level. Each of them has its advantages and disadvantages and needs to be tailored to the national policy context. These options can also be combined, and several variations are possible. Table 1 depicts each option, with a high-level summary of the advantages and disadvantages plus key considerations. This menu of options is a toolbox which national governments can use to encourage faster uptake of clean heating technologies. Table 1 summarises the main policy options for reforming taxes and levies on heating fuels.

At the time of writing, it is unclear to what extent EU legislation will require Member States to implement specific options such as adjusting levels of taxation. Through the ETS 2 there may be a carbon price added to fossil heating fuels, but this would most likely be set by the ETS regime rather than national governments. In order to alleviate the impact on households, governments could consider lowering other taxes in return, focusing on those taxes that disproportionately affect low-income households.


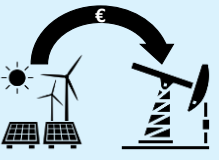
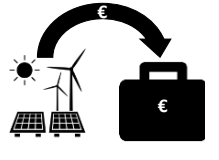

⁶⁹ Swedish Energy Agency. (2022). *Annual Energy Balance*.

<http://pxexternal.energimyndigheten.se/pxweb/en/%c3%85riig%20energibalans/?rxid=ee03e1ee-e561-4ef6-8f06-aae44b13c8b3>

⁷⁰ Svenska Kyl & Värmepumpföreningen., (2022). *PULSEN 2021*. <https://skvp.se/statistik/pulsen/2021>

⁷¹ This analysis is done for comparative purposes, portraying the carbon price impact on the oil boiler TCO. Using technology and fuel prices as well as carbon tax levels from when the carbon tax was introduced would provide a more meaningful historical comparison between the two technologies.

Table 1: Options for reform of taxes and levies

	Option	Description	Examples	Advantages	Disadvantages	Key considerations
	Lower tax on electricity for heating	Lowering the tax rate applied to electricity that is used for heating	Denmark	Simplicity No negative impact on low-income customers	Loss in revenue If tax rate is low to start with, impact is limited	Potential for incentivising excessive electric resistive heating
	Shift levies to fossil fuels	Levies are shifted from electricity to fossil fuels	Netherlands Considered in UK	Simultaneously lowers cost of clean heating and increases cost of fossil heating	Impact on low-income customers using fossil fuels	Need to ensure low-income customers are not disadvantaged, and protected from impact
	Shift levies to public budget	Levies are shifted to the public budget	Germany	No negative impact on low-income customers	Additional cost item in public budget	Potentially less stable funding for clean energy programmes previously funded through levies
	Environmental taxation	Fossil fuels are taxed based on environmental impacts	Swedish carbon tax	Simplicity Source of additional revenue to support heat decarbonisation	Impact on low-income customers using fossil fuels	Need to ensure low-income customers are not disadvantaged, and protected from impact

Policy recommendations

Decarbonising heat in the buildings sector will require a combination of regulatory, pricing and supporting policy measures to overcome the many barriers to an energy transition that affect the ways in which most Europeans currently heat their homes and workplaces. Both national policy portfolios and the overarching EU policy framework will need to change to drive the changes needed. Ensuring that end-users are getting the right price signals is just one element in this picture.

In many countries, reforming existing taxes and levies on heating fuels is an important piece of the puzzle in solving the heat decarbonisation challenge. Policymakers subsidising or regulating for clean heating technology face significant obstacles in a context where fossil fuel heating is the most economic option for end-users. Where fossil fuel heating is cheaper than clean heating, subsidies for clean heating technologies would need to be higher, while regulating the phase-out of fossil fuel heating would be politically challenging.

Main recommendation for national policymakers

Policymakers have to address the imbalance in taxes and levies between fossil fuels and electricity to ensure that climate targets can be met.

There are a number of steps that can be taken to help find the right solution for each country's context:

Step 1: Assess existing landscape of taxes and levies

A first step would be to carefully analyse the existing landscape of taxes and levies in a specific country differentiated by fuels, heating systems and segments of the population. Assessing the TCO of heating technologies, including all of the costs and benefits to the household associated with them (capital costs, running costs, any government incentives offered), can highlight whether or not the economics of clean heating are favourable enough or whether reform is needed.

Step 2: Compare options for reform against defined criteria

There is no single blueprint for reforming taxes and levies as every country is different in terms of the types of heating systems used, the building stock, existing heating infrastructure (for example whether or not district heating is used), income distribution, and existing social welfare provisions.

Each option is associated with advantages and disadvantages, and the criteria used to assess them will differ. Importantly, policymakers will want to pay particular attention to the distributional impacts of existing taxes and levies compared to potential reform options. Other factors to consider include the effects on the public budget, the impact the reform option would have on the economics of clean heating, and clean energy and social programmes currently funded via taxes and levies.

Step 3: Implement one policy option or a combination of options

Following the comparison and assessment of options, the most appropriate option can be implemented subject to the usual procedures including consultation. In some cases, a combination of options may be the most effective approach. For example, combining a carbon tax on fossil heating fuels and shifting levies from electricity to the public

budget would have more impact on the relative running costs of heating systems than shifting levies from electricity alone.

Complementary policies may be needed to offset any negative impacts on low-income households, for example through targeted energy efficiency programmes funded through carbon revenue recycling and the public budget.

Step 4: Monitor impact and recalibrate if necessary

Close monitoring of the impact of the policy option after implementation allows for a more effective calibration (e.g., the magnitude of a carbon tax). Important indicators include the uptake rates of clean heating systems following implementation, the impact on households of different income groups, feedback from supply chain actors, and the reduction in carbon emissions from heating.

Recommendations for the EU Fit for 55 Package

The EU policy framework can support the decarbonisation of heat in buildings in many ways. There are two key Directives concerning the energy prices faced by end-users: the ETS Directive and the Energy Taxation Directive. Together, reform of these EU laws would help to rebalance two of the key policy-driven elements of energy prices – carbon prices and energy taxes.

EU policymakers should extend emissions trading to the buildings and road transport sectors to rebalance carbon prices among heating fuels, using revenues to tackle energy poverty.

Agreeing to an increase in the costs of fossil fuels now, at a time of unusually high energy prices, is politically tricky. However, if policymakers commit to use the revenues to compensate low-income households and invest in renovation, the extension of emissions trading could improve the economic case for heat decarbonisation, with limited distributional implications.

The imbalance in carbon prices facing users of fossil fuels and electricity (and some district heating systems) sends the wrong signal to households and businesses. Rebalancing carbon prices, through the extension of emissions trading, would remove this problem. Initially, a separate system (ETS 2) could operate within a price corridor, similar to the systems in Germany and Austria, to limit the increase in heating fuel costs and provide a clear price signal. In the longer run, ETS 2 could merge with ETS 1.

Revenues could be used to ensure that those on the lowest incomes are not made worse off financially, and to form part of a fund for energy efficiency and heat decarbonisation projects among low-income households. This fund, as envisaged by the Social Climate Fund, would need to be supplemented by additional funding to adequately tackle the worst-performing buildings among the EU stock as an immediate priority. A renovation fund, financed partly by future ETS revenues, could begin operating before the introduction of ETS 2.

EU policymakers should reform the Energy Taxation Directive to ensure that taxes on heating fuels better reflect their environmental impacts

Beyond climate impacts, the combustion and production of biofuels and fossil fuels cause environmental damages that are rarely reflected in energy taxes. Electricity – often the least environmentally damaging energy vector – is almost always the most highly taxed, while biomass is not taxed at all as far as we are aware. The European

Commission's proposals for reform would create higher minimum taxation rates and, crucially, a ranking rule that would ensure that electricity always has the lowest rate. This would require Member States to either reduce electricity taxes, increase taxes on other fuels, or a mixture of both. Proposals to phase in increases in minimum tax rates among low-income households would enable Member States with low current tax rates to accelerate the electrification of heat before rates rose significantly.

Reform at EU level is both uncertain, owing to the ongoing negotiations (particularly for the ETD, which is expected to require unanimous approval by Member States), and not immediate. The European Commission has proposed a start date of 2026 for ETS 2. The reforms would also not address the distribution of levy costs across fuels. National governments can take action now to get ahead on the heat transition without waiting for the introduction of EU-wide measures.

Annex 1: Methodology

Taxes and levies

For the case studies, existing taxes and levies have been primarily identified based on the original laws and decrees in the different countries.

If the tax rate or the reason for introduction could not be defined based on the latter, national statistics and evaluation reports from government administrations and regulators have been used as secondary sources.

Externalities

Recalculating energy levies into implicit carbon taxes implies that CO₂ is the key pollutant one wants to reduce by means of energy taxation. However, using energy causes multiple pollutants with a climate, environmental or health impact – with each an external economic cost.

For the sake of clarity, we focus on four key pollutants:

- **CO₂eq** – Equivalent carbon dioxide emissions describe the climate impact of the use of the energy vector.
- **NO_x** – Nitrogen oxides are a family of poisonous, highly reactive gases which mainly impact on respiratory conditions, causing inflammation of the airways at high levels.
- **PM_{2.5}** and **PM₁₀** – Short-term exposure to fine particles has been associated with premature mortality, increased hospital admissions for heart or lung causes, acute and chronic bronchitis, asthma attacks, and restricted activity days.

We account for the external cost of CO₂ emissions at a *shadow cost* of €120/tCO₂eq for 2022 as proposed by the EIB and OECD.⁷²

CE Delft⁷³ has extensively documented the societal costs of NO_x, PM₁₀ and PM_{2.5} emissions. NO_x is accounted for at €24/kg, though a distinction in shadow cost could be made between a rural (€11-25) and urban environment (€23-51). Similarly, PM_{2.5} is accounted for at €84/kg, while distinction could be made for a rural (€60-129) and urban environment (€131-281).

A summary of the accounted external costs for each of the emission types is depicted in Table 2.

Table 2. Average external costs for emissions, based on EIB (2020) and CE Delft (2017)

€/kg	CO ₂	NO _x	PM _{2.5}	PM ₁₀
CE Delft, € ₂₀₁₅	0.057	22.8	79.7	55.7
€ ₂₀₂₂	0.120	24.0	84.0	58.7

⁷² CO₂ Shadow prices are expressed in 2016 euros and converted using the 2016 exchange rate from OECD. European Investment Bank. (2020). *EIB climate bank roadmap 2021-2025*. <https://www.eib.org/en/publications/the-eib-group-climate-bank-roadmap>

⁷³ Shadow prices are originally expressed in 2015 euros and converted to 2021 values using the 2015 exchange rate from OECD. See: de Bruyn, S., van der Veen, R., Korteland, M., & Bijleveld, M. (2017). *Milieuschadetekosten van verschillende technologieën voor woningverwarming*. Vlaamse Milieumaatschappij & CE Delft. https://ce.nl/wp-content/uploads/2021/03/CE_Delft_7P97_Milieuschadetekosten_woningverwarming_DEF.pdf

To determine the externalised environmental costs for each energy vector used for heating and cooling, the average specific CO₂, NO_x and PM emissions should be defined. Both the direct emissions (at the location of use) and indirect emissions (occurring as a consequence of the activity, but elsewhere) are of importance here.

For the purposes of this study, we will base ourselves on the average emissions found by CE Delft (2017) as summarised in Table 3.⁷⁴

Table 3. Assumed direct and indirect emissions per energy vector, per MWh, based on CE Delft (2017)

(kg/MWh)	CO ₂	NO _x	PM _{2.5}	PM ₁₀
Natural gas	234	0.203	0.006	0.005
Heating oil	309	0.301	0.020	0.012
Wood	^(a) 24	0.361	0.072	2.020
Coal	373	0.462	0.104	1.669
Electricity	^(b) 170	0.164	0.011	0.001

(a) No direct emissions have been accounted for, only indirect emissions.

(b) The number of 170 kg/MWh is defined as the expected average European carbon intensity between 2020 and 2030.

The resulting environmental externalities for each of the energy vectors are estimated at €25 /MWh for the use of electricity, at €34-47 /MWh for gas and gas oil heating, €136/MWh for biomass heating, and €162/MWh for coal.

Total cost of ownership

This paper presents scenarios in four countries that evaluate the impact of revising taxes and levies. In doing so, a TCO methodology was applied for Denmark, the Netherlands, Germany and Sweden. As some aspects have been excluded from this analysis, the figures presented in this paper are not intended to be precise representations of the total cost of ownership but should adequately show the contrast between the different tax and levy scenarios.

For all countries, the calculation consists of a capital cost component and an operating cost component. The annual capital costs are represented by upfront costs (equipment and installation) and potential subsidies amortised over the equipment lifetime. Cost of capital is not included. The annual operating costs are represented by fuel demand (per country and calculated from heating demand and appliance efficiency), fuel prices (excluding taxes and levies,) and any additional taxes and levies.

General data used in the analysis are from the following sources:

- Space and water heating demand in households and number of households are from Eurostat.⁷⁵

⁷⁴ de Bruyn, S, et al., 2017.

⁷⁵ Eurostat. (n.d.). *Data Browser*. https://ec.europa.eu/eurostat/databrowser/view/NRG_D_HHQ; Eurostat. (2022). *Number of private households by household composition, number of children and age of youngest child*. https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=lfst_hhnhtych&lang=en

- Electricity and gas prices before taxes are from Eurostat, 2021-S2.⁷⁶
- Taxes and levies per country are from a range of national sources.⁷⁷
- Subsidy amounts are primarily from Cool Products, with some national sources mixed in.⁷⁸
- Upfront costs of heat pumps, gas boilers and oil boilers are from a mix of sources, including Cambridge Econometrics,⁷⁹ Energieheld,⁸⁰ and the Swedish Heat Pump Agency.⁸¹

The scenarios are the following:

- **Denmark:** PRE is with an energy tax of €120/MWh on electricity, while POST is with this tax reduced to €1/MWh.
- **Germany:** PAST is without a carbon price on heating fuels and an EEG levy of €65/MWh, 2022 is with a carbon price of €6/MWh on gas and EEG at €37/MWh and FUTURE is with a carbon price of €10/MWh (2026 rate) and EEG at €0/MWh after its move to general taxation.
- **Netherlands:** PRE is with an energy tax of €125.7/MWh on electricity and €19/MWh on gas while POST alters these rates to €94.3/MWh and €34.9/MWh respectively.
- **Sweden:** PRE is with no carbon tax while POST is with a carbon price of €28.3/MWh on heating oil.

The analysis does not consider maintenance costs, standing charges or cost of capital. It also does not factor in the energy tax rebate as applied to energy bills in the Netherlands. As representative CAPEX data are tricky to acquire, the analysis assumes that upfront costs are full equipment and installation costs. RAP will continue refining this methodology and data sources for future studies.

⁷⁶ Eurostat. (2022). *Electricity prices for household consumers - bi-annual data (from 2007 onwards)*.

https://ec.europa.eu/eurostat/databrowser/view/nrg_pc_204/; Eurostat. (2022). *Gas prices for household consumers - bi-annual data (from 2007 onwards)*. https://ec.europa.eu/eurostat/databrowser/view/nrg_pc_202/default/table?lang=en

⁷⁷ Umwelt Bundesamt & Deutsche Emissionshandelsstelle. (2020). *Wie betrifft der nationale Emissionshandel Verbraucher*innen?* <https://skat.dk/skat.aspx?oid=2246453#:~:text=Electricity%20tax%20deduction&text=In%202021%2C%20the%20electricity%20tax,process%20purposes%20and%20room%20heating>; https://www.dehst.de/DE/Nationaler-Emissionshandel/nEHS-verstehen/neh-verstehen_node.html;jsessionid=DCE568A103AB363DA041D1922B773AAF.1_cid292#doc16289998;

⁷⁸ Tognetti, F. (2020). *Analysis of existing incentives in Europe for heating powered by fossil fuels and renewable sources*. Coolproducts. https://www.coolproducts.eu/wp-content/uploads/2020/12/Analysis-of-Fossil-Fuel-Incentives-in-Europe_FINAL.pdf; https://www.bafa.de/DE/Energie/Heizen_mit_Erneuerbaren_Energien/Foerderprogramm_im_Ueberblick/foerderprogramm_im_ueberblick_k_node.html; Rijksdienst voor Ondernemend Nederland. (2020). *ISDE: Warmtepomp woningeigenaren*. <https://www.rvo.nl/subsidies-financiering/isde/woningeigenaren/warmtepomp>

⁷⁹ Assumed 10kW system, European Climate Foundation & Cambridge Econometrics. (2022). *Modelling the socioeconomic impacts of zero carbon housing in Europe*. <https://europeanclimate.org/wp-content/uploads/2022/03/modelling-the-socioeconomic-impact-of-zero-carbon-housing-in-europe-final-technical-report-march2022.pdf>

⁸⁰ Kloth, P. (2022). *Neue Gasheizung - Kosten, Förderung und Wirtschaftlichkeit*. Energieheld. <https://www.energieheld.de/heizung/gasheizung/kosten>

⁸¹ Svenska Kyl & Värmepumpföreningen, 2022.

Annex 2: Elasticities of demand for heating fuels

Empirical estimates of the impacts of energy taxes tend to show that the demand for energy is relatively unresponsive to changes in its price.

Energy is a price-inelastic good, meaning that a 1% increase in its price would lead to less than a 1% decrease in its consumption (its price elasticity of demand is between 0 and -1). This is because it is a necessity for the basics of human life (heating, cooking, light). Faced with an increase in the price of energy and a budget constraint, other less essential (and less energy-intensive) spending tends to be reduced first.

Estimates of the price elasticity of demand for heating fuels in Europe range from -0.025 to -0.26, with long-run estimates ranging from -0.05 to -0.32 for fossil gas and -0.025 to -0.50 for electricity, showing that it is very price-inelastic.⁸² Long-run elasticities (the impact after several years of higher prices) tend to be higher (closer to -1) as some energy users will have been able to adapt to higher prices by investing in energy-efficient products and equipment.

Cross-price elasticities of demand are important in the context of the electrification of space and water heating. Cross-price elasticities are empirical estimates of the responsiveness of demand for one good or service when the price of a substitute is changed. For example, analysis in Sweden showed that, when transport energy use was disaggregated, increases in the price of gasoline led to decreases in gasoline consumption, offset by increases in diesel consumption and vice versa (for example, gasoline had a long-run own price elasticity of demand of -1.09 and diesel had a long-run cross-price elasticity of demand with respect to gasoline prices of 0.40).⁸³

The availability of substitute fuels and, crucially, technologies that use those fuels, allows the impact of changes in fuel prices to lead to more elastic changes in its consumption. This highlights the importance of other enabling policy measures in ensuring that energy users are able to switch fuels when changes in energy taxes aimed at fuel switching are instituted.

⁸² Europe Economics. (2016). *Evaluation of fiscal measures in the national policies and methodologies to implement Article 7 of the Energy Efficiency Directive*.
https://ec.europa.eu/energy/sites/ener/files/documents/final_report_on_fiscal_measures_used_under_article_7_eed_0.pdf

⁸³ Europe Economics, 2016.



RAP[®]

Energy Solutions for a Changing World

Regulatory Assistance Project (RAP)[®]
Belgium · China · Germany · India · United States

Rue de la Science 23
B – 1040 Brussels
Belgium

+32 2-789-3012
info@raponline.org
raponline.org

© Regulatory Assistance Project (RAP)[®]. This work is licensed under a Creative Commons Attribution-NonCommercial License (CC BY-NC 4.0).