Low Carbon Ukraine
Policy advice on low-carbon policies for Ukraine

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Pathways for reforming Ukraine's carbon tax

Towards an ETS-compatible upstream tax with an expanded scope

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About Low Carbon Ukraine

Low Carbon Ukraine is a project that continuously supports the Ukrainian and Moldovan governments with demand-driven analyses and policy proposals to promote the transition towards a low-carbon economy.

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Executive summary

- Ukraine is facing a formidable challenge in **fully aligning its climate legislation and policy instruments with the European Union** (EU) while repelling the full-scale Russian invasion.

- With the backdrop of **Ukraine's EU accession process**, Ukraine needs to significantly **step up its climate policy ambitions** in the coming years. Carbon pricing, either through a carbon tax, an emissions trading system (ETS), or a combination of both instruments, is widely regarded as the most efficient way to cost-effectively achieve cross-sectoral emissions reductions.

- A **reformed** and **increased carbon tax** could serve as a powerful complementary policy to Ukraine's planned national ETS. While the ETS will cover mostly larger energy and industrial installations, the proposed reform would establish an **upstream tax** covering smaller energy and industrial installations, as well as emissions from buildings, road transport and additional sectors. By covering these sectors with a continuously increasing tax rate gradually approaching expected EU ETS 2 price levels, Ukraine's reformed carbon tax would be **aligned with the scope of the EU ETS 2**, facilitating Ukraine's EU accession process.

- An **upstream tax** would also **simplify administration** by taxing fewer entities and leveraging existing data systems, enabling broader sectoral coverage and reducing risks of manipulation.

- If politically desired, it could also be designed to serve as a **price floor to the ETS** in order to reduce carbon price uncertainty within Ukraine's upcoming ETS.

- Depending on the ambition in the price path, the reformed tax could achieve **emissions reductions of up to 10% by 2030** in the buildings and transport sectors vs. a scenario without a carbon tax.

- However, without adequate social compensation, the tax risks disproportionately **impacting lower-income households**. To address this, **revenues** from the tax – projected at **EUR 1.2-4.2 billion annually** by 2030 – can fund targeted, consumption-independent subsidies, climate dividends, or reductions in other taxes to **offset regressive effects**.

- Social compensation for the reformed carbon tax and **upcoming energy price liberalisation** should be considered holistically, mitigating excessive effects on lower-income households while maintaining incentives for energy efficiency and energy conservation.

- While the ETS and reformed carbon tax could be two **key pillars in Ukraine's climate architecture**, they **should not be the only two policies**. However, **carbon pricing**, in the form of the reformed carbon tax and the ETS, can make complementary policies, such as targeted support for renewable energy and energy efficiency investments, much more effective.

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1 Introduction and background

Ukraine is facing a formidable challenge in **fully aligning its climate legislation and policy instruments with the European Union** while repelling the Russian full-scale invasion. With the backdrop of Ukraine's EU accession process, Ukraine needs to significantly step up its climate policy ambitions in the coming years. **Carbon pricing**, either through a carbon tax, an emissions trading system (ETS), or a combination of both instruments, is widely regarded as the most efficient way to cost-effectively achieve cross-sectoral emissions reductions.[1]

Ukraine has introduced a **carbon tax** in 2011 with a **very low tax rate** of 30 UAH/tCO_2, i.e. ca. 0.68 EUR/tCO_2 at the time of writing.[2] In addition to its low level, the tax is largely based on the self-reporting of emissions, which allowed for **widespread tax avoidance**.[3] As part of the Ukraine-EU Association Agreement, which entered into force in 2017, Ukraine has also **committed to introducing an ETS**. While a law on monitoring, reporting and verification of emissions (**MRV**) **has been adopted** and entered into force in 2021, reporting for the first year (2021) was temporarily suspended in early 2022 due to the full-scale Russian invasion of Ukraine. Preliminary methods for ETS cap setting and allowance allocation, as well as the development of an ETS law has started in conjunction with a stakeholder engagement process.[4] Introducing a **Ukrainian Emissions Trading System** mirroring the scope of the EU ETS, but tailored to the specific needs and conditions of Ukraine's war and post-war economy – if done carefully – can provide a powerful instrument ensuring institutional and economic convergence to EU industrial and environmental standards, while ensuring price certainty and competitiveness.[5]

Ukraine's currently existing **carbon tax will require significant reform** in the context of the upcoming introduction of Ukraine's ETS. An **undue double burden from the carbon tax and ETS should be avoided**. A reformed carbon tax, however, could provide a powerful **complementary tool to cover other sectors and installations** outside of the scope of Ukraine's upcoming ETS, prepare the ground for a future Ukrainian ETS 2 covering buildings, road transport and additional sectors mirroring the upcoming EU ETS 2 (see Box 1 on p. 6), and might also serve as a **price floor instrument** for the installations covered by Ukraine's upcoming ETS in the energy and industrial sectors.[6] In the wake of such a major reform, the **carbon tax rate** should also be reviewed to ensure a gradual convergence towards EU carbon pricing levels.

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[1] See for example Pigou, A. (2017). *The economics of welfare*. Routledge; Baranzini et al. (2017). Carbon pricing in climate policy: seven reasons, complementary instruments, and political economy considerations. *Wiley Interdisciplinary Reviews: Climate Change*, *8*(4), e462.

[2] https://zakon.rada.gov.ua/laws/show/2755-vi#Text (accessed on 04.07.2024)

[3] Romanko, S. (2018). Carbon Tax Perspectives in Ukraine: Legal Regulation and Comparison of the National and European Experience of Implementation. *Journal of Vasyl Stefanyk Precarpathian National University*, 5(2), pp. 137–144.

[4] https://icapcarbonaction.com/en/ets/ukraine

[5] Low Carbon Ukraine (2024). *Designing a suitable Emissions Trading System for Ukraine*. (Link)

[6] The ETS (1) would also cover aviation and maritime transport, if fully mirroring the EU ETS scope.

2 Reform needs and design options

Ukraine's **existing carbon tax** is **insufficient** for incentivising emissions reductions. This is due to its low levels (30 UAH/tCO_2, i.e. ca. 0.68 EUR/tCO_2 at the time of writing). It is also **ineffective** due to a lack of monitoring, reporting and verification (MRV), as well as **inequitable** if no changes are made upon the introduction of the planned ETS since some installations would be covered by both the ETS and the carbon tax, while others would only be subject to the tax.[7]

Increasing tax rates within the existing carbon tax regime toward levels in line with other European countries' carbon prices could help address the insufficient decarbonisation incentives. Simultaneously, **reinstating the mandatory MRV rules** could reduce the risk of ineffectiveness due to tax avoidance. However, in the context of the upcoming introduction of Ukraine's ETS, a larger reform is required to **avoid an undue double burden** from the carbon tax and the ETS. Several options exist:

1. The **carbon tax could be repealed entirely**, which would reduce the scope of sectors and installations subject to carbon pricing to those covered by the ETS.
2. The tax could also be reformed in such a way to only cover **sectors and installations outside of the scope of the upcoming ETS**, i.e. smaller industrial installations, as well as additional sectors such as emissions from buildings, road transport and other sectors.
3. Finally, the tax could be extended to the above sectors, while **maintaining it for sectors/installations within the scope of the upcoming ETS** but with an additional rule that allows taxpayers to **deduce the average price of ETS allowances** from the tax liability. This would effectively establish a lower bound carbon price floor for those sectors/installations within the ETS at the level of the carbon tax rate.

2.1 Sectoral scope

An outright repeal of the carbon tax (see Option 1 above) might have **distortionary effects**, especially within the industrial and energy sectors. The **ETS will only cover the combustion of fuels in large stationary installations** with a total rated thermal input exceeding 20 MW, if Ukraine's ETS follows the scope of the EU ETS.[8] In the case of a repeal of the carbon tax, smaller industrial installations below the **20 MW threshold** would not be subject to carbon pricing any longer, gaining an unfair advantage vis-à-vis larger players.

Similarly, within the power and heat sector, the current proliferation of small, distributed gas turbines and gas piston generators in response to Russia's unprovoked attacks against Ukraine's civilian energy infrastructure will lead to a large share of Ukraine's future thermal energy

[7] In particular, smaller industrial installations would only be subject to the carbon tax.

[8] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC

installations being under the 20 MW threshold and thus outside of the scope of Ukraine's upcoming ETS. A **reformed carbon tax covering** these **smaller stationary installations** could thus **level the playing field** between larger and smaller energy and industrial installations.

Other distortions could be reduced by **extending the carbon tax to additional sectors**, namely the combustion of fossil fuels in the **buildings and transport sectors**. Ukraine's energy markets suffer from large implicit subsidies to households through regulated consumer prices below cost-covering levels.[9] The price gap between regulated and cost-covering price levels has been particularly high for district heating and electricity[10] requiring a far-reaching tariff reform enabling cost recovery for all market participants, improving investment incentives for new energy generation and storage, reducing the quasi-fiscal burden to the state, avoiding the accumulation of debt in different market segments, increasing incentives for energy efficiency investments, and allowing the pass-through of carbon prices to final consumers (see Chapter 2.5 for more detail).

Within the context of such a wide-ranging energy tariff reform, prices for electricity and district heating would increase substantially, reflecting their true cost but reducing incentives for electrification and the expansion of district heating. However, the successive electrification of road transport and home heating, as well as the further rollout of high efficiency and low carbon district heating are key for the decarbonisation of the transport and buildings sectors in line with European and Ukrainian climate targets.[11] Furthermore, electricity and district heating will already be covered by carbon pricing through the upcoming ETS[12] covering emissions from fossil-based electricity and heat generation. To **improve the economic incentives for electrification and district heating** following a cost-reflective energy tariff reform, levelling the playing field with other transport and heating fuels is therefore crucial. As such, we suggest **extending the reformed carbon tax to the combustion of petroleum-based motor fuels, natural gas for heating**, as well as certain other fossil fuel uses.

An additional argument for extending the scope of the carbon tax to buildings, road transport and additional sectors is **Ukraine's EU accession process**. As the EU prepares to introduce their second Emissions Trading System (ETS 2) covering these sectors (see Box 1), Ukraine needs to prepare for eventually joining the EU ETS 2 as well. While preparations are underway to introduce an ETS mirroring the ETS 1 for electricity, heat generation, and energy intensive industry sectors[13], there are **currently no plans to introduce an ETS 2 for buildings, road transport and additional sectors**. A carbon tax with a continuously increasing tax rate gradually approaching expected EU ETS 2 price levels covering these sectors could serve as a **transitional**

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[9] See for example Low Carbon Ukraine (2022). *Policy reforms supporting Ukraine's green reconstruction*. (Link)

[10] It needs to be noted that great progress has been achieved throughout the last year to increase electricity household consumer prices to more cost-reflective levels.

[11] GOPA International Energy Consultants GmbH (2024). *Post War Development of the Renewable Energy Sector in Ukraine*. (Link)

[12] Or by the reformed carbon tax for smaller energy installations below the 20 MW threshold

[13] As well as aviation and maritime transport, if fully mirroring the EU ETS scope.

regime to prepare Ukraine's future accession to the EU ETS 2. In order to facilitate this transition, the scope of Ukraine's reformed carbon tax could be **aligned with the scope of the EU ETS 2**. Thus, we propose that the scope of Ukraine's reformed carbon tax closely follows the activities outlined in Annex III to the EU's Emissions Trading Directive (ETD).[14]

Box 1: EU ETS 2 covering road transport, buildings and additional sectors

The EU ETS 2 is an important addition to EU ETS 1 and a fundamental pillar within the EU's package "Fit-For-55" for reaching the goal of reducing greenhouse gas emissions by at least 55% by 2030. In 2005, the EU Emission Trading System 1 (ETS 1) was introduced to limit the total amount of carbon emissions in the EU using a cap-and-trade system of emission allowances that must be surrendered downstream, i.e. by emitting installations. Its sectoral coverage includes electricity and heat generation, energy intensive industry sectors, maritime transport, and aviation within the European Economic Area including flights departing in Switzerland or the United Kingdom.

In 2023, the EU ETS 2 was created to complement the existing EU ETS 1 by covering emissions from fuel combustion in road transport, buildings, and for smaller industrial installations that are not yet covered by EU ETS 1. Its operating principle remains cap-and-trade but in contrast to the longer established trading system, the emission allowances are to be surrendered upstream by distributors of relevant fossil fuels. The initial distribution of allowances is done via auctions and member states are obliged to use a share of these auction revenues for supporting vulnerable households and micro-enterprises through a contribution to the Social Climate Fund (SCF). The remaining share ought to be used for social measures and further climate action to cushion a regressive tax burden and to push emission reduction even further. Since 2023, at least 50% of EU ETS 1 auction revenues must be used for energy- and climate related efforts as well. EU ETS 2 will be fully operational in 2027 (or in 2028, by derogation, in case of extraordinarily high energy prices).

Source: Author's own compilation based on European Commission (n.d.). ETS2: buildings, road transport and additional sectors. (Link)

2.2 Downstream vs. upstream carbon taxation

Carbon taxes on the emissions from the combustion of fossil fuels can be levied at different points of the value chain. The current Ukrainian carbon tax is a **downstream tax**, applied directly to the emissions of downstream installations, i.e. the final consumers of fossil fuels. A downstream carbon tax (or ETS) requires a well-functioning monitoring, reporting and verification (MRV) system to ensure that all relevant emissions are reported and taxed. One advantage of downstream taxation is the direct application of the **"polluter pays" principle** providing a visible signal of the cost of their emissions to downstream installations. However, a downstream tax can be **administratively burdensome** if many small installations are included in the scheme, each requiring their own MRV reports.

[14] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC; also see European Commission (2024). *MRR Guidance document for ETS2*. (Link)

Alternatively, different variations of **upstream carbon taxation** exist. Under an upstream carbon tax, emissions from the combustion of fossil fuels are taxed indirectly by **taxing the carbon content of fossil fuels** either when produced and imported, or when released for consumption, i.e. when sold to final consumers. Since most (or all) of the tax burden would be passed on by producers, importers and/or retailers to final consumers, the "polluter pays" principle still holds in the case of an upstream tax, albeit in a more indirect way than with a downstream tax. The key advantage of an upstream tax is its **simplicity**: Since producers, importers, or retailers are less numerous than final consumers, the **administrative burden is much smaller** than in the case of a downstream tax. This allows to include additional sectors in the carbon tax, such as combustion processes in buildings and road transport.

Furthermore, **standard factors of embedded emissions**, based on a **benchmark carbon content**, can be defined for each type of fuel, simplifying the procedure for assessing the total embedded emissions, meaning that only the amount of fuel produced, imported or released for consumption is required to be assessed for calculating the total tax liability. As such, for many fuels, **existing structures for data collection and verification can be used** to assess the tax liability under an upstream carbon tax, such as the amount of fuel sold and taxed under the existing excise tax in Ukraine (predominantly covering motor fuels) or subject to transmission or distribution fees (natural gas). The use of benchmark emission factors and pre-existing data collection and verification procedures also **reduces the risk of manipulation and tax evasion**.

In order to enable the extension of the reformed carbon tax to the combustion of petroleum-based motor fuels, natural gas for heating, and other fossil fuel uses in line with the scope of the upcoming EU ETS 2, we recommend **moving to an upstream carbon tax** in Ukraine. Following the EU ETS 2 approach, we suggest to generally tax fuels **when released for consumption**, i.e. at the stage of retailers. See European Commission (2024) for more guidance on monitoring and reporting under an upstream carbon pricing system at the level of retailers.[15]

2.3 Avoiding an undue double burden from carbon tax and ETS

When introducing an upstream carbon tax, while a parallel (pre-existing or new) downstream carbon pricing mechanism is in place (e.g. Ukraine's upcoming ETS) it is important to **avoid an undue double burden for the same emissions** from both systems. In other words, the emissions covered by Ukraine's downstream ETS should not be unduly priced again through the upstream tax on the fuel consumed by the downstream ETS installations.

[15] European Commission (2024). *MRR Guidance document for ETS2*. (Link)

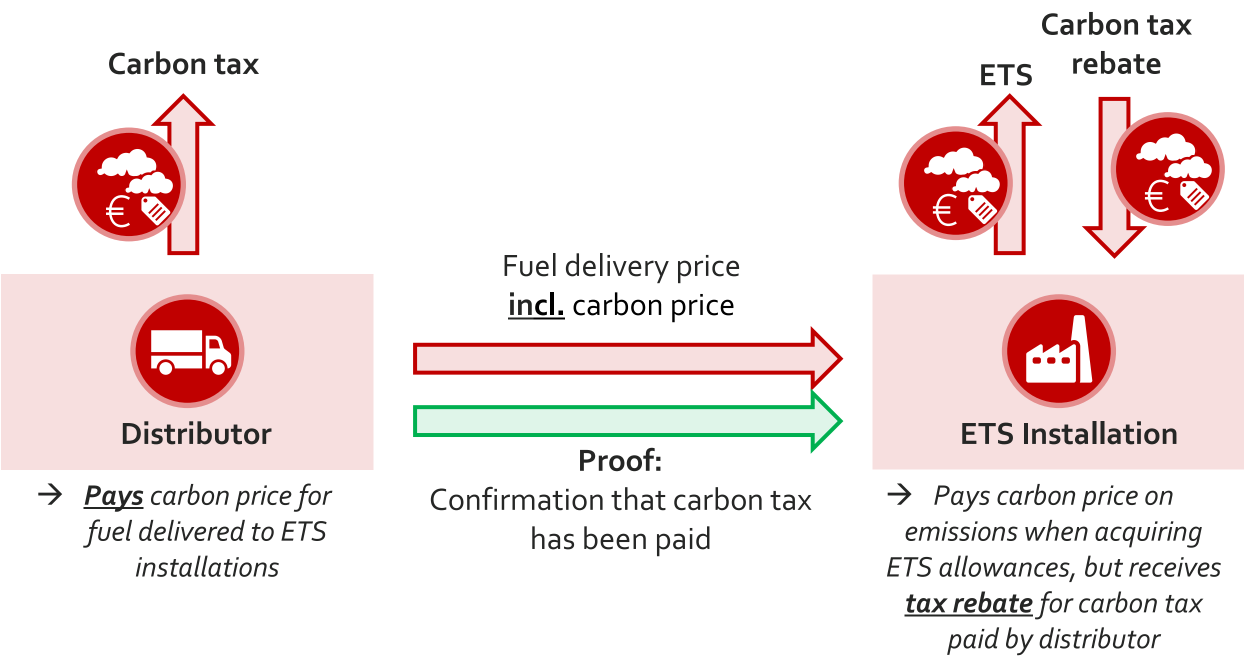
Fortunately, there is ample **experience within the EU** for how to deal with this issue as many countries already have an upstream carbon tax while participating in the downstream EU ETS 1. Furthermore, with the upcoming introduction of the upstream EU ETS 2, there are now Union-wide rules for how to deal with the risk of double counting emissions.[16]

Broadly speaking, there are two possible methods to reduce the risk of an undue double burden on installations covered by the downstream ETS, which we call (1) the **Swedish approach** and (2) the **German approach**, which is also the approach taken for the EU ETS 2.

1. **Swedish approach:**

   The **upstream carbon tax is levied for all relevant fuels** when released for consumption, including those with an end-use in the downstream ETS. Installations covered by the downstream ETS[17] can subsequently **request a tax rebate** for the tax paid by their retailer/distributor and passed on to them, through submitting a *confirmation of use* that, as the name suggests, confirms the use within an installation covered by the downstream ETS[18] and is verified under the downstream ETS MRV rules.[19]

Figure 1: Swedish approach to avoid double burden (simplified illustration)



Source: Author's own illustration

[16] European Commission (2024). *MRR Guidance document for ETS2*. (Link)

[17] and other installations using the relevant fuel for activities outside of the scope of the upstream carbon tax, for example for non-energy consumption as a chemical feedstock

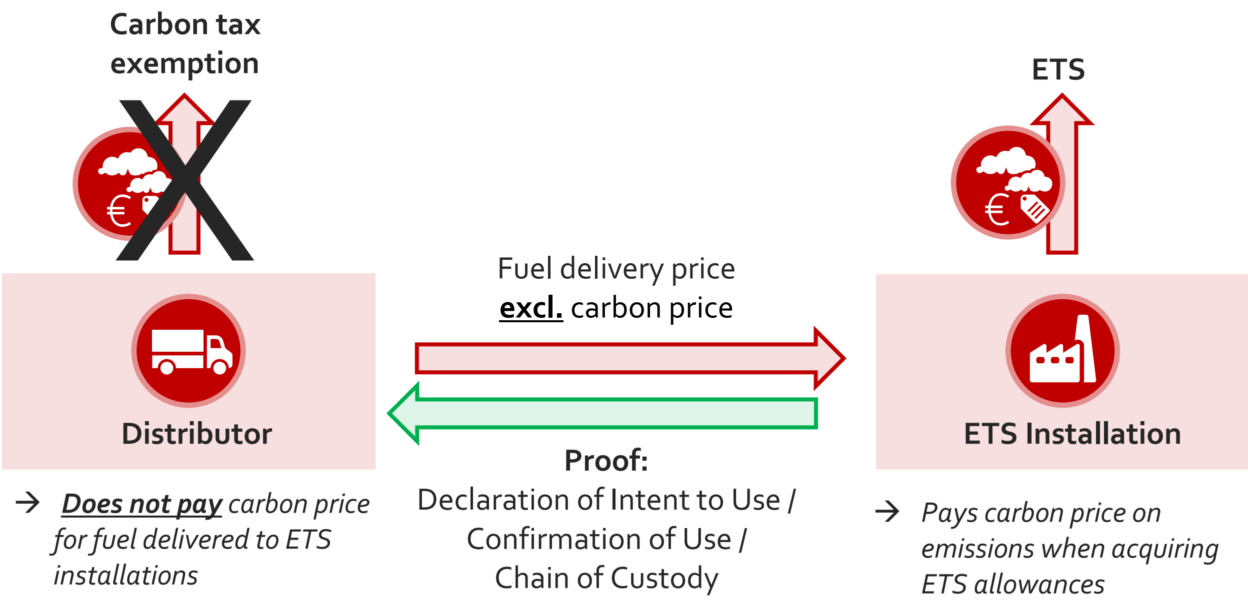
[18] or any other activity outside of the scope of the upstream carbon price, for example non-energy consumption of the fuel as a chemical feedstock

[19] Catapult Energy Systems (2018). *Sweden Energy and Carbon Tax Policy. Rethinking Decarbonisation Incentives – Policy Case Studies.* (Link)

2. **German approach:**

Regulated entities of the upstream carbon price[20] (i.e., fuel distributors/retailers) shall enter into a contractual arrangement with the end-users of their fuels released for consumption. A *declaration of intent to use* within an installation covered by the downstream ETS[17] passed from end-user to distributor can be used to **exempt the relevant fuel volumes from the upstream carbon price**. This should be confirmed ex-post with the *confirmation of use* by the end-user passed to the distributor. If there is no direct contractual relationship, intermediary parties (traders) need to be engaged to establish a *chain of custody*, i.e. a chain of traceable contractual arrangements and invoices to prove the fuel released for consumption has been used by an installation covered by the downstream ETS.[17, 21]

Figure 2: German approach to avoid double burden (simplified illustration)



Source: Author's own illustration

Both approaches have certain advantages and disadvantages. The **Swedish approach is much simpler** and is associated with significantly lower reporting obligations and therefore a lower bureaucratic burden for companies. Regulated entities subject to the upstream carbon tax pay the tax for the entire volume of fuels released for consumption and do not have to trace fuels to the end-consumer. Installations covered by the downstream ETS only follow their regular MRV obligations under the downstream ETS and use the *confirmation of use* prepared under those obligations to request a tax rebate at little extra transactional cost.

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[20] We use the broader term carbon price here since the upstream carbon pricing system in Germany, as well as the upcoming EU ETS 2, are classified as Emissions Trading Systems (ETS) while the proposed upstream carbon price for Ukraine is a carbon tax.

[21] See for example European Commission (2024). *MRR Guidance document for ETS2*. (Link)

The **German approach is more bureaucratically cumbersome**. Nevertheless, it would allow Ukrainian companies to **get familiar with an approach and reporting obligations similar to those under the EU ETS 2**. Note, however, that Germany's national ETS (nETS) and the EU ETS 2 rely on ex-post emissions reporting and (ETS allowance) surrendering obligations in the following year. This means the *confirmation of use* or *chain of custody* can usually be established before the reporting and surrendering deadlines. In contrast, upstream carbon taxes are **usually designed similar to fuel excise taxes**, meaning that the **tax has to be paid immediately** when the fuel is released for consumption. Thus, in contrast to the German nETS and the upcoming EU ETS 2, Ukraine's proposed upstream carbon tax could only grant a tax exemption for the cases where a *declaration of intent to use* is provided at the same time of the transaction releasing the fuel for consumption. Tax exemptions for other fuels used by an installation covered by the downstream ETS[16] where the end-use is only confirmed ex-post through a *confirmation of use* or *chain of custody* could only be granted via a tax rebate to the regulated upstream entity in the following year. Alternatively, the carbon tax could be designed different than an excise tax with **reporting and payment obligations only in the subsequent year**, closely following the EU ETS 2 reporting mechanism in that aspect as well.

In principle, both approaches are suitable to avoid an undue double burden from Ukraine's upcoming ETS and a reformed upstream carbon tax. Thus, the **regulatory burden** of the German approach **should be weighed against its benefits of introducing a system more closely resembling the EU ETS 2**, which Ukraine will eventually join upon acceding to the European Union.

2.4 Using the carbon tax as a price floor for Ukraine's upcoming ETS

As discussed in Chapter 2.1, a reformed carbon tax covering smaller stationary installations and other sectors not subject to Ukraine's upcoming ETS, such as buildings and road transport, could **level the playing field** between different industrial installations, as well as between different heating and transport modes. This assumes that the carbon tax rate and the effective carbon price prevailing within the ETS are roughly equal. However, depending on the final design of Ukraine's upcoming ETS, there might be a large **price uncertainty** for emissions allowances in the ETS. Such a price uncertainty might not only jeopardise the level playing between different industrial installations, heating and transport modes. It could also pose a serious **risk** to Ukraine's energy and industrial **investment climate** and the **smooth functioning** of the ETS.[22]

One possible pathway to reduce carbon price uncertainty within Ukraine's upcoming ETS could be the implementation of a **price collar** with an **increasing allowance price floor**. Such a price floor could be established through an auction reserve price, i.e. a price below which bids for emissions allowances are not accepted. Alternatively, Ukraine could choose a slightly different approach for introducing a carbon price floor, not through an auction reserve price but through a reform of its existing carbon tax. Instead of avoiding any overlap between the scope of

[22] Low Carbon Ukraine (2024). *Designing a suitable Emissions Trading System for Ukraine*. (Link)

Ukraine's ETS and the reformed carbon tax, the scope of the reformed upstream carbon tax could deliberately include fuels delivered to installations covered by the ETS. However, installations subject to the downstream ETS (under the Swedish approach) or their fuel suppliers (under the German approach) would be **eligible for a tax deduction or rebate**, not amounting to the full level of the carbon tax but **corresponding to the level of average ETS prices**. As long as ETS allowance prices are below the nominal tax rate, installations covered by the downstream ETS (or their suppliers) would **pay the difference** between ETS allowance prices and the nominal tax rate. As soon as ETS allowance prices rise above the nominal tax rate, the tax is no longer due (but the refund would be capped at the level of the nominal carbon tax rate). Adjusted in this way, the carbon tax would effectively **function as a carbon price floor** for installations covered by the ETS, since the cumulative carbon price (i.e. the sum between ETS allowance price and the effective carbon tax due) would always be larger or equal to the nominal carbon tax rate.

The convenient aspect of this approach is that it is **fully compatible with the EU ETS**, since the price floor is not built into the ETS itself (through an auction reserve price) but implemented outside the scheme through tax law. In fact, the **United Kingdom** has introduced a carbon price floor (CPF) via exactly this approach in 2013 while being a member of the EU ETS.[23]

A **key design question** for such a CPF would be the **ETS reference price determining the carbon tax deduction**. If the carbon tax is levied on a rolling basis, i.e. immediately when fuels are released for consumption, a short-term, possibly weekly, average ETS allowance price could be used to determine the tax deduction for fuels used in downstream ETS installations. In a scenario where the carbon tax is only levied once a year, i.e. retroactively for fuels released for consumption throughout the past year, the average annual allowance price of that previous year could be applied instead.

Of course, using the carbon tax as a price floor for Ukraine's upcoming ETS **only makes sense in the case of a fully-fledged downstream ETS** with a **floating price**. In the case of an auction reserve price serving as a price floor or during a transitional ETS phase with fixed prices, the reformed carbon tax should not be applied to emissions covered by the ETS. This underscores the **need for coordination** between designing Ukraine's ETS and reforming Ukraine's carbon tax.

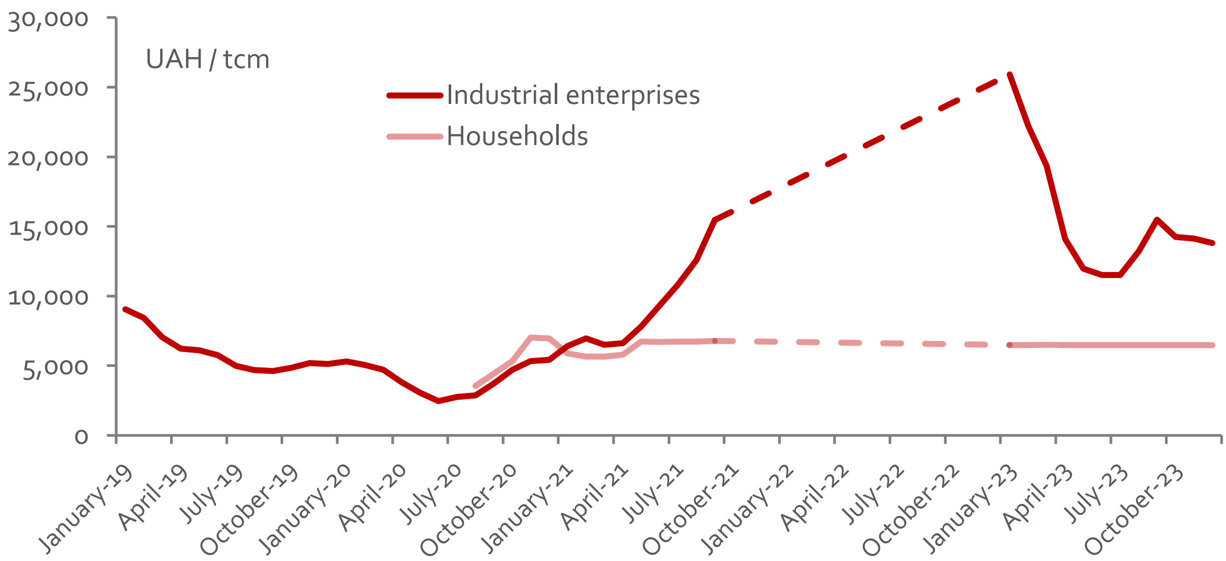
2.5 Carbon taxation as part of a wider energy tariff reform

While coordination is required between the carbon tax reform process and ETS design, it is also required in the context of broader energy tariff reform in Ukraine. Currently, natural gas supply prices for households and district heating companies are regulated at levels far below market prices for natural gas. Figure 3 shows that the natural gas price for households has been effectively frozen at a nominally fixed price level since early 2021, far below market rates paid

[23] UK Parliament (2018). *Carbon Price Floor (CPF) and the price support mechanism*. (Link)

by industrial enterprises. The **quasi-fiscal subsidy** for natural gas and gas-based district heating generation is financed through the state-owned company Naftogaz and its subsidiaries.[24]

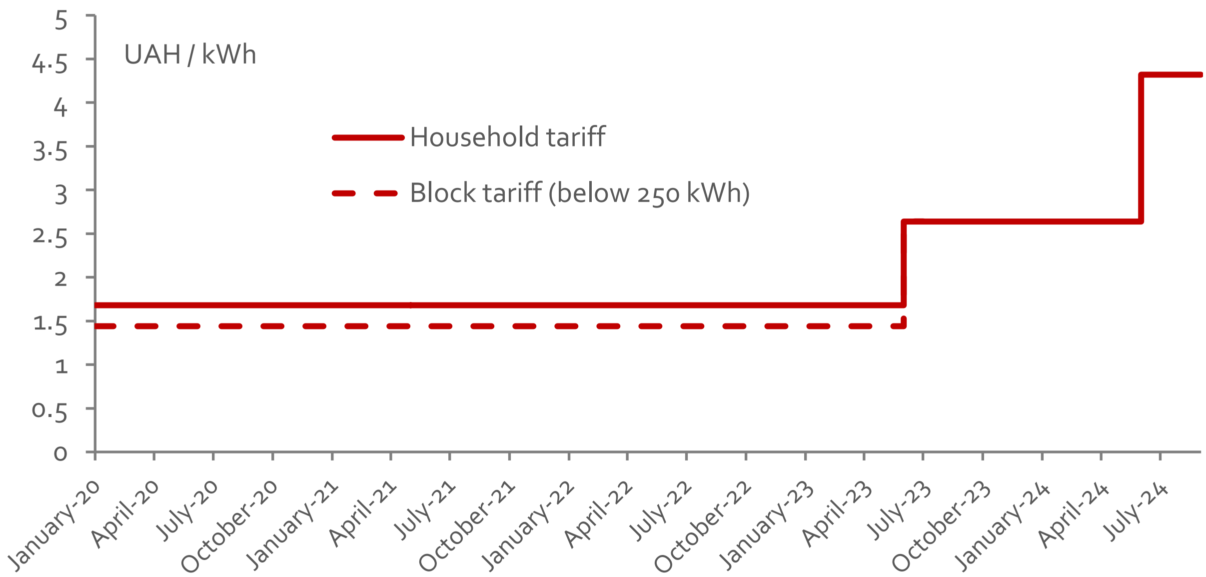
Figure 3: Weighted average Ukrainian retail price of natural gas by market segment (UAH per tcm)



Note: Data missing in late 2021 and 2022. *Source: NEURC*

Additionally, final district heating prices for households are often set below levels that would allow for sufficient investments in existing and new district heating generation, distribution, and supply infrastructure. Since district heating companies are often municipally owned, this can be described as a quasi-fiscal subsidy to residential district heating consumers as well.

Figure 4: Household electricity tariffs (UAH per kWh)



Source: Cabinet of Ministers of Ukraine

[24] Energy Community Secretariat (2024). A need for the reforms of the Ukraine's gas market. *Ukraine Energy Market Observatory Assessment 1/24*. (Link)

Finally, Ukraine's electricity market continues to feature a Public Service Obligation (PSO) for household electricity supply. In practice, this means that residential electricity retail prices are administratively set at fixed levels, which have historically been far below full cost recovery. However, recent revisions of residential electricity tariffs have increased prices close to cost-reflective levels (see Figure 4). The household PSO is financed through special obligations paid from revenues of the state-owned electricity generation companies Energoatom and Ukrhydroenergo. The PSO thus represents another quasi-fiscal subsidy to residential electricity consumers.

Subsidised residential gas, district heating and electricity prices create **sizeable fiscal and quasi-fiscal losses** for the state and often an **inability** for the municipally- and state-owned energy companies **to modernise their infrastructure** and adequately **invest in existing and new capacities** without direct budget support or donor-funded financial support. Furthermore, the absence of cost-reflective energy prices drastically **reduces incentives to conserve energy** and to invest in **energy efficiency**.[25] Moreover, existing direct and indirect energy subsidies are not only inefficient but also **inequitable**. Wealthier households, who usually consume more energy per capita, profit more from subsidised energy tariffs than less wealthy households.

Since subsidies are usually not paid directly from the budget but implicitly granted through low regulated tariffs, the underfunding of energy services also leads to a **problem of debt accumulation** between the service provider and other market participants, which propagates through the market. Low (non-cost-reflective) district heating (and water supply) prices lead to deficits of municipally owned utility companies, many of which in turn accumulate debt to their local Universal Service Suppliers (USS) for electricity. Some of the USS in turn accumulate significant debt to Ukrenergo, Ukraine's electricity transmission system operator.[26] Ukrenergo in turn accumulates arrears for other payment obligations such as to service providers on the balancing market and to the Guaranteed Buyer (GB). The GB in turn accumulates arrears in its payments of the renewable support scheme (Green Tariff) which creates **liquidity problems for renewable investors** and adversely affects the investment climate for new renewable energy investments.[27]

As such, there are many important reasons to **reform retail markets** for natural gas, district heating and electricity to enable **cost recovery** for all market participants, improve **investment incentives** for new energy generation and storage, increase incentives for **energy efficiency** investments, **reduce the quasi-fiscal burden** to the state and **avoid the accumulation of debt** in different market segments. However, the structure of Ukraine's future energy tariffs also

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[25] See for example Bilek, P., Stubbe, R., and Saparova, D. (2024). *The Green Reconstruction of the Residential Sector of Bucha*. (Link)

[26] Another important debtor to Ukrenergo is the state-owned nuclear company Energoatom, who accumulated payment arrears for its special obligations to finance the household Public Service Obligation (PSO), i.e. the subsidised household (and small non-household) electricity tariffs.

[27] Bilek, P., Stubbe, R., and Weser, H., (2024). *A Solar Marshall Plan for Ukraine. Empowering Ukraine's brighter future: bottlenecks and key policy reforms needed to boost solar PV deployment*. (Link)

matters for the introduction of a reformed **upstream carbon tax** covering additional sectors and fuels such as natural gas consumption by households and district heating companies. As current household energy tariffs for electricity, natural gas and district heating are set administratively, it is **not trivial to allow the pass-through of carbon prices** to final household consumers. Either tariff levels would have to be regularly revised to include carbon prices or, preferably, **energy tariffs for households could be gradually liberalised** in favour of competitive retail markets that allow a direct pass-through of carbon prices (and all other supply costs) to final consumers across all market segments. In parallel, existing price subsidies could be replaced with a targeted, consumption-independent **support scheme to vulnerable consumers** or broad-based social transfers at the same or lower cost to public budgets.[28] Without a pass-through of carbon prices to final consumers, the reformed carbon tax could risk exacerbating deficits and debt accumulation of utility service providers, underlining the **importance of coordination** between energy tariff reform and carbon tax reform.

3 Estimating impacts from three reform scenarios

This Chapter estimates the effects of **three different carbon tax scenarios** (described in 3.1) on the level of **energy prices** (3.2), **household budgets** (3.3), **emissions** (3.4), and **government revenues** (3.5). Chapter 4 will discuss policy implications, including different options for revenue recycling, i.e. for how to use the generated tax revenues to support households – in particular vulnerable households – in order to mitigate the distributional impacts of the tax.

3.1 Scenarios

The following impact assessment assumes an implementation of an **upstream carbon tax** with a **pre-determined increasing price schedule** covering emissions from buildings, road transport and additional sectors following Annex III to the EU ETD[29], as well as covering the activities within the scope of Ukraine's upcoming ETS (following Annex I to the EU ETD) via the mechanism described in Chapter 2.4 (serving as a price floor to the ETS). While we focus our analysis on the effects for household consumers in Chapters 3.2 to 3.4, we also report indicative total revenues from all sectors in Chapters 3.5.

The analysis assumes a carbon tax rate of **10 EUR/tCO_2 by 2025** and considers **three scenarios for 2030** with **30 EUR/tCO_2** (low), **60 EUR/tCO_2** (medium) and **90 EUR/tCO_2** (high). Due to the short-term economic uncertainties during the unprovoked Russian full-scale invasion of Ukraine, we only analyse impact on household budgets and emissions for 2030. Results for the impact on energy prices and indicative tax revenues are also reported for 2025.

[28] See for example Low Carbon Ukraine (2022). *Policy reforms supporting Ukraine's green reconstruction*. (Link)

[29] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC; also see European Commission (2024). *MRR Guidance document for ETS2*. (Link)

3.2 Impact on energy prices

Estimating the impact of an upstream carbon tax on energy prices within a liberalised market is quite straightforward. However, due to the regulated nature of energy prices in Ukraine for natural gas, district heating and electricity supply to households, additional assumptions regarding cost pass-through have to be made. We assume that the **carbon tax is passed on fully to consumers** in 2025 through a one-off adjustment of the regulated prices equivalent to the amount of the carbon cost[30], i.e. without any additional changes to tariffs. Carbon costs are also fully passed through to consumers for road motor fuels, which are already liberalised.

We find the following impact on energy prices for 2025:

Table 1: Impact of 10 EUR/tCO_2 carbon tax on energy prices by 2025

Fuel *(customer category)*	*Carbon content (tCO_2/MWh)*	*Carbon cost[30] (EUR/MWh)*	*Price without carbon tax (EUR/MWh)*	*Price with carbon tax (EUR/MWh)*
Natural gas *(large industry [31])*	0.2	**2.00**	38.97	**40.97** (+5%)
Natural gas *(households)*	0.2	**2.41**	25.68	**28.09** (+9%)
District heating[32] *(households)*	0.37	**4.44**	50.80	**55.24** (+9%)
Electricity[33] *(wholesale)*	n/a	n/a	n/a	n/a
Electricity[33] *(households)*	n/a	n/a	n/a	n/a
Gasoline	0.26	**3.11**	176.64	**179.75** (+2%)
Diesel	0.27	**3.19**	157.07	**160.26** (+2%)
LPG	0.23	**2.72**	110.51	**113.23** (+2%)

Source: Author's own calculations, see Annex for details.

[30] The full estimated carbon cost includes the carbon tax and its impact per MWh of fuel, as well as the increase in excise tax (for electricity) and VAT payments following the introduction of the carbon tax (except for large industry and wholesale prices).

[31] Assuming large industry buying at wholesale prices (plus carbon tax).

[32] Following the approach by Dodonov, B. (2018). *Ukraine: Phasing out Energy Subsidies*. (Link)

[33] The electricity generation mix by 2025 is highly uncertain due to Russia's unprovoked attacks against Ukraine's civilian energy infrastructure, ongoing efforts to replace destroyed power plants with decentralised flexible gas generators and uncertain electricity demand. Furthermore, large fossil-based power generation is subject to Ukraine's upcoming ETS which will not be operational yet by 2025. We do not estimate effects for electricity prices by 2025.

We assume fully liberalised and **cost-reflective energy prices by 2030** and a complete pass-through of carbon costs to consumers (including for road motor fuels, which are already liberalised currently). For 2030, results for energy prices in the 'low' scenario (30 EUR/tCO_2) are displayed in **Table 2**, 'medium' scenario (60 EUR/tCO_2) in **Table 3** and 'high' scenario (90 EUR/tCO_2) in **Table 4**.

Table 2: Low scenario – Impact of 30 EUR/tCO_2 carbon tax on energy prices by 2030

Fuel *(customer category)*	*Carbon content (tCO_2/MWh)*	*Carbon cost[30] (EUR/MWh)*	*Price without carbon tax (EUR/MWh)*	*Price with carbon tax (EUR/MWh)*
Natural gas *(large industry[31])*	0.2	**6.00**	29.42	**35.42** (+20%)
Natural gas *(households)*	0.2	**7.23**	48.32	**55.55** (+15%)
District heating[32] *(households)*	0.37	**13.34**	73.11	**86.45** (+18%)
Electricity *(wholesale)*	0.03	**0.95**	62.19	**63.14** (+2%)
Electricity *(households)*	0.03	**1.18**	107.63	**108.81** (+1%)
Gasoline	0.26	**9.34**	169.66	**179.00** (+6%)
Diesel	0.27	**9.56**	151.90	**161.46** (+6%)
LPG	0.23	**8.17**	97.42	**105.59** (+8%)

Source: Author's own calculations, see Annex for details.

Table 3: Medium scenario – Impact of 60 EUR/tCO_2 carbon tax on energy prices by 2030

Fuel *(customer category)*	*Carbon content (tCO_2/MWh)*	*Carbon cost[30] (EUR/MWh)*	*Price without carbon tax (EUR/MWh)*	*Price with carbon tax (EUR/MWh)*
Natural gas *(large industry[31])*	0.2	**12.00**	29.42	**41.42** (+41%)
Natural gas *(households)*	0.2	**14.45**	48.32	**62.77** (+30%)
District heating[32] *(households)*	0.37	**26.67**	73.11	**99.78** (+36%)
Electricity *(wholesale)*	0.03	**1.90**	62.19	**64.09** (+3%)
Electricity *(households)*	0.03	**2.35**	107.63	**109.98** (+2%)
Gasoline	0.26	**18.68**	169.66	**188.34** (+11%)
Diesel	0.27	**19.12**	151.90	**171.02** (+13%)
LPG	0.23	**16.34**	97.42	**113.76** (+17%)

Source: Author's own calculations, see Annex for details.

Table 4: High scenario – Impact of 90 EUR/tCO_2 carbon tax on energy prices by 2030

Fuel *(customer category)*	*Carbon content (tCO_2/MWh)*	*Carbon cost[30] (EUR/MWh)*	*Price without carbon tax (EUR/MWh)*	*Price with carbon tax (EUR/MWh)*
Natural gas *(large industry [31])*	0.2	**18.00**	29.42	**57.42** (+61%)
Natural gas *(households)*	0.2	**21.68**	48.32	**70.00** (+45%)
District heating[32] *(households)*	0.37	**40.01**	73.11	**113.12** (+55%)
Electricity *(wholesale)*	0.03	**2.85**	62.19	**65.04** (+5%)
Electricity *(households)*	0.03	**3.53**	107.63	**111.16** (+3%)
Gasoline	0.26	**28.02**	169.66	**197.68** (+17%)
Diesel	0.27	**28.68**	151.90	**180.59** (+19%)
LPG	0.23	**24.52**	97.42	**121.94** (+25%)

Source: Author's own calculations, see Annex for details.

Naturally, the higher the carbon content of the energy carrier, the higher the carbon cost to end consumers. Since we assume a very low carbon content of electricity by 2030, based on a scenario closely following the "with additional measures" scenario of Ukraine's National Energy and Climate Plan (NECP)[34], we find a **very low carbon cost for electricity** across all scenarios with ca. 1.00-3.50 EUR/MWh or 0.10-0.35 EUR-ct/kWh. District heating has the highest carbon content of all energy carriers assessed here due to the mix of natural gas and coal as input fuels, conversion losses in heat generation, as well as heat distribution losses. Consequently, carbon cost per MWh of final heat consumption amounts to between 13 EUR/MWh (low scenario) and 40 EUR/MWh (high scenario) by 2030. Natural gas and road motor fuels are placed somewhere in between.

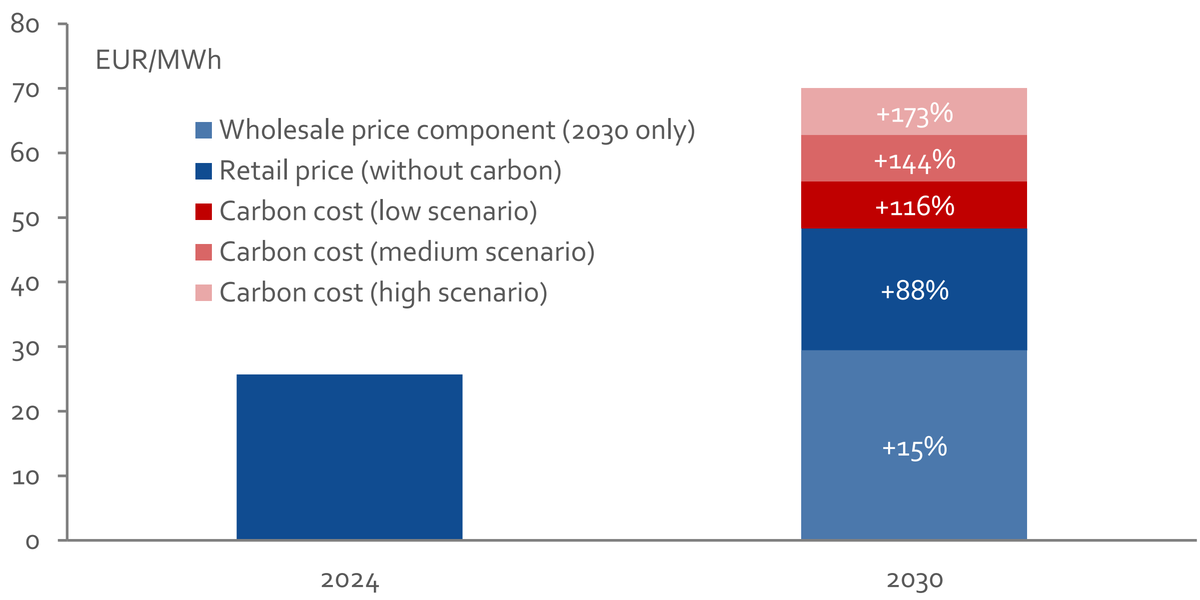
However, there are **large differences in terms of price increases** between these energy carriers as well, since the different fuels have very different pre-carbon-tax cost-reflective price levels. Natural gas, projected to cost only about 48 EUR/MWh before the carbon tax for retail consumers in 2030 would increase by up to 45% to 70 EUR/MWh in the 'high' scenario. Gasoline and diesel, while more carbon intensive than natural gas, would only see a 17% and 19% price increase even in the 'high' scenario (from 1.53 to 1.78 EUR/l and from 1.53 to 1.82 EUR/l, respectively) since their initial prices (incl. excise taxes) per energy content are already much higher.

[34] CMU (2024). *National Energy and Climate Plan of Ukraine 2025-2030*. (Link)

When assessing the **price increase from today until 2030**, yet another picture emerges, since additional drivers of energy price changes are (a) the evolution of **regional and global wholesale energy prices**, especially for natural gas and oil products and (b) the **required adjustment in retail prices to cost-reflective levels** following price liberalisation (assumed to take place before 2030).

The most drastic example is natural gas, which is currently priced drastically below cost-reflective market levels for household consumers (see Figure 3 on p.12). Even though the wholesale price for gas is projected to come down to about 29 EUR/MWh in 2030, this is still 15% above current subsidised 2024 household retail prices. Cost-reflective retail prices are estimated a whopping 88% higher in 2030 vs. today's price without a carbon tax, or 116% (low scenario) 144% (medium scenario) and 173% (high scenario) above today's price when including the carbon tax (see 18Figure 5).

Figure 5: Natural gas household price in 2024 and 2030 (by scenario)

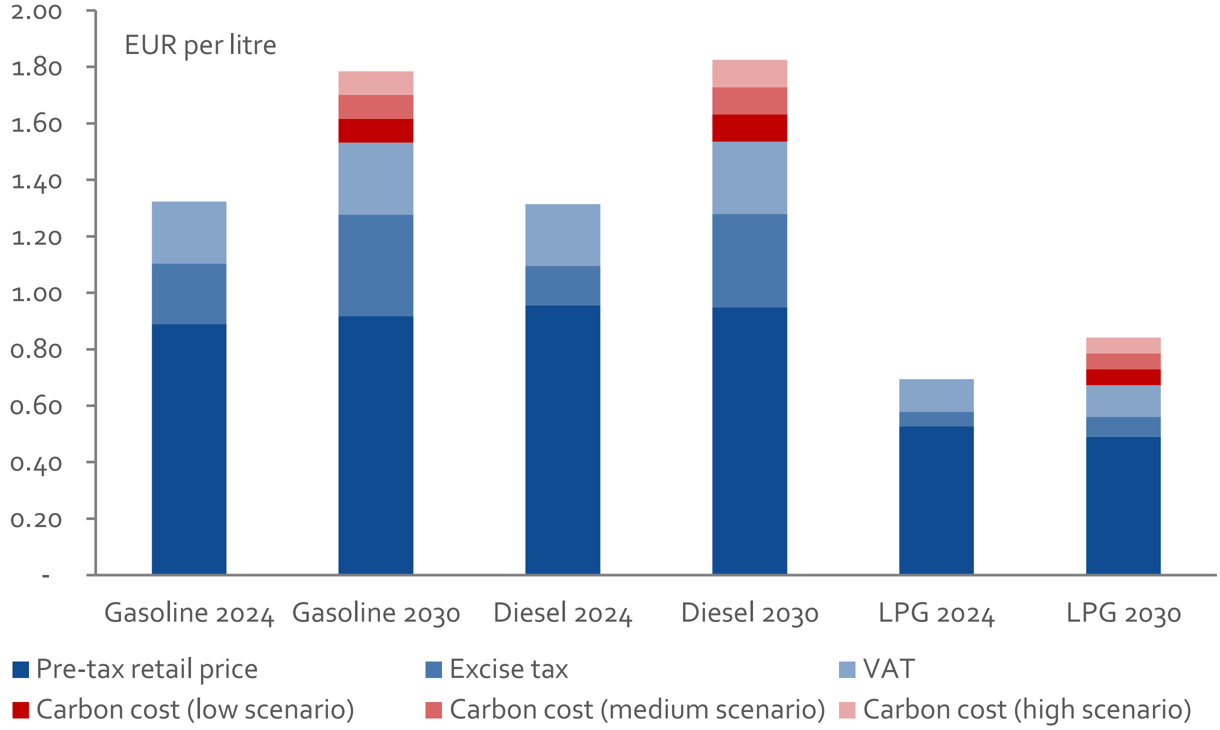


Note: Price differential in white vs. 2024 household price. *Source: Author's own calculations, see Annex for details.*

The effect is less pronounced for other energy carriers which already cost more per MWh of energy content. Good examples are the road motor fuels gasoline, diesel and LPG which are already liberalised, reflecting the full pre-carbon cost today, including an existing excise tax (see Figure 6). In fact, the majority of the increase in projected 2030 retail prices across most scenarios does not come from the carbon tax but from the planned increase in the excise tax, as Ukraine revised its excise tax levels to gradually be in line with minimum allowed EU levels.[35]

[35] https://en.interfax.com.ua/news/economic/1001098.html, also see https://unn.ua/en/news/the-government-approved-the-gradual-increase-of-excise-taxes-on-fuel-and-some-alcoholic-beverages-to-the-eu-minimum-levels-ministry-of-finance

Figure 6: Road motor fuel retail prices in 2024 and 2030 (by scenario)



Note: Prices are displayed in EUR per litre. EUR per MWh prices are displayed in Table 1-Table 4 to improve comparability across energy carriers. Source: Author's own calculations, see Annex for details.

3.3 Impact on household budgets

Increasing energy prices without social compensation can have regressive distributional effects, meaning that poorer households are disproportionally affected. This is because poorer households usually spend more for energy services, especially for residential energy (electricity, heating and natural gas) as a share of total income.[36] Therefore, we argue that the proposed carbon tax reform, as well as the wider energy tariff reform discussed in Chapter 2.5, should be accompanied by a targeted, consumption-independent **support scheme to vulnerable consumers** or broad-based social transfers.[37] In fact, such a scheme could be financed directly or indirectly by the increased tax revenues from the carbon tax, excise taxes and VAT, as well as from saved energy subsidies, at the same or lower cost to public budgets than the current price subsidies.

In order to inform the design of such a support scheme, as well as to understand the effects of the carbon tax without social compensation, we perform a **distributional analysis** of the carbon tax scenarios to understand the effect of higher energy prices on household budgets for

[36] The opposite is true for road motor fuels in Ukraine according to the data (Ukraine's Household Budget Survey). We find that higher-income households in Ukraine do not only spend more in absolute terms on road motor fuels but also as a share of household income, which makes road motor fuels a luxury or superior good according to the economic definition.

[37] See for example Low Carbon Ukraine (2022). *Policy reforms supporting Ukraine's green reconstruction*. (Link)

different types of households and different income groups. The distributional analysis is based on representative income and expenditure data from Ukraine's household budget survey (HBS) and the model-based projections of future energy prices presented in the previous Chapter.[38]

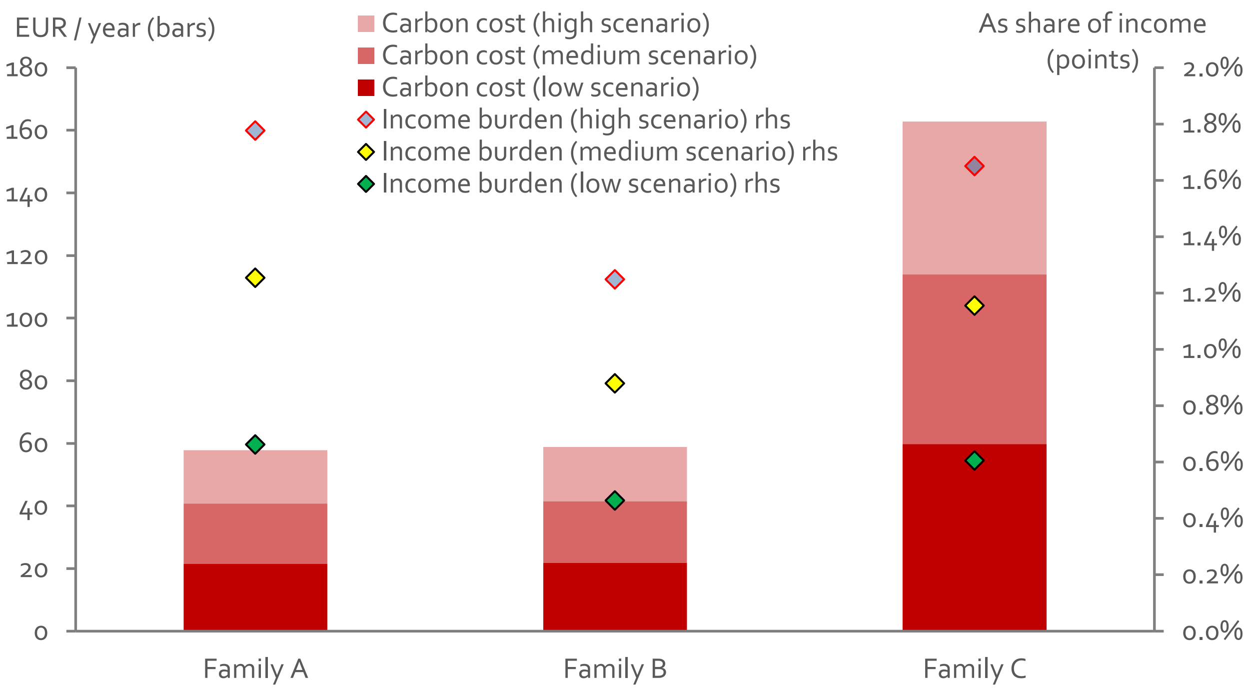
First, we assess the impact on three archetypical families presented in Table 5 below. We consider three archetypical families: A **lower-income family** with a single adult and two children (Family A), a **medium-income family** with two adults and two children (Family B) as well as a **high-income family** with two adults and no children (Family C) to demonstrate the effect of the three assessed carbon tax scenarios.

Table 5: Overview of archetypical families

	Family A	*Family B*	*Family C*
Household type	1 adult 2 children	2 adults 2 children	2 adults no children
Income group	Lower income (bottom 40%)	Medium income ($5^{th} – 6^{th}$ decile)	High income (top 20%)
Average income (in 2030)	EUR 3,250	EUR 4,700	EUR 9,850

Note: Average income rounded to closest EUR 50. Source: Author's own calculations.

Figure 7: Carbon cost per archetypical family and scenario (2030)



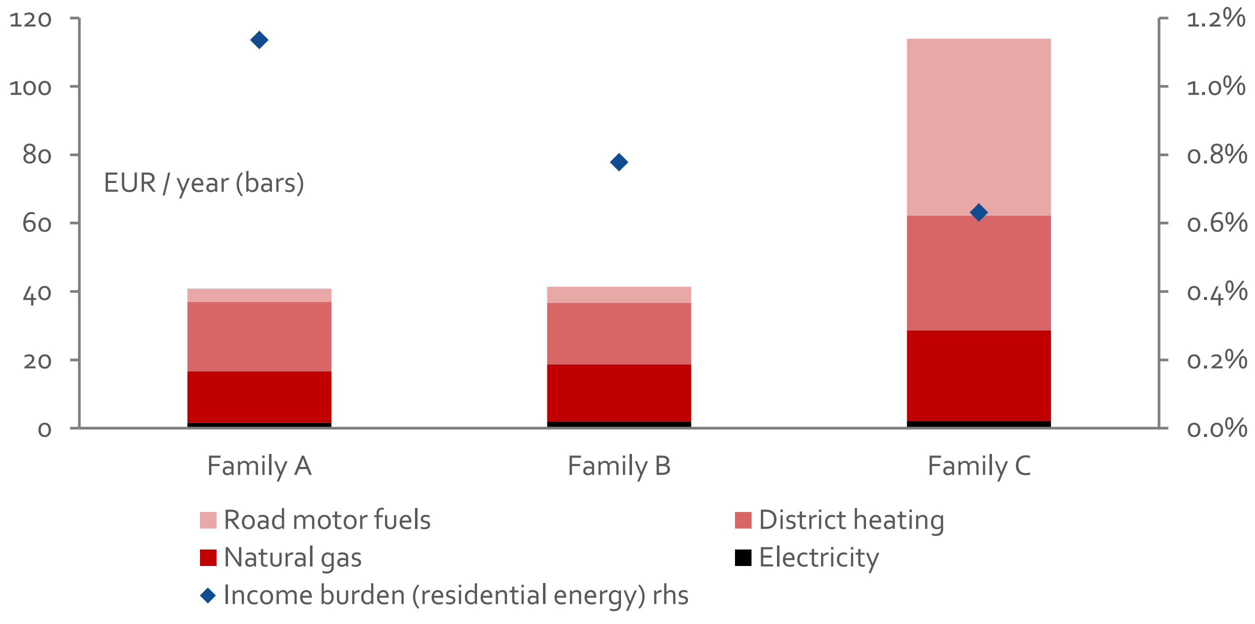
Source: Author's own calculations, see Annex for details.

[38] Importantly, we assume that the share of the total energy bill covered by the housing and utilities subsidy (HUS) remains constant compared to the base year of 2016. Only the impact of the remainder of the bill, paid for by the households themselves is considered in the impact assessment. For more details, see in the Annex.

As Figure 7 above illustrates, the average Family A and Family B would both pay about EUR 22 (low scenario), EUR 41 (medium scenario) and EUR 58-59 (high scenario) for the cost of carbon per year. As a share of income, the lower income Family A is more affected, with a burden ranging from 0.7 % to 1.8 % of total income. The income burden of Family B ranges from 0.5 % to 1.2 %. Interestingly, the carbon cost of the high-income Family C is not only larger in absolute terms.[39] It is also larger as a share of income than Family B's, ranging from 0.6% to 1.7% of total income, despite the much higher income of Family C.

This can be explained by the much higher expenditure for road motor fuels of high-income households. When decomposing the carbon cost by different fuels, it becomes clear that the **main share** of the carbon costs for families A and B come **from natural gas and district heating**, while Family C has a large additional burden from **road motor fuels** (see Figure 8 for the decomposition of the medium scenario).[40] Consequently, if we only consider the income burden from the carbon cost of residential energy carriers, i.e. excluding road motor fuels, a typical pattern of **decreasing burden for higher income households** emerges (see the blue markers in Figure 8 below).

Figure 8: Carbon cost per archetypical family, decomposed by fuel (medium scenario, 2030)



Source: Author's own calculations, see Annex for details.

While it can be instructive to consider selected archetypical families, a full distributional analysis should assess effects across the entire distribution of income of the population. Figures 9 to 11 on the next page display the decomposed average carbon cost per decile, as well as the average total and residential (excl. road motor fuels) income burden of the carbon tax by scenario.

[39] with EUR 60 (low scenario), EUR 114 (medium scenario) and EUR 163 (high scenario)

[40] Electricity only plays a minor role in the overall carbon cost since it is assumed to have a very low carbon intensity by 2030 in Ukraine.

Figure 9: Carbon cost per decile, decomposed by fuel (low scenario, 2030)

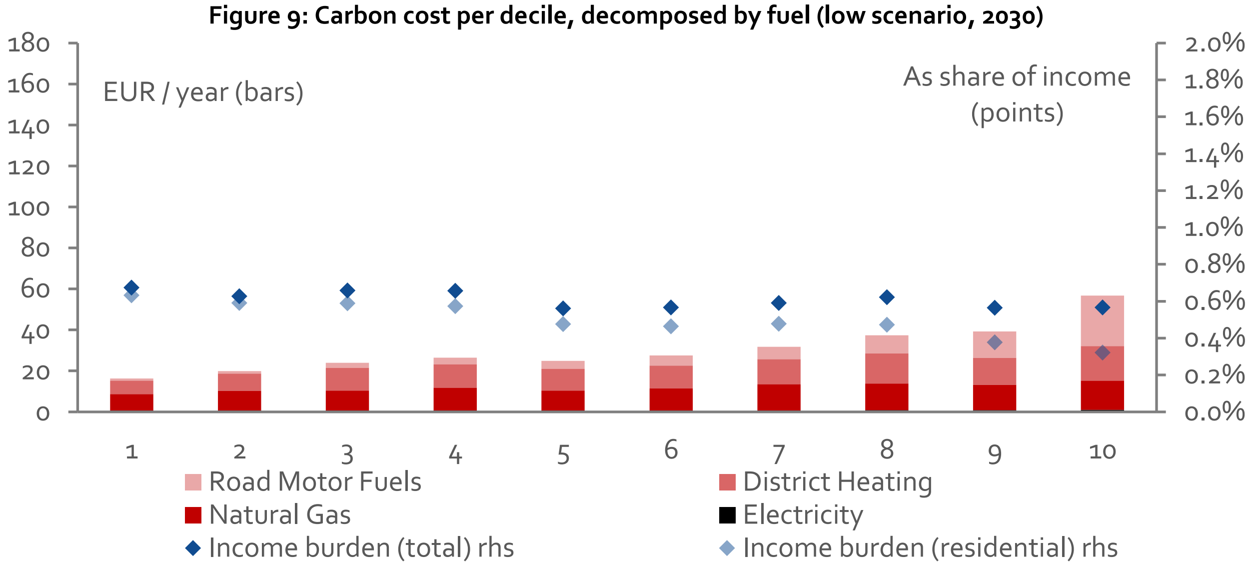


Figure 10: Carbon cost per decile, decomposed by fuel (medium scenario, 2030)

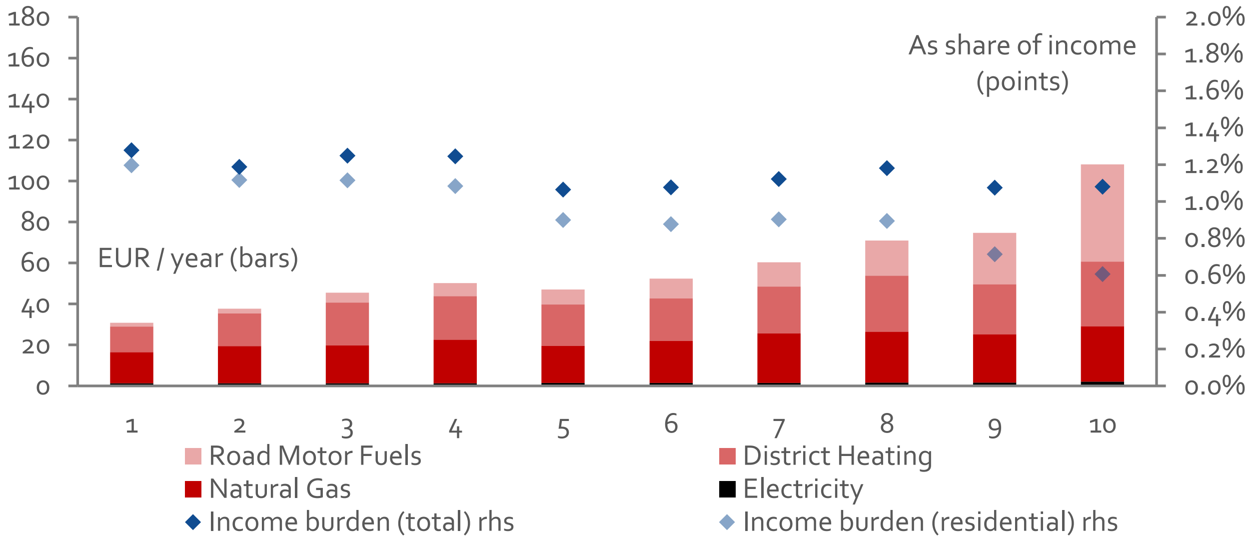
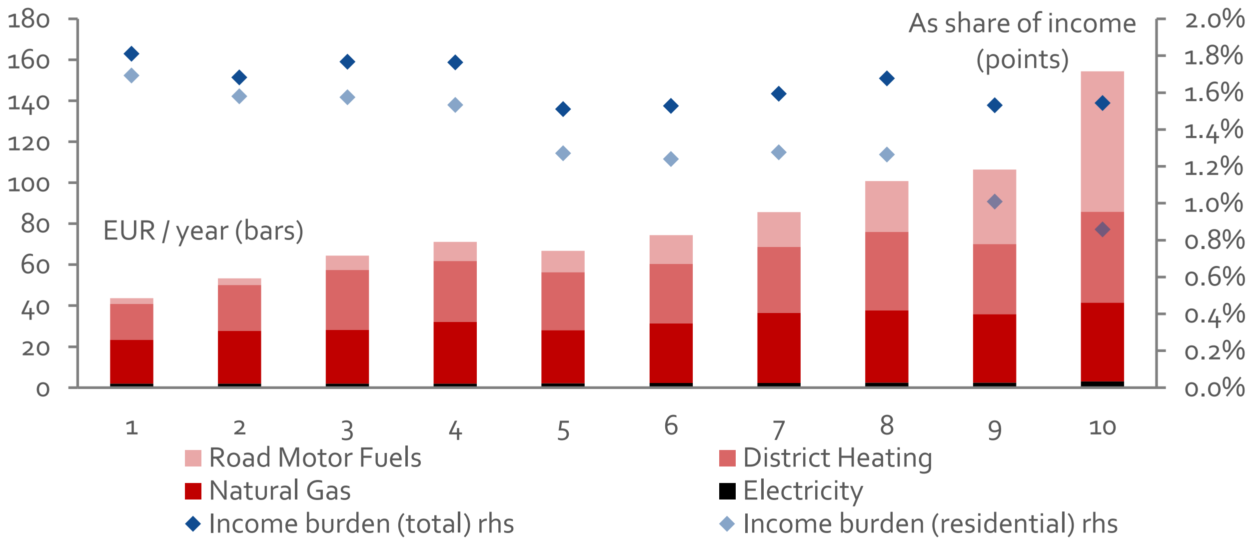


Figure 11: Carbon cost per decile, decomposed by fuel (high scenario, 2030)

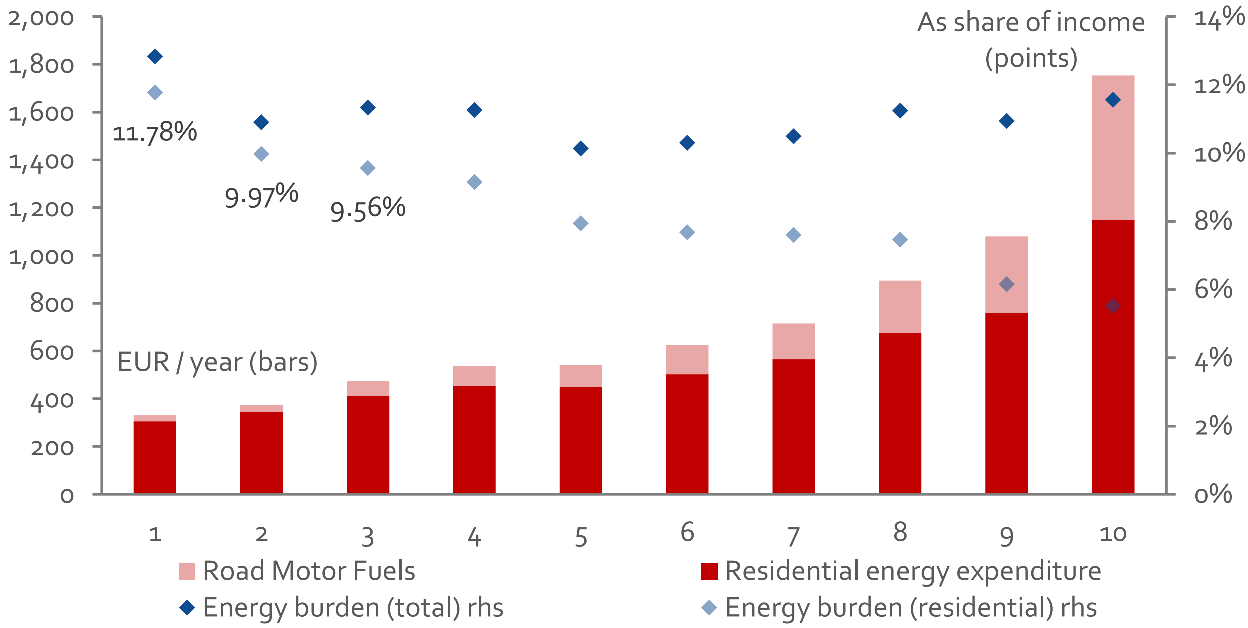


Source for Figures 9-11: Author's own calculations, see Annex for details.

Not surprisingly, absolute carbon costs are increasing per income, while relative carbon costs (as a share of income) are decreasing for higher income deciles, especially when considering the burden for residential energy services (excl. road motor fuels). This demonstrates that **carbon prices, without an adequate redistributive compensation mechanism, can be regressive**, i.e. they affect lower-income households more strongly than higher income households as a share of household income.[41]

While the average carbon cost income burden per decile is relatively modest across all scenarios and deciles (between 0.57 % and 0.67 % in the low scenario and between 1.51 % and 1.81 % in the high scenario) it should be noted that the **carbon tax adds to already higher energy prices in 2030**, assuming prices for all energy carriers are liberalised and cost-covering. Hence, considering the overall energy burden paints a slightly different picture.

Figure 12: Total energy expenditure and total energy burden (medium scenario, 2030)



Source: Author's own calculations, see Annex for details.

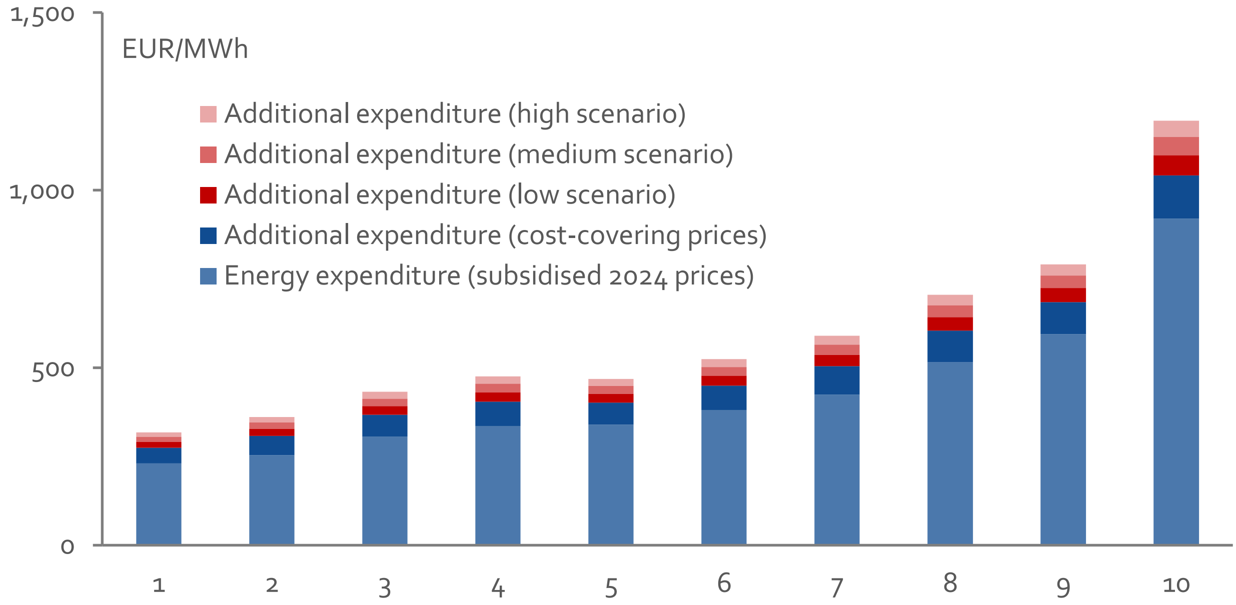
In the example of the medium scenario (see Figure 12 above), the average total energy expenditure per decile ranges **from EUR 330** (bottom 10%) **to EUR 1,750** (top 10%) with an energy burden (share of total income) of between 10.1 % and 12.8 % (incl. road motor fuels) or 5.5 % and 11.8 % (residential energy). Considering the most commonly used definition **of energy poverty**[42], defining energy poor households as those **spending more than 10%** of total income on residential energy services, this means that the average household of the **bottom decile would be considered as energy poor**. The average household in the second and third decile would also be close to that threshold.

[41] It could be argued that the assumption of a constant share of the total energy bill covered by HUS (compared to the base year of 2016) is not an adequately strong compensation mechanism for the considered scenarios.

[42] See for example Schuessler, R. (2014). Energy Poverty Indicators: Conceptual Issues-Part I: The Ten-Percent-Rule and Double Median/Mean Indicators. *ZEW-Centre for European Economic Research Discussion Paper*, (14-037). (Link)

Comparing the total energy expenditure in the medium scenario from Figure 12 with the carbon cost in the medium scenario from Figure 10, it becomes clear that the **carbon cost only takes a moderate share of the overall energy burden** (between 6-10 % for the medium scenario). Figure 13 demonstrates that the **required increase in energy prices to reach cost-covering price levels** – assumed to take place before 2030 – plays an equally or even larger role than the carbon tax (depending on the carbon price scenario) for increases in energy expenditure.

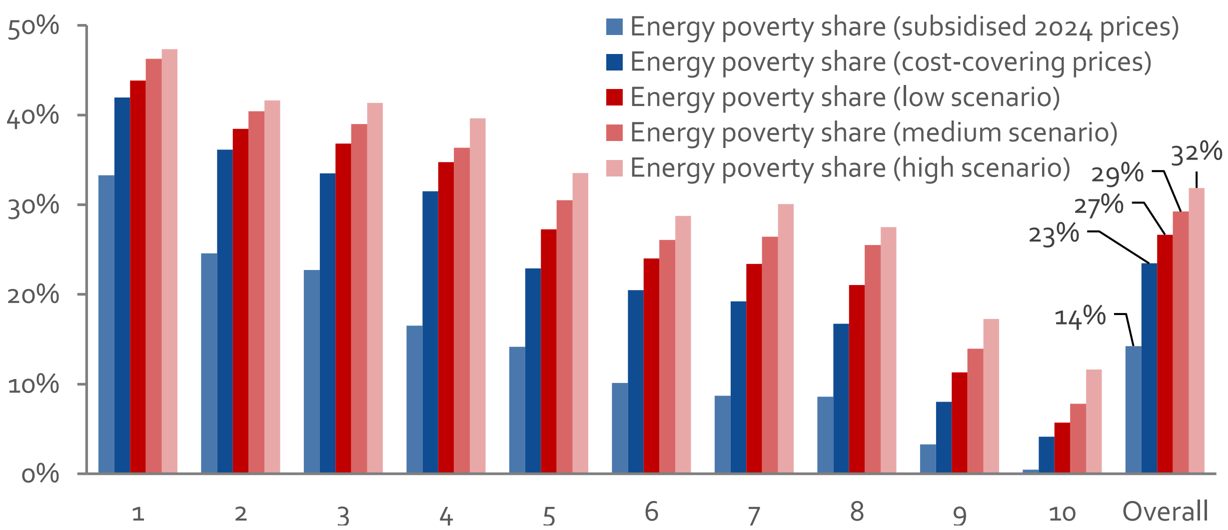
Figure 13: Total energy expenditure in 2030 by decile under different price scenarios (incl. two scenarios without carbon tax)



Source: Author's own calculations, see Annex for details.

When considering not only the average household per decile, but taking into account the variation within deciles, a more drastic picture emerges. Figure 14 displays the **share of energy poor households** per decile and for the overall population for different energy price scenarios.

Figure 14: Share of energy poor households per decile and for the overall population (2030 by scenario)



Source: Author's own calculations, see Annex for details.

Figure 14 demonstrates that the share of energy poor households, in a situation without the introduction of any form of **additional social compensation mechanism**, would increase from about **14 %** in the overall population under current subsidised energy prices to **23 %** with the introduction of cost-covering prices but without a carbon tax, and to **between 27 % and 32 %** according to the different carbon price scenarios. The effect would be strongest for lower- and medium-income households, but even high-income households could be affected. As with total energy expenditure (Figure 13) the **increase in energy prices** to reach cost-covering price levels, plays an equally or even larger role than the carbon tax for the share of energy poor households.

These numbers should not be taken lightly. They underline that **carbon pricing and broader energy price reform[43] necessarily need to come hand in hand with a robust and well-designed social compensation mechanism from the very onset of the process**.

3.4 Impact on emissions

The effect of the carbon tax on emissions depends on the level of baseline emissions expected without a carbon tax, as well as the **demand reaction** of energy consumers to higher energy prices. Due to the short-term economic uncertainties during the unprovoked Russian full-scale invasion of Ukraine, we only analyse medium-term impacts on emissions for 2030. We assume a range of **baseline emissions for 2030** approximately based on the "with existing measures" (WEM) and "with additional measures" (WAM) scenarios of Ukraine's National Energy and Climate Plan (NECP).[44] For a summary of the assumed baseline emissions, see Table 6 below.

Table 6: Range of assumed 2030 baseline emissions by sector

	Baseline 2030 emissions ($MtCO_2eq$)
Residential	20 – 25
Services	5 – 7
Transport	15 – 20
Total	**40 – 52**

Source: Author's own assumptions based on Ukraine's NECP

[43] While the main focus of this Policy Proposal focusses on reforming Ukraine's carbon tax, we deliberately and repeatedly mention the context of broader energy reform (also see Chapter 2.5). This has both conceptual and practical reasons. Firstly, quantifying the effects of the carbon tax reform requires making assumptions regarding pre-tax energy price levels. Secondly, however, such a broader energy price reform will have distributive effects in itself. Designing a sound policy for responding to distributive consequences of energy price increases should ideally consider both.

[44] The NECP's WEM and WAM scenarios serve as a baseline for a scenario without a carbon price since the assumed carbon price in both scenarios is insignificantly low for 2030. However, other non-carbon price measures are included in these scenarios. Note: Supply and agriculture sectors excluded due to uncertainty of inclusion in the carbon tax and/or ETS. Source: CMU (2024). *National Energy and Climate Plan of Ukraine 2025-2030*. (Link)

While some emissions of smaller industrial installations, as well as small-scale fossil-based electricity and heat generation would be covered by the reformed carbon tax, it is unclear what share of those sectors would be subject to Ukraine's national ETS vs. the reformed carbon tax. Therefore, we only consider the **residential, services and transport sectors** as a **lower bound** for the emissions reduction potential from the tax.

Based on the price increase per energy carrier and scenario, the fuel mix per sector, as well as the assumed own-price elasticities of demand, demand reduction potentials for the residential and transport sectors are derived. For the service sector, the same pro rata reduction than in the residential sector is assumed, due to the similar nature of the sectors (space heating as the main driver).

Table 7: Emissions reduction potential by sector and scenario (2030)

	Residential	*Services*	*Transport*	***Total***
Baseline 2030 emissions ($MtCO_2eq$)	20 – 25	5 – 7	15 – 20	40 – 52
Savings, low scenario ($MtCO_2eq$ and %)	0.8 – 1.0 (-3.8%)	0.2 – 0.3 (-3.8%)	0.3 – 0.4 (-2.2%)	1.3 – 1.7 **(-3.2%)**
Savings, medium scenario ($MtCO_2eq$ and %)	1.5 – 1.9 (-7.7%)	0.4 – 0.5 (-7.7%)	0.7 – 0.9 (-4.4%)	2.6 – 3.3 **(-6.4%)**
Savings, high scenario ($MtCO_2eq$ and %)	2.3 – 2.9 (-11.5%)	0.6 – 0.8 (-11.5%)	1.0 – 1.3 (-6.7%)	3.9 – 5.0 **(- 9.7%)**

Source: Author's own calculations, see Annex for details.

We find that the three sectors have an overall medium term emissions reduction potential of between **-3.2%** (low scenario), **-6.4%** (medium scenario) and **-9.7%** (high scenario). This would lead to around **1.5 Mt** (low scenario), **3 Mt** (medium scenario) and **4-5 Mt** (high scenario) **of annual saved emissions** by 2030.[45]

When comparing the three sectors, **higher relative reduction potentials are found for the residential and service sectors** due to the higher elasticity (i.e. higher responsiveness to prices) and larger relative price increases for natural gas and district heating across the different scenarios. The transport sector, on the other hand, contributes only about 25% of total emissions reductions across all scenarios, despite making up almost 40% of all baseline emissions from the three sectors.

[45] Results are very sensitive to the assumed price elasticities of demand, as well as the assumed baseline emissions without a reformed carbon tax. See Annex for details.

3.5 Impact on government revenues

Following the results for the emissions and emissions reductions per sector and scenario, sectoral and total carbon tax revenues are calculated (Table 8). We find **that total tax revenues of between EUR 1.2 – 1.5 billion** in the low-price scenario, **EUR 2.2 – 2.9 billion** in the medium scenario, and **EUR 3.3 – 4.2 billion** in the high scenario could be collected by 2030 under the assumed tax rates (EUR 30, 60 and 90 per ton of CO_2). This would amount to about **1 – 3.5% of Ukraine's GDP by 2030**.

Table 8: Carbon tax revenues by sector and scenario (2030)

	Residential	*Services*	*Transport*	***Total***
Low scenario (EUR mn)	600 – 700	100 – 200	400 – 600	**1,200 – 1,500**
Medium scenario (EUR mn)	1,100 – 1,400	300 – 400	900 – 1,100	**2,200 – 2,900**
High scenario (EUR mn)	1,600 – 2,000	400 – 600	1,300 – 1,700	**3,300 – 4,200**

Source: Author's own calculations, see Annex for details. *Note: Results rounded to closest EUR 100 mn.*

While the resulting tax revenues are sizeable, a large share of those revenues would probably be **needed to compensate affected consumers** (see Chapter 3.3 and the following Chapter 4) for the resulting energy price increases. However, that is not a problem, since the primary goal of the carbon tax is not to raise new government revenues, but to internalise the external cost of carbon and to incentivise consumers to consume fewer fossil fuels and switch to cleaner technologies.

4 Policy implications

4.1 Effectiveness and interaction with other policies

A reformed and increased carbon tax, extended to emissions from buildings, road transport and additional sectors can serve as a powerful complementary tool to Ukraine's planned national ETS. Depending on the ambition in the price path, it could achieve **emissions reductions of up to -10% by 2030** in the buildings and transport sectors vs. a scenario without a carbon tax (see Chapter 3.4). While the ETS would cover the large industrial and energy installations, the carbon tax could also cover smaller installations to **level the playing field** within the industry and energy sectors. If politically desired, it could also be designed to serve as a **price floor to the ETS** in order to reduce carbon price uncertainty within Ukraine's upcoming ETS.

The proposed carbon tax reform could significantly **improve the profitability of investments into clean heating technologies** such as thermal renovations, heat pumps, and clean district heating, **as well as low-carbon transport** technologies such as electric vehicles.[46] Nevertheless, a carbon tax reform **should not be the only policy** for the decarbonisation of the buildings and transport sectors. Infrastructure investments (e.g. the modernisation of municipal district heating grids, railway and local public transport infrastructure, as well as quick charging infrastructure for electric vehicles) and **investment support** for households and businesses (e.g. through a relaunch and scale-up of the warm loans and 5-7-9 programmes) are also needed, due to the size of up-front investment needs and borrowing constraints of households and municipal utility companies. However, a reformed carbon tax can improve the conditions for effective public and private investments in clean energy solutions as it levels the playing field with carbon-intensive technologies. Therefore, it can make the aforementioned complementary policies much more effective.

4.2 Social compensation

As illustrated by Chapter 3.3, a significant carbon tax covering buildings, road transport and additional sectors without any form of additional social compensation would have large negative **distributional effects**. Fortunately, the reformed carbon tax also generates significant **government revenues** (see Chapter 3.5) that could be used to cushion, or even fully mitigate, the distributional impact of the tax. Broadly speaking, there are **three options** for social compensation mechanisms, that could also be combined with one another. Two options are **broad-based**, while one would be **targeted** at lower-income and/or vulnerable consumers.

The first and most simple option is to **reduce other taxes**, such as the personal income tax. The added benefit from a revenue-neutral tax swap (i.e. substituting a share of revenues from the personal income tax with the reformed carbon tax) is the so-called **"double dividend"**. In addition to reducing market distortions from externalities through the carbon tax, this could also lower economic distortions from the pre-existing personal income tax.[47] However, such a tax swap would not mitigate the regressive effects of the carbon tax, unless the personal income tax is only reduced for lower-income individuals (moving away from the current flat tax regime in Ukraine). Even when combined with a progressive personal income tax reform, there might be a lot of **individuals and households that would not be reached** by this form of social compensation, if they do not pay any personal income tax in the first place.

Another option for a broad-based social compensation mechanism could be per-capita or per-household universal cash transfers, often called **"climate dividends"** in the context of carbon pricing (see Box 2). Due to their per-capita or per-household nature, climate dividends have a strong progressive effect that is well-suited to mitigate the regressive impact of the carbon tax. In addition, if well-designed and well-communicated, climate dividends can help foster political

[46] For the residential sector, see for example Bilek, P., Stubbe, R., and Saparova, D. (2024). *The Green Reconstruction of the Residential Sector of Bucha*. (Link)

[47] See for example Jaeger, W. K. (2012). The double dividend debate. In *Handbook of research on environmental taxation* (pp. 211-229). Edward Elgar Publishing.

support for carbon pricing.[48] Climate dividends could be paid directly by the government or by a dedicated climate dividend trust fund.[49]

Box 2: Climate Dividends

Climate dividends, also known as **carbon dividends**, **carbon tax and dividend** or **climate income** are financial mechanisms designed to address climate change by imposing a tax on carbon emissions and redistributing the collected revenues to citizens in the form of universal regular dividends or rebates. This approach aims to incentivise reductions in greenhouse gas emissions while ensuring that households, especially low- and middle-income ones, are compensated for any increased costs resulting from the carbon tax. A prominent example is **Canada's Climate Action Incentive**, where revenues from the federal carbon tax are returned to households as annual payments. The **Swiss carbon tax on fossil fuels** also redistributes a significant portion of the revenue to residents via **health insurance rebates**, reducing the financial burden on citizens while promoting emissions reductions.

By returning revenues to households, **climate dividends help mitigate the regressive nature of carbon pricing**, ensuring that lower-income families are not disproportionately affected. The direct financial benefit to citizens **can enhance public acceptance** of carbon pricing policies, making them more politically viable.

Source: Author's own compilation

The third and last option for a social compensation mechanism could be a **targeted transfer scheme**, such as a **reformed housing and utilities subsidy** (HUS). The HUS has been instrumental to mitigate negative distributional effects during the 2015/2016 natural gas tariff reform.[50] By combining income assessment and expected (but *not* realised) volume of energy consumption, it avoids the highly distortionary effects of direct energy subsidies.[51] If combined with targeted energy efficiency subsidies for high-volume-low-income consumers, such as via an expanded Warm Loans programme, its efficiency could be increased further.[52]

While the exact policy design for a recalibration of the HUS is beyond the scope of this paper, we do briefly assess the impact of a climate dividend to redistribute revenues from the reformed

[48] See for example Maestre-Andrés, S., Drews, S., & van den Bergh, J. (2019). Perceived fairness and public acceptability of carbon pricing: a review of the literature. *Climate policy*, *19*(9), 1186-1204. Conversely, ill-designed regressive carbon tax policy can cause lasting damage to the public perception of carbon taxes, as shown by Douenne, T., & Fabre, A. (2022). Yellow vests, pessimistic beliefs, and carbon tax aversion. *American Economic Journal: Economic Policy*, *14*(1), 81-110.

[49] Marron, D. B., & Maag, E. (2018). How to design carbon dividends. Urban-Brookings Tax Policy Center. *Available at SSRN 3305124*. (Link)

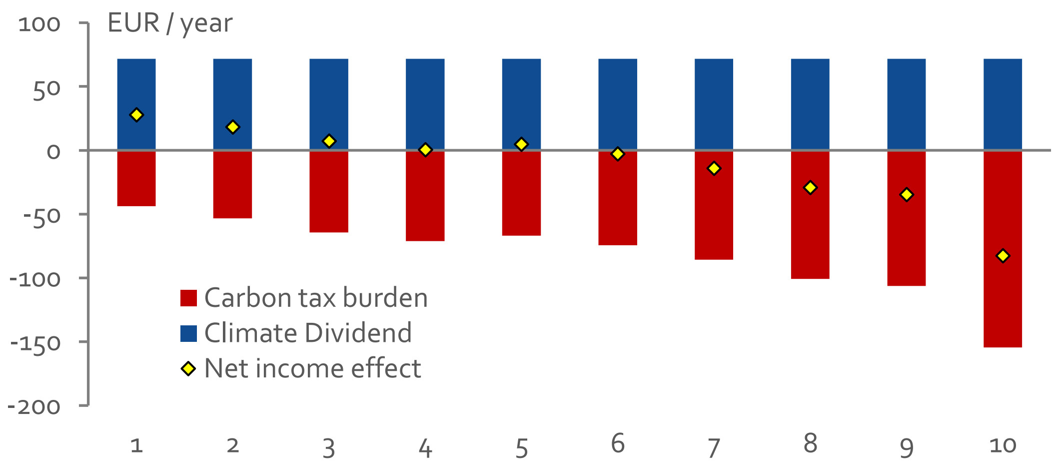
[50] Alberini, A., & Umapathi, N. (2021). *Government assistance when household energy bills are high: Lessons from Ukraine*. Brookings Commentary. (Link)

[51] HUS payments are based on social norms for energy consumption, derived from number of household members, dwelling surface area, a number of additional factors, as well as an income assessment.

[52] Alberini, A., & Umapathi, N. (2024). What Are the Benefits of Government Assistance with Household Energy Bills? Evidence from Ukraine. *The Energy Journal*, *45*(3), 223-250. (Link to Working Paper)

carbon tax. As Figure 15 demonstrates, a climate dividend could **effectively support low- and medium-income households** facing a higher carbon tax. If 100% of revenues raised directly from residential consumers[53] would be used for a universal climate dividend, the average household from the 1st to 5th percentile, i.e. the lower-income half of the population, would see a **net positive income effect** from the combined carbon tax and climate dividend. In other words, while a socially unmitigated carbon tax would be strongly regressive, a carbon tax with climate dividends could be **socially progressive**.[54]

Figure 15: Net income effect of carbon tax and climate dividend divided by decile (high scenario, 2030)



Source: Author's own calculations, see Annex for details.

A combination of the above mechanisms is also possible. It should be noted that social compensation for the reformed carbon tax and necessary energy price liberalisation should be considered together. In other words, a **social compensation mechanism** should not only be designed to compensate lower- and medium-income households for the cost of carbon, but also **protect households from falling into energy poverty** from the expected effects of energy price liberalisation more broadly (see Figure 14 in Chapter 3.3).

While a detailed discussion of the HUS design goes beyond the scope of this paper, one option could be to recalibrate the HUS to be more progressive, i.e. to compensate lower-income households stronger, to account for the effects of energy price liberalisation, while introducing a climate dividend to redistribute carbon tax revenues more broadly.

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[53] Only the share of the carbon tax paid directly through increased consumer bills is considered for the climate dividend here. Since we assume that the share of the total energy bill covered by the housing and utilities subsidy (HUS) remains constant compared to the base year of 2016, the part of the carbon tax that would be covered by the mechanically increasing HUS payment is not considered for the climate dividend, since it would be needed to finance the increase in the HUS payments. See Annex for additional details.

[54] We assume a climate dividend that follows the OECD-modified equivalence scale to provide household size-adjusted universal lump sum transfers. Displayed in Figure 15 are net income effects adjusted for household size to a representative two-person household. A single household would receive 67% of the displayed sum, a larger household would receive an additional 33 percentage points per household member aged 14 or older and an additional 20 percentage points per household member under 14 years old. See Annex for additional details.

5 Conclusion

A **reformed** and **increased carbon tax** could serve as a powerful complementary policy to Ukraine's planned national ETS. While the ETS will cover mostly larger energy and industrial installations, the proposed reform would establish an **upstream tax** covering smaller energy and industrial installations, as well as emissions from buildings, road transport and additional sectors. By covering these sectors with a continuously increasing tax rate gradually approaching expected EU ETS 2 price levels, Ukraine's reformed carbon tax would be **aligned with the scope of the EU ETS 2**, facilitating Ukraine's EU accession process. Moreover, the tax could help **level the playing field** between smaller and larger industrial and energy installations. The upstream tax would also **simplify administration** by taxing fewer entities and leveraging existing data systems, enabling broader sectoral coverage and reducing risks of manipulation. If politically desired, it could also be designed to serve as a **price floor to the ETS** in order to reduce carbon price uncertainty within Ukraine's upcoming ETS.

While the ETS and reformed carbon tax could be **two key pillars in Ukraine's climate architecture**, they **should not be the only two policies**. Targeted support for renewable energy investments through competitive auctions for feed-in premiums, public **infrastructure investments** and **investment support** to households and businesses, e.g. through a re-launch and scale-up of the warm loans and 5-7-9 programmes, are also needed, due to the size of up-front investment needs, politically induced investment risks and borrowing constraints of households and companies. However, **carbon pricing**, in the form of carbon tax reform and the ETS, can make complementary policies much more effective.

Depending on the ambition in the price path, the reformed tax could achieve **emissions reductions of up to 10% by 2030** in the buildings and transport sectors, as opposed to a scenario without a carbon tax. However, without adequate social compensation, the tax risks disproportionately **impacting lower-income households**. Energy poverty could rise significantly, affecting up to 32% of households. To address this, **revenues** from the tax – projected to be **EUR 1.2-4.2 billion annually** by 2030 – can fund targeted, consumption-independent subsidies, climate dividends, or reductions in other taxes to **offset regressive effects**. Social compensation for the proposed carbon tax reform as well as upcoming energy price liberalisation should be considered together. A **reformed, more progressive housing and utilities subsidy (HUS)** could cushion the impact of energy price liberalisation, particularly on lower-income households, while the carbon tax revenues could fund a universal climate dividend. If 100% of revenues raised directly from residential consumers would be used for the climate dividend, the average household from the 1^{st} to 5^{th} percentile, i.e. the **lower-income half of the population**, would see a **net positive income effect** from the combined carbon tax and climate dividend.

'Catching up' and converging with European climate policy architecture and carbon price levels certainly is not easy for Ukraine. However, this analysis shows that **it can be possible** without excessive adverse effects on lower-income households if smart, well-designed social compensation mechanisms are introduced.

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Annex: Modelling Approach

The following section provides a detailed overview of the methodology adopted in Chapters 3 and 4.2. Chapter 3 estimates the impact of three carbon price scenarios for the year 2030, with 30 EUR/tCO_2 (low), 60 EUR/tCO_2 (medium) and 90 EUR/tCO_2 (high) on the level of energy prices, household budgets, emissions, and government revenues. Additionally, Chapter 4.2 quantifies the net impact of a scenario with the high carbon tax rate (90 EUR/tCO_2) and a climate dividend on household budgets.

Energy prices

2030 wholesale natural gas prices are estimated based on an import-parity approach for natural gas, following short-term commodity price projections from World Bank and long-term projections from Umweltbundesamt (UBA). Similarly, cost-covering 2030 retail prices are estimated following the import-parity approach of Dodonov (2018). Respective carbon prices are added per scenario, accounting for VAT. Cost-covering district heating prices are also derived via an import-parity approach, assuming natural gas-generated district heating.

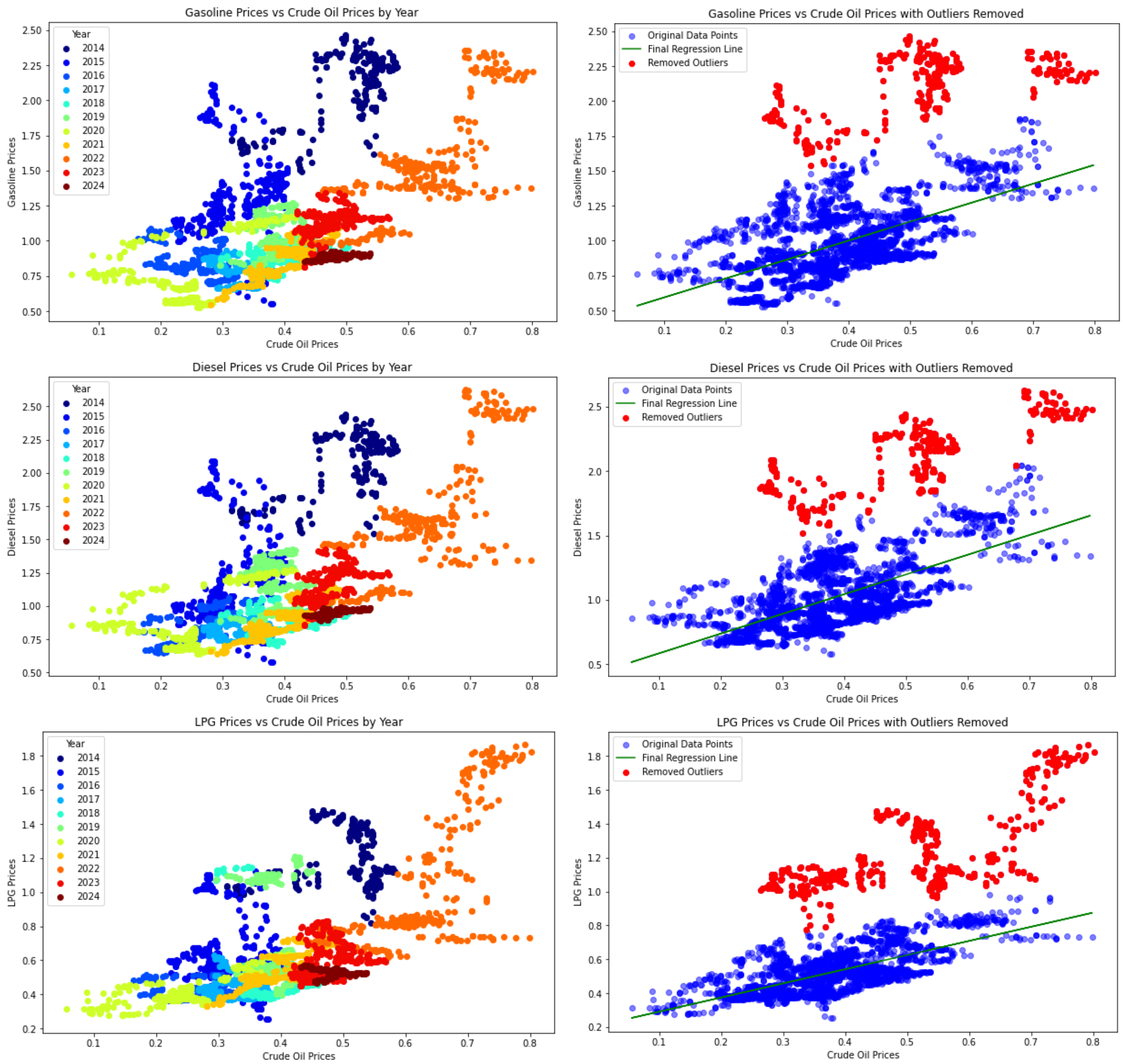
Electricity wholesale prices are derived from a total system cost analysis based on LCU's Ukrainian electricity system capacity expansion and dispatch optimisation model. A model-run closely following expected installed capacities and electricity demand from the "with additional measures" scenario of Ukraine's National Energy and Climate Plan (NECP) has been used as the basis for the estimation. Cost-covering electricity retail prices are derived by accounting for transmission and distribution losses, adding network costs, electricity excise tax and VAT. Increasing carbon tax rates are added per scenario, accounting for VAT, with an average grid emissions intensity derived from the electricity system model-run.

Finally, road motor fuel prices are derived based on Europe Brent crude oil price projections from World Bank and UBA, via a linear regression approach utilising 10 years of historical daily Europe Brent crude oil spot prices and Ukrainian average daily gasoline, diesel and LPG prices. Outliers, in particular from the years 2014/2015 and 2022 where shortages due to Russia's invasions strongly affected Ukrainian fuel prices, are excluded from the regression (see Figure A1 on next page).

Final retail prices for gasoline, diesel and LPG prices are derived accounting for the road motor fuel excise taxes, the planned excise tax increase and VAT. Respective carbon prices are added per scenario, accounting for energy and carbon content of the different fuels and VAT. A weighted average of the road motor fuels is then calculated, following the shares of the respective modes, as household expenditure data is only reported for road motor fuels aggregately.

Based on projected cost-covering 2030 retail prices and historical average residential retail energy tariffs, all converted to 2023-EUR, real energy price increases per scenario are calculated.

Figure A1: Gasoline, diesel and LPG prices vs. crude oil prices
(by year and with a regression line excluding outliers)



Source: Author's own calculations based on US EIA and mylpg.eu

Household income and expenditures

The microfile of Ukraine's 2016 Household Budget Survey is used as the basis for estimations.[55] Household income and expenditure by energy item (electricity, natural gas, district heating, road motor fuels) is rescaled with the OECD-modified equivalence scale, normalised to a couple without children = 1.[56] After initial analysis, a share of missing observations for district heating and road motor fuel expenditure is imputed via a log-log regression of (equivalised) expenditure

[55] Unfortunately, a more recent microfile for the HBS was not available to the author at the time of writing.

[56] For more information, see for example: https://www.ons.gov.uk/peoplepopulationandcommunity/personalandhouseholdfinances/incomeandwealth/compendium/familyspending/2015/chapter3equivalisedincome#equivalisation-methodology

over household income to reflect the correct average share of district heating usage and car ownership in Ukraine.

In order to derive expected 2030 household income, cumulative real 2016-2030 GDP growth (including future projections by IMF) is applied to 2016 household incomes.

2030 expected energy expenditures (by energy item) under a hypothetical scenario with 2016 real energy tariffs are calculated as a first step, based on fitted values for 2030 income from log-log regressions of (equivalised) energy expenditure over 2016 household income (i.e. expenditure adjusted to 2030 income levels with income elasticities of demand derived from the 2016 data) and income-adjusted (i.e. heteroskedasticity-adjusted) residuals from the 2016 fitted and observed values (except for the imputed values where no observed values exist).

In a second step, the direct effect of price increases on expenditures, as well as price elasticity of demand is taken into account for the 2016-2030 real price increases under the different carbon price scenarios. We use short-term price elasticities of demand from Labandeira et al. (2017), displayed in Table A1 below.[57]

Table A1: Energy products elasticities used for the scenario estimation

Energy carrier	*Short-term[57] price elasticity*
Electricity	– 0.126
Natural gas	– 0.180
District heating[58]	– 0.180
Road motor fuels[59]	– 0.235

Source: Labandeira et al. (2017) and author's own calculations

Estimated household expenditures after accounting for income and energy price changes are compared to household income and aggregated by decile to obtain the analyses in Chapter 3.

[57] Labandeira, X., Labeaga, J. M., & López-Otero, X. (2017). A meta-analysis on the price elasticity of energy demand. *Energy policy*, *102*, 549-568.

The rationale for *short-term* elasticities despite the long time horizon is that, usually, elasticities are observed for price changes of a single good, with ceteris paribus assumptions for other goods' prices. The short-term elasticity mainly reflects behavioural adjustments, e.g. driving less when gasoline prices increase, while the long-term elasticity reflects structural adjustments, e.g. switching from a gasoline to a diesel car. Since many energy prices are adjusted in parallel for the considered scenarios, substitution (switching from gasoline to diesel cars, or from district heating to natural gas space heating) is not as easy. Of course, substitution with low- or zero-carbon technologies is possible, such as adopting an electric vehicle or a heat pump for space heating. However, we believe that these substitution effects are less pronounced for the considered carbon price scenarios than substitution effects with long-term elasticities observed under a ceteris paribus price change. Thus, short-term elasticities are chosen as a conservative assumption.

[58] Elasticity of natural gas is used, as both carriers are mainly used for space heating.

[59] weighted average elasticity of gasoline and diesel

Note that reported 2016 expenditures by energy item are net of housing and utilities subsidies (HUS) and benefits. At the time, the HUS has been a relatively broad-based support mechanism with 34.6% of households enrolled in the scheme during the 2016/2017 heating season.[60] While the HUS does not perfectly target nor sufficiently cover low-income or otherwise vulnerable households[61] it does contain progressive design elements and has been relatively successful in reducing energy poverty in the context of the drastic 2015/2016 energy tariff reforms while maintaining incentives for energy efficiency and energy conservation.[62]

Therefore, when estimating 2030 energy expenditures, we implicitly assume that HUS subsidies cover an equivalent share of the total energy bill to 2016 levels. On the one hand, HUS rules have been tightened in the past years since 2016, reducing the coverage. Increased income in 2030 would further reduce HUS coverage since eligibility thresholds and total subsidies depend on household income. On the other hand, energy price increases such as those assumed for 2030 would mechanically increase the HUS coverage again due to the design of the HUS, as subsidies depend on the total cost of normative[63] (not realised) energy consumption. Thus, the assumption of a constant share of the total energy bill being covered by HUS across time and scenarios, based on the 2016 realised share per household, is a justifiable simplification that is agnostic of any future adjustments to the HUS design. Since the effect on energy expenditures and income burden of households are the variable of interest, we could not fully ignore the role of HUS, but detailed recommendations for design changes to the scheme are beyond the scope of this paper and might be subject of a future analysis.

Climate dividend payments

For the analysis in Chapter 4.2, as described in footnote 53 and 54, we assume that only the share of the carbon tax paid directly through increased consumer bills is considered for the climate dividend. Since we assume that the share of the total energy bill covered by the HUS remains constant compared to the base year of 2016, the part of the carbon tax that would be covered by the mechanically increasing HUS payment is not considered for the climate dividend, since it would be needed to finance the increase in the HUS payments. We assume a climate dividend that follows the OECD-modified equivalence scale to provide household size-adjusted universal lump sum transfers. A single household would receive 67% of the sum for a standard two-person household, a household larger than two would receive an additional 33 percentage points per household member aged 14 or older and an additional 20 percentage points per household member under 14 years old.

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[60] Berlin Economics (2021). *EEF support for HUS recipients: Conceptual ideas and quantitative estimations for a revolving mechanism*. (unpublished)

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[62] Alberini, A., & Umapathi, N. (2024). What Are the Benefits of Government Assistance with Household Energy Bills? Evidence from Ukraine. *The Energy Journal*, 45(3), 223-250. (Link to Working Paper)

[63] depending on household size, dwelling surface area, etc.

Emissions and government revenues

We assume a range of baseline emissions for 2030 approximately based on the "with existing measures" (WEM) and "with additional measures" (WAM) scenarios of Ukraine's National Energy and Climate Plan (NECP).[64] Sectoral 2030 emissions for the residential sector derived from the HBS microsimulation are roughly in line with NECP emissions, however, passenger car emissions as estimated from the HBS microsimulation are significantly below NECP transport emissions, which cannot be explained by the share of non-passenger car transport emissions. Possibly, road motor fuel expenditure is underreported in the HBS. Therefore, NECP values are used instead.

Emissions reductions are derived from percentage reductions between a non-carbon tax 2030 cost-covering price scenario and the respective carbon price scenarios from the microsimulation, applied to baseline emissions (from NECP). The same pro-rata emissions reductions from the residential sector are assumed for the services sector due to the similar nature of the sectors (with space heating from natural gas and district heating being the main driver of energy consumption and emissions). Effectively, this means that we assume a similar price elasticity of demand for the services sector (public and commercial buildings).

Carbon tax revenues are total sectoral carbon emissions for the residential, services and transport sectors for the respective scenario multiplied with the carbon tax rate. This means that we disregard additional VAT revenues in this analysis. However, the revenues reported in this section (Chapter 3.5) includes all carbon tax revenues, including those that would be needed to finance increased HUS payments.

[64] The NECP's WEM and WAM scenarios serve as a baseline for a scenario without a carbon price since the assumed carbon price in both scenarios is insignificantly low for 2030. However, other non-carbon price measures are included in these scenarios. Note: Supply and agriculture sectors excluded due to uncertainty of inclusion in the carbon tax and/or ETS. Source: CMU (2024). *National Energy and Climate Plan of Ukraine 2025-2030*. (Link)