

Support to the Preparation of Social Climate Plans

Deliverable 2

**Report on the impacts of ETS2, the
identification of vulnerable groups
and stakeholder engagement plans**

Final report for Belgium

REFORM/2021/OP/0006 Lot 1



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Rotterdam, 27/03/2025

REFORM/2021/OP/0006 Lot 1

Support to the Preparation of Social Climate Plans

In association with:



Copenhagen
Economics



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List of Abbreviations

Abbreviation / Acronym	Full Term / Definition
AMEDI	Assessing and Monitoring Employment and Distributional Impacts
BA	Beneficiary Authority
BIPV	Building-integrated photovoltaics
BXL	City of Brussels
CCEG	Climate Change Expert Group
CET	Central European Time
CTP	Climate Target Plan
CO₂	Carbon Dioxide
CPAS	Centre public d'action sociale
CREG	Commission for Electricity and Gas Regulation
CWaPe	Regulator of the Electricity and Gas Market in Wallonia
DG CLIMA	Directorate-General for Climate Action
DG EMPL	Directorate-General for Employment, Social Affairs and Inclusion
DG ENER	Directorate-General for Energy
DG MOVE	Directorate-General for Mobility and Transport
DG RECOVER	Directorate-General Recovery and Resilience Task Force
SG REFORM	Directorate-General for Structural Reform Support
DG REGIO	Directorate-General for Regional and Urban Policy
DLV	Deliverable
DNHS	Do no significant harm
EC	European Commission
ECO	Energy Company Obligation
EED	Energy Efficiency Directive
EGD	European Green Deal
ELLE	Estonian, Latvian & Lithuanian Environment
ENBEE	Environment and Building Energy Efficiency
EPAH	Energy Poverty Advisory Hub
EPBD	Energy Performance of Buildings Directive
EPCs	Energy performance contracts
EPOV	EU Energy Poverty Observatory
ERV	Energy Recovery Ventilation
ET	Expert Team
EU	European Union
EU ETS	European Emissions Trading System
EU ETS2	EU ETS for buildings, road transport and additional sectors
EUR	Euro
Eurostat	Statistical office of the European Union
EUROMOD	European Union-wide tax-benefit model
EV	Electric Vehicle
FEBEG	Federation of Belgian Electricity and Gas Companies

Abbreviation / Acronym	Full Term / Definition
FCO	Forced Car Ownership
FOD	Federal Public Service
GIS	Geographic information system
GDP	Gross Domestic Product
GDPR	General Data Protection Regulation
GHG	Greenhouse gas
GiZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
HBS	Household Budget Survey
IA	Impact Assessment
IBSA	L'Institut Bruxellois de Statistique et d'Analyse
IEA	International Energy Agency
IEECP	Institute for European Energy and Climate Policy
IR	Inception Report
ISADF	L'indicateur synthétique d'accès aux droits fondamentaux
IWEPS	L'Institut wallon de l'évaluation, de la prospective et de la statistique
JRC	Joint Research Centre
KO Meeting	Kick-off Meeting
LFS	Labour Force Survey
LIHC	Low Income High Cost M&I Measure and Investment
LTR	Long Term Renovation Strategies
M&I	Measures and Investments
MS	Member State (of the European Union)
NACE	Statistical classification of economic activities in the European Community
NECP	National Energy and Climate Plan
NGO	Non-governmental organisation
NUTS	Nomenclature of Territorial Units for Statistics
Oeko	Institute for Applied Ecology
PACE	Plan Air Climate and Energy
PM	Project Manager
PMT	Project Management Team
QA	Quality Assessment
QAM	Quality Assurance Manager
RRF	Recovery and Resilience Facility
RRP	Recovery and Resilience Plans
SBS	Structural Business Statistics
SCF	Social Climate Fund
SCP	Social Climate Plans
SILC	EU Statistics on income and living conditions
SME	Small and Medium-sized Enterprise
SWD	Staff Working Document
TATR	Toronto's Tower Renewal Program

Abbreviation / Acronym	Full Term / Definition
ToR	Terms of Reference
TSI	Technical Support Instrument
UK	United Kingdom
VAT	Value-added tax
VEKA	Flemish Energy and Climate Agency
VREG	Flemish Regulator of the Electricity and Gas Market
WAM	Projections scenario 'with additional measures'
WG	Working Group

1. Introduction

This is the draft Deliverable 2 report for the project *Support to the Preparation of Social Climate Plans*. This project is funded by the European Union via the Technical Support Instrument, and is managed by the European Commission Reform and Investment Task Force (SG REFORM). The contractor (a consortium led by Trinomics which includes Ecorys, E3-Modelling, IEECP, Oeko-Institut, Copenhagen Economics, Sweco Finland (previously Gaia), EpV, EGÚ Brno, ENBEE, ELLE, as well as several independent consultants) support nine Member States (Belgium, Croatia, Czechia, Denmark, Finland, Latvia, Lithuania, Romania, and Slovakia) in the development of their national Social Climate Plans. These plans set out national approaches to reduce the potential negative impacts of the introduction of the Emissions Trading System 2 (ETS2) on vulnerable people, households and micro-enterprises.

This report provides a detailed approach to assessing the impacts of ETS2 and identifying vulnerable groups in Belgium. This report presents the results of activities carried out during the second phase of the project, excluding the Stakeholder Engagement Plan, which will be submitted as a separate document.

During this assessment, we encountered several challenges that should be carefully considered when interpreting the results. First, data limitations posed a significant constraint, as the analysis relied on incomplete coverage, outdated indicators, and gaps in relevant data, which restricted the depth and precision of insights. While this report utilises a whole range of datasets at the national and EU-level, some data gaps and caveats still exist. For example, related to the energy performance of the building stock or to spatial indicators of transport availability and the accessibility of essential services. Data on micro-enterprises also suffers from many limitations. Some data sources would benefit from more regular and thorough updating. The recent energy crisis has had a substantial impact on several trends analysed in this report, with its long-term implications, particularly regarding sustained price increases, remaining unclear. Additionally, the introduction of emerging concepts in the Social Climate Fund regulation, such as vulnerable transport users and vulnerable micro-enterprises, presented another challenge, as standardised assessment methodologies for these groups have not yet been established. Finally, the ETS2 operates within a broader policy context as part of the Fit for 55 package, which includes multiple measures being implemented simultaneously by Member States. This overlap makes it inherently complex to isolate the specific impact of ETS2, adding a significant margin of uncertainty to the findings as well as underestimation of users' reaction to price signals.

Overall, it is expected that the results on ETS2 effects, notably from the micro-analysis, are over-estimating the effects of ETS2, due to (i) the use of HBS 2015 data (while fossil fuel consumption will have already gone down by 2027), (ii) the application of only short-term elasticities, (iii) the 100% cost pass through assumption. Nevertheless, some factors also contribute to some underestimation, such as some households underreporting their heating and transport expenditure in the HBS 2015 data.

As regards the transport side, it needs to be flagged that the report heavily focusses on affordability dimension of transport poverty, as spatial data on transport availability and accessibility is scarce.

1.1. Reading Guide

This report is structured as follows:

- ✓ **Chapter 1** (the current chapter) provides an introduction to the aims of the project phase that identifies ETS2 impacts;
- ✓ **Chapter 2** outlines the approach that has been taken for assessing the impacts of ETS2 and identification of vulnerable groups, including the definitions and indicators that will be used nationally;
- ✓ **Chapter 3** provides the impacts of ETS2, based on the macro- and micro-modelling;
- ✓ **Chapter 4** provides a preliminary long list of measures considered and identified during national stakeholder consultations;
- ✓ **Chapter 5** provides the recommendations for the collection and use of data, indicators and criteria to identify and estimate the size of the vulnerable groups; and
- ✓ **Chapter 6** outlines the next steps.

1.2. Context indicators

In this chapter, we provide a summary of some key contextual information and the estimated impact of ETS2 on fuel prices. Throughout the report, we look at recurring costs in heating and transport. In heating, this applies to heating fuels and heating costs. In transport, this applies to fuels and expenditures for public transport. We do not include costs related to the purchase or operation of vehicles other than fuels costs.

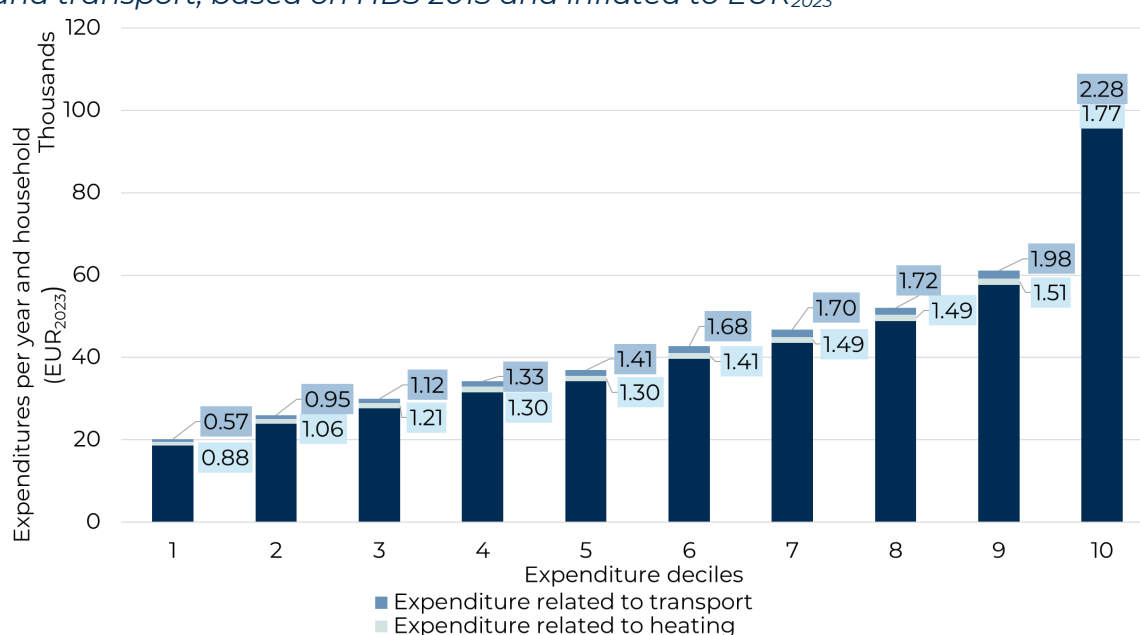
1.2.1. Household expenditure

Figure 1-1 gives an overview of total household overall spending and expenditures on heating and transport based on the HBS 2015 and inflated to EUR₂₀₂₃. Expenditures on heating and transport consider fuel expenditure for heating, as well as expenditures for petrol and diesel used in transport and recurring expenditures for public transportation. We do not include costs related to purchasing a vehicle or operational costs beyond fuel costs.

On average, Belgian households spent 6% of their total expenditures on heating and transport in 2015, with heating expenditure the larger of the two until the third decile and transport expenditure the larger component from the fourth decile onwards.

Throughout this report, expenditure deciles are based on total expenditures of a household and constructed using new OECD equivalence weights. We use expenditure instead of income deciles as total expenditures are generally seen as a good approximation of lifetime income and because the variable related to total expenditures is generally seen as more reliable in the EU HBS compared to the variable total income.

Figure 1-1 Overview of total household expenditure and expenditures on heating and transport, based on HBS 2015 and inflated to EUR₂₀₂₃



Source: HBS 2015, calculations with Oeko-Institut SEEK-EU micro model

Note: Expenditure deciles are constructed using new OECD equivalence weights. Inflated using the Eurostat all-items HICP for Belgium of 1.2607.

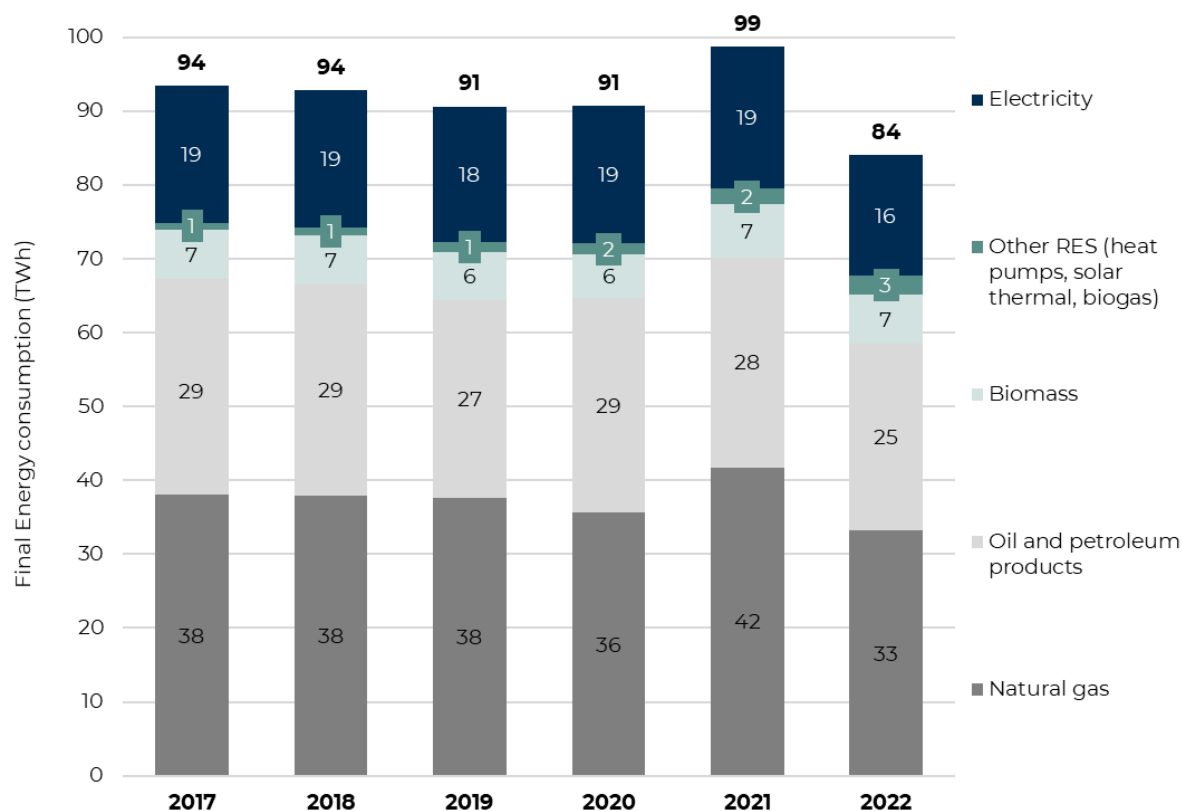
1.2.2. Household energy use – context indicators

Final energy consumption by households in Belgium totals approximately 84 TWh in 2022 (or approximately 16 485 kWh per household), a decrease of approximately 11% since 2017. Figure 1-2 shows the split of households final energy consumption (all uses) per fuel type¹. Since 2019, renewable energy resources contribute approximately 11% of the total, with biomass (solid primary biomass i.e. wood and wood pellets) providing around 7.9% and other renewables, including heat pumps, providing around 3.1%. Their use of other renewables has increased by around 163% (from 1TWh to 2.62 TWh) since 2017. Natural gas plays a large role in household

¹ Original Eurostat data measured final energy consumption in terajoules. These data points were converted to terawatt hours for **Erreur ! Source du renvoi introuvable.** and **Erreur ! Source du renvoi introuvable.**

energy consumption at 39.2% of the total. The oil and petroleum products, which in this case refers primarily to the use of heating oil, also play a key role, having a share of 30% of the total in 2022. Electricity consumption for appliances, lighting and heating of around 16 TWh has consistently represented approximately 19.2% of the total.

Figure 1-2 Total final energy consumption in households (2017–2022)

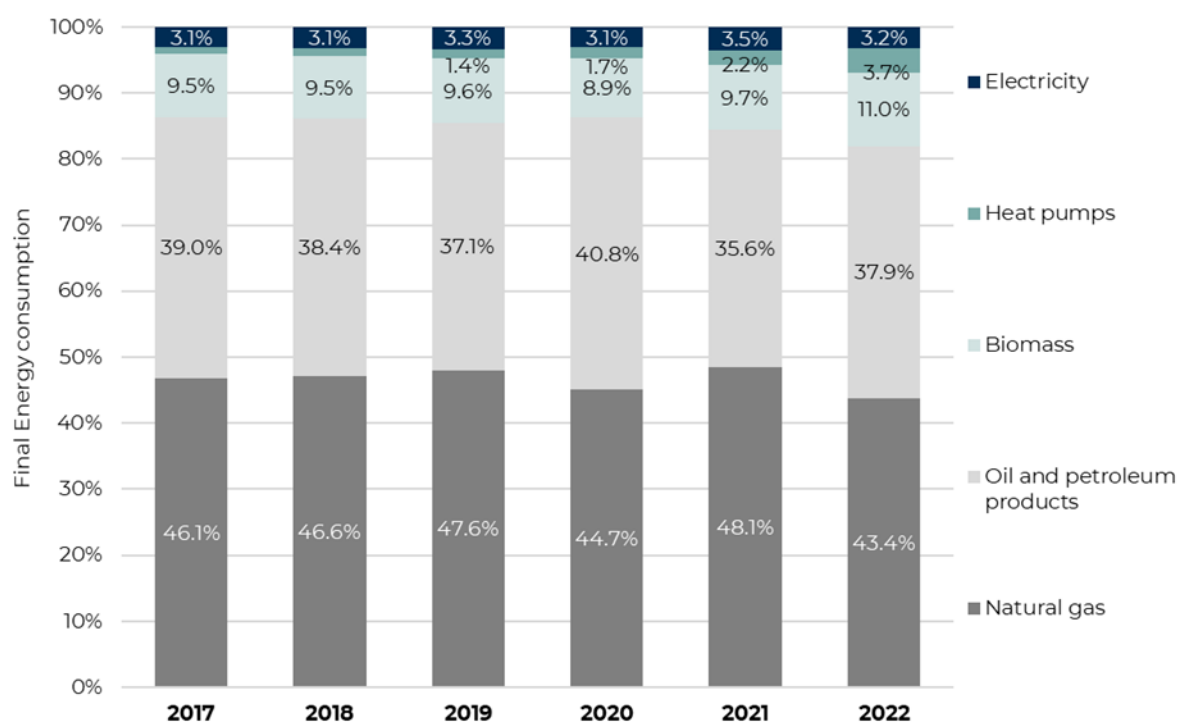


Source: [EUROSTAT \[nrg_d_hhq\]](#)

Figure 1-3 focusses in on final energy consumption for space heating use in households. This is important as the consumption type most likely to be impacted by ETS2, it is also typically the largest household energy consumption category, responsible for approximately 72% of all final energy consumption by households in Belgium. As noted below, the role of natural gas in Belgium is significant, it contributes only 43.4% to space heating energy use. Oil (heating oil) had a 37.9% share of the total in 2022, down from 39% in 2017. The 3.2% contribution of electricity of the total represents a significant use of electric resistance heating. Heat pumps account for around 3.7% of the total space heating final energy consumption, up from 0.9% in 2017, highlighting the growth in use of this technology. Heat pump sales totalled approximately 104 000 units in 2023, with about 312 000 units

installed in total². This represents approximately 6% of the 5.14 million households in Belgium³.

Figure 1-3 Household space heating energy use (2017–2022)



Source: [EUROSTAT \[nrg_d_hhg\]](#)

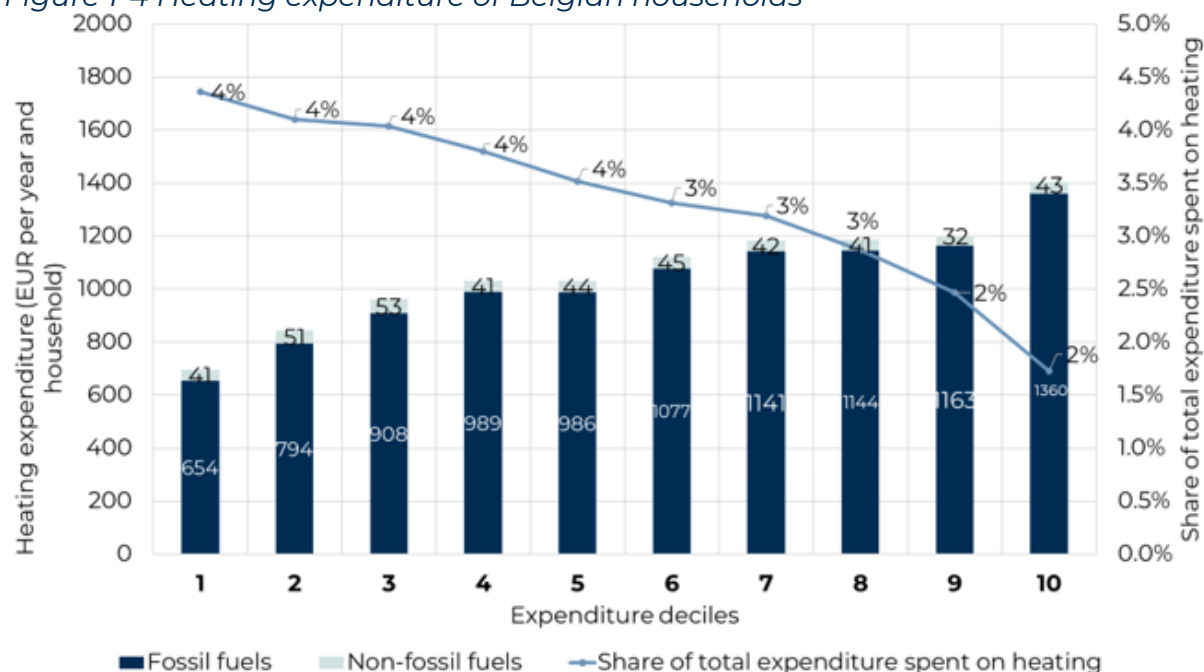
Figure 1-4 shows the heating expenditure by Belgian households by expenditure deciles, from lowest total expenditures to highest total expenditures⁴. Fossil fuels shown in the graph include natural gas, heating oil and coal, while non-fossil fuels include district heating and biomass. The chart shows how much the average household in each expenditure decile spends for the two fuel categories, noting that within each decile, some households will use fossil fuels while other use non-fossil fuels. The chart's figures therefore depend on the share of each fuel category used within each decile, and the amount spent on that fuel. Expenditures for heating fuels rise in absolute terms per income decile (higher-income households often have more floor space that they need to heat), while the share of total expenditure that needs to be spent on heating is higher for lower income groups at 4% and decreases for the higher income groups to 2%.

² EHPA. (2024). European Heat Pump Market and Statistics Report 2024. https://www.ehpa.org/wp-content/uploads/2024/08/Executive-summary_EHPA-heat-pump-market-and-statistic-report-2024-2.pdf.

³ Eurostat. (2024). Number of households by migration status, working status and household composition (lfst_hhmgscmp). https://ec.europa.eu/eurostat/databrowser/view/lfst_hhmgscmp/default/table?lang=en.

⁴ Expenditure deciles are constructed using new OECD equivalence weights. We use expenditure instead of income deciles as total expenditures are generally seen as a good approximation of lifetime income and because the variable related to total expenditures is generally seen as more reliable in the EU HBS compared to the variable total income.

Figure 1-4 Heating expenditure of Belgian households



Source: HBS 2015, calculations with Oeko-Institut SEEK-EU micro model

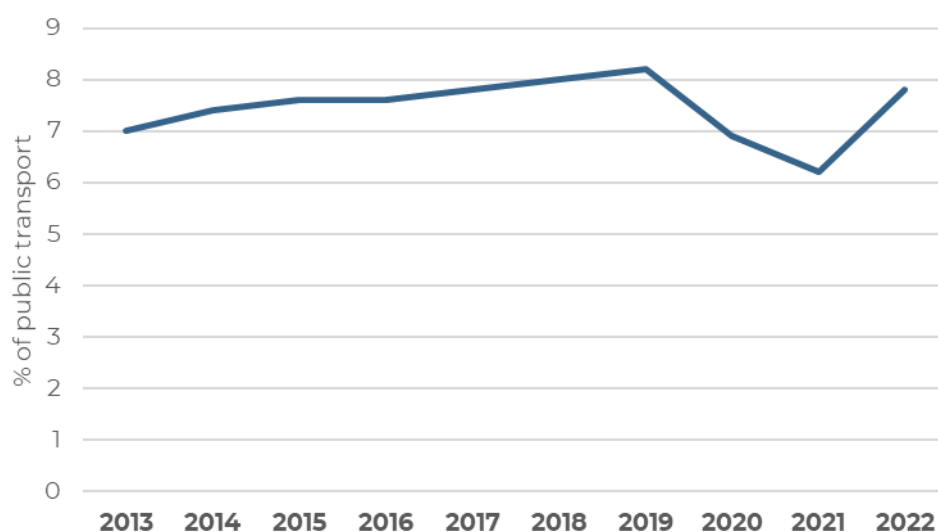
Note: Expenditure deciles are constructed using the new OECD scale. Inflated using the Eurostat all-items HICP for Belgium of 1.2607.

In Chapter 3.1.1 and Annex B, we discuss that the level of expenditures for heating from the EU HBS 2015 generally exceeds the level given by the Belgian national HBS for 2016 and 2018. This indicates that the analysis based on the EU HBS 2015 may overestimate ETS2 impacts at given prices.

1.2.3. Transport user context indicators

Regarding transport poverty, Belgium remains heavily reliant on passenger cars as the main mode of transport, contributing approximately 92% of the total passenger transport km⁵. Public transport contributes the remaining 8% of the total, as shown in **Erreur ! Source du renvoi introuvable.** A sharp decrease in public transport use in 2019–2021 can be attributed to the lockdown measures related to the COVID-19 pandemic, the 2022 trend implies a return towards the pre-COVID levels of about 8% modal share for public transport.

⁵ A passenger-kilometre is the unit of measurement for the transport of one passenger over one kilometre by a defined mode of transport.

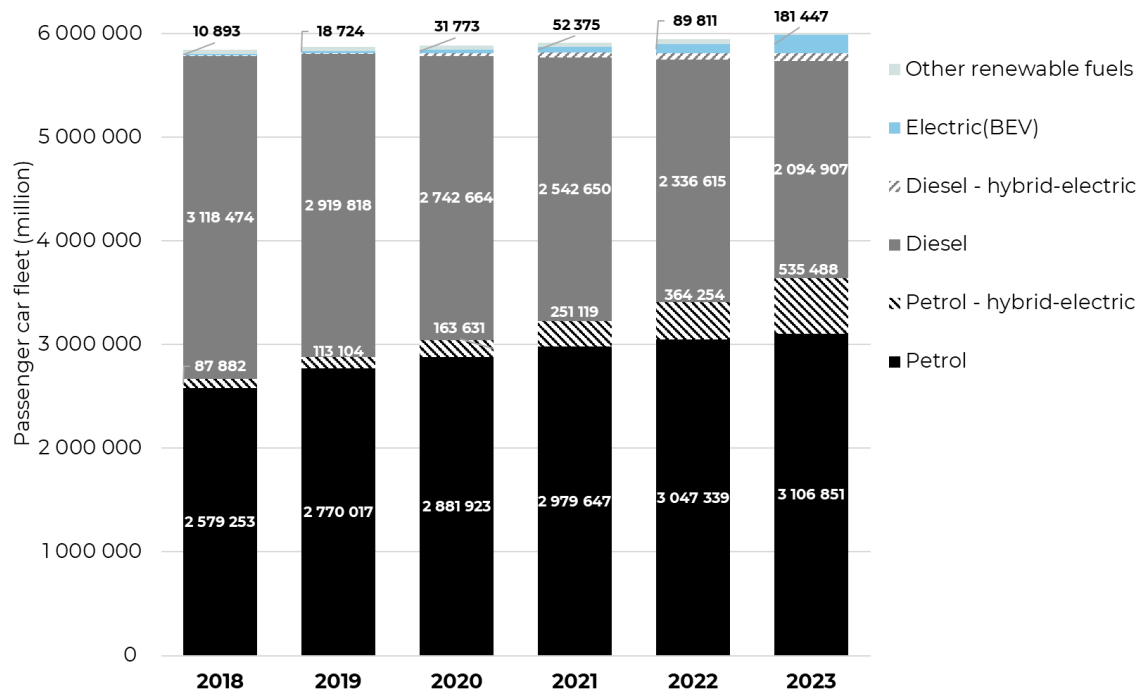
Figure 1-5 Share of public transport in inland passenger/km transport

Source: [EUROSTAT \[nrg_d_hhq\]](#)

Car ownership in Belgium is increasing, as shown in Figure 1-6, with car ownership totalling approximately 6.05 million in 2023, equivalent to approximately 0.5 per inhabitant, or 1.18 per household (5.14 million households in Belgium), which is close to the EU average of 1.28 cars per household⁶. The great majority of passenger cars are petrol and diesel fuelled, with these representing approximately 97% of the total vehicle fleet. An increasing share of these vehicles are now hybrid vehicles (including Plug-in Hybrid Electric Vehicles). In 2023, 10% of the petrol and diesel fuelled vehicles were hybrids. 0.2% of the passenger vehicles run on LPG or natural gas. Fully electric vehicles represent only about 3% of the total, with 181 447 vehicles at the end of 2023.

⁶ Calculated on the basis of Eurostat passenger car fleet data [road_eqs_carhab] and household composition data [fst_hhnhtych].

Figure 1-6 Passenger car fleet by fuel (2018–2023)

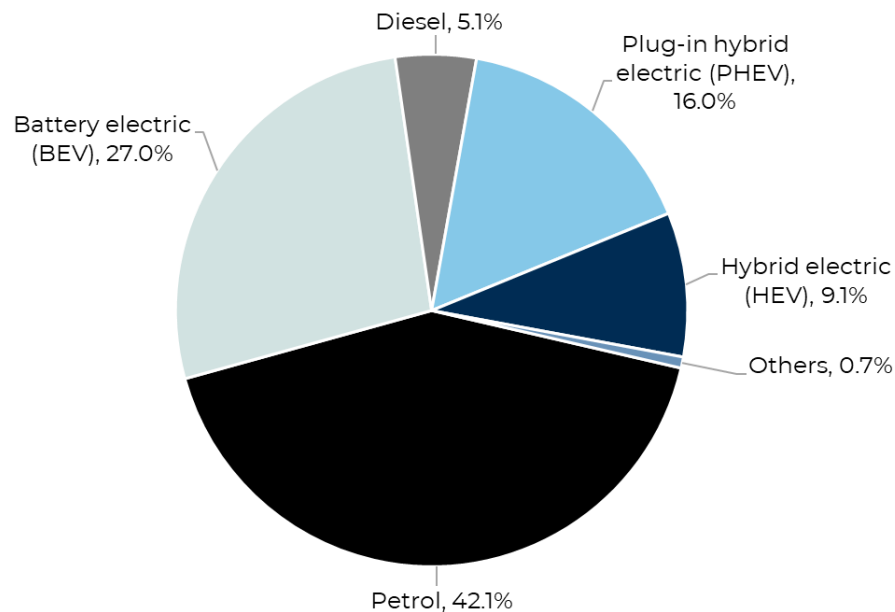


Source: [Eurostat \(tran_r_elvehst\)](#)

Note: Other renewable fuels includes hydrogen, bioethanol, biodiesel, bi-fuel and other fuels not included in the existing list.

Looking at market trends, approximately 520 000 new passenger cars are sold each year in Belgium, and latest year-to-date (Jan–Sep) 2024 data shows – see Figure 1-7 – that full battery electric vehicles (BEV) have a 27% market share. Whilst hybrid electric vehicles represent a further 9.1% of the total, the great majority of new vehicles remain petrol (42.1%) or diesel (5.1%) fuelled.

Figure 1-7 Year to date (Jan–Sep) 2024 new car registrations by energy source

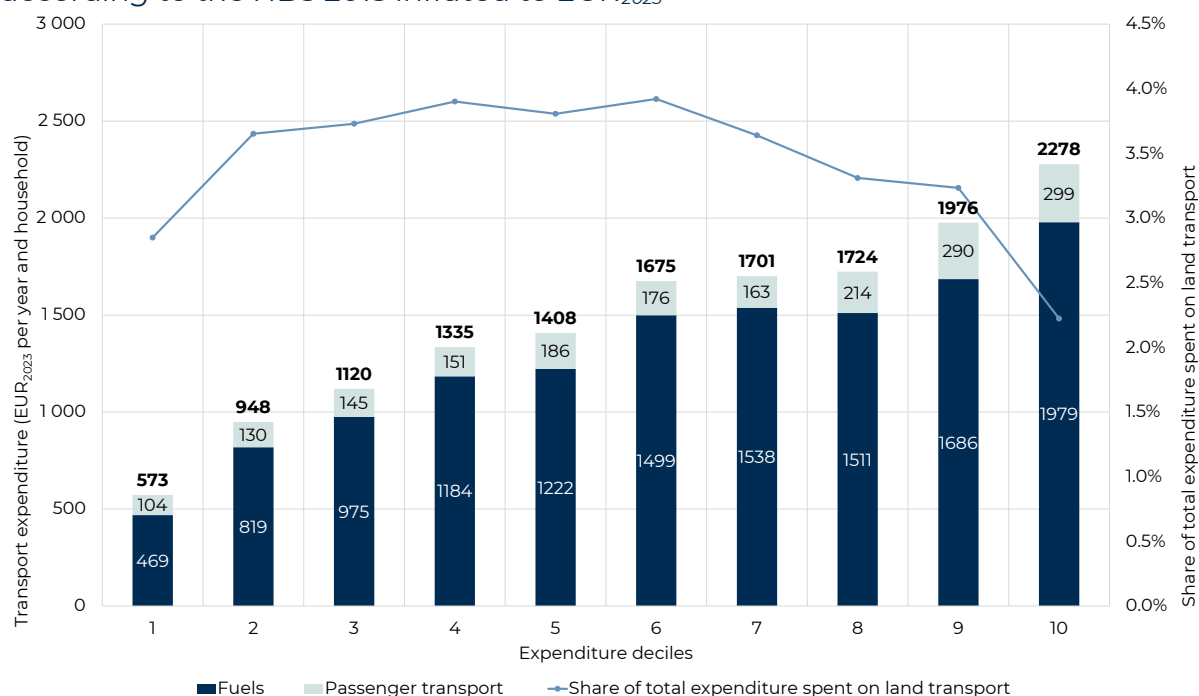


Source: [European Automobile Manufacturers' Association \[New car registrations\]](#)

It is clear that passenger transport in Belgium will be affected by the ETS2 as the penetration of full electric vehicles is still quite low. Additionally, the electrification of the car fleet is driven by leasing cars and as such mainly concerns high income deciles.

Figure 1-8 shows the significant increase of expenditures for transport along the expenditure deciles. One reason for this increase is the fact that many lower-income households do not own a vehicle at all. The share of total expenditures that is spent on transport rises along the expenditure deciles and peaks in the 4th–6th decile. Fuels (petrol and diesel) are the most important expenditure elements. According to the EU-SILC 2023, car ownership in Belgium rises from 52% in the first income decile to 91% in the tenth.

Figure 1-8 Transport expenditure by Belgium households by expenditure deciles according to the HBS 2015 inflated to EUR₂₀₂₃



Source: HBS 2015, calculations with Oeko-Institut SEEK-EU micro model

Note: Expenditure deciles are constructed using new OECD equivalence weights. Inflated using the Eurostat all-items HICP for Belgium of 1.2607.

1.2.4. Current state of play – micro-enterprises

Based on data provided in the 2024 SME factsheet from the European Commission, the total number of micro-enterprises in Belgium is 719 242. Micro-enterprises employ 1 081 664 people, meaning that the average micro-enterprise has 1.50 employees. The analysis of the vulnerability of micro-enterprises in Belgium focuses on two aspects: *buildings and transport*.

The analysis includes the following.

- The target group used in the first part of the analysis of the impacts of ETS2 includes **service-sector micro-enterprises using fossil fuels in their**

building. Analysis of impacts on the building energy consumption and expenditure is carried out for around 86% of total micro-enterprises (around 618 800 companies) which use fossil fuels.

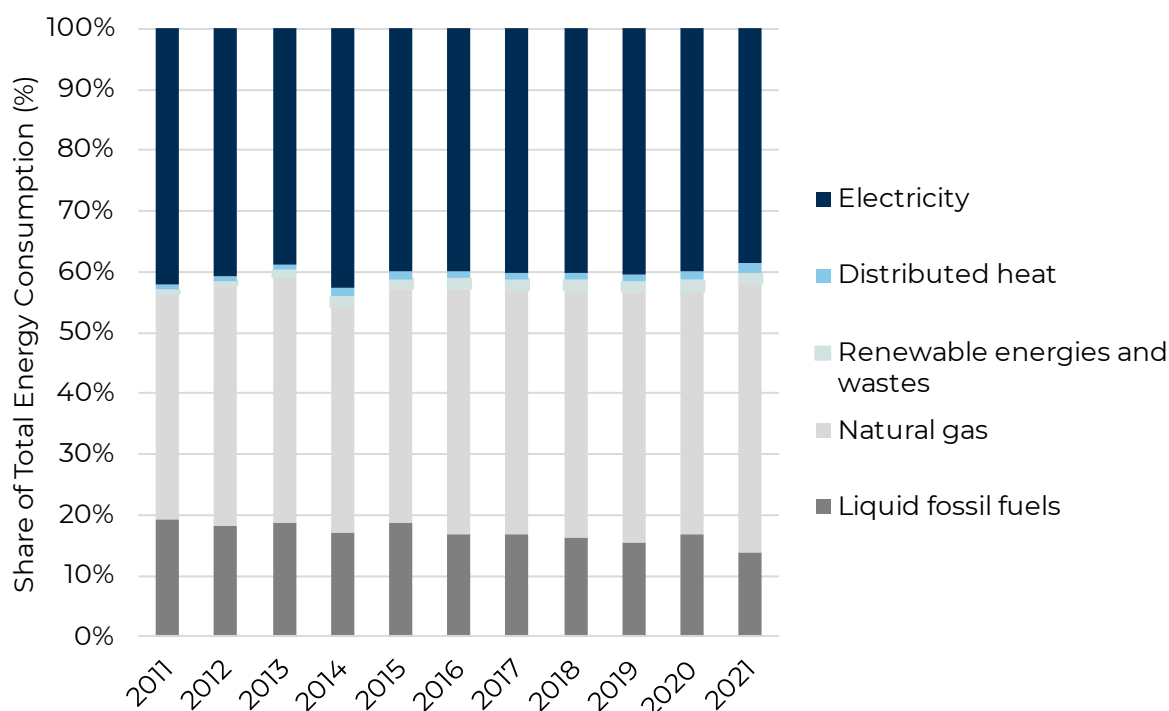
- Analysis of impacts on the transport fuel consumption and expenditure in the **micro-enterprises that own a vehicle** (around 150 200, 21%).
- **Transport-intensive micro-enterprises**, companies that own and use cars significantly more than average (such as taxi companies), companies that own and use trucks, LDV, or buses (a total of around 40 000 transport and transport-intensive companies).

The groups can be estimated based on datasets available in the JRC-IDEES database¹, supported by the data from the ORBIS database.

Buildings energy use

Figure 1-9 shows the energy consumption of the (entire) service sector per fuel type. This shows that distributed heat and electricity are by far the largest fuel categories in consumption. The consumption of liquid fossil fuels (i.e. heating oil) has declined by about 26% since 2011. The share of renewable energy and wastes in consumption is low, but 2021 data suggests that it is increasing.

Figure 1-9 Energy consumption by fuel for the service sector (2011–2021)



Source: JRC-IDEES [[JRC-IDEES-2021_BE](#)]

To estimate the number of micro-enterprises using different combination of fuels, we use the number of employees (common trait). We analysed statistics on number of employees per building and estimate the number of micro-enterprises based on the average number of employees per micro-enterprise (1.50). This results

in the following number of micro-enterprises (numbers are rounded to the nearest 500):

- 437 800 micro-enterprises use natural gas for all mentioned final thermal uses;
- 148 900 micro-enterprises use heating oil;
- 32 200 micro-enterprises use LPG for cooking.

The most common fuel used by service-sector companies is natural gas which is used in 61% of buildings for heating, domestic hot water (DHW), and cooking; 21% of companies use oil for heating and DHW, while LPG is used for cooking in 4% of total building sum. The remaining 14% of buildings occupied by micro-enterprises are not included as none of the fuels used is in the scope of the ETS2.

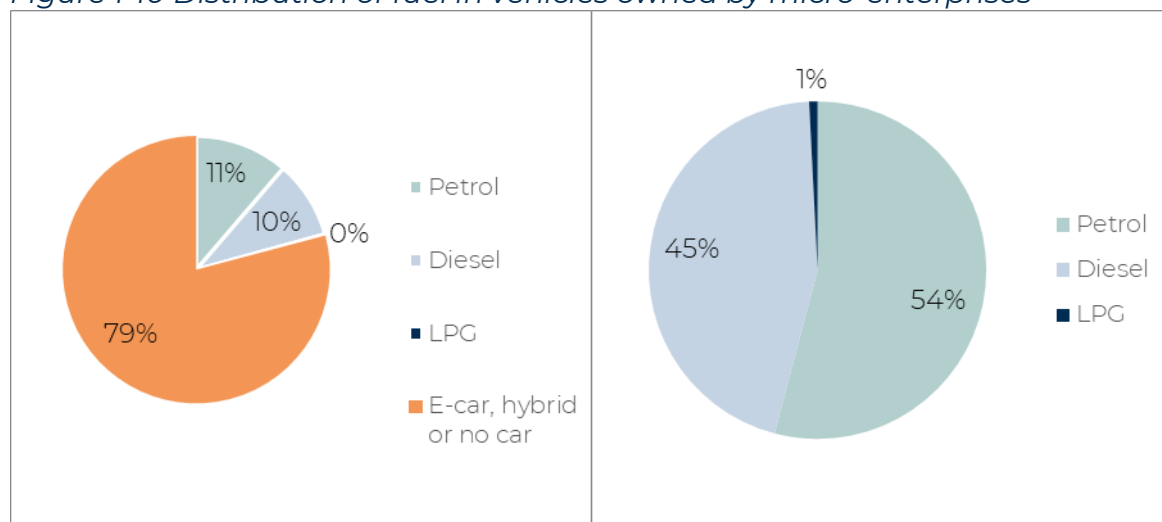
Transport energy use

Besides the energy consumption in buildings, micro-enterprises that own vehicles will incur additional costs. This will affect differently micro-enterprises that own a company vehicle, and those operating in transport sectors, which may own several cars, trucks or buses. To estimate the number of companies that own a vehicle, we used data provided by the JRC IDEES and the *Belgian Ministry of Transport*.

Figure 1-10 shows the share of fuel used by company vehicles in Belgium in 2021. The majority of micro-enterprises do not own a vehicle, while the most common type of fuel is petrol. In absolute figures:

- 81 300 micro-enterprises own a petrol-powered vehicle;
- 67 700 micro-enterprises own a diesel-powered vehicle; and
- 1 200 micro-enterprises own a vehicle that uses LPG.

Figure 1-10 Distribution of fuel in vehicles owned by micro-enterprises



Source: Institute for European Energy and Climate Policy (IEECP) micro-modelling

1.2.5. Estimated impact of ETS2 on fuel prices

The implementation of the ETS2 will add costs to fossil fuel suppliers which are expected to be passed onto consumers (for the purpose of the report, we assume

100% of costs are passed through, this is standard practice, although in reality suppliers may choose to phase-in the increase or absorb some of it themselves). Accurate estimates of the effect on unit fuel prices can be made as the CO₂ content of key fuels is known. As shown in Table 1-1, ETS2 is expected to increase petrol and diesel prices by approximately 7–8 cents/litre (excluding VAT) at an ETS2 price of 30 EUR/tCO₂ in 2027, increasing to 14 cents (petrol) and 16 cents (diesel) per litre with an ETS2 price of 60 EUR/tCO₂ by 2030. The estimated impact on heating oil mirrors that of diesel as the carbon content is the same.

For natural gas, the estimated impact per kWh is for a price increase (excluding VAT) of approximately 0.5 cents/kWh at an ETS2 price of 30 EUR/tCO₂ in 2027, and by 1.1 cents/kWh with an ETS2 price of 60 EUR/tCO₂ by 2030.

For brown coal, the carbon content is approximately double that of natural gas per kWh, consequently the price impact is also approximately double, and is estimated to be priced at 1.1 cents/kWh in 2027, increasing to 2.1 cents/kWh in 2030.

The increase in price attributed to ETS2 will also lead for small further increase in VAT charged for the fuel. The rates for VAT vary per Member State and per fuel, therefore, the full effect would see the values in the table below increased by this percentage.

Table 1-1 Calculated impact of ETS2 on fuel prices, EUR per unit, excluding VAT, based on stated ETS2 price assumptions⁷

Unit	Carbon content [tCO ₂ /l /kWh]	ETS2 impact on unit cost [EUR per litre/kWh], excluding VAT	2027	2028	2029	2030	2031	2032
litre	0.00240079	Petrol	0.07	0.12	0.13	0.14	0.14	0.14
litre	0.00267628	Diesel	0.08	0.13	0.15	0.16	0.16	0.16
litre	0.0026728	Heating Oil	0.08	0.13	0.15	0.16	0.16	0.16
kWh	0.00018204	Natural Gas	0.005	0.009	0.010	0.011	0.011	0.011
kWh	0.00035712	Brown coal	0.011	0.018	0.020	0.021	0.021	0.021

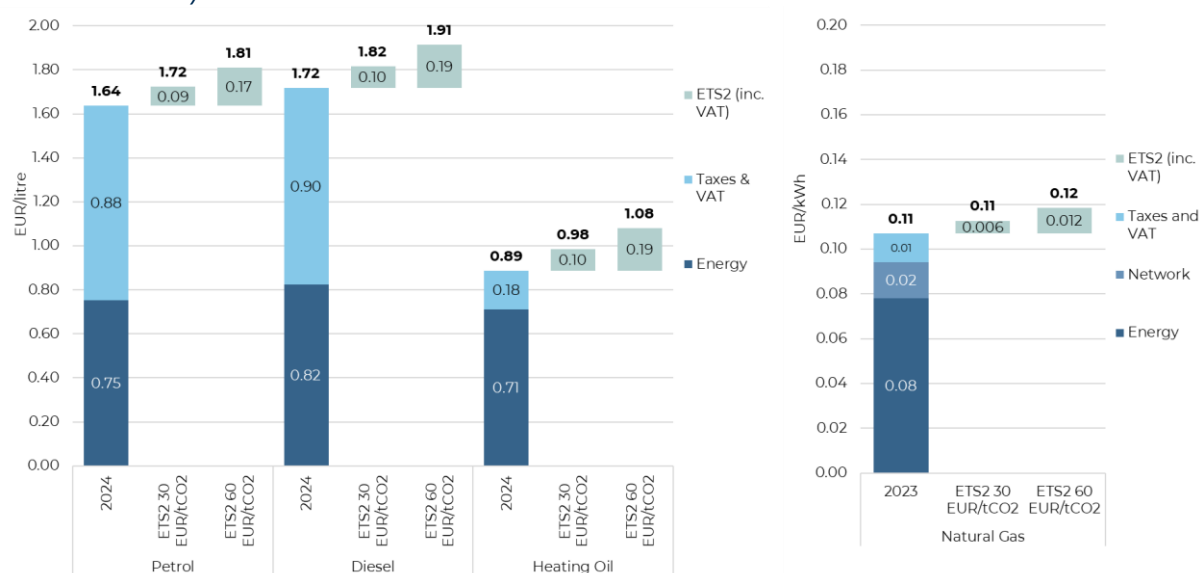
Source: HBS 2015, calculations with Oeko-Institut SEEK-EU micro model

Note: The estimated impact on petrol and diesel prices is based on a 100% mix of these fuels. In reality a small share (typically <7%) of blending with biofuels is likely to occur. This biofuel share would not be subject to the ETS2 impact. The calculated impact of ETS2 would be reduced by the % of biofuels, at 7%, this equates to a roughly 0.01 EUR per litre lower impact on the prices of both fuels by 2030.

⁷ According to the European Commission, the ETS2 price assumption to be taken is 30 EUR/tCO₂ in 2027, 50 EUR/tCO₂ in 2028, 55 EUR/tCO₂ in 2029, and 60 EUR/tCO₂ in 2030–2032.

Figure 1-11 puts these ETS2 price increases in the context of average 2024 prices in Belgium, this shows for petrol, diesel, heating oil and natural gas the relatively small impact the ETS2 could have on the total price. The relative impact can be greater or smaller in reality depending on the actual fuel and ETS2 prices in this period. Coal is not shown as price data is unavailable (due to very low usage).

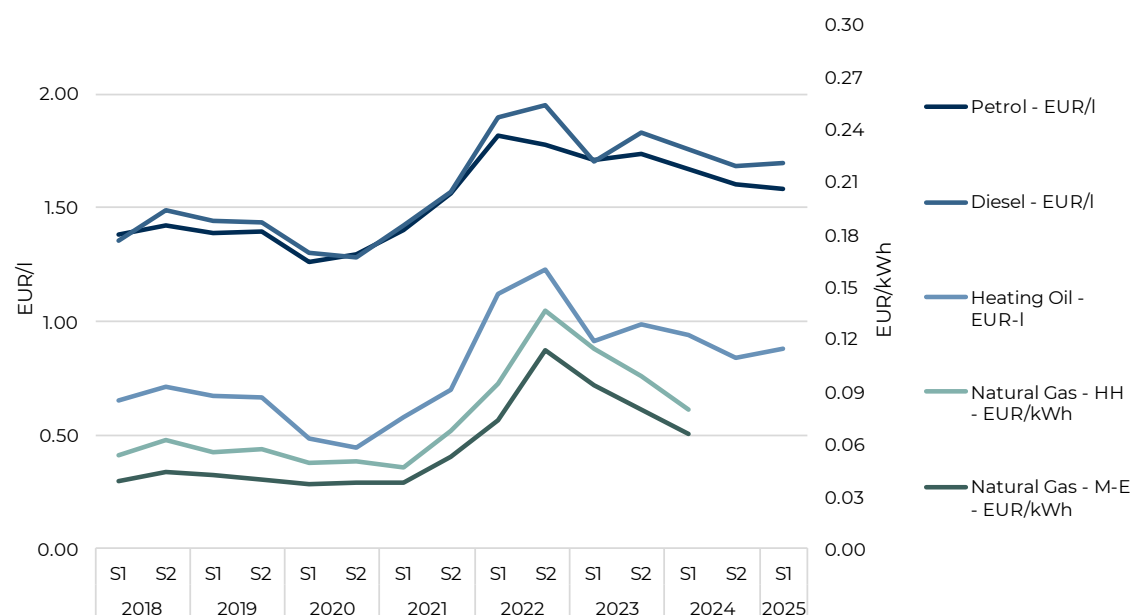
Figure 1-11 Estimated unit price impact compared to 2024 prices, with ETS2 price assumptions of 30 EUR/tCO₂ and 60 EUR/tCO₂ (ETS2 price increase component includes VAT)



Note: The taxes and VAT component of prices includes any existing carbon taxes.

Energy prices have been an important issue in the last few years with the price crisis that started at the end of 2021 leading to significant additional costs for most households, individuals, enterprises and governments. These have had important impacts on poverty and vulnerability. The price evolution of key fuels relevant for this work is shown in Figure 1-12 where the price crisis is clearly visible, particularly for petrol and diesel, but also for other fuels. For the oil-derived fuels, prices remain significantly higher than 2018–2019 prices. These fuels are the most relevant for Belgium and its SCP.

Figure 1-12 Evolution of fuel prices for households and micro-enterprises, 2018–2025



Source: Own elaboration based on [EUROSTAT \[nrg_pc_203\]](#) and EU Oil Bulletin

Note: Gas prices for micro-enterprises (non-household consumers) are prices excluding VAT and all recoverable taxes and levies for band I1 (i.e. the band with the smallest consumption of <1 000 GJ per year). It is unclear if micro-enterprises, given that they are often home-based, would pay the non-household rate in reality, however, the difference is very small between non-household and household prices. (2) Carbon taxes, where these exist, are included in the prices presented above, these are not typically recoverable for micro-enterprises.

2. Initial approach for identification of vulnerable groups in Belgium

This chapter presents definitions and indicators used in the impact assessment to identify the impacts of ETS2, in particular quantifying the number of energy poor households, transport poor users, vulnerable households and transport users, and vulnerable enterprises.

2.1. Application of the definitions of energy and transport poverty at the national level within the ETS2 context

In the context of the SCF, the group of **vulnerable households** consists of two (overlapping) subgroups (Art. 2(10) SCF Regulation):

- Households in energy poverty;
- Households vulnerable to the introduction of the ETS2 *'including low income and lower middle-income ones, that are significantly affected by the price impacts of [the ETS2] and lack the means to renovate the building they occupy.'*

'Energy poverty' is in the SCF Regulation defined in the same way as in the Energy Efficiency Directive (EED) as 'a household's lack of access to essential energy services, where such services provide basic levels and decent standards of living and health, including adequate heating, hot water, cooling, lighting, and energy to power appliances, in the relevant national context, existing national social policy and other relevant national policies, caused by a combination of factors, including at least non-affordability, insufficient disposable income, high energy expenditure and poor energy efficiency of homes'.

Belgium aligns its legal definition⁸ of energy poverty with the EED recast (provided below), which is used to assess energy poverty according to its recognised indicators (mainly through the Energy Poverty Barometer). The European indicators are in this study used for a high-level identification of the vulnerable groups, on the basis of modelling results, and complemented by ad hoc analysis.

The concept of 'households vulnerable to the introduction of the ETS2' is a new concept introduced by the SCF Regulation. Considering that Belgium does not use the concept of vulnerability yet, the SCF Regulation definition will be applied in the SCP. The focus of the analysis and of the measures should lie on identifying and addressing impacts on those belonging to this vulnerable group. Energy poor households are also eligible for measures, independently of the effect of ETS2 on

⁸ Eetamb. (2024). Koninklijk Besluit van 19/04/2024 houdende criteria voor de beoordeling van het aantal huishoudens dat kampt met energiearmoede. https://etaamb.openjustice.be/nl/koninklijk-besluit-van-19-april-2024_n2024004117.html.

their energy costs, although ETS2-specific impacts should be the main focus of the SCP.

The group of **vulnerable transport users** consists of two (overlapping) subgroups (Art. 2(12) SCF Regulation):

- ‘Individuals and households in transport poverty’; and
- ‘Individuals and households, including low income and lower middle-income ones, that are significantly affected by the price impacts of [the ETS2⁹] and lack the means to purchase zero- and low-emission vehicles or to switch to alternative sustainable modes of transport, including public transport.’ (Art. 2 SCF Regulation).

Transport poverty is defined as *individuals and households’ inability or difficulty to meet the costs of private or public transport, or their lack of or limited access to transport needed for their access to essential socioeconomic services and activities, taking into account the national and spatial context* (Art. 2(2) SCF Regulation¹⁰). The definition aligns with the **availability**, **accessibility**, and **affordability** as core dimensions related to transport poverty.

- **Availability** is addressed by referencing the “lack of or limited access to adequate and equitable transport.” This includes the physical presence, usability, and fair access to transport options, such as accessible public transport stops for people with disabilities or private vehicles, which are important for mobility in rural and peripheral urban areas.
- **Accessibility** is captured through the focus on enabling access to “essential socio-economic services and activities,” ensuring that the system supports connectivity to employment, education, and healthcare.
- **Affordability** is emphasised by mentioning the “inability or difficulty to meet costs” as well as “enforced lack of car”, addressing the financial burdens exacerbated by ETS2-induced fossil fuel price increases.

Belgium has not yet fully developed the concept of transport poverty in national policy making. Therefore, the definition of ‘transport users vulnerable to the introduction of the ETS2’ (second bullet) applied in the context of the SCP should be used directly from the SCF Regulation and this group will be the focus of the analysis and the measures and investments in the SCP. As for energy poverty, measures targeted at addressing transport poverty in general can also be financed via the SCF.

The SCF regulation defines **vulnerable micro-enterprises** as those that “are significantly affected by the price impacts and that lack the means either to

⁹ This refers to “the inclusion of greenhouse gas emissions from road transport within the scope of Directive 2003/87/EC”.

¹⁰ Eurlex. (2023). Regulation (EU) 2023/955 of the European Parliament and of the Council of 10 May 2023 establishing a Social Climate Fund and amending Regulation (EU) 2021/1060. <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32023R0955>.

renovate the building they occupy, or to purchase zero- and low-emission vehicles or to switch to alternative sustainable modes of transport”.

2.1.1. Energy poverty

Belgium uses its own definition of energy poverty as provided in the Royal Decree of April 19, 2024^{11,12,13}. This definition is fully in line with the EU definition in the SCF regulation while highlighting the main causes of energy poverty.

Energy poverty (at federal level, Royal Decree) is defined as:

“a household's lack of access to essential energy services, where such services provide basic levels and decent standards of living and health, including adequate heating, hot water, cooling, lighting, and energy to power appliances, in the relevant national context, existing national social policy and other relevant national policies, caused by a combination of factors, including at least non-affordability, insufficient disposable income, high energy expenditure and poor energy efficiency of homes”.

A set of indicators have been developed to transpose these definitions of energy poverty into measurable, actionable numbers. These help policymakers to understand the prevalence of energy poverty and vulnerability and how this is evolving. This in turn gives insight into the impact of current policies and events, to identify the need for new policy.

Since 2015, the King Baudouin Foundation has published an “energy poverty barometer”. This barometer captures measured (i.e. 2M, referring to consumption two times above the median), hidden (i.e. M/2, referring to consumption below the half of the median) and subjective (inability to keep home warm) energy poverty. In each of these approaches, an indicator is combined with “low income”. Since the overlap between these three methods of calculation is very small, the main focus is on 'total energy poverty'.

To identify the vulnerable groups (already in an energy poverty situation or at risk of falling into energy poverty with higher fossil fuel prices) that would benefit from structural measures, these data are considered sufficient, assuming that structural measures focus on a broad target group, including the households in energy poverty. For compensatory measures, more refined data are needed to focus the support on specific vulnerable groups. The impossibility today of cross-referencing SILC data with, for example, actual energy consumption and precise heating or transport costs, makes it difficult to provide more refined data.

¹¹ Etaamb. (2024). Available at Arrêté royal établissant les critères pour évaluer le nombre de ménages en situation de précarité énergétique. https://etaamb.openjustice.be/fr/arrete-royal-du-19-avril-2024_n2024004117.html.

¹² Art 2, § 2.2.

¹³ The Royal Decree (annex) establishes a total of 14 EP indicators, of which seven primary indicators, two secondary indicators and five contextual indicators.

2.1.2. Transport poverty

Prior to the SCF regulation, Belgium had no official definition of transport poverty, and therefore has opted to adopt the EU definition as mentioned above.

The definition of 'transport users vulnerable to the introduction of the ETS2' that Belgium will apply in the context of its SCP will hence be the same as in the SCF Regulation.

However, caution is needed regarding the interpretation of 'essential socio-economic services', which should not only cover essential services such as health and social services, education, shopping or commuting to the place of work, but also activities such as visiting friends, traveling to parks or green areas, etc. Consequently, it is recommended to keep the definition, without listing services that could be considered as essential.

Transport poverty should also be related to the right to mobility, which is seen as the right to access essential services and activities. It can be seen as a derivative of the rights to education, healthcare, housing, etc.¹⁴.

2.2. Indicators used for identifying energy and transport poverty and vulnerable groups

2.2.1. Indicators measuring energy poverty and vulnerability of households in the SCF context

This chapter gives an overview of the indicators that can be used to assess energy poverty in Belgium, as well as the indicators used to assess vulnerability to ETS2 impacts. Note that the concept of energy poverty and the indicators used to measure energy poverty are independent of the SCP and should be applied in policy-making across the board, as well as in both EED, EPBD and SCF implementation. For vulnerability indicators, the relevant factors of the definition, i.e. households and individuals 'significantly affected by ETS2 costs, that are in the lower or lower-middle income group and lack the means to renovate the building they occupy' need to be taken into account.

The foundation for defining indicators that address household energy poverty in Belgium is based on the common indicators established by the EU Commission. These have been further developed as part of this assignment (across the nine Member States involved) and complemented by a set of additional national context indicators for vulnerability deemed relevant for Belgium. The energy indicators are based on the SCF regulation and subsequent logic and partitioning of the EC recommendations related to energy poverty.

¹⁴ See for example Rapport sur la cohésion sociale en wallonie droit à la mobilité. (2019). <http://cohesion sociale.wallonie.be/sites/default/files/RCS-Mobilit%C3%A92020.pdf> and the Flemish Decreet betreffende de basisbereikbaarheid (26/04/2019): "Artikel 5. § 1. Basisbereikbaarheid heeft tot doel: 1° het bereikbaar maken van belangrijke maatschappelijke functies [...]".

In addition, all indicators, including their relevance and data availability, have been assessed to reflect the national and regional aspects of Belgium by the country expert team together with the Belgian BAs and various institutional stakeholders, inc. data experts.

This chapter contains both indicators estimated by the Expert Team for all countries, as well as any other information on energy poverty indicators that are already used at the national level and that the country is planning to apply in the context of the SCP. As stated in Chapter 1.2.1, throughout this report, expenditure deciles are based on total expenditures of a household and constructed using new OECD equivalence weights. We use expenditure instead of income deciles as total expenditures are generally seen as a good approximation of lifetime income and because the variable related to total expenditures is generally seen as more reliable in the EU HBS compared to the variable total income.

Energy poverty indicators

Table 2-1 presents the energy poverty indicators, highlighting **in bold** the three main indicators that are already used in the frame of the Belgian energy poverty reporting (i.e. Energy Poverty Barometer).

Table 2-1 Energy poverty indicators based on COM Recommendation on Energy Poverty (C/2023/4080 and SWD(2023) 647) provided by Expert Team for Belgium

Indicator Name	Definition/Description	Data Source	Relevance / Importance	Indicator for energy poverty	Indicator for energy vulnerability
Inability to keep home adequately warm	Inability to keep home adequately warm for financial reasons, delineated to the 5 lowest deciles (revenue equivalent) (*) Royal Decree primary indicator 4 (PER)	Eurostat, SILC 2023 Belgian SILC Additional analysis in the Energy Poverty Barometer	High	X	
<i>Arrears on utility bills</i>	Households that have been unable to pay utility bills due to financial difficulties within the past 12 months.	Eurostat, SILC 2023 National data available for actual non-payment records of energy utilities	Medium	X	

Indicator Name	Definition/Description	Data Source	Relevance / Importance	Indicator for energy poverty	Indicator for energy vulnerability
High share of energy expenditure in relation to income (2M)	High share of energy expenditure in relation to <u>disposable</u> income after having extracted housing costs ¹⁵ (from real revenues), delineated to the 5 lowest deciles (revenue equivalent), and using more than twice the median (and not the average). Royal Decree primary indicator 2 (PEm)	Eurostat, HBS 2023 Belgian HBS Additional analysis in the Energy Poverty Barometer	High	X	x
Low absolute energy expenditure (M/2)	Low absolute energy expenditure delineated to the 5 lowest deciles (revenue equivalent), having excluded explained low costs (e.g. insulated dwellings ¹⁶ , secondary house). Royal Decree primary indicator 3 (PEm)	Eurostat, HBS 2023 Belgian HBS Additional analysis in the Energy Poverty Barometer	High		x
<i>Residential energy spendings >10% of budget</i>	Share of individuals living in households which spend more than 10% of their budget on residential heating. Whether 10% is the most appropriate threshold for Belgium is still to be confirmed.	Eurostat Household budget survey 2023 National data available	Medium		x
Leak, damp, rot dwelling	Living in a dwelling with a leaking roof, damp walls, floors or foundation, or rot in window frames or floor	EU-SILC 2023	Medium	x	x
AROP	EED default indicator: Arithmetic mean of the three indicators above and AROP indicator	EU-SILC 2019	Medium		x
Above 10% of total expenditure	Share of the (household) population that spends more than 10% of total	HBS 2015	Medium		X

¹⁵ Additionally, housing costs are capped at twice the median ratio between housing costs and income.

¹⁶ Information on insulation quality is not taken into account, since this information is not yearly available in SILC (only in ad hoc modules). The indicator excludes households heating with heating pumps or solar energy.

Indicator Name	Definition/Description	Data Source	Relevance / Importance	Indicator for energy poverty	Indicator for energy vulnerability
	expenditures on heating and household is in bottom half of expenditure distribution				

The combination of the three main indicators with a delineation of income groups (deciles 1 to 5) ensures that we can identify the impacted groups and exclude the upper-middle-class and high-income groups from the scope. The limit to the five lowest deciles is based on the SCF Regulation which refers to 'low income and lower middle-income households', as such indicating that assessments should not exceed the 5th percentile. Some stakeholders are advocating to extend the scope, arguing that D6 decile, or even D7, are also impacted by ETS2.

For each of these indicators we can rely on annually available data (SILC and HBS), which facilitates both processing and monitoring. Moreover, certain data are only available every few years, as the questions can evolve. These limitations are well known, but until today the SILC dataset remains the most valuable data source for mapping energy poverty.

The prominent share calculated for each indicator will help identifying the target groups for which an additional in-depth analysis may be required. The two most prominent indicators or target groups will be further analysed with regard to their income level (income quintile), and the degree of urbanisation (cities, town and suburban, rural areas). Additional parameters will be considered to determine the level of vulnerability of specific households groups, such as the housing payment type (rent, mortgage, no payment), the number of children/adults, household type (single, one-parent, etc.), etc.

Energy vulnerability indicators

For the vulnerability indicators, the relevant factors of the definition are used, i.e. households and *individuals in the* 'lower or lower-middle incomes that are significantly affected by the ETS2 and that lack access to essential energy services, where such services provide basic levels and decent standards of living and health, including adequate heating, hot water, cooling, lighting, and energy to power appliances, in the relevant national context, existing national social policy and other relevant national policies, caused by a combination of factors, including at least non-affordability, insufficient disposable income, high energy expenditure and poor energy efficiency of homes. Important to note, that the vulnerability

indicators should be adjusted to take into account the elements of the definition, i.e. relate to the heating fuels covered by the ETS2 (natural gas or heating oil), or the relevant income categories.

This chapter contains the main indicator used for modelling, similarly estimated for all countries. It also contains ongoing in-country work and references on energy poverty and vulnerability.

Table 2-2 Vulnerability to energy poverty and to the introduction of the ETS2 indicator

Indicator	Data
Adapted 2M indicator - Only households and individuals with fossil fuel expenditure (natural gas, heating oil, coal) are included. - To reflect the requirement that this should be limited to low and lower-middle incomes, we include households in the bottom half of the expenditure distribution. 2M threshold is estimated without CO₂ costs for all households and heating sources (using HBS 2015). This threshold is then fixed for all CO₂ price levels. - Vulnerable households are those that spend more than the 2M threshold based on their fossil-fuel heating costs including CO₂ costs. - The number of vulnerable households according to this indicator differs for each CO₂ price level.	HBS 2015

Source: Own elaboration

This adapted 2M indicator uses the same threshold value as the classic 2M indicator (albeit focusing only on heating costs). The median share of expenditure spent on heating is determined for all households based on the HBS 2015, including for households that heat with electricity, district heating and biomass. It is therefore based on expenditures before the introduction of the ETS2. The threshold value is fixed at twice this median expenditure relative to income. For Belgium, the median value is equal to 2.9% and the 2M value equal to 5.8%.

For the different ETS2 price levels evaluated in this report (see Chapter 1.2.5), the adapted indicator then checks whether the heating fossil-fuel expenditure share in total expenditures is above the 2M value or not. The respective ETS2 prices are added to the 2015 expenditures, which are inflated to EUR₂₀₂₃ using the Eurostat all-items HICP. We are thus carrying out a comparative static analysis that takes the expenditures in the HBS 2015 as a basis and checks how vulnerability changes in case ETS2 prices are added on top of these expenditures. We apply the short-term price elasticities discussed in Chapter 3.1.1. As also explained in Chapter 3.1.1, using the HBS 2015 for this analysis of vulnerability may overestimate vulnerability at given ETS2 prices, as households have since reduced their fossil fuel use due to

other policies and measures, as well as due to overall economic developments (see Chapter 3.5 where the impact of other policies and measures is taken into account).

This 2M indicator is used to determine the share of the Belgian households and the share of the total population vulnerable to the introduction of the ETS2 in the heating sector (see Chapter 3.2.1). The 2M indicator is broken down to determine the share of the Belgian population deemed vulnerable to the introduction of the ETS2 in heating by expenditure tercile, with varying CO₂ prices (at 30 EUR/tCO₂, 50 EUR/tCO₂, 55 EUR/tCO₂ and 60 EUR/tCO₂). A similar breakdown is then applied by degree of urbanisation (with the same CO₂ prices).

Additional household expenditure and increased share of additional expenditure due to the implementation of ETS2

The following two indicators are simulated:

- additional household expenditure due to the ETS2 in EUR₂₀₂₃/year with carbon prices of 30 EUR/tCO₂ and 60 EUR/tCO₂; and
- additional household expenditure due to the ETS2 as share of the total expenditure with carbon prices of 30 EUR/tCO₂ and 60 EUR/tCO₂.

These ETS2 costs related to energy for Belgian households indicators are simulated based on the following variables:

- by income decile, for households using fossil fuels for heating, at a carbon price of 30 EUR/tCO₂ and at 60 EUR/tCO₂ (with and then without taking into account price elasticity);
- by income decile, for all households, at a carbon price of 60 EUR/tCO₂;
- by degree of urbanisation, for households using fossil fuels for heating, at a carbon price of 60 EUR/tCO₂; and
- by region, for households using fossil fuels for heating, at a carbon price of 60 EUR/tCO₂.

Additional simulations made by the Belgian Federal Planning Bureau

The expenditure variables resulting from the simulations (absolute and relative increases compared to total income) can be calculated for different groups using a series of individual variables that define household categories. This allows targeted analyses of specific vulnerable groups, and allows the impact to be estimated and its magnitude measured. Table 2-3 presents the first level variables that will be combined with second level variables.

Table 2-3 First and second level variables in the additional simulations made by the Belgian Federal Planning Bureau

First level variables	Second level variables
• By region • By population density • By equivalised income decile • By age group • By gender • By citizenship	○ By region ○ By household type ○ By household type AND region ○ By household type AND population density

First level variables	Second level variables
• By educational • By economic status • By eligibility to social tariff • By household type • By housing payment type • By heating fuel type • By AROP • By measured energy poverty (2M adapted) • By hidden energy poverty (M/2 adapted)	○ By number of adults ○ By number of children ○ By number of children AND region ○ By household type AND population density ○ By expenditure decile (or equivalised income decile) ○ By expenditure decile AND region

2.2.2. Indicators measuring transport poverty and vulnerability of transport users in the SCF context

This chapter provides an overview of the indicators that have been used to assess transport poverty in Belgium, as well as the indicators to assess vulnerability to ETS2 impacts.

It also contains additional in-country modelling or analysis of relevant data related to transport poverty or vulnerability in the transport sector, e.g. spatial data or country-specific information that is important.

Transport poverty indicators

Nine indicators are used to analyse the impact of ETS2 on target groups, showing the share of the Belgian population identified as facing transport poverty. These indicators are depicted in Table 2-4.

Table 2-4 Transport poverty indicators based on COM Transport Poverty study¹⁷

Indicator	Data
Share of the population that is both materially and socially deprived (MSD) individuals and owns a car (Forced Car Ownership)	EU-SILC 2023
Share of the population for which the nearest public transport stop is 'too far away'	EU-SILC 2014
Share of the population with 'very difficult' access to public transport	Eurofound EQLS 2016
Share of the population with 'too difficult' access to public transport because of reduced mobility.	EU-SILC 2014
Share of the population with a one-way commute to work of more than 30 minutes	EU-LFS 2019
Share of the population facing enforced lack of a car (answering 'No- cannot afford' to the question of whether they own a car)	EU-SILC 2023
Share of the population for which public transport is 'too expensive'	EU-SILC 2014

¹⁷ European Commission. (2024). Transport poverty: definitions, indicators, determinants, and mitigation strategies - Final Report.
<https://ec.europa.eu/social/main.jsp?catId=738&langId=en&pubId=8651&furtherPubs=yes>.

Indicator	Data
Share of the (household) population that spends more than 6% of total expenditures on transport (only including recurrent expenditures such as fuels, tickets) and household is in bottom half of expenditure distribution	HBS 2015
Share of the (household) population for which the share of transport expenditures in total expenditures exceeds twice the national median and household is in bottom half of expenditure distribution	HBS 2015

The prominent share for each indicator will help identifying the target groups for which an additional in-depth analysis may be required. The two groups with the most prominent shares will be further analysed with regard to the income group (income quintile), and the degree of urbanisation (cities, town and suburban, rural areas).

Transport vulnerability indicators

For the vulnerability indicators, the relevant factors of the definition are used, i.e. households and individuals in the 'lower or lower-middle incomes that are significantly affected by the ETS2 and that lack the means to purchase zero- or low-emission vehicles or to switch to alternative sustainable modes of transport, including public transport'.

This Chapter contains the main indicator used for modelling, similarly estimated for all countries. It also contains ongoing in-country work and references on transport poverty indicators.

Table 2-5 Vulnerability to transport poverty and to the introduction of ETS2: Indicator based on an adaptation of the 2M indicator and on HBS 2015 data

Indicator	Data
“Adapted 2M indicator” transport - Only households and individuals with fossil fuel expenditure for passenger transport (petrol, diesel) are included. - To reflect the requirement that this group should be limited to low and lower-middle incomes, we include only households in the bottom half of the expenditure distribution. - The 2M threshold is estimated for all households and all mobility options without CO₂ costs (using HBS 2015). This threshold is fixed regardless of the CO₂ price level. - Vulnerable households are those that spend more than the 2M threshold based on the fossil-fuel transport costs including CO₂ costs. - The number of vulnerable households according to this indicator differs depending on the CO₂ price level.	HBS 2015

This 2M indicator reflects the percentage of households that spend a high share of their disposable income on transport (only including recurrent expenditures such as fuels, tickets, insurance, etc.). In accordance with European guidelines, a high

share is defined as twice the national median. As such, vulnerable transport users are those in the first five income deciles who spend at least twice the national median of their disposable income on transport expenditure. For Belgium, the median is equal to 2.8% and the 2M threshold 5.6%.

The 2M indicator is used to determine the share of the Belgian households and the share of the total population vulnerable to transport poverty and particularly vulnerable to the introduction of ETS2 (see Chapter 3.3.1). The 2M indicator is applied to the entire territory of Belgium, and then separately for each region.

The 2M indicator is then broken down to determine the share of the Belgian population deemed vulnerable to the introduction of the ETS2 in transport by expenditure tercile, with varying CO₂ prices (at 30 EUR/tCO₂, 50 EUR/tCO₂, 55 EUR/tCO₂ and 60 EUR/tCO₂). A similar breakdown is then applied by degree of urbanisation and by region (with the same CO₂ prices).

Additional household expenditure and increased share of additional expenditure

The following two indicators are simulated:

- additional household expenditure due to the ETS2 in EUR₂₀₂₃/year; and
- additional household expenditure due to the ETS2 as share of their total expenditure.

These transport related ETS2 costs for Belgian households are estimated based on the following variables:

- by income decile, for households using fossil fuels for transport, at a carbon price of 30 EUR/tCO₂ and at 60 EUR/tCO₂;
- by income decile, for all households, at a carbon price of 60 EUR/tCO₂; and
- by degree of urbanisation, for households using fossil fuels for transport, at a carbon price of 60 EUR/tCO₂.

Additional simulations made by the Belgian Federal Planning Bureau

The expenditure variables resulting from the simulations (absolute and relative increases compared to total expenditure) can be calculated for different groups using a series of individual variables that define household categories. This allows targeted analyses of specific vulnerable groups, and allows the impact to be estimated and its magnitude measured. Table 2-6 presents the first level variables that will be combined with second level variables.

Table 2-6 First and second level variables in the additional simulations made by the Belgian Federal Planning Bureau

First level variables	Second level variables
• By region • By population density • By equivalised income decile • By age group • By gender • By citizenship	○ By region ○ By household type ○ By household type AND region ○ By household type AND population density

First level variables	Second level variables
• By educational • By economic status • By car ownership • By cannot afford a car • By AROP • By measured transport poverty (2M adapted) • By transport poverty (11%)(*)	○ By number of adults ○ By number of children ○ By number of children AND region ○ By household type AND population density ○ By expenditure decile (or equivalised income decile) ○ By expenditure decile AND region ○ By car ownership ○ By car ownership AND region

"Transport poverty 11%" represents the share of the (household) population that spends more than 11% of total expenditures on transport (only including recurrent expenditures such as fuels, tickets) and household is in bottom half of expenditure distribution

Additional considerations

- Possession of a company car and similar transport benefits-in-kind have an impact on the average transport expenditure, as this cost is incurred by the company and not by the individual car user and as such is not reflected in the household expenditure on transport.
- There are large differences between households living in rural and urban areas, therefore it is important to identify the households residing in cities, towns and suburbs or rural areas (or in line with DEGURBA territory typology).
- Combining this indicator with an assessment of transport expenditure by the same households might be useful, since there is often a trade-off between housing, high transport and energy expenditure; an additional indicator could be created that analyses the sum of both.

2.2.3. Vulnerability of micro-enterprises in the SCF context

The SCF regulation defines vulnerable micro enterprises as those that "are significantly affected by the price impacts and that lack the means either to renovate the building they occupy, or to purchase zero- and low-emission vehicles or to switch to alternative sustainable modes of transport".

This is a new concept for most Member States, and national policies rarely refer to micro-enterprises specifically. Based on discussions held in the last months, it is proposed to operationalise the definition of vulnerable micro-enterprises by looking at micro-enterprises that:

- use fossil fuels for their buildings or vehicles, and both are not new or refurbished, but also have inadequate funds to invest in renovation and purchase of vehicles, based on their profit account; and
- have a high energy expenditure to start with and are energy dependent, either for building or transport – which means having fuel use in the sectors significantly affected by ETS2.

The issue with the modal shift is still a discussion point, as the companies that are transport – vulnerable are also those that cannot switch to public transport due to the nature of their core business activities.

The following chapter provides an explanation of the indicators used to determine the number of vulnerable micro-enterprises, according to the ETS2 definition and the criteria mentioned in Chapter 2.2.3. An assessment of micro-enterprises vulnerability according to these indicators is then presented for Belgium in Chapter 3.

Core Indicator 1:

Micro-enterprises that use fossil fuels and do not have the means to renovate the building they occupy, purchase zero- or low-emission vehicles or switch to alternative sustainable modes of transport.

This indicator estimates the number of micro-enterprises that are unable to invest in building renovation (including the transition towards low-carbon heating sources) or sustainable vehicles. These are identified by the fact that their gross margin (**profit**) is lower than the **yearly depreciation of investments** in the a) building renovation and/or b) zero-emission mobility. Only micro-enterprises that use fossil fuels for their a) building and/or b) vehicles are affected by ETS2.

Core Indicator 2:

Micro-enterprises with significant energy expenditure:

This indicator estimates the number of micro-enterprises that operate in sectors with **significant energy expenditure for building services and transport**. Considering that datasets for fossil energy costs by sector are not available at national level, sectors with significant energy expenditure are assumed to be those with high energy consumption at EU level (sectors in which companies spend on average more than 5% of their annual turnover on fossil energy costs). These sectors are identified in Chapter 3.

The combination of the two indicators (Core Indicators 1 and 2) provides an estimate of the number of **companies that have substantial energy costs, and are unable to afford investments in buildings' energy efficiency and/or new sustainable vehicles that allow them to offset the impacts of ETS2.** These two indicators allow to identify the vulnerable micro-enterprises according to the definition of the SCF Regulation.

The two core indicators may be complemented by additional indicators, which would allow to further refine the number of vulnerable micro-enterprises, or identify them with more precision. Additional indicators that can be considered are listed below.

- **Limited access to capital:** this indicator considers the companies' access to financial resources, and how this may impact their ability to invest in building improvements or renewal of their vehicles fleet. This additional indicator may result in considering some micro-enterprises as not vulnerable (as they are able to access investment capital at reasonable terms).
- **Composition of the market and competitiveness:** Understanding the structure of the market and the level of competition that may affect the financial resilience of companies, which can make some companies more vulnerable than others.
- **Distribution of vulnerable companies per region:** Analysing how vulnerability is spread geographically and identifying regions with higher concentrations of at-risk companies.
- **Relevance of accessible public transport:** Assessing whether the availability and reliance on public transport affect companies' operational costs or access to human resources.
- **Additional indicators:** This category covers other country-specific factors, such as number of companies located in distant, or sectors that are particularly vulnerable because affected by unique challenges or risks.

Table 2-7 Structural indicators for determining vulnerable micro-enterprises

Indicator	Explanation	Used (y/n)
1. CI1: Means to renovate	Micro-enterprises which do not have the means to renovate the building they occupy, purchase zero- and low-emission vehicles or switch to alternative sustainable modes of transport (refers to the three obligatory indicators)	Yes, it is the core indicator
CI2: 2.1	Micro-enterprises with significant (>5% total expenditure) energy expenditure for on-site fossil fuels consumption, and which face significant cost increases after introduction of ETS2	Yes, it is the core indicator
CI2: 2.2	Micro-enterprises with significant (>5% total expenditure) expenditure for transport fuels, and which face significant cost increases after introduction of ETS2	Yes, it is the core indicator

Based on desk research and on the discussions held with federal and regional institutional actors, there are very limited datasets on micro-enterprises available in Belgium and even less related to their energy and transport patterns. Table 2-8 presents the set of additional indicators and whether they are used in Belgium.

Table 2-8 Additional indicators that are used or not in Belgium (Y/N) for the narrowing to only the most vulnerable micro-enterprises

Indicator	Explanation	Used (y/n)
5. Exclude already refurbished buildings	Energy performance of building below threshold (significant investments needed)	From impact assessment tool

Indicator	Explanation	Used (y/n)
6. Limited access to capital	There is no data available for micro-enterprises in Belgium	No
7. Composition of the market and competitiveness	There is no data available for micro-enterprises in Belgium	No
8. Regional development, regional vulnerability	There is no data available for micro-enterprises in Belgium	No
9. Companies with relevance of public transport but with low accessibility	There is no data available for micro-enterprises in Belgium	No
10. Additional indicators	Sector distribution of micro-enterprises (vulnerable sectors)	Yes, <i>this indicator is tentatively considered in Belgium</i>

3. Impacts of ETS2 and identification of vulnerable groups in Belgium

3.1. Modelling approach

The impact of ETS2 on poverty and vulnerability has been estimated using different models. The primary estimation for households and transport users has been made using micro-economic modelling approaches. The impacts on micro-enterprise vulnerability have been estimated using statistical analysis. Looking forward to the need for measures and investments in the SCP, macro-economic modelling has been used to provide insights into the impacts of the ETS2 (and other Fit for 55 policies) on household and individual expenditures, investments and other behaviours. The following chapter provides a summary of the methodological approach taken for each of these. More detailed descriptions and information can be found in the annexes to this deliverable.

3.1.1. Micro-modelling: Households and transport users

The micro modelling of households and transport users is based on Oeko-Institut's microsimulation model SEEK-EU (Figure 3-1) with the datasets of the EU Household Budget Survey (HBS) 2015 and the EU Statistics on Income and Living Conditions (EU-SILC) 2023 serving as the main inputs (see Annex A for more details on the data used in the model)¹⁸. Related to the EU HBS, the last available datasets are those from 2015 and 2020. In the context of this study, we use the 2015 data, as i) 2020 is a pandemic year which affects expenditure in the transport sector quite significantly and ii) several data issues have been identified with the 2020 dataset. Additionally, as stated in Chapter 1.2.5, for the purpose of the report, we assume 100% of costs are passed through onto the consumers.

On the one hand, using the 2015 data, we represent a pre-pandemic and pre-energy crisis year, thus giving a more likely impression of a 'regular year'. On the other hand, the ETS2 impact we estimate is likely to overstate the actual ETS2 impact as, between 2015 and 2027, the consumption of fossil fuels by households in the heating and transport is reduced due to other energy and climate policies and changes in the overall price levels of these fuels. Those changes in the demand for fossil fuels induced by other policies and developments are taken into account in the modelling presented in Chapter 3.5. We do expect, however, that in the case of vulnerable groups, these reductions are less pronounced and the 2015 data more likely a reflection of the current situation, as these groups lack the means to invest in climate-friendly alternatives. Enabling these investments is the goal of the Social Climate Fund.

¹⁸ See Annex A for more details on the data used in the model.

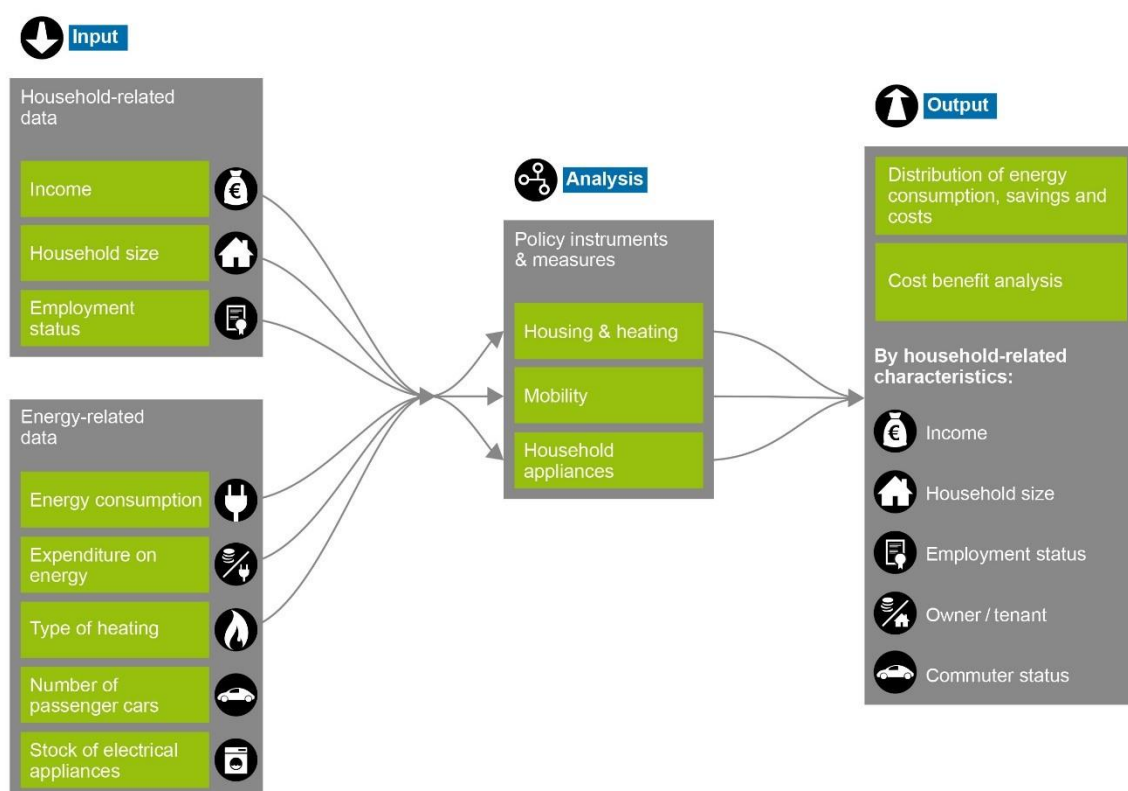
There may also be small differences in the SILC indicators presented here and those available in national statistics. This can be explained by differences in the data preparation process, such as the exclusion of implausible data points. In addition, Eurostat revises the versions of the micro-data provided when discrepancies are found and therefore there are different versions of the micro-data provided. As a result, the database used may vary slightly. This is also the case for the HBS microdata. The differences in the HBS indicators can mainly be explained by the different methodologies used. This includes, for example, different expenditure categories used for the calculation of expenditure-based indicators such as the 2M or M/2 indicator, which has a direct impact on the thresholds used in the calculation. Differences in the data preparation process, such as the exclusion of implausible data points, also play a role.

Throughout this report, expenditure deciles are based on total expenditures of a household and constructed using new OECD equivalence weights. We use expenditure instead of income deciles as total expenditures are generally seen as a good approximation of lifetime income and because the variable related to total expenditures is generally seen as more reliable in the EU HBS compared to the variable total income. Throughout this report, expenditure deciles are based on total expenditures of a household and constructed using new OECD equivalence weights. We use expenditure instead of income deciles as total expenditures are generally seen as a good approximation of lifetime income and because the variable related to total expenditures is generally seen as more reliable in the EU HBS compared to the variable total income.

In Annex B, we compare descriptive statistics from the EU HBS 2015 to descriptive statistics of the Belgian national HBS 2016–2022. It becomes clear that average expenditures for heating recorded in the EU HBS 2015 are higher than those recorded in 2016 and 2018 in the national Belgian HBS, especially for the bottom half of the income distribution. For 2022, expenditures are more similar, but 2022 was a high-price year, where higher expenditures indicate higher prices rather than higher consumed amounts. We therefore conclude that results from the EU HBS 2015, especially for lower-income groups may overestimate the ETS2 impact, since the Belgian national HBS generally shows lower values.

The microsimulation SEEK-EU has a modular structure. In the first module, the database is prepared and, amongst other steps, missing values are assigned or, in some cases, extreme / extraordinary values are corrected. In the next step, the target groups relevant for the context of the ETS2 and the SCF are defined, these groups include income (expenditure) deciles, the degree of urbanisation and the dwelling type. A further module calculates the energy and transport poverty indicators and the indicators showing vulnerability to the introduction of the ETS2, as well as the expected impact of the ETS2 in terms of the additional expenditure spent on GHG emission costs.

Figure 3-1. Oeko-Institut SEEK-EU micro simulation model



In the context of this report, we estimate a main scenario, where behavioural changes of the households and transport users in response to ETS2 prices are accounted by using general short-term elasticities for heating and road transport¹⁹. As a sensitivity analysis, a scenario that does not account for behavioural changes at the level of households and transport users is estimated, in this scenario the amounts of fossil fuels consumed stay the same as in the baseline data of the HBS 2015.

The short-term price elasticities we apply in the main scenario are equal to -0.1 for fossil fuels used in buildings and -0.2 for fossil fuels used in road transport. These elasticities are broadly in line with those estimated in Temursho, U. & Weitzel, M. (2024) and Oeko-Institut (2020). Short-term elasticities cover changes in consumption that are achieved with little or no investments, such as heating less or using the car less often. We choose the lower end of the short-term elasticity estimates to make sure that we account for the fact that vulnerable households may already be consuming at a level that only just fulfils their basic needs and may

¹⁹ Elasticities are used to model how flexible consumers are in response to price changes. A low price elasticity means that if prices increase consumers are not readily able to reduce their consumption, for example a house should have a minimum level of heating. A high price elasticity means that consumption is much more easily reduced, i.e. household spending on entertainment or restaurants. Heating and transport fuels price elasticities are usually low, as houses need to be heated and people need to travel for work and other reasons, therefore price increases lead to higher costs much more than they lead to reduced consumption.

be falling below this level, if they reduce their consumption²⁰. The short-term price elasticities applied in the micro modelling are very different from a long-term elasticity that would also capture investment activity by households. The SCF was set up because it is likely that middle- and higher-income households can invest and shift away from fossil fuels more easily and thus have a higher long-run price elasticity. In Chapter 3.5, we cover changes in consumption that are long-term linked to both changes in behaviour and investment activity.

We apply the ETS2 price path and its translation to end consumer prices presented in Chapter 1.2.1, taking into account country-specific VAT rates. For Belgium, a VAT rate of 21% was applied to the fossil fuels, except for natural gas, where a rate of 6% was applied. We add the expected ETS2 costs based on this price path to the 2015 expenditures from the EU HBS 2015, which are inflated to EUR₂₀₂₃ using the Eurostat all-items HICP. We are thus carrying out a comparative static analysis that takes the expenditures in the HBS 2015 as a basis and checks how vulnerability and costs change in case ETS2 prices are added on top of these expenditures.

The EU HBS 2015 was compared to the Belgian national HBS of 2022. The comparison indicated that the expenditures for fossil fuels in the Belgian national HBS are rather lower than those observed in the EU HBS even after accounting for price changes between the years. This was further discussed in a call with the Federal Plan Bureau. This needs to be taken into account when interpreting the results, which may present an upper bound to the impacts. The analysis could also be repeated with a more recent national HBS.

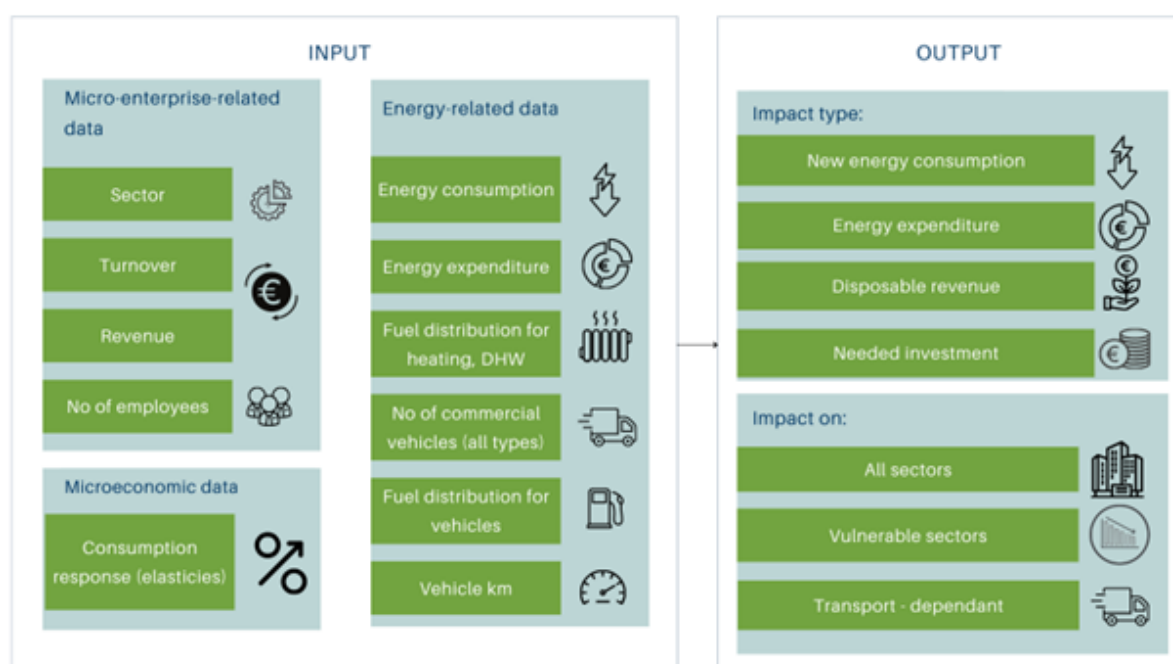
3.1.2. Micro-modelling: Micro-enterprises

In order to assess the impacts of ETS2 on micro-enterprises, we used IEECP's tool (see Figure 3-2), which was developed based on work conducted to assess the impact of policies on vulnerable energy consumers. The datasets used in all countries include JRC IDEES 2021 data on energy consumption in the service and transport sectors and the EUROSTAT SBS 2022 dataset on companies, complemented with ORBIS database.

The tool assigns the investment, disposable revenue and defines the specific effect of the sectors with significant energy expenditure, based on the available data in existing datasets. The results help not only to quantify the total impact on micro-enterprises but also to identify the number of companies that are significantly affected by this impact.

²⁰ Note that indirect impacts on households deriving from an increase in the price of goods (because of increase in transport costs) are not considered in modelling.

Figure 3-2 Calculation process for micro-enterprises



The number of micro-enterprises is derived by preference from national data sources where available, due to its greater granularity. However, when necessary, national data are supplemented by the EUROSTAT SBS and ORBIS databases. Assessing the ETS2 impact on micro-enterprises is challenging due to limited data on energy use at this level of granularity, this is compounded by reliance on broader SME categories in existing datasets. Methodological approaches used to address this include (1) modelling energy consumption based on traits like employee numbers; (2) using shared databases; and, (3) conducting surveys where possible.

Baseline energy consumption in buildings and transport is estimated through datasets like JRC-IDEES, adjusted for technology efficiency, and categorised by energy carrier and vehicle type, considering transport-dependent sectors separately. The ETS2 impact is calculated by analysing changes in energy expenditure and price elasticity for various consumption scenarios, alongside annualised investment costs for 2027–2032 to estimate the vulnerability of micro-enterprises.

Contrary to the assumption made for energy suppliers, which assumes a 100% pass-through (see Chapter 1.2.5), our analysis of micro-enterprises vulnerability does not consider the possibility of them passing the cost increase onto their customers, whether these are other micro-enterprises, the public sector, or households. The extent to which a micro-enterprise may be able to do so depends on many factors, such as the sectors it operates in, the substitutability of its products or services, and its competitors. Nonetheless, when assessing vulnerability, it is safe to assume that most vulnerable micro-enterprises are

unlikely to be able to pass the cost increase because they are already operating on tight margins (to be considered vulnerable, a company's annual profits must be lower than the additional energy expenditure and investment required to offset the cost increase due to ETS2). Pass-through may be more likely for micro-enterprises operating in transport-intensive sectors, where the vast majority of operators will incur similar cost increases.

More detailed information on the approach is provided in Annex A.

3.1.3. Macro modelling

The macro analysis is based on E3-Modelling's suite of models GEM-E3 (macro-economy), PRIMES (energy system) and MHM (Multiple household satellite module). The GEM-E3 model provides the scale and composition of economic growth for each country, PRIMES provides the energy system that is consistent with the economic growth and the MHM module computes expenditures per household (decile) for different incomes and households. The macro-level data are largely derived from EUROSTAT, GTAP v11, IEA and ILO, whereas the household data are derived by EUROSTAT using the HBS²¹ and the experimental ICW databases²².

The reason for using this combination of models is to capture the dynamics of the energy and economic system but also the interplay between energy and climate policies. GEM-E3 captures how the income of households can change over time whereas the PRIMES model captures how not only ETS2 but also other energy efficiency and RES policies affect and interact with households' decisions and consumption patterns in the future. Expansion of the ETS through ETS2 will drive efficiency improvements through technology substitution, behavioural changes and renovation.

It is beneficial to the selection of measures and investments in the social climate plans to deepen the understanding of the changes in energy expenditures whilst also accounting for a number of changes including:

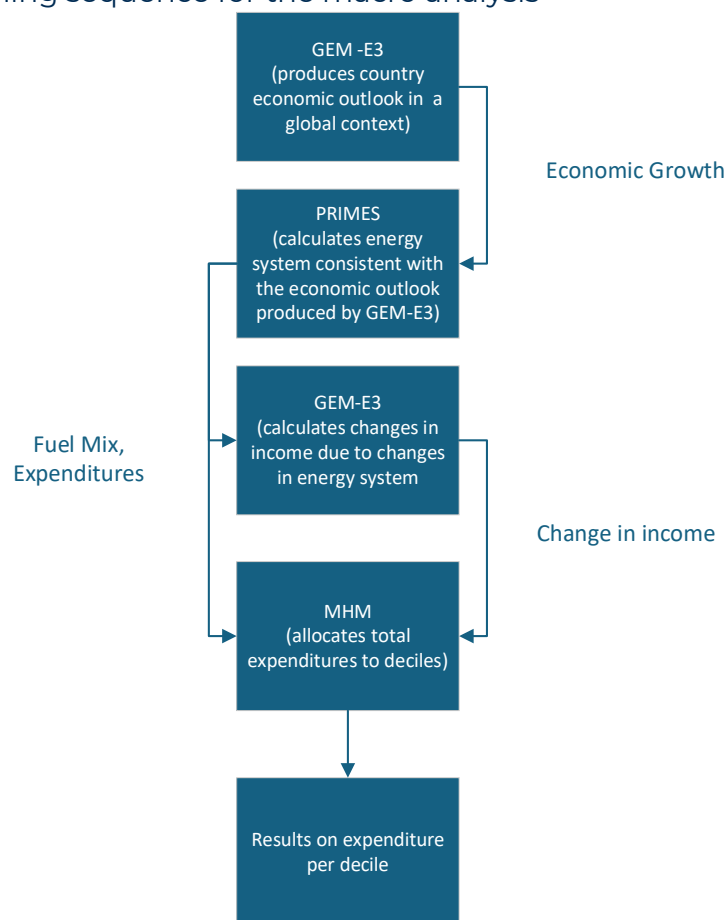
- i) household income over time;
- ii) fuel and technology adoption driven by energy policies;
- iii) technology cost dynamics; and
- iv) behaviour changes.

To account for this the following modelling sequence and exchange of information among models is adopted (see Figure 3-3).

²¹ Mainly the hbs_exp_t133: Mean consumption expenditure by income quintile, hbs_str_t223: Structure of consumption expenditure by income quintile and COICOP consumption purpose.

²² Mainly the icw_aff_01: Disposable income of households (with expenditure greater than zero) spent on essential goods and services by income quantiles - experimental statistics.

Figure 3-3 Modelling sequence for the macro analysis



For this study two scenarios have been considered.

1. **A baseline scenario** consistent with the REF2020²³ producing the following indicators.
 - Power supply mix and investments;
 - Energy efficiency investments by HHs;
 - Fuel mix in industry;
 - Fuel mix in buildings (HHs, commercial sector);
 - Fuel mix in transport modes;
 - Expenditure for new vehicle stock;
 - Carbon prices;
 - Consistency check for fuel and electricity price changes.
2. **A Policy scenario (named MIX²⁴)** where a mix of climate and energy policies are implemented to reach EU carbon neutrality in 2050. This scenario includes a number of policies for the residential, commercial and transport sectors beyond the introduction of ETS2 carbon price.

²³ European Commission. (2021). EU Reference Scenario 2020. https://energy.ec.europa.eu/data-and-analysis/energy-modelling/eu-reference-scenario-2020_en.

²⁴ European Commission. (2021). Policy scenarios for delivering the European Green Deal. https://energy.ec.europa.eu/data-and-analysis/energy-modelling/policy-scenarios-delivering-european-green-deal_en.

3. **An intermediate scenario** that is consistent with the MIX scenario for ETS sectors and consistent with the REF2020 scenario for ETS2 sectors.

The policy implications are derived by comparing the policy MIX scenario with the intermediate reference scenario. A detailed description of the policies and developments considered in each scenario is presented in Table 3-1 below.

Table 3-1 Most relevant characteristics of scenarios (REF2020 and MIX)

	REF2020	MIX: Medium EE and RES policy + medium carbon price in non-ETS sectors
Brief description	Stylised focused on aggregate EU outcome of the NECPs 2019	Moderate bottom-up policies for: i) RES deployment, ii) energy efficiency, iii) extension of ETS scope to buildings, iv) road transport, v) keep them in Effort Sharing Regulation (ESR). Same ETS price for old and new ETS. The carbon prices for ETS and ETS2 shall be higher than those of REF so to further reduce GHG emissions to reach the GHG targets.
GHG emissions in 2030 compared to 1990	Bottom up from NECP 2019	-55%
Energy efficiency in Buildings	As legislated (2019)	MIX policies included: • double renovation rates increasing their depth (towards medium renovations); • achieving higher (than 3%) renovation in public buildings; • improving enforcement of Energy Performance of Buildings Directive (EPBD); • improving technical building systems, products and appliances performance; • further penetration of Building Automation and Control Systems (BACS); • increasing of district heating and cooling; • achieving efficiency standards for data centres; • meeting minimum EU requirements for energy performance of new buildings (to be improved over the years starting from 2025, for example to increase efficiency by 20% every 5 years); • achieving deeper renovation favoured by policy context and slightly lowering perceived risk factor for investment decisions; • implementation of energy taxation based on energy content and exemptions (Energy Taxation Directive review in addition to carbon pricing acts); • implementation of policies supporting bigger penetration of heat pumps.
Energy efficiency in Transport	As legislated (2019)	Modal shift, intelligent transport systems, higher loads etc.; and energy taxation (ETD review)

REF2020		MIX: Medium EE and RES policy + medium carbon price in non-ETS sectors
RES in buildings	As legislated (2019)	• Medium penetration of RES in buildings, i.e. ◦ increase RES heating and cooling values and increasing binding targets as stipulated in the revised Renewable Energy Directive (RED II); this includes district heating and industry) – at least 1.5% per annum; ◦ higher uptake of not only heat pumps but also solar thermal, geothermal, bio-methane, direct electricity and RES in district heating as well as on-site RES (for own consumption); • Biomass consumption remains stable • Strong minimum RES energy for electricity and heat use that is locally produced
RES in transport and policies impacting transport fuel content	As legislated (2019)	• Renewable fuel supplier obligation on all transport modes including renewable fuels obligation on aviation and shipping, i.e. ◦ moderate uptake of advanced biofuels without double counting; ◦ minor uptake of renewable e-fuels by 2030 in transport. • Low ambition increase on fuel content

The macro-economic analysis in Chapter 3.5 provides outputs of absolute (in EUR) and relative (as % of total household or individual expenditure) for the following indicators.

- **Total Energy expenditures** for households
 - **Energy (fuel) expenditures**, representing all household expenditures on fossil fuels, renewables, electricity and district heating. In addition to the total figure, the outputs also include a figure for this category broken down by energy carrier, this breakdown does not include 'heat' and therefore in some cases there is a small variation of the totals in the breakdown figure compared to the total figure.
 - **Renovation expenditures**, represents additional costs for energy efficiency renovations. These are relevant as the MIX scenario design includes policies to increase the renovation rate (i.e. doubling renovation rates increasing their depth at the EU level relative to the reference scenario). The expenditure figures included in the report represent annualised costs (i.e. capital costs associated with renovation expenditures for equipment and fuel purchasing costs, spread over the assumed lifetime of the renovation).
 - **Equipment expenditures**, this represents either purchasing the same but more efficient technology or switching to a more advanced or lower emitting technology. The expenditure figures included in the report represent annualised costs (i.e. capital costs associated with

investment expenditures for equipment and fuel purchasing costs, spread over the assumed lifetime of the equipment). These are relevant as besides renovation, the scenario includes measures towards the improvement of technical building systems, products and appliances performance, as well as policies supporting bigger penetration of heat pumps relative to the reference scenario. Renewables in buildings include incentives for the uptake of RES in heating and cooling - e.g. heat pumps- in line with a binding RES H&C target for 2030 (i.e. an increase of at least 1.5% per annum in the period 2021 to 2030).

- **Transport expenditures** for individual transport users
 - **Operating expenditures**, representing fuel costs for private transport.
 - **Purchased transport expenditures**, representing spending on public transport services.

3.2. Impacts of ETS2 on energy poverty and vulnerability (households)

There are approximately 5.16 million households in Belgium²⁵. In 2021, about half of the Belgian population was living in a household consisting of a couple with children, and just over a fifth was living as a couple without children. People living alone account for 15.6% of the population and 11.3% of Belgians are single parents (these two groups are overrepresented in city centres).

In Belgium, 67.2% of households are owners, 22.7% are tenants at market price, 6.8% are tenants in social housing and 3.3% benefit from reduced rent (via their family or employer) or free housing²⁶. There are important variations between the three regions.

As mentioned in Chapter 1, natural gas and heating oil are the most common heating method in dwellings in Belgium, with differences between regions. In 2021²⁷:

- 66% of households used natural gas as primary heating fuel (representing 49% of total energy consumption for heating);
- 21% used heating oil (representing 33% of total energy consumption for heating);
- 7% used electricity;
- 3% used bioenergy;
- 1% used heat pumps;

²⁵ Statbel. (2024). La Belgique comptait 5.163.139 ménages privés au 1er janvier 2024. <https://statbel.fgov.be/fr/themes/population/structure-de-la-population/menages>.

²⁶ Statbel. (2024). La Belgique comptait 5.163.139 ménages privés au 1er janvier 2024. <https://statbel.fgov.be/fr/themes/population/structure-de-la-population/menages>.

²⁷ FPS Economy. (2023). Analyse de la consommation énergétique des ménages en Belgique 2021. <https://economie.fgov.be/fr/publications/analyse-de-la-consommation-1>.

- 1% used propane or butane; and
- 1% with other forms of heating (e.g. solar thermal, coal).

BE-SILC 2022 data gives the following breakdown (in % of households).

Table 3-2 Distribution of primary heating fuel (in % of households) per region

	Electricity	Natural gas	Heating oil	Other
Flanders	7.5%	71.2%	14.7%	6.6%
Brussels	6%	86%	7.5%	0.5%
Wallonia	6%	42.4%	37.5%	13.8%
Belgium	6.9%	63.7%	21.1%	8.3%

Thus, the most critical factors affecting household heating energy expenses are natural gas and heating oil prices. Due to the climate, heating is in Belgium considered as an essential service, and the need for cooling during the summer months is increasing as a result of climate change. But space cooling needs are not (yet) considered as essential services and do not require to be addressed in the frame of the SCP.

3.2.1. Impact of the ETS2 on the number of vulnerable households

Figure 3-4 shows the share of the Belgian population deemed vulnerable to energy poverty and particularly vulnerable to the introduction of ETS2 according to the modified 2M indicator for heating. The threshold value is fixed at twice this median expenditure relative to income. For Belgium, the median value is equal to 2.9% and the 2M value equal to 5.8%. As described in Chapter 2.2.1, the vulnerability indicator is limited to low and lower-middle income households by considering only the bottom half of the expenditure distribution. We show both:

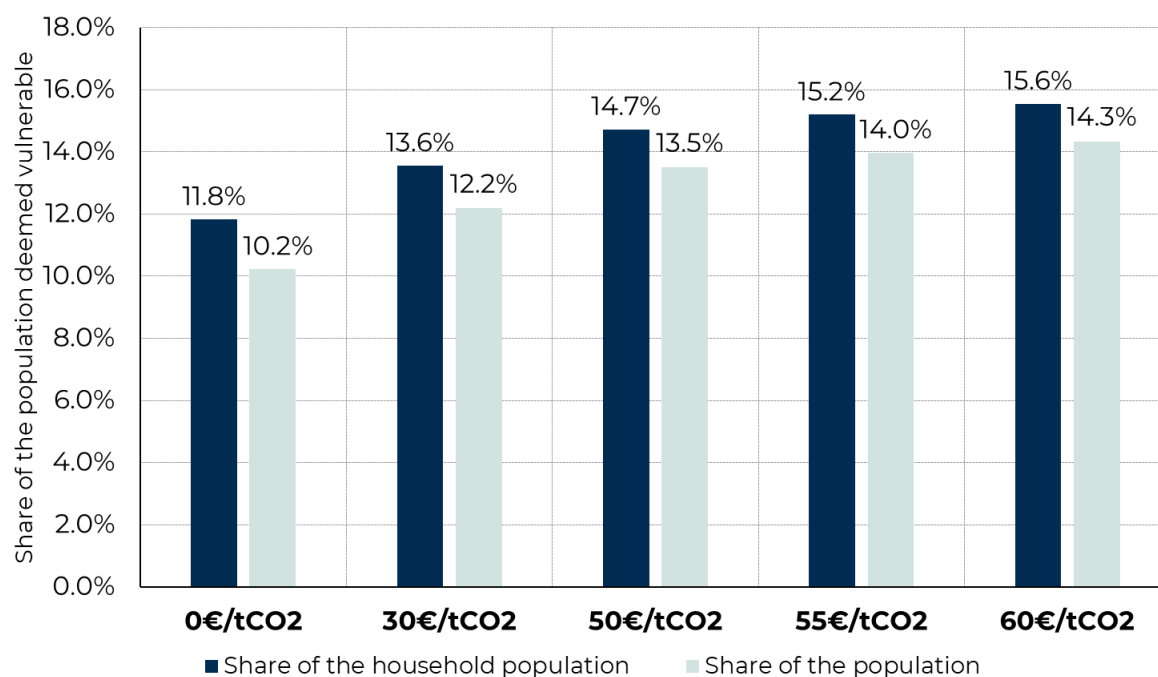
- the share of the vulnerable households (What percentage of all Belgian households is deemed vulnerable to energy poverty and particularly vulnerable to the introduction of ETS2?); and
- the share of vulnerable persons in the overall population (What share of the overall Belgian population do the persons living in these households represent?).

The share of the population deemed vulnerable to energy poverty and particularly vulnerable to the introduction of ETS2 related to heating is shown before the introduction of the ETS2, here shown at a price of 0 EUR/tCO₂, indicating the share of households deemed vulnerable based on their expenditures for fossil fuels according to the HBS 2015 (see Table 2-2). We also show the share of vulnerable households and individuals for ETS2 prices of 30 EUR/tCO₂, 50 EUR/tCO₂, 55 EUR/tCO₂ and 60 EUR/tCO₂. This analysis, and other modelling results presented in this chapter, consider the impacts of ETS2 in terms of additional energy costs for different carbon prices, i.e. EUR 30, EUR 50 EUR 55 and EUR 60. The impacts are estimated based on heating costs as presented in Figure 1-1.

As expected, the share of households and persons vulnerable to energy poverty

and particularly vulnerable to the introduction of ETS2 in Belgium rises slightly with rising CO₂ prices from 12% to 16% (share of households) and 10% to 14% (share of the total population). Most of the individuals and households deemed vulnerable to energy poverty and particularly vulnerable to the introduction of ETS2 were so before the introduction of the ETS2. The higher share in the household population is related to the fact that the households affected have fewer household members than the average (i.e. many one-person households).

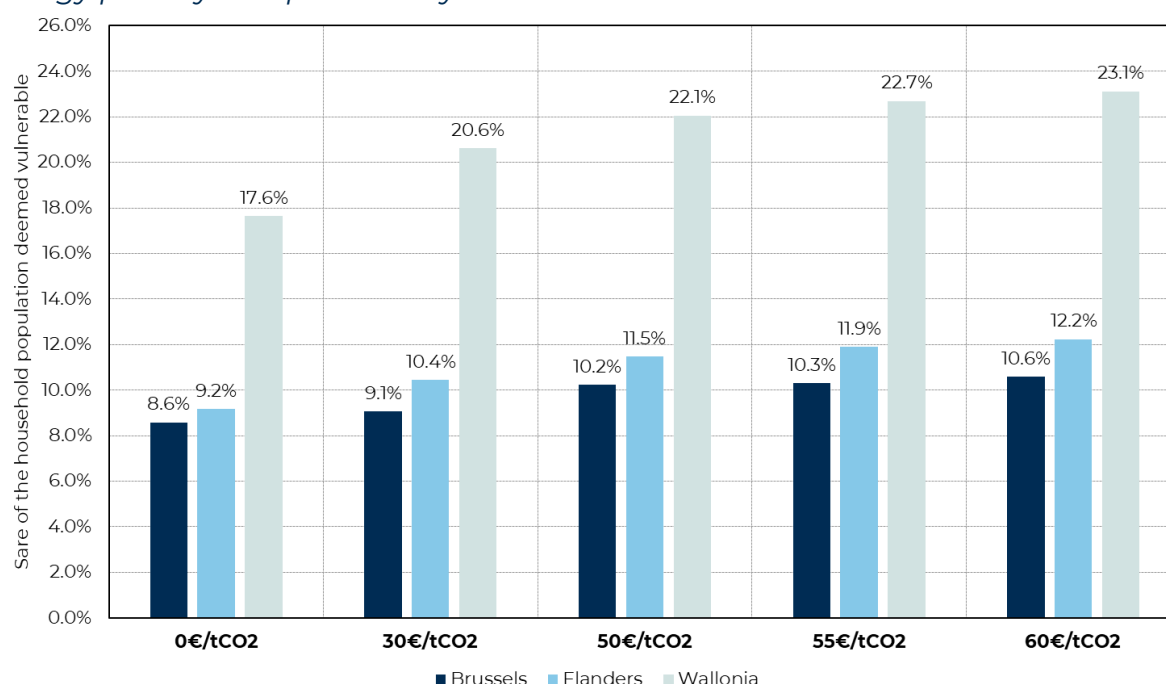
Figure 3-4 Share of the Belgian household population and share of the total Belgian population vulnerable to energy poverty and particularly vulnerable to the introduction of ETS2



Source: Oeko-Institut SEEK-EU micro model

Figure 3-5 shows the share of Belgian households deemed vulnerable to energy poverty and particularly vulnerable to the introduction of ETS2 in each Belgian region. The highest share of vulnerable households is expected in Wallonia, followed by Flanders and Brussels. Further explanation is given below. These are average figures, and more than likely should be assessed at a more granular level to consider the specificities of local levels (keeping in mind this analysis is based on the households in the bottom half of the income distribution).

Figure 3-5 Share of the Belgian household population by region vulnerable to energy poverty and particularly vulnerable to the introduction of ETS2

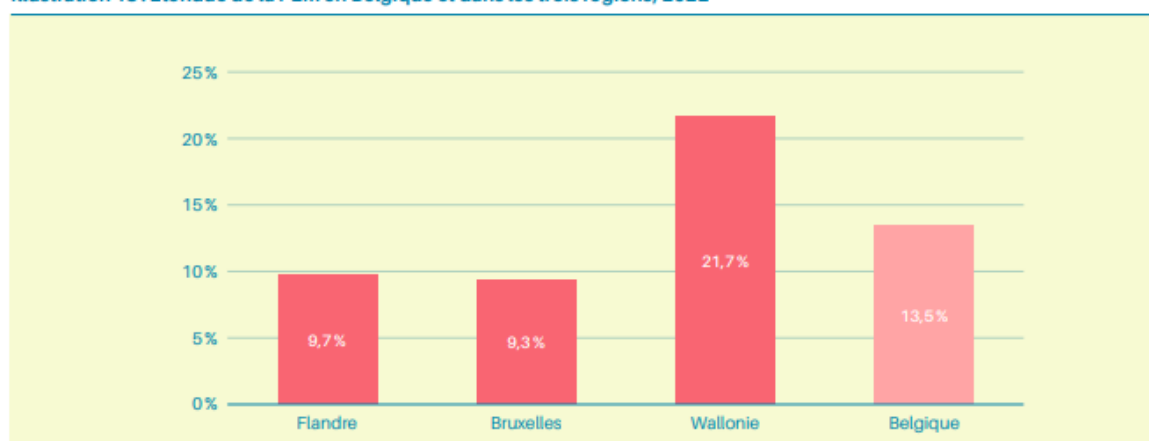


Source: Oeko-Institut SEEK-EU micro model

This trend aligns with the observation/analysis made in the frame of the Energy Barometer (2024)²⁸. In 2022, measured energy poverty (MEP or 2M) affected around 13.5% of households, but with differences between regions: 9.7% in Flanders; 9.3% in the Brussels-Capital Region and 21.7% in Wallonia (as depicted by Figure 3-6).

Figure 3-6 Measured Energy Poverty by region in Belgium, 2022

Illustration 18 : Étendue de la PEM en Belgique et dans les trois régions, 2022



Nombre de ménages dans BE-SILC 2022: 6.727 (3.148 en Flandre, 1.184 en RBC et 2.395 en Wallonie)

Remarque : La taille de l'échantillon des ménages en PEM en Bruxelles-Capitale étant réduit, le chiffre doit être pris uniquement à titre illustratif.

Source: BE-SILC 2022; Statbel; calculs propres

Source: Energy Poverty Barometer (2022 datasets)²⁹

²⁸ Fondation Roi Baudoin. (2024). Baromètre de la précarité énergétique. https://media.kbs-frb.be/fr/media/11986/PUB_3961_Barom%C3%A8trePr%C3%A9carit%C3%A9Energ%C3%A9tique_2024_DEFDEF. (available in French).

²⁹ Fondation Roi Baudoin. (2024). Baromètre de la précarité énergétique. https://media.kbs-frb.be/fr/media/11986/PUB_3961_Barom%C3%A8trePr%C3%A9carit%C3%A9Energ%C3%A9tique_2024_DEFDEF. (available in French).

The differences between the figures resulting from EU statistics and the outcomes of the Barometer come from the difference in the definitions of both indicators (provided in Chapter 2).

Several factors may explain Wallonia's greater vulnerability to measured energy poverty: a higher energy bill (as depicted in Figure 3-7), lower disposable incomes than in Flanders, even if slightly higher than in the Brussels-Capital Region (as depicted in Figure 3-8), and a higher proportion of households heating with oil (see Table 3-2).

Figure 3-7 Evolution of monthly average energy bill by region in Belgium

Illustration 3: Facture énergétique médiane des ménages en Belgique et selon la région

(en €/mois à prix constant, base = 2013; 2019-2022)



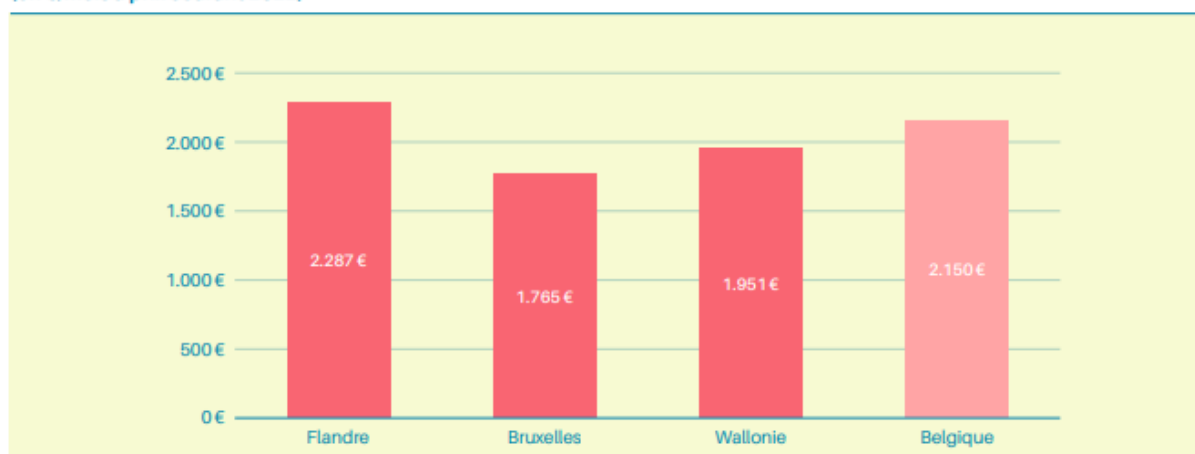
Source: données BE-SILC 2019-2022; Statbel; calculs propres

Source: Energy Poverty Barometer (2022 datasets)

Higher energy bills in Wallonia is explained by higher natural gas prices, a less mild climate, generally larger housing and of lower building energy performance quality.

Figure 3-8 Equivalised average disposable income by region in Belgium

Illustration 14 : Revenus disponibles équivalents (EQ_INC20) médians des ménages au niveau national et selon la région (en €/mois à prix courant 2022)



Nombre de ménages dans BE-SILC 2022 : 6.727 (3.148 en Flandre, 1.184 en RBC et 2.395 en Wallonie)

Source : données BE-SILC 2022 ; Statbel ; calculs propres

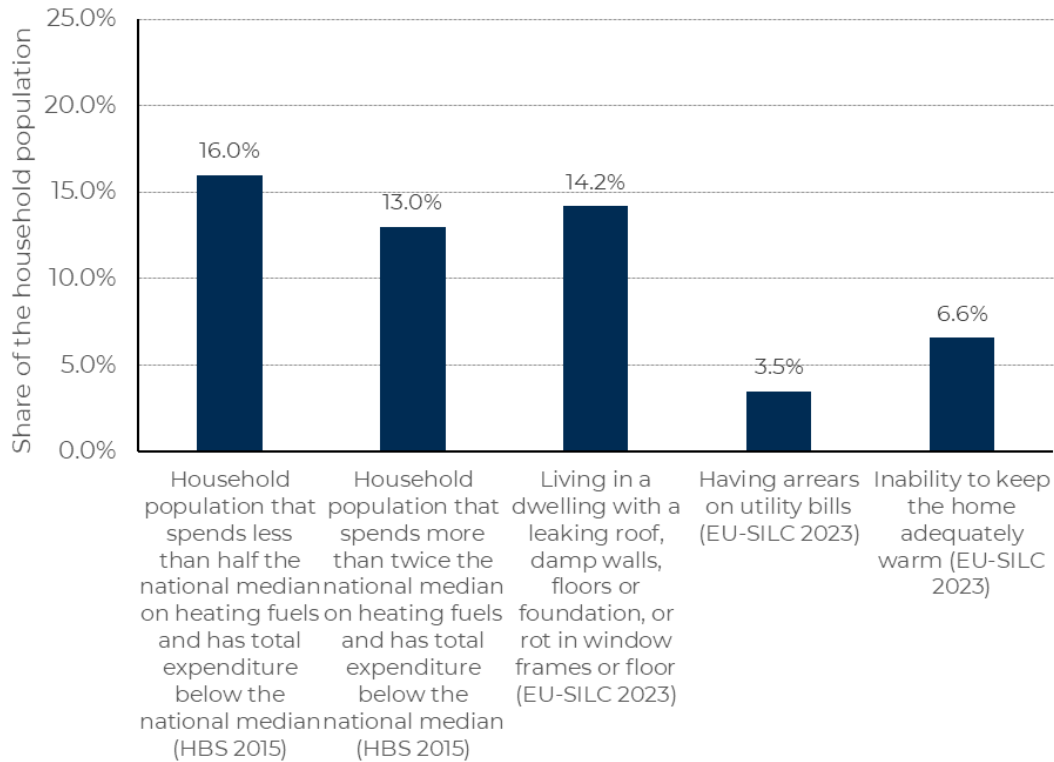
Source: Energy Poverty Barometer (2022 datasets)

3.2.2. Target group analysis of energy poverty indicators

Figure 3-9 shows results on the share of energy poor households for a number of indicators for Belgium based on EU-level datasets of the EU HBS 2015 and the EU-SILC 2023. The share ranges from 3.5% for the indicator 'arrears on utility bills' to 16% for the M/2 indicator showing 'hidden energy poverty'³⁰. Figure 3-10 shows the same indicators but displays results as a share of the total population. If results are higher for the total population than for the household population, this means that affected households likely have more household members than the average household. Figure 3-10 also shows the EED default indicator estimated based on published Eurostat figures based on the EU-SILC 2019. As described in Table 2-1, the EED indicator relates to the arithmetic mean of the three EU-SILC indicators: inability to keep the home warm, arrears on utility bills, leak, damp or rot, and the AROP indicator.

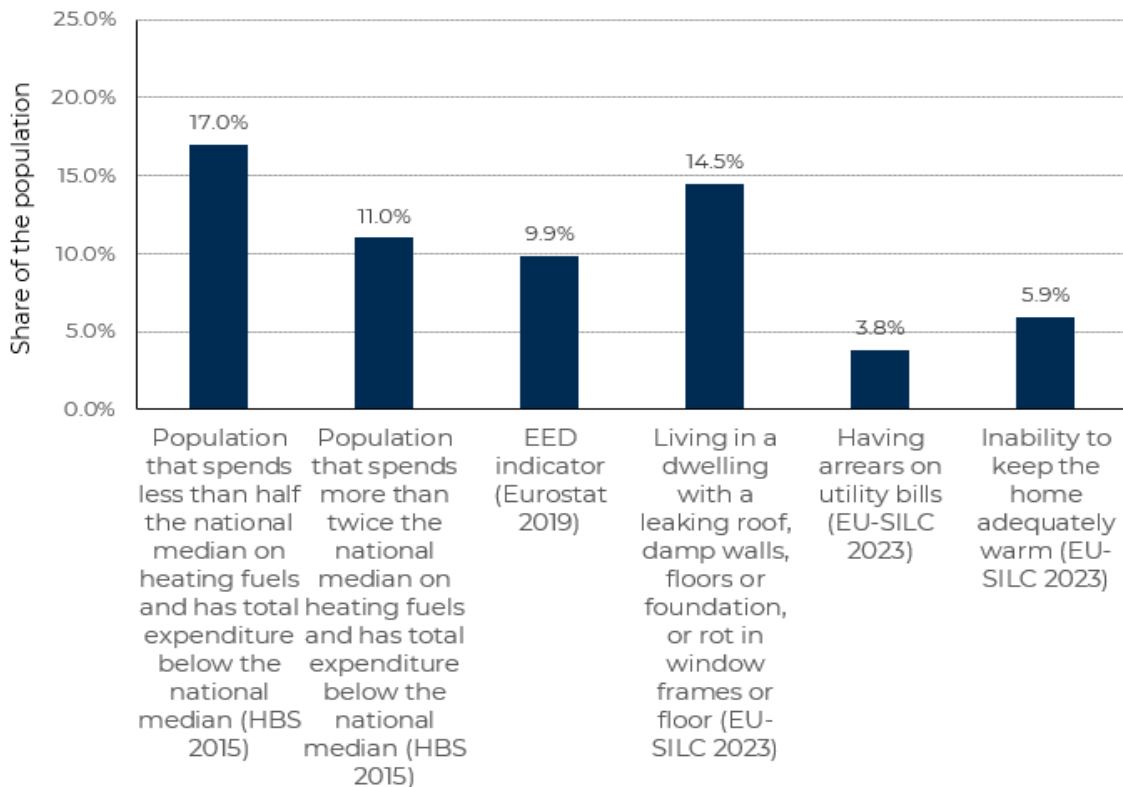
³⁰ The EU hidden energy poverty indicator (M/2) is different from the Belgian hidden energy poverty indicator (in the Energy Poverty Barometer), as explained in Chapter 2.

Figure 3-9 *Share of households identified as energy poor according to a number of indicators in Belgium*



Source: Oeko-Institut SEEK-EU micro model

Figure 3-10 *Share of the total population identified as energy poor according to a number of indicators in Belgium*



Source: Oeko-Institut SEEK-EU micro model

Note: The 2M indicator – second bar from the left – shown in Figure 3-9 is related to heating expenditure by all households, while the modified 2M indicator (Chapter 3.2.1) is limited to fossil-fuel using households, which is why results on the two indicators diverge.

According to the Energy Poverty Barometer (2022 datasets)³¹, 31.5% of households living in housing with a **quality defect** (defined as: presence of leaks in the roof, damp walls or floors, rotting woodwork, no bath/shower or toilet in the home, too dark) are in energy poverty compared to 19.5% for other households. Households at risk of poverty are significantly more at risk of living in substandard housing (26.6%) than other households (17.3%). In addition, from the 22 November - 6 December survey, several stakeholders on a various topics, were referring to the Barometer as an important and well recognised reference with regard to energy poverty. These stakeholders were providing figures coming from the Barometer.

A large proportion of households in energy poverty live in **poor quality apartments** (e.g. in Flanders, the worst performing dwellings are occupied by the lowest income quintiles, according to the Belgian Housing survey 2023 - *Steunpunt wonen*, 2024³², which is more than likely the same in the two other regions).

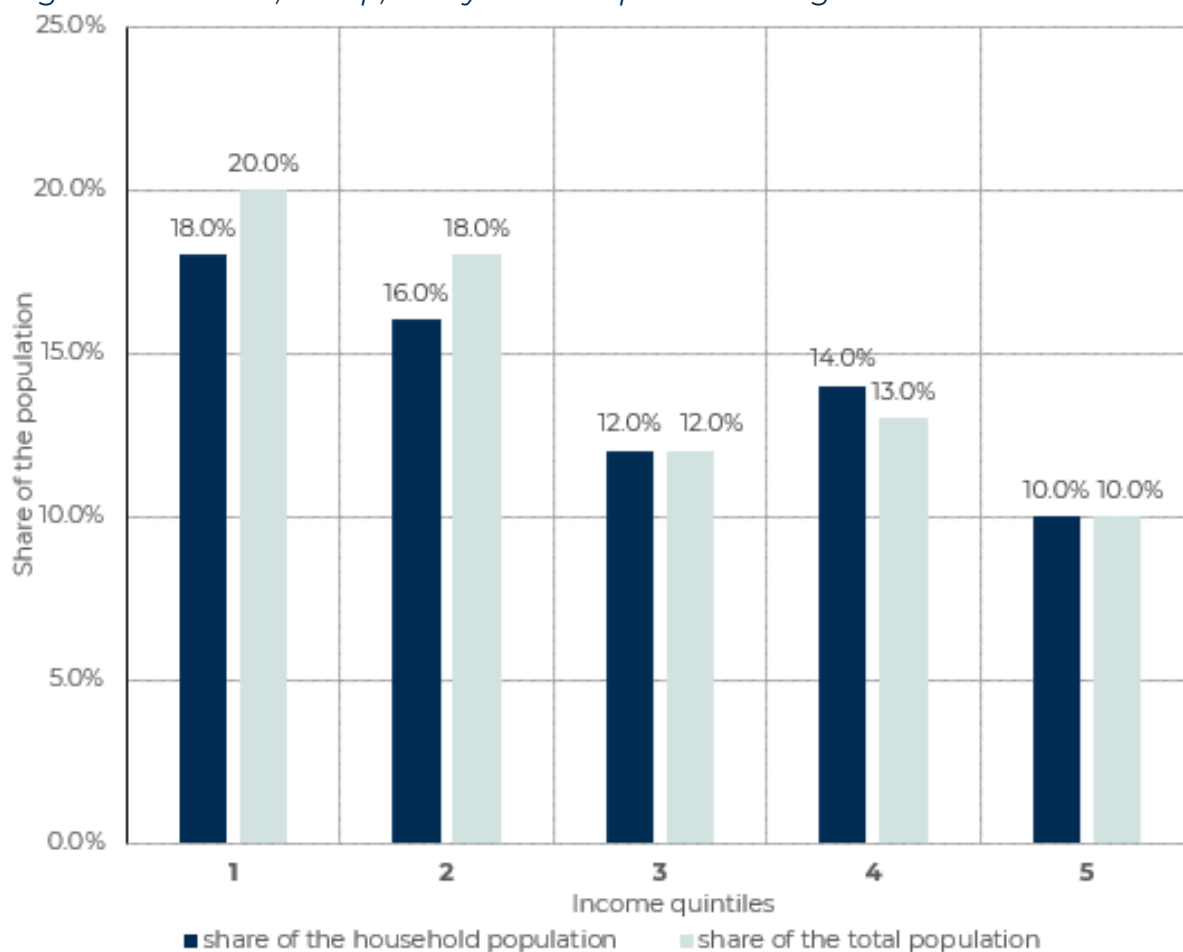
The following graphs explore the EU-SILC 2023 indicator with the highest values by income quintiles and degree of urbanisation. In the Belgian case, this is the 'leak, damp, rot' indicator. Figure 3-11 shows the indicator by income quintiles³³.

³¹ Fondation Roi Baudouin. (2024). Baromètre de la précarité énergétique. https://media.kbs-frb.be/fr/media/11986/PUB_3961_Barom%C3%A8trePr%C3%A9carit%C3%A9Energ%C3%A9tique_2024_DEFDEF. (Available in French).

³² Steunpunt Wonen. (2023). Woonsurvey 2023: eerste resultaten voor de basisindicatoren. [2024_11_14_Nieuwsbericht_nota-Woonsurvey-2023.pdf](https://www.steunpuntwonen.nl/media/1114/Nieuwsbericht_nota-Woonsurvey-2023.pdf). (Available in Dutch).

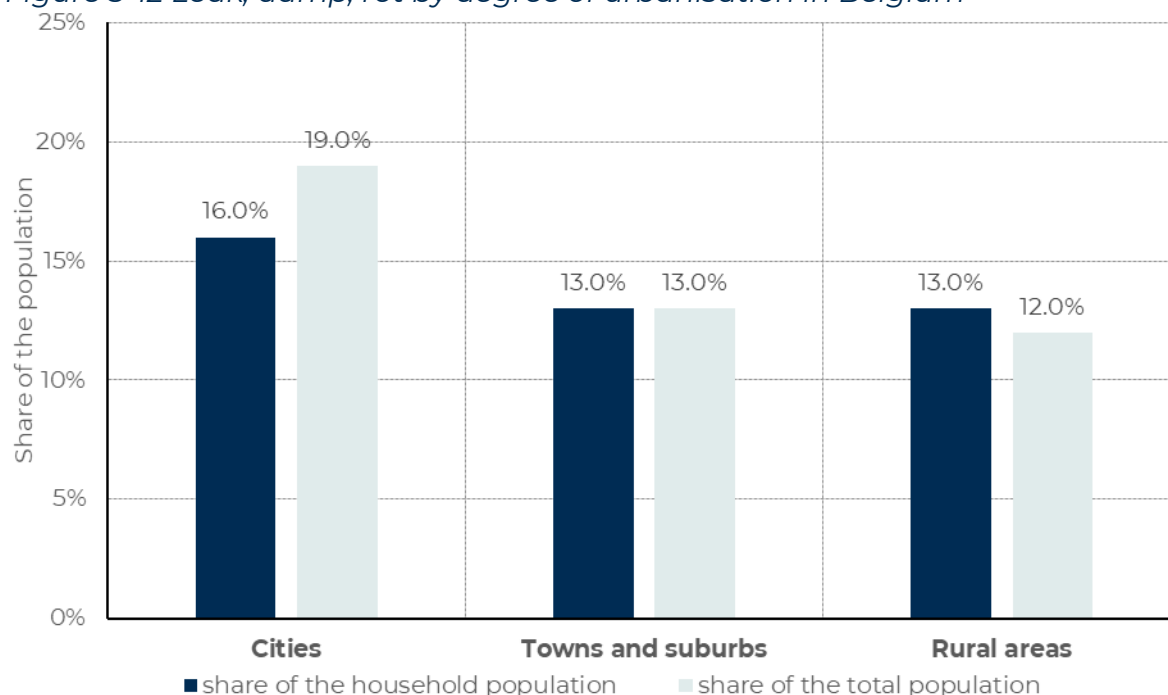
³³ Note that, throughout our analysis, we may show quintiles and terciles instead of deciles due to the limited number of observations for different grouping of the expenditure groups. This ensure that the results provided are sufficiently robust.

Figure 3-11 Leak, damp, rot by income quintile in Belgium



Source: Oeko-Institut SEEK-EU micro model, EU-SILC 2023 data

The share of households and persons identified declines with income. In the first and second income quintile, the difference between the share of the household population and total population is especially high, indicating that many affected persons live in households with many family members. Figure 3-12 shows results by degree of urbanisation.

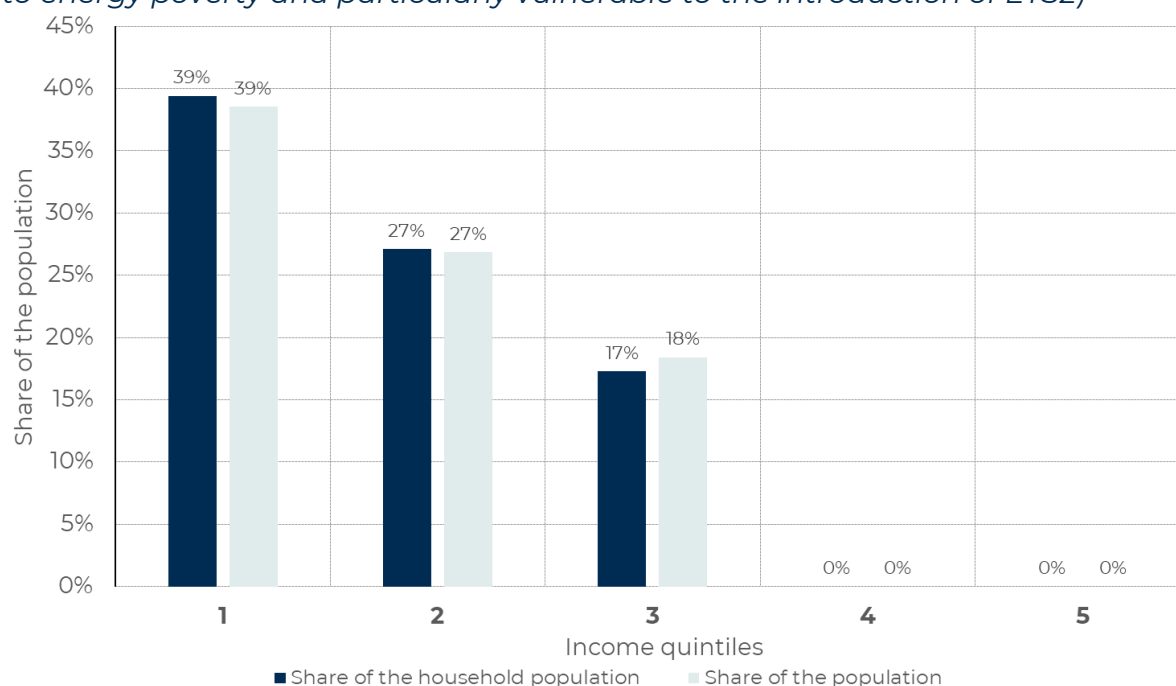
Figure 3-12 Leak, damp, rot by degree of urbanisation in Belgium

Source: Oeko-Institut SEEK-EU micro model, EU-SILC 2023 data

The largest share is identified for densely populated areas, where the share of persons is higher than the share of households, indicating a lot of affected households with many family members.

The following graphs explore the HBS-2015 indicator with the highest values by income quintiles: population that spends less than half the national median on heating fuels and has a total expenditure below the national median (HBS 2015) or M/2 indicator. Figure 3-13 shows the M/2 indicator by income quintiles, and Figure 3-14 by degree of urbanisation.

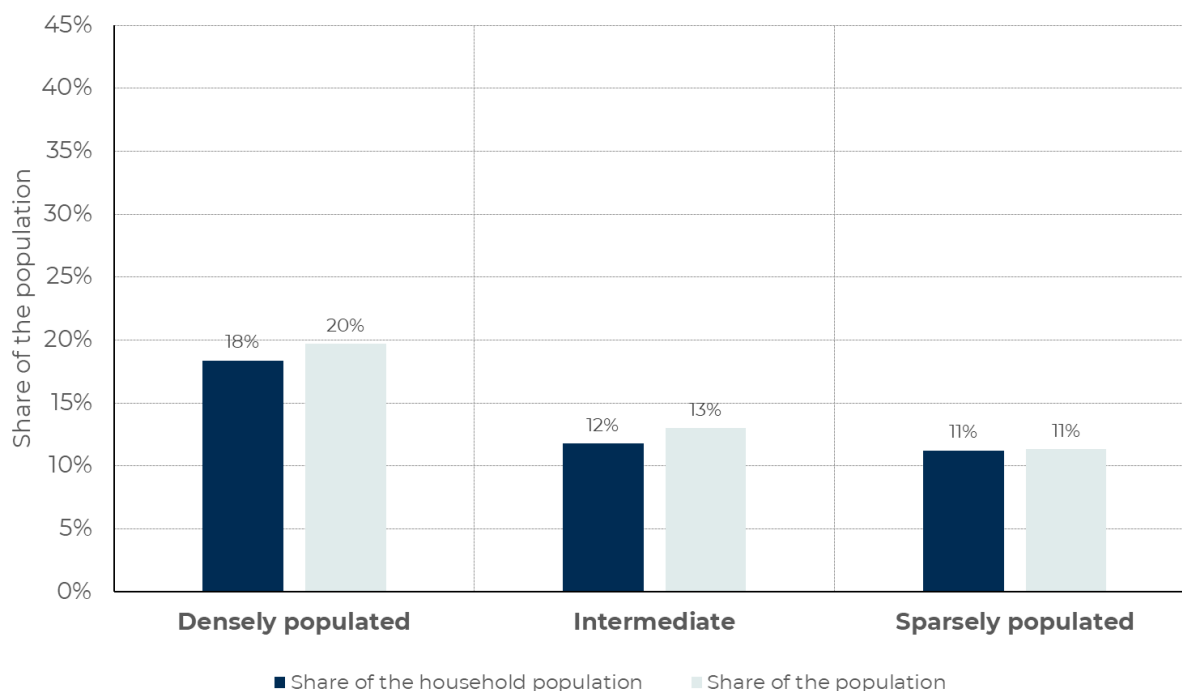
Figure 3-13 M/2 indicator by income quintile in Belgium (population vulnerable to energy poverty and particularly vulnerable to the introduction of ETS2)



Source: Oeko-Institut SEEK-EU micro model

The share of households and persons identified declines sharply with income. The difference between the share of the household population and total population is very limited, indicating that the size of households aligns with the national average. It also shows the important share of the population that spends less than half the national median on heating fuels and has a total expenditure below the national median in the first two deciles, but still in the third decile. No households and individuals in the fourth and fifth quintile are identified, as the indicator is restricted to the bottom half of the expenditure distribution.

Figure 3-14 M/2 indicator by degree of urbanisation in Belgium (population vulnerable to energy poverty and particularly vulnerable to the introduction of ETS2)



Source: Oeko-Institut SEEK-EU micro model

The largest share is identified for densely populated areas, where the share of persons is higher than the share of households, indicating a lot of affected households with many family members.

A higher percentage in urban areas could be explained by different factors: more restrictions (consumption behaviour); smaller dwellings with lower energy losses (apartments); more households benefiting from the social tariff on gas; and in urban areas, poverty incidence is higher, resulting in more households with low incomes.

According to the Energy Poverty Barometer (2022 datasets)³⁴:

- Households that heat mainly with natural gas are less affected by energy poverty, unlike those that heat mainly with electricity or **heating oil**; 19.1% of households that heat mainly with gas are in energy poverty compared to 27.8% of those that heat mainly with fuel oil and 26.9% of those that heat mainly with electricity. ETS2 is going to amplify this further. Also, households using heating oil do not benefit from the same level of protection (protected customer status and social tariff) as gas consumers³⁵. Hence, particular attention should be paid to households heating with fuel oil, butane/propane, or coal.

³⁴ Fondation Roi Baudouin. (2024). Baromètre de la précarité énergétique. https://media.kbs-frb.be/fr/media/11986/PUB_3961_Barom%C3%A8trePr%C3%A9carit%C3%A9Energtique_2024_DEFDEF. (Available in French).

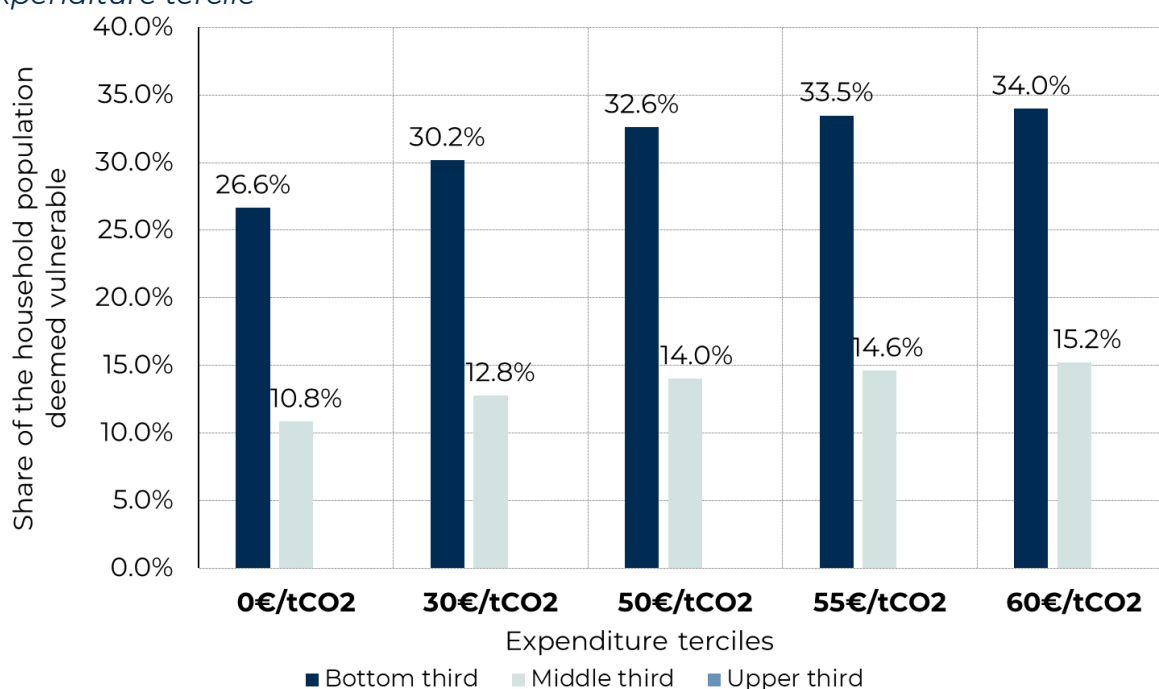
³⁵ As a reminder, there is a social tariff for gas and electricity but not for other vectors.

- 40.3% of households **without professional work income** and 15.8% of households with only one professional income are affected by energy poverty. Compared to 2021, the energy poverty rate increased more sharply for households with only one professional income (+10.2%) than for households with no income (+7.4%).
- **Single people** and **single-parent families** are the households most vulnerable to energy poverty: 37.9% of single people and 37.4% of single-parent families are affected by energy poverty. Compared to 2021, the situation of single people is stable while that of single-parent families seems to be worsening (i.e. the energy poverty rate increased from 24.8% in 2021 to 37.4% in 2022). In general, seniors (as single people) are more affected by energy poverty but some benefit from other sources of income (e.g. rental from properties) which is impossible to capture in the SILC data.
- Women are clearly overrepresented in single-parent families and elderly single people, the profiles most vulnerable to energy poverty.
- **Tenants are significantly more vulnerable** to energy poverty: 45.5% of social tenants and 33.0% of tenants in the private sector are affected by energy poverty, compared to 15.0% of owners. However, many tenants benefit from social gas (and electricity) tariffs.
- 12.0% of households in Belgium received **social assistance for energy** or water in 2022, from 7.7% in 2021, considering that in 2022, social tariffs for gas and electricity were granted temporarily to households benefiting from increased assistance.
- In 2022, 27.8% of those aged 65 and over are in energy poverty compared to 12.4% of those under 49.

Target groups analysis of the energy vulnerability indicator: Which households are most likely vulnerable to the introduction of the ETS2?

Figure 3-15 shows the share of the Belgian household population that is deemed vulnerable to vulnerable to energy poverty and particularly vulnerable to the introduction of ETS2 according to the modified 2M indicator. It shows the share along the expenditure distribution and for the bottom, middle and upper third of overall expenditures. As the modified 2M indicator is limited to the bottom half of the expenditure distribution (see Chapter 2.2.1), no households in the upper third are deemed vulnerable to energy poverty and particularly vulnerable to the introduction of ETS2. With 27–34% the share amongst the bottom third is high and higher than in the middle third at 11–15%.

Figure 3-15 Share of the Belgian household population deemed vulnerable to energy poverty and particularly vulnerable to the introduction of ETS2 by expenditure tercile



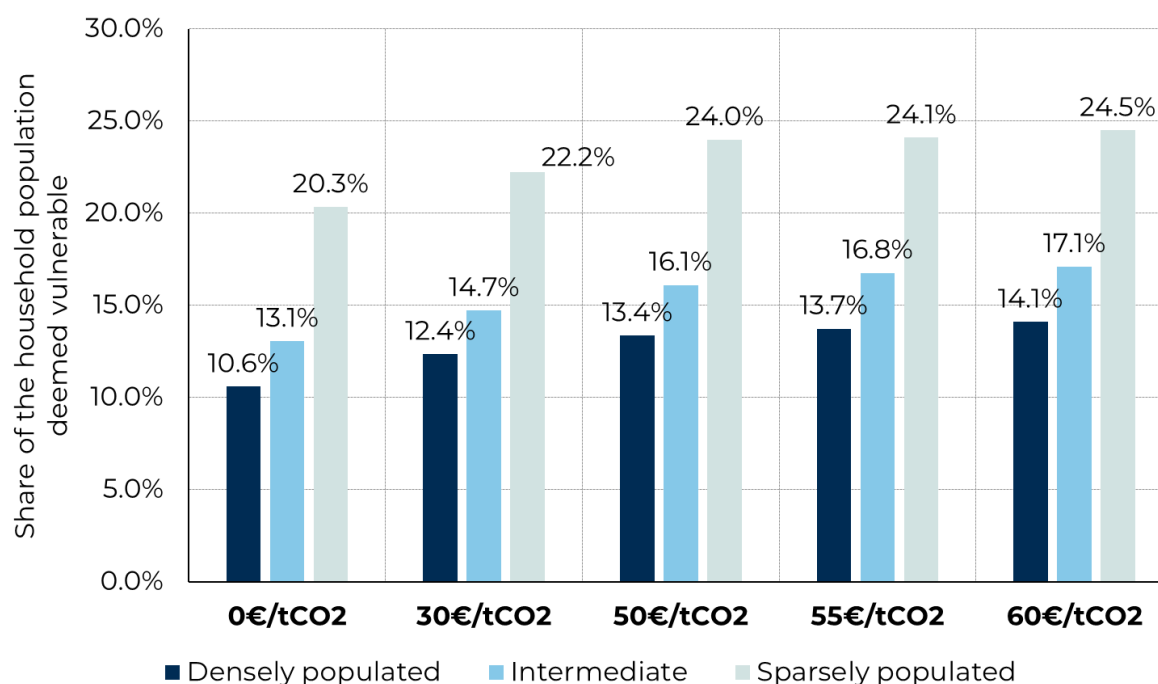
Source: Oeko-Institut SEEK-EU micro model

The distribution of vulnerability along the expenditure and income distribution depends on the amount and price (varying prices according to social tariff, fixed or variable price on energy contract, capacity to store a large amount of heating fuel when price is low ; etc) of fossil fuels that are used by households in the expenditure brackets, as well as their total expenditures and incomes.

Figure 3-16 shows the share of the Belgian household population deemed vulnerable to energy poverty and particularly vulnerable to the introduction of ETS2 by degree of urbanisation. The highest vulnerability is calculated for sparsely populated areas, where 20–25% of households are deemed vulnerable, depending on the level of the ETS2 price. The share is estimated at 13–17% for intermediate population density and 11–14% for densely populated areas.

The distribution amongst the different population densities reflects the consumption of fossil fuels in these areas, as well as the level of total energy expenditures and incomes.

Figure 3-16 Share of the Belgian household population deemed vulnerable to energy poverty and particularly vulnerable to the introduction of ETS2 by degree of urbanisation



Source: Oeko-Institut SEEK-EU micro model

The Barometer shows the effects of 2022 higher energy prices compared to the situation before the 2022 energy crisis. It also turns out that **households heating with fuel oil are hit harder** than those heating with natural gas. In addition, it appears that hidden energy poverty has risen sharply³⁶ and that the impact on measured energy poverty may be temporary due to the temporary measures taken by the government during the energy crisis (latest figures of the King Baudouin Foundation date from 2022). Stakeholders noticed in their contacts with these target groups that **energy poverty has rather risen, with reduced energy consumption resulting in reduced comfort or the switch to lamp petroleum which is less healthy** (see data from the Social Heating Fund).

3.2.3. ETS2 impact by target group

Estimated ETS2 costs and cost burden in the heating sector by target group

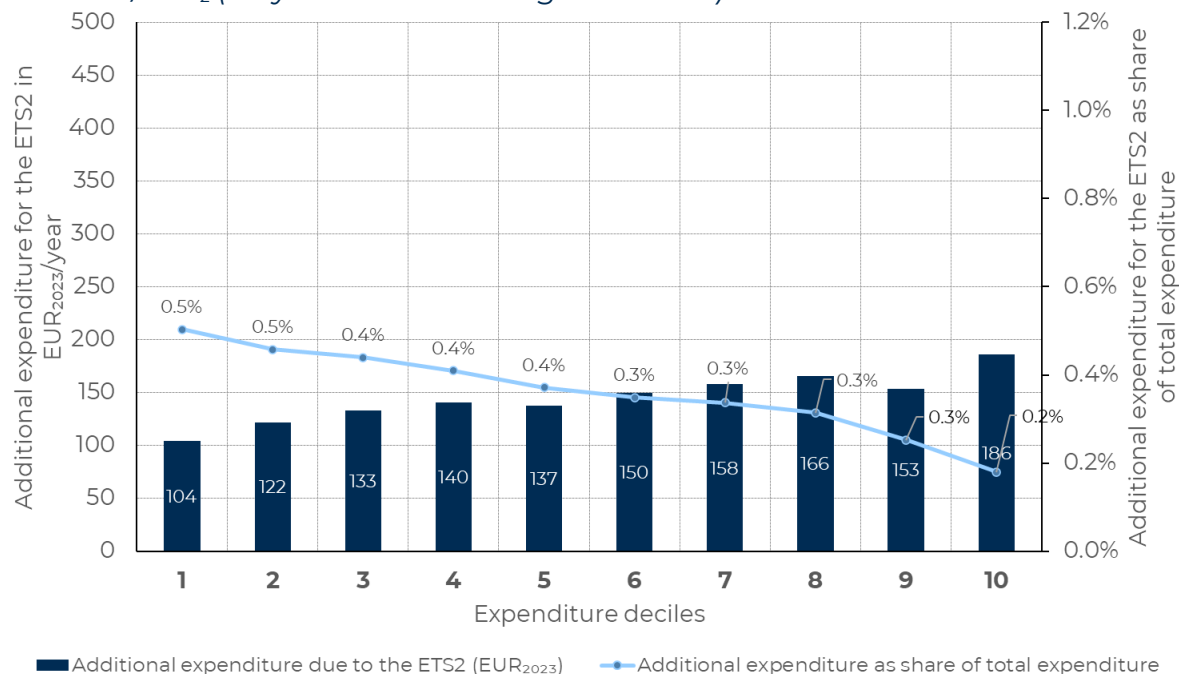
This analysis relies on the EU HBS 2015. As noted above, expenditures are generally higher than in the corresponding Belgian national HBS. This indicates that the following results may overestimate ETS2 impacts at given CO₂ prices to some extent.

Figure 3-17 shows the estimated ETS2 costs at a carbon price of 30 EUR/tCO₂ in the heating sector for Belgian households for our main scenario that includes a price

³⁶ This sharp rise could be a result of the fact that more households were eligible for the social tariff, and hence saw a lower energy bill.

elasticity of -0.1 for heating (see Chapter 3.1.1). The figure shows the impact by expenditure decile only for those households using fossil fuels for heating.

Figure 3-17 ETS2 costs related to heating for Belgian households at a carbon price of 30 EUR/tCO₂ (only households using fossil fuels)



Source: Oeko-Institut SEEK-EU micro model

Note: Expenditure deciles are based on total expenditures of a household that are equivalised using the new OECD scale. We use total expenditures as a proxy for the long-term income of a household.

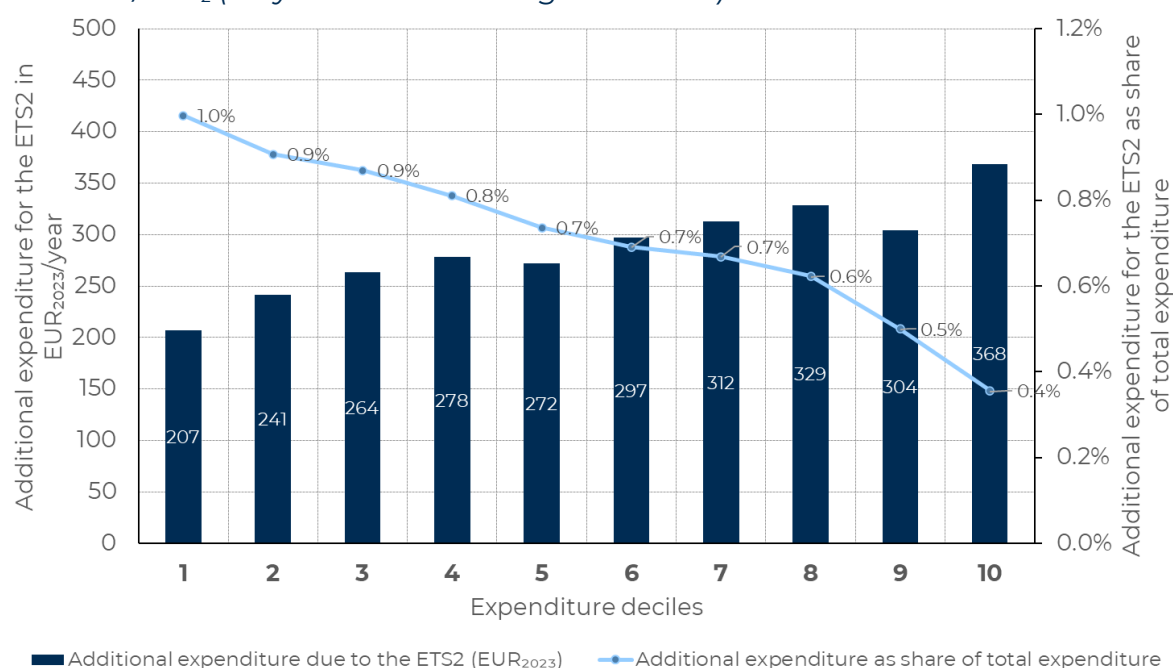
As households with higher overall expenditures use more natural gas and heating oil, the expected additional cost per year rises from 100 EUR/year in the first decile to 190 EUR/year in the tenth decile. This compares to an average EUR₂₀₂₃ 1 564 total annual heating costs without ETS2 for Belgian households using fossil fuels.

The share of total expenditure that needs to be spent on the ETS2 costs at a carbon price of 30 EUR/tCO₂ is highest at 0.5% in the first decile and declines to 0.2% in the tenth decile. This reflects the fact that higher income households can more easily accommodate the extra expenditure and need to spend less of their overall budget. However, this is an average within a decile category, and can hardly be used as such, but requires additional in-depth analysis.

At a carbon price of 60 EUR/tCO₂ (Figure 3-18), the estimated ETS2 costs rise to 210 EUR/year in the first decile and 370 EUR/year in the tenth decile. The share of total expenditure that needs to be spent on ETS2 costs, is equal to 1% in the first decile and then declines to 0.4% in the tenth decile.

Without taking the price reaction of households into account, i.e. assuming a price elasticity of 0 related to the carbon price, the impacts at 60 EUR/tCO₂ are slightly higher by 5 EUR/year in the first decile and 9 EUR/year in the tenth decile.

Figure 3-18 ETS2 costs related to heating for Belgian households at a carbon price of 60 EUR/tCO₂ (only households using fossil fuels)

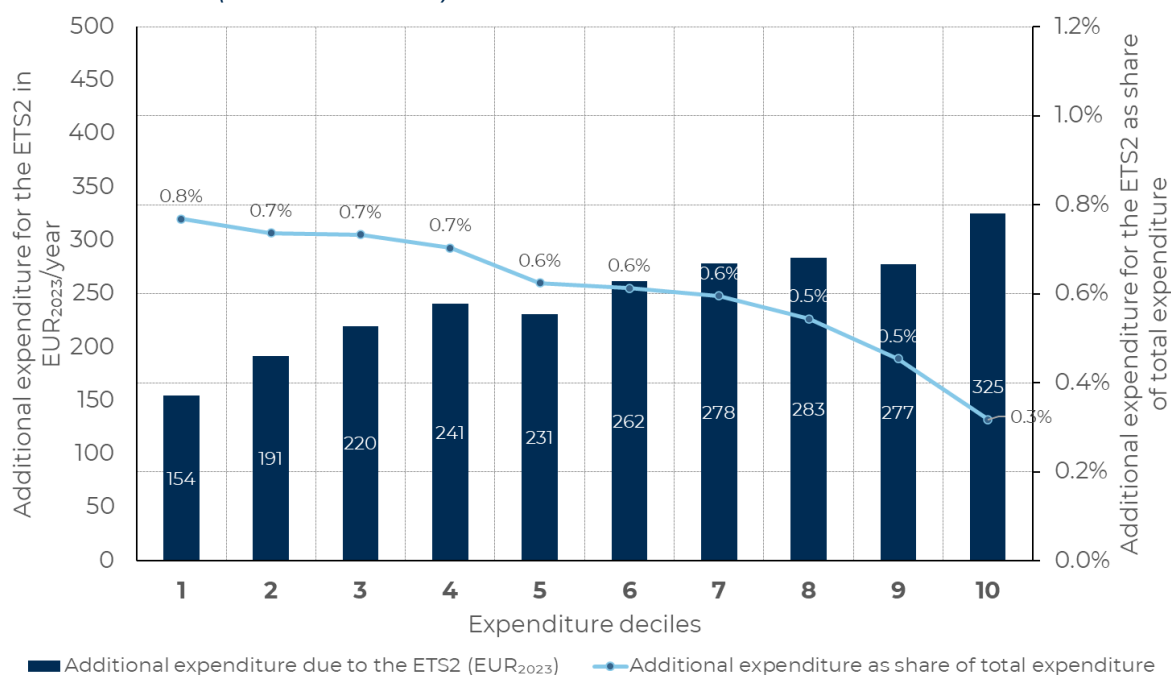


Source: Oeko-Institut SEEK-EU micro model

If all households are included in the analysis, i.e. also those that use heating fuels that will not be directly impacted by the ETS2, such as electricity, biomass, the average impact in the deciles is smaller (Figure 3-19). The distribution of the impact across deciles is similar, reflecting the fact that fossil fuel use is high across all deciles in Belgium.

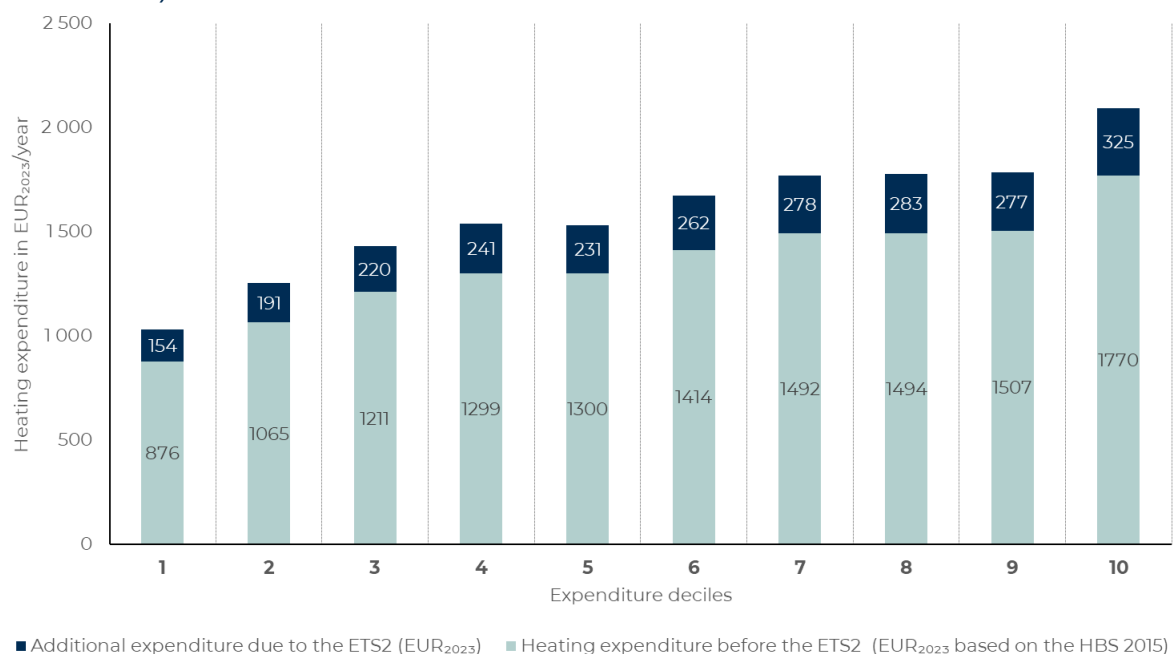
Figure 3-20 compares expected ETS2 costs at a carbon price of 60 EUR/tCO₂ to total heating expenditures based on the HBS 2015 (inflated to EUR₂₀₂₃). In Figure 3-21, both households using fossil fuels (directly affected by the ETS2) and those using district heating, heat pumps, biomass and electric heating are included. At 60 EUR/tCO₂, ETS2 costs are expected to represent about 15% of total heating costs for Belgian households, when expenditure patterns from the EU HBS 2015 are used.

Figure 3-19 ETS2 costs related to heating for Belgian households at a carbon price of 60 EUR/tCO₂ (all households)



Source: Oeko-Institut SEEK-EU micro model

Figure 3-20 ETS2 costs related to heating for Belgian households at a carbon price of 60 EUR/tCO₂ compared to heating costs according to the HBS2015 (all households)



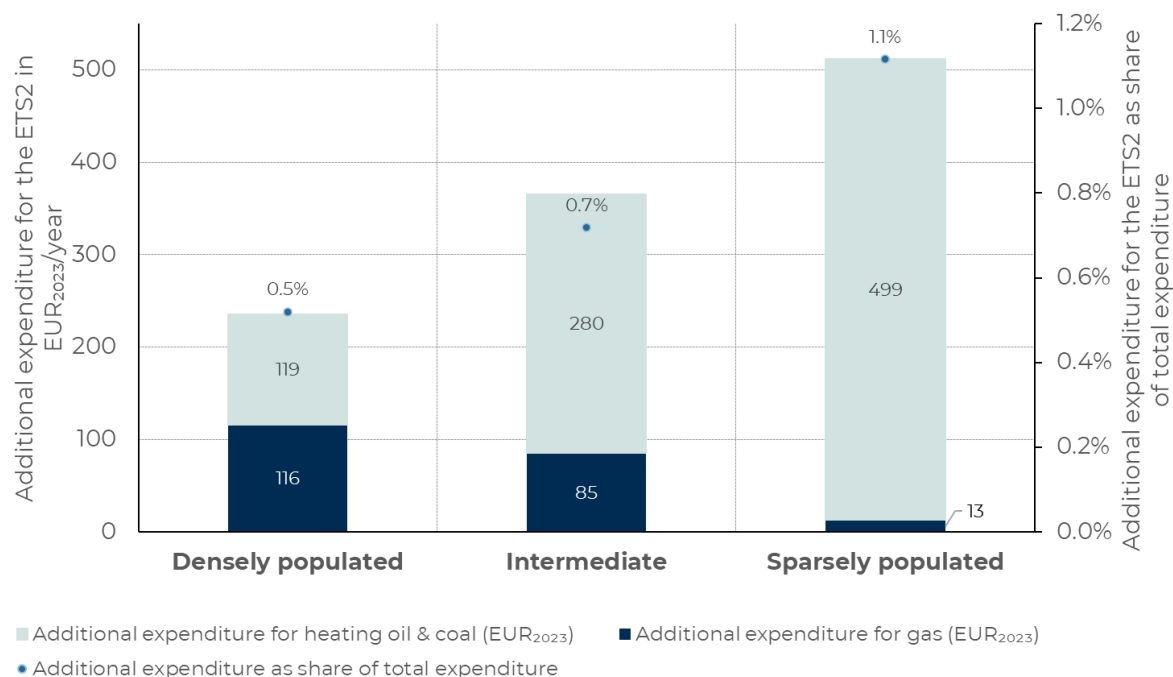
Source: Oeko-Institut SEEK-EU micro model

Note: A value of 1.2607 was applied to inflate expenditures to EUR₂₀₂₃, based on the Eurostat all items HICP [prc_hicp]

Figure 3-21 shows the estimated impact of the ETS2 by degree of urbanisation at a carbon price of 60 EUR/tCO₂ and only for those households using fossil fuels. The

estimated carbon costs are highest for an average household living in a sparsely populated area at 510 EUR/year and smallest for the average household living in a densely populated area at 240 EUR/year. The share of expenditure that needs to be spent ranges from 0.5% in densely populated areas to 1.1% in sparsely populated areas.

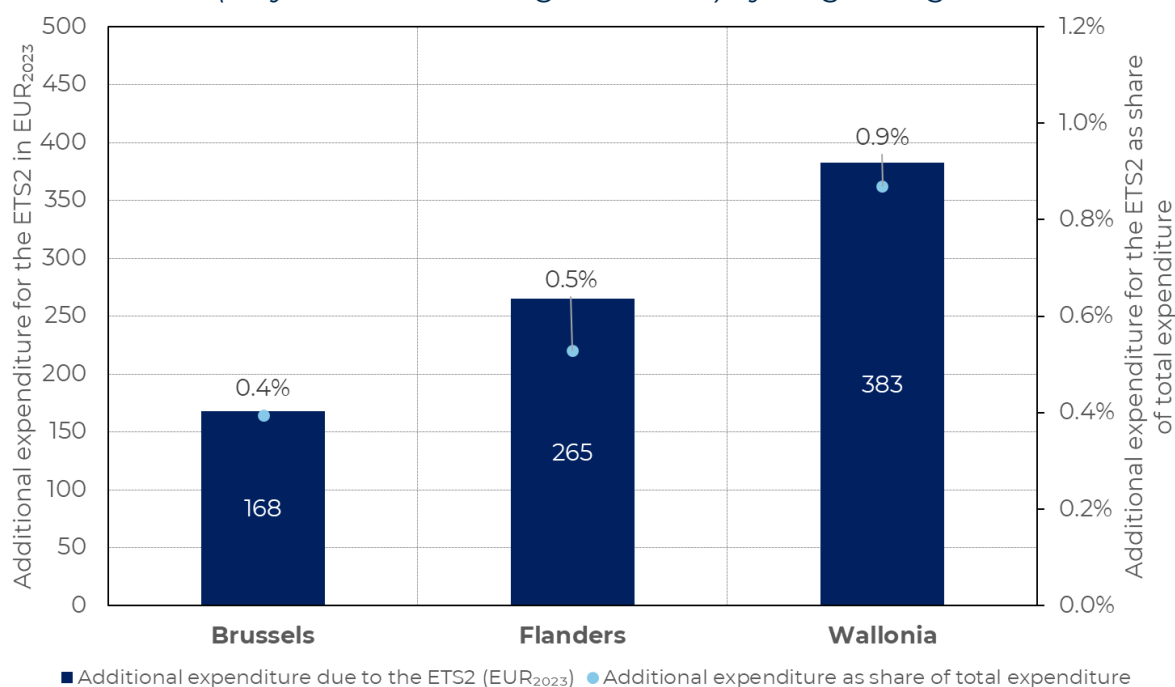
Figure 3-21 ETS2 costs related to heating for Belgian households at a carbon price of 60 EUR/tCO₂ (only households using fossil fuels) by degree of urbanisation



Source: Oeko-Institut SEEK-EU micro model

Figure 3-22 shows the impact for fossil-fuel using households in the Belgian regions. The highest impact both in terms of euros spent and the share of total expenditures to be spent is expected for Wallonia.

Figure 3-22 ETS2 costs related to heating for Belgian households at a carbon price of 60 EUR/tCO₂ (only households using fossil fuels) by Belgian regions



Source: Oeko-Institut SEEK-EU micro model

It is important to keep in mind that the figures show average impacts per decile or per degree of urbanisation and that there are households that experience much higher impacts. Higher impacts are expected at high consumption and high prices of fossil fuels coupled with low incomes, e.g. low income households in buildings with low energy performance and large floor space.

Main take-aways from the micro analysis based on SEEK-EU:

- For the average household in Belgium, the ETS2 impact at prices of 30–60 EUR/tCO₂ lies at around 145–290 EUR/year for households using fossil fuels.
 - This average does not allow to identify precisely the many different situations, with discrepancies, e.g. a single old person living in a rural area in a bad insulated dwelling heated by heating oil will not face the same difficulties as a single-old person living in an apartment heated with natural gas in a city centre and benefiting from the social tariff.
 - Also, income deciles possibly take into account only direct income (depending on the source of data), but not additional rental income when a household owns dwellings and rent them. This will strongly influence the total disposable income, and consequently vulnerability.

- Households with higher income will be more affected in terms of additional euros spent, as they burn more fossil fuels³⁷ (natural gas, heating oil) to heat their homes. However, due to the higher incomes, the relative impact on overall expenditures is lower compared to those for low-income households. Belgian households in the lowest income deciles that use fossil fuels for heating are estimated to spend 0.5–1.0% of their total expenditures on ETS2 costs at prices of 30–60 EUR/tCO₂. These results reflect the average impact on a decile, but does not make a difference between households benefiting or not from a social tariff.
- The analysis by degree of urbanisation shows higher estimated impacts in sparsely populated areas both in terms of the additional costs in euros and the share of total expenditures spent on ETS2 costs. The distribution of impacts is related to the use and the type of fossil fuels (floor area, energy performance of the building and heating system, natural gas vs heating oil), as well as income levels. The type of fossil fuel used also depends on the fact that sparsely populated areas have limited access to gas network and therefore to the social tariff. Household in sparsely populated areas do still have access to the Social Heating Fund if they use heating oil.³⁸
- The highest impact both in terms of euros spent and share of total expenditures to be spent is expected for Wallonia.

3.2.4. Supplementary analysis of ETS2 impacts (study undertaken by Federal Planning Bureau)

The Federal Planning Bureau (FPB) has conducted simulations to assess the impact of ETS2 on Belgian households. These simulations provide insights to inform the Belgian Social Climate Plan, particularly regarding the effects of ETS2 on vulnerable groups. This chapter outlines describes the results for some combinations of variables³⁹.

The ETS2 simulations were conducted using the latest version of EUROMOD (J0.1+), released in September 2024. EUROMOD is a microsimulation model developed by the Joint Research Centre (JRC) of the European Commission. The model runs on SILC data with imputed expenditures from HBS. This imputation is done by the JRC based on sophisticated methods of statistical matching developed for this purpose. The most recent data released by EUROMOD is the 2022 SILC data with computed expenditures from the 2015 HBS. It enables, among other things, the

³⁷ Households with higher incomes burn more fossil fuels, because they heat more according to their needs, while lower income households will maybe restrict heating (e.g. setting temperature at 19 degrees instead of 21). Or they live in bigger homes (floor surface) and thus need to use more energy. These are all assumptions, as higher income households could also live in more insulated homes, thus needing less fossil fuels to heat their home.

³⁸ The Social Heating Fund ('Fonds Social Chauffage'/'Sociaal Stookoliefonds') provides financial assistance to low-income households who use heating oil (like fuel oil, petroleum, propane in bulk) to heat their homes.

³⁹ A separate document produced by the FPB provides a brief overview of the simulations and their limitations.

simulation of reforms in indirect taxes (such as VAT and excise duties) on household expenditures. For ETS2, the model was used to estimate the additional expenditures households would face following the implementation of a carbon tax (modelled as additional excise duties on fossil fuels for heating and transport). Simulations were carried out for the introduction of ETS2 on 1 January 2024 at a price of 60 EUR/tCO₂.

The primary output of the ETS2 simulations in EUROMOD is household expenditures. These are available for a baseline scenario (reflecting the situation on 1 January 2024, before ETS2) and for four ETS2 scenarios (EUR 30, EUR 50, EUR 55 and EUR 60 per ton of CO₂). By comparing household expenditures before and after ETS2, FPB calculates the additional expenditures households would face due to ETS2. These simulations do not consider elasticity, although this should be taken into account in later phases. The model estimates the 'overnight effects' of ETS2 without accounting for adaptations in consumption patterns. Therefore, the results highlight the households that will face the greatest challenges following ETS2. Moreover, similar to the SEEK-EU model presented above, expenditure patterns are based on 2015 data and may not reflect more recent trends, especially following the energy crisis; furthermore, the model is static and does not capture fossil fuel price volatility.

The modelling provides the following outputs or indicators:

- additional household expenditure in ETS2 scenarios (EUR per month or year); and
- additional household expenditure relative to income in ETS2 scenarios (%).

The expenditure indicators resulting from the simulations are calculated for different groups using a range of individual- and household-level variables. These groups are called “persona” as they represent an elaborated household archetype with 1, 2 or 3 characteristics. This enables targeted analyses of specific (potentially vulnerable) groups.

The following graphs represent the average impact on households by equivalised income decile and further distinguishes between expenditures on heating fuels and transport fuels.

The variables are listed below (and are further elaborated by the FBP in its separate note).

Table 3-3 Individual- and household-level variables used to calculate expenditure indicators

Household financial information (table A2)	Demographic and socioeconomic characteristics (table A3)
• Disposable income • Equivalised income decile • Expenditure decile	• Age group (individual and household head) • Gender (individual and household head)

	• Citizenship (individual and household head) • Marital status (individual and household head) • Educational level (individual and household head) • Economic status (individual and household head) • Eligibility to the social tariff
Household composition (table A4) • Number of children • Number of adults • Number of male adults • Number of female adults • Number of male seniors • Number of female seniors • Household size • Household type	Location and housing characteristics (table A5) • Region • Population density • Number of rooms • Housing payment type • Heating fuel type • Car ownership • Cannot afford a car

There are three category levels, which are listed below.

Table 3-4 Categories of variables used to calculate expenditure indicators

	Category level 1	Category level 2	Category level 3
Variables	- Region - Population density - Equivalised income decile - Age group - Gender - Citizenship - Educational level - Economic status - Eligibility social tariff - Household type - Household payment type - Heating fuel type - Car ownership - Cannot afford a car - AROP - Measured energy poverty - Hidden energy poverty - Transport poverty 2M - Transport poverty 11%	- Region - Household type - Population density - Number of adults - Number of children - Gender - Equivalised income decile - Car ownership	- Region - Population density - Number of adults - Number of children

Methodology

Trinomics conducted this analysis based on simulation results provided by the FPB. The following steps have been taken.

- In total, 100 combinations of 1, 2 or 3 variables have been simulated, generating more than 2 700 archetypes (done by the FPB);
- To focus on and analyse the most relevant results, the additional household expenditure relative to income (resulting from the introduction of ETS2) have been ranked from the highest to the lowest. The 13 highest values have been selected for which the sample of the archetype comprised at least 50 households (described below); and
- Graphs corresponding to the selected archetypes have been created to allow comparison of different combinations.

Table 3-5 Combinations of variables from different categories

	Category level 1	Category level 2	Category level 3
1	Transport poverty 2M [yes]	Household type	Population density
2	Transport poverty 2M [yes]	Equivalised income decile	Region
3	Transport poverty 2M [yes]	Car ownership	Region
4	Measured energy poverty [yes]	Household type	Population density
5	Transport poverty 2M [yes]	Household type	Region
6	Measured energy poverty [yes]	Household type	Region
7	Transport poverty 2M [yes]	Equivalised income decile	/
8	Measured energy poverty [yes]	Region	/
9	Transport poverty 11% [yes]	Region	/
10	Transport poverty 11% [yes]	Car ownership	Region
11	Measured energy poverty [yes]	Household type	/
12	Heating fuel type	Household Type	Population density [rural]
13	Heating fuel type	Household Type	Region [Wallonia]

Presentation of the results

Legend of the below graphs

The dots represent the “mean household additional expenditures relative to income (ratio on the right axis). The bars represent the “mean household additional expenditures (EUR/y) on the left axis).

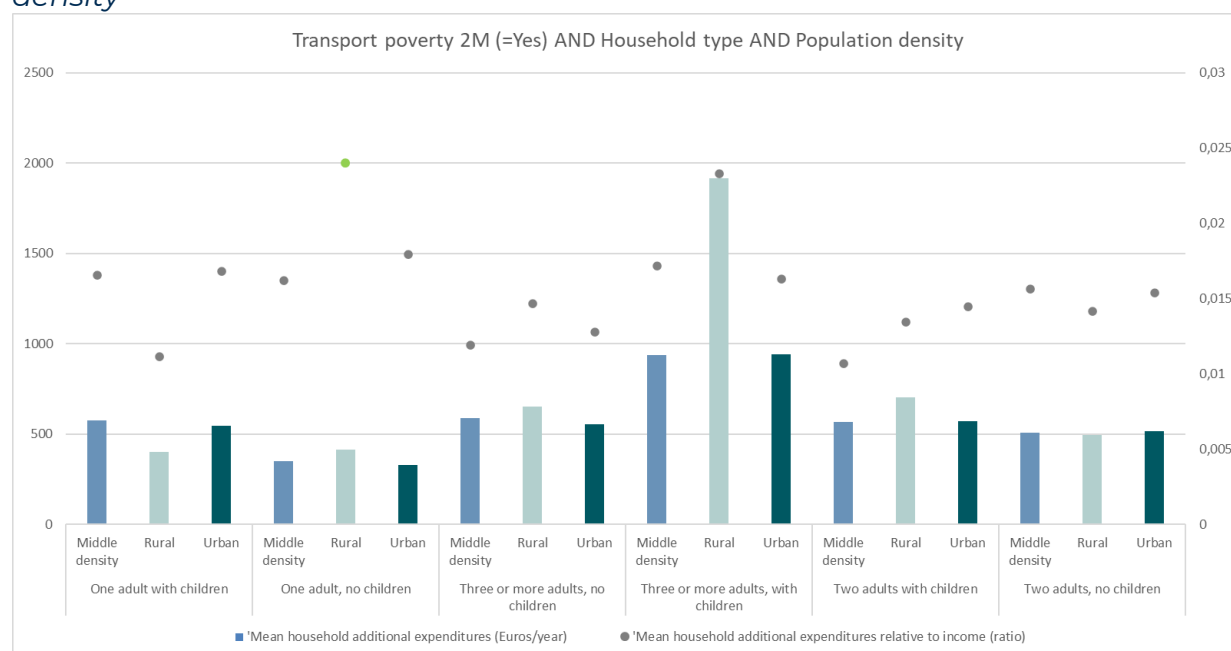
Colours of dots

- Green dot – highest value (not discarded);
- Red dots - values discarded given the too limited sample size;
- Grey dots – all other values

The colours of the bars represent the last variable of the persona (e.g. for the “Transport poverty 2M AND household type AND population density” persona, there are three colours representing middle density, rural and urban areas.

- Two archetypes show a very high increase of their energy and transport expenditure relative to their income: **single person households** in transport poverty 2M living in rural areas with an increase of 2.40% and **households with three or more adults and children** in transport poverty 2M living in rural areas with 2.33%.

Figure 3-23 Additional expenditures per household (in EUR/year and as % of income) for transport poverty 2M (=Yes) AND household type AND population density



Source: Own elaboration, based on simulations made by the Federal Plan Bureau, December 2024

Table 3-6 Combination of variables for the above simulation

Category level 1	Category level 2	Category level 3
Transport poverty 2M	Household type	Population density
Yes	Single person household	Rural areas
Yes	Three or more adults and children	Rural areas

- Two archetypes show a very high increase of their energy and transport expenditure relative to their income: **household in transport poverty 2M in the lowest equivalised income decile** in Wallonia and in Flanders⁴⁰, with 2.37% and 2.27% respectively. The next highest values refer to the second and third deciles, with 2.01% and 1.92% respectively.

⁴⁰ Although Flanders only counts 46 responses, and should therefore be discarded.

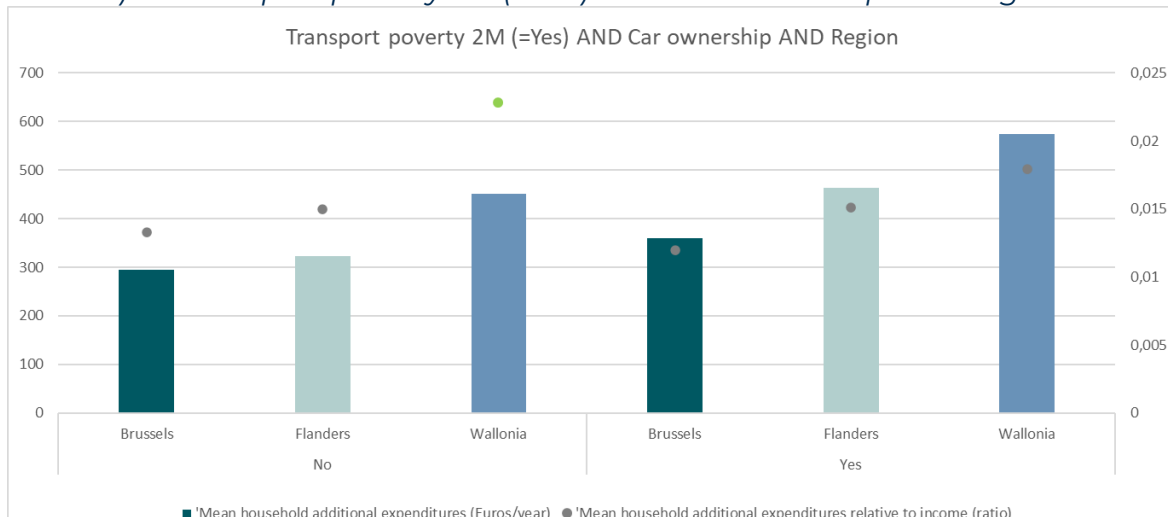
Figure 3-24 Additional expenditures per household (in EUR/year and as % of income) for transport poverty 2M (=Yes) AND equivalised income decile AND region



Source: Own elaboration, based on simulations made by the Federal Plan Bureau, December 2024

3. One archetype shows a very high increase of their energy and transport expenditure relative to their income: **households in transport poverty 2M without car and living in Wallonia** with 2.28%. The next highest value refer to household in transport poverty 2M with a car and living in Wallonia with 1.79%.

Figure 3-25 Additional expenditures per household (in EUR/year and as % of income) for transport poverty 2M (=Yes) AND car ownership AND region

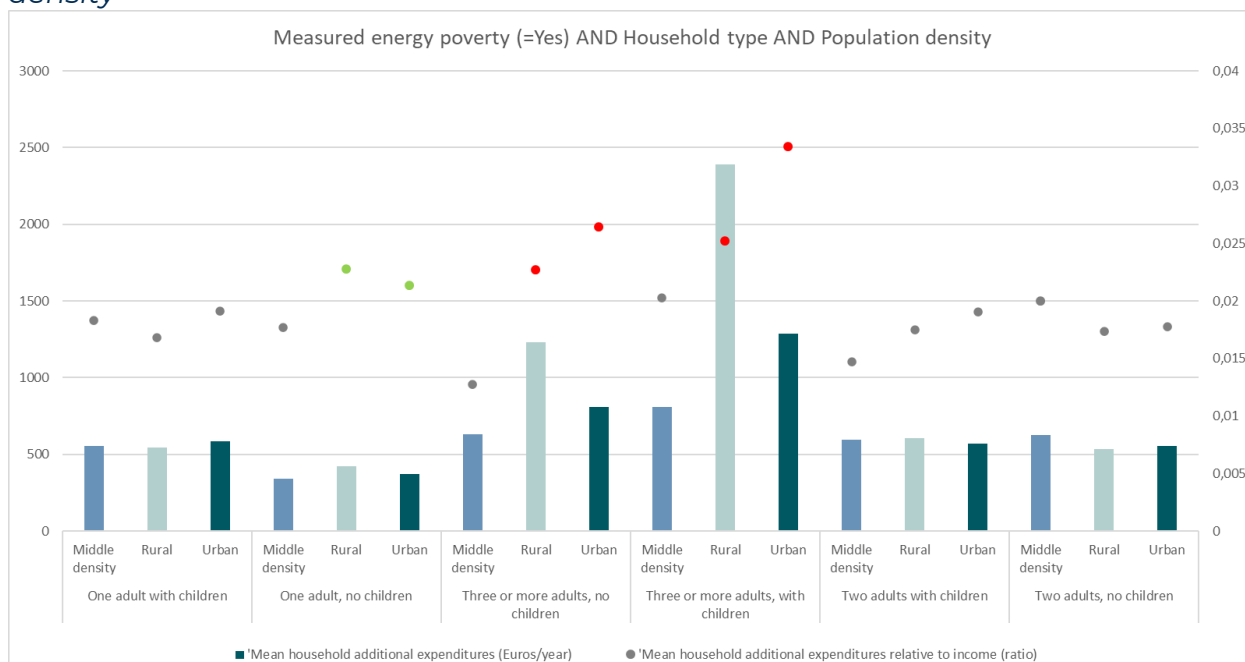


Source: Own elaboration, based on simulations made by the Federal Plan Bureau, December 2024

4. The three highest values (indicated in the graph with orange dots) have to be discarded given the too limited sample size.

Therefore, one archetype shows a high increase of their energy and transport expenditure relative to their income: **single person households** in measured energy poverty 2M living in **rural areas** with 2.28%, followed by single person households living in **urban areas** with 2.13%.

Figure 3-26 Additional expenditures per household (in EUR/year and as % of income) for measured energy poverty (=Yes) AND household type AND population density



Source: Own elaboration, based on simulations made by the Federal Plan Bureau, December 2024

- One archetype shows a very high increase of their energy and transport expenditure relative to their income: **single person households** in transport poverty 2M living in Wallonia with 2.25%; while the next value, households with at **least three adults with children** living in Flanders, has to be discarded (too small sample size).

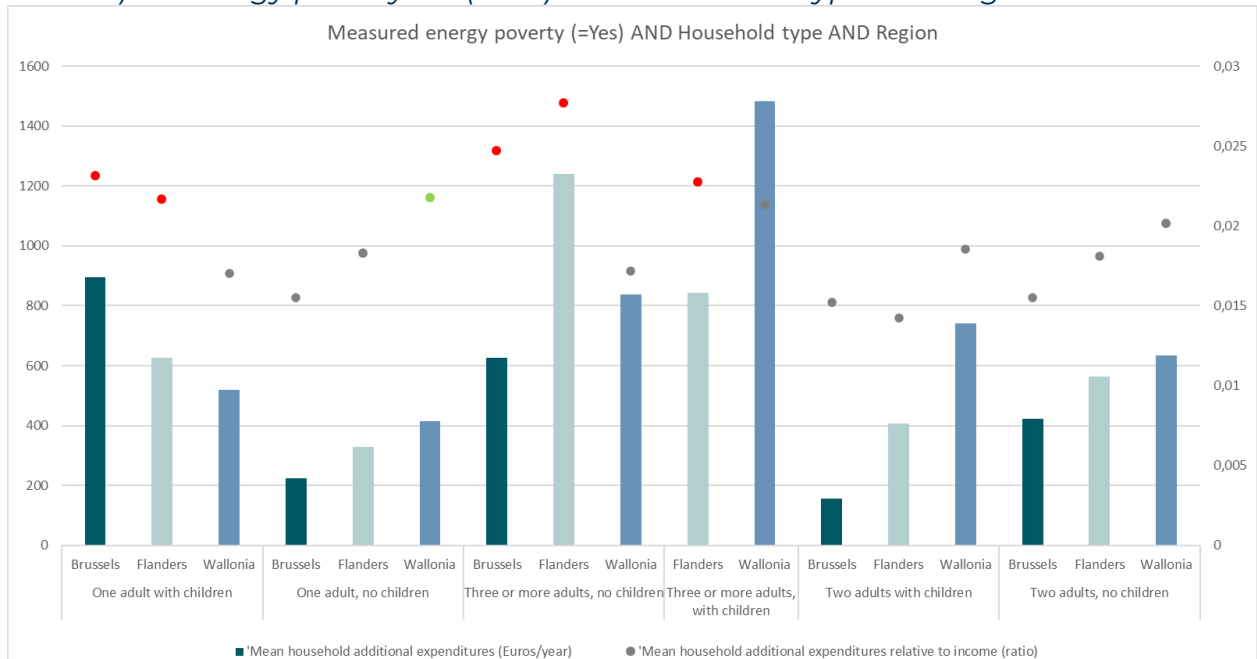
Figure 3-27 Additional expenditures per household (in EUR/year and as % of income) for transport poverty 2M (=Yes) AND household type AND region



Source: Own elaboration, based on simulations made by the Federal Plan Bureau, December 2024

6. One archetype shows a very high increase of their energy and transport expenditure relative to their income: **single person households** in measured energy poverty living in Wallonia with 2.24%, while the next value, single-parent household with children in measured energy poverty living in Flanders, has to be discarded (too small sample size).

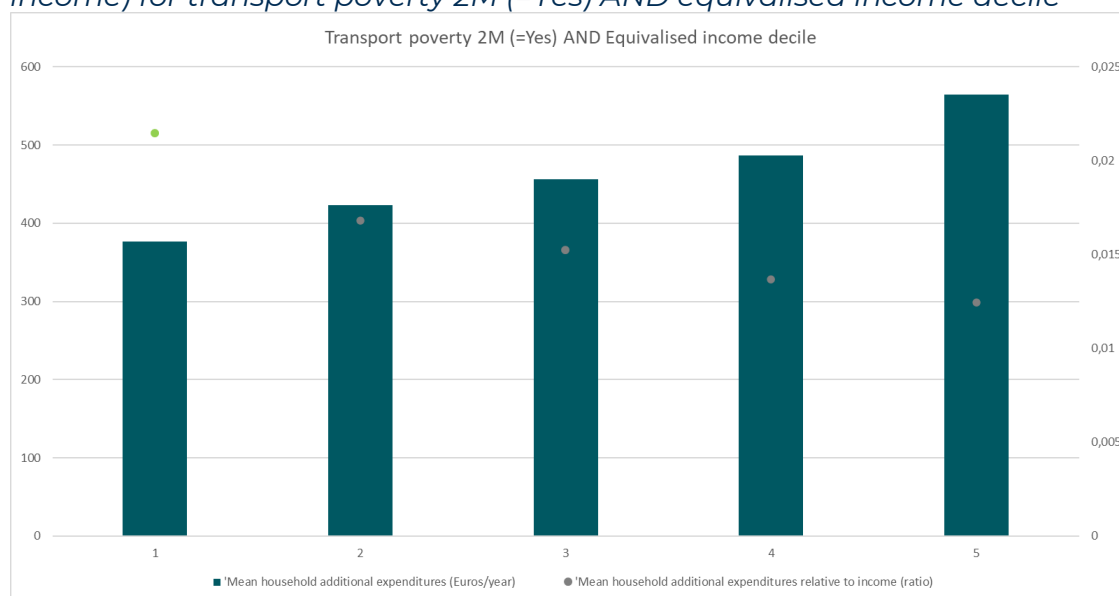
Figure 3-28 Additional expenditures per household (in EUR/year and as % of income) for energy poverty 2M (=Yes) AND household type AND region



Source: Own elaboration, based on simulations made by the Federal Plan Bureau, December 2024

7. One archetype shows a very high increase of their energy and transport expenditure relative to their income: **households in transport poverty 2M** in the **lowest equivalised income** decile with 2.14%. The percentage decreases progressively in higher income deciles.

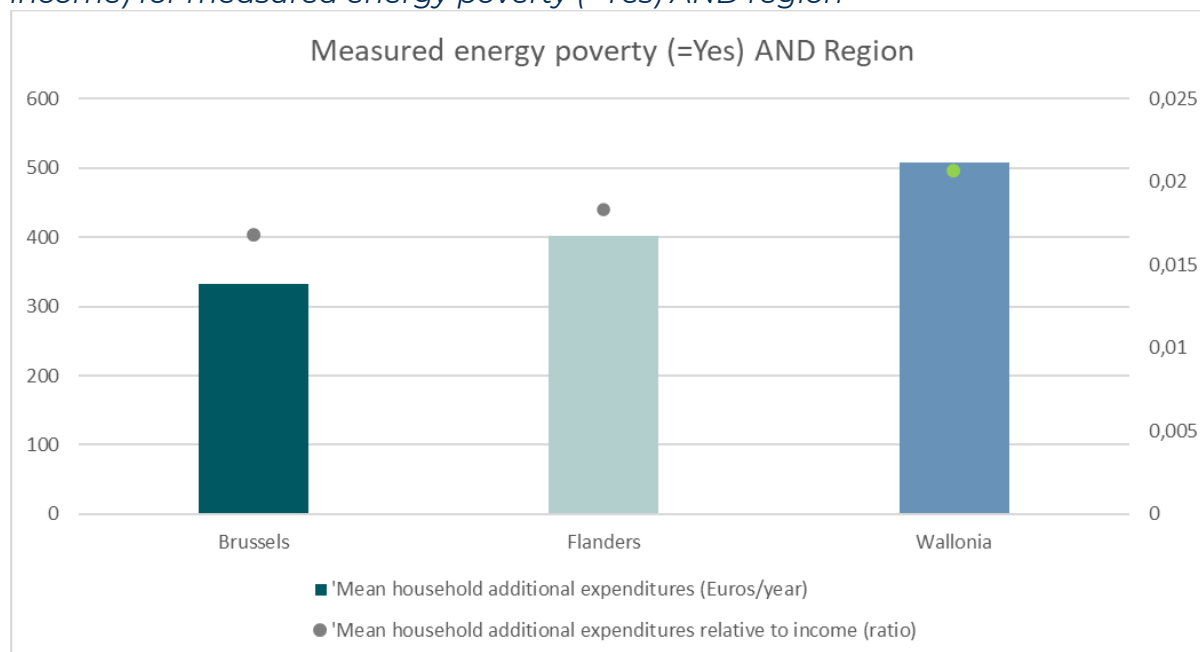
Figure 3-29 Additional expenditures per household (in EUR/year and as % of income) for transport poverty 2M (=Yes) AND equivalised income decile



Source: own elaboration, based on simulations made by the Federal Plan Bureau, December 2024

8. One archetype shows a very high increase of their energy and transport expenditure relative to their income: **households in measured energy poverty living in Wallonia** with 2.07%.

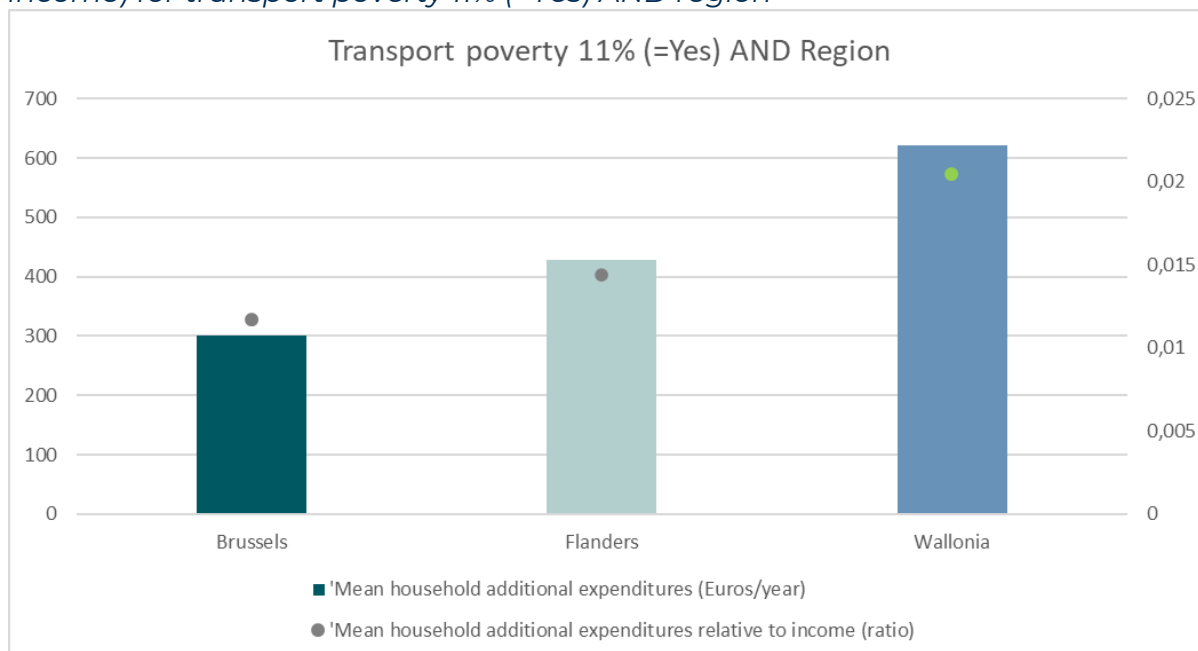
Figure 3-30 Additional expenditures per household (in EUR/year and as % of income) for measured energy poverty (=Yes) AND region



Source: own elaboration, based on simulations made by the Federal Plan Bureau, December 2024

9. One archetype shows a very high increase of their energy and transport expenditure relative to their income: **households in transport poverty 11% living in Wallonia** with 2.04%.

Figure 3-31 Additional expenditures per household (in EUR/year and as % of income) for transport poverty 11% (=Yes) AND region

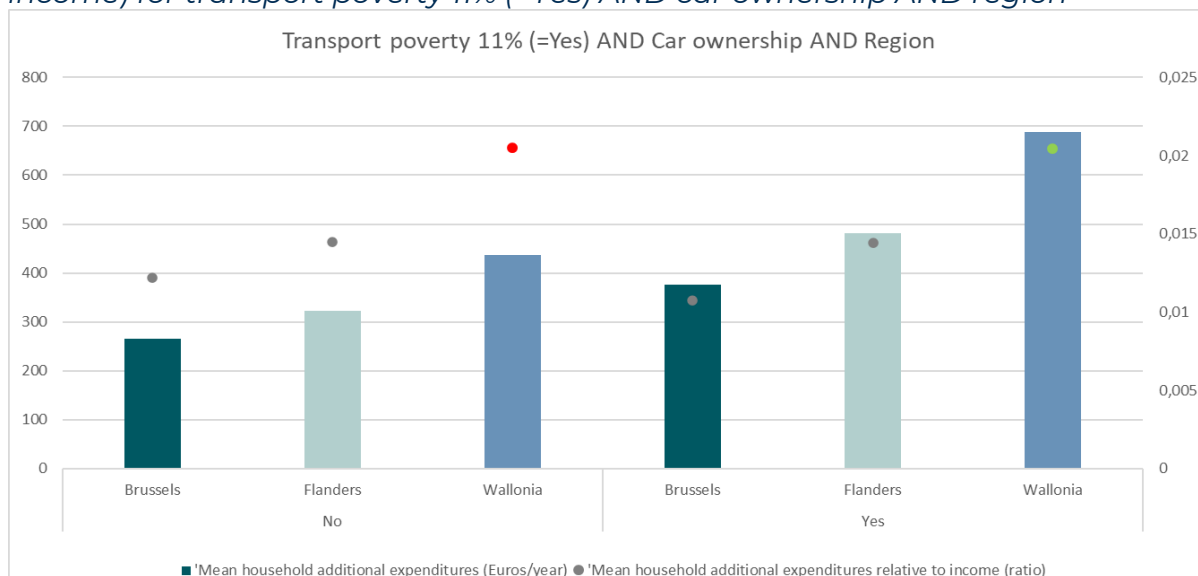


Source: own elaboration, based on simulations made by the Federal Plan Bureau, December 2024

10. The highest value (indicated in the graph with red dot) have to be discarded given the too limited sample size.

One archetype has a very high increase of their energy and transport expenditure relative to their income: **households in transport poverty 11% living in Wallonia with a car** with 2.04%.

Figure 3-32 Additional expenditures per household (in EUR/year and as % of income) for transport poverty 11% (=Yes) AND car ownership AND region

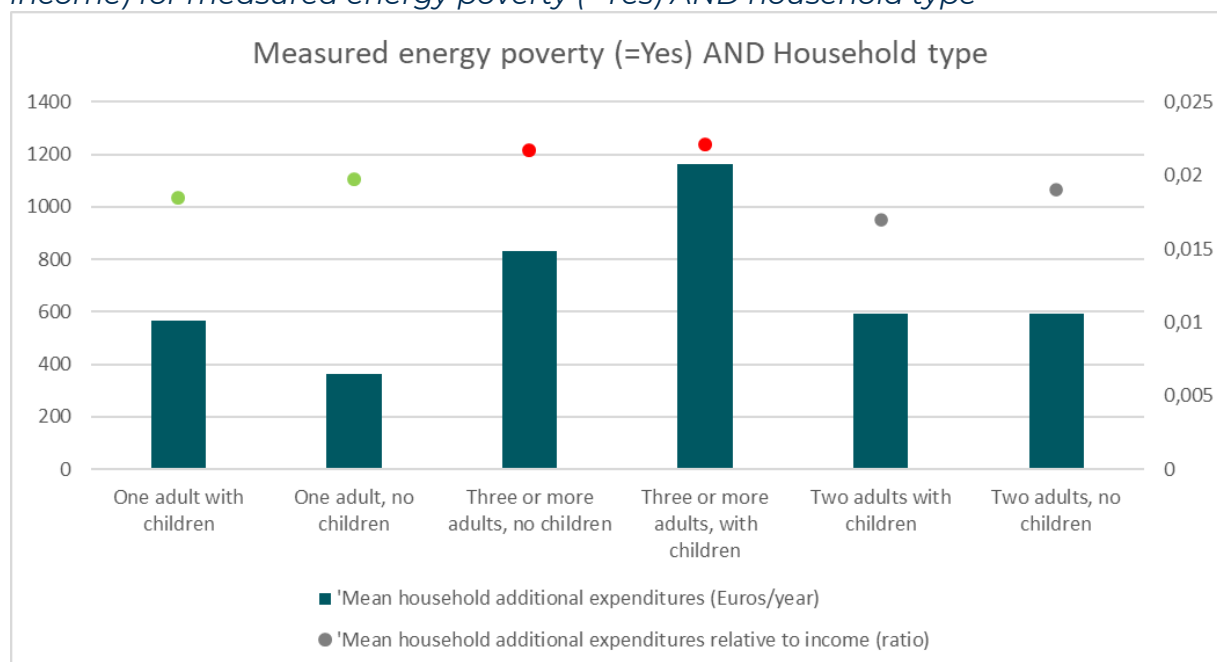


Source: own elaboration, based on simulations made by the Federal Plan Bureau, December 2024

11. The two highest values (indicated in the graph with red dots) have to be discarded given the too limited sample size.

Therefore, two archetypes show a high increase of their energy and transport expenditure relative to their income: **single person and one-parent households with children** households in measured energy poverty with 1.97% and 1.85% respectively.

Figure 3-33 Additional expenditures per household (in EUR/year and as % of income) for measured energy poverty (=Yes) AND household type

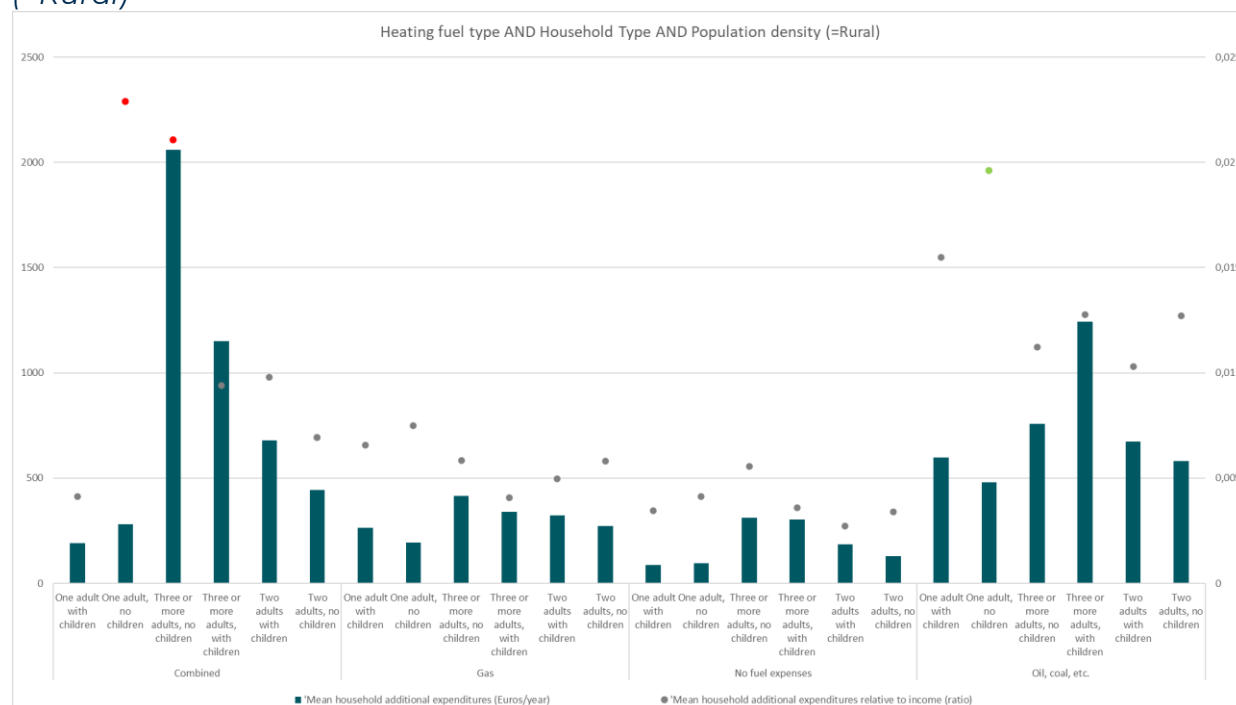


Source: own elaboration, based on simulations made by the Federal Plan Bureau, December 2024

12. The two highest values (indicated in the graph with red dots) have to be discarded given the too limited sample size.

Therefore, one archetype shows a high increase of their energy and transport expenditure relative to their income: **single person households using heating oil and living in rural** areas with 1.96%. This is closely followed by single person households using heating oil in urban areas with 1.91% (not shown on the graph below, which only includes rural areas).

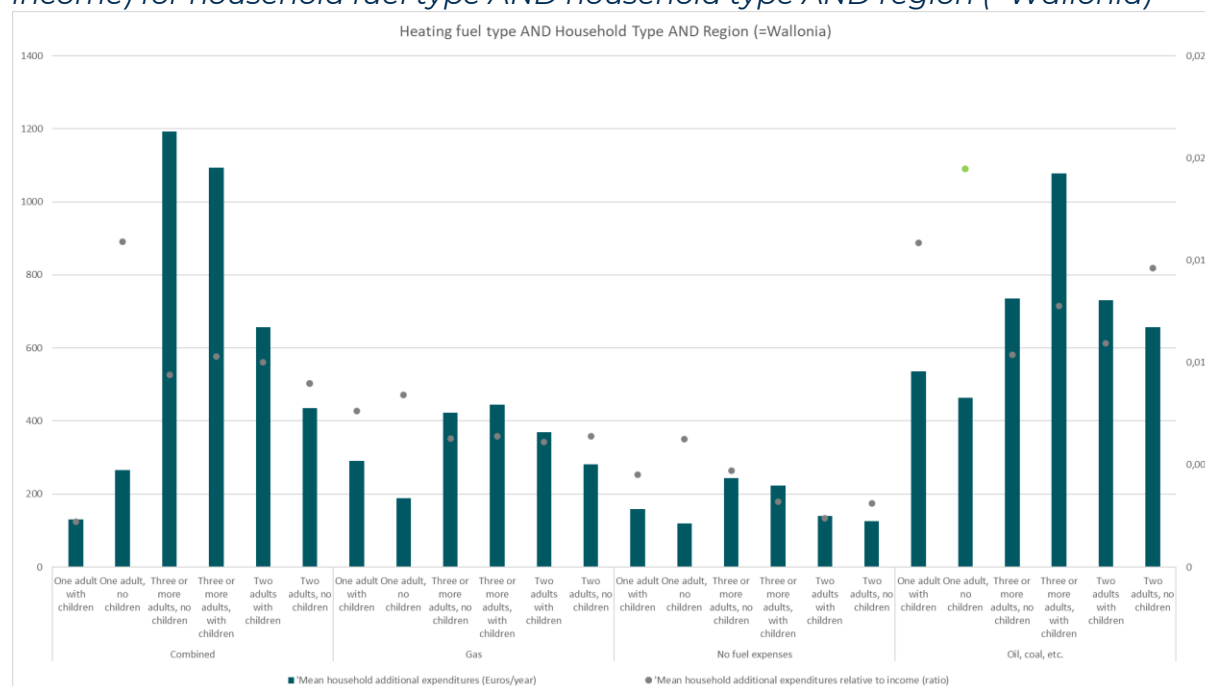
Figure 3-34 Additional expenditures per household (in EUR/year and as % of income) for household fuel type AND household type AND population density (=Rural)



Source: own elaboration, based on simulations made by the Federal Plan Bureau, December 2024

13. One archetype shows a high increase of their energy and transport expenditure relative to their income: **single person households** using **heating oil and living in Wallonia** with 1.95%.

Figure 3-35 Additional expenditures per household (in EUR/year and as % of income) for household fuel type AND household type AND region (=Wallonia)



Source: own elaboration, based on simulations made by the Federal Plan Bureau, December 2024

Key findings

REM: as reminder, the percentages shown in the graph above refer to the increase in expenditures relative to income.

Key findings are:

- ETS2 impact is the highest on single person households in measured energy poverty living in rural areas, closely followed by one-parent households in rural areas.
- ETS2 impact is the highest on single person households in measured energy poverty.
- ETS2 impact is the highest on households in measured energy poverty living in Wallonia (2.07% vs 1.83% in Flanders and 1.67% in Brussels).
- Single person households using heating oil and living in rural areas are a vulnerable group (the first one without link to a “poverty” variable).
- Single person households using heating oil and living in Wallonia are another vulnerable group.

Additional comments

- Single-person households are the most represented in the different archetypes, across all combinations. One-parent households are also represented, but to a lesser extent, while households with three or more adults are regularly included, either with or without children (which does not allow to draw specific conclusions).
- For Brussels, several samples are not large enough to allow their selection for the concerned archetypes, leading to discard multiple first occurrences (highest values) of households living in Brussels. Consequently, the first archetype that can be considered (not discarded) relates to transport poverty (2M) from the lowest income decile, living in Brussels, with a value of 1.46%. This expenditure increase is however higher in the 2 other regions (see above). Thereafter, the next highest values of households in Brussels refer to single person households using heating oil (1.41%), all households using oil (1.36%), followed by households in transport poverty (2M) (1.29%).

Conclusions based on these simulations

- Single person households, particularly those living in rural areas, are among the most impacted.
- One-parent households with children are also a highly impacted group.
- Households using heating oil are among the most impacted.

3.2.5. Supplementary analysis of impacts

From the modelling results, the assessment of the persona/archetypes, and the various sources, several different household profiles can be considered as vulnerable to fossil energy consumption for heating. There are also several overlaps, e.g. single-parent households using heating oil might fall under the

lowest income deciles and consequently could be counted twice if we use both parameters separately. In addition, several key drivers - which are not included in the modelling as no data were collected, but have a direct influence on the vulnerability of the groups - are analysed.

This chapter presents:

- **preliminary considerations** – It lists the main constraints that need to be considered;
- the **main categories** that could be used to address relevant vulnerable group options; and
- the **key drivers** that are embedded in the persona of households.

Preliminary considerations

- Low income households can have other income sources that are not included in the datasets, e. g. from renting dwellings or from their financial savings.
- It would be relevant to assess further how income deciles are correlated to the energy performance of the dwelling occupied by the concerned households, and whether they have the financial means to renovate^{41,42,43}.
- Budgetary elasticity of single-parent households is lower, especially if another parent does not contribute to the children's costs.
- In response to the stakeholder survey (22 November – 6 December 2024), a stakeholder highlighted that “we need to take into account the overall income of households in relation to the number of people (minors and adults) who are dependent”.
- According to a report of the National Bank of Belgium⁴⁴, households in the lower income quartiles that are not entitled to the social energy tariff are experiencing above-average inflation, having had to spend relatively more on increased gas and electricity bills than households in medium and higher income quartiles. However, most households in the lowest income quartile benefited from the social energy tariff.
- Only a minority of social housing units are energy performant.
- Tenants in well renovated social housing are better protected from ETS2 impacts, than households in badly insulated social housing. In those cases, low rents can help tenants to pay their (high) energy bills. Households that

⁴¹ CRB. (2023). Advies: Renovatie van het residentiële huurbestand en van de mede-eigendommen. <https://www.ccecrb.fgov.be/p/nl/1051/renovatie-van-het-residentiele-huurbestand-en-van-de-mede-eigendommen>.

⁴² Steunpunt Wonen. (2024). Woonsurvey 2023: eerste resultaten voor de basisindicatoren. https://steunpuntwonen.be/wp-content/uploads/2024/03/2024_11_14_Nieuwsbericht_notas_Woonsurvey-2023.pdf. (available in Dutch).

⁴³ Statbel. (2021). Meer dan 4,5 miljoen Belgen niet in staat om te sparen. <https://statbel.fgov.be/nl/nieuws/meer-dan-45-miljoen-belgen-niet-staat-om-te-sparen>.

⁴⁴ National Bank of Belgium. (2022). Report 2022 – Preamble, Economic and Financial Developments, Regulation and Prudential Supervision. https://www.nbb.be/doc/ts/publications/nbbreport/2022/en/t1/report_2022_t1_complet.pdf.

meet the criteria to have access to social housing but are deprived of it, have to rent on the private market at higher prices which may increase their sensitivity to energy poverty.

- A tenant receiving a social integration income will find it more difficult to rent an energy performant flat or house than a household with a higher income.

Main categories of vulnerable groups based on key drivers

The list of vulnerable (sub)groups, based on the persona (profile archetype, responding to a series of well-defined characteristics), will be characterised to group them comprehensively along the following key variables.

- **On income** – reflects to which extent it addresses the lowest deciles compared to the higher ones.
- **On payment type** – shows the difference between tenant and owner (with or without mortgage).
- **On household type** – focus on single person and one-parent with children households.
- **On population density** – highlights whether rural areas are more sensitive to energy poverty than urban areas.
- **On fuel type** – shows the differences between households using heating oil and natural gas.
- **On dwellings with leaking roof, damp walls, floors or foundation, or rot in window frames or floor** – as overall group.

CATEGORY 1 - Income

The share of total expenditure that households need to spend on the ETS2 costs for heating their dwelling at a carbon price of 60 EUR/tCO₂ is highest at almost 1% in the first income decile and declines to 0.9% in the third decile. This high impact is confirmed by the macroeconomic modelling results which take into account fuel expenses but also the costs of renovation with heating system replacement and investment in building insulation (see Chapter 3.5). Including these additional costs increases the slope decrease from low to higher deciles, emphasising the importance to pay first attention to the three lowest income deciles, which **means 30% of the population**.

Specific data collection constraints that will influence the size of the vulnerable group are:

- additional income that may not be taken into account;
- the possible benefit from a social energy tariff; and
- the possible benefit from a (very) low rent in social housing.

CATEGORY 2 – Payment type

Tenants are significantly more vulnerable to energy poverty: 45.5% of social tenants and 33.0% of tenants in the private sector are affected by energy poverty,

compared to 15.0% of owners. In 2021, 64.5% of conventional housing in Belgium was owner-occupied, according to Statbel figures⁴⁵. This means that **35.5% of households are tenants**, with an important discrepancy between apartments (30.6% owner-occupied) and houses (82.1% owner-occupied).

Specific data collection constraints that will influence the size of the vulnerable group are:

- the possible benefit from a social energy tariff; and
- the possible benefit from a (very) low rent in social housing.

CATEGORY 3 – Household type

In 2021 (Statbel, 2024)⁴⁶, about half of the Belgian population lived in a household consisting of a couple with children, and just over 20% lived in a two-parent household without children. **Single people households represent 15.6% of the population**, and single-parent households represent **11.3%**.

Specific data collection constraints that will influence the size of the vulnerable group are:

- additional incomes that may not be taken into account;
- the possible benefit from a social energy tariff;
- the possible benefit from a (very) low rent in social housing; and
- the financial situation (savings, mortgage) of the households.

CATEGORY 4 – Population density

The number of occupied traditional dwellings in Belgium stands at 4.9 million, almost 385 000 more than in 2011, of which 57% are located in Flanders, 32% in Wallonia and 11% in Brussels-Capital. This distribution is similar to that of 2011⁴⁷.

The following graph shows that Brussels is very densely populated, while Flanders is a mix between highly dense urban and more rural areas, and Wallonia is by far the less densely populated region although counting a few densely populated cities and zones in the North.

⁴⁵ Statbel. (2024). 71% des logements des années 80 sont occupés par leur propriétaire.

<https://statbel.fgov.be/fr/themes/census/logement/regime-de-propriete>.

⁴⁶ Statbel. (2024). Composition de la population vivant dans des ménages privés en 2021.

<https://statbel.fgov.be/fr/themes/census/menages-et-noyaux/menages>.

⁴⁷ Statbel. (2021). Type de logement. <https://statbel.fgov.be/fr/themes/census/logement/type-de-logement>.

Picture 3-1 Population density (in number of occupied housing) in Belgium



Source: [Statbel – Type de logement](#)

CATEGORY 5 - Fuel type

Households that heat mainly with natural gas are less affected by energy poverty, than those that heat mainly with electricity or **heating oil**; 19.1% of households that heat mainly with gas are in energy poverty compared to 27.8% of those that heat mainly with fuel oil. ETS2 is expected to amplify this further.

Also, households using heating oil do of course not qualify for the social gas tariff⁴⁸, although they can access the social heating fund⁴⁹, which is limited while the social gas tariff takes into account the whole consumption. Households benefiting from the social gas or electricity tariff may also use the Fonds Energie in case of financial difficulties to pay their energy bill.

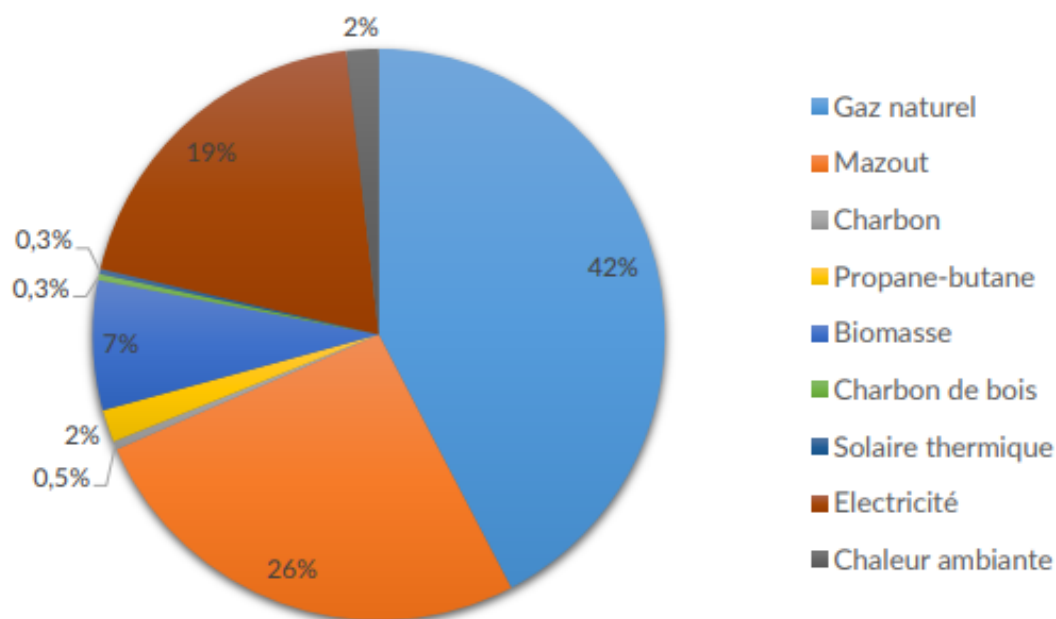
A proxy of fuel type is the link with the degree of urbanisation. Considering the two main energy fuels, i.e. heating oil and natural gas, households in urban areas are mainly supplied with natural gas, while heating oil (and to a certain extent propane and butane) is the only option in rural areas.

Figure 3-36 shows the distribution of the energy consumption of households in the residential sector in Belgium.

⁴⁸ As a reminder, there is a social tariff for gas and electricity but not for other vectors.

⁴⁹ Verwarmingsfonds. (n.d.). Social Verwarmingsfonds. <https://www.verwarmingsfonds.be/>.

Figure 3-36 Final energy consumption per energy source in the residential sector in Belgium in 2021



Source: [FPS Economy \(2023\)](#)

Note: Electricity is out of scope (already covered by ETS), while biomass (wood) is considered carbon neutral (and consequently not subject to ETS2).

There are important differences in the fuel mix between the regions and between rural and urban areas.

CATEGORY 6 – Leak, damp & rot dwellings

Increasing the energy performance of the housing stock could also be driven by the need to improve health conditions for those households living in dwellings with leaking roof, damp walls, floors or foundation, or rot in window frames or floor. The most impacted households are living in urban areas, and are situated in the two lowest income deciles.

Key drivers

Building performance

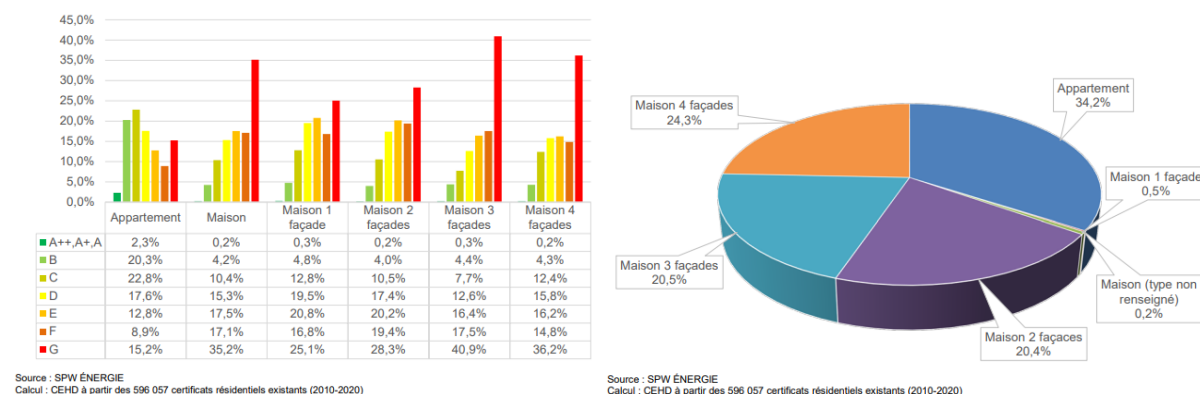
The energy performance of the building stock is a key parameter to consider when developing measures targeting the most impacted groups. It can be assumed that the groups identified today as the most vulnerable and the most impacted by ETS2 live in dwellings with poor energy performance. However, this cannot be objectively demonstrated by the statistics, as data on energy consumption is not regularly collected in existing household surveys.

Hence, the measures considered in the SCP should first focus on the worst performing buildings, as their renovation offers the highest energy savings and consequently benefits for their occupiers, of which a large share is assumed to be vulnerable.

in Flanders, dwellings with low EPB values could be identified using the EPB database⁵⁰, although every dwelling has not yet an EPB value. Similarly to Flanders, in Brussels, EPCs are also centralised and accessible⁵¹.

For Wallonia, the following figures illustrate the distribution of the level of energy performance per dwelling type (left) and the distribution of certified dwellings per dwelling type (right).

Figure 3-37 Distribution of energy performance level per dwelling type (left) and distribution of energy certified dwelling per dwelling type (right)



Source: [Service Public Wallonie - Logement \(2021\)](#)

Social energy tariff

A social gas tariff currently protects to some extent gas consumers, while households using heating oil can benefit from a specific allowance but do not have the same social protection as gas consumers.

At the end of 2020, about 10% of households in Belgium benefited from the social tariff (electricity and/or natural gas), with just over 300 000 protected customers for gas⁵².

3.2.6. Summary of vulnerable groups characterisation

Belgium currently counts 11.76 million inhabitants⁵³ and 5.16 million households.

Multiple vulnerability factors have been identified, such as low-income (3 lowest income deciles), using heating oil, poor energy performing dwellings, single person households, one-parent households, living in rural areas.

⁵⁰ Vlaanderen. (n.d.). Energieprestatiedatabank. <https://www.vlaanderen.be/epb-pedia/werken-als-verslaggever/energieprestatiedatabank>.

⁵¹ Environment Brussels. (2025). Le registre des certificats PEB des logements bruxellois. <https://environnement.brussels/pro/outils-et-donnees/sites-web-et-outils/le-registre-des-certificats-peb-des-logements-bruxellois>.

⁵² FEBEG. (2020). Elargissement des catégories de bénéficiaires du tarif social pour l'électricité et le gaz. <https://www.febeg.be/fr/nouvelles/elargissement-des-categories-de-beneficiaires-du-tarif-social-pour-lelectricite-et-le-gaz>.

⁵³ Statbel. (2024). La Belgique comptait 11.763.650 habitants au 1er janvier 2024. <https://statbel.fgov.be/fr/nouvelles/la-belgique-comptait-11763650-habitants-au-1er-janvier-2024>.

The following aspects characterise energy poor or vulnerable households in Belgium.

1. **Income level:** Energy poor households often belong to the 3 lowest income deciles, with yearly incomes less than EUR 3 058 (gross salary)⁵⁴ This financial strain is higher when the energy bill is higher.
2. **Rental:** there are different types of tenants: those who have a low income are vulnerable and mostly live in poor quality dwellings while tenants with higher income live in better quality dwellings.
3. **Single person and one-parent households:** with single people households representing 15.6% of the population, and 11.3% are part of a single-parent household.
4. **Population density:** dwellings located in rural areas, will on average be more impacted by ETS2. The pressure increases with transport vulnerability.
5. **Heating source:** Households using heating oil have been identified as a vulnerable group in relation to impacts of ETS2. Approximately 1.3 million households are still using heating oil in Belgium. Assuming an equal distribution across income deciles⁵⁵ would lead to around 402 000 of these being low-income households. Mainly rural areas are concerned, but heating oil is also to some extent still used in densely populated areas.
6. **Leak, damp, rot dwellings (poor quality dwellings):** These dwellings are mainly occupied by low income households, and show to be highly impacted by ETS2 mainly in Wallonia and in the two first income deciles. Using these parameters could help narrowing down the vulnerable group further.
7. **Energy performance:** The impact of ETS2 will be higher on dwellings with a poor energy and general quality performance. The likelihood of a dwelling being oil-heated and less energy performant increases with its age. Typically, residents in these buildings are older which might decrease their capability or willingness to renovate.
8. **Social tariff:** In the low income deciles, households without specific social protection (i.e. using heating oil, and without social energy tariff) will be highly exposed to the impacts of ETS2. However, this has not been analysed as part of the modelling approach and can hence not be verified. In addition, households that benefited from increased compensation for health care costs⁵⁶, who were given an extension of the social tariff during the 2022 energy crisis may be another group at risk.

⁵⁴ Statbel. (2024). Le salaire mensuel brut moyen s'élève à 4 076 euros.

<https://statbel.fgov.be/fr/themes/emploi-formation/salaires-et-cout-de-la-main-doeuvre/salaires-mensuels-bruts-moyens>.

⁵⁵ We have no references to demonstrate this, this is a very simplistic assumption.

⁵⁶ FPS Economy. (2024). Tarif social pour l'énergie pour les personnes bénéficiant d'une intervention majorée. <https://economie.fgov.be/fr/themes/energie/energie-sociale/tarif-social-pour-lenergie/tarif-social-pour-lenergie>.

3.3. Impacts of ETS2 on transport poverty and vulnerability

3.3.1. Impact of the ETS on the number of vulnerable transport users

The modified 2M indicator, for which results are shown in this Chapter focusses on the affordability dimension of transport poverty and vulnerability, as we use it to investigate vulnerability to the ETS2 – a price instrument. The dimensions of the availability of transport and the accessibility of essential services are, however, equally important in defining transport poverty⁵⁷. We acknowledge this by showing a whole range of transport poverty indicators in this report⁵⁸.

Figure 3-38 shows the share of the Belgian population deemed vulnerable to transport poverty and particularly vulnerable to the introduction of ETS2 according to the modified 2M indicator (see Chapter 2.2.2). For Belgium, the median related to costs for petrol, diesel and recurring expenditures for public transport is equal to 2.8% and the 2M threshold 5.6%. We show both:

- the share of the household population (What percentage of all Belgian households is deemed vulnerable to transport poverty and particularly vulnerable to the introduction of ETS2?); and
- the share of the overall population (What share of the overall Belgian population do the persons living in these households represent?).

The share of the population deemed vulnerable to transport poverty and particularly vulnerable to the introduction of ETS2 is shown before the introduction of the ETS2, here shown at a price of 0 EUR/tCO₂, indicating the share of households deemed vulnerable based on their expenditures for transport fuels in the HBS 2015 (see Table 2-4). We also show the share of households and individuals vulnerable to transport poverty and particularly vulnerable to the introduction of ETS2 for ETS2 prices of 30 EUR/tCO₂, 50 EUR/tCO₂, 55 EUR/tCO₂ and 60 EUR/tCO₂. The share of vulnerable households in Belgium is estimated at 10–12%, the share of the total population is estimated at 11–13.5%.

This analysis, and other modelling results presented in this chapter, consider the impacts of ETS2 in terms of additional energy costs for different carbon prices. The impacts are estimated based on transport costs as presented in Chapter 1. Most of the households and individuals deemed vulnerable to the introduction of the ETS2 are identified even at carbon prices of 0 EUR/tCO₂, indicating they are vulnerable based on their expenditures for petrol and diesel even before any carbon price is added, i.e. EUR 30, EUR 50, EUR 55 and EUR 60 per tonne of CO₂.

The fact that a larger share of the total population is deemed vulnerable to transport poverty and particularly vulnerable to the introduction of ETS2 reflects

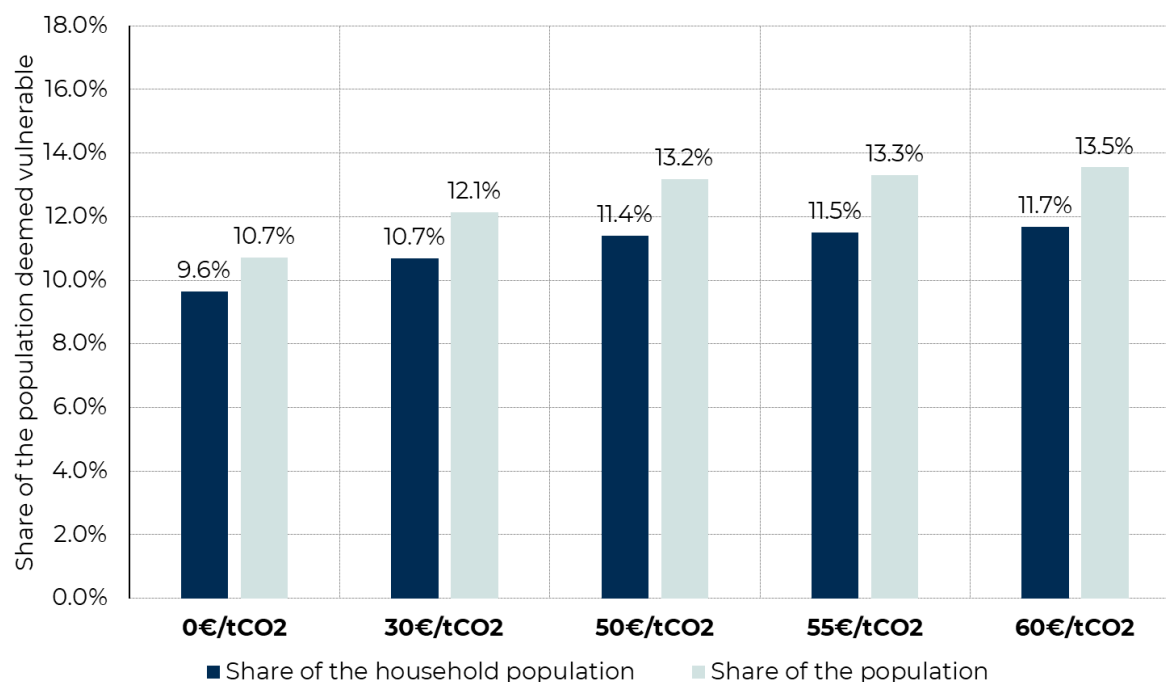
⁵⁷ European Commission. (2024). Transport poverty: definitions, indicators, determinants, and mitigation strategies.

<https://ec.europa.eu/social/main.jsp?catId=738&langId=en&pubId=8651&furtherPubs=yes>.

⁵⁸ At the EU-level, the data situation is challenging related to estimating indicators of availability and accessibility. In some countries, relevant national and local level data is available.

the fact that more households with many household members are affected (this is also reflected by the fact that the difference between both indicators increases with rising CO₂ prices, from 1.4% at 30 EUR/tCO₂, and 1.8% at 60 EUR/tCO₂).

Figure 3-38 Share of the Belgian household population and share of the total population vulnerable to transport poverty and particularly vulnerable to the introduction of ETS2



Source: Oeko-Institut SEEK-EU micro model

Usually, households with more children have to drive to more various places (school, activities, shopping, ...), and therefore rely more on individual cars to drive longer distances. This factor is important for the accessibility dimension of transport poverty.

Takeaways

- With a CO₂ price at 60 EUR/tCO₂, 11.7% of the Belgian household population are vulnerable to transport poverty and particularly vulnerable to the introduction of ETS2;
- Comparing the share between population and household population, it appears that households with many household members are more affected than smaller households.

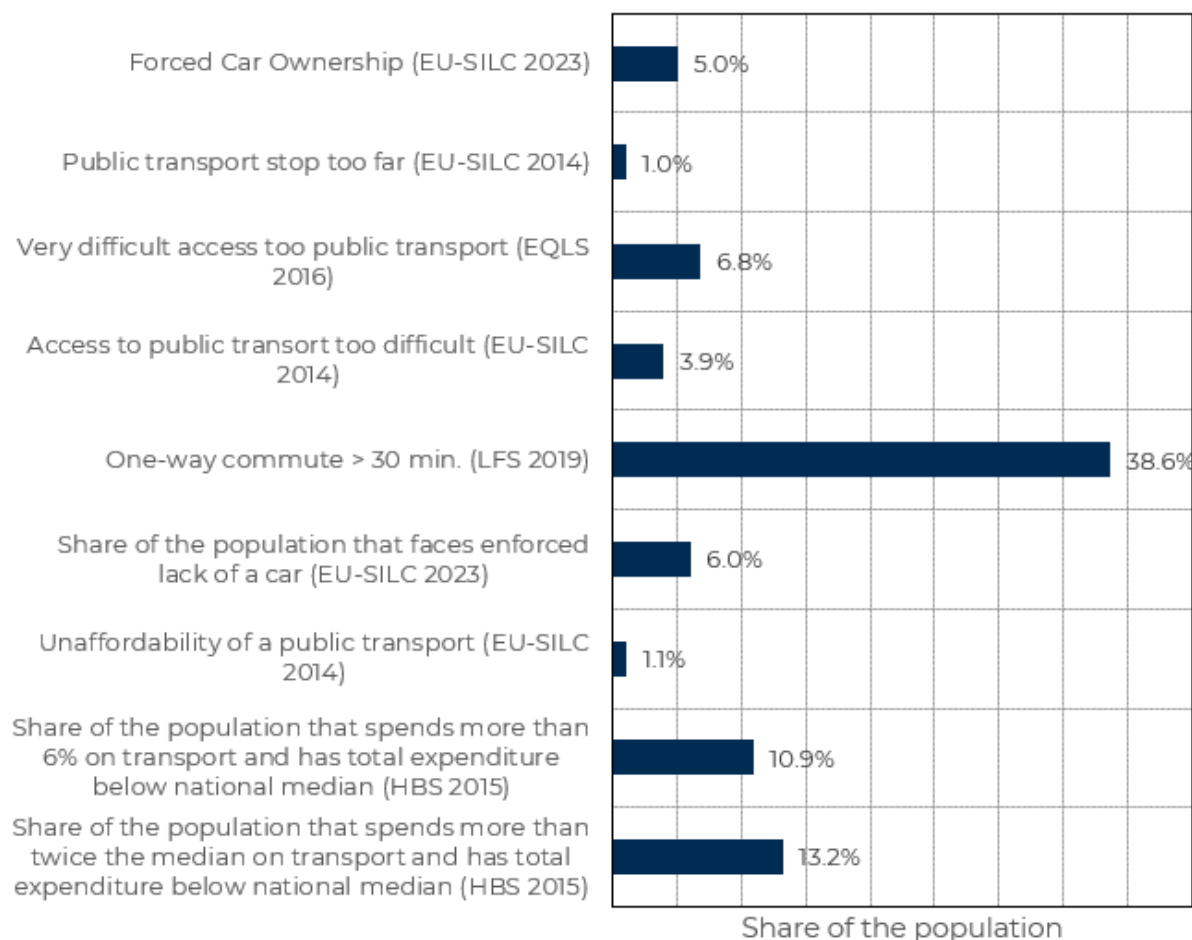
3.3.2. Target group analysis

Target groups analysis: Which households are most likely transport poor?

Figure 3-39 shows the share of the population identified by transport poverty indicators that reflect several aspects of transport poverty for Belgium. The shares

range from 1% for the unaffordability of public transport to 39% for individuals that have a one-way commute to work⁵⁹ of over 30 minutes.

Figure 3-39 Share of the Belgian population identified by transport poverty indicators that reflect several different aspects of transport poverty



Source: Oeko-Institut SEEK-EU micro model

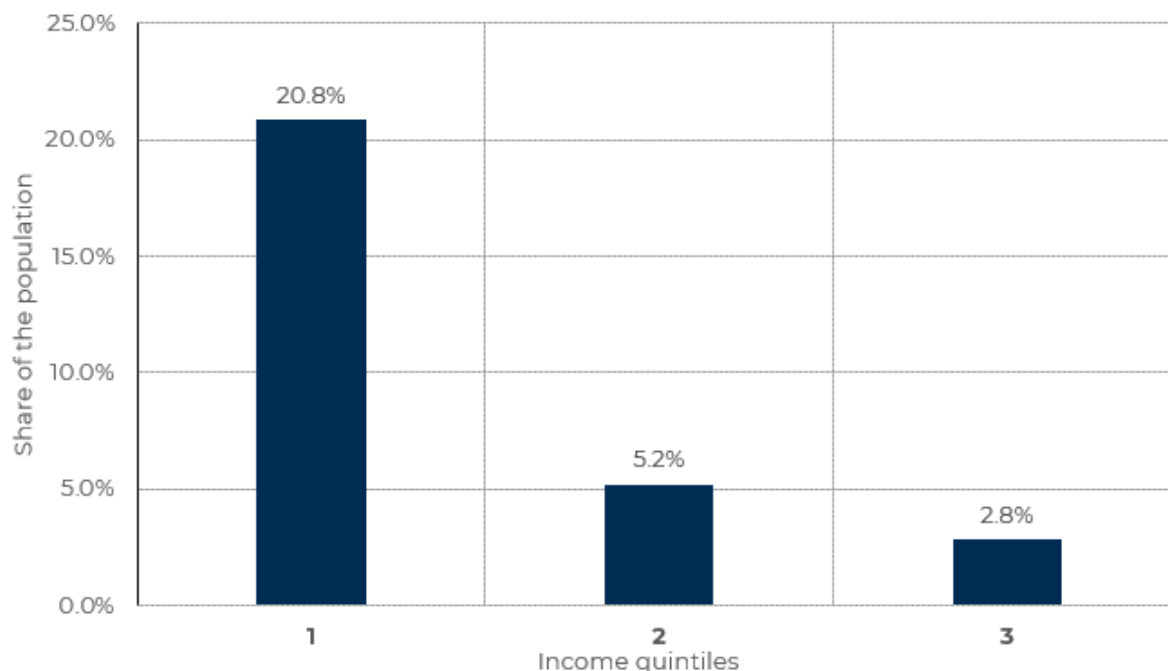
The following target group analysis focusses on two indicators that highlight the lack of a car and difficult access to public transport. We choose these indicators, as they focus on additional aspects relevant to transport poverty that may not be fully covered by the vulnerability indicator that focusses on fossil fuel use (see Chapter 3.3.1). The indicators may thus help identifying additional target groups that could benefit from the SCF due to being transport poor.

Figure 3-40 shows the share of the Belgian population affected by enforced lack of a car by income quintile. This indicator identifies people that answer that they cannot afford a car to the question of whether they own one. The fourth and fifth quintile cannot be displayed due to low number of observations, meaning that in the top 40% of the income distribution, there are very few individuals facing

⁵⁹ The factor of accessibility is not limited to commuting, however given a lack of data on other factors such as access to essential services, commuting is used as the main indicator.

enforced lack of a car. Enforced lack of a car is a much bigger issue for the bottom quintile of the income distribution, where 21% say that they cannot afford a car.

Figure 3-40 Share of the population affected by enforced lack of a car in Belgium by income quintile

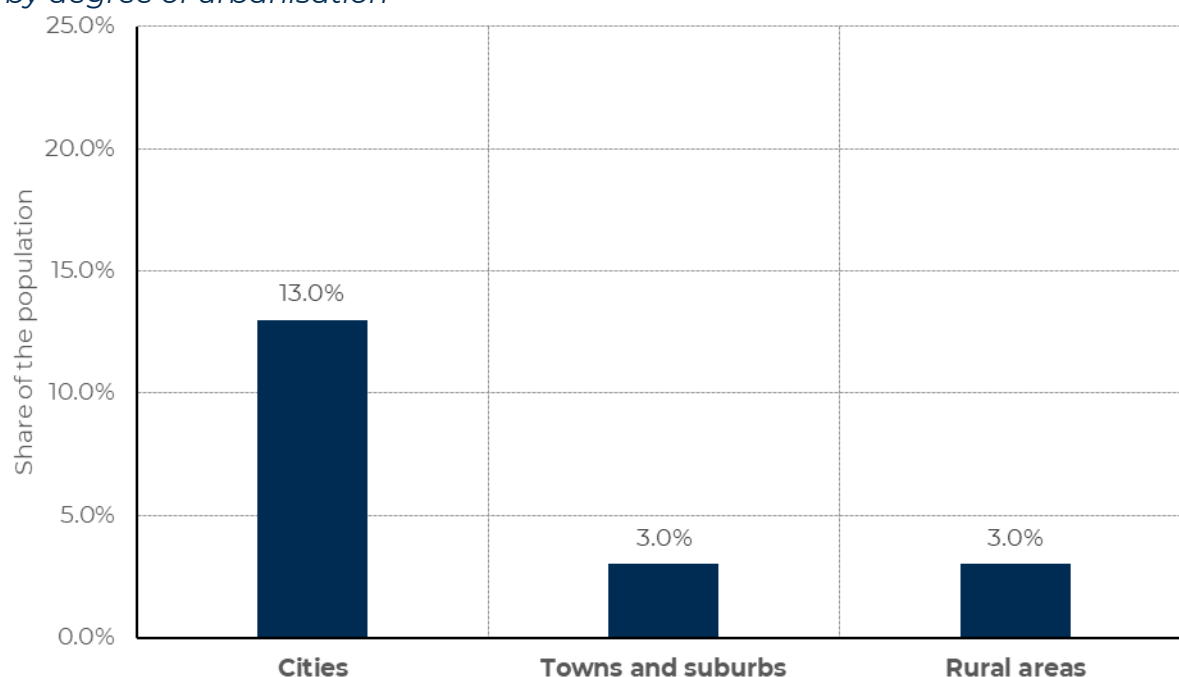


Source: Oeko-Institut SEEK-EU micro model based on EU-SILC 2023

Note: The third quintile should be flagged due to a low number of observations (20–49 observations). Quintiles 4 and 5 cannot be displayed due to a low number of observations (less than 20 observations).

Figure 3-41 shows the same indicator by degree of urbanisation. The Belgian population living in cities is much more likely to indicate that they cannot afford a vehicle compared to the population living in rural areas. The indicator usually shows higher shares in urban compared to rural areas (in urban areas, poverty incidence is also higher), as a car may be a necessity in rural areas with households owning one, even if they cannot afford it or have to reduce other consumption.

Figure 3-41 Share of the population affected by enforced lack of a car in Belgium by degree of urbanisation



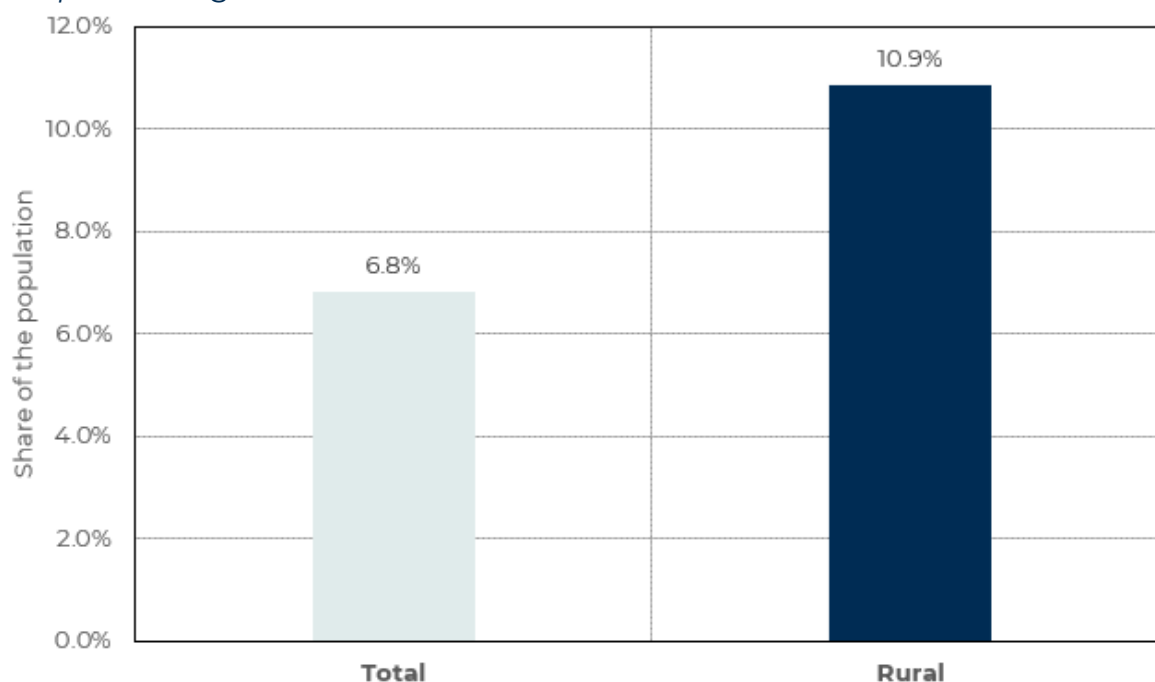
Source: Oeko-Institut SEEK-EU micro model based on EU-SILC 2023

According to a study on poverty in Wallonia (IWEPS, 2024)⁶⁰, individual car deprivation is mainly a concern for single-parent households (including single people under 65 years old).

Figure 3-42 shows the share of the population affected by very difficult access to public transport and indicates that the difficult access is a larger issue in rural areas.

⁶⁰ Les Éditions du Service public de Wallonie. (2024). IWEPS – Regards statistiques – Tableau de bord de la pauvreté en Wallonie. <https://ediwall.wallonie.be/iweps-regards-statistiques-ndeg13-tableau-de-bord-de-la-pauvrete-en-wallonie-numerique-131155>.

Figure 3-42 Share of the population affected by very difficult access to public transport in Belgium: Total share and share in rural areas



Source: Oeko-Institut SEEK-EU micro model based on EQLS 2016

Other considerations

In **Belgium**, half of single people do not own a car in 2023⁶¹, while 73% of Belgian households own at least one car (but only 45% in Brussels-Capital).

According to a recent research (Eva Van Eenoo, VUB 2024)⁶²:

- the spatial distribution of the car-dependent society is nearly ubiquitous, except within inner cities. In essence, this implies that the places where the foundation for a car-independent society is being laid today, or where it has already partially materialised, are predominantly limited to inner-city areas;
- in Belgium, less than 2% of company cars are used by the lowest income decile;
- in 2018, for the lowest income decile in Belgium, more than 75% of households with one adult have no car, while this figure drops to around 38% for households with at least two adults.

In **Wallonia**, according to a report on social cohesion⁶³ on 2018 datasets:

- 77% of daily trips by Walloon households are made by road, 71% by car, 5% by TEC bus and 1% by motorbike. For 18% of Walloons, the main transportation mode remains walking;

⁶¹ Statbel. (2023). La moitié des personnes seules ne possèdent pas de voiture.

<https://statbel.fgov.be/fr/nouvelles/la-moitie-des-personnes-seules-ne-possedent-pas-de-voiture>.

⁶² Van Eenoo, E. (2024). Navigating a car-dependent society: the case of Flanders (Belgium).

[Eva_Van_Eenoo_PhD_Thesis.pdf](#).

⁶³ IWEPS and SPW. (2020). Rapport sur la cohésion sociale en Wallonie – Droit à la mobilité – 2019.

<http://cohesionsociale.wallonie.be/sites/default/files/RCS-Mobilit%C3%A92020.pdf>.

- 60% of Walloon inhabitants have an appropriate walking access to public transport (bus and train);
- the percentage of the population located in the pedestrian vicinity of stops well served by public transport varies greatly from one municipality to another (a map is provided in the report).

In **Brussels-Capital region** (BCR), a recent study on transport poverty and car dependency in BCR and Belgium (Brussels Mobility, 2024 on SILC 2023 datasets) presented the following analysis.

- 20.8% of households face enforced lack of a car (car deprived due to financial reasons). These “car deprived” households are also seriously deprived on various other aspects (no spontaneous expenses, no holiday, no furniture, no proteins, etc.). The national average is at 7.9%, while in Flanders 5.6% of households face enforced lack of a car, and 7% in Wallonia.
- around 19% of these “car deprived” households also face space heating deprivation, which leads them to face a double vulnerability risk (energy and transport), while above 25% of the “forced car” households also face space heating deprivation.
- The “car deprived” households are mainly isolated individuals, mono-parental households, couples with at least one kid below 25 years olds (around 70% are households composed of 1 or 2 members).
- More than 45% are households with at least one member which is active.
- As general trend, the average intensity usage of individual car by income quintile car increases with higher quintile, the lowest quintile with the lowest intensity. However, in the lowest quintile, there are households with a high car intensity usage (>25 000 km/year) due to professional and family reasons.
- With regard to modal usage in Brussels for non-motorised households (inc. enforced lack of a car), as general trend, the important use of public transport (43.8%) for the lowest income class reduces progressively until the highest class (22.2%). In average this use is mainly replaced by the use of bike (from 4.8% for the lowest income to 24.2% for the highest).
- When analysing the coupling between the accessibility of public transport⁶⁴ and the typology of households according to the report to car use, there seems to be no clear link between forced car ownership and the accessibility of public transport.

In **Flanders**:

- In 2023⁶⁵, citizens still travel mainly by car (43% as a driver and 14% as a

⁶⁴ Score of the FPS Mobility and Transport.

⁶⁵ Vlaanderen. (2023). Vlaming fietst en wandelt meer, elektrische fiets wordt steeds populairder: Cijfers van analyserapport Onderzoek Verplaatsingsgedrag 6 beschikbaar. <https://www.vlaanderen.be/mobiliteit-en-openbare-werken/onderzoek-verplaatsingsgedrag-vlaanderen-ovg/onderzoek-verplaatsingsgedrag-vlaanderen-6-2021-2022/vlaming-fietst-en-wandelt-meer-elektrische-fiets-wordt-steeds-populairder-cijfers-van-analyserapport-onderzoek-verplaatsingsgedrag-6-beschikbaar>.

passenger), but for the first time car use dived below 60% in the modal split (in 2019 the car still had a share of 65%). However, the car is still used for 75.6% of kilometers travelled. Since 1994, bicycle use in Flanders has never been so high. 18% of the trips are made by (electric) bicycle (an increase of 4% compared to 2019) and 17% by foot. Public transport (public bus, tram, (pre)metro and train) is less used, with only 4% of Flemish journeys (compared to 7% in 2019). About 3% is done in a different way: van, scooter etc.

- Without having a car, it is more difficult to find a job. Mobiel 21⁶⁶ investigated what transport poverty does when somebody is looking for job. The finding is that 1 out of 3 job seekers cannot get to the workplace.
- According to a recent study on transport poverty in Flanders (MORA, 2024)⁶⁷, 9.2% of the population of households in cities are facing transport poverty (with as basic need the access to public transport), against 5.3% of out-of-cities households (with as basic need with regard to the lack of transport for the last km to home).

According to a study on “Less mobile, a conscious choice?” (UGent, VUB, network sustainable mobility, Mobiel21⁶⁸), there are five different profiles of less mobile people (mobile elderly, young starters, urban public transport dependent, suburban car dependent, older adults in rural areas), the transport disadvantaged person does not exist as it covers a variety of situations, (1), public transport is indispensable (2), work situation and transport poverty are strongly linked, no access to a car is linked to a lack of a social network. In other words, transport poverty takes different forms and cannot be traced back to one particular group in society, which makes the identification of vulnerable groups more complicated.

- (1) Transport poverty as a concept cannot be linked exclusively to age, income, level of education, work situation, place of residence, ownership of means of transport such as car or bicycle or access to public transport. Each characteristic can contribute to a situation of transport poverty, but is not inherently linked to the term itself.
- (2) e.g. 43% of respondents to a survey declared they do not agree to the question “If necessary, I can completely avoid public transport in the coming year” (at the beginning of COVID-19).

Target groups analysis: Which transport users are most likely vulnerable to transport poverty and particularly vulnerable to the introduction of ETS2?

Figure 3-43 shows the share of the Belgian population that is deemed vulnerable to transport poverty and particularly vulnerable to the introduction of ETS2. It shows the share along the expenditure distribution and for the bottom, middle and

⁶⁶ Mobiel21. (2021). Zonder auto geen job? <https://www.mobiel21.be/nl/inzichten-en-praktijkverhalen/zonder-auto-geen-job>.

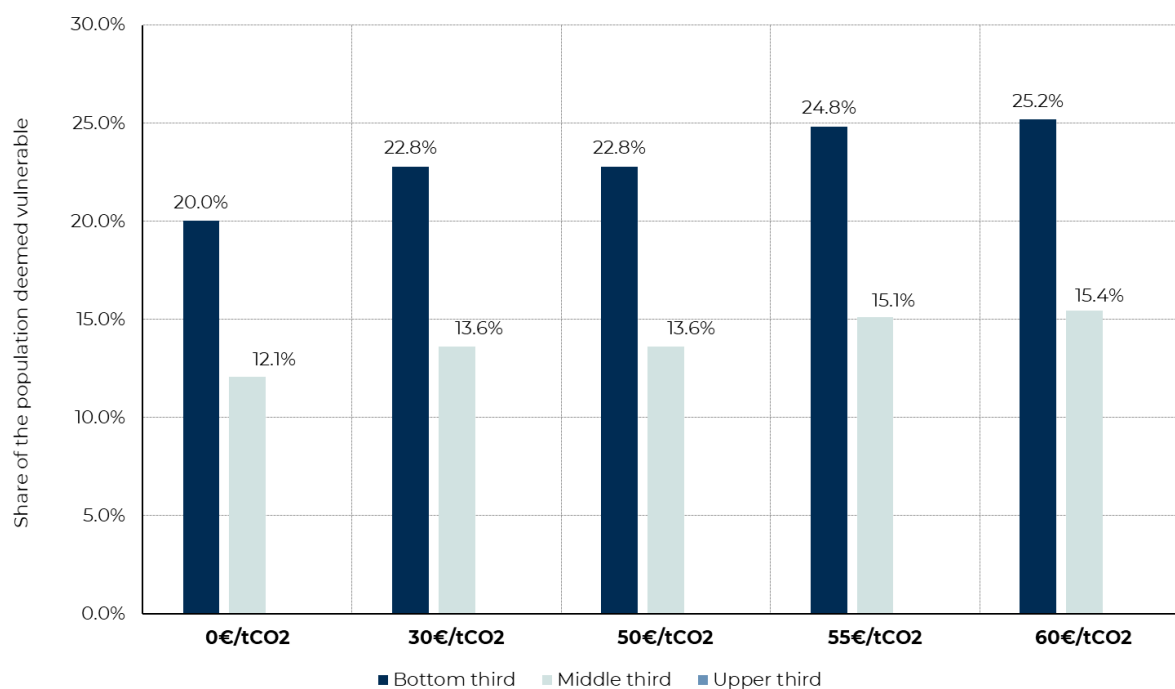
⁶⁷ Mobiliteitsraad (MORA). (2024). Mobiliteitsarmoede in vlaanderen. https://reset.vlaanderen/wp-content/uploads/2024/11/MORA_20241025_Mobiliteitsarmoede_ADV.pdf.

⁶⁸ Mobiel21. (2021). Minder mobiel, een bewuste keuze? https://www.mobiel21.be/downloads/Mobiel-21_Onderzoek-Vervoersarmoede_2021.pdf.

upper third of overall expenditures. As the modified 2M indicator is limited to the bottom half of the expenditure distribution (see Chapter 2.2.2), no one in the upper third are deemed vulnerable to transport poverty and particularly vulnerable to the introduction of ETS2. With 20–25% the share amongst the bottom third is high and higher than in the middle third at 12–15%.

The distribution of vulnerability along the expenditure and income distribution depends on the amount of fossil fuels that are used for transport in the expenditure brackets, which in turn reflects dependence on combustion vehicles and the availability of alternatives (public transport, active mobility). Vulnerability is also driven by overall expenditures and incomes. The lower the income, the harder to accommodate additional cost.

Figure 3-43 Share of the Belgian population deemed vulnerable to transport poverty and particularly vulnerable to the introduction of ETS2 by expenditure tercile

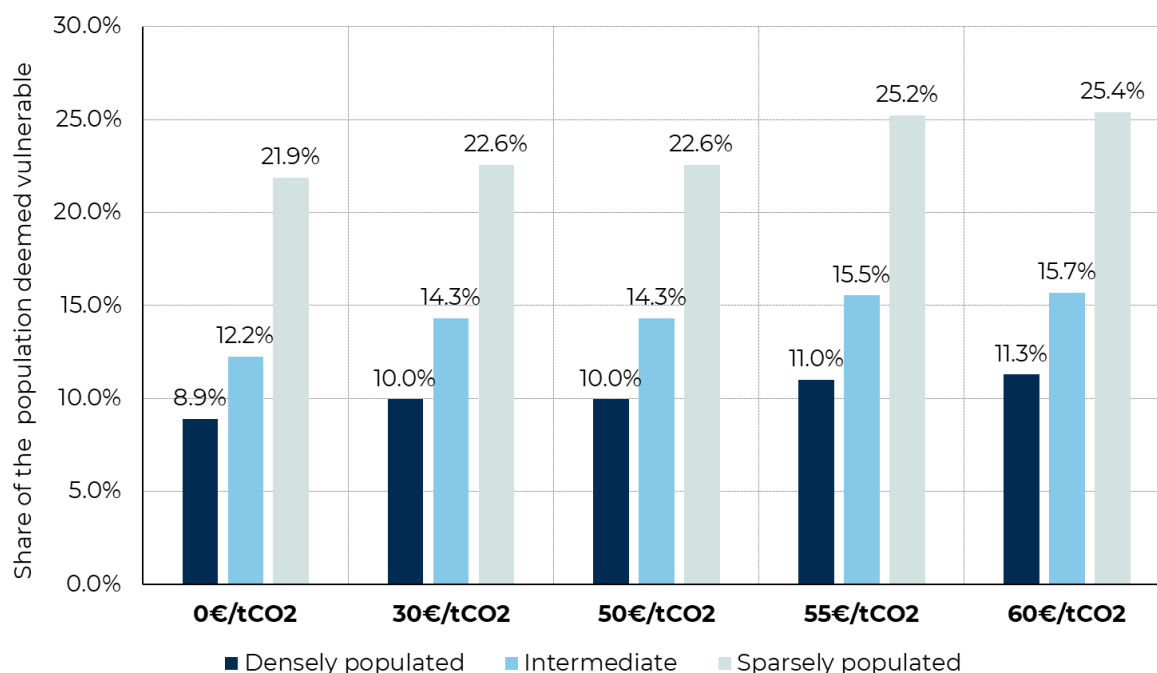


Source: Oeko-Institut SEEK-EU micro model

Figure 3-44 shows the share of the Belgian population deemed vulnerable to transport poverty and particularly vulnerable to the introduction of ETS2 by degree of urbanisation. The highest vulnerability is calculated for sparsely populated areas, where 22–25% of the population are deemed vulnerable, depending on the level of the ETS2 price. The share is estimated at 12–16% for intermediate population density and 9–11% for densely populated areas.

The distribution amongst the different population densities reflects the consumption of fossil fuels for transport in these areas, as well as the level of total expenditures and incomes.

Figure 3-44 Share of the Belgian population deemed vulnerable to transport poverty and particularly vulnerable to the introduction of ETS2 by degree of urbanisation



Source: Oeko-Institut SEEK-EU micro model

For Wallonia, according to a report on social cohesion⁶⁹, on average, a Walloon household devoted 15% of its annual budget (i.e. 5 007 euros) to cover its transport costs in 2016. This share is below 10% for the lowest quartile, and above 17% for the highest quartile. According to Statbel, in 2022 these numbers were 10.8% (Belgium), 10.3% (Flanders), 12.9% (Wallonia), and 7.3% (Brussels) for all income quartiles. For the lowest income quartile, the share of transport in expenditures was 7.6% (Belgium), 6.4% (Flanders), 9.3% (Wallonia), and 2.9% (Brussels)^{70,71}.

Main take-aways:

- With a CO₂ price at 60 EUR/tCO₂, 11.7% of the Belgian household population is deemed vulnerable to transport poverty and particularly vulnerable to the introduction of ETS2 in the transport sector.
- Comparing the share between population and household population, it appears that households with many household members are more affected than smaller households.
- The shares of the population identified by transport poverty indicators that reflect several different aspects of transport poverty for Belgium, is the highest for 1/ enforced lack of a car (6%) and 2/ the difficult access to public

⁶⁹ IWEPS and SPW. (2020). Rapport sur la cohésion sociale en Wallonie – Droit à la mobilité – 2019. <http://cohesionsociale.wallonie.be/sites/default/files/RCS-Mobilit%C3%A92020.pdf>.

⁷⁰ Statbel. (2023). Budget des ménages. <https://statbel.fgov.be/fr/themes/menages/budget-des-menages>.

⁷¹ The sample for the lowest income quartile for Brussels in the 2022 HBS only contained 60 households. Therefore, caution is needed for the interpretation and generalisation of these results.

transport (6.8%). These two indicators may thus help identifying vulnerable groups:

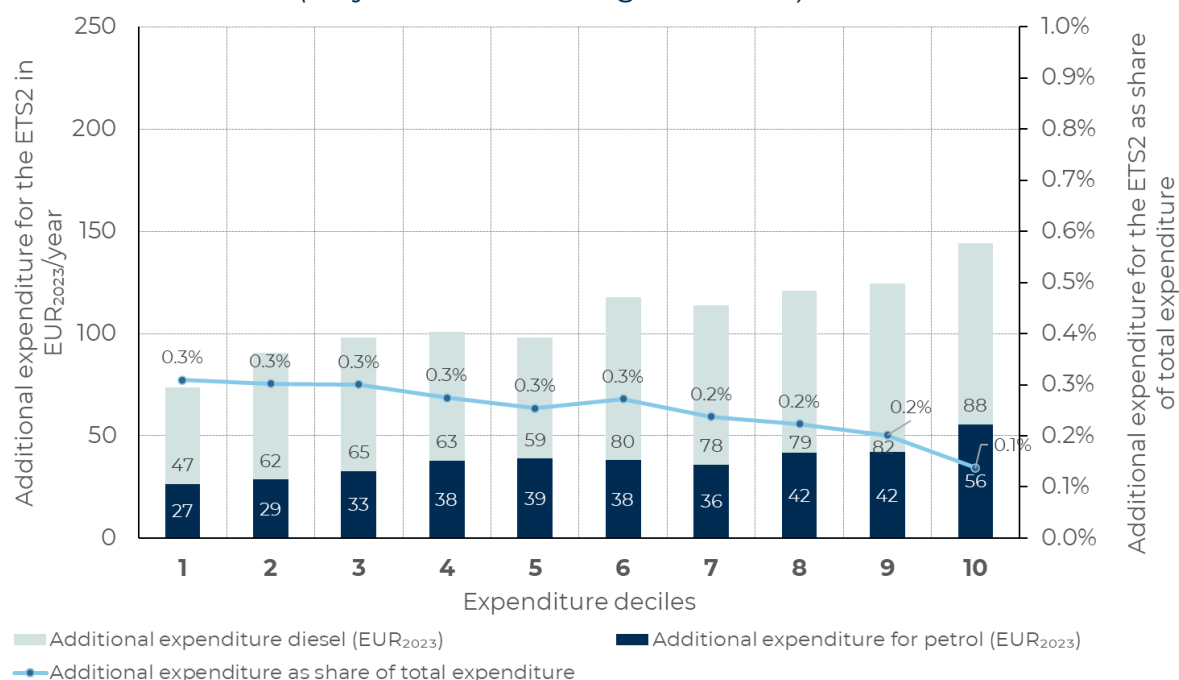
- Enforced lack of a car is a much bigger issue for the bottom quintile of the income distribution, where 20.8% say that they cannot afford a car. Also, Belgian population living in cities is much more likely to indicate that they cannot afford a vehicle (13% of the population) compared to the population living in rural areas (3%).
 - The share of population affected by very difficult access to public transport in Belgium is higher in rural areas (10.9%) than on average (6.8%), although there are a lot of variations between municipalities.
- The share of the Belgian population that is deemed vulnerable to transport poverty and particularly vulnerable to the introduction of ETS2 (modified 2M indicator is limited to the bottom half of the expenditure distribution) is higher amongst the bottom third (20–25%) than for the second third (12–15%).
 - The highest vulnerability is calculated for sparsely populated areas, where 22–25% of the population are deemed vulnerable, while the share is estimated at 12–16% for intermediate population density and 9–11% for densely populated areas.

3.3.3. ETS2 impact by target group

Figure 3-45 shows the estimated ETS2 costs at a carbon price of 30 EUR/tCO₂ in the transport sector for Belgian households for the main scenario that includes an elasticity of -0.2 for transport⁷² (see Chapter 2.2.2). The figure shows the impact by expenditure deciles only for those households using petrol or diesel.

⁷² Of course, it is to be expected that elasticities differ by income group and by population density: Berry, C. and Börjesson, M. (2024). Income and fuel price elasticities of car use on micro panel data. <https://doi.org/10.1016/j.eneco.2024.107661>.

Figure 3-45 ETS2 costs related to transport for Belgian households at a carbon price of 30 EUR/tCO₂ (only households using fossil fuels)



Source: Oeko-Institut SEEK-EU micro model

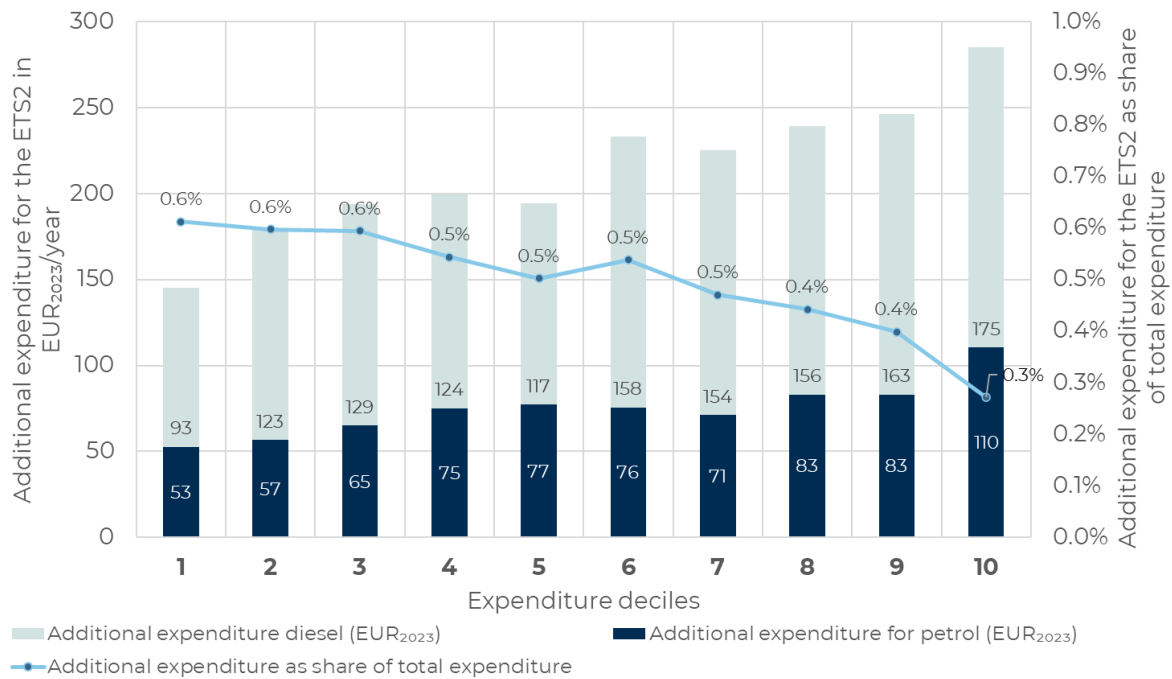
As households with higher overall expenditures use more petrol and diesel, the expected additional cost per year rises from 75 EUR/year in the first decile to 145 EUR/year in the tenth decile. This compares to EUR₂₀₂₃ 2 004 total annual transport costs without ETS2 for Belgian households with expenditures for diesel or petrol according to the EU HBS 2015.

The share of total expenditure that needs to be spent on the ETS2 costs at a carbon price of 30 EUR/tCO₂ is relatively constant at 0.3% for the first six deciles dropping to 0.2% in the seventh decile and then 0.1% in the tenth decile.

At a carbon price of 60 EUR/tCO₂ (Figure 3-46), the estimated ETS2 costs rise to 145 EUR/year in the first decile and 285 EUR/year in the tenth decile. The share of total expenditure that needs to be spent on ETS2 costs, is equal to 0.6% up until the third decile, then declines to 0.5% until the seventh decile and to 0.3–0.4% for the top three deciles. This reflects the fact that higher-income households are more easily able to absorb the additional costs.

Without taking the reaction of households into account, i.e. assuming an elasticity of 0 related to the carbon price, the impacts at a carbon price of 60 EUR/tCO₂ are slightly higher by 7 EUR/year in the first decile and 16 EUR/year in the tenth.

Figure 3-46 ETS2 costs related to transport for Belgian households at a carbon price of 60 EUR/tCO₂ (only households using fossil fuels)

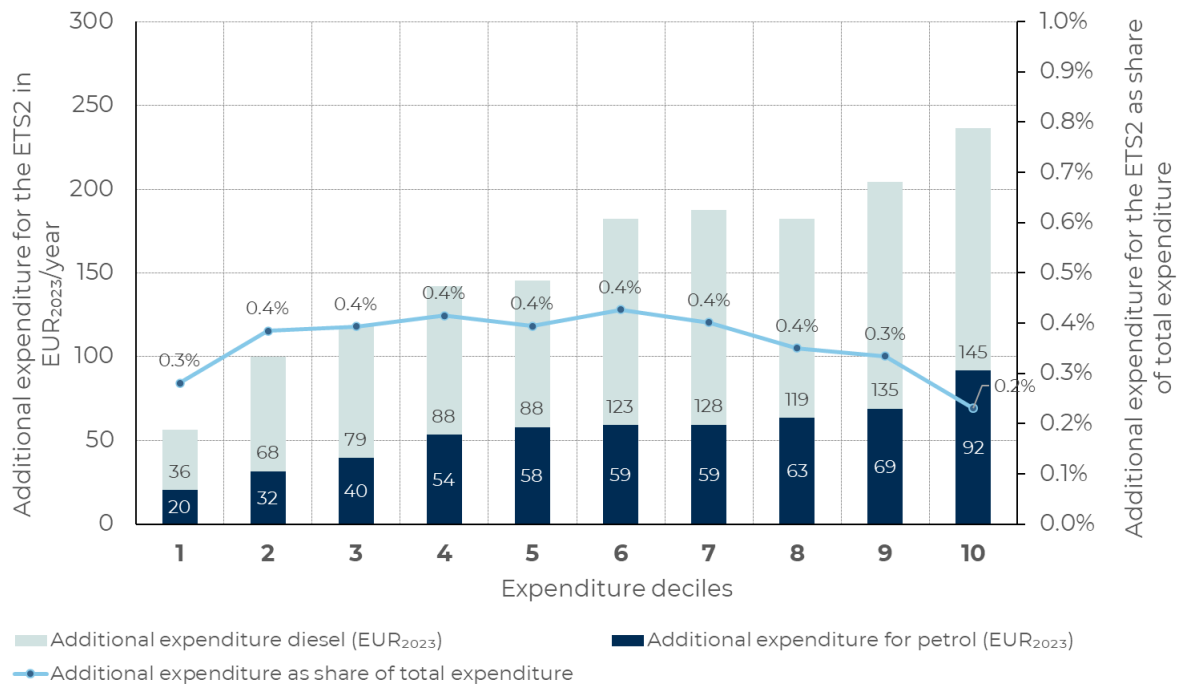


Source: Oeko-Institut SEEK-EU micro model

If all households are included in the analysis, i.e. also those that do not drive a vehicle and will therefore not be directly affected by the ETS2, the average impact is smaller (Figure 3-47Figure). Especially in the first decile the impact is smaller, as less households own a vehicle compared to other deciles.

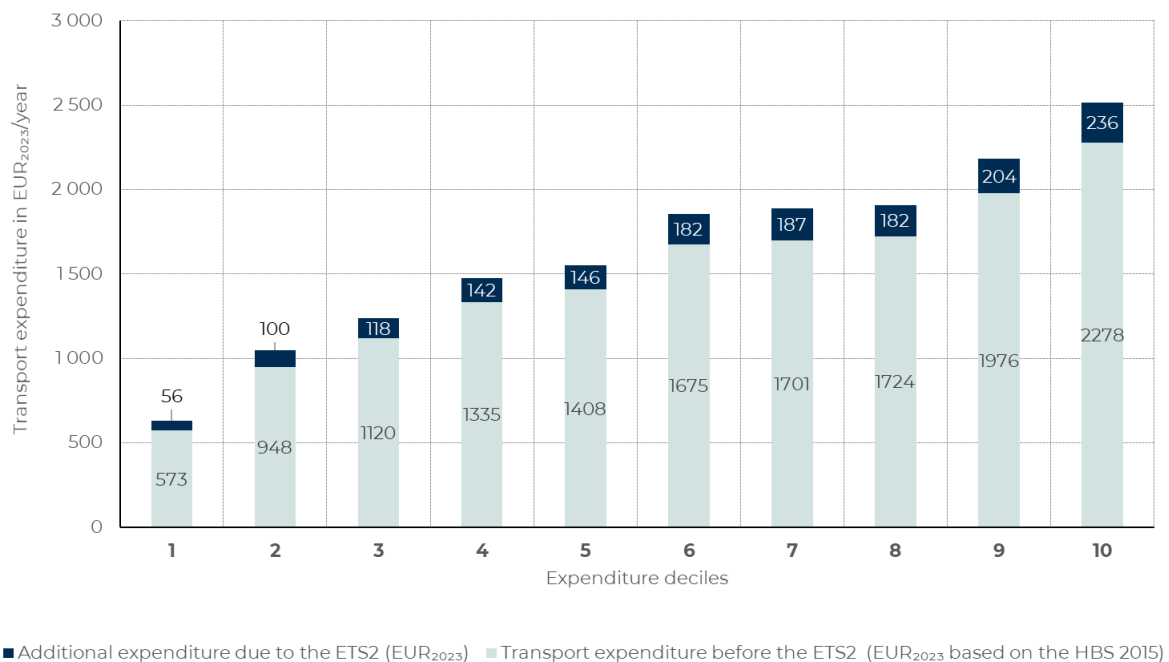
Figure 3-50 compares expected ETS2 costs at a carbon price of 60 EUR/tCO₂ to expenditures for transport based on the HBS 2015 (inflated to EUR₂₀₂₃). In Figure 3-50, both households owning a car and those without are included. Overall, the additional cost due to the ETS2 is expected to represent a fraction of overall transport costs for households in Belgium.

Figure 3-47 ETS2 costs related to transport for Belgian households at a carbon price of 60 EUR/tCO₂ (all households)



Source: Oeko-Institut SEEK-EU micro model

Figure 3-48 ETS2 costs related to transport for Belgian households at a carbon price of 60 EUR/tCO₂ compared to transport costs according to the HBS2015 (all households)



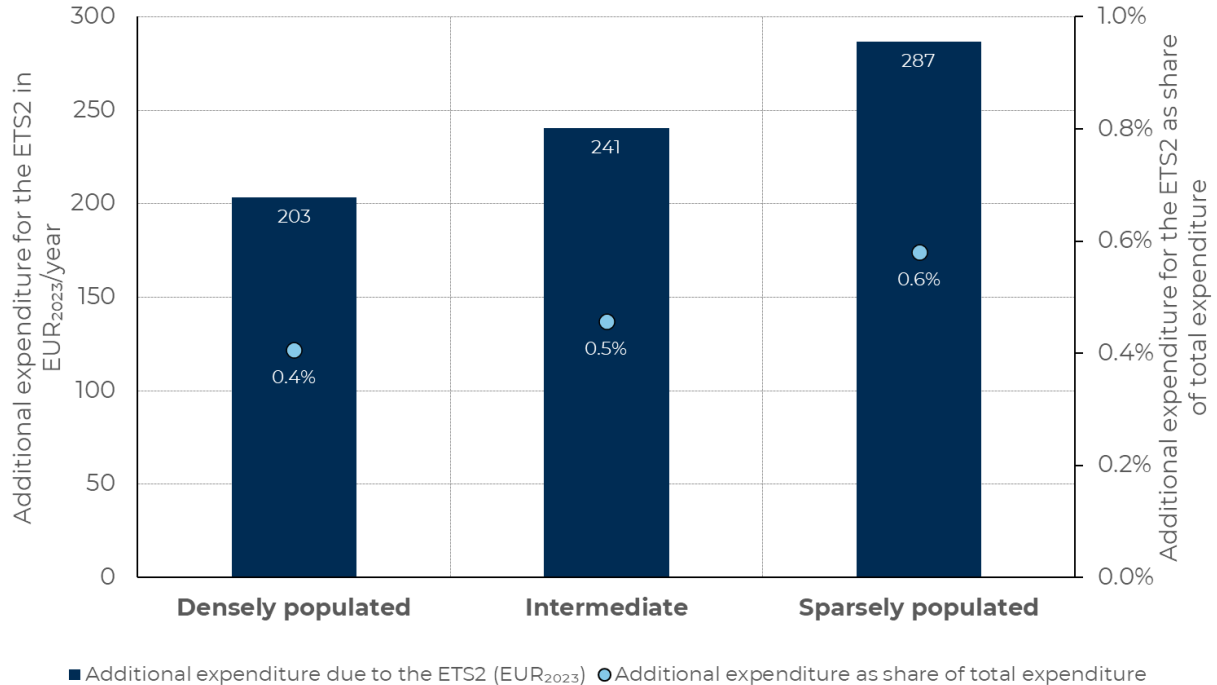
Source: Oeko-Institut SEEK-EU micro model

Note: A value of 1.2607 was applied to inflate expenditures to 2023EUR, based on the Eurostat all items HICP [prc_hicp]

Figure 3-49 shows the estimated impact of the ETS2 by degree of urbanisation at a carbon price of 60 EUR/tCO₂ and only for those households using fossil fuels. The estimated carbon costs are highest for an average household living in a sparsely populated area at 290 EUR/year and smallest for the average household living in a

densely populated area at 200 EUR/year. The share of expenditure that needs to be spent ranges from 0.4% in densely populated areas to 0.6% in sparsely populated areas.

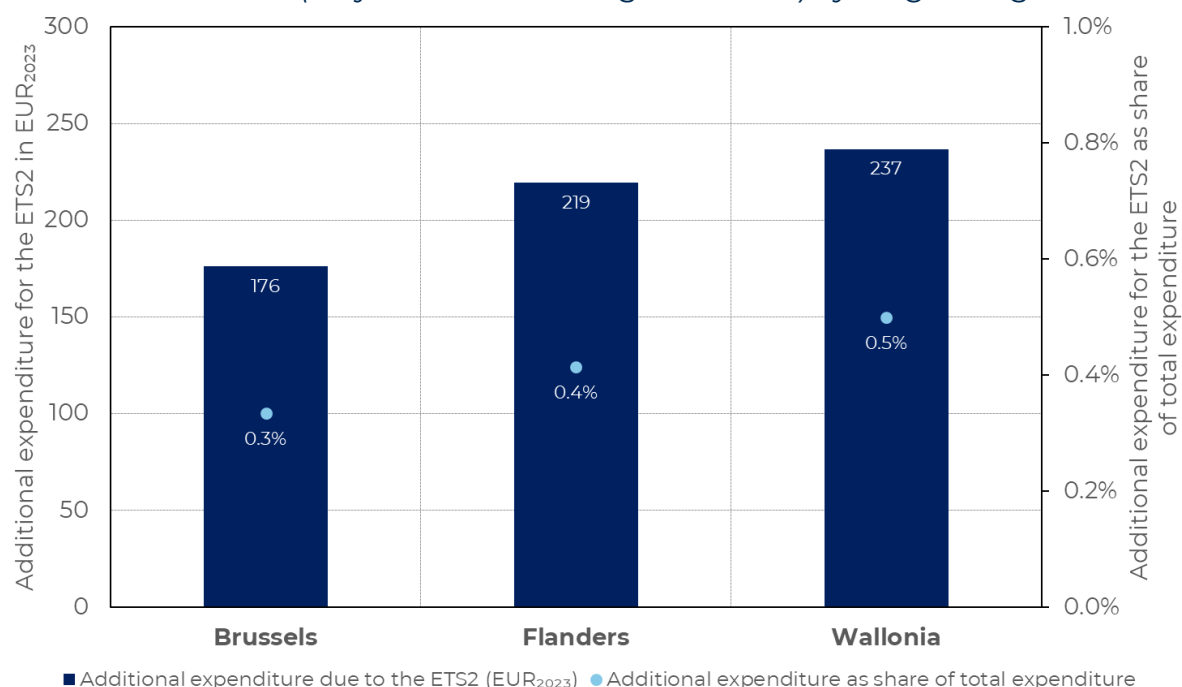
Figure 3-49 ETS2 costs related to transport for Belgian households at a carbon price of 60 EUR/tCO₂ (only households using fossil fuels) by degree of urbanisation



Source: Oeko-Institut SEEK-EU micro model

Figure 3-50 shows the estimated impact by Belgian region for fossil-fuel using households. Wallonia is expected to have the highest impact both in terms of the additional euros spent and the share of total expenditure spent on ETS2 costs.

Figure 3-50 ETS2 costs related to transport for Belgian households at a carbon price of 60 EUR/tCO₂ (only households using fossil fuels) by Belgian region



Source: Oeko-Institut SEEK-EU micro model

It is important to keep in mind that the figures show average impacts per decile or per degree of urbanisation and that there are households that experience much higher impacts. Higher impacts are expected at high consumption of motor fuels coupled with low incomes. This could be households that live far away from their workplace and have to commute by car, while also having low incomes.

Main take-aways from the micro analysis based on SEEK-EU

- For the average household in Belgium, the ETS2 impact at prices of 30–60 EUR/tCO₂ lies at 110–215 EUR/year for households using diesel and petrol to fuel their vehicle.
- Households with higher incomes will be more affected in terms of the additional euros spent, as they are more likely to own a vehicle and drive over longer distances, thus using more petrol and diesel.
- However, due to their higher overall incomes and expenditures, the impact on overall expenditures for high income households is smaller. At a price of 60 EUR/tCO₂, the lowest income decile is expected to spend 0.6% on ETS2 costs, while the highest income decile only spends 0.3%
- The fact that many low-income households do not own a car is important. These households can still be supported by the Social Climate Fund, if they are deemed to be in transport poverty.
- The analysis by degree of urbanisation shows higher estimated impacts in sparsely populated areas both in terms of the additional costs in euros and in terms of the share of total expenditures spent on ETS2 costs.

3.3.4. Supplementary analysis of impacts (study undertaken by Federal Planning Bureau)

In the energy simulations (presented in Chapter 3.2.4) both energy and transport fuel expenditures were considered, while for transport the focus is on transport expenditure only. Consequently the values (i.e. shares of additional expenditure in total expenditure) are of course much lower.

Table 3-7 Categories of variables used to calculate expenditure indicators

	Category level 1	Category level 2	Category level 3
Variables	- Region - Population density - Equivalised income decile - Age group - Gender - Citizenship - Educational level - Economic status - Eligibility social tariff - Household type - Household payment type - Heating fuel type - Car ownership - Cannot afford a car - AROP - Measured energy poverty - Hidden energy poverty - Transport poverty 2M - Transport poverty 11%	- Region - Household type - Population density - Number of adults - Number of children - Gender - Equivalised income decile - Car ownership	- Region - Population density - Number of adults - Number of children

Methodology

The following steps have been conducted.

- In total 100 combinations of 1, 2 or 3 variables have been simulated, generating more than 2 700 archetypes (done by the FPB);
- To focus on and analyse the most relevant results, the additional household expenditure relative to income (resulting from the introduction of ETS2) have been ranked from the highest to the lowest. The seven highest values have been selected for which the sample of the archetype consisted of least 50 households (described below);
- Graphs corresponding to the archetypes have been created to allow comparisons for the following combinations.

Some of the results of the energy chapter, addressing both energy and transport, can be used for transport.

Table 3-8 Combinations of variables from different categories

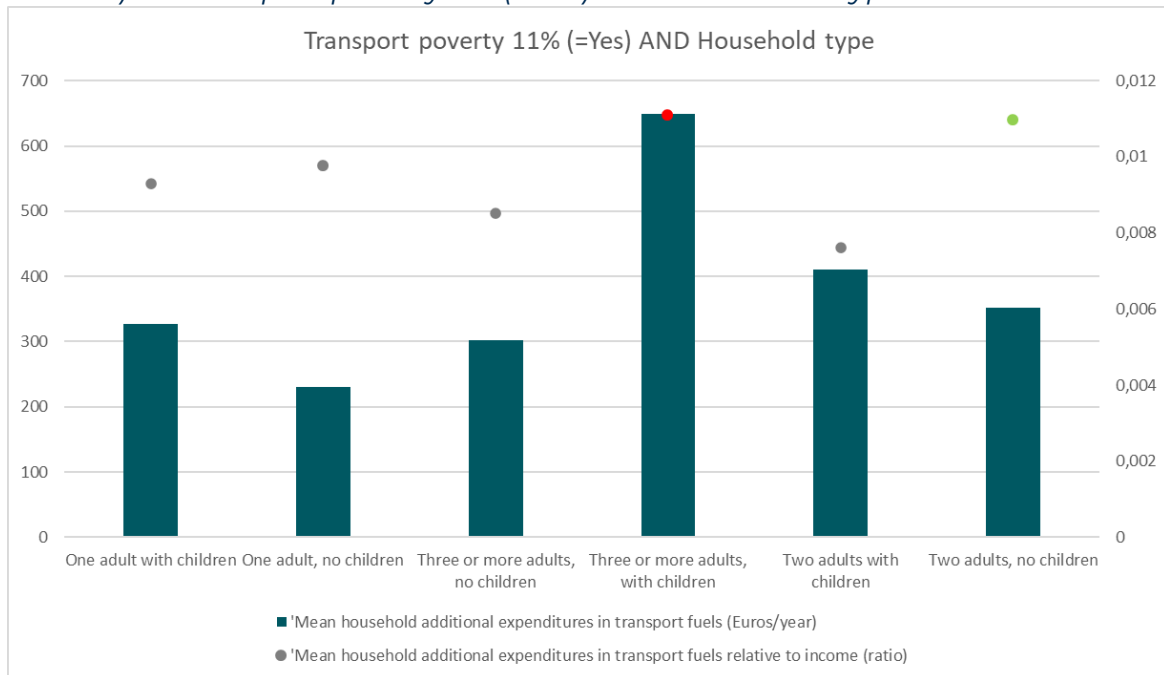
	Category level 1	Category level 2	Category level 3
1	Transport poverty 2M [yes]	Household type	Population density
2	Transport poverty 2M [yes]	Equivalised income decile	Region
3	Transport poverty 2M [yes]	Car ownership	Region
4	Measured energy poverty [yes]	Household type	Population density
5	Transport poverty 2M [yes]	Household type	Region
6	Measured energy poverty [yes]	Household type	Region
7	Transport poverty 2M [yes]	Equivalised income decile	/
8	Measured energy poverty [yes]	Region	/
9	Transport poverty 11% [yes]	Region	/
10	Transport poverty 11% [yes]	Car ownership	Region
11	Measured energy poverty [yes]	Household type	/
12	Heating fuel type	Household Type	Population density [rural]
13	Heating fuel type	Household Type	Region [Wallonia]
14	Transport poverty 11%	Household type	/
15	Transport poverty 2M [yes]	Equivalent income decile	Region
16	Transport poverty 11% [yes]	Region	/
17	Transport poverty 2M [yes]	Equivalent income decile	/
18	Transport poverty 2M [yes]	Household type	Region
19	Transport poverty 2M [yes]	Household type	Population density
20	Transport poverty 2M [yes]	Region	/

Presentation of the results

1. The highest value (indicated in the graph with red dots) have to be discarded given the too limited sample size.

Therefore, one archetype shows a very high increase of its transport expenditure relative to its income: **two adults without children households in transport poverty (11%)** with 1.1%. The next values are for single person and one-parent households with respectively 0.97% and 0.93%.

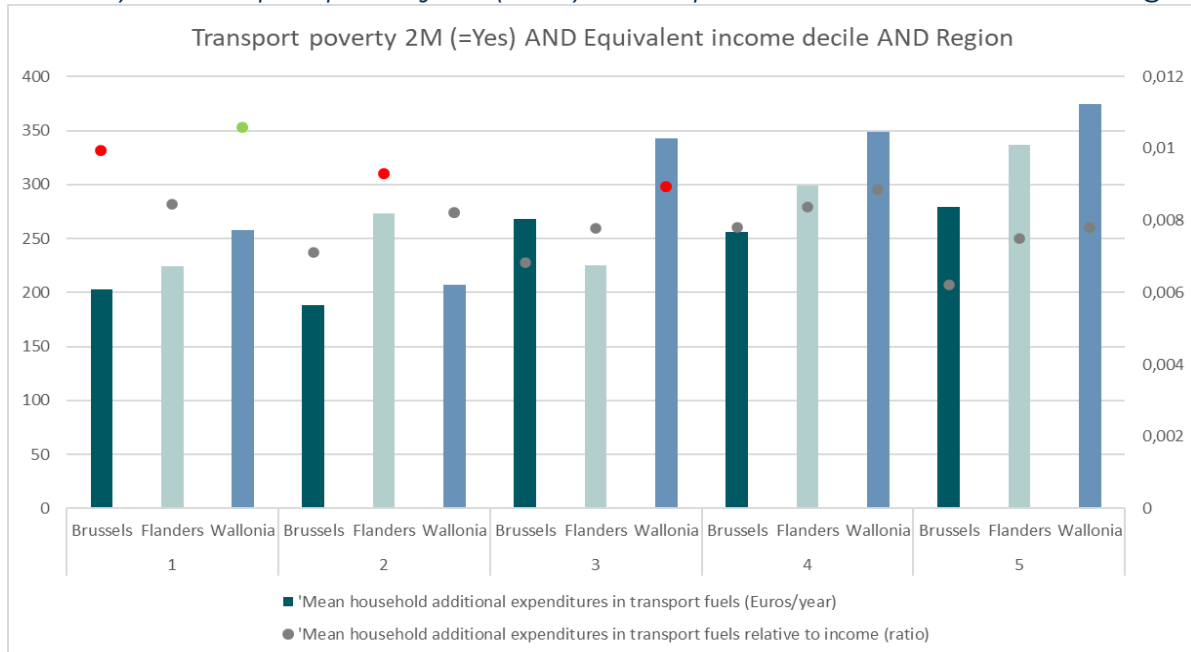
Figure 3-51 Additional expenditures per household (in EUR/year and as % of income) for transport poverty 11% (=Yes) AND household type



Source: own elaboration, based on simulations made by the Federal Plan Bureau, December 2024

- One archetype shows a very high increase of its transport expenditure relative to its income: **households in transport poverty 2M** and in the **first income decile** living in **Wallonia** with 1.06%. The next three values have to be discarded (red dots) given the too limited sample size. Therefore, the second highest value have households in transport poverty 2M and in the fourth income decile living in Wallonia, with 0.89%.

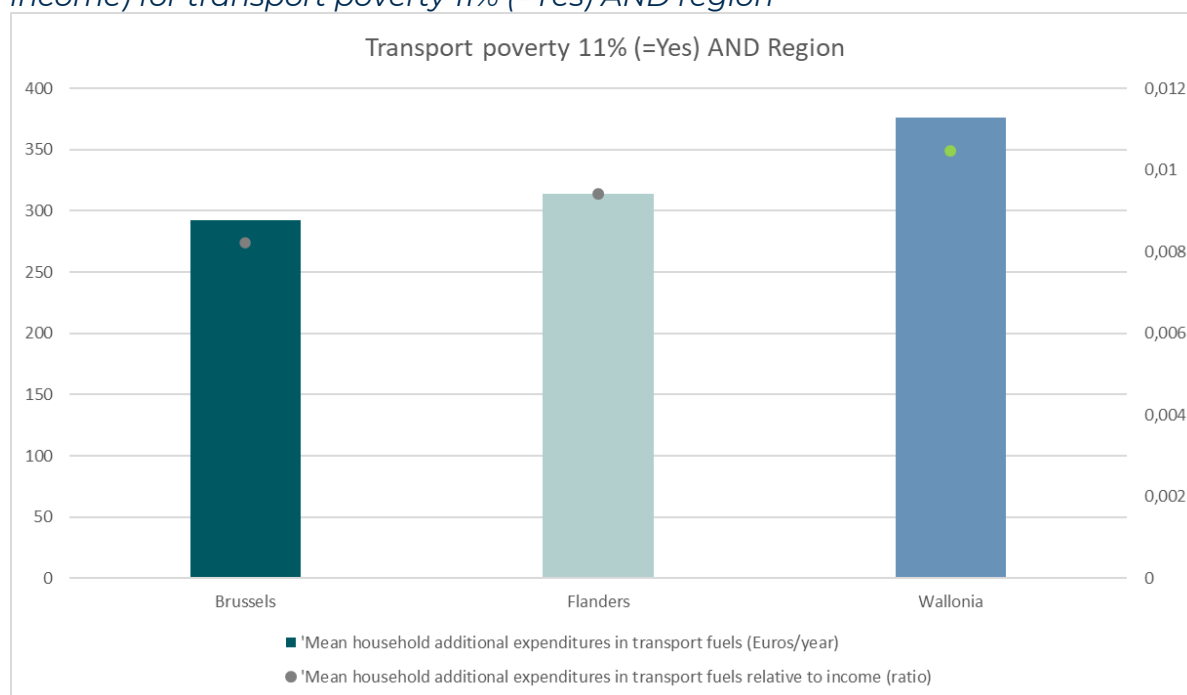
Figure 3-52 Additional expenditures per household (in EUR/year and as % of income) for transport poverty 2M (=Yes) AND equivalent income decile AND region



Source: own elaboration, based on simulations made by the Federal Plan Bureau, December 2024

3. One archetype shows a very high increase of its transport expenditure relative to its income: households in **transport poverty (11%) living in Wallonia** with 1.05% (archetype 9 in energy shows that energy and transport expenditures represent together 2.04%).

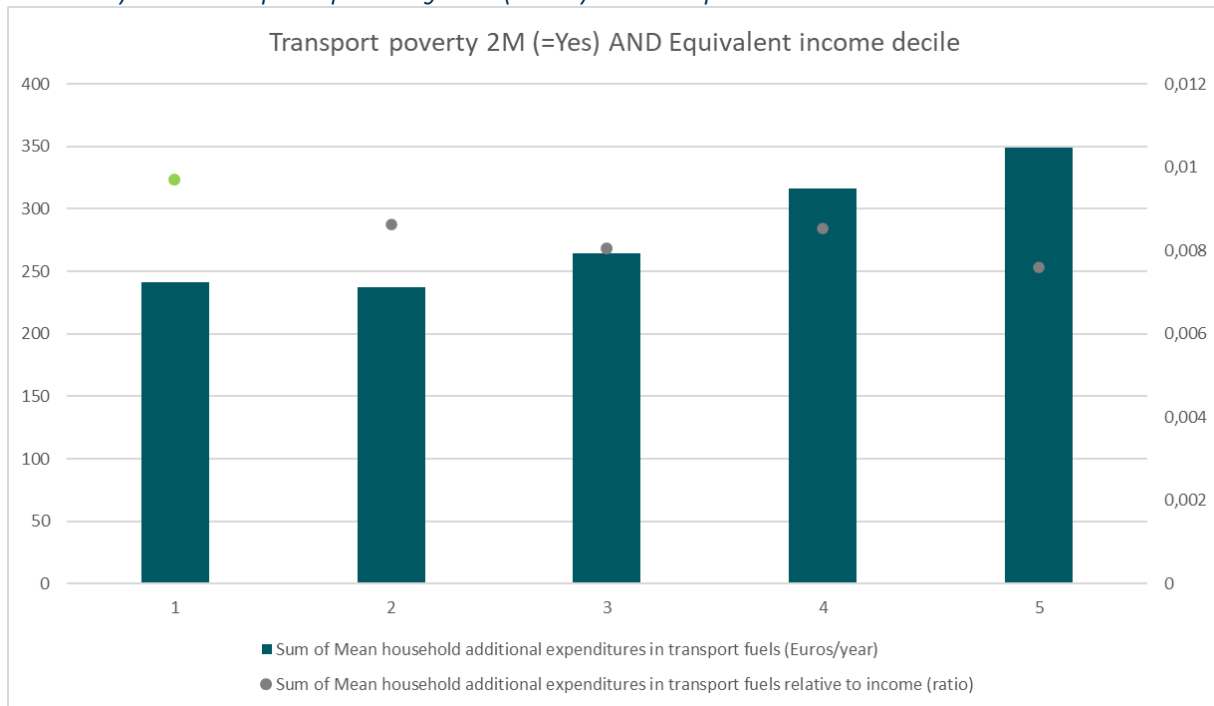
Figure 3-53 Additional expenditures per household (in EUR/year and as % of income) for transport poverty 11% (=Yes) AND region



Source: own elaboration, based on simulations made by the Federal Plan Bureau, December 2024

4. One archetype shows a very high increase of its transport expenditure relative to its income: households in **transport poverty 2M and belonging to the first income decile** with 0.97%. Similarly to archetype 15, the fourth income decile is also impacted, approximately at the same level as the second income decile with 0.85% and 0.86% respectively.

Figure 3-54 Additional expenditures per household (in EUR/year and as % of income) for transport poverty 2M (=Yes) AND equivalent income decile

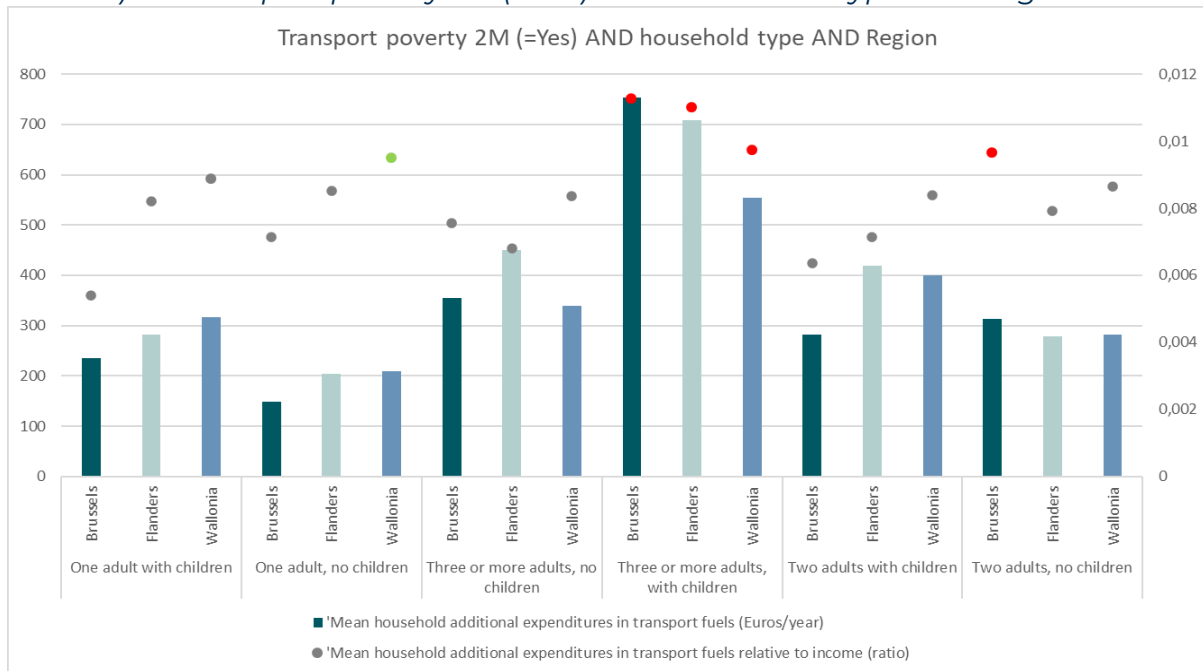


Source: own elaboration, based on simulations made by the Federal Plan Bureau, December 2024

5. The four highest values (indicated in the graph with orange dots) have to be discarded given the too limited sample size.

Therefore, one archetype shows a high increase of its transport expenditure relative to its income: **single person households** in transport poverty 2M and **living in Wallonia**, with 0.95%.

Figure 3-55 Additional expenditures per household (in EUR/year and as % of income) for transport poverty 2M (=Yes) AND household type AND region

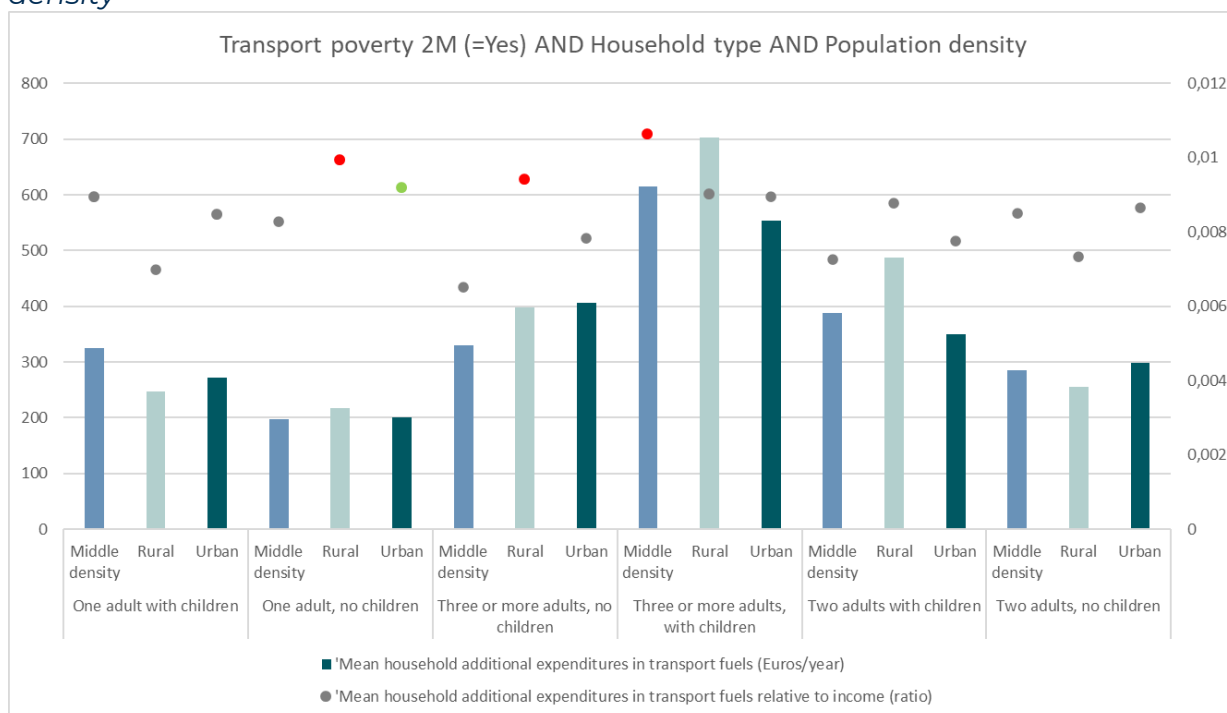


Source: own elaboration, based on simulations made by the Federal Plan Bureau, December 2024

6. The three highest values (indicated in the graph with red dots) have to be discarded given the too limited sample size.

Therefore, one archetype shows a very high increase of its transport expenditure relative to its income: **single person** households in transport poverty 2M **living in densely populated areas** with 0.92%. The next highest value have all been discarded, due to the low sample size.

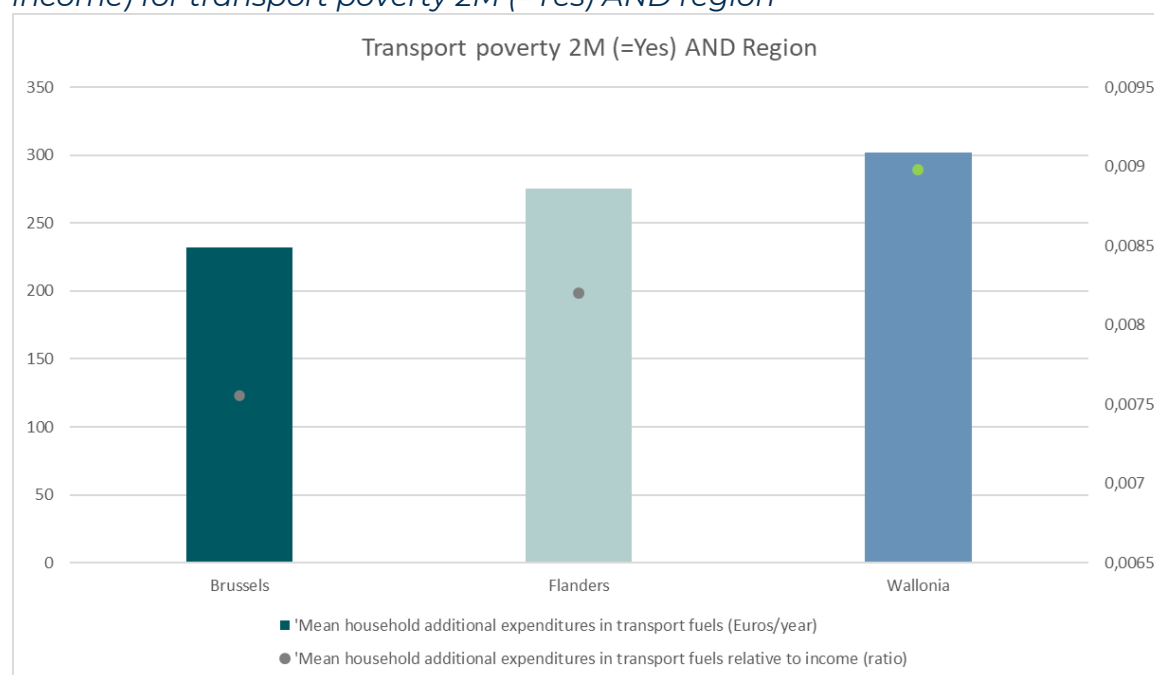
Figure 3-56 Additional expenditures per household (in EUR/year and as % of income) for transport poverty 2M (=Yes) AND household type AND population density



Source: own elaboration, based on simulations made by the Federal Plan Bureau, December 2024

7. One archetype shows a very high increase of its transport expenditure relative to its income: **households in transport poverty 2M living in Wallonia** with 0.9%, which is close to archetype 16.

Figure 3-57 Additional expenditures per household (in EUR/year and as % of income) for transport poverty 2M (=Yes) AND region



Source: own elaboration, based on simulations made by the Federal Plan Bureau, December 2024

Key findings

- Transport poverty (2M) is often linked to rural areas and to single or multi-adults households.
- ETS2 impact on households in transport poverty (2M) is the highest in the first equivalent income decile, in Wallonia, while the level remains quite high for the second and third income deciles, for expenditure related to transport only, and for the sum of transport and energy expenditure.
- ETS2 impact on households living in Wallonia in transport poverty (2M) is the highest for all households with regard to their transport expenditure, and with regard to their energy and transport expenditures when they do not own a car.
- Transport poverty (2M) is also linked to single person households in Wallonia, by considering transport expenditure alone (0.95%), or together with energy expenditure (2.25%).
- Transport poverty (11%) is by far the highest in Wallonia, by considering transport expenditure alone (1.09%), or together with energy expenditure (2.04%), and then in densely populated areas (0.92%).
- Transport poverty 11% is the highest in Wallonia for households owning a car.

Additional observations

- A household in Wallonia has a higher likelihood to be in transport poverty 2M when it does not own a car (2.28%), than with a car (1.79%). These figures relate to the impact on both energy and transport expenditures. It would be different by considering transport expenditures only, as the main expenses for transport are related to a car.

Conclusions based on these simulations

- The localisation of the household is a crucial parameter to identify risk of transport poverty, as households in Wallonia and rural areas in general will be more impacted by ETS2.
- The level of income has an influence, but the impact across the first four deciles should be considered.
- The impact of car ownership, and consequently high fuel expenditure, seems to be counterbalanced by the energy expenditures for households not owning a car.
- There are several elements that are not taken into account in the simulations (because the variables were not included or the sample size was not representative) but that would still require some attention, such as households with several children (having more complex transport patterns), elderly persons in remote areas, access to public transport, etc. Hence conclusions should focus on the previous three dots, while also paying attention to individuals or households that were not identified to be at risk of transport poverty.

3.3.5. Supplementary analysis of impacts

At a price of 60 EUR/tCO₂ around 13.5% of the Belgian population, 11.57 million inhabitants) would pay a high share of their disposable income for transport (more than twice the median %), and are therefore considered as vulnerable to transport poverty (**2M indicator**). Although this is a good indication of the amplitude of transport poverty, it does not offer a strong basis to breakdown and identify more granular vulnerable groups. E.g. the households according the 2M indicator are spread across all income deciles.

From the modelling results, the assessment of the persona/archetypes, and the various sources, several different household profiles can be identified as vulnerable to transport costs. There are also several overlaps, e.g. single-parent households with children might fall under the lowest income deciles and consequently could be counted twice if we address both criteria separately. In addition, several key drivers - which are not included in the modelling as no data are collected, but have a direct influence on the vulnerability of the groups - are analysed.

Therefore, this chapter presents:

- **preliminary considerations** – It lists the main constraints that need to be considered;
- the **main categories** that could be used to address the different vulnerable group options; and
- the **key drivers** that are embedded in the persona

Some preliminary considerations

Based on the literature (e.g. Lucas et al. 2016; Jeekel, 2019; Mattioli, 2021), the following groups (and their combination) show a higher risk of transport poverty in Belgium, that might be impacted by ETS2:

- residents in less densely populated locations;
- households with children (more complex travel patterns, mobilities of care);;
- single-parent households (one parent must organise (and pay for) the travel, women are overrepresented);
- elderly persons (lower income + physical ability is, on average, lower);
- disabled persons;
- persons without access to a car (in particular in rural and suburban areas); and
- households with low income.

Based on the stakeholders' feedback, the following groups should also be considered:

- households affected by Forced Car Ownership;
- households with a motorised vehicle that is no longer allowed in low emission zones;
- households without (suitable) access to public transport due to the distance between their dwelling and the nearest bus/train stop, or due to inadequate public transport timetables or impossibility to reach the required destinations;
- individuals too young or old to drive a car; and
- individuals with physical or cognitive disabilities, or with temporary or occasional health limitations.

Other important considerations include the following.

- Lower-skilled jobs often involve shift work and/or unregular working hours, and therefore a car is needed; many of these jobs are located in areas without suitable public transport.
- Households with children have on average more than one car, due to the inadequacy of public transport infrastructure. Solutions to reduce the dependence on cars, and hence the related fossil energy costs are investments in safe and reliable public transport, especially in cities⁷³.
- Development of semi-collective transport solutions (collectivised / granted VTC) to overcome specific constraints (last km without public transport).

⁷³ Slate. (2022). Au Japon, les villes sont si bien faites que les enfants de 3 ans peuvent marcher seuls. <https://www.slate.fr/story/226542/japon-ville-enfants-parents-mere-tokyo-securite-entraide-modele-courses>.

Main categories of vulnerable groups based on key drivers

The list of vulnerable (sub)groups, based on the persona (profile archetype, responding to a series of well-defined characteristics), will be characterised to group them comprehensively along the key variables listed below.

- **Population density** – highlights to which extent rural areas are more sensitive to transport poverty;
- **Income** - highlights to which extent transport poverty is mainly related to the lowest income deciles;
- **Access to public transport (too difficult)** – highlights to which extent difficult access to public transport is an influencing factor of transport poverty;
- **Household type and size** – highlights to which extent the type and size of households (number of adults and children) have an influence on transport poverty, with a specific attention to single person and one-parent with children households;
- **Enforced lack of a car** – assess the relevance of this criterion to identify vulnerable groups; and
- **Forced car ownership** - assess the relevance of this criterion to identify vulnerable groups.

CATEGORY 1 – Population density

In rural areas, dependence on a car is driven by two factors: long distances, with possibly complex transport patterns, and limited alternatives such as public transport.

The following graph shows that Brussels is very densely populated, while Flanders is a mix between highly populated urban areas and more rural areas, and Wallonia is by far the least densely populated region although counting more densely populated cities and zones in the North.

Picture 3-2 Population density (in number of occupied housing) in Belgium



Source: [Statbel – Type de logement](#)

The density of population is for transport the first influencing factor, and can be used to start identifying the most vulnerable groups.

CATEGORY 2 - Income

Some indicators show a clear correlation between transport poverty and income level. This is the case for the Enforced lack of car, which affects mainly the first income quintile (20.8% of the population), and the second quintile (5.2%). In general, the share of the population deemed vulnerable to the introduction of the ETS2 is obviously higher for the lowest expenditure tercile (25.2% with a CO₂ price at 60 EUR/tCO₂) than for the second tercile (15.4%).

The share of total expenditure that needs to be spent for transport per household on the ETS2 costs at a carbon price of 60 EUR/tCO₂ is highest (slightly above 0.6%) and is almost equal for the three lowest income deciles, while dropping from the fourth one, emphasizing the need to focus on the three lowest income deciles, which **means 30% of the population**.

CATEGORY 3 - Access to public transport (too difficult)

Access to public transport mainly impacts households living in rural areas, with 10.9% of the population affected by very difficult access to public transport (while the national average share is 6.8%, i.e. 793 thousand inhabitants). It remains difficult to estimate the share of this group that will face a significant fuel cost increase price due to the introduction to ETS2 (high number of km). The share of this group across income deciles is not known, but can be assumed to be equally distributed (there is intuitively no correlation between income and access to public transport).

Considering the increased share of expenditure for transport in total expenditure (for a carbon price of 60 EUR/tCO₂ and only households using fossil fuels for transport only), only the three lowest income deciles should be considered as they face a higher share increase (~0.6%). This would reduce the size of the group to 2.04% of the population (238 000) facing difficult access to public transport, while belonging to the lowest income deciles.

In this group, we should ideally identify the population effectively using a car for long distances (mainly in rural areas, but not only), but this combination is currently not known. However, this could be replaced by proxies like transport density (which is available at municipal level, to target a possible measure), the number of household members (more kids leads to more mobility needs), and/or the degree of urbanisation (which is also closely linked to the transport density).

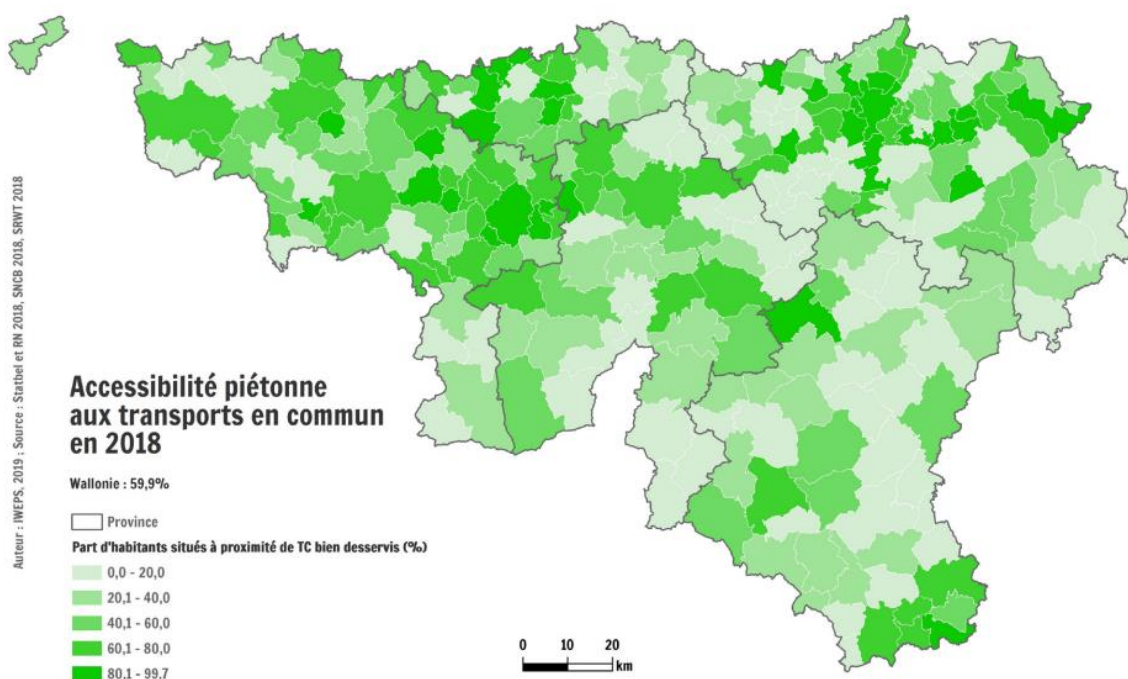
In **Belgium**, half of the single people do not own a car in 2023⁷⁴. For the concerned households, accessibility to public transport or to alternatives to an own car is crucial, to access all basic services and activities. The use of public transport is still very low, especially in Wallonia (only 5% of daily trips was done via buses in 2018) and in Flanders (only 4%, while traveling by bicycle did reach 18% in 2023).

The percentage of the population located in the pedestrian vicinity of stops well served by public transport varies greatly from one municipality to another, as depicted by the following map.

⁷⁴ Statbel. (2023). La moitié des personnes seules ne possèdent pas de voiture.
<https://statbel.fgov.be/fr/nouvelles/la-moitie-des-personnes-seules-ne-possedent-pas-de-voiture>.

Figure 3-58 Walking accessibility to public transport in Wallonia by municipality (IWEPS, 2018)

Carte 1 : Accessibilité piétonne aux transports en commun (2018) - source IWEPS¹⁸



Source: [RCS-Mobilité2020.pdf](#)

CATEGORY 4 – Household type and size

From the modelling realised in this project, there is no correlation between the transport related impact of ETS2 and the household types and sizes.

CATEGORY 5 - Enforced lack of a car

Around 6% of the Belgian population, i.e. 700 000 inhabitants, is estimated to face **enforced lack of a car** (or are car deprived). This share increases to 20.8% for the lowest income quintile, which represents 4.16% of the population, or 485 million inhabitants. This group is not directly impacted by ETS2, as it does not use fuel for transport, although it could to some extent benefit from M&I. However, this group is hardly identifiable for targeted M&I.

The share of car deprived households is in cities (13%) significantly higher than in rural areas (3%); if the access to public transport in cities is sufficient, specific measures for this group are not deemed necessary. It should be noted that, also in urban areas, people can have a high need for a car. Examples: people living or working in areas underserved by public transport; people living in a city but working outside the city; or working hours not synchronized with public transport availability; groups that are not able to use public transport, etc.

CATEGORY 6 - Forced car ownership

Around 5% of the Belgian population, i.e. 583 thousands inhabitants, is estimated to face **Forced Car Ownership**. This group of households with FCO will face directly

the increase of the fuel price due to the ETS2. The share of households facing FCO is higher in Wallonia (12.7%) than in Brussels-Capital (5.7%) and Flanders (3.6%).

3.3.6. Summary of impacts

Belgium currently counts 11.76 million inhabitants⁷⁵ and 5.16 million households⁷⁶.

Multiple vulnerability factors have been identified, such as population density, low-income (three lowest income deciles) and access to public transport. Enforced lack of a car and forced car ownership can be used as monitoring indicators (to track impacts of ETS2) but not to identify specific vulnerable groups.

The following aspects can be summarised to characterise transport poor or vulnerable households in Belgium.

- **Population density:** Households located in rural areas, will be more impacted, although there are variations between rural areas.
- **Income level:** Transport poor households often belong to the 3 lowest income deciles, with yearly incomes less than EUR 3 058 (gross salary). This financial strain is higher when the transport bill (due to the ETS2) will increase.
- **Access to public transport (too difficult):** this is a factor of already existing transport poverty, but it can significantly reinforce the impact on forced car ownership when limited alternatives to individual car ownership exist.

3.4. Impacts of ETS2 on micro-enterprise vulnerability

3.4.1. Impacts of ETS2 based on micro-modelling

Impacts of ETS2 based on micro-modelling analysis (using both indicators and target groups)

The analysis of the vulnerability of micro-enterprises in Belgium focuses on two aspects: *buildings and transport*. The impacts of ETS2 on buildings' and transport energy costs are evaluated on the basis of national fuel prices, CO₂ emission fuel-factors, and expected changes in the price of ETS2 (see Chapter 1.2.1). Our analysis also considers a reduction in the use of each fuel in response to the increase in price (elasticity).

It is important to consider that the analysis presented in this Chapter relies on several assumptions and it does not include all micro-enterprises registered in Belgium. This is because our main data source (the European Commission SME FACTSHEET 2024 based on EUROSTAT SBS) only provides information on 719 242

⁷⁵ Statbel. (2024). La Belgique comptait 11.763.650 habitants au 1er janvier 2024. <https://statbel.fgov.be/fr/nouvelles/la-belgique-comptait-11763650-habitants-au-1er-janvier-2024>.

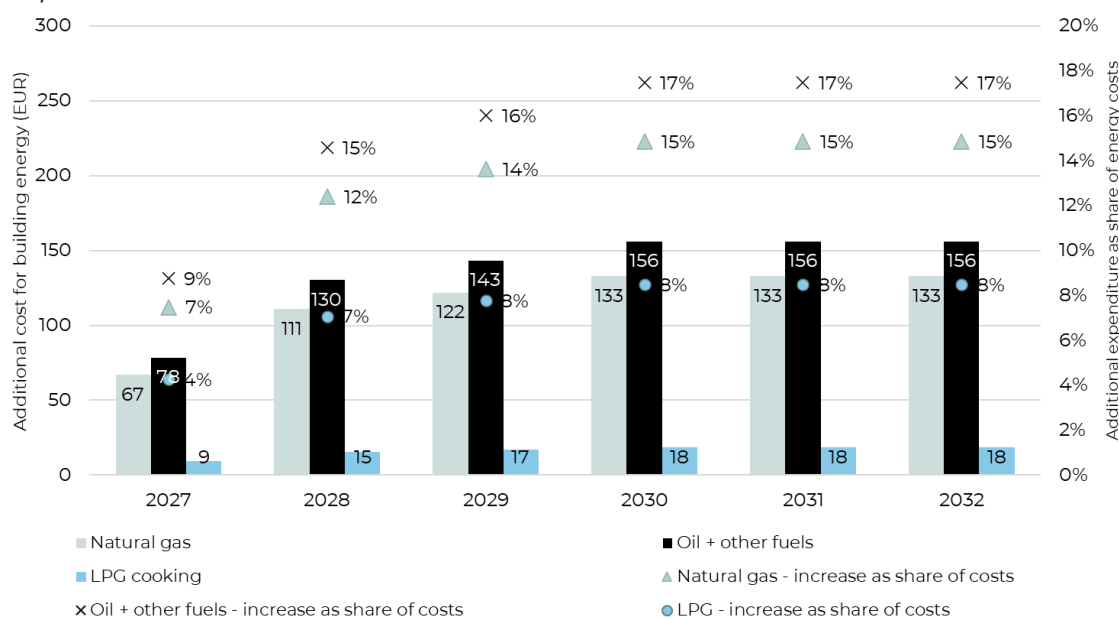
⁷⁶ Statbel. (2024). Ménages. <https://statbel.fgov.be/fr/themes/population/structure-de-la-population/menages>.

micro-enterprises compared to the 800 000 included in Eurostat. Therefore, these results cover 90% of the total number of micro-enterprises.

Figure 3-59 shows the additional building-related costs for the average micro-enterprise using either natural gas, oil, or LPG as main heating fuel up to 2032. Annual cost increases for buildings using oil and gas of around 14% of baseline costs are to be expected equivalent to an increase of around EUR 122 for gas and EUR 153 for oil from 2030. Data on total companies expenditure is not available, and therefore cannot be used to put annual cost increases under a broader perspective. However, we expect this increase to be a small fraction of total expenditure, similar to the increase observed for households.

Across all affected micro-enterprises, the cost increases will amount to EUR 82 million per year from 2030 onwards. Many micro-enterprises are home based and it is not possible to disentangle these costs between the two categories (households and micro-enterprises). These costs could therefore overlap to some extent with the increase in buildings energy costs presented in the analysis of vulnerable households.

Figure 3-59 Additional costs for energy in buildings for the average micro-enterprise that uses fossil fuels, excluding transport and transport-intensive companies

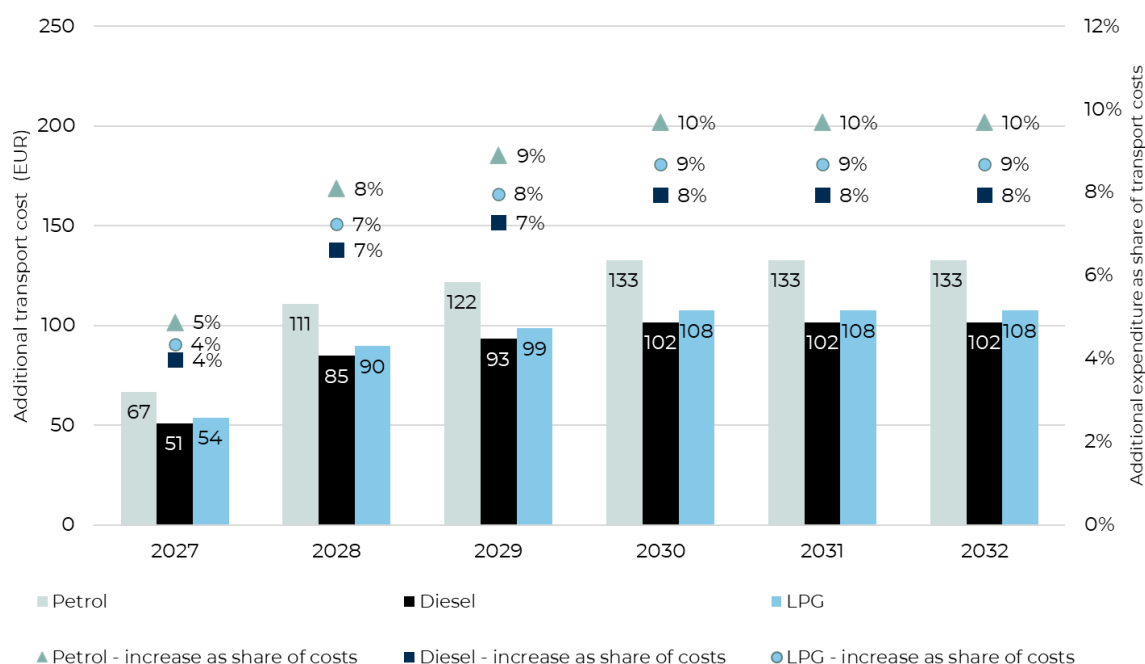


Source: Institute for European Energy and Climate Policy (IEECP) micro-modelling

The impacts of ETS2 on transport costs are in Figure 3-60, which shows that ETS2 may increase total transport fuel costs of the companies that own a fossil fuel vehicle by up to EUR 133 per year from 2030, an increase of up to 10%. Across all companies in Belgium, this results in an overall increase in annual transport costs of EUR 15.5 million per year from 2030 onwards. Additional costs are higher in

companies that are transport intensive, like transport or delivery, so we show them later separately. They are not included in Figure 3-60.

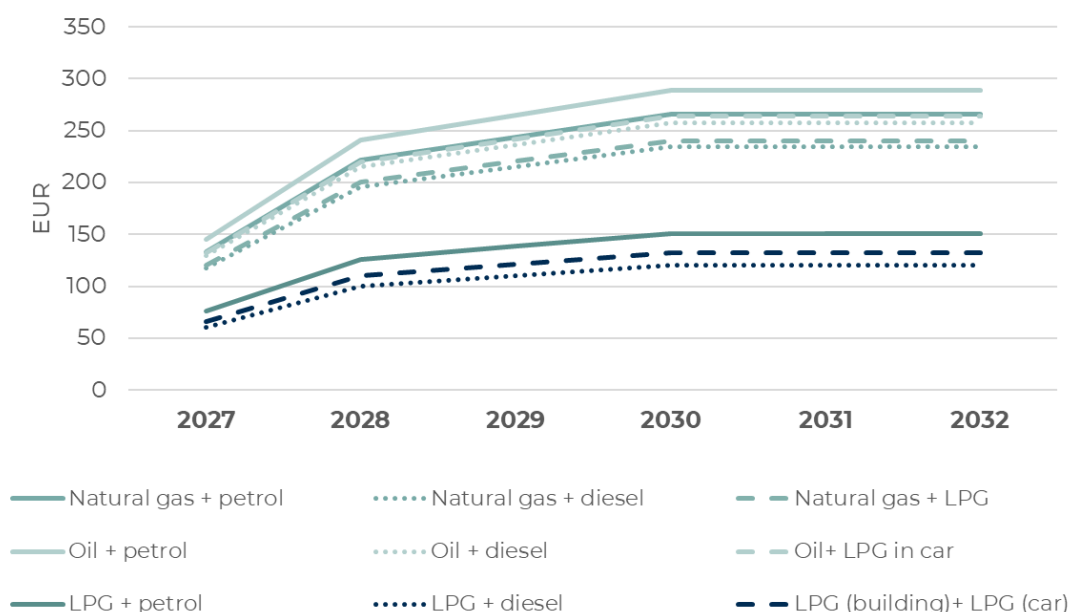
Figure 3-60. Additional costs for energy in transport for all average micro-enterprises, excluding transport (or transport intensive) companies (MEUR)



Source: Institute for European Energy and Climate Policy (IEECP) micro-modelling

To evaluate the total impact on the average micro-enterprise, we evaluated different combinations of building fuel and transport fuels. Figure 3-61 shows the annual cost increases of these combinations for 2030, highlighting that micro-enterprises that use oil for heating and DHW, or LPG for cooking, and petrol for vehicle use, are going to incur in the highest increase in energy cost, with almost EUR 300 of additional costs per year from 2030 onwards. This is a case only for micro-enterprises that use an office space and own a car, which is not a majority of companies.

Figure 3-61. Average additional cost per micro-enterprise (EUR)



Source: Institute for European Energy and Climate Policy (IEECP) micro-modelling

As discussed in the introduction to this chapter, we have analysed separately the effects of ETS2 on transport companies and transport-intensive micro-enterprises. We consider transport-intensive micro-enterprises those that fall within the NACE classes listed in Table 3-9.

Table 3-9. Transport and transport-intensive sectors

Sector	NACE class	No of companies*	Key assumptions per micro-enterprise**
Construction of residential and non-residential buildings (design excluded)	F4120	20 070	1 heavy-duty truck (D, P)
Urban and suburban passenger transport	H4931	200	2 buses (D)
Taxi operations	H4932	2 600	1 passenger car (P, D)
Other passenger transport by land	H4939	820	2 buses (D)
Freight transport by road	H4941	8 080	4 heavy-duty trucks (D)
Other postal and courier activities	H5320	4 360	2 LDVs(D)
Event catering activities	I5621	3 600	2 LDVs(D)
Tour operator activities	N7912	290	2 buses(D)

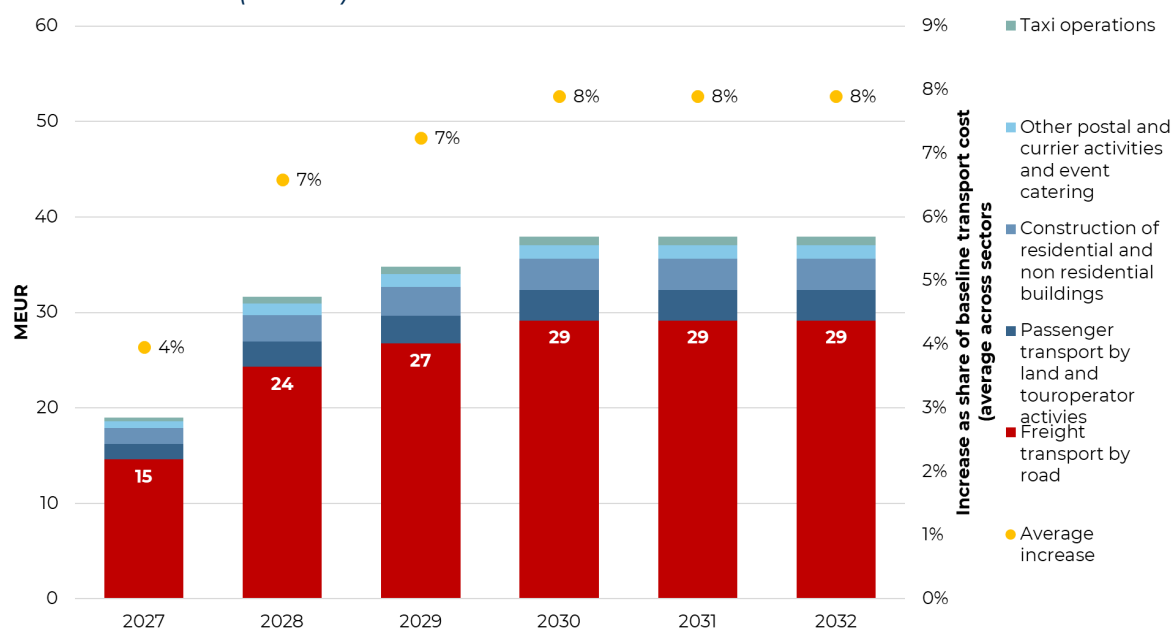
*rounded to the nearest 10

*D: diesel; P: Petrol; L: LPG (most common fuels)

For companies in these sectors the effects on energy consumption and cost changes are much higher than for average companies. Figure 3-62 shows that the impact of ETS2 on these micro-enterprises is expected to reach nearly EUR 38 million per year from 2030 onwards. Similarly to buildings and vehicles, these additional costs include a reduction in mileage following the increase in fuel prices (elasticity). The majority of the additional costs are to be borne by companies operating in road freight transport (8 000 companies, assumed to have 4 heavy-

duty trucks each), followed by construction-sector companies (16 500 companies, which we assume to own one vehicle per company and fewer km per year, compared to freight transport). Across all transport and transport-intensive sectors, it is expected that transport costs increases will amount to 8% of transport costs by 2030.

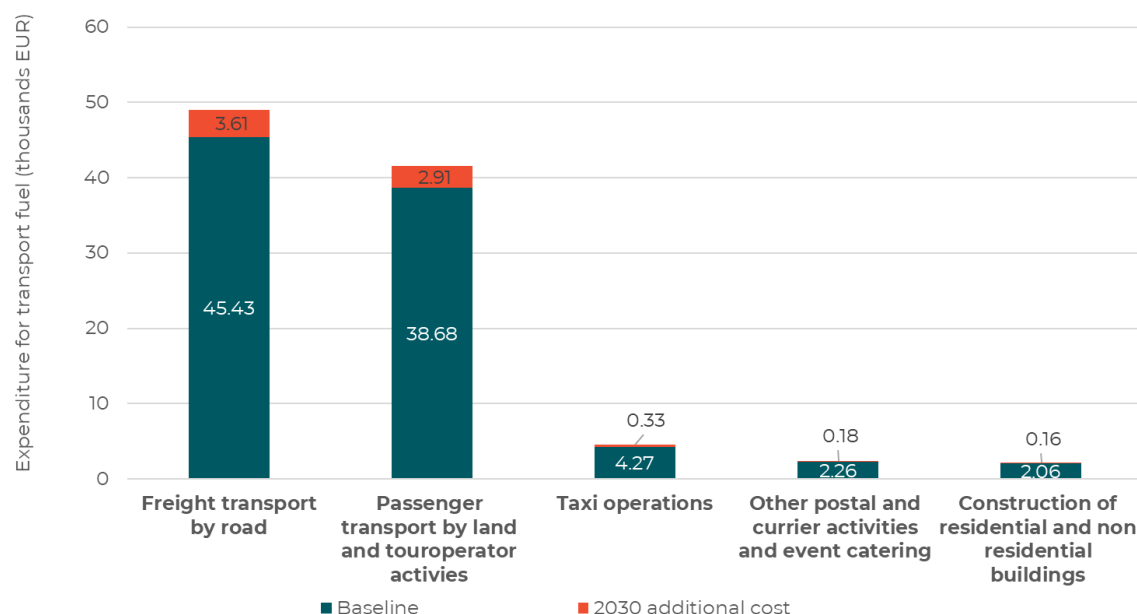
Figure 3-62. Additional cost for all micro-enterprise after ETS2 for transport intensive sectors (MEUR)



Source: Institute for European Energy and Climate Policy (IEECP) micro-modelling

The following figure shows additional costs per micro-enterprise in these sectors in the year 2030. Considering the average costs per micro-enterprise (Figure 3-63), companies operating in Freight transport by road are also the most affected (around 3 600 EUR/year), followed by tour operators and companies operating in road passenger transport (2 900 EUR/year). This effect is a combination of the high number of vehicles per micro-enterprise, high number of km per year (around 27 300 km and 37 200 km per year, respectively), and high fuel consumption (around 35 and 44 l/100 km, respectively).

Figure 3-63. Additional cost per micro-enterprise for transport and transport-intensive sectors in 2030



Source: [Institute for European Energy and Climate Policy \(IEECP\) micro-modelling](#)

Modelled number of vulnerable micro-enterprises / Identification of vulnerable micro-enterprises

Based on the chosen indicators (detailed in previous Chapters, see 2.2.3.), a simulation and approximation of the number of vulnerable micro-enterprises is provided in Table 3-10.

Table 3-10 Approximation of vulnerable micro-enterprises based on the definition

Indicator number	Indicator name	Number of vulnerable ME	Share of total micro-enterprise
Core Indicator 1	Micro-enterprises that use fossil fuel, which do not have the means to renovate the building they occupy, purchase zero- and low-emission vehicles or switch to alternative sustainable modes of transport (means to renovate):	112 000	15.6%
Core Indicator 2	Micro-enterprises with significant energy expenditure	34 400	4.8%
CORE indicator 2.1	Significant energy expenditure for on-site fossil fuels consumption after introduction of the ETS2	18 800	2.6%
Core indicator 2.2	Significant energy expenditure for transport after introduction of the ETS2	15 600	2.2%
ADDITIONAL IndicatorS			

Indicator number	Indicator name	Number of vulnerable ME	Share of total micro-enterprise
5	<i>Vulnerable enterprises once micro-enterprises operating from refurbished and new buildings are excluded</i>	34 100	4.7%

Vulnerable micro-enterprises are those captured by the two core indicators, in alignment with the definition of vulnerability in micro-enterprise. The Core Indicator 1 estimates the number of micro-enterprise that:

- a. *Use fossil fuels; and*
- b. *Do not have enough profit to renovate the building or buy an adequate vehicle.*

To determine the means of micro-enterprises to renovate buildings or to purchase zero- and low-emission vehicles (criterion b), the financial capability of affected micro-enterprises to invest needs to be assessed. This is done using following methodology:

- Renovation costs are calculated based on the information from the BPIE Recovery investment for deep renovation, used for the non-residential sector.³ Since this data is from 2020, the investment was adjusted using the construction analytics index to the period from 2025–2032. The investment is divided into annual instalments during the ETS2 implementation SCP scope (2027–2032).
- Vehicle purchase costs are calculated based on average market prices for a 4-seater car, light duty vehicles (LDV), trucks and buses. Vehicle costs are also divided in 6 instalments.

Depending on whether a company is using only building, only vehicle, or both, their yearly profit is not high enough to cover the additional expense for energy coming from ETS2 and this investment instalment, it is considered to fall under Core Indicator 1. Data on companies' average profit and the percentage that falls under this profit criterion originates from the ORBIS database. Based on our analysis, in Belgium, there are approximately **112 000** micro-enterprises that fulfil these criteria, equivalent to a share of approximately 15.6% of all micro-enterprises.

The second part of the definition refers to the significant energy expenditure in transport or buildings (Core Indicator 2). Based on the analysis presented in Chapter 3.4.3. combining Core IndicatorS 1 and 2, we estimate that the total number of vulnerable companies in Belgium is **34 400**.

However, a portion of these 34 400 micro-enterprises is based in new or refurbished buildings. Based on JRC IDEES 2021 available dataset, around 1.4% of all companies are located in new or refurbished buildings (3 483 out of 256 694 buildings in the service sector). If we assume that the share is equally distributed between vulnerable and non-vulnerable companies, we can assume that roughly

300 vulnerable micro-enterprises may be located in these buildings. This brings the number of vulnerable micro-enterprises down to **34 100**, which is around 4.7% of all micro-enterprises.

Summary of impacts

Belgium has approximately 719 242 micro-enterprises, and employing over 1 081 664 people. The analysis of their vulnerability to the introduction of ETS2 focused on two critical sectors: buildings and transport.

In the buildings sector, the most common fuel used by service-sector companies is natural gas, which is used in 61% of buildings for heating, domestic hot water (DHW), and cooking; 21% of companies use oil for heating and DHW, while LPG is used for cooking in 4% of the total building sum. The remaining 14% of buildings occupied by micro-enterprises are not included as none of the fuels used is in the scope of the ETS2.

In the transport sector, 21% of micro-enterprises own vehicles, and approximately 40 000 businesses are considered transport-intensive, including those involved in freight transport, passenger transport, and construction. Freight companies are the most significantly impacted, with expected additional costs of approximately EUR 3 700 annually per company due to the high number of vehicles, increased distances travelled (around 17 500 km annually), and substantial fuel consumption (approximately 35 litres per 100 km). Passenger transport and tour operator companies will also face increased costs, estimated at EUR 1 500 annually per company.

Among a series of combinations of building fuel and transport fuels, micro-enterprises that use heating oil for their building (space and DHW) in combination with vehicle fuels are going to incur the highest cost increase, with over EUR 250 of additional yearly costs from 2030 onwards.

Approximately 112 000 micro-enterprises lack the financial resources to invest in energy-efficient building renovations, transition to low-carbon vehicles, or adopt alternative modes of transport. Among these, 34 100 micro-enterprises are identified as critically vulnerable due to their significant energy expenditure and low profit margins. Based on the JRC IDEES 2021 available dataset, around 1.4% of all companies are located in new or refurbished buildings. If we assume the share is equally distributed between vulnerable and non-vulnerable companies, we can assume that roughly 300 vulnerable micro-enterprises may be located in these buildings. This brings the number of vulnerable micro-enterprises down to 34 100, which is around 4.7% of all micro-enterprises.

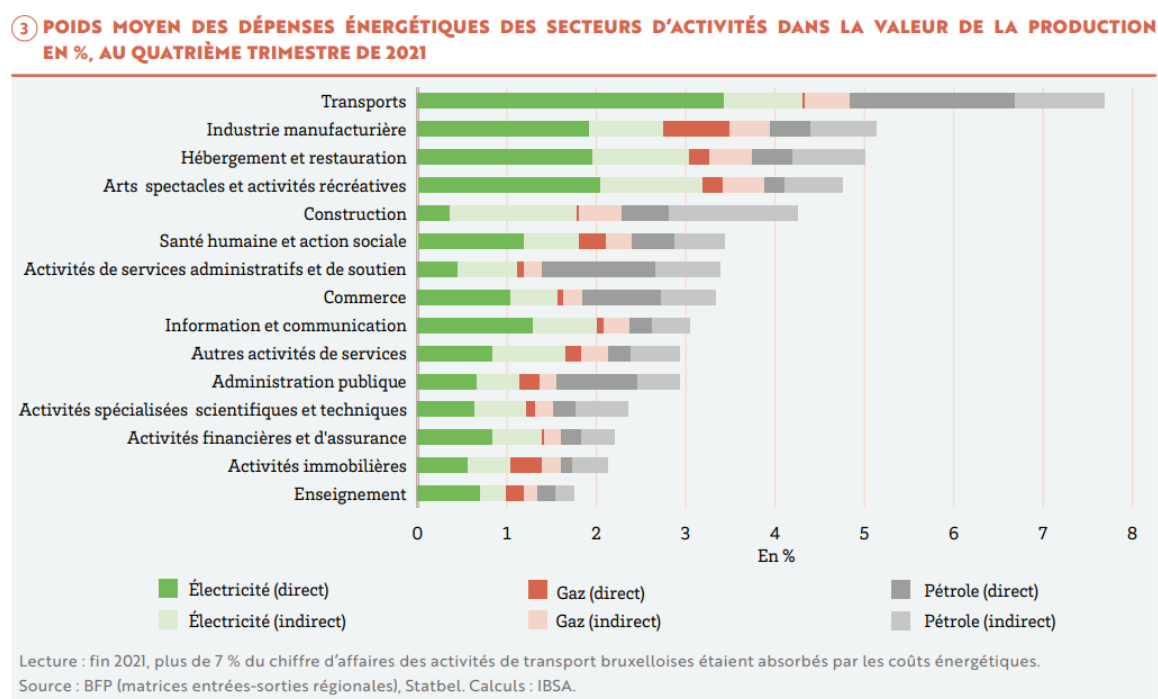
3.4.2. Supplementary analysis of impacts

To complement the assessment of the amount of vulnerable enterprises, we carry out an additional assessment of sectors that might be particularly vulnerable, based on the share of their fossil fuel expenditure relative to their total expenditure.

In 2022, a study was conducted by the Brussels Institute for Statistics and Analysis (IBSA) on the economic activity of Brussels during the energy crisis⁷⁷. The methodology developed by IBSA to understand the specific effects of the energy crisis on economic activity in Brussels can be relevant to identify the sectors that are most likely to be affected by the rise in energy bills due to ETS2 considering their specific energy (and/or transport) consumption patterns. However, as the structure of economic activity in Brussels is very different from that in other regions⁷⁸, the results of the analysis conducted by IBSA can only be used as a proxy to reflect the Belgian economic context. **We would recommend to conduct a similar analysis in the other two regions.** This would allow to identify which sectors are the most vulnerable to rises in energy prices.

The study shows that **depending on the quantity and type of energy consumed, rises in energy prices have a larger or lesser impact on economic activities.** Figure 3-64 presents the average weight of energy expenditure in total production value (in percentage), by sector in Brussels.

Figure 3-64 Average weight of energy expenditures in total production value by sector (in %) in Q4 2021



Source: IBSA, 2022

The transport sector (confirming the above modelling results), the manufacturing industry and the construction sectors are the most dependent on fossil fuels (gas

⁷⁷ Institut Bruxellois de statistique et d'analyse. (2022). L'activité économique bruxelloise face à la crise énergétique. https://ibsa.brussels/sites/default/files/publication/documents/Focus-51_FR_0.pdf. (Available in French).

⁷⁸ There are many differences between the three regions concerning their economic activities, but one of the main factors is that Brussels is a fully urbanised region, while both Wallonia and Flanders have both rural areas.

and petrol mainly for transport, given there is little use of heating oil in Brussels). Also, administrative and support/social services are quite dependant on fossil fuels.

From stakeholders' experience, the following elements can be highlighted⁷⁹.

- Micro-enterprises will be more impacted regarding their energy consumption, than regarding their transport consumption. However, this is partly because for most companies it's only a small part, although it may overlook transport intensive companies that shake up the average.
- According to survey respondents key factors that can lead to energy poverty or vulnerability for micro-enterprises are high energy prices, high initial costs of energy-saving technologies and lack of efficiency in buildings, which confirms the above modelling.
- According to survey respondents the main causes of transport poverty for micro-enterprises are high fuel costs and inadequate public transport.

Another study on the impact of the energy crisis on entrepreneurship in Brussels indicates that the economic activities that were most impacted by the energy crisis were productive activities, catering sector (hotels, restaurants, cafes) and convenience stores⁸⁰.

3.4.3. Summary and conclusions

According to the modelling results, approximately 34 100 micro-enterprises (~4.7% of the total number of micro-enterprises) are identified as critically vulnerable due to their significant energy and transport expenditure and low profit margins.

Among the concerned micro-enterprises, the following activities are the most vulnerable to transport poverty.

- Freight companies, with expected additional costs of approximately EUR 3 600 annually per company (with an average of 17 500 km annually).
- Passenger transport and tour operator companies will also face increased costs (estimated at EUR 2 900 annually per company).
- Construction activities, with on-site use but also transport of material and employees.
- Some administrative and support/social services, highly dependent on transportation.

Among a series of combinations of building fuel and possibly transport fuels, micro-enterprises that use heating oil for their building (space and domestic hot

⁷⁹ **Disclaimer:** The information provided is based on the results of the stakeholder survey conducted as part of the TSI in Belgium. There were 46 respondents and about half of the respondents indicated they had "no opinion" on the questions related to micro-enterprises. Given the size of the respondents sample, the results cannot be considered as statistically significant.

⁸⁰ Hub Brussels (2022). Impact de la crise énergétique sur les entreprises bruxelloises. <https://hub.brussels/fr/blog/enquete-limpact-de-la-crise-energetique-sur-les-entreprises-bruxelloises/>.

water), possibly in combination with vehicle fuels are going to incur the highest cost increase, for:

- manufacturing or productive activities, with important energy use for building and process heat (e.g. micro-food industry like bakery);
- hostel, restaurants and catering activities.

3.5. Impacts of the implementation of the EU energy and climate targets: expenditures and investments

3.5.1. Households: total expenditures on fuels for heating, electricity, durable goods and renovation

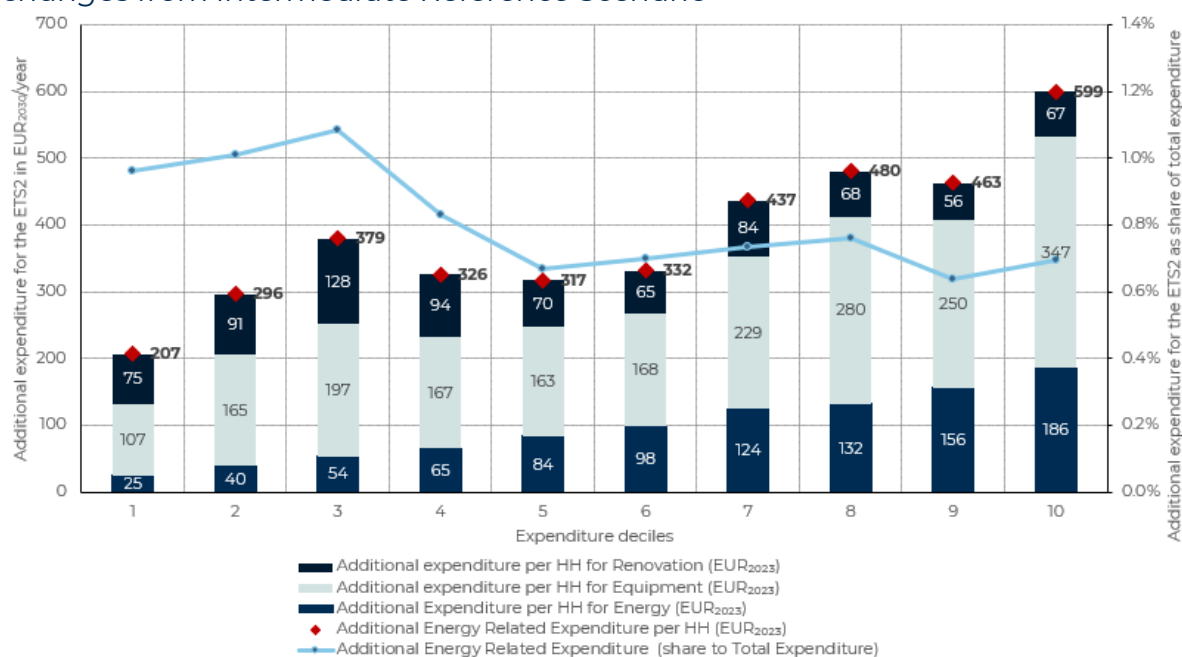
The ETS2 and the implementation of the EU energy and climate targets for 2030 are expected to moderately increase the energy expenditures of all households⁸¹ as shown in Figure 3-65. Our analysis shows that a significant driver of the increase in expenditure is investments for replacing equipment (i.e. more energy efficient appliances and electric heat pumps) and for renovation. The household fuel mix in Belgium is heavily based on fossil fuels (~70% of total consumption in households comes from fossil fuels⁸²). Therefore, the ETS2 driven increase in fossil fuel costs improves the relative financial case for replacing fossil heating systems with (electric) heat pumps, which is a major explanatory factor in the high increase in equipment spent across all income deciles. It should be noted that it is expected that policy (including the SCP) provides support to lower income deciles to fund the investments (renovation and equipment) necessary, i.e. households would not need to meet all of the investment costs mentioned themselves.

The potential for cost-effective energy-saving improvements in the building stock occupied by households in all income deciles is substantial. However, when assessed as a share of total expenditure, the additional costs compared to the Intermediate Reference scenario are proportionally higher for households in lower income deciles than higher income deciles. When compared with the Reference scenario the expected net impact is around a 1% increase for households in the four lowest income deciles and around an 0.7% increase for the households in the six highest income deciles. The following chapters present the decomposition of energy expenditures by fuel, equipment and renovation.

⁸¹ See Chapter 1.2 of the report for expected change in per unit fuel costs resulting from ETS2.

⁸² See also Chapter 1.2 for more details.

Figure 3-65 Change in Total Energy Expenditures in 2030 – Policy Scenario changes from Intermediate Reference Scenario



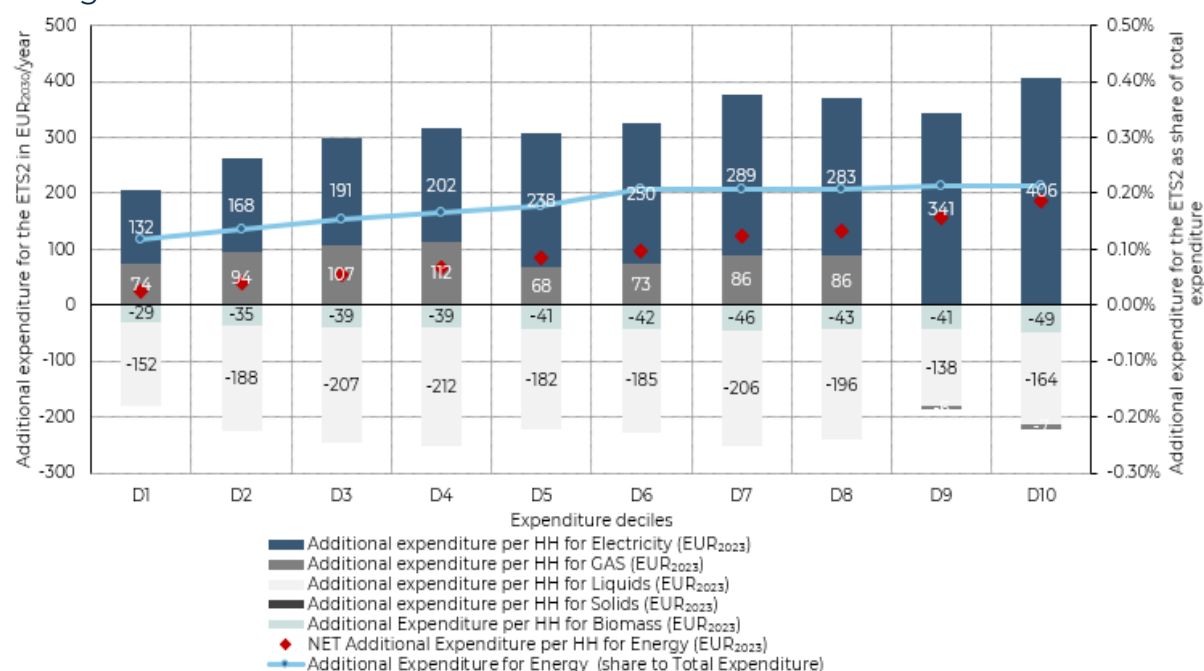
Source: GEME3, PRIMES, MHM

3.5.2. Households: expenditures split by energy carrier

The impact on energy related expenditure can be broken down per fuel, as shown in Figure . The net increase in energy related expenditure (as shown in the previous figure) is shown by the diamond marker. The lowest decile faces net additional expenditures on fuel and electricity of around 25 EUR/year, this steadily increases per decile up to around 185 EUR/year for the highest decile. It should be noted, that there is some decrease in the overall spending on energy – less expenditures on fuels somewhat counterbalances the increase in electricity spending due to purchase of more efficient appliances.

Overall, these net effects are driven by a reduction in expenditure for the consumption of oil (and to a smaller extent biomass), and an increase in expenditure for electricity and gas. **The main driver of this change is the replacement of oil-fired boilers with heat pumps and gas-fired boilers.** The only significant variation in this general explanation is found in the two highest income deciles, where households are expected to replace not only oil but also some gas boilers with heat pumps, and the substitution effect is large enough to reduce overall gas expenditures, when compared to the reference scenario.

Figure 3-66 Change in Energy related Expenditures in 2030 – Policy Scenario changes from Intermediate Reference Scenario

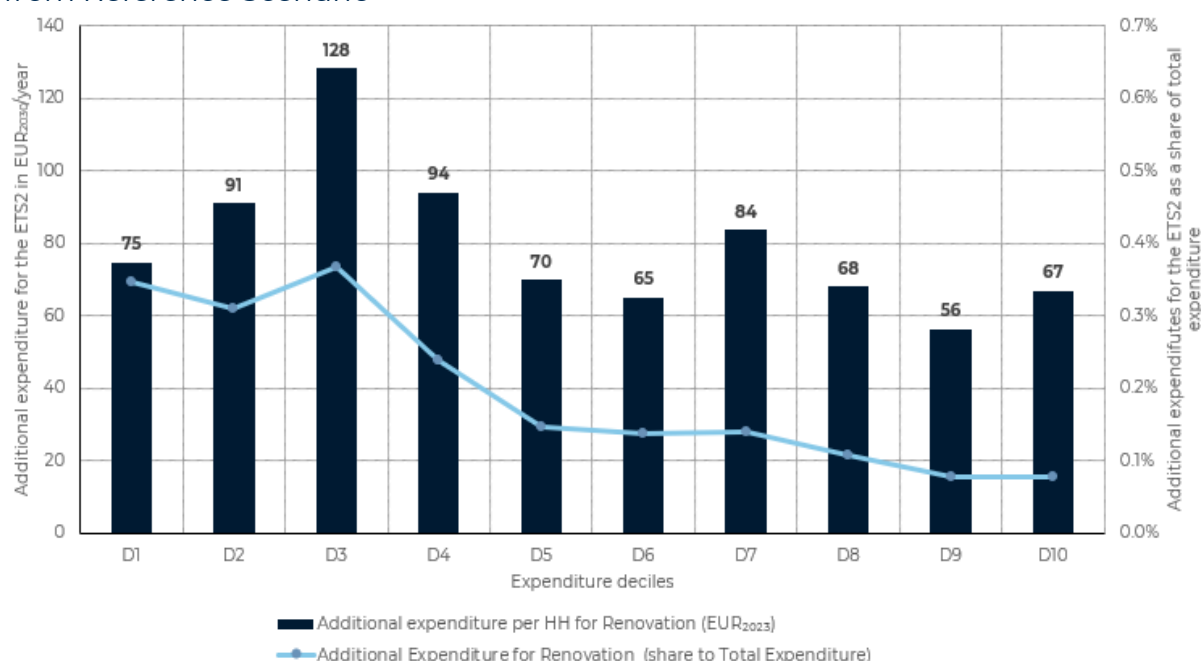


Source: GEME3, PRIMES, MHM

3.5.3. Households: investments in renovation

Renovation expenditures are largely driven by the need to meet the energy efficiency targets in 2030 and the policies associated with this. For the households in the four lowest income deciles this increases spending by an additional 75–130 EUR/year. This is also the highest increase as a share of total expenditures. The absolute expenditures are also higher for the lowest deciles, with the exception of the 7th decile. It is understood that the main driver of this difference is that renovation needs and potential are higher in lower income households.

Figure 3-67 Change in Renovation Expenditures in 2030 – Policy Scenario changes from Reference Scenario

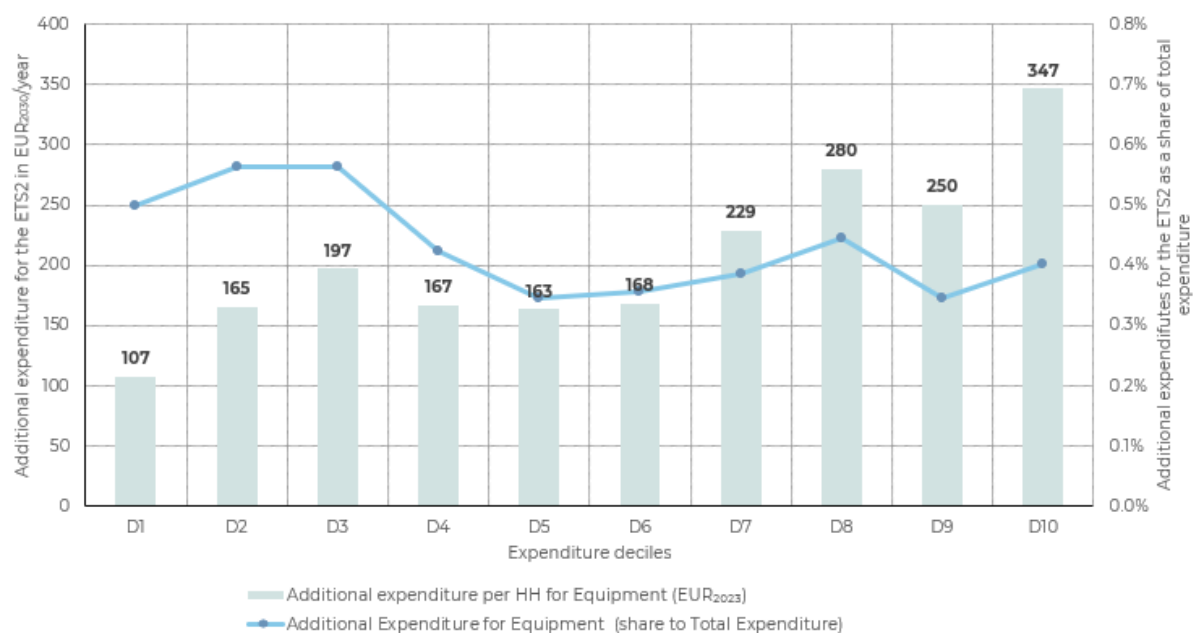


Source: GEME3, PRIMES, MHM

3.5.4. Households: investments in equipment

Expenditures on equipment (space and water heating/air-cooling/cooking) devices increase by 110 EUR/year for households in the first income decile, and to a maximum of 350 EUR/year for the highest income decile. Households in the lowest three income deciles have the highest proportional increase in expenditures as they invest in upgrading their oil-boilers to use gas. Whilst households in the higher income deciles, particularly in the ninth and tenth as shown earlier, switch from oil and gas to heat pumps, that is more expensive than conventional heating technologies but also more efficient.

Figure 3-68 Change in Equipment Expenditures in 2030 – Policy Scenario changes from Reference Scenario

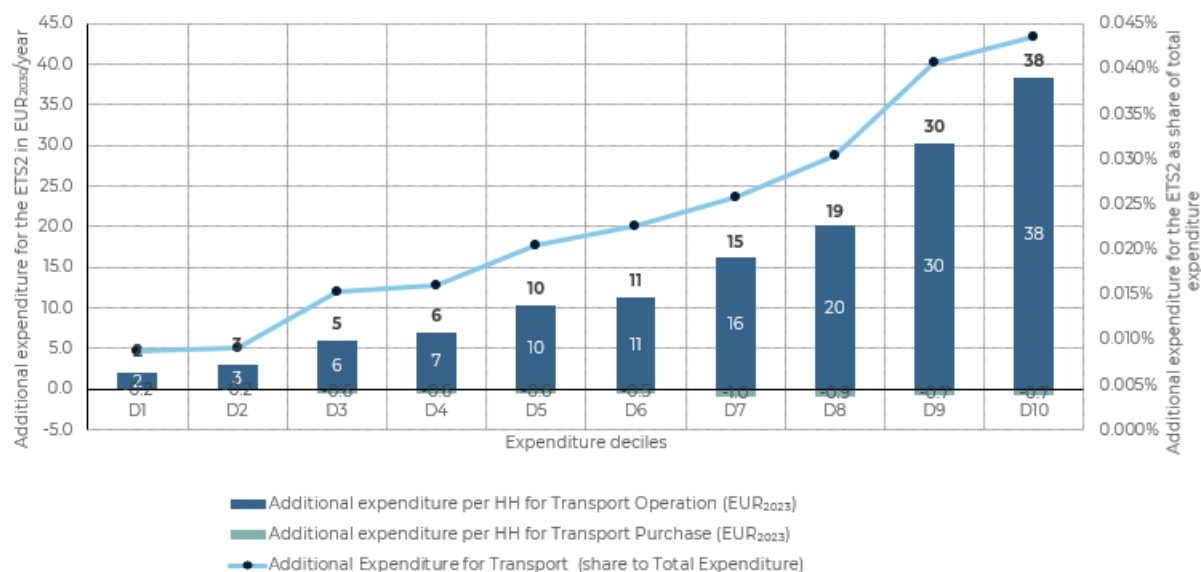


Source: GEME3, PRIMES, MHM

3.5.5. Transport: expenditures on fuels

The ETS2 extension and the implementation of the EU energy and climate targets for 2030 are expected to have a limited net impact on transport costs for households, ranging from 3 EUR/year for households in the first income decile to around 40 EUR/year for households in the highest income decile. This is because the Belgian fleet is, on average, fuel efficient and (by 2030) includes a growing number of electric vehicles, minimising the impact of the increase in fossil fuel prices driven by ETS2.

Figure 3-69 Change in Transport Expenditures in 2030 – Policy Scenario changes from Reference Scenario



Source: GEME3, PRIMES, MHM

3.5.6. Summary

We analysed the changes to households' energy and transport expenditure deriving from the introduction of the Fit for 55 package of measures implementing the Green Deal, which include the ETS2. We conclude the following.

- Overall, the effects are quite moderate. The net impact on total energy expenditures is significant in absolute terms (200–600 EUR/year), reflecting around a 1% increase in total household expenditure for the most affected households. The proportionally most affected households are to be found in the four lowest income deciles.
- The increase is explained by the fact that in Belgium fossil fuels consumption is high (compared to other Member States) and, when the carbon price is applied, the savings from renovation are not enough to counterbalance the increases in households energy expenditure.
- Improving energy efficiency in buildings increases the resilience of households in fluctuations of fuel and electricity prices. In the current analysis the benefits of renovation are presented in all deciles as lower consumption of fuels and electricity. The largest share of the cost increases are driven by the purchases of equipment and renovation investments, rather than additional fuel costs (where the policies including ETS2 have a net impact of increasing costs by 25–185 EUR/year). These types of expenditures are not annual but mostly one time investments that will provide benefits to households and micro-enterprises, such as reductions in energy bills which payback the initial investment over time and increases in the value of buildings.
- Increasing capital expenditures – on renovations and equipment (e.g. more energy-efficient appliances) constitute the largest expenditure increases. These expenditures reduce energy demand and associated operating expenditures.
- Households in lower income deciles are expected to purchase heating appliances, usually switching from oil to gas, while households in the highest income deciles are more likely to switch from gas to heat pumps.
- High efficiency of the current vehicle fleet, and the electrification of passenger vehicles, lead to only marginal increases in household transport expenditure.

3.6. Comparison of results

In this chapter we have used two different methodologies to assess the impacts of ETS2 on vulnerable households and transport users. Firstly, we used a static approach based on micro-data analysis that estimated the impact on the energy cost of households for heating (Chapter 3.2) and for individuals for transport (Chapter 3.3). This approach is considered static as it assumes that the ETS2 carbon price is introduced on the existing (2015) system with no flexibility for households to adapt their energy consumption behaviour apart from a reduction in

consumption levels due to changes in prices (i.e. no fuel switch, model shift or renovation considerations).

Secondly, we provided a dynamic model-based analysis of the ETS2 implications, that incorporates the evolution of consumption patterns which respond to fuel price projections, changes in technological costs and technology adoption. The model also incorporates income and population changes towards 2030, as well as the implementation of the EU energy and climate targets in 2030 (including the Fit for 55 package), which can also drive households' investments in renovation and more efficient appliances and vehicles, impacting fuel consumption.

Both methodological approaches provide relevant insights into the impacts of ETS2 on energy expenditure of households. In the case of CO₂ prices of 60 EUR/tCO₂, our analysis shows that when households do not consider other technological options but mainly respond to price changes via a change in consumption levels (i.e. approach 1), energy costs for heating purposes increase from 0.3% to 0.7% of total expenditure of goods and services for high and low-income households respectively and by 0.2% to 0.4% of total expenditure of goods and services for transport purposes, with higher impacts for medium income households.

Once additional technological options are considered (approach 2), and in combination with other measures and policies associated with the Fit for 55 package implementing the Green Deal, the heating-related fuel expenditure are expected to increase by 0.1% to 0.2% of total expenditure of goods and services for low and high-income households respectively, driven primarily by a fuel switch towards electrification, and to a less extent by higher expenditure for gas that is registered in low-income households. This fuel switch is facilitated by expenditures for advanced heating equipment (i.e. from oil boilers to gas for low-income households or to heat pumps for higher income groups) which is estimated to increase. In the case of low-income households, expenditures for advanced heating equipment are projected around 0.5% of total expenditure of goods and services, compared to around 0.4% for the high-income households. Expenditures for renovation also increase primarily for low-income households by around 0.3% of total expenditure of goods and services.

For transport, fuel expenditure is modelled to increase only marginally, due to modal shift to public transport and to some extent to more efficient vehicles for high-income households, and similar to the static analysis the highest impacts are experienced by the highest-income deciles (however, the values from the dynamic analysis are significantly lower, e.g. around 0.05% of total expenditure of goods and services for high-income groups).

Looking towards Deliverable 3 and the measures and investments to include in the social climate plan, we note that especially in the case of the most vulnerable households, the investments in renovation and more efficient equipment may not

by funded via the households' disposable income but rather through policies (including SCP) providing dedicated financing sources (e.g. grants).

4. Preliminary long list of measures and investments considered

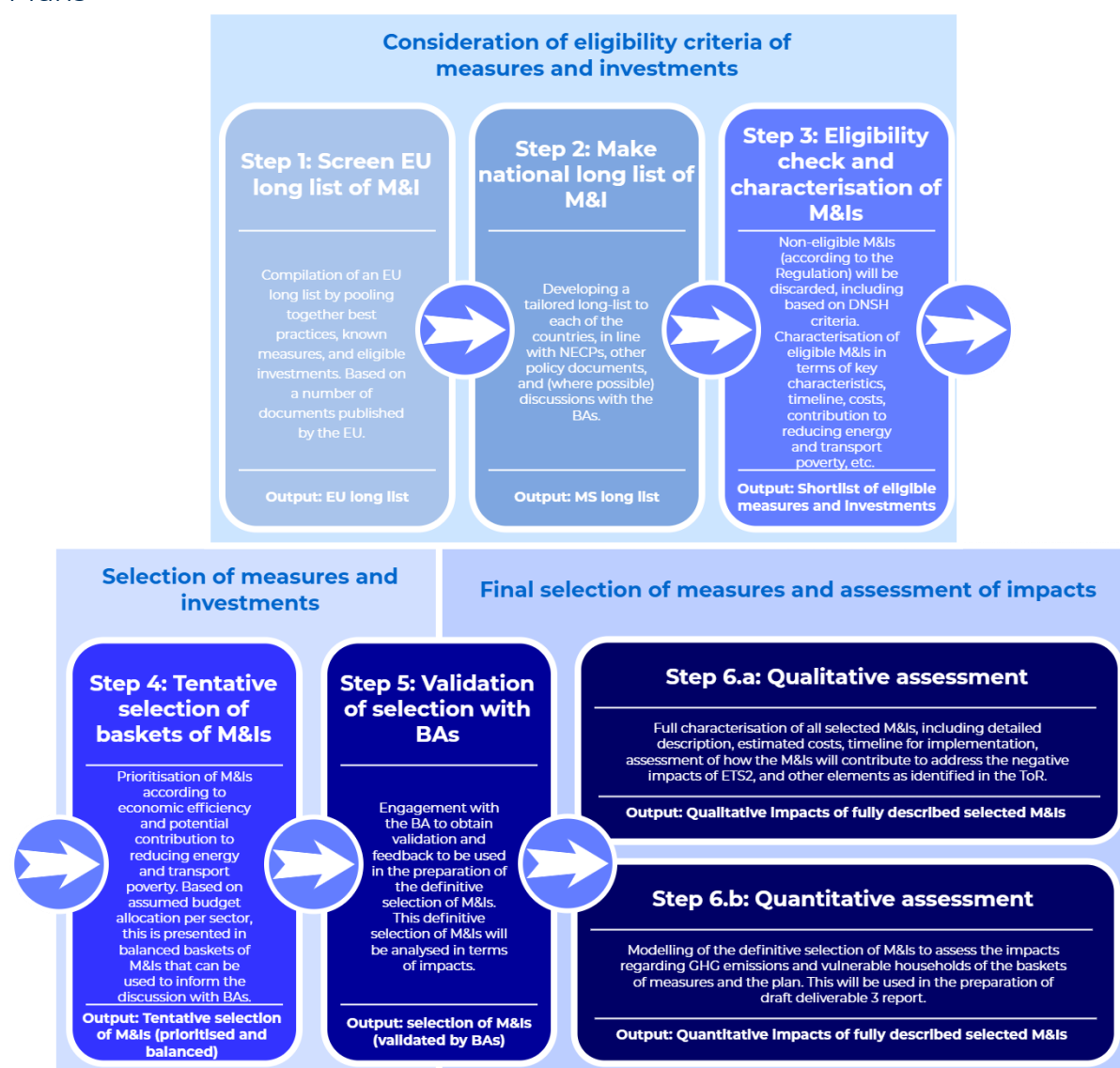
This chapter outlines the process of defining an initial long list of measures and investments for potential inclusion in the national Social Climate Plans, using the EU long list from the Inception Report (Deliverable 1) as a guiding reference⁸³.

4.1. The process towards defining M&I for the Social Climate Plans (SCP)

The process steps towards defining measures and investments (M&I) for the SCP is presented in Figure 4-1. The first step, i.e. the establishment EU long list of M&I has been completed, with results presented in the inception report⁸³. Chapter 4.2 deals with step 2, i.e. making a national long list of M&I. Next steps (shortlisting) are presented in Chapter 4.3.

⁸³ This long list is informed by Regulation (EU) 2023/955 of the European Parliament and Council (10 May 2023), which established the Social Climate Fund (SCF) and amended Regulation (EU) 2021/1060, as well as the consultation on the application of the 'DNSH' principle under the SCF, both of which have already identified effective practices. Additionally, we have compared these practices with policies in the International Energy Agency (IEA) policies database and successful policy implementations highlighted in reports, such as the 2023 publication by the Global Covenant of Mayors. We also acknowledge the work produced by DG CLIMA, as requested by the Regulation, in the 'Support for the Implementation of the Social Climate Fund: Note on Good Practices for Cost-Effective Measures,' which provides examples of potential measures for the SCF. DG MOVE has contributed additional relevant work on public transport and shared mobility through the Expert Group for Urban Mobility (EGUM) and DG ENER has focused on energy poverty and related measures through the Energy Poverty and Vulnerable Consumers Coordination Group.

Figure 4-1 Process towards defining measures and investments for Social Climate Plans



4.2. Developing the national list of M&I

In Belgium, the establishment of the long list is a continuous and interactive process with the beneficiaries.

4.2.1. Elaboration of the national long list of M&I (step 1)

The objective of this second process step is to tailor the EU long list to Belgium-specific context, taking into account current measures already in place by each of the four entities (at regional-level and at federal-level) and the specific priorities of the four entities, to provide a more comprehensive and targeted choice set.

In order to deliver this objective the following sub-steps have been carried out:

- establishment of a “preliminary national long list” (4 November);
- establishment of an “national long list of eligible M&I”, based on the screening of the three SCF eligibility criteria (by 7 January); and

- iii. establishment of a relevant list (or final national long list) of measures (by 17 January).

Sub-step i is focused on identifying a preliminary list of priorities for the Beneficiary Authorities in relation to M&I already in place and which could be expanded and included in the SCPs (see requirements on additionality of the funding below). It also involved scanning for any new M&I that could be currently under consideration. This “preliminary national long list”, established by the Beneficiary Authorities with the support of the Country Team, was discussed with the national stakeholders during the 4 November workshop. The 4 November workshop was organised by the Beneficiary Authorities and the Belgian Combat Poverty Service with the support from the Country Team. It provided a good basis to get stakeholders advice to rank the measures and investments. The survey will provide additional insights to help refining some measures and investments, to support their prioritisation, their ranking and their possible selection. Annex D presents this “preliminary national long list”.

Sub-step ii, this “national long list of eligible M&I” will be established by the Project Team, on the basis of additional screening of national-level M&I, the feedback gathered during the 4 November workshop, the input provided during the November survey, and interactions with various administrations and experts.

This list is designed to ensure that the M&I to be included in the national long list are eligible under the criteria set out in the Regulation, referring to the (i) target groups, (ii) the scope of action and (iii) avoiding double funding. Regarding the screening of national-level M&I on the first two eligibility criteria (target groups and scope of action), a screening table is developed in which the target groups and scope of action are added to the EU long list, facilitating the screening of existing or intended M&I. Basically, if an existing or intended M&I fits the EU long list, the existing or intended M&I meets the first two criteria and only a check on additionality is needed (see description on double funding below).

If an existing or intended M&I is not included in the EU long list (or screening table), it can still be included in the national long list, if the M&I aligns with the three above-mentioned eligibility criteria (target group, scope of action, additionality). These criteria must be assessed in order to be included. For scope of action, this means that the M&I needs to comply with the DNSH principle⁸⁴. This compliance should be verified by assessing each measure against the six environmental objectives outlined in the DNSH Technical Guidance. To this end, we use a screening questionnaire to test the existing or intended national M&I.

The third criterion relates to double funding: the funds to be potentially received under the SCP cannot replace existing national or EU funding, and the same cost cannot be funded twice. Therefore, an assessment is made whether M&I are

⁸⁴ In line with Article 17 of Regulation (EU) 2020/852 (Taxonomy Regulation).

already in place at the national level. If so, funds to be received from the SCF cannot substitute recurring national budgetary expenditure. Instead, funds to be provided for these existing programmes will need to be used only for their expansion or to be “scaled up”.

The “national long list of eligible M&I” includes the measures and investments that successfully passed the screening, highlighting how they meet the eligibility criteria (target group, type/scope of measure, and additionality).

Sub-step iii, the “national long list of eligible M&I” will then be tailored to the specific needs of the four entities, which will possibly reduce the list, or expand it after additional internal consultation with other concerned administrations. This will be done by the four BAs. A last verification will be conducted by the Project Team, to ensure the possible additional M&I are eligible to SCF.

From there we will have four “entity” long lists of M&I, that will be further discussed at entity levels, although discussions will still be coordinated among the entities. However, these “long” lists will already be rather short, as they will take into consideration the constraints and needs of institutional and non-institutional stakeholders.

4.2.2. Shortlisting of M&I (step 2)

This step aims to finalise the selection of the measures by ranking them in the four “entity” lists. This is done on the basis of pre-defined criteria, to support the justification of their selection. We will use a simplified multi-criteria analysis (MCA) approach, using key qualitative criteria (these criteria will remain simple and will not contain quantification). The ranking will also support their later prioritisation (under step 3).

Each measure will be scored against the following criteria (RAG rating)⁸⁵:

- stakeholder feedback;
- ease of implementation; and
- coherence with the available budget (considering EPOV, TPOV and ME poverty, for the 3 regions and the federal, for a period of 6 years)

A pre-scoring of the criteria will be conducted on the “preliminary national long list” under step 1 – sub-step ii (done by the Project Team by 7 January). The scoring of the additional M&I (added between 7 and 17 January) will be proposed by the Project Team by 19 January. The BAs will have until 24 January to validate or tailor the scoring of each measure, and then to select (shortlist) the M&I with the highest ranking. This will lead to a shortlist tailored to the entity specific needs and priorities.

Additional or alternative criteria could be:

- tailorable to specific identified vulnerable groups;

⁸⁵ Red (not relevant), Amber (slightly relevant), Green (highly relevant).

- alignment with existing policies and strategies (inc. complementarity); and
- availability of co-finance from other sources (EU, federal/regional, private).

4.2.3. Summary of final list of M&I

The results of the entire process, and the reason for selection or discard of measures will be provided in Deliverable 3.

4.3. Next steps towards characterising M&I

In line with Figure , the next steps leading to the characterisation of M&I for the SCPs are described in Table 4-1.

Table 4-1 Next steps towards selecting M&I for Social Climate Plans

Step	Objective
Step 3: Eligibility check and characterisation of M&Is	Perform a final check on M&Is and discard ineligible ones, including on DNSH criteria, as well as begin the characterisation of the measures on elements that are useful for further steps (e.g. costs and timelines).
Step 4: Tentative selection of baskets of M&Is	Obtain information and structure the M&Is in a way that is useful to inform discussions with the BAs on the final selection of measures. This involves a prioritisation of measures and presenting how the possible measures help fulfil the objectives of the plan.
Step 5: Validation of selection with BAs	Obtain the final selection of measures in discussion with the BAs, who ultimately have the decision power on which measures to present on the plan.
Step 6.a and 6.b: Qualitative and quantitative assessment.	Finalise the characterisation of the measures to include on the plan, as well as impacts in vulnerable groups, energy poverty, and transport poverty, so that BAs can use the information in the drafting process of the plans.

This list of M&I will be tailored to each entity, which will then operate its own political process. The final selection of shortlisted M&I will be at the discretion of each government. This TSI will be limited to providing the assessment (characterisation and impact assessment) of the shortlisted measures and investments selected under step 2.

5. Recommendations for the collection and use of data, indicators and criteria to identify and estimate the size of the vulnerable groups

5.1. Current gaps

5.1.1. General Considerations

One of the major constraints with regard to data collection is the lack of information related to energy consumption of households in the main data sources. The link with the level of impact due to the introduction of ETS2 can be hardly assessed and therefore it complicates the identification of the dwellings that have a low level of energy performance.

Some data can be considered very subjective (data that inform the “keeping the house adequately warm” indicator, e.g.) and should therefore, even though these are considered as critical and informative indicators, be considered with caution (e.g. even households with a higher income level can feel their dwelling is not adequately warm, especially during winter if they want to limit the gas bill increases, to avoid that a too high share of their income should be spent to heat their dwelling).

A more granular level was needed to identify more targeted groups via persona (or household archetypes, see Chapter 3.2.3) with well-defined characteristics. This higher granularity allowed to confirm or precise some preliminary findings, or to narrow down the groups to target smaller groups. However, given the regional sensitivities and contexts, a detailed break down with clearly defined groups and an exact size of the group(s) has not been done yet.

Energy and transport poverty data often lack gender dimension. Gender-sensitive policies should be considered in the Social Climate Plans (SCP). Targeted interventions can help ensure that women, especially those in vulnerable households or running micro-enterprises, are adequately supported in the transition to a low-carbon economy. When developing Plan, potential gender disproportions should be taken into account. During characterisation process of M&I, extra information on gender aspects will be added. In addition, other sensitivities – such as age and special needs, should be considered.

5.1.2. Vulnerable households

- The coverage of building energy certificates in Belgium is low, making it difficult to obtain detailed information on the energy performance of the

building stock. But starting by the identification of the **worst energy performing dwellings** would be an adequate approach.

- The three **lowest income deciles** is a large group representing 30% of the population. There are large variations between households in the same decile, with the largest part of protected households (social energy tariff). A breakdown of the number of households that are part of the 3 first deciles could be done by region on:
 - using heating oil in rural, urban and middle density areas separately;
 - single person and one-parent households; and
 - the level of performance of the dwelling and its sanitary level (i.e. leak, damp, rot – yes/no).
- The **population renting** a dwelling is particularly vulnerable and should be addressed specifically, as they don't have the possibility to renovate the property they occupy. Therefore, a breakdown of the number of tenant households could be done by region on:
 - the level of energy performance of the dwelling and whether it is a public or private (social) housing.
- Although households in **oil-heated dwellings** are recognised as particularly vulnerable, there is no reliable data on the current number of such dwellings in Belgium. Estimates vary widely and the breakdown of the number of households using heating oil could be done by region on:
 - The level of energy performance of the dwelling.
- Regarding **social energy tariffs**, some stakeholders assume that households benefitting from social tariffs are already protected and should therefore not receive additional protection; measures should therefore rather focus on the next part of the population at risk of energy poverty with ETS2. Other stakeholders suggest to continue focusing on the protected groups considering they are the most vulnerable and will feel a higher relative impact (for a similar level of consumption) from ETS2. The current assessment does not allow to recommend an option as this would require additional analysis. However, on the basis of the assessment under the "Supplementary analysis of impacts (persona from Federal Planning Bureau)" (see Chapter 3.2.4), the social tariff can indeed be considered as an indicator for the vulnerability of a group.

5.1.3. Vulnerable transport users

- **Population density** has been recognised as a critical factor in the Belgian context and must be carefully considered when developing measures and indicators. Given the varying population densities across the three regions, it is essential to tailor solutions to meet the specific needs for transport vulnerable population. Access to public transport and other alternatives to individual car ownership is crucial.

- The three **lowest income deciles** represent a large group (30% of the population). There are large variations between households in the same income decile, with different transport needs/patterns. A breakdown of the number of households from the 3 lowest income deciles could be done by region on:
 - accessibility to public transport and to alternatives to individual car ownership; and
 - household types, separating single person, one-parent, and multi-children households.
- **Accessibility to public transport:** this requires to develop a strategy at local level (at least municipality level), starting with mapping the time needed to connect to the closest public transport connection point (see map for Wallonia under Chapter 3.3.5). This should also be coupled with zones where there is a higher density of low income households. Such combination could help prioritise the zones where measures should be taken.
- **Household type and size:** further analysis is probably needed to determine what household typology could be most affected by the impact of ETS2 on transport costs:
 - in particular single person, one-parent with children and multi-children households, also considering by region;
 - the population density and income level; and
 - car ownership.

5.1.4. Vulnerable micro-enterprises

- There is currently no national data on the energy consumption of micro-enterprises for building heating and possibly “processes” (electricity, heating oil, bioenergy or natural gas), and for transport purposes.
- Fuel costs for micro-enterprises are not centralised.
- Most micro-enterprises are closely related to households, with part of a residential building being used or rented for a professional activity. This complicates the identification of professional and private vulnerabilities to fossil energy costs, and could possibly lead to duplication when the same actors are targeted from both perspectives (household and micro-enterprise).
- Defining adequate indicators to assess the vulnerability of micro-enterprises is challenging due to the absence of data on the real estate and vehicles that micro-enterprises use for their operations.

5.2. Recommendations

5.2.1. General considerations

- Bring the more granular analysis of vulnerable groups from the national simulations (also based on EU-SILC and HBS) to the EU-level, in order to

assess the impact of measures and investments on these more granular datasets.

- Reinforce the involvement of experts to bring additional insights and continue engaging with representatives of vulnerable groups to gather data on their size, relevance, and other pertinent factors.
- Methods to precisely identify groups targeted by measures and investments is still to be defined, to ensure they can access the available measures while not overburdening the request with additional data and information to be provided by applicants, and treated by the concerned authority. This requires further identification of the areas where these households are located and how to reach them. This effort could serve as a measure in itself and is a prerequisite for the success of subsequent initiatives.
- In Belgium, existing measures are currently underutilised, so efforts should prioritise disseminating information to identified relevant groups⁸⁶.

5.2.2. Vulnerable households

- Amend the (SILC) survey questionnaire at Belgian level (and EU level) to include information related to the energy consumption, and where available to the EPC (energy performance level).
- Assess the correlation between the level of energy performance of dwellings and their quality (i.e. leak, damp, rot – yes/no)
- Identify the number of households in the three lowest income deciles by region, with regard to:
 - the level of energy performance of dwellings (priority to identify the worst performing ones) linked to the sanitary level (i.e. leak, damp, rot – yes/no);
 - usage of heating oil; and
 - single person and one-parent households vs the rest of the population
- Identify the number of tenants considering the level of energy performance of the dwelling they occupy and whether it is a public or private (social) housing.
- Identify the number of households using heating oil considering the energy performance of the dwelling.

5.2.3. Vulnerable transport users

- More regular data collection, SILC and HBS.
- More granular data collection, SILC and HBS, on NUTS2.
- Include questions on the cost of transport (specifically for car usage) and mobility practices in the SILC survey.
- For households owning or using an individual car, it remains difficult to distinguish households that will continue to rely on an own car due to their

⁸⁶ For example, the Fair Energy Transition project: <https://fair-energy-transition.eu/>.

patterns of mobility from households that could change their mobility behaviours (using bikes, shared cars, public transport or walking).

- Conduct a study on the mobility behaviour and barriers for modal shift (to be conducted in very specific and local contexts), with as main focus the assessment of the need of car ownership⁸⁷, as objectively as possible (although this is highly sensitive and left to subjectivity, as it relates to behaviour).
- Make the results public of assessments which identify the number of households in the three lowest income deciles by region, with regard to
 - the accessibility to public transport; and
 - single person, one-parent households, multi-children households vs the rest of the population.

⁸⁷ Shared cars is a good alternative, for example: <https://www.cambio.be/fr-bxl/cambio-carsharing-louvain>.

6. Conclusions and next steps

6.1. Conclusions

This report has delivered critical insights into the impacts of the Emissions Trading System 2 (ETS2) on various vulnerable groups in Belgium, including households, transport users, and micro-enterprises. By employing context-specific indicators, we have assessed the implications of ETS2, highlighting the groups most affected and the broader consequences across different sectors. The analysis has revealed how ETS2 will influence vulnerable populations, taking into account factors such as income levels, fuel usage, and regional disparities.

Throughout this assessment, we encountered several challenges that must be acknowledged when interpreting the findings. Despite utilising a comprehensive array of datasets at local, national, and EU levels, data gaps and limitations persist. Additionally, the recent energy crisis and the COVID-19 pandemic have significantly altered several trends, leaving the long-term effects of rising prices uncertain.

The introduction of new concepts within the Social Climate Fund regulation, such as vulnerable transport users and micro-enterprises, has also posed challenges due to the absence of established assessment methodologies. Furthermore, the ETS2 operates within a complex policy framework, making it difficult to isolate its specific impacts and introducing a considerable margin of uncertainty into our results.

Engagement with stakeholders will be crucial in this process. Strengthening collaboration with key groups, including representatives from vulnerable communities, will help refine proposed measures and secure commitment for their implementation. The findings from this assessment should serve as a foundation for fostering dialogue and building consensus around priority actions.

In conclusion, the insights derived from this analysis will guide the development of targeted measures and investments aimed at enhancing both social and environmental outcomes in Belgium. Key takeaways include:

Impacts on households, individuals and transport users

- The ETS2 is part of a broader set of measures (the Fit for 55 package) that Member States will be implementing at the same time. Isolating the effect of this single measure is therefore complicated, and the results provided include a significant margin of uncertainty. Technology changes as a part of the clean energy transition and other measures and policies associated with the Fit for 55 package implementing the Green Deal should be considered. We estimate

that once these are incorporated, the heating-related fuel expenditure are expected to increase by 0.1% to 0.2% of total expenditure of goods and services for low and high-income households respectively (see Chapter 3.6).

- Households using **fossil fuels for heating** face an annual energy cost increase of EUR 210–370 under ETS2, from the lowest income to the highest decile at a carbon price of 60 EUR/tCO₂. The share of total expenditure that needs to be spent per household on the ETS2 costs at a carbon price of 60 EUR/tCO₂ is highest at almost 1% in the first decile and lower for all other deciles.
- According to the Energy Poverty Barometer, in 2022, measured energy poverty in Belgium was estimated to be at 13.5%, and is the highest in Wallonia (21.7%), followed by Flanders (9.7%) and then Brussels (9.3%). Vulnerable households are multifaceted, depending on many parameters, including the region they belong to. Consequently, we cannot estimate a precise share of the population to be considered vulnerable.
- Recognised energy-poor households can benefit from social tariffs (approximately 10% of energy customers benefitted from the social tariff in 2020), i.e. reduced prices for natural gas and electricity, or access the heating oil social fund. An increase of their energy bill will hit them strongly given their current bill is low, and hence additional expenditure will represent a higher share of increase than households not benefitting from a social tariff. Heating oil consumers do not benefit from the same level of protection (“protected consumers”).
- Among the two heating fuels (natural gas vs heating oil), the most critical is heating oil, given that it emits more CO₂ (higher cost), and its consumers are not protected, contrary to natural gas consumers. Also heating oil users are often found in old and non-performant dwellings, most of the time in rural areas (without gas distribution).
- According to stakeholders, it is possible look at many different households configurations (via a combination of characteristics, used as variables in the modelling), but the key conclusion is always that the most critical factor is the level of income. The household type (e.g. single-persons, which represent an important share of energy poor households), the population density, the fuel type, status of occupier (owner vs tenant) are all relevant indicators, but they will “validate” a form of “vulnerability status” only if these households also have a low income. Focusing on the three first deciles means that 30% of the population could be considered to be vulnerable. But within deciles, disparities are huge and hard to capture with our modelling analysis (they contain all particularities of households, with all its societal dimensions).

- A two-facet external factor is also key to determine whether an action is needed, and at which depth and pace: the level of energy performance of a dwelling, and its living quality (which in most cases is strongly linked to energy).
- Tenants are significantly more vulnerable to energy poverty: 45.5% of social tenants and 33.0% of tenants in the private sector are affected by energy poverty, compared to 15.0% of owners. In 2021, 64.5% of conventional housing in Belgium was owner-occupied, according to Statbel figures⁸⁸. This means that 35.5% of households are tenants, with an important discrepancy between apartments (30.6% owner-occupied) and houses (82.1% owner-occupied).
- Households with **diesel or petrol vehicles** will see an annual cost rise of EUR 145–285 from the lowest to the highest income decile at a carbon price of 60 EUR/tCO₂. In Belgium daily transport heavily relies on individual cars, diesel and petrol-fuelled, with difference by region.
- The shares of population deemed transport-vulnerable are the highest for those spending more than twice the median on transport (2M) and having total expenditure below national median (13.2%), households with very difficult access to public transport (6.8%), facing a enforced lack of a car (6%) and with force car ownership (5%).
- Population with enforced lack of a car is the highest in low income decile (20.8%), and in urban areas (13%). Difficult access to public transport concerns mainly population living in rural areas (10.9%). Car deprived are mainly single person and one-parent households.
- With a CO₂ price at 60 EUR/tCO₂, 11.7% of the Belgian household population is vulnerable to transport poverty and particularly vulnerable to the introduction of ETS2 (2M), with 13.5% of the total population affected (meaning it concerns mainly large families). This share is by far the highest for the first expenditure tercile (25.2% vs 15.4% in second tercile), and in sparsely populated areas (25.4% vs 11.3% in densely populated areas)
- The additional transport expenditure relative to total expenditure is very high for the population in the first lowest income decile living in Wallonia and facing transport poverty 2M (up to 1.06% of relative additional expenditure). Single person households living in sparsely populated areas and facing transport poverty 2M also face an important increase (up to 0.92%).
- The sum of **both energy and transport expenditure** is the highest relative to total expenditure for single person household in transport poverty 2M living in rural areas with an increase of 2.40% and households with three or more adults and children in transport poverty 2M living in rural areas with 2.33%.

⁸⁸ Statbel. (2024). Régime de propriété. <https://statbel.fgov.be/fr/themes/census/logement/regime-de-propriete>.

- **Identification of vulnerable micro-enterprises.** In 2024, the total number of micro-enterprises in Belgium is 719 242. Building energy consumption and expenditure is analysed for around 86% of micro-enterprises (61% natural gas, 21% heating oil and 4% LPG), and transport fuel consumption for around 21% (with around 40 000 companies considered transport-intensive).
- Among a series of combinations of building fuel and transport fuels, micro-enterprises that use heating oil for their building (space and DHW) in combination with vehicle fuels are going to incur the higher cost increase, with over EUR 250 of additional yearly costs from 2030 onwards.
- Micro-enterprises with significant energy expenditure (building) after the introduction of ETS2 and not having enough profit to renovate their building or purchase low-carbon vehicles represent around 4.7% of the total (34 100 micro-enterprises).
- Companies operating in freight transport by road are the most affected and could be expected to incur an additional cost of around 3 700 EUR/year, followed by tour operators and companies operating in road passenger transport (1 500 EUR/year).
- Other sectors also possibly vulnerable to both building energy and transport are/ small manufacturing companies, horeca, construction, social and health services, and commerce.

These findings provide a critical foundation for refining strategies and prioritising actions to enhance both social and environmental outcomes. In addition, it is crucial to consider that hidden (~M/2) and perceived (cannot warm adequately) energy poverty is a significant issue in Belgium. Consequently, analyses relying solely on expenditure data fail to fully capture the extent of vulnerabilities. Therefore, it is essential to include energy poverty indicators that account for hidden and perceived energy poverty and factor these into the design of measures and investments for the Belgian SCP.

6.2. Next steps

The next phase involves translating the insights from this report into actionable steps to ensure that the proposed measures and investments achieve their intended objectives, as well as any actions agreed with the national BAs.

- **Refinement of measures and investments**
 - Collaborate with stakeholders to address any gaps identified in this assessment, focusing on engaging further with institutional (i.e. concerned administrations from the four entities) and non-institutional stakeholders (civil society, representatives of poor households and the social sector, academics, business).

- Ensure measures are tailored to meet the specific needs of energy and transport vulnerable groups, with focus on share of population in the first and second income decile while maintaining alignment with overarching objectives. Special care will be given to the pre-identified vulnerable groups and sub-groups.
- **Engagement with Stakeholders:**
 - Strengthen collaboration with key stakeholders, including the civil society (with NGO), Statistical services, experts from social field, government institutions, academics and private sector, to refine proposed measures and secure their commitment to implementation.
 - Use the assessment findings to foster dialogue and build consensus around priority actions.
- **Finalisation:**
 - Discuss main outcomes of Deliverable 2 with BA, at entity level (three regions and one federal entity). Continue stakeholder engagement process consulting main experts to formulate the short list of measures in preparation for Deliverable 3.

7. Annexes

Annex A: Further details on the micro-modelling approach

Main data sources of the SEEK-EU microsimulation model

The **Household Budget Survey (HBS)**⁸⁹ is a national survey carried out by the Member States. It contains information on households' expenditure on goods and services, as well as other important household characteristics, such as income group and household type. Eurostat collects and compiles the national datasets and publishes them every five years. The last available publications are those from 2015 and 2020. In the context of this study, we use the **2015** data, as i) 2020 is a pandemic year which affects expenditure in the transport sector quite heavily and ii) several data issues have been identified with the 2020 publication.

The **EU Statistics on Income and Living Conditions (EU-SILC)**⁹⁰ are a dataset that is collected based on a household survey by all EU Member States in each year. They contain information on household income, living conditions, poverty and social exclusion indicators. The national datasets are compiled by Eurostat and published on a yearly basis. In the context of this study, we use survey data from the year **2023**.

For a number of transport poverty indicators, we also use the EU Labour Force Survey (LFS)⁹¹ and the Eurofound European Quality of Life Survey (EQLS)⁹².

- **Micro-enterprises micro-modelling approach**

The chapter below provides a comprehensive description of the modelling approach to assess the impacts of ETS2 on micro-enterprises, in addition to what has been described in Chapter 3.1.2.

Limitations and caveats

There are some significant limitations to determine the impact of ETS2 on micro-enterprises and the final number of vulnerable micro-enterprises. These are listed below.

⁸⁹ Eurostat. (n.d.). Household Budget Surveys – Overview. <https://ec.europa.eu/eurostat/web/household-budget-surveys>.

⁹⁰ Eurostat. (n.d.). Microdata – EU statistics on income and living conditions. <https://ec.europa.eu/eurostat/web/microdata/european-union-statistics-on-income-and-living-conditions>.

⁹¹ Eurostat. (n.d.). Microdata – EU labour force survey. <https://ec.europa.eu/eurostat/web/microdata/european-union-labour-force-survey>.

⁹² Eurofound. (n.d.). European Quality of Life Surveys (EQLS). <https://www.eurofound.europa.eu/en/surveys/european-quality-life-surveys-eqls>.

- Many of the EU level and national datasets differentiate enterprises only down to SMEs (small and medium enterprises), with insufficient elements to further identify micro-enterprises. Micro-enterprises operate in a wide range of industries with varying scales, energy use, and operational modes, making it challenging to generalise or standardise data.
- The definition of vulnerability of micro-enterprises related to energy does not exist in any of the countries.
- The level disaggregation of companies in the databases we used is level 2 “NACE division” (for example H49: Land transport and transport via pipelines), while for the purpose of this analysis it would be more useful to differentiate companies at level 4 “NACE class” (for example H49.32 Taxi operation or 49.41 Freight transport by road). This is because companies in different level 4 NACE classes have significantly different energy consumption and patterns, although they belong to the same NACE division.
- Comprehensive information on the energy consumption or energy expenditure of micro-enterprises is largely unavailable. Two Member States of the nine included in this project — Croatia and Czechia — collect data on companies’ average energy expenditure (in monetary terms) at the NACE division level. While this provides insights into sectors potentially affected by ETS2, it lacks precision, as it encompasses all company sizes and energy carriers (electricity, district heating, biomass included).
- Additional data, such as information on buildings’ age, energy systems or ownership, as well as the energy performance of buildings occupied by micro-enterprises, is rarely available. When available, it usually pertains to the entire service sector, covering both public and private entities (with the exception of Croatia, where data from the National Energy Management Information System⁹³ allows a more precise estimate of energy use in micro-enterprises). A similar lack of data availability applies to vehicles ownership and usage, and use of other modes of transport. Several countries, however, collect information that allows to differentiate privately-owned and company vehicles.
- A significant challenge for the analysis of micro-enterprises is discerning between the company use of private dwellings and vehicles for commercial purposes (and vice-versa). However, there is currently no reliable and statistically significant data on this matter.

⁹³ ISGE, Croatia's National Energy Management Information System, is a web-based platform used to monitor, analyse, and optimise energy and water consumption in public sector buildings, aiding in energy efficiency and sustainability goals.

Number of micro-enterprises (micro-enterprises)

The number of micro-enterprises in a country is available from national sources (generally the National Statistical Office) for the majority of the nine Member States included in this analysis. When this was not the case, we used by data provided by EUROSTAT SBS⁹⁴, and calibrated with the ORBIS database⁹⁵. EUROSTAT SBS categorises companies based on the number of employees and turnover, although we identified inconsistencies with other sources. Therefore, where available, we used one or more national datasets to estimate the number of micro-enterprises, and their characteristics.

Assumptions

To estimate the number of enterprises affected by ETS2, and the extent of this impact, it is necessary to estimate several key determinants:

- The size, type and energy performance of the dwellings the micro-enterprises use, including also whether they use premises owned or rented by the micro-enterprises, or private dwellings;
- The type of energy carriers used for different final purposes; and
- Vehicle number, type and fuel consumption.

As none of the nine Member States carry out a systematic census of micro-enterprises, or surveys reaching a statistically significant sample-size, it is necessary to estimate these determinants by other means. In this analysis, we use a combination of sources and methodological approaches.

- Available data in the joint public databases for all countries is used (JRC IDEES, EUROSTAT SBS, IEA, ORBIS, DG MOVE statistical pocketbook etc.).
- Available data in national statistics is used to understand sectoral composition, sectoral energy use, and various trends, such as energy expenditure;
- Average energy use is estimated based on a common trait (the number of employees NACE sector); and
- Primary data is collected where possible (surveys of micro-enterprises or focus groups with targeted associations of companies in most important NACE codes).

⁹⁴ Eurostat. (2024). Enterprise statistics by size class and NACE Rev.2 activity (from 2021 onwards). https://ec.europa.eu/eurostat/databrowser/product/view/sbs_sc_ovw?category=bsd.sbs.sbs_ovw.

⁹⁵ Orbis is a comprehensive global database of company information, owned and maintained by Bureau van Dijk, a Moody's Analytics company. It provides detailed information on companies worldwide, including financial statements, ownership structures, industry classification, and much more: [Orbis](#).

Determination of the energy consumption baseline

The estimation of the energy consumption baseline in micro-enterprises requires an analysis of two complementary aspects: fossil fuel consumption in buildings (for space heating, cooking and domestic hot water), and fossil fuel consumption in transport.

- **Calculation of the baseline energy consumption in buildings:**

The baseline energy consumption is calculated by analysing the energy consumption of an average tertiary-sector company for various end uses—space heating, domestic hot water (DHW), and cooking, based on data from the Integrated Database of the European Energy System (IDEES) (2021). The IDEES database provides energy consumption data for service sector buildings per Member State, but does not account for company size. To estimate the energy consumption in buildings of micro-enterprises, we first compute the average useful energy consumption per employee and per building (described below), and we then estimate the average consumption of micro-enterprises in each NACE sector based on the average number of employees.

We use the IDEES dataset also to calculate the energy requirement for thermal services. This enables us to quantify how much energy is converted into useful energy for thermal services.

$$UEC_E = \frac{UEC_B}{SIZE}$$

- UEC_B = Useful energy consumption/building for different purposes – **available data**
- UEC_E = Useful energy consumption/employee
- $SIZE$ = Representative building cell size (employees/representative building cell) – **available data**

In the second step, the calculated unitary final energy consumption for each end use is refined by incorporating the efficiency performance of specific technologies.

$$FEC_{E(HNG)} = FEC_{E(HNG)} \times Eff$$

- FEC_E = Final energy consumption/employee- **calculated**
- FEC_E = Useful energy consumption/employee- **calculated**
- Eff = Efficiency of certain energy transformations (useful to final energy) – **known data**
- NG = natural gas (used as example)
- H = heating (used as example)

Table 7-1 Example of resulting table:

Natural gas use for space heating, DHW & catering	
Energy consumption by end-uses (kWh per employee)	(kWh per employee)
Space heating	3 746
Cooling	N/A

Natural gas use for space heating, DHW & catering	
Hot water	753
Cooking	767

This adjustment allows to estimate the final energy consumption of an average micro-enterprise relying primarily on gas, oil or LPG for thermal purposes, where applicable (e.g., heating, DHW, and cooking). Additionally, the IDEES database provides information on the share of buildings using various energy carriers for different end uses, enabling a more detailed analysis.

$$FEC_{ME(HNG)} = FEC_{E(HNG)} \times \left[\frac{\text{no of employees}}{(ME)} \right]$$

- FEC_{ME} = Final energy consumption/ME- **calculated**
- NG= natural gas (used as example)
- H= heating (used as example)

We then estimate the fuel use in buildings by considering different the possible combination of fuels. This includes:

1. only natural gas for all end uses;
2. oil for heating and DHW, and LPG for cooking;
3. only oil for heating, with other fuels such as electricity for cooking; and
4. LPG for cooking and other fuels such as electricity for heating and DHW⁹⁶. The fuel mix depends on the country.

The estimate of energy expenditure includes all micro-enterprises, including companies operating from residential premises. Due to the lack of data that allow us to distinguish between commercial and private premises, we assume all micro-enterprises occupy commercial buildings, while in practice it is known that a significant part operate from private premises.

• Calculation of the baseline energy (fuel) consumption in transport

The calculation of the baseline energy consumption for transport is more complicated than the one in buildings. Our methodology considers two separate cases:

- *average micro-enterprises which owns a vehicle;*
- *transport – intensive micro-enterprises, which are likely to own several vehicles.*

As a first step, the data on vehicle distribution has been categorised based on fuel type and ownership status (using national datasets, JRC IDEES, and a number of assumptions). We also segmented the vehicle fleet into groups according to the type of fuel they use (petrol, diesel, LPG, other) and distinguishing between private ownership and corporate or public fleet usage. This initial classification provides a

⁹⁶ Note: some of the fuels used in buildings are ineligible for the purposes of the SCF Regulation.

foundational structure for further analysis, enabling targeted insights into energy consumption patterns and emissions based on ownership and fuel characteristics.

○ **Group 1: Average micro-enterprises**

Based on the total fleet of commercially owned cars, we estimate the proportion of vehicle owned by micro-enterprises by analysing ownership patterns and distribution trends within the commercial fleet. We allocate passenger cars to micro-enterprises based on the number of employees (total number of passenger cars owned by micro-enterprises divided by the average number of employees). We use turnover to allocate a share of other vehicle ownership on micro-enterprises.

Fuel consumption data per car is averaged based on data available in literature, while vehicle-kilometer statistics are derived from the JRC IDEES database, supplemented with national resources for greater accuracy and timeliness.

$$FEC_{car} = \frac{D_{car}(km)}{100} * C_{fp} \left(\frac{l}{100km} \right) * F_{fp}$$

- FEC_{car} = Final energy consumption/car - **calculated**
- D_{car} = Average distance/car in a year - **available data**
- C_{fp} = Fuel consumption per car - **available data**
- F_{fp} = Fuel factor (kWh/l) - **available data**
- p = Petrol (used as example)

○ **Group 2: Transport-intensive micro-enterprises**

We define as transport-intensive micro-enterprises those operating in sector or economic activities that rely heavily on transportation for the movement of goods, services, or personnel. Examples include logistics, delivery services, passenger transport services (e.g., taxis, ride), and certain companies where material inputs and distribution require substantial transport infrastructure.

Table 7-2 NACE codes for transport-intensive industries

Sector	NACE
Construction of residential and non-residential buildings	F4120
Urban and suburban passenger transport	H4931
Taxi operations	H4932
Other passenger transport by land	H4939
Freight transport by road	H4941
Other postal and courier activities	H5320
Event catering activities	I5621
Tour operator activities	N7912

Transport-intensive sectors are assigned an average number of vehicles based on a combination of national data, informed assumptions, and survey results, where such data is available. This approach ensures a reasonable estimation tailored to the specific characteristics and operational needs of these sectors.

The problem with transport is the same as for buildings, consistent data on the exact number of vehicles owned by micro-enterprises is lacking, particularly given that many micro-enterprises use privately owned vehicles for business purposes. Consequently, our estimates account for both the per-company use and the total use.

Calculation of the ETS2 impacts

As part of our analysis, we also estimate the impact of price changes resulting from the implementation of ETS2. This step enables an evaluation of how the updated carbon pricing mechanism influences overall energy expenditure across different consumption patterns.

Table 7-3 Prices and factors used for ETS2 impact evaluation

Data sources and additional information	
UNFCCC	Greenhouse Gas Emissions Calculator 2021 Emission Factors UNFCCC
2024 Eurostat- Gas prices for non-household consumers CBI	https://ec.europa.eu/eurostat/databrowser/product/view/nrg_pc_203
National prices for all fuels in consumption	Example: average price of oil distributed to non-household consumers
Country level information	Example: VAT in Croatia on natural gas is currently 5%, and from 2025 it will be back to 13%

This analysis estimates each year of the period from 2027 to 2032 with a linear increase, considering various building scenarios and different types of vehicles, without taking into consideration other policy influences. Each case accounts for the respective energy consumption patterns, with adjustments based on the price changes introduced by ETS2. This analysis includes companies that use only buildings, as well as those that utilise both vehicles and buildings, accounting for energy consumption and price changes under ETS2 for each scenario. Since transport dependant companies have significantly different baseline energy consumption we consider them separately.

Example: micro-enterprises with cars using diesel

1. The first step is to calculate energy price increase:

$$\delta P_{EDn} = EF_D X \delta P_{ETS2(n,n-1)}$$

- δP_{ED} = (Diesel) energy price increase

- EFD = Diesel emission factor (kg CO₂/kWh) - **available data**
- δP_{ETS2} = ETS2 price increase (euros/tn) – **calculated**
- n = year

2. Using baseline energy consumption and price elasticities, final energy consumption for every year is calculated as:

$$FEC_{D,n} = FEC_{D,n-1} \times (1 + \delta P_{ED} \times \frac{PED}{P_{ED,n-1}})$$

- $FEC_{D,n}$ = Final energy consumption of diesel fuel for year n – **calculated**
- $FEC_{D,n}$ = Final energy consumption of diesel fuel for year $n-1$ – **calculated**
- δP_{ED} = (Diesel) energy price increase – **calculated**
- P_{ED} = (Diesel) energy price – **calculated**
- PED = price elasticity of demand - **available data**
/in case of country different elasticities from documented sources or national plans (such as NECPs), the new elasticities can be used/

Table 7-4 Price elasticities used in the ETS2 impact scenario⁹⁷

Commercial sector	Price elasticity
Natural gas (and LPG)	-0.299
Heating oil	-0.188
Petrol	-0.194
Diesel	-0.157
LPG (car fuels)	-0.18

We estimate the energy consumption of diesel/car after the introduction of the ETS2, for every year of the period 2027–2032, as well as the new energy expenditure based on the energy price which includes ETS2 costs ($\text{Additional expenditure} = FEC_{D,n} \times P_{ED,n}$). We expect that micro-enterprises will reduce their energy consumption in response to the increase of the fuel price (at a rate determined by the elasticity of each fuel).

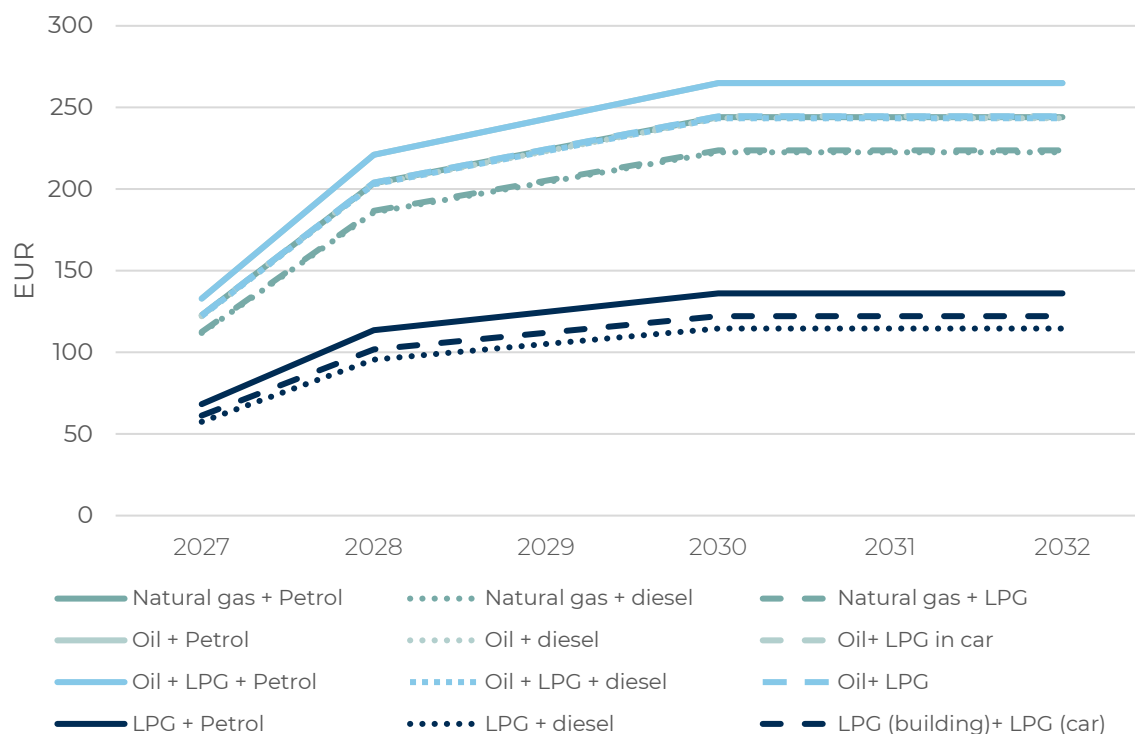
⁹⁷ Sources of price elasticities used are based on Labandeira, X., Labeaga, J. M., & López-Otero, X. (2017). A meta-analysis on the price elasticity of energy demand. *Energy policy*, 102, 549-568.
https://cadmus.eui.eu/bitstream/handle/1814/40870/RSCAS_2016_25.pdf?sequence=3.

Table 7-5 Example of additional costs per micro-enterprise for diesel fuel

Diesel emission factor (kg CO ₂ /kWh)	0.265						
Diesel price before ETS2 (€/kWh)	0.162						
Elasticity	-0.157						
	Baseline	2027	2028	2029	2030	2031	2032
ETS2 price (€/tn)		30	50	55	60	60	60
Diesel price increase (€/kWh)		0.008	0.005	0.001	0.001	0.000	0.000
Diesel price after ETS2 (€/kWh)		0.170	0.175	0.177	0.178	0.178	0.178
CARS average company							
FEC per vehicle ETS2 (kWh)	6 290						
Cost per vehicle before ETS2 (€)	1 019						
FEC per vehicle after ETS2 (kWh)		6 242	6 211	6 204	6 196	6 196	6 196
Cost per vehicle after ETS2 (€)		1 061	1 088	1 095	1 102	1 102	1 102
FEC per vehicle savings after ETS2 (%)		0.8%	1.3%	1.4%	1.5%	1.5%	1.5%
FEC per vehicle savings after ETS2 (kWh)		48	79	86	94	94	94
Additional cost per vehicle after ETS2 (%)		4.1%	6.8%	7.5%	8.2%	8.2%	8.2%
Additional cost per micro - enterprise after ETS2 (€) - owns a diesel car		42	69	76	83	83	83
Additional cost for all micro -all companies using diesel for cars (M€)		0.24	0.40	0.44	0.48	0.48	0.48

The same methodology is used to determine the additional costs for the energy carriers used in buildings. The results are shown as a combination of energy carriers for building use and for vehicles.

Figure 7-1 Example of average additional costs per micro-enterprise



To determine the impact on the total number of micro-enterprises, we use the share of buildings using certain energy carrier for different energy use.

- F_p = Percentage of buildings using certain energy carrier for different energy use
- (F_{PHeat} , F_{PDHW} , F_{PCook}) - **available data**

Determination of the vulnerable group in micro-enterprises

As part of our analysis, we also estimate the number of vulnerable micro-enterprises.

These are identified by the two core indicators, in alignment with the definition of vulnerability in micro-enterprises. The Core Indicator 1 estimates the number of micro-enterprises that:

- use fossil fuels; and
- do not have enough profit to renovate the building they operate in, or substitute their vehicle with a zero- or low-emission vehicle.

Analytically, a) is a starting point and includes all the companies using fossil fuels, explained in the previous chapter.

To determine the means of micro-enterprises to renovate buildings or to purchase zero- and low-emission vehicles, the financial capability of affected micro-enterprises to invest needs to be assessed. This is done using following methodology.

- Renovation costs are calculated based on data on renovation costs for non-residential buildings as provided by the Croatian Long Term Renovation Strategy (LTRS). Since this data is from 2020, the investment costs provided in the LTRS is then adjusted using a construction analytics index to adjust the costs for the period considered in this analysis (2025–2032). The total investment cost is then divided in annual instalments for the ETS2 implementation SCP in scope (2027–2032).
- Vehicle purchase costs are calculated based on average market prices for a 4-seater car, light duty vehicles (LDV), trucks and buses. Vehicle costs are also divided in six instalments.

Companies that cannot invest are those whose annual profits are lower than the additional energy expenditure and investment together.

$$\text{Annual instalment} + \text{energy expenditure} > \text{Profit/Loss account (net)}$$

The second part of the definition refers to the significant energy expenditure in transport or buildings (Core Indicator 2). Based on research data or national information, companies that have relatively high energy expenditure in total expenditure are considered significantly affected. These are usually companies in transport intensive sectors, or those that use significant amount of building energy.

Sectors estimated to have significant energy expenditure, based on the available national datasets, are shown below:

Table 7-6 NACE class per sector with higher building energy consumption

Sectors with higher building energy consumption	NACE class
Hotels and similar accomodation	I5510
Holiday and other short-stay accommodation	I5520
Other accomodation	I5590
Restaurants and mobile food service activities	I5610
Renting and operating of own or leased real estate	L6820
Education	P85
Human health activities	Q86
Residential care activites	R87
Operation of sport faciiliites	R9311
Fitness activities	R9313
Washing and (dry-)cleaning of textile and fur products	S9601
Hairdressing and other beauty treatment	S9602

Sectors with higher building energy consumption	NACE class
Physical well-being activities	S9604
Sectors with higher transport energy consumption	NACE class
Construction of residential and non-residential buildings (design excluded)	F4120
Urban and suburban passenger transport	H4931
Taxi operations	H4932
Other passenger transport by land	H4939
Freight transport by road	H4941
Other postal and courier activities	H5320
Event catering activities	I5621
Tour operator activities	N7912

- Composition of the two indicators:

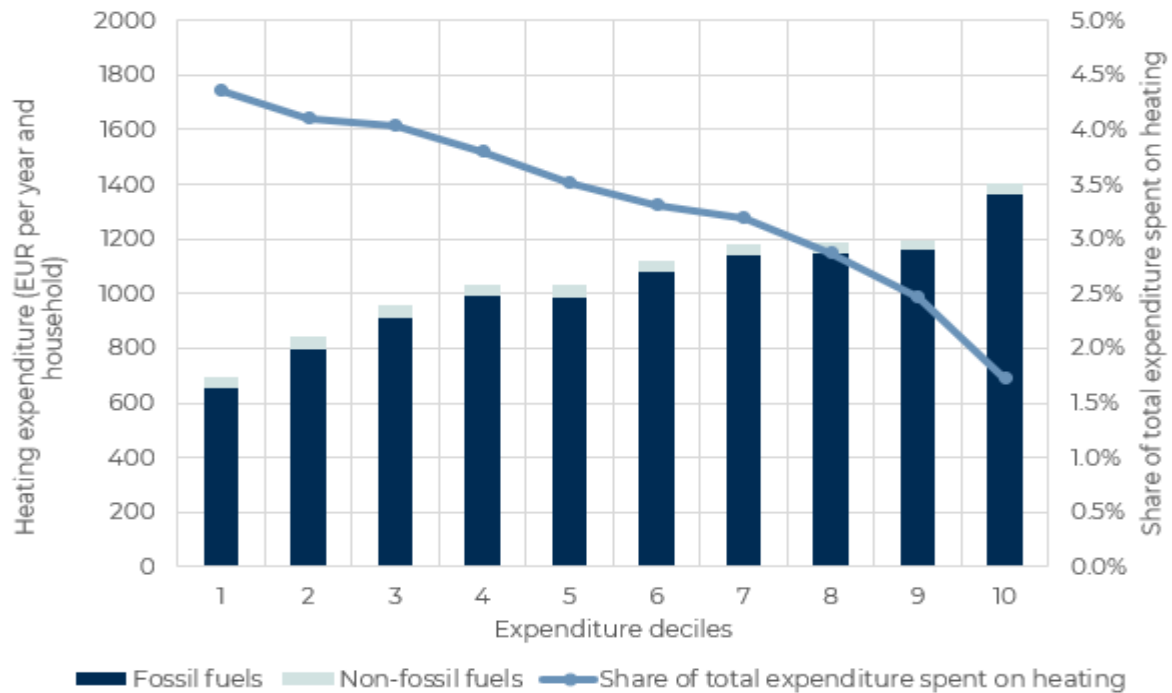
$[Annual\ instalment_n > Profit/Loss\ account\ (net)_n] \wedge [company\ belongs\ to\ a\ sector\ with\ significant\ baseline\ energy\ expenditure]$

Additional indicators are used differently country by country.

Annex B: HBS 2015: Descriptive statistics on heating and transport expenditure for Belgium

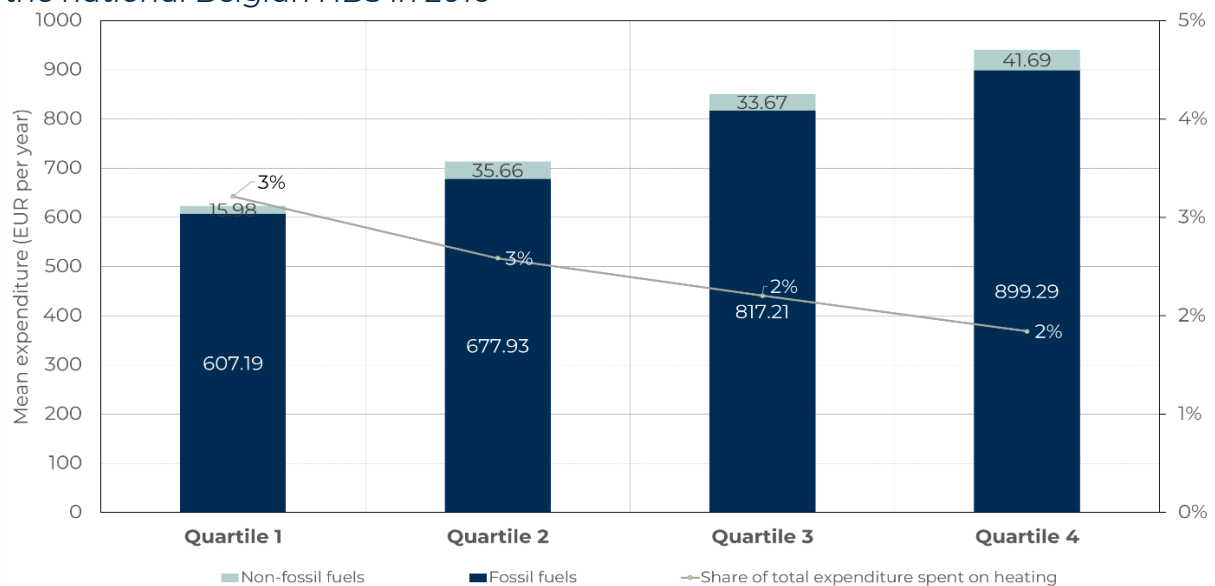
This chapter includes descriptive statistics of the HBS 2015 heating and transport expenditure.

Figure 7-2 Heating expenditure by Belgian households by expenditure deciles in 2015



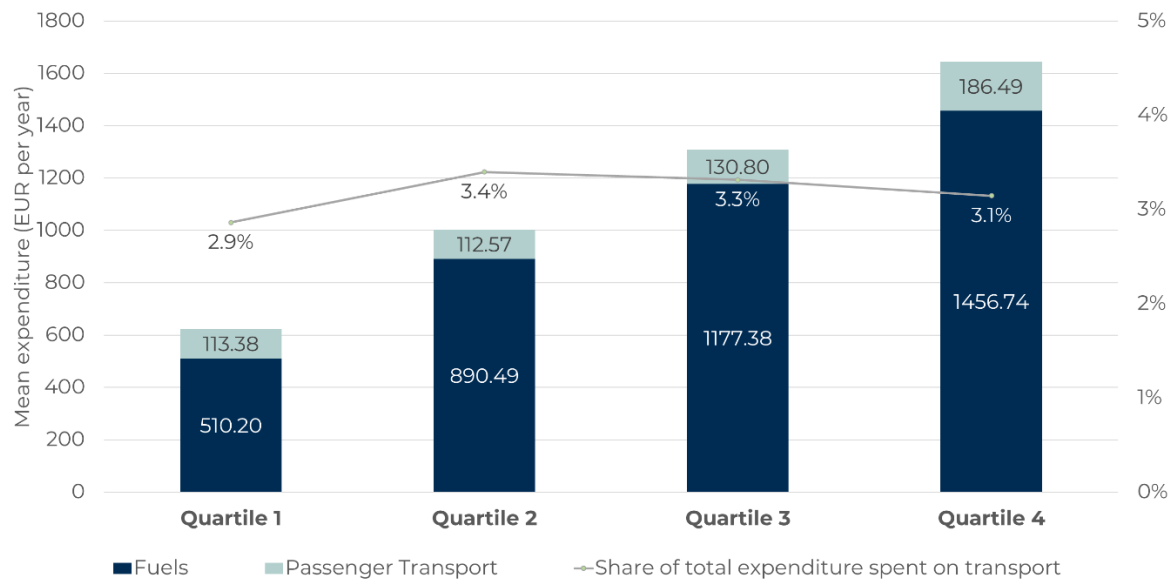
Source: HBS 2015, calculations with Oeko-Institut SEEK-EU micro model

Figure 7-3 Heating expenditure by Belgian households by quartile according to the national Belgian HBS in 2016



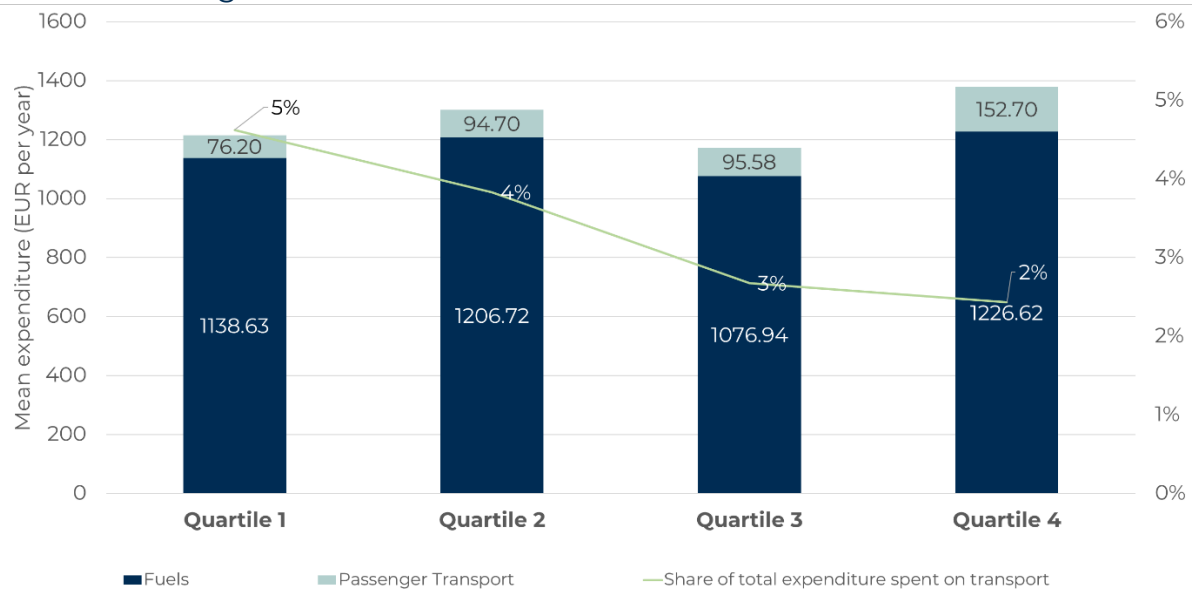
Source: Belgian national HBS 2016

Figure 7-4 Heating expenditure by Belgian households by quartile according to the national Belgian HBS in 2018



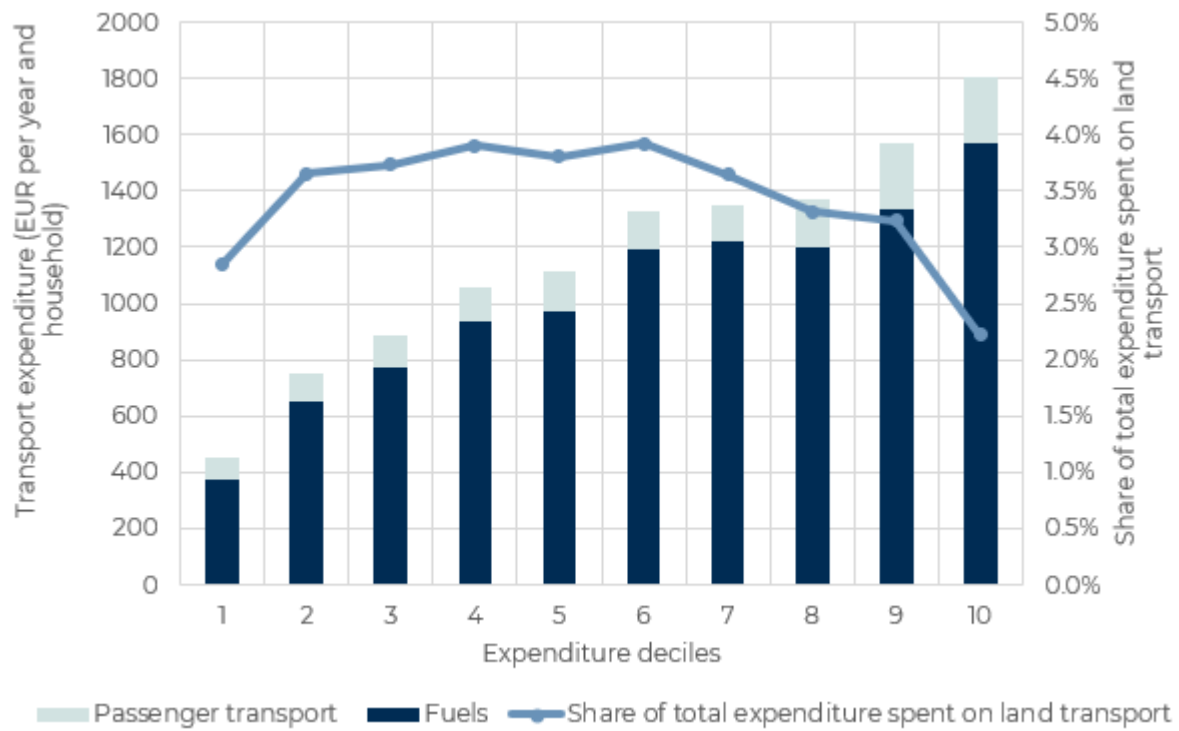
Source: Belgian national HBS 2018

Figure 7-5 Heating expenditure by Belgian households by quartile according to the national Belgian HBS in 2022



Source: Belgian national HBS 2022

Figure 7-6 Transport expenditure by Belgian households by expenditure deciles in 2015



Source: HBS 2015, calculations with Oeko-Institut SEEK-EU micro mode

Annex C: HBS 2015: Zeroes in heating and transport expenditure

Table 7-7 shows the share of households that, according to the HBS 2015, do not have any heating expenditure (first column), as well as the share of households that do not have any transport expenditure according to the HBS 2015 (second column).

Table 7-7 Share of households with zero heating or zero transport expenditure according to the HBS 2015

MS	Share of households in the HBS 2015 with zero heating expenditure	Share of households in the HBS 2015 with zero transport expenditure
BE	12%	19%
CZ	11%	5%
DK	4%	43%
FI	52%	32%
HR	9%	18%
LT	6%	49%
LV	12%	44%
RO	17%	49%
SK	5%	16%

Source: HBS 2015, calculations with Oeko-Institut SEEK-EU micro model

The HBS 2015 can display **zeros in the data for heating expenditure** due to several reasons:

- households do not heat their home;
- households do not have any heating expenditure, because someone else is paying directly for their heating costs;
- households use heating fuels that they do not need to pay for, e.g. wood; and/or
- households use electricity for heating, which is not included in our calculations. In the HBS 2015, the category “electricity” contains all electricity use by households, including for lightning, appliances, heating and e-mobility.

The HBS 2015 can display **zeros in the data for transport expenditure** due to several reasons:

- households are not mobile;
- households do not have any transport expenditure, because someone else is paying directly for their transport costs;
- households use transport fuels that they do not need to pay for, e.g. walking or cycling;

- households use electricity for transport, which is not included in our calculations. In the HBS 2015, the category “electricity” contains all electricity use by households, including for lightning, appliances, heating and e-mobility; and/or
- there are issues with the data.

Table 7-8 shows the share of households with zero expenditure in the different transport categories according to the HBS 2015. In Table 7-7, only households that have zero expenditures across all categories are displayed in the second column.

Table 7-8 Share of households with zero transport expenditure by transport category according to the HBS 2015

MS	Diesel	Petrol	Passenger transport by train	Passenger transport by underground and tram	Passenger transport by bus and coach	Passenger transport by taxi and hired car with driver
BE	51%	60%	86%	93%	91%	97%
CZ	72%	32%	54%	100%	34%	92%
DK	84%	48%	100%	100%	100%	94%
FI	83%	55%	90%	100%	81%	93%
HR	80%	51%	94%	92%	76%	98%
LT	84%	76%	99%	100%	75%	99%
LV	88%	74%	95%	97%	78%	98%
RO	94%	83%	99%	93%	80%	97%
SK	89%	60%	82%	100%	48%	92%

Source: HBS 2015, calculations with Oeko-Institut SEEK-EU micro model

Table 7-9 shows the share of households with zero expenditure in the different heat energy categories according to the HBS 2015. In Table 7-7, only households that have zero expenditures across all categories are displayed in the second column.

Table 7-9 Share of households with zero heating expenditure by fuel according to the HBS 2015

MS	Natural gas	Liquid fuels	Coal	Other solid fuels	District heating
BE	47%	67%	98%	88%	100%
CZ	32%	97%	93%	78%	61%
DK	75%	94%	100%	76%	34%
FI	98%	93%	100%	49%	92%
HR	33%	98%	99%	48%	92%

MS	Natural gas	Liquid fuels	Coal	Other solid fuels	District heating
LT	34%	100%	94%	64%	50%
LV	22%	100%	100%	100%	48%
RO	22%	100%	100%	91%	92%
SK	19%	99%	95%	83%	54%

Source: HBS 2015, calculations with Oeko-Institut SEEK-EU micro model

Annex D. National long list of M&I

Table 0-1 Building sector long list of measures and investments

Categories from EU long list	Selected M&I at MS level (please write down the name/description of the M&I)	(i) Target	(ii) Scope of action ⁹⁸							(iii) Additionality
			(a)	(b)	(c)	(d)	(e)	(f)	(g)	M&I already included in existing national or EU funding (y/n). If yes, is M&I used for expansion or for “scaling up” (y/n).
Building renovations										
Insulation and windows: Improve insulation of walls, roofs, and floors, and replace windows to enhance energy efficiency		Vulnerable households	✓		✓					
		Vulnerable households and vulnerable micro-enterprises	✓		✓					
		Vulnerable households	✓		✓					
		Vulnerable households	✓		✓					
Technical building systems: Upgrade heating, cooling,		Vulnerable micro-enterprises	✓		✓					

⁹⁸ a) Support building renovations in worst performing buildings (b) Support access to affordable energy-efficient housing (c) Contribute to energy savings in buildings or reduce energy poverty (d) Provide targeted, accessible, and affordable information (e) Support entities developing and providing affordable energy efficiency solutions (f) Provide access to zero- and low-emissions vehicles and bicycles (g) Incentivise the use of affordable and accessible transport alternatives.

Categories from EU long list	Selected M&I at MS level (please write down the name/description of the M&I)	(i) Target	(ii) Scope of action ⁹⁸							(iii) Additionality
			(a)	(b)	(c)	(d)	(e)	(f)	(g)	M&I already included in existing national or EU funding (y/n). If yes, is M&I used for expansion or for "scaling up" (y/n).
ventilation, and domestic hot water systems, including the installation of heat pumps (and possibly hybrid heating systems with significant RES share)		Vulnerable households, vulnerable micro-enterprises	✓		✓					
Renewable energy integration: Install solar panels, wind turbines, and other renewable energy systems on buildings		Vulnerable households	✓		✓					
Deep renovations: Conduct comprehensive renovations to significantly enhance the energy performance of buildings		Vulnerable households	✓		✓					
		Vulnerable households	✓		✓					
Financial instruments: Utilise on-bill financing, energy performance contracts, and energy		Vulnerable households	✓		✓		✓			
		Vulnerable households and	✓		✓		✓			

Categories from EU long list	Selected M&I at MS level (please write down the name/description of the M&I)	(i) Target	(ii) Scope of action ⁹⁸							(iii) Additionality
			(a)	(b)	(c)	(d)	(e)	(f)	(g)	M&I already included in existing national or EU funding (y/n). If yes, is M&I used for expansion or for "scaling up" (y/n).
company obligations to support building renovations		vulnerable micro-enterprises								
Energy efficiency improvements										
Energy audits: Provide energy audits and advisory programmes for tenants and landlords to identify and implement energy-saving measures		Vulnerable households				✓				
		Vulnerable households				✓				
Smart metering: Install smart meters to monitor and optimise energy use		Vulnerable households			✓					
Building automation: Implement advanced building automation and control systems to enhance energy management		Vulnerable micro-enterprises			✓					
Community Energy Savings Programmes: Implement area-based		Vulnerable households				✓				

Categories from EU long list	Selected M&I at MS level (please write down the name/description of the M&I)	(i) Target	(ii) Scope of action ⁹⁸							(iii) Additionality
			(a)	(b)	(c)	(d)	(e)	(f)	(g)	M&I already included in existing national or EU funding (y/n). If yes, is M&I used for expansion or for "scaling up" (y/n).
energy efficiency advisory schemes targeting low-income areas										
Capacity building: Offer training and capacity-building programmes for stakeholders involved in the implementation of SCF measures		Vulnerable households					✓			
Support services: Provide technical support for the implementation and management of the measures to ensure efficiency and effectiveness		Vulnerable households			✓	✓				
		Vulnerable households			✓	✓				
Energy efficiency programmes: Implement targeted programmes to reduce energy consumption in low-income households		Vulnerable households			✓					
Affordable housing										

Categories from EU long list	Selected M&I at MS level (please write down the name/description of the M&I)	(i) Target	(ii) Scope of action ⁹⁸							(iii) Additionality
			(a)	(b)	(c)	(d)	(e)	(f)	(g)	M&I already included in existing national or EU funding (y/n). If yes, is M&I used for expansion or for "scaling up" (y/n).
Social housing: Develop and renovate social housing with high energy efficiency standards, ensuring affordable energy costs for vulnerable households		Vulnerable households	✓	✓	✓					
		Vulnerable households	✓	✓	✓		✓			
Affordable rental solutions: Provide financial support or tax incentives for energy-efficient rental housing to benefit low-income tenants		Vulnerable households		✓	✓					
Climate bonus: Provide additional rent allowances for energy-efficient dwellings to low-income households		Vulnerable households, vulnerable transport users	✓		✓					
Decarbonising heating and cooling										
Heat pumps: Promote the installation of electric heat pumps for heating		Vulnerable households	✓		✓					

Categories from EU long list	Selected M&I at MS level (please write down the name/description of the M&I)	(i) Target	(ii) Scope of action ⁹⁸							(iii) Additionality
			(a)	(b)	(c)	(d)	(e)	(f)	(g)	M&I already included in existing national or EU funding (y/n). If yes, is M&I used for expansion or for "scaling up" (y/n).
and cooling according to dwelling type										
District heating: promote connections to district heating networks using renewable energy sources		Vulnerable households			✓					
Renewable energy communities: Support community-based renewable energy projects and energy-sharing schemes		Vulnerable households			✓	✓				
		Vulnerable households, vulnerable micro-enterprises			✓	✓	✓			
Clean Heating for all: Provide grants for replacing fossil fuel heating systems with climate-friendly alternatives for low-income households		Vulnerable households	✓		✓					

Table 0-2 Transport sector long list of measures and investments

Categories from the EU long list	Selected M&I at MS level (please write down the name/description of the M&I)	(i) Target	(ii) Scope of action							(iii) Additionality
			(a) Support building renovations in worst performing buildings	(b) Support access to affordable energy-efficient housing	(c) Contribute to energy savings in buildings or reduce energy poverty	(d) Provide targeted, accessible, and affordable information	(e) Support entities developing and providing affordable energy efficiency solutions	(f) Provide access to zero- and low-emissions vehicles and bicycles	(g) Incentivise the use of affordable and accessible transport alternatives	M&I already included in existing national or EU funding (y/n). If yes, is M&I used for expansion or for “scaling up” (y/n).
Zero- and Low-emissions vehicles										
Purchase/rental incentives: Offer financial incentives for the purchase/rental of electric and hybrid vehicles and bicycles, including subsidies and tax rebates		Vulnerable micro-enterprises and vulnerable transport users						✓		
		Vulnerable transport users						✓		
		Vulnerable micro-enterprises and vulnerable transport users						✓		

Categories from the EU long list	Selected M&I at MS level (please write down the name/description of the M&I)	(i) Target	(ii) Scope of action							(iii) Additionality
			(a) Support building renovations in worst performing buildings	(b) Support access to affordable energy-efficient housing	(c) Contribute to energy savings in buildings or reduce energy poverty	(d) Provide targeted, accessible, and affordable information	(e) Support entities developing and providing affordable energy efficiency solutions	(f) Provide access to zero- and low-emissions vehicles and bicycles	(g) Incentivise the use of affordable and accessible transport alternatives	M&I already included in existing national or EU funding (y/n). If yes, is M&I used for expansion or for “scaling up” (y/n).
Charging infrastructure: Develop public and private charging infrastructure for electric vehicles to ensure widespread availability		Vulnerable micro-enterprises and vulnerable transport users						✓		
Second-hand market: Promote the development of a second-hand market for zero-emission vehicles and bicycles to make them more accessible		Vulnerable micro-enterprises, vulnerable transport users						✓		
Integration of unconventional vehicles: Adapt city planning to accommodate the		Vulnerable transport users						✓		
		Vulnerable transport users						✓		

Categories from the EU long list	Selected M&I at MS level (please write down the name/description of the M&I)	(i) Target	(ii) Scope of action							(iii) Additionality
			(a) Support building renovations in worst performing buildings	(b) Support access to affordable energy-efficient housing	(c) Contribute to energy savings in buildings or reduce energy poverty	(d) Provide targeted, accessible, and affordable information	(e) Support entities developing and providing affordable energy efficiency solutions	(f) Provide access to zero- and low-emissions vehicles and bicycles	(g) Incentivise the use of affordable and accessible transport alternatives	M&I already included in existing national or EU funding (y/n). If yes, is M&I used for expansion or for “scaling up” (y/n).
uptake of space-saving, low-polluting, cost-efficient, and safer electric vehicles such as micro cars and electric wheelchairs		Vulnerable transport users						✓		
Public transport enhancements (including urban rail)										
Fleet expansion: Expand and modernise public transport fleets with zero-emission vehicles such as electric buses		Vulnerable transport users							✓	
		Vulnerable transport users							✓	
Infrastructure development: Invest in the development of public transport infrastructure, including		Vulnerable transport users							✓	

Categories from the EU long list	Selected M&I at MS level (please write down the name/description of the M&I)	(i) Target	(ii) Scope of action							(iii) Additivity
			(a) Support building renovations in worst performing buildings	(b) Support access to affordable energy-efficient housing	(c) Contribute to energy savings in buildings or reduce energy poverty	(d) Provide targeted, accessible, and affordable information	(e) Support entities developing and providing affordable energy efficiency solutions	(f) Provide access to zero- and low-emissions vehicles and bicycles	(g) Incentivise the use of affordable and accessible transport alternatives	M&I already included in existing national or EU funding (y/n). If yes, is M&I used for expansion or for “scaling up” (y/n).
new stop patterns on existing routes										
Multimodal mobility: Support multimodal transport options that integrate public transport with cycling, walking, and shared and on-demand mobility services		Vulnerable transport users						✓	✓	
Public transport dedicated trajectories: Separating public transport from private traffic to improve service reliability (ensure travel times and prevent delays)		Vulnerable transport users							✓	
Active mobility										

Categories from the EU long list	Selected M&I at MS level (please write down the name/description of the M&I)	(i) Target	(ii) Scope of action							(iii) Additionality
			(a) Support building renovations in worst performing buildings	(b) Support access to affordable energy-efficient housing	(c) Contribute to energy savings in buildings or reduce energy poverty	(d) Provide targeted, accessible, and affordable information	(e) Support entities developing and providing affordable energy efficiency solutions	(f) Provide access to zero- and low-emissions vehicles and bicycles	(g) Incentivise the use of affordable and accessible transport alternatives	M&I already included in existing national or EU funding (y/n). If yes, is M&I used for expansion or for “scaling up” (y/n).
Bicycle infrastructure: Develop safe and attractive cycling infrastructure, including bike paths separated from motor traffic, and on-street bike lanes in lower-traffic streets		Vulnerable transport users						✓	✓	
Pedestrian infrastructure: Develop safe and attractive walking infrastructure, including expansion of pavements, pedestrian zones, and shared spaces		Vulnerable transport users							✓	
		Vulnerable transport users				✓			✓	

Categories from the EU long list	Selected M&I at MS level (please write down the name/description of the M&I)	(i) Target	(ii) Scope of action							(iii) Additionality
			(a) Support building renovations in worst performing buildings	(b) Support access to affordable energy-efficient housing	(c) Contribute to energy savings in buildings or reduce energy poverty	(d) Provide targeted, accessible, and affordable information	(e) Support entities developing and providing affordable energy efficiency solutions	(f) Provide access to zero- and low-emissions vehicles and bicycles	(g) Incentivise the use of affordable and accessible transport alternatives	M&I already included in existing national or EU funding (y/n). If yes, is M&I used for expansion or for “scaling up” (y/n).
Secure bicycle parking in strategic locations: Develop secure bike parking facilities to facilitate seamless all necessary travels and reduce theft		Vulnerable transport users						✓	✓	
Bicycle programmes: Subsidise the purchase/rent of bicycles and reward zero-emission commuter travel		Vulnerable transport users						✓		
		Vulnerable transport users						✓		
		Vulnerable transport users						✓		

Categories from the EU long list	Selected M&I at MS level (please write down the name/description of the M&I)	(i) Target	(ii) Scope of action							(iii) Additionality
			(a) Support building renovations in worst performing buildings	(b) Support access to affordable energy-efficient housing	(c) Contribute to energy savings in buildings or reduce energy poverty	(d) Provide targeted, accessible, and affordable information	(e) Support entities developing and providing affordable energy efficiency solutions	(f) Provide access to zero- and low-emissions vehicles and bicycles	(g) Incentivise the use of affordable and accessible transport alternatives	M&I already included in existing national or EU funding (y/n). If yes, is M&I used for expansion or for “scaling up” (y/n).
Integrate bicycle variants: Design bike paths and bike parking facilities to welcome bicycle variants such as cargo bikes and e-bikes		Vulnerable transport users						✓		
Multimodal and shared mobility										
Shared mobility services: provide financial support and/or promote bike-sharing, car-sharing, and ride-sharing services to reduce reliance on private vehicles		Vulnerable transport users							✓	
Mobility on demand: Develop sustainable and affordable mobility-on-demand services, such as		Vulnerable transport users							✓	

Categories from the EU long list	Selected M&I at MS level (please write down the name/description of the M&I)	(i) Target	(ii) Scope of action							(iii) Additionality
			(a) Support building renovations in worst performing buildings	(b) Support access to affordable energy-efficient housing	(c) Contribute to energy savings in buildings or reduce energy poverty	(d) Provide targeted, accessible, and affordable information	(e) Support entities developing and providing affordable energy efficiency solutions	(f) Provide access to zero- and low-emissions vehicles and bicycles	(g) Incentivise the use of affordable and accessible transport alternatives	M&I already included in existing national or EU funding (y/n). If yes, is M&I used for expansion or for “scaling up” (y/n).
app-based ride-hailing and shuttle services, while considering digital poverty										
Cargo bike services : Offer cargo bike mobility options in strategic city areas (e.g. commercial areas) to promote less polluting heavier load transportation (furniture, groceries, tools, children)		Vulnerable micro-enterprises and vulnerable transport users						✓	✓	
P&R facilities: Install Park & Ride facilities at city limits to facilitate transportation switching and promote more sustainable and cost-		Vulnerable transport users							✓	

Categories from the EU long list	Selected M&I at MS level (please write down the name/description of the M&I)	(i) Target	(ii) Scope of action							(iii) Additivity
			(a) Support building renovations in worst performing buildings	(b) Support access to affordable energy-efficient housing	(c) Contribute to energy savings in buildings or reduce energy poverty	(d) Provide targeted, accessible, and affordable information	(e) Support entities developing and providing affordable energy efficiency solutions	(f) Provide access to zero- and low-emissions vehicles and bicycles	(g) Incentivise the use of affordable and accessible transport alternatives	M&I already included in existing national or EU funding (y/n). If yes, is M&I used for expansion or for “scaling up” (y/n).
effective routes and transport modes										
MaaS (Mobility as a Service): Mobile apps offering the most convenient trajectory from A to B by integrating all mobility services		Vulnerable transport users							✓	
Support for vulnerable transport users										
Offset increased transport costs for vulnerable users		Vulnerable transport users							✓	
Affordable transport solutions: Offer subsidies		Vulnerable transport users							✓	

Categories from the EU long list	Selected M&I at MS level (please write down the name/description of the M&I)	(i) Target	(ii) Scope of action							(iii) Additionality
			(a) Support building renovations in worst performing buildings	(b) Support access to affordable energy-efficient housing	(c) Contribute to energy savings in buildings or reduce energy poverty	(d) Provide targeted, accessible, and affordable information	(e) Support entities developing and providing affordable energy efficiency solutions	(f) Provide access to zero- and low-emissions vehicles and bicycles	(g) Incentivise the use of affordable and accessible transport alternatives	M&I already included in existing national or EU funding (y/n). If yes, is M&I used for expansion or for “scaling up” (y/n).
for public transport passes and other affordable mobility options to ensure accessibility for all		Vulnerable transport users							✓	

Table 0-3 Cross-sectoral long list of measures and investments

Cross-sectoral measure and/or investment	Selected M&I at MS level (please write down the name/description of the M&I)	(i) Target	(ii) Scope of action							(iii) Additionality
			(a) Support building renovations in worst performing buildings	(b) Support access to affordable energy-efficient housing	(c) Contribute to energy savings in buildings or reduce energy poverty	(d) Provide targeted, accessible, and affordable information	(e) Support entities developing and providing affordable energy efficiency solutions	(f) Provide access to zero- and low-emissions vehicles and bicycles	(g) Incentivise the use of affordable and accessible transport alternatives	M M&I already included in existing national or EU funding (y/n). If yes, is M&I used for expansion or for “scaling up” (y/n).
Information, education, and awareness										
Campaigns: Conduct information campaigns on energy efficiency and sustainable mobility to raise awareness		Vulnerable households and vulnerable transport users				✓				
		Vulnerable households			✓	✓	✓			
Advisory services: Provide accessible advisory services on energy savings and sustainable transport options		Vulnerable households and transport users				✓				

Cross-sectoral measure and/or investment	Selected M&I at MS level (please write down the name/description of the M&I)	(i) Target	(ii) Scope of action							(iii) Additionality
			(a) Support building renovations in worst performing buildings	(b) Support access to affordable energy-efficient housing	(c) Contribute to energy savings in buildings or reduce energy poverty	(d) Provide targeted, accessible, and affordable information	(e) Support entities developing and providing affordable energy efficiency solutions	(f) Provide access to zero- and low-emissions vehicles and bicycles	(g) Incentivise the use of affordable and accessible transport alternatives	M M&I already included in existing national or EU funding (y/n). If yes, is M&I used for expansion or for “scaling up” (y/n).
Community programmes: Support community-scale initiatives and educational programmes to promote sustainable practices		Vulnerable households				✓				
Policy and regulatory measures										
Incentive programmes: Develop national and regional programmes that incentivise energy efficiency and sustainable transport investments (measure)		Vulnerable micro-enterprises	✓		✓					
		Vulnerable transport users								

Cross-sectoral measure and/or investment	Selected M&I at MS level (please write down the name/description of the M&I)	(i) Target	(ii) Scope of action							(iii) Additionality
			(a) Support building renovations in worst performing buildings	(b) Support access to affordable energy-efficient housing	(c) Contribute to energy savings in buildings or reduce energy poverty	(d) Provide targeted, accessible, and affordable information	(e) Support entities developing and providing affordable energy efficiency solutions	(f) Provide access to zero- and low-emissions vehicles and bicycles	(g) Incentivise the use of affordable and accessible transport alternatives	M M&I already included in existing national or EU funding (y/n). If yes, is M&I used for expansion or for “scaling up” (y/n).
Regulatory reforms: Implement reforms to facilitate building renovations and the adoption of renewable energy solutions		Vulnerable households and vulnerable micro-enterprises			✓		✓			
		Vulnerable households and vulnerable micro-enterprises			✓					
Innovation and technology development										
Pilot projects: Support pilot projects to test and demonstrate innovative		Vulnerable households and vulnerable			✓					

Cross-sectoral measure and/or investment	Selected M&I at MS level (please write down the name/description of the M&I)	(i) Target	(ii) Scope of action							(iii) Additionality
			(a) Support building renovations in worst performing buildings	(b) Support access to affordable energy-efficient housing	(c) Contribute to energy savings in buildings or reduce energy poverty	(d) Provide targeted, accessible, and affordable information	(e) Support entities developing and providing affordable energy efficiency solutions	(f) Provide access to zero- and low-emissions vehicles and bicycles	(g) Incentivise the use of affordable and accessible transport alternatives	M M&I already included in existing national or EU funding (y/n). If yes, is M&I used for expansion or for “scaling up” (y/n).
solutions for energy efficiency and low-emission transport		micro-enterprises								
		Vulnerable households			✓					
		Vulnerable transport users							✓	
Public-Private Partnerships										

Cross-sectoral measure and/or investment	Selected M&I at MS level (please write down the name/description of the M&I)	(i) Target	(ii) Scope of action							(iii) Additionality
			(a) Support building renovations in worst performing buildings	(b) Support access to affordable energy-efficient housing	(c) Contribute to energy savings in buildings or reduce energy poverty	(d) Provide targeted, accessible, and affordable information	(e) Support entities developing and providing affordable energy efficiency solutions	(f) Provide access to zero- and low-emissions vehicles and bicycles	(g) Incentivise the use of affordable and accessible transport alternatives	M M&I already included in existing national or EU funding (y/n). If yes, is M&I used for expansion or for “scaling up” (y/n).
Cooperatives and social enterprises: Encourage the development of cooperatives and social enterprises (energy communities and micro-enterprises) in the energy and transport sectors to foster community-driven solutions		Vulnerable households and vulnerable micro-enterprises			✓					

Cross-sectoral measure and/or investment	Selected M&I at MS level (please write down the name/description of the M&I)	(i) Target	(ii) Scope of action							(iii) Additionality
			(a) Support building renovations in worst performing buildings	(b) Support access to affordable energy-efficient housing	(c) Contribute to energy savings in buildings or reduce energy poverty	(d) Provide targeted, accessible, and affordable information	(e) Support entities developing and providing affordable energy efficiency solutions	(f) Provide access to zero- and low-emissions vehicles and bicycles	(g) Incentivise the use of affordable and accessible transport alternatives	M M&I already included in existing national or EU funding (y/n). If yes, is M&I used for expansion or for “scaling up” (y/n).
Private sector engagement: Foster partnerships with private sector entities to leverage investment in sustainable projects		Vulnerable transport users						✓		
Financial support										

Cross-sectoral measure and/or investment	Selected M&I at MS level (please write down the name/description of the M&I)	(i) Target	(ii) Scope of action							(iii) Additionality
			(a) Support building renovations in worst performing buildings	(b) Support access to affordable energy-efficient housing	(c) Contribute to energy savings in buildings or reduce energy poverty	(d) Provide targeted, accessible, and affordable information	(e) Support entities developing and providing affordable energy efficiency solutions	(f) Provide access to zero- and low-emissions vehicles and bicycles	(g) Incentivise the use of affordable and accessible transport alternatives	M M&I already included in existing national or EU funding (y/n). If yes, is M&I used for expansion or for “scaling up” (y/n).
Temporary and targeted direct income support: Provide targeted temporary direct income support to vulnerable households and transport users to mitigate immediate financial impacts	• Funds to help vulnerable households and vulnerable transport users pay for the price impact of ETS2	Vulnerable households, vulnerable micro-enterprises, and vulnerable transport users								