Habitat for Humanity® Magyarország

# Distributional impact of carbon pricing in **Hungary**

National policy paper

June 2023

Supported by:

Federal Ministry for Economic Affairs and Climate Action

European Climate Initiative EUKI

on the basis of a decision by the German Bundestag

# Executive summary

Global CO2 emissions need to be taxed to reduce the European Union's dependence on solid fossil fuels and avoid the consequences of climate change. Taxing carbon emissions is one of the policy measures that would reduce the EU's dependence on fuel imports and help mitigate climate change.

In this paper we have carried out a simulation of a stylized general carbon tax, assessing its impact on the economy and the welfare of the population. In the framework of the analyses a macro- (MEMO: MacroEconomic Mitigations Options) as well as a microeconomic (QUADIS) modelling was conducted. The macro model calculated the carbon tax to ensure a climate target of a 40% reduction in emissions by 2032, consistent with pan-European targets. The micro model describes patterns of consumption and hence patterns of welfare gains and losses after the introduction of the tax. At the same time, we recognise that a carbon tax will generate revenue that can be used to alleviate the losses of the least well-off in society. We have chosen three scenarios: one in which the revenue is distributed across society as a whole (lump sum), one in which the revenue is used to support the poorest households (subsidies), and one in which the revenue is used to reduce other taxes, such as income tax (double dividend). The first two scenarios produce progressive tax outcomes, while the latter are less so.

As a result of the macroeconomic modelling, for Hungary, a carbon tax of $73.54 per tonne would be needed to reach the 40% reduction target. Unlike in the other countries studied, the introduction of a carbon tax in Hungary would have a positive impact on GDP at the end of the period analysed. The introduction of a carbon tax could contribute to reducing the dependence of the Hungarian economy on imported fossil fuels. If a carbon tax were introduced, gas imports would fall by more than one third (35%) and oil imports by one fifth (19%) by 2034.

The microeconomic modelling shows that in the absence of any revenue redistribution, the tax display moderate regressive effects: households from lower income deciles are disproportionately more affected relative to more affluent ones. The price subsidy scenario is the most advantageous in reducing welfare losses for less affluent households, especially for the bottom 30% of the Hungarian population.

## Recommendations

- Redistribution of revenues targeting the less affluent is desirable both in terms of reducing emissions and energy poverty. Carbon pricing in Hungary is expected to have relatively negligible losses for the less affluent households if the government pursues any form of complementary redistributive policy. For instance, as transport fuel use is very high among the richest households and elasticity of transport fuels is very low, a carbon tax would generate a high income from transport fuels that can be generously redistributed in a way that it benefits lower income groups (e.g in the form of subsidies) as well as the environment (investment in sustainable public transport).
- Carbon pricing should not be limited to one (e.g. the power) sector, with other categories of consumption perfectly isolated and exempted from taxation. Our micro-model results reflect a broader carbon pricing scenario, which allows people to adjust their expenditure patterns, reducing the unfavorable adverse effects of one particular (e.g. the electricity) channel.
- A carbon tax that operates by increasing the price of electricity has regressive tendencies. Therefore, Hungarian policymakers need to encourage a less carbon-intensive power sector, which would be, in turn, less affected by fluctuation in the price of carbon.
- Large investment and support programmes for energy efficiency measures – including deep renovations for residential buildings – must be introduced promptly to assist decarbonisation efforts and to help prepare for higher energy prices.

# Introduction

## Problem statement

Global CO2 emissions need to be taxed to reduce the European Union's dependence on solid fossil fuels and avoid the consequences of climate change. Taxing carbon emissions is one of the policy measures that would reduce the EU's dependence on fuel imports and help mitigate climate change.

A carbon tax is economically efficient because it provides incentives to limit emissions in sectors where the costs are lowest. However, despite the effectiveness of a carbon tax in limiting the use of solid fossil fuels, governments may still be hesitant to introduce a carbon tax because of public acceptance problems. If the revenues from a carbon tax are not redistributed on the basis of the principle of social equity, or if the aggregate economic impact of the measure is negative, a carbon tax as a policy instrument could fail.

At EU level, 34 million citizens are experiencing energy poverty. In Hungary, 5.2% of the population reported experiencing difficulties in keeping their home adequately warm. Despite having the cheapest domestic electricity and gas prices in the EU (and sixth and fifth lowest respectively among EU member states in purchasing power standard) in 2021, median incomes are the third lowest among EU member states, the share of energy in total expenditure had been among the highest in the EU and the share of energy expenditure of the poorest households in Hungary was almost twice the EU average in 2018.

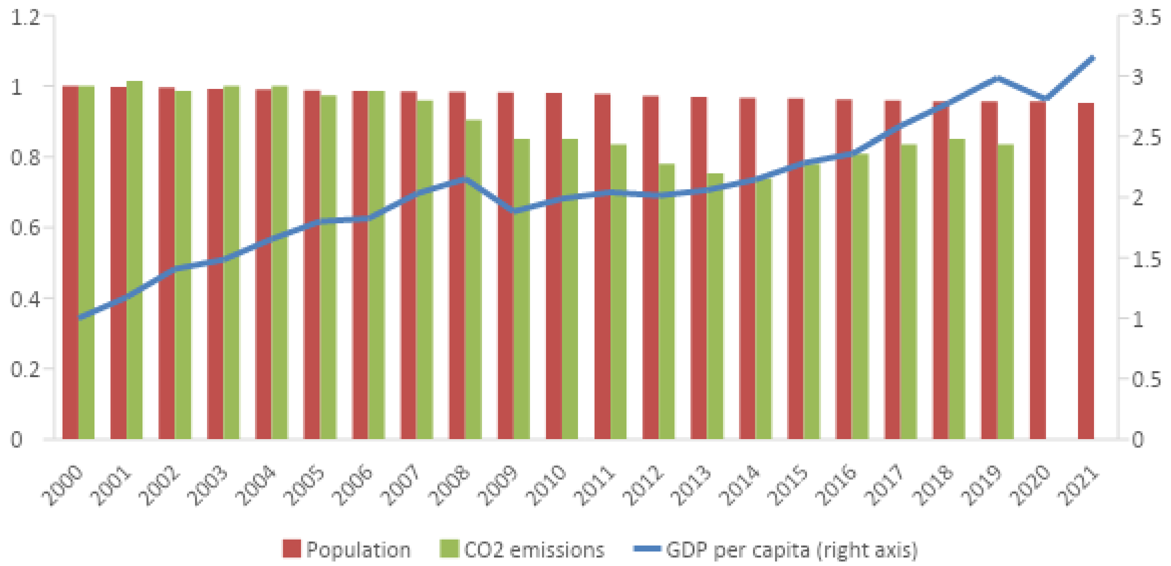
The main types of carbon pricing are Emissions Trading Systems (also called cap-and-trade) and carbon taxes. In this paper we have investigated the latter option: we analysed the economic and social feasibility of carbon pricing in Hungary, simulated a stylised general carbon tax, evaluating its impact on the economy and the welfare of the population.

# Background

## Country details

In the last two decades, Hungary recorded a significant GDP improvement, with temporary setbacks due to global economic crises. CO2 emissions have decreased between 2000 and 2014 by almost 26%, however the trend reversed and have since increased to the level in 2010. The Hungarian population decreased by almost 5% between 2000-2021, while the employment rate significantly increased during the last decade, at a higher rate than the EU average. Industry and construction have a stronger role in the Hungarian economy compared to the EU average, while the share of services in Hungarian employment represented 68 percent, which was slightly lower than in the EU (72.9%).

Figure 1. Changes in GDP per capita, CO2 emissions and population between 2000 and 2021 (2000 = 100)




*Source: Eurostat*

The residential sector with its 34% share of final energy consumption is the biggest consumer, 51% of which is covered by natural gas and 21% by solid biomass[1]. Oil and petroleum products are predominantly (78%) used in the transport sector. Share of renewable energy in the total final energy consumption is 11% and 21% within household consumption. Solid biomass (mostly firewood) is by far the most important renewable source (79% of final renewable energy consumption), while in the case of household use, they practically cover all renewables (98%). However, this form of energy causes significant air pollution and is predominantly used by low-income households out of necessity.

Nearly half of electricity production and 38% of all primary energy production is covered by nuclear power, produced at a single plant located in Paks. The second most important source of electricity is natural gas, which is also the most important source of all final consumption

[1] Hungarian Energy and Public Utility Regulatory Authority (MEKH, 2022); https://mekh.hu/eves-adatok

(33%) followed closely by oil and petroleum products (31%). Solid fossil fuels only represent 1% of final consumption and 9% of primary production.

Hungary, in terms of energy sources, relies heavily on imports; 54% of energy sources come from abroad which is more than double the EU average (25.4%). In the case of gas, this is 110% (due to additional exports) 76% of which comes from Russia. The Hungarian government introduced a utility price cut and cap in 2013 and has regulated the prices of household gas to be fixed at a level 25% cheaper than in 2012. Simultaneously, a large share of utility providers has been centralized by the government. By 2022, the cost of gas (and electricity) on the market was multiples of the regulated price, which prompted the government to set up a utility fund – alongside a defence fund – by imposing a new tax on "extra profits" of large firms in certain sectors (e.g.: banking, telecommunication, retail, aviation, etc.). This was followed by further modification of the utility price cap policy in order to ease its heavy burden on the budget. From 1st of August 2022 domestic consumers have to pay a higher price for their consumption that is over the average consumption.[2]

The Hungarian government's strategy towards carbon neutrality – which is reflected in the National Energy and Climate Plan (NECP) – is based on scaling up solar and biomass energy and holding on to nuclear power. However, wind energy is only marginally part of the energy mix (as it is technically banned to install new wind turbines since 2013) and there are serious concerns on too little investment into energy efficiency especially in the residential sector. Furthermore, Hungary's heavy dependence on Russian oil and gas and the government's openly negative stance against EU climate policies may also hinder the needed efforts to reach decarbonisation.

## Energy poverty

In Hungary multiple factors contribute to the risk of energy poverty. First, the highly inefficient dwelling stock requires high energy consumption. Secondly, while energy prices (except for firewood) are state regulated and has been fixed since 2013, resulting in the cheapest domestic electricity and gas prices in the EU (and sixth and fifth lowest respectively among EU member states in purchasing power standard) in 2021, median incomes are the third lowest among EU member states[3]. Consequently, the share of energy in total expenditure had been among the highest in the EU - before the current energy price boom - and the share of energy expenditure of the poorest households in Hungary was almost twice the EU average in 2018[4]. One-fifth of the population and majority of the lowest income group rely entirely on solid fuels - mostly firewood - to heat their home. Price of firewood has been increasing dynamically - unlike fixed gas prices - and in recent years at an increased rate[5]. Therefore firewood users have become more vulnerable in the past decade.

According to the Eurostat indicators commonly used to measure energy poverty, 9.7% of the population had arrears on utility bills in 2021 (6.4% is the EU average)[6] while only 5.2% of the

[2] 259/2022. (VII. 21). Government Decree, https://net.jogtar.hu/jogszabaly?docid=a2200259.kor

[3] Eurostat, https://ec.europa.eu/eurostat/databrowser/bookmark/f243f38a-ef0f-4780-9612-90d5094de1d7?lang=en

[4] European Commission, https://eur-lex.europa.eu/resource.html?uri=cellar:8a32875d-0e03-11eb-bc07-01aa75ed71a1.0001.02/DOC_3&format=PDF

[5] Central Statistical Office, https://www.ksh.hu/stadat_files/ara/hu/ara0004.html

[6] EU-SILC, https://ec.europa.eu/eurostat/databrowser/bookmark/4a0bf544-604c-413c-99e2-fc28b95189d7?lang=en

population reported experiencing difficulties in keeping their home adequately warm[7]. At the same time, one-fifth of the total population and one-fourth of children lived in a dwelling with a leaking roof, damp walls, floors or foundations[8] in 2020. In the same year, 7.6% of the population was affected by severe housing deprivation[9].

Vulnerable consumers (which is a legal status based on social and health criteria) are eligible for installment payment of arrears and prepayment meters if they are indebted. The social solid fuel subsidy program provides in-kind support (wood or coal) for low-income households that heat with solid fuels. The support is only available in settlements with less than 5000 inhabitants. Often low-quality fuels (wet wood or lignite) are provided, and the criteria and distribution mechanism increase inequalities. Municipalities may offer housing subsidies and debt-management services; however these are not universal, centrally controlled measures, and therefore do not reach many households in need.

In 2013 the utility price reduction and caps were introduced in Hungary[10]. These measures reduced gas, electricity and district heating prices and guaranteed price stability for domestic consumers, until the recent changes in August 2022. The price cap reduced the high energy burden of households, consequently the share of population having arrears on utility bills reduced by half in 9 years (though still higher than the EU average). Due to the flat rate and universal nature of the measure, savings of rich households were significantly higher, as their consumption tends to be higher. Currently, households consuming gas and electricity under a specific “average consumption” threshold value (63,645 MJ/year for gas and 2523 kWh/year for electricity) defined by the state are still protected from direct impacts of volatile changes in energy prices, though indirectly they feel the changes through inflation which has been the highest in Hungary among EU states; food prices and the cost of services increase as the commercial sector pays market price for gas and electricity. Households consuming above the threshold, however, need to pay the (near) market price for the excess amount. Based on the data of the Central Statistical Office, 38.5% of households were already using electricity and gas within the current protected (average consumption) range before the partial phasing out of the cap, so they will not be directly affected by the new measure and will continue to pay the same for energy. The rest of households consume outside the subsidy-protected range for at least one energy source: 6.8% of all households for only gas, 33.6% for only electricity and 21% for both[11]. However, households have started to significantly reduce their consumption and/or switch to solid fuels, which means that most households are likely to remain below the threshold, especially for gas.

With the current global energy price increase and re-nationalised energy companies it is questionable how long the state can guarantee fixed energy prices for households that put a large burden on the national budget.

In the last decade generous subsidy programs were introduced for the renovation of privately owned dwellings and for property acquisition, though these have not had any energy efficiency criteria. Low-income households are systematically neglected and/or excluded from larger

[7] EU-SILC, https://ec.europa.eu/eurostat/databrowser/bookmark/c5caeff6-897b-4e52-b618-8e06bd85fe84?lang=en

[8] EU-SILC, https://ec.europa.eu/eurostat/databrowser/bookmark/fdd9a992-b7de-4b8d-8875-a2e30aeb2515?lang=en

[9] EU-SILC, https://ec.europa.eu/eurostat/databrowser/view/ILC_MDHO06Q/default/table?lang=en&category=livcon.ilc.ilc_md.ilc_mdho

[10] LIV./2013. Law on Utility Price Reduction; https://net.jogtar.hu/jogszabaly?docid=a1300054.tv

[11] Central Statistical Office, 2023, https://www.ksh.hu/statszemle_archive/all/2023/2023_02/2023_02_118.pdf

housing and energy policies. 70% of Hungarian households lack the savings to invest in energy efficiency or to be eligible for the aforementioned subsidies.[12]

## Policy context

The Utility Price Reduction (UPR) programme, introduced in 2013, is the major policy measure impacting household energy bills, making them independent of market prices. The programme, which was in force in this form until 1. August 2022, covers natural gas, electricity, district heating and piped water, so Hungarian households paid much lower prices for energy than households in other EU countries especially in 2021 and the first half of 2022 - although previously there have also been times when Hungarians paid more when global market prices were low.

Currently, the components of household electricity and gas bills consist of the energy price, the system usage/system charges and the VAT. There is therefore no specific energy or carbon tax on households, but with the highest VAT rate in the EU at 27%, this component accounts for a proportionally higher share of their costs than the EU average. Taxes on heating and electricity consumption are currently only included in the energy prices of non-residential consumers (those with a consumption above 1320 kWh), who pay around 1.7 times more per kWh of electricity than residential consumers. In addition, the government introduces a price cap on transport fuels on 15 November 2021 in response to soaring global prices, which was discontinued in 6 December 2022. The tax content is unaffected - but the weak Hungarian currency (forint, HUF) means that we already fall short of the minimum levels required by the 2003 EU directive, which is still in force. Petroleum derivatives are currently taxed in Hungary through excise duty, the minimum value of which is set by the 2003 European Union Directive: 359 euros per thousand litres for petrol (about 143 HUF/l) and 330 euros per thousand litres for diesel (about 132 HUF/l).

There is currently no official definition or indicators of energy poverty in Hungary. There are two documents which make a reference or connect to the term. One is the Hungarian NECP, which states: Hungary will measure the effectiveness of its policy to further reduce heating difficulties by monitoring the share of households spending at least 25% of their income on energy costs (9.8% in 2016). The other one is the Law on Energy Efficiency, which defines the “supported household” as a vulnerable household whose annual energy cost per household for heating the dwelling to 20°C and producing hot water in the dwelling house exceeds 25% of the household's annual income, where the annual energy cost and the household's annual income are the arithmetic average of the energy cost and the average income of the household for the calendar years starting from 2020 and ending at the time of calculation. Also, pursuant to Article 28 of Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019, households in Hungary can register as ‘protected consumers’ provided they are recipients of certain social benefits (such as care allowance, old age pension, municipal allowance for housing costs). The protected consumer status allows for instalment payment or deferred payment on utility bills (albeit once every calendar year), as well as for the installation of prepaid meters free of charge by their energy provider should they accumulate arrears over 60 days.

[12] Central Statistical Office, 2020

# Findings

## Brief overview of methodology

In this paper we have carried out a simulation of a stylized general carbon tax, assessing its impact on the economy and the welfare of the population. In the framework of the analyses a macro- as well as a microeconomic modelling was conducted.

**A macroeconomic** multi-sector dynamic stochastic general equilibrium (DSGE) model **named MEMO (MacroEconomic Mitigations Options)** was applied, to determine the tax level needed to reach the 40% $CO_2$ emission reduction target. We use this model to simulate the changes in employment, wages, and prices of goods at a sector level in response to the introduction of a carbon tax. The results of the MEMO model are expressed as percent deviations from the no-intervention scenario.

MEMO combines two strands of economic modelling: it is an Input-Output (IO) model embedded in a dynamic stochastic general equilibrium framework. The advantages of using such a framework over a static IO model are that it enables us to account for a variety of dynamic economic adjustment mechanisms. The essential features of MEMO are that it has an open economy search and matching mechanism on the labour market and endogenous technical adaptation of energy efficiency in response to changes in the price of carbon emissions.

The main agents of the model are:

- households, which maximise utility from consumption;
- firms, which maximise profits;
- the government, which collects taxes and spends the revenue on public consumption; and
- the foreign trade sector.

The following approach is used to model the carbon tax. First, we set a 40% $CO_2$ emission reduction target by 2032, compared to 2022 for all countries. Second, we adjust the carbon tax (expressed in $ per tonne of $CO_2$) for each country to achieve the 40% reduction in carbon emissions. The value of the carbon tax depends on the country's overall macroeconomic situation, as well as its carbon intensity and energy mix.

**The QUAIDS micromodel** assumes that people's well-being can be measured by analysing their spending habits: how much they spend and on what types of products. In this regard, we say that a citizen is identified as welfare-deprived if, after the introduction of a carbon tax, that citizen has less things to buy than before the tax was introduced. The carbon tax we consider is calculated on the basis of a macro model to ensure a climate target of a 40% reduction in emissions by 2032, consistent with pan-European targets.

In terms of inputs, the micro-model relies on three main inputs: sectoral output levels taken from the existing literature, information on the quantity of goods and services consumed by citizens taken from national household surveys, and price data taken from national statistical offices. Together these allow us to describe patterns of consumption and hence patterns of welfare gains and losses after the introduction of the tax. To measure losses, we group people by income deciles, giving us broader social groups.

At the same time, we recognise that if we introduce a carbon tax, it will generate revenues that can be used to alleviate the losses of the least well-off in society. We have chosen three scenarios: one in which the revenue is distributed across society as a whole (lump sum), one in which the revenue is used to support the poorest households (subsidies), and one in which the revenue is used to reduce other taxes such as income tax (double dividend). The first two scenarios produce progressive tax results, while the latter are less so.

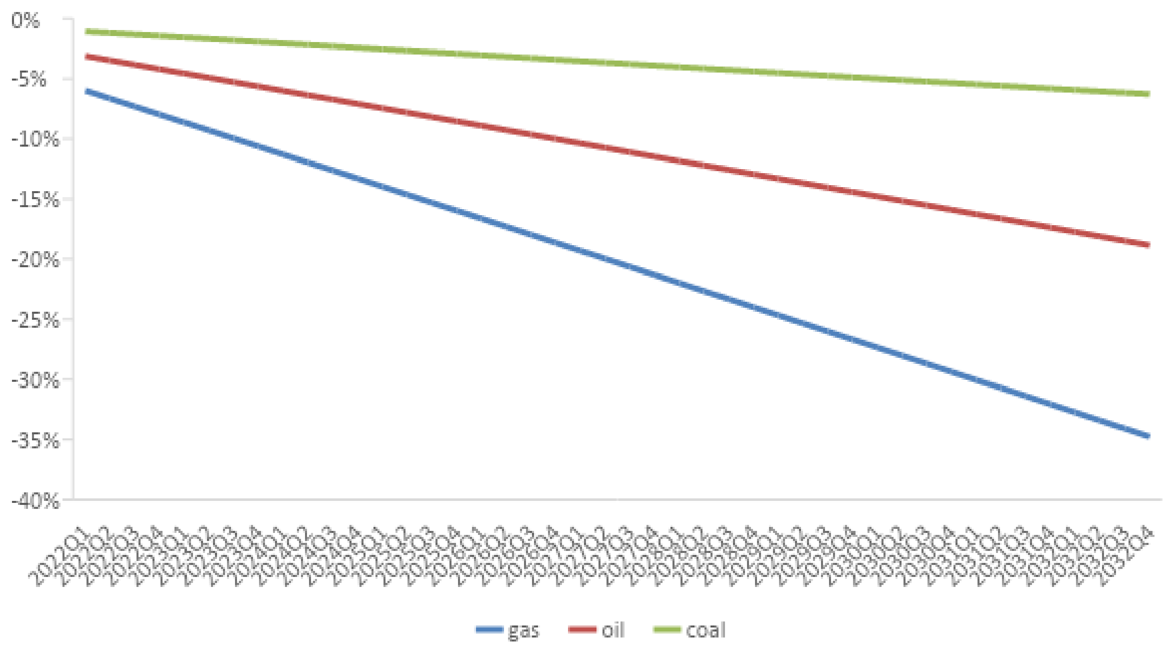
Our main limitation is that we only use expenditure data for the period 2015/2016 to 2019/2020, so we miss the current large inflation shock.

## Impact on macro-economic indicators

The precise tax levels for each country and each year are obtained from the aforementioned DGSE macro-model, ensuring that effects on trade, domestic restructuring, and sectoral changes are accounted for in the first stage of the quantitative modelling exercise. **For Hungary, a carbon tax of $73.54 per tonne would be needed to reach the 40% reduction target**.

As a result of the macroeconomic modelling, unlike in the other countries studied, the introduction of a carbon tax in Hungary would have a positive impact on GDP at the end of the period analysed. The introduction of a carbon tax (Figure 2) could contribute to reducing the dependence of the Hungarian economy on imported fossil fuels. If a carbon tax were introduced, gas imports would fall by more than one third (35%) and oil imports by one fifth (19%) by 2034. A carbon tax would already have a significant impact in the short term, reducing gas imports by 13% and oil imports by 7% by 2024. The impact of a carbon tax on coal would be less significant. The share of coal in Hungary's energy supply is already smaller (7%) than gas (34%) and oil (28%).

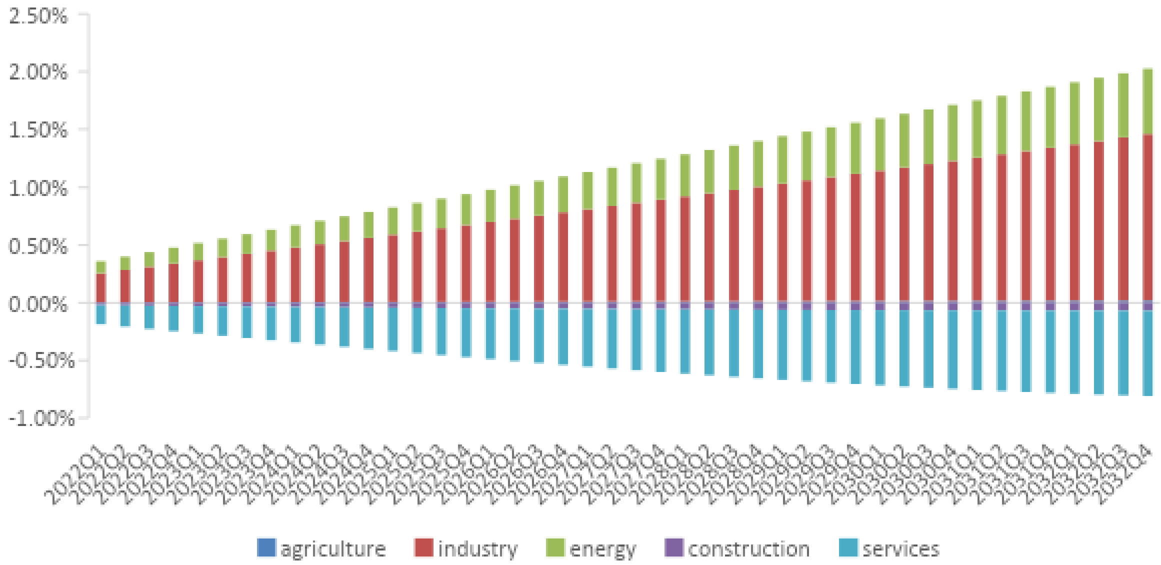
Figure 2. Differences in fuel imports in Hungary (% deviation from the no-carbon tax scenario)




*Source: own elaboration based on the MEMO model.*

We have assessed which five **key sectors** would be at greatest risk of negative impacts on the Hungarian economy from the introduction of a carbon tax (Figure 3.). The services sector would contribute the most to the decline in GDP by 2032, albeit below 1% (-0.74% compared to 2022), followed by construction (-0.07%). Services are a major contributor to Hungarian economic growth, so impacts on this sector should be addressed first. It is important that services have significant economic capacity, high growth potential and the ability to adapt and reorient to new economic conditions - therefore negative impacts can be managed. However, by 2032, we expect higher GDP contributions from industry (+1.44%) and energy (0.6%). Overall, we estimate that the introduction of a carbon tax would lead to more (potentially double) gains in GDP than losses.

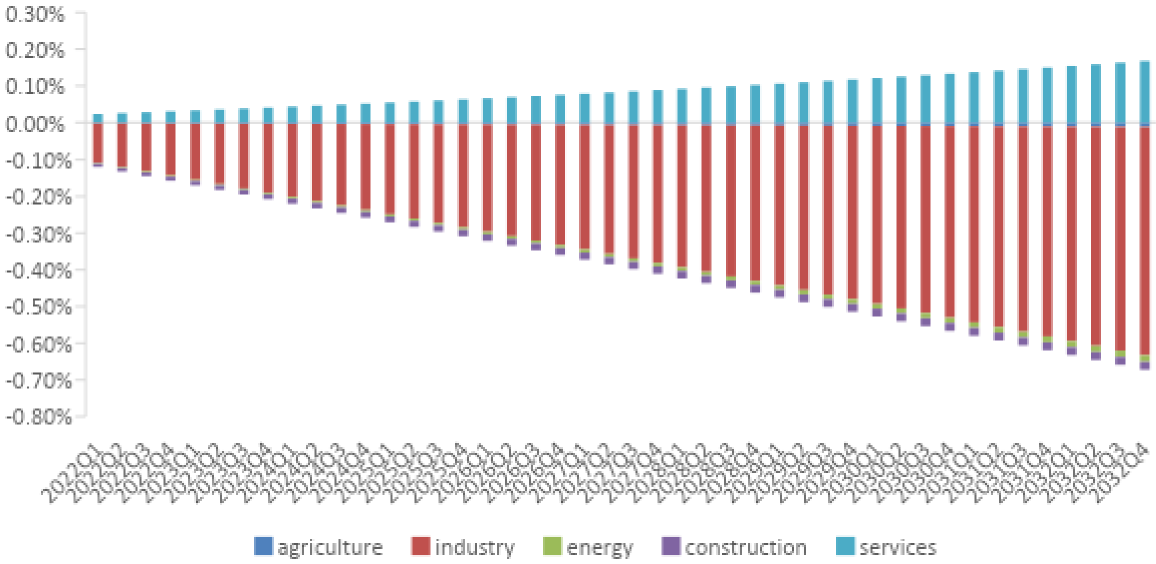
Figure 3. Differences in value-added in Hungary (% deviation from the no-carbon tax scenario)




*Source: own elaboration based on the MEMO model.*

**The labour market effects** of the carbon tax in Hungary will be small and manageable until 2032, as employment will fall by 0.1%. The carbon tax impacts are most pronounced in the industrial sector (-0.62%). However, employment in the service sector is expected to increase after the carbon tax (+0.17%). We expect the magnitude of the employment impacts to increase in the long run. Therefore, labour market adjustments resulting from the carbon tax should be addressed, for example, by increasing unemployment benefits and ensuring active labour market policies. Hungary has recently experienced lower unemployment and strong wage growth, but labour shortages in sectors such as construction (Figure 4.)

Figure 4. Differences in employment in Hungary (% deviation from the no-carbon tax scenario)



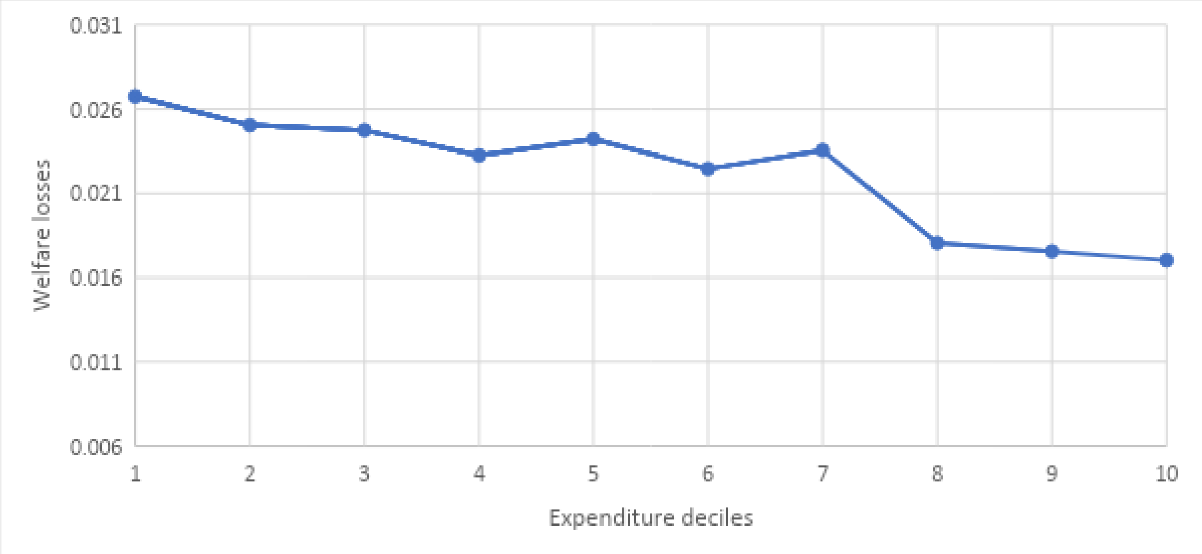

*Source: own elaboration based on the MEMO model.*

## Impact on microeconomic indicators

Microeconomic modelling was used to analyse the impact of the carbon tax, identified by macro modelling, on the welfare of the population.

Figure 5 shows the incidence of the welfare losses induced by a Hungarian nationwide carbon tax applied cross-sectoral to the entire economy between 2022 and 2033. The first outcome to underline is that **in the absence of any revenue redistribution, the tax display moderate regressive effects: households from lower income deciles are disproportionately more affected relative to more affluent ones**. The average loss of the 10% of poorest Hungarian households is more than 1,6 times higher than that of the wealthiest 10% (i.e., a compensating variation of 0.026 vs. 0.016). In terms of the taxonomy of loss types, it is immediate to identify three categories: the highest payers (i.e., the first two expenditure deciles), the medium payers (i.e., the following five deciles), and the low payers (i.e., the top three decile).

Figure 5. Welfare losses across deciles in 2033 before redistribution

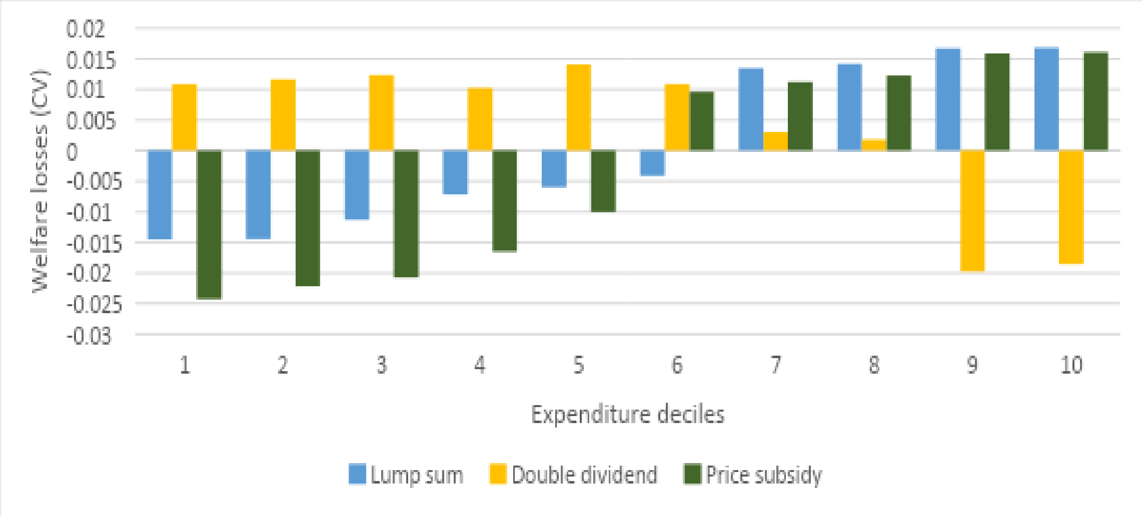



*Source: own elaboration*

These adverse effects are driven by a high tax level of 73,54 $/tCO2 (compared to the other CEE countries). A second conclusion is that all households would have to earn between 1.7% and 2.7% more monthly to maintain their initial consumption level before introducing the carbon tax. In the presence of other sources of price inflation, this implies a significant effort for a considerable share of the population (especially for the least affluent, bottom 10%), suggesting that a governmental intervention targeting the less affluent might be politically and socially desirable. This is especially relevant given the recent developments in 2022, which have increased the inflationary and energy price pressure faced by most citizens, and that of 2023, where inflation is by far the highest within the EU.

Figure 6 displays the distribution of welfare losses (CV) across the Hungarian population when considering concurrently the carbon tax and, alternatively, the three redistribution scenarios. As expected, the three scenarios produce different sets of winners and losers by 2033 when compared to the baseline scenario before the introduction of the carbon tax in 2022. The winners of each scenario are represented by the households that, after redistribution, incur “negative welfare losses” (i.e., welfare gains). Before engaging with the distinct scenarios, it is relevant to note that overall losses are reduced substantially in all three cases: while the average CV varies between 0.017 and 0.027 in the baseline scenario, depending on the most affected deciles, we are now seeing a reduced interval bounded upwards by a positive CV of 0.016 (losses incurred in the price subsidy scenario by richest decile of the Hungarian society). Therefore, carbon pricing in Hungary is expected to have relatively negligible losses for the less affluent households if the government pursues any form of complementary redistributive policy. However, not all redistribution provides more gains for the less affluent.

Figure 6. Welfare losses across deciles in 2033 after redistribution




*Source: own elaboration*

**The price subsidy scenario** is the most advantageous in reducing welfare losses for less affluent households, especially for the bottom 30% of the Hungarian population. Under this model of revenue recycling, households belonging to the first five deciles (which by construction include the median household type and represent, therefore, most of the population) not only see a reduction of losses but become net-winners of the new policy regime, as their average CV is negative. Therefore, 50% of the population incurs at least some welfare gains. In simple terms, this means that such households would have more income available for additional expenditures after introducing the carbon tax and this type of redistribution. As the carbon price redirects expenditure towards relatively less carbon-intensive sectors, our model predicts, therefore, that Hungarians will have more money to spend on cleaner commodities. Finally, while the wealthiest 50% of the population would become the net payers for this policy (i.e., net losers), their losses are modest (the CV is between 0.009 and 0.016). Briefly, the most affluent Hungarian households would lose at most 1.6% of their monthly income.

**The lump-sum scenario**, like the price subsidy approach to redistribution, ensures that the bottom 60% of the households incur no losses, becoming the net winners of this policy regime. Only people from the seventh income decile would occur rather minimal welfare losses ranging between CV of 0.013-0.016. Nevertheless, under these conditions, the net losers of the carbon tax regime are households in the top four deciles, representing the wealthier minority of the Hungarian population. However, the total costs of carbon pricing are distributed more equally between these categories when compared to the price subsidy. However, there would not be a significant difference in the losses of the most affluent households in both the price subsidy and lump-sum scenarios. Thus, the lump-sum scenario would bring less benefits for the poorest at the “same price” for the richest. The lump-sum redistribution would be more easily viable compared to the price subsidy, mainly because it is the simplest one to design, implement, and monitor from the perspective of domestic decision-makers and it also represents a more balanced distribution scenario.

**The double divided scenario** induces very different distributional and welfare effects and stands in clear opposition to the two scenarios previously analysed. In this case 80% of the society would remain net losers of introducing a carbon tax, while the richest 20% would receive significant welfare gains (with a CV between – 0,019 and 0,018). On average, the poorest 10% of Hungarian households would have an average CV at 0.01, which is less than half of the losses without redistribution. Accordingly, while the poor remain the net losers (i.e., the distributional effects are the same as before redistribution), the welfare effects are significantly less pronounced for the aggregate population. On the other hand, the net winners are the most affluent top two deciles. This would increase inequalities within the country and does not correctly address concerns such as energy poverty at the bottom of the income distribution**.**

### Drivers of welfare and distributional effects

To understand what drives the results described in the previous sub-section, we look at the intermediary outputs of the QUAIDS model: the price elasticity of demand for the six categories constructed for the purpose of this analysis. Table 1 presents both the compensated and the uncompensated elasticities for the case of Hungary.

Table 1 Price elasticity of demand for the six categories in Hungary

| | | | Price (1% increase) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Food | Others | Electricity | Transport | Transport fuels | Other energy costs |
| Compensated elasticities | Demand (%) | Food | -0.1065236507 | -0.1440102844 | -0.1540253039 | -0.04956650241 | -0.4661701096 | 0.1400555385 |
| | | Others | -0.6577123386 | -0.2569155446 | 0.3369637843 | -0.03737857219 | 0.2597354026 | 0.5760887227 |
| | | Electricity | -0.9724168303 | -0.4667628258 | -0.3524334138 | 0.5440687761 | -0.4307055757 | 0.7403288168 |
| | | Transport | -0.3001412448 | -0.4781192617 | 0.5083563208 | -0.8507796526 | 1.26305844 | -0.1423746018 |
| | | Transport fuels | -1.649315735 | 0.201273873 | -0.240066648 | 0.7516150353 | -0.00119323961 | 0.2389528032 |
| | | Other energy costs | 0.4100233139 | 0.3692057813 | 0.3423612679 | -0.06953470566 | 0.1982553998 | -0.3103449014 |
| Uncompensated elasticies | Demand (%) | Food | -0.8845587841 | -0.1479658786 | -0.1825664131 | -0.08010651066 | -0.5173758369 | 1.394383655 |
| | | Others | -0.6817128495 | -0.2685298704 | 0.2990509088 | -0.07794670575 | 0.1917157489 | 0.5678904418 |
| | | Electricity | -1.119727877 | 0.4334511881 | -0.3524101435 | 0.5191687468 | -0.430747325 | 0.7398256203 |
| | | Transport | -0.7736548139 | -1.514786921 | 0.4335568253 | -0.9308177895 | 1.128860342 | -0.3041210442 |
| | | Transport fuels | -2.128778065 | 0.963047393 | -0.2414238718 | 0.6705713776 | -0.1370772709 | 0.2387890247 |
| | | Other energy costs | 0.4084224247 | 0.3657009397 | 0.3421083803 | -0.09659458272 | 0.1982100291 | -0.3103995858 |

The compensated price elasticities only comprise the substitution effect, while the uncompensated price elasticities also contain the income effect of price changes. Pragmatically, when taken together, this means that we can see, in the case of the Hungarian economy, how the average household would shift its consumption pattern due to the rising costs associated with the increase in the price of carbon emissions.

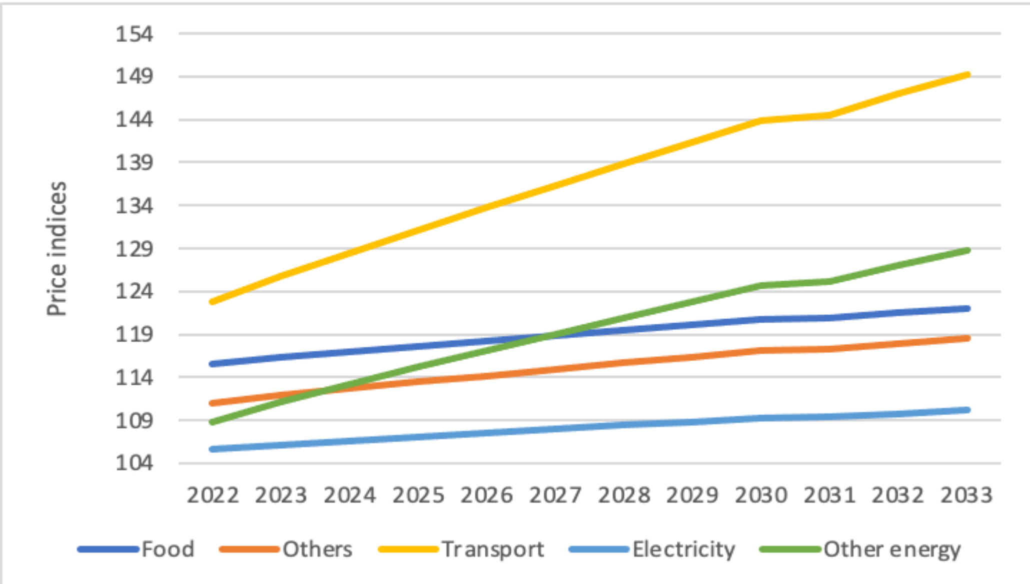
**There are two key conclusions when analysing the Hungarian elasticities:**

The first is that elasticities of the energy consumption categories (i.e., the values on the main diagonals) display negative signs, implying that the increase in the price of energy goods would result in an immediate decrease in the quantity of that good that is demanded by households across society. This implies that introducing a comprehensive carbon tax conducive to effects through multiple economic channels would result in lower aggregate consumption levels for all energy goods. The effect is significantly higher for public transport while the lowest for transport fuels (private transportation ways). While this is a complex issue, the results seem to indicate that when faced with rising prices for energy, part of households would first reduce their usage of public transport before reducing domestic energy use, while use of transport fuels (e.g. use of cars) would be hardly affected.

A second observation regards the cross-elasticities of energy consumption categories. While not all Hungarian families are, on average, at risk of being energy-poor, Table 1 reveals alarming relationships: an increase in the price of electricity results, ceteris paribus, in less demand for food for the average Hungarian household. Similarly, this is the case for transport, and transport fuels. Interestingly in case of price increase of transport fuels, households would decrease the demand for food more than for the transport fuels themselves.

In addition to using variation in monthly (logged) price indices to estimate the distributional effects of a carbon tax, our model also requires understanding variation in the evolution of relative prices between 2022 and 2033. Given that we run our model for each year in this period, Figure 7 shows the predicted annualized price indices for the six categories. The evolution of each predicted price index depends only on the relative burden imposed by carbon taxation on each economic sector, which in turn depends on the average level of emissions from that sector.

Figure 7 Predicted evolution of prices between 2022 and 2033




*Source: own elaboration*

A first observation when looking at goods and services in the power sector is that the price of electricity is more stable in Hungary, given the fixed price until a certain consumption level. On the other hand, transport and other energy have the steepest evolutions, that translate into welfare losses.

A second observation is that the price of transport is a clear outlier. As the distribution of prices in the transport sector has been historically skewed towards more affluent consumers, this implies that the regressivity of the carbon tax (which also affects transport) might be reduced, especially when opposed to a tax that would apply only to the power sector or to heating.

# Discussion

The biggest decarbonisation challenge for the Hungarian economy is its heavy dependence on Russian oil and gas, and the fact that Hungarian society has been disconnected from the gas and electricity market for almost a decade due to governments' flagship policies of utility price caps.

Therefore, carbon pricing is a challenging issue to tackle in Hungary, including the issue of public attitudes. A representative survey in 2019 found that from a range of options the least popular measure was to increase taxes on fossil fuels (oil, coal, natural gas), which Hungarians are rather against (4.6 on a scale of 10)[13].

However, on a macroeconomic scale it has its clear advantages. As a result of our macroeconomic modelling, the introduction of a carbon tax in Hungary would have a positive impact on GDP at the end of the period analysed. The introduction of a carbon tax could also contribute to reducing the dependence of the Hungarian economy on imported fossil fuels.

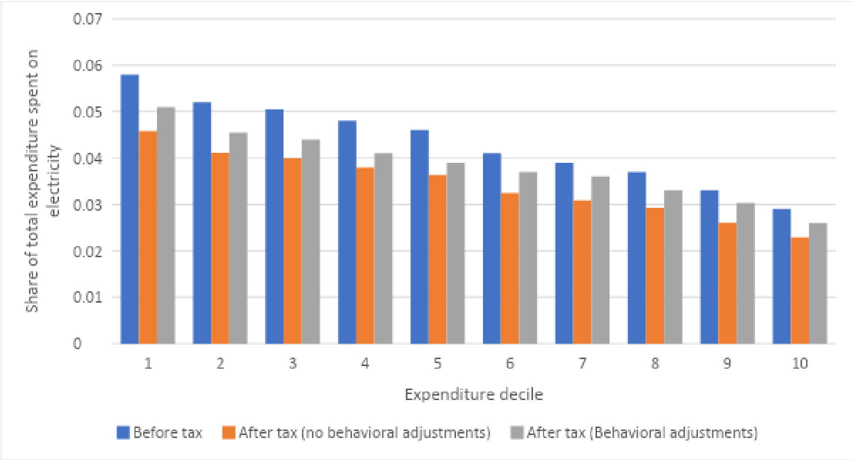
To better understand how the carbon tax propagates in society, we decompose its effects by descriptively looking at how this new policy regime alters expenditure patterns in the four categories of goods and services associated with the energy sector. It is crucial, however, to always remember that our results discuss a carbon pricing regime in which all the economic sectors are taxed relative to their average carbon content. Therefore, when isolating each sector separately, we can only draw limited conclusions about how general carbon taxes that apply to that sector would behave.

All the expenditure patterns are the results of the introduction of the carbon tax in 2022. The “Before tax” patterns are directly extracted from the HBSs, while the “After tax” patterns are predicted after the first period of taxation is introduced, also in 2022.

First, one must look at the most widely distributed and homogenous energy consumption category: electricity. As revealed in Figure 8, electricity consumption displays clear regressive tendencies, as households from the lowest income deciles spend a significantly higher share of their income on electricity. This pattern remains consistent both before and after the introduction of a carbon tax, but the new policy mildly enhances the differences between income deciles. More precisely, while a drop in electricity consumption is present amongst all households, the relative drop gets higher as one approaches the left-tail of the expenditure distribution. Furthermore, the pattern in the case of Hungary is close to linear, showcasing that, indeed, the poorest Hungarians have to bear a disproportionate financial burden for fulfilling their needs. The numbers appear alarming in absolute terms: the bottom 10% of Hungarian households in terms of expenditure must pay, on average, 5.1% of their income for electricity, almost 2 times the average share paid by the richest 10% of Hungarians. As our results are derived from micro-data before 2020, more recent data could change these numbers, as the price of electricity has been increased for households that have higher consumption than the average. This could impact both the poorest households that rely on old and inefficient devices or the richest households that have higher energy consumption in general.

[13] DemNet, 2019; https://demnet.hu/a-magyar-klimapara-eghajlatvaltozas/

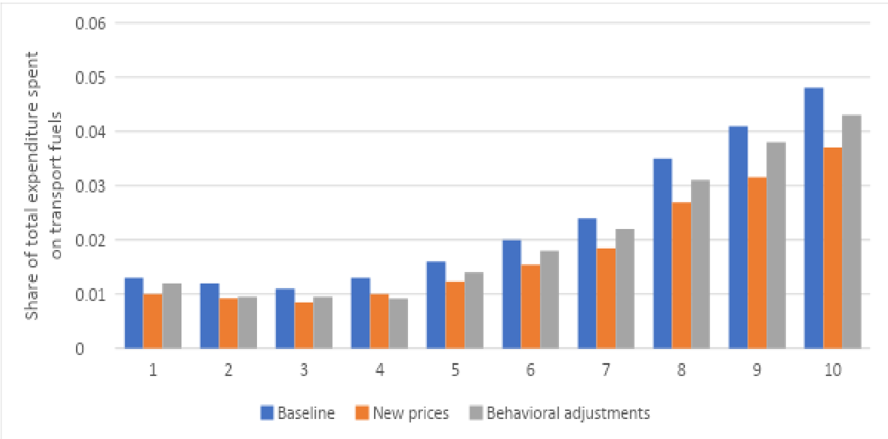
Figure 8 Expenditure pattern for electricity consumption in Hungary




*Source: own elaboration*

Figure 9 reveals a steady relationship between income status and the share of the monthly budget spent on transport fuels (e.g., gasoline, diesel) before and after the introduction of the carbon tax. In both scenarios, the share of income spent on this energy consumption category increases with income. The most affluent households spend more than 5 times more from their income on transport fuels. If taking into consideration that their income is also significantly higher, this means that private use of transport fuels is dramatically higher among richest households. At the same time as one can see in Figure 6 households from the first four expenditure decile dedicated only as little as 1-1.5 % of their income on transport fuels, thus this category of goods appears to be very modest among low-income households. Nevertheless, the highest fall in consumption can be observed among the households in the fourth decile and the richest income groups, even if that fall is not significant.

Figure 9. Expenditure pattern for transport fuels in Hungary

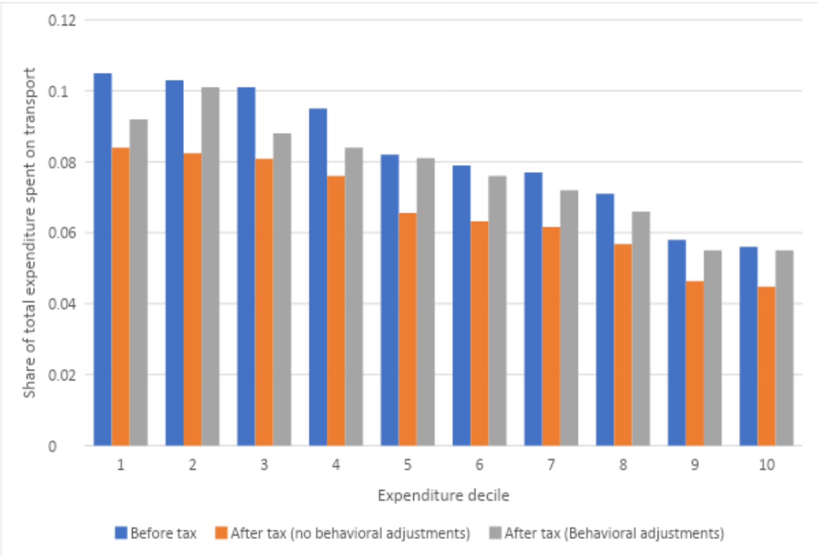



*Source: own elaboration*

Under these auspices, a carbon tax that applies only to transport fuels could be, ceteris paribus, very pernicious if not complemented by properly designed social and public transport policies. A price increase or a drop in consumption of transport fuel for the poorest half of the Hungarians could mean severe restriction of their mobility. This would be especially alarming in rural areas where many basic services are only accessible in closer towns, while public transport services are weak. Therefore households use their car for accessing basic services and if the price of that would increase and thus, they reduce travels, it would mean a crucial reduction of their quality of their life. At the same time as transport fuel use is very high among the richest households and elasticity of transport fuels is very low, a carbon tax would generate a high income from transport fuels that can be generously redistributed in a way that it benefits lower income groups (e.g in the form of subsidies) as well as the environment (investment in sustainable public transport)

Figure 10 complements the discussion on the relationship between the decile a household belongs to and the share of its monthly income spent on transport services. Once again, the results show the similar distribution before and after the introduction of the carbon tax. A first observation is that the reduction in consumption is high only among households in the first, third- and fourth-income group. If not adequately addressed by the authorities, this could mean that people switch from public transportation to their personal cars. As this is more likely for more affluent households, adverse distributional effects would seem to arise even without direct tax regressivity. However, in this case, like in the case of income spent on electricity, the relationship is regressive: the poorest Hungarians have to pay almost 3% of their income on transportation, outside of fuels. This includes public transport, ride-sharing services, and other intra- and inter-country transportation modes. Corroborating the results in the second and third figures, it is easy to observe that overall, transportation is much less costly for wealthy households, regardless of the mode of transportation chosen by individuals.

Figure 10 Expenditure pattern for transport services in Hungary




*Source: own elaboration*

Reflecting on how a carbon tax affects households if it were to increase the transportation price, ceteris paribus, the prospects are rather bleak. The least affluent 30% of Hungarians spend over 10% of their income on these services. Therefore, policymakers should design carbon pricing mechanisms that account for the regressivity of taxes, cost of the transport services and design measures that encourage the cost-effectiveness of transport. Such measures could imply sustainable public transportation that is not affected by carbon taxes, a more comprehensive system of national railway transportation, emissions-free urban mobility, or even supporting the replacement of cars that operate based on combustion engines with electric vehicles among low-income households.

# Policy conclusions and recommendations

Based on the findings of our modelling, introducing a carbon tax would not only have a positive impact on Hungarian GDP at the end of the period analysed, but it would also contribute to reducing the dependence of the Hungarian economy on imported fossil fuels. However, without the redistribution of carbon tax revenues, the tax display moderate regressive effects: households from lower income deciles are disproportionately more affected relative to more affluent ones.

Recommendations:

- Redistribution of revenues targeting the less affluent is desirable both in terms of reducing emissions and energy poverty. Carbon pricing in Hungary is expected to have relatively negligible losses for the less affluent households if the government pursues any form of complementary redistributive policy. For instance, as transport fuel use is very high among the richest households and elasticity of transport fuels is very low, a carbon tax would generate a high income from transport fuels that can be generously redistributed in a way that it benefits lower income groups (e.g in the form of subsidies) as well as the environment (investment in sustainable public transport).
- Carbon pricing should not be limited to one (e.g. the power) sector, with other categories of consumption perfectly isolated and exempted from taxation. Our micro-model results reflect a broader carbon pricing scenario, which allows people to adjust their expenditure patterns, reducing the unfavorable adverse effects of one particular (e.g. the electricity) channel.
- A carbon tax that operates by increasing the price of electricity has regressive tendencies. Therefore, Hungarian policymakers need to encourage a less carbon-intensive power sector, which would be, in turn, less affected by fluctuation in the price of carbon.
- Large investment and support programmes for energy efficiency measures – including deep renovations for residential buildings – must be introduced promptly to assist decarbonisation efforts and to help prepare for higher energy prices.