IEECP
INSTITUTE FOR EUROPEAN ENERGY AND CLIMATE POLICY

10 YEARS

# The costs of the Emissions Trading Scheme in buildings and transport in Greece and policy recommendations for the Social Climate Plan

July 2025

This document was produced with the financial assistance of the European Union and the German Federal Ministry for Economic Affairs and Climate Action and GIZ in the context of the project "Technical support for the development of a Social Climate Plan and the implementation of the EU Emissions Trading Systems as well as the Carbon Border Adjustment Mechanism in Greece" (CLIMA+). The views expressed herein can in no way be taken to reflect the official opinion of the European Union and the German Federal Ministry for Economic Affairs and Climate Action.

Copyright 2025, Institute for European Energy and Climate Policy (IEECP).

Except otherwise noted, the reuse of this document is authorised under the Creative Commons Attribution 4.0 International (CC BY 4.0) licence. This means that reuse is allowed provided appropriate credit is given and any changes are indicated.

IEECP is a non-for-profit, independent research institute working since 2015 on science-based climate change mitigation, energy efficiency and renewable energy policy, with an international interdisciplinary team of experts generating and disseminating scientific knowledge. We work closely with EU institutions, international organisations, national, regional and local governments, think-tanks, NGOs, academics and the business world to lead the transition to climate neutrality and to a sustainable energy future for various sectors. We build valued partnerships with renowned organisations from across Europe as we believe collaboration and creating a community helps carrying our ideas and results further, to shape, together, a low-emissions, resilient future. www.ieecp.org

Institute for European Energy and Climate Policy Stichting - IEECP
Amsterdam Sloterdijk Teleport Towers, Kingsfordweg 151,
1043GR Amsterdam, The Netherlands
KvK: 64602214; VAT: NL0855739198

www.ieecp.org - contact@ieecp.org

# TABLE OF CONTENTS

List of Tables ..... 4
List of Figures ..... 5
List of Abbreviations ..... 7
Introduction ..... 8
1 Status in Greece ..... 10
1.1 Overview of national context ..... 10
1.2 Definitions of energy / transport poverty and vulnerability ..... 13
2 Indicators of poverty and vulnerability ..... 18
2.1 Household poverty and vulnerability indicators ..... 19
2.1.1 Vulnerability indicators to comply with the SCF definition ..... 22
2.2 Transport poverty and vulnerability indicators ..... 25
2.2.1 Vulnerability indicators for compliance with SCF definitions ..... 29
2.3 Vulnerability indicators for micro-enterprises ..... 33
3 Impacts of ETS2 on vulnerable groups in Greece ..... 45
3.1 Vulnerable Households ..... 46
3.2 Vulnerable transport users ..... 49
3.3 Households and transport uses ..... 51
3.4 Vulnerable micro-enterprises ..... 56
3.5 Sensitivity analysis with higher ETS2 prices ..... 60
4 Calculation of ETS2 impacts at regional level ..... 65
4.1 Vulnerable Households ..... 65
4.2 Vulnerable transport users ..... 67
5 Proposals for measures to alleviate the costs ..... 69
5.1 Buildings ..... 70
5.1.1 Energy efficiency upgrades of residential buildings for vulnerable households ..... 70
5.1.2 Supporting the installation of energy efficient heating, cooling and domestic hot water production systems in existing residential buildings ..... 72
5.1.3 Provision of energy efficient low rent apartments ..... 74
5.1.4 Energy efficiency upgrades and substitution of fossil fuel heating systems in non-residential buildings for micro-enterprises ..... 77

5.1.5 One-Stop- Shops for vulnerable citizens and micro-enterprises with parallel support to Citizen Led Initiatives and Energy Communities ..... 79
5.2 Transport ..... 81
5.2.1 Financial incentives for the purchase or leasing of electric vehicles and bicycles ..... 81
5.2.2 Providing incentives to use affordable and accessible public transport . 83
5.2.3 Creation of active mobility infrastructure (cycle paths, health/walking paths) – Develop micromobility infrastructure by connecting cities with nearby populated areas ..... 86
5.2.4 Temporary direct income support ..... 86
6 Conclusions ..... 90
7 Annex – Methodology for calculating ETS2 impacts ..... 93
7.1 Households ..... 93
7.2 Transport ..... 98
7.3 Micro-enterprises ..... 101

# LIST OF TABLES

Table 1. Structure of households' number ..... 14
Table 2. Outcomes derived from the household vulnerability indicators. ..... 19
Table 3. Outcomes derived from the Transport vulnerability indicators (in %) ..... 26
Table 4. Indicators for detecting vulnerable micro-enterprises ..... 35
Table 5. Eligible micro-enterprises with details in the ETS2 ..... 38
Table 6. Total number of vehicles per fuel type ..... 42
Table 7. Sample of vehicles in companies that cannot afford to purchase a new clean vehicle ..... 43
Table 8. Sample to the total number of vehicles under the eligible ME ..... 44
Table 9. ETS2 prices for households provided by the European Commission ..... 45
Table 10. ETS2 prices for transport provided by the European Commission ..... 45
Table 11. Higher ETS2 prices for households ..... 60
Table 12. Higher ETS2 prices for transport ..... 61
Table 13. Unitary final energy consumption in Greece per Standard International Energy Product Classification (SIEC) in TJ ..... 94

Table 14. Total use of natural gas ..... 96
Table 15. Consumption per fuel type ..... 96
Table 16. Number of households per income category ..... 96
Table 17. Number of vulnerable households per income category and fuel-type ..... 97
Table 18. Estimation of the unitary final energy consumption of the average household for the different types of vehicles ..... 99
Table 19. Weighted Average of consumption for each fuel category per income category ..... 99
Table 20. Calculation of the unitary final energy consumption of the average household for the different types of vehicles ..... 100
Table 21. Alignment of the number of households with the number of private vehicles ..... 100
Table 22. Number of households per fuel type used ..... 100
Table 23. Vulnerable Households in Transport ..... 101
Table 24. Example of resulting table ..... 104
Table 25. NACE codes for transport-intensive industries ..... 106
Table 26. Prices and factors used for ETS2 impact evaluation ..... 106
Table 27. Price elasticities used in the ETS2 impact scenario ..... 108

# LIST OF FIGURES

Figure 1. Average monthly costs of energy for Greek households ..... 14
Figure 2. Number of households with the inability to renovate ..... 23
Figure 3. AROPE by degree of urbanization in Greece ..... 24
Figure 4. AROPE in elderly people in Greece ..... 24
Figure 5. Conceptualization of transport poverty. Source: European Commission / DG EMPL report on transport poverty ..... 25
Figure 6. Population that can afford a private vehicle ..... 30
Figure 7. Households with the inability to purchase new emissions-free vehicle ..... 31
Figure 8. Population percentage that is materially and socially deprived and can own a private vehicle ..... 31
Figure 9. Materially deprived by degree of urbanisation ..... 32

Figure 10. Materially deprived in all degrees of urbanisation, by capability of owning a car ..... 32

Figure 11. Share of trains and buses available for public transport ..... 33

Figure 12. Additional annual cost for households using Natural Gas after the introduction of ETS2 ..... 46

Figure 13. Additional annual cost for households using heating Oil after the introduction of ETS2 ..... 46

Figure 14. Additional annual cost for households using LPG after the introduction of ETS2 ..... 47

Figure 15. Total additional costs for all vulnerable households after the introduction of ETS2 ..... 48

Figure 16. Total additional annual cost for all households after the introduction of ETS2 ..... 48

Figure 17. Additional annual cost for households using gasoline for their transport after the introduction of ETS2 ..... 49

Figure 18. Additional annual cost for households using diesel for their transport after the introduction of ETS2 ..... 49

Figure 19. Total additional annual cost for vulnerable households for their transport after the introduction of ETS2 ..... 50

Figure 20. Total additional annual cost for all households for their transport after the introduction of ETS2 ..... 51

Figure 21. Average change in energy expenditure related to income ..... 51

Figure 22. Households using natural gas for heating and diesel transport ..... 52

Figure 23. Households using natural gas for heating and LPG for transport ..... 52

Figure 24. Households using oil for heating and gasoline for transport ..... 53

Figure 25. Households using oil for heating and diesel for transport ..... 53

Figure 26. Households using oil for heating and LPG for transport ..... 54

Figure 27. Change of poverty and vulnerability indicators due to ETS2 (% households) ..... 55

Figure 28. Change of vulnerability indicators across income groups due to ETS 2 (% households) ..... 55

Figure 29. Average additional costs per micro-enterprise in buildings ..... 56

Figure 30. Additional cost per micro-enterprise using diesel in HDV for transport ..... 57

Figure 31. Additional cost per micro-enterprise using diesel in LDV for transport ..... 57

Figure 32. Additional cost per micro-enterprise using Gasoline in LDV for transport ..... 58

Figure 33. Additional cost per micro-enterprise using Oil in taxis for transport ..... 58
Figure 34. Additional cost per micro-enterprise using Oil in buses for transport ..... 59
Figure 35. Additional costs from ETS2 per fuel ..... 59
Figure 36. Additional costs of vulnerable households using natural gas and gasoline ..... 62
Figure 37. Additional costs of vulnerable households using heating oil and gasoline 62
Figure 38. Additional cost of vulnerable households using heating oil and diesel..... 63
Figure 39. Average additional costs per micro-enterprise in buildings ..... 63
Figure 40. Additional costs per micro-enterprise using diesel in HDV for transport ..... 64
Figure 41. Average additional costs to regions with households with natural gas ..... 66
Figure 42. Average additional costs to regions with households with LPG ..... 66
Figure 43. Average additional costs to regions with households with oil ..... 67
Figure 44. Average additional costs per region for households with gasoline ..... 67
Figure 45. Average additional costs per region for households with diesel ..... 68
Figure 46. Average additional costs per region for households with LPG ..... 68
Figure 47. Illustration of the modelling and analysis methodology ..... 102

# LIST OF ABBREVIATIONS

| | |
|---|---|
| **SCP** | Social Climate Plan |
| **SCF** | Social Climate Fund |
| **ETS2** | Emission Trading System 2 |
| **SMEs** | Small and Medium Enterprises |
| **M-E** | Micro-enterprise |
| **NECP** | National Energy and Climate Plan |
| **EED** | Energy Efficiency Directive |
| **EPBD** | Energy Performance of Buildings Directive |
| **EEOs** | Energy Efficiency Obligation Schemes |
| **EU-SILC** | European Union Statistics on Income and Living Conditions |
| **HBS** | Household Budget Survey |
| **EQLS** | European Quality of Life Surveys |
| **LDV** | Light-Duty Vehicles |
| **HDV** | Heavy-Duty Vehicles |
| **LTRS** | Long-Term Renovation Strategy |
| **hds** | Households |
| **AROPE** | At-risk-of-poverty |

# INTRODUCTION

The Social Climate Fund (SCF) is a pivotal component of the European Union's strategic framework for addressing the socioeconomic impacts anticipated with the establishment of the Emissions Trading System (ETS2) for the carbon dioxide ($CO_2$) emissions from fuel combustion in buildings, road transport, and small industries. This new regulatory mechanism represents a major step toward fulfilling the EU's commitment to climate neutrality by 2050, focusing on sectors that have shown limited progress in terms of their decarbonisation during the past years. By setting a price on carbon emissions in these new sectors, ETS2 aims to reduce greenhouse gas emissions through market-driven adjustments. However, the associated increase in energy and transportation costs poses a significant burden, especially for vulnerable groups that may struggle to absorb these additional expenses and invest accordingly. Low-income households and small businesses that rely on affordable energy and means of transport are especially susceptible to the economic impacts of ETS2.

To support these groups, the SCF was established with Regulation (EU) 2023/955[1] to mobilise approximately €86.7 billion over the period from 2026 to 2032. The SCF is designed to mitigate the regressive effects of ETS2 by providing targeted financial support to Member States, which can then develop measures tailored to their specific national, regional and local needs. These measures can include investments in energy efficiency, clean mobility solutions, and even temporary direct income support to help protect vulnerable groups against increased living costs. The SCF aims to ensure that the transition to a green economy is equitable and inclusive, safeguarding social stability while advancing environmental objectives. To benefit from the funding under the SCF, all EU member states are required to prepare a Social Climate Plan (SCP) by June 2025.

The establishment of the ETS2 addresses a critical need to reduce emissions from high-impact areas like buildings and road transport. These sectors contribute significantly to Europe's carbon footprint, and their inclusion under ETS2 aligns with the EU's broader climate targets. However, this transition introduces a challenge, which is tackling the impact of higher energy and fuel prices on economically vulnerable segments of society. In response, the SCF regulation outlines several strategic objectives:

1. **Enhancing Energy Efficiency in Buildings and heating decarbonisation**: By funding energy-efficient retrofits and upgrades, like the heating system upgrade, the SCF seeks to reduce household (and possibly microenterprises) energy costs while improving living conditions. Building improvements not only reduce emissions but also create long-term economic benefits for low-income households, reducing their energy burden. The building improvements must be

[1] Support for the implementation of the Social Climate Fund - Publications Office of the EU

accompanied by removing fossil fuel heating, DHW and cooking systems to cleaner alternatives.

2. **Supporting Clean and Affordable Mobility**: SCF resources will support the expansion of public transportation, promote the adoption of zero-emission vehicles, and facilitate mobility solutions that reduce dependency on personal vehicles. These measures are crucial for transport-dependent individuals and micro-enterprises affected by higher fuel costs.
3. **Providing Direct Income Support**: Recognizing the immediate impacts of carbon pricing on household budgets and transport users, the SCF will offer temporary financial assistance to households and transport users facing disproportionate economic stress from ETS2. This direct support is intended to cushion the initial financial burden and allow these groups to adapt progressively to a low-carbon economy.

The successful preparation of Greece's SCP relies on an inclusive, collaborative stakeholder engagement process. This process involves a wide array of stakeholders—including government authorities, economic and social partners, civil society organisations, and research institutions[2]—to ensure that the SCP accurately reflects the needs and interests of all affected groups.

The aim of this report is to present the findings of the assessment of ETS2 impacts that can be helpful for the Social Climate Plan in Greece. More specifically, it departs from the vulnerability in households, transport and micro-enterprises, and it is followed by the expected impacts of the increase in the energy costs of vulnerable groups as a result of the ETS2. Finally, the report presents policy recommendations to alleviate the financial burden to the vulnerable households for the Greek Social Climate Plan.

[2] Support for the implementation of the Social Climate Fund - Publications Office of the EU

# 1 STATUS IN GREECE

## 1.1 Overview of national context

Greece's efforts to address energy poverty and vulnerability are framed by an evolving policy landscape, deeply influenced by its socioeconomic structure and the commitments under European legislation. Since the early 2010s, energy poverty has been recognised as a critical issue, necessitating coordinated actions at both national and local levels. The Greek government has actively incorporated energy poverty mitigation into its broader climate and energy strategies, creating an integrated approach that aligns with the European Union's goals for decarbonisation and social equity.

Central to this effort is the National Energy and Climate Plan (NECP), which prioritises energy efficiency and renewable energy as pivotal tools for reducing the energy burden on vulnerable groups. The NECP sets ambitious targets for energy efficiency improvements, aiming for a comprehensive reduction in energy poverty indicators by promoting residential building upgrades, fostering decentralised renewable energy systems, and expanding energy community initiatives. These actions are not only aligned with the Energy Efficiency Directive (EED) and the Energy Performance of Buildings Directive (EPBD) but also integrate the principles of just transition to ensure no segment of society is left behind.

In parallel, the National Action Plan to Combat Energy Poverty offers a structured framework to alleviate energy vulnerability through targeted investments and policy measures. Introduced in 2021, this plan is designed to reduce energy poverty by 50% by 2025 and 75% by 2030, compared to 2016 levels. Key components include strengthening consumer protection mechanisms, improving energy affordability through subsidies, and supporting the transition to low-emission heating and cooling technologies.

Greece presents unique socioeconomic and environmental challenges that need to be considered in the preparation of its SCP. The SCP should also consider the geographical disparities of Greece, having numerous islands and rural regions dependent on transport for supply of goods, people, services. Support mitigating the impacts of ETS2 in these regions is crucial for effecting cohesion in the country. The country faces high rates of energy poverty, with substantial numbers of households struggling to meet basic energy needs. Since 2012, Greek authorities, with EU support, have conducted extensive monitoring of energy poverty trends. Data from 2012 to 2023 reveal that while there has been progress, a significant portion of the population remains at risk. The Greek government has developed key national indicators to assess and address these vulnerabilities, including:

- Index I-II: The annual cost of the total household's energy is lower than 80% of the annual cost to cover the minimum required energy consumption / The net

income of each household on an annual basis should be lower than 60% of the median of the corresponding income for all households

- Index I-Ileq: The annual cost of the total energy consumption of each household should be lower than 80% of its annual cost to cover the minimum required energy consumption / The reduced net income of each household based on the equivalent number of persons belonging to each household, according to the OECD scale, on an annual basis, is lower than 60% of the median of the corresponding income for all households, according to definition of relative poverty. According to the National Action Plan to Combat Energy Poverty that Index is selected as the key indicator for measuring and monitoring the phenomenon of energy poverty. [3]

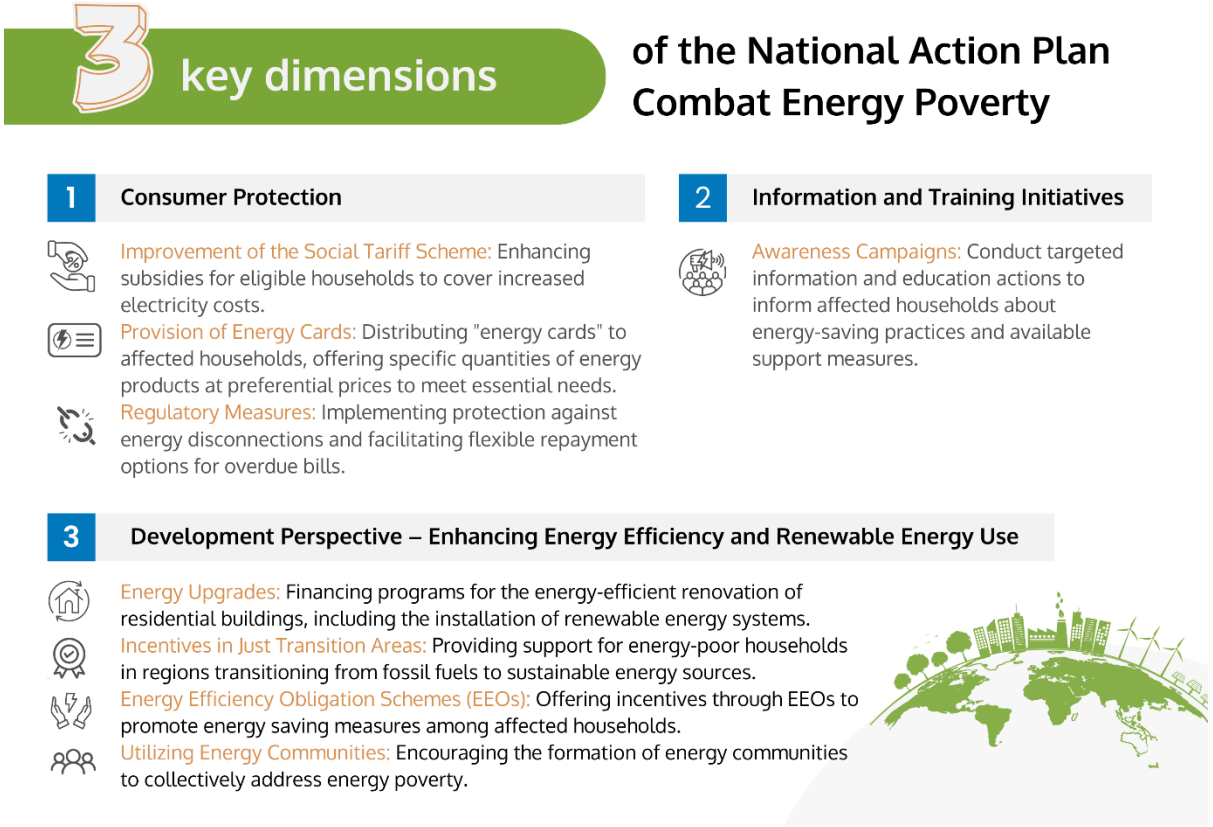
According to recent assessments, 14% of Greek households (approximately 573,000) met these criteria in 2016, with the percentage declining to around 12% (497,000 households) by 2020 and 12.4% (513,000 households) for 2021. These indicators have been instrumental in identifying and monitoring energy-poor households in Greece.

The **National Action Plan Combat Energy Poverty** is structured around three key dimensions:

- Consumer Protection:
  - Improvement of the Social Tariff Scheme: Enhancing subsidies for eligible households to cover increased electricity costs.
  - Provision of Energy Cards: Distributing "energy cards" to affected households, offering specific quantities of energy products at preferential prices to meet essential needs.
  - Regulatory Measures: Implementing protection against energy disconnections and facilitating flexible repayment options for overdue bills.
- Development Perspective – Enhancing Energy Efficiency and Renewable Energy Use:
  - Energy Upgrades: Financing programs for the energy-efficient renovation of residential buildings, including the installation of renewable energy systems.
  - Incentives in Just Transition Areas: Providing support for energy-poor households in regions transitioning from fossil fuels to sustainable energy sources.
  - Energy Efficiency Obligation Schemes (EEOs): Offering incentives through EEOs to promote energy-saving measures among affected households.
  - Utilizing Energy Communities: Encouraging the formation of energy communities to collectively address energy poverty.
- Information and Training Initiatives:

[3] Energy poverty indicators in Greece, source: https://energypoverty.gr/en/index.html

- Awareness Campaigns: Conduct targeted information and education actions to inform affected households about energy-saving practices and available support measures.




The plan also emphasises the establishment of a monitoring and evaluation mechanism to track progress and ensure the effectiveness of implemented measures. This includes the development of specific indicators to assess energy poverty levels and the impact of policy interventions.

In alignment with the NECP and the Action Plan for Energy Poverty, Greece's SCP framework seeks to address these challenges through region-specific initiatives. Furthermore, the SCP needs to be aligned with Just Transition strategies, the priorities of the Recovery and Resilience Plan (RRP) for building renovations and energy efficiency, as well as the new EED and the EPBD (regarding eligibility of actions). Key actions include subsidies for energy-efficient renovations in low-income regions, support for alternative and low-emission transport options, and incentives for cleaner heating and cooling technologies. These actions not only address immediate vulnerabilities but also contribute to Greece's long-term energy transition goals.

Greece has established a national energy poverty observatory to monitor and address energy poverty in Greece. Developed by the Center for Renewable Energy Sources and Saving (CRES) in 2014, its primary objectives include assessing energy poverty levels, identifying contributing factors, and supporting the design and

implementation of effective policy measures. The observatory employs specific indicators to quantify energy poverty, such as:

- The ratio of actual energy consumption to the theoretically required energy consumption.
- The proportion of household income spent on energy expenditures.

Households are considered energy poor if their actual energy consumption is less than 80% of the required amount and if energy expenditure exceeds 10% of their income.

## 1.2 Definitions of energy / transport poverty and vulnerability

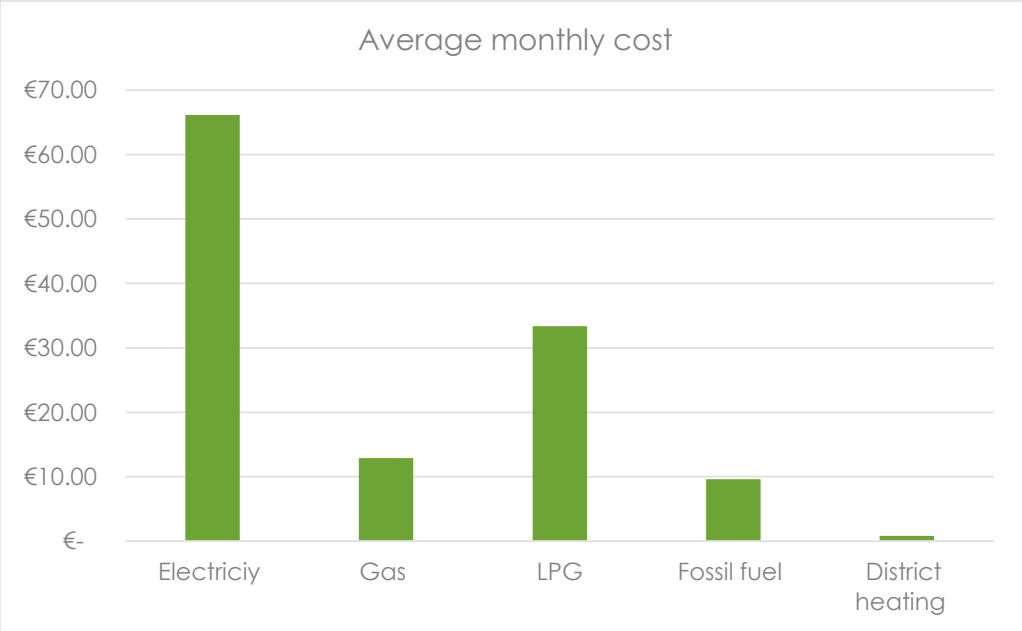
In Greece, poverty is primarily defined in alignment with European Union standards, utilising the concept of relative poverty. The at-risk-of-poverty threshold is set at 60% of the national median equivalized disposable income after social transfers. This approach is consistent with the methodology employed by Eurostat and is used to assess the proportion of the population at risk of poverty or social exclusion. The specific poverty threshold can vary annually based on income distribution data. For instance, according to the European Anti-Poverty Network (EAPN) Greece's Poverty Watch Report 2024, the poverty threshold was set at €6,030 annually for a single-person household and €12,663 for households with two adults and two dependent children. At the same time the national definition of vulnerable groups in Greece will be overarching to the definition of poverty. According to Article 52 of Law 4001/2011 on the operation and organisation of the markets for electricity and natural gas, "vulnerable customers", for the purposes of this Law and the supply of electricity[4] and natural gas, include the following categories:

a) financially weak household customers suffering from energy poverty;
b) customers or their wives or persons over whom they have care and control under the law and who are living with them and depend to a large extent on a constant and uninterrupted energy supply.
c) elderly customers at least seventy (70) years old, provided that they are not living with another person who is under that age;
d) customers with serious health problems, especially persons with a serious physical or mental disability or who are mentally retarded or have serious audio-visual or mobility problems or multiple disabilities or a chronic illness, who are therefore unable to manage or negotiate their contract with the supplier;
e) customers in remote areas, especially non-interconnected islands, who are entitled to special services both in terms of price and in terms of quality and security of supply and transparency of contractual terms and conditions compared with other customers.

[4] In this context it is important to note that the concept of vulnerable electricity customers is not directly relevant for the Social Climate Plan, as electricity is not part of the fuels that are covered by the ETS2.

Moreover, the average monthly cost per households appears in Figure 1. As it seems, the major expense is for fuel cost for electricity that is significant high than the rest of other energy costs.

**Figure 1. Average monthly costs of energy for Greek households**




The national Greek statistics (Household Budget Survey) utilise a metric for the number and composition of the households based on eight income categories, which are separated by the income variances among them (from 0 to 750€, followed by 751 to 1100€ and so on). These income categories that are also used in this study appear in below. Each income category has a threshold signifying the maximum unitary household income level per month.

Table 1 below. Each income category has a threshold signifying the maximum unitary household income level per month.

**Table 1. Structure of households' number**

| Household composition | Total | <750€ | <1100€ | <1450€ | <1800€ | <2200€ | <2800€ | <3500€ | >3501€ |
|---|---|---|---|---|---|---|---|---|---|
| Single person below 65 years old | 704,697 | 198,380 | 202,301 | 134,676 | 85,375 | 21,840 | 35,799 | 17,074 | 9,251 |
| Single person 65 years old and above | 673,523 | 284,559 | 188,584 | 112,143 | 53,133 | 15,819 | 14,788 | 2,839 | 1,659 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Single couple | 953,256 | 81,873 | 163,520 | 189,367 | 140,566 | 137,984 | 130,765 | 63,801 | 45,380 |
| Couple with 1 child above 16 years old | 312,050 | 7,139 | 39,765 | 48,549 | 43,980 | 59,177 | 55,484 | 24,925 | 33,030 |
| Couple with 1 child up to 16 years old | 262,014 | 10,922 | 21,634 | 29,902 | 40,878 | 49,332 | 57,201 | 18,659 | 33,486 |
| Couple with 3 children and more above 16 years old | 100,349 | 2,083 | 8,896 | 18,072 | 13,158 | 13,114 | 19,342 | 14,062 | 11,622 |
| Single parent with 1 child or more up to 16 years old | 47,501 | 13,992 | 13,113 | 10,139 | 4,347 | 1,658 | 2,799 | 1,453 | 0 |
| Couple or single parent with children above 16 years old | 740,346 | 28,729 | 55,889 | 74,802 | 96,991 | 126,025 | 150,974 | 103,976 | 102,959 |
| Other type of household | 463,298 | 32,625 | 45,819 | 66,304 | 62,104 | 74,225 | 82,849 | 51,471 | 47,902 |

As regards the definition of energy poverty in Greece, according to the national Law 4001/2011, Art. 2(i) as energy poverty is defined

***"The situation of consumers, in which they find themselves in a difficult position, due to their low income, as indicated by their tax returns, combined with their professional situation, family situation and specific health conditions, to cover the costs of their reasonable supply needs for electricity or Natural Gas, as these costs constitute a significant proportion of their disposable income"***

Additionally, the National Action Plan to combat energy poverty was approved in September 2021 by the Ministry of Environment and Energy under the Ministerial Decision No. ΥΠΕΝ/ΓΔΕ/89335/5599 (Official Gazette B' 4447/28.09.2021). The plan identifies households affected by energy poverty through specific quantitative indicators, as the ones referred above (Index I-II and Index I-II$_{eq}$) as well as the development of a specialised process for monitoring and evaluating the course of mitigating the phenomenon by 2030 (see Section 2.1).

The Regulation 2023/955 establishing a Social Climate Fund (SCF Regulation)[5], also using definitions established in other EU directives, defines relevant terms for the development of Social Climate Plans. In the absence of relevant national definitions, it is recommended to adopt the following definitions for the purposes of developing the Social Climate Plan for Greece.

Key definitions under the SCF Regulation include the following:

- **Energy poverty**: 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[6].
- **Transport poverty:** Individuals' and households' inability or difficulty meeting the costs of private or public transport, or their lack of or limited access to transport needed for their access to essential socio-economic services and activities, taking into account the national and spatial context[7].
- **Household:** A person living alone or a group of persons who live together, providing oneself or themselves with the essentials of living[8].
- **Vulnerable households EU/2023/955:** Households in energy poverty or households, including low-income and lower-middle-income ones, that are significantly affected by the price impacts of the inclusion of greenhouse gas

[5] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02023R0955-20240630

[6] The definition at the EU level is originally from the Energy Efficiency Directive 36 2023/1791 - which must be transposed by MS by October 2025. See Art 2.(52) "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 now 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".

[7] The European Pillar of Social Rights, in its Principle 20, lists transport (alongside water, energy, sanitation, financial services and digital communication) among the essential services to which everyone should have access.

[8] As defined in Art.2(15) of EU 2019/1700 Establishing a common framework for European statistics relating to persons and households.

emissions from buildings within the scope of Directive 2003/87/EC (i.e. ETS2) and lack the means to renovate the building they occupy[9].

- **Vulnerable transport users:** Individuals and households in transport poverty, but also individuals and households, including low-income and lower-middle-income ones, that are significantly affected by the price impacts of the inclusion of greenhouse gas emissions from road transport within the scope of Directive 2003/87/EC and lack the means to purchase zero- and low-emission vehicles or to switch to alternative sustainable modes of transport, including public transport.
- **Micro-enterprise:** An enterprise that employs fewer than 10 persons and whose annual turnover or annual balance sheet does not exceed EUR 2 million, calculated in accordance with Articles 3 to 6 of Annex I to European Commission Regulation (EU) No 651/2014.
- **Vulnerable micro-enterprises:** Micro-enterprises that are significantly affected by the price impacts of the inclusion of greenhouse gas emissions from buildings or road transport within the scope of Directive 2003/87/EC and that, for the purpose of their activity, 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, including public transport, as relevant.

[9] As per Art 2(10) of the SCF Regulation

# 2 INDICATORS OF POVERTY AND VULNERABILITY

A range of indicators has been developed to operationalise the definitions of energy and transport poverty and vulnerability into measurable, actionable numbers. The selected indicators allow policymakers to grasp the prevalence of these issues, and the way they evolve. This in turn gives insight into the impact of current policy and events and the need for new policies. This section provides an overview of vulnerability indicators for households, transport users, and micro-enterprises. The time series for the indicators includes the period of 2019-2022 with the available Household Budget Survey (HBS) data (which is gathered yearly for Greece) and the EU SILC database. The calculations take place on the basis of the income category that the households belong to. The Greek HBS presents the data on household consumption in eight income categories. For the purposes of the Social Climate Plan for Greece, based on the definitions of vulnerable households and vulnerable transport users under the SCF Regulation which are focusing on "low to low-middle income" categories, the focus of this analysis will be on the households in Greece that belong to the first four income categories.

To determine the thresholds for categorising various types of households as vulnerable groups under the ETS2, we depart from the concept of income threshold. This is the standard practice for all types of social policies, which apportion the amounts to be distributed as income support or as subsidies to households based on their income. The selection of the appropriate threshold for the disposable income, to determine the vulnerable groups, is calculated from the average income of vulnerable groups as defined by each indicator for vulnerability. Specifically, the values for each indicator, where data were available, correspond to an average income level from the household sample of the HBS, which is then extrapolated to the whole population in Greece.

The same applies to the additional vulnerability indicators (inability to renovate and inability to purchase a new and efficient zero-emissions vehicle), which seem appropriate for determining vulnerability based on the SCF Regulation and the definitions of energy and transport vulnerability. An important note is that this assessment serves to estimate the total size of vulnerable groups based on their income level, within the scope of significantly affected by the ETS2. The average income is calculated from the HBS sample for households with non-zero income based on their declarations (including individuals receiving pensions and other public benefits, as these are considered sources of income).

The methodology and outcomes of these indicators are analyzed in detail in Oikonomou et al 2025[10] and this report provides the basic findings of the analysis.

## 2.1 Household poverty and vulnerability indicators

The indicators in Table 2 *are* provided in the latest 'EU guidance on energy poverty' SWD (2023)647, which notes that *"Each of the indicators has advantages and disadvantages and Member States need to take this carefully into account when using them. They might decide to use additional domestic indicators (based on the national or local level data) coming from their national statistical offices. Some Member States also use composite indicators. There are no composite indicators from Eurostat"*[11]

However, the recast Energy Efficiency Directive (2023) [12] (Art 8.3) requires the consideration of four indicators (see * indicators in Table 3) as a reference point on energy poverty and a range of composite indicators have been developed by others (in countries where no national definition of energy poverty has been adopted).[13]

A combination of these indicators should be used by MSs to capture the complexity of energy poverty and vulnerability to ETS2 implementation. As noted, these may be complemented by national indicators. For an initial baseline assessment, we recommend the use of indicators 1a, 2, 10, and 13, which align directly with the reporting and energy-saving requirements of the Energy Efficiency Directive.

**Table 4. Outcomes derived from the household vulnerability indicators.**

| Hds | Indicator Code | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | Number of households |
|---|---|---|---|---|---|---|---|---|---|
| % | **RI.1** Inability to keep home adequately warm or cool | 25.6 | 22.9 | 19.6 | 20.4 | 19.0 | 20.5 | 19.4 | 824,237 |

[10] Oikonomou, V,, Livraghi, S., Karalaiou, K., Rogulj, I., Spyridakos, S., Tourkolias, C. 2025. How to distinguish Income Indicators of Energy and Transport Vulnerability—A Case Study of Greece. Sustainability 17(10), 4275; https://doi.org/10.3390/su17104275

[11] a17c2aa6-02ca-49b3-8df6-b106ca9f37ed_en

[12] Directive - 2023/1791 - EN - EUR-Lex

[13] Composite indicator approaches include: the Rented Private Housing Energy Poverty Indicator (REPI) (EU – Energy Poverty Dashboard), the Index of Vulnerable Homes (IVH) (England), Building Fuel Poverty Index (BFP) (Italy), Structural Energy Poverty Vulnerability (SEPV) (EU), Energy Poverty Vulnerability Index (EPVI) (Portugal) and Composite Energy Poverty Index (CEPI) (EU) as well as the Domestic Energy Poverty Index (EDEPI).)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| % | **RI.2** Arrears on utility bills | 33.4 | 29.9 | 28.1 | 24.3 | 23.3 | 29.8 | 31.4 | 1,335,859 |
| % | **RI.3** High share of energy expenditure in relation to income (2M) | 17.2 | 16.2 | 16.3 | 17.4 | 17.3 | 16.8 | | 716,605 |
| % | **RI.4** Low absolute energy expenditure (M/2) | 11.4 | 13.8 | 8.8 | 11.4 | 9.7 | 9.3 | | 395,748 |
| % | **RI.5** Residential energy spending>10% of budget | 41.4 | 37.8 | 40.5 | 38.4 | 39.2 | 44.2 | | 1,883,223 |
| % | **RI.6** Expenditure on energy as percentage of total household expenditure | 8.0 | 7.8 | 8.3 | 8.5 | 8.4 | 9.1 | | 387,048 |
| €/kWh | **RI.7** Electricity prices per average household | 0.167 | 0.17 | 0.157 | 0.17 | 0.18 | 0.23 | 0.23 | |
| €/kWh | **RI.8** Gas prices average household | 0.056 | 0.06 | 0.057 | 0.05 | 0.07 | 0.12 | 0.11 | |
| €/kWh | **RI.9** Gas prices average household | 0.067 | 0.07 | 0.068 | 0.07 | 0.08 | 0.14 | 0.12 | |
| % | **RI.10** Share of population with leak, damp or rot in their dwelling | 14.3 | 14.8 | 14.0 | 14.1 | 0.0 | 0.0 | 11.6 | 495,337 |
| toe/dw | **RI.11** Final energy consumption per m2 in the residential sector, climate corrected | 1.040 | 0.98 | 1.010 | 1.040 | 1.030 | 1.03 | | |
| % | **RI.12** LIHC (Low Income High Costs) | 50.2 | 50.1 | 50.0 | 50.0 | 50.1 | 50.0 | | 2,129,891 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| % | **RI.13** AROPE* (At-risk-of-poverty ) | 19.4 | 18.1 | 18.5 | 19.6 | 19.7 | 18.4 | | 783,937 |

**The calculation of the equivalent number of Households presented in the last column makes use of the total number of households provided in the HBS 2022 database. Currently there is no data available for the number of vulnerable households per gender, age and other vulnerabilities. A bottom-up approach with stakeholders might assist in collecting this kind of data.*

The **RI.1** indicator, referring to the "*Inability to keep home adequately warm or cool*" shows that an average of 21%, or about one-fifth (1/5) of the Greek households (2017 to 2023 average) could not secure thermal comfort. At the same time, the outputs from the "*Arrears in utility bills*" (**RI.2**) indicate that the percentage of households that "fall behind" in their energy bill obligations, still rose during the years 2022 and 2023 from 29.8 to 31.4%; this increment can be attributed to the increased use of heating and cooling systems due to climate-related changes and the growth of energy costs following the recent energy crisis[14].

The results derived from the **RI.3** indicator show that the percentage of Greek households with "*high share of energy/transport expenditure in relation to income (2M)*" remains 16.8% in 2022. However, these rates imply that a certain number of households remained in a risky economic position over a period of 6 years, revealing potential phenomena of "hidden energy poverty"[15]. Similarly, the **RI.4** indicator outputs present that in 2022, 9.3% of the Greek households belonged to the group whose "*share of energy/transport expenditure within their income is more than twice the national average*". These rates depict certain households are constantly burdened economically from disproportionate expenses on energy needs.

The **RI.5** indicator outputs show that a great majority of households in Greece, 44.2% in 2022, spend more than 10% of their budget on residential energy needs. The rising trends of **RI.6** "*Expenditure on energy as percentage (%) of total household expenditure*", from 8% in 2017 to 9% in 2022 reveal a small, yet, advancing financial burden for the Greek households. The increase of the **RI.7** rates, referring to the "*Electricity prices for average households*"), from 0.167 €/kWh in 2017 to 0.232 €/kWh in 2023, reflects the rising costs of electricity, and subsequently, the energy bill burdening of the households in Greece. The sharp rise recorded in the "*Gas Prices for average households*" according to the **RI.8** indicator, particularly in the years 2022 and 2023, depicts the soaring gas prices due to the energy market volatility at the specific time. Furthermore, the gas price rise significantly affects the households' consumption, as presented in the **RI.9** outcomes, with the prices doubling by 2023 to

[14] http://www.ecb.europa.eu/press/economic-bulletin/focus/2022/html/ecb.ebbox202204_01~68ef3c3dc6.en.html

[15] Uncovering Hidden Energy Poverty: A Critical Look at Overlooked Challenges | Energy Poverty Advisory Hub

0.122€/kWh, from 0.067€/kWh in 2017. The **RI.10** indicator, describing the percentage of households living in malfunctioning dwellings (leaks, damp spaces, etc.) presents a fall from 14.3% in 2017 to 11.6% in 2023. These dropping rates can imply increasing renovation/refurbishment activities in the housing sector, following relevant nationally funded programs.

Next, the steady rates derived from the **RI.11** indicator, describing the "*energy consumption per square meter in the residential sector*", suggest consistent energy efficiency levels in the households. Nevertheless, it can be proposed that further improvements could lead to additional energy cost reductions. The outputs deducted from the **RI.12** indicator, describing "*households that are at risk of poverty, i.e. expenditures are less than 60% of the national median after paying for energy/transport AND the share of energy/transport in total expenditures/income is larger than national median*", show that a significant average of 50.06% of households in Greece has been facing financial vulnerability to potential future rises in energy costs during the period 2017 to 2023.

Finally, the minor discrepancies in the rates of the indicator **RI.13**, referring to households "*at a risk of poverty*" reveal that a significant percentage of households - 18.95% on average - in Greece is constantly on the margin of poverty. These numbers imply that an important group of households are vulnerable to energy market volatility.

Over 20% of the population, corresponding to almost 900.000 households, is considered energy poor

Taking the average of the population sample from the HBS regarding the energy poverty in Greece (from indicators **RI.1, RI.2, RI.10, RI.13**) we estimate **that around 20.2% falls under energy poverty**. In absolute terms and extrapolating the percentage from the HBS sample to the entire population (4,257,034 households), we estimate that **859,843 households are considered energy poor**. Based on the National Energy Poverty Action Plan, according to the Indicators I and Ileq (See Section 3.1), the households under extreme energy poverty in 2021 were 12.4% (increased by 12% as of 2020), amounting to 513,000 households.

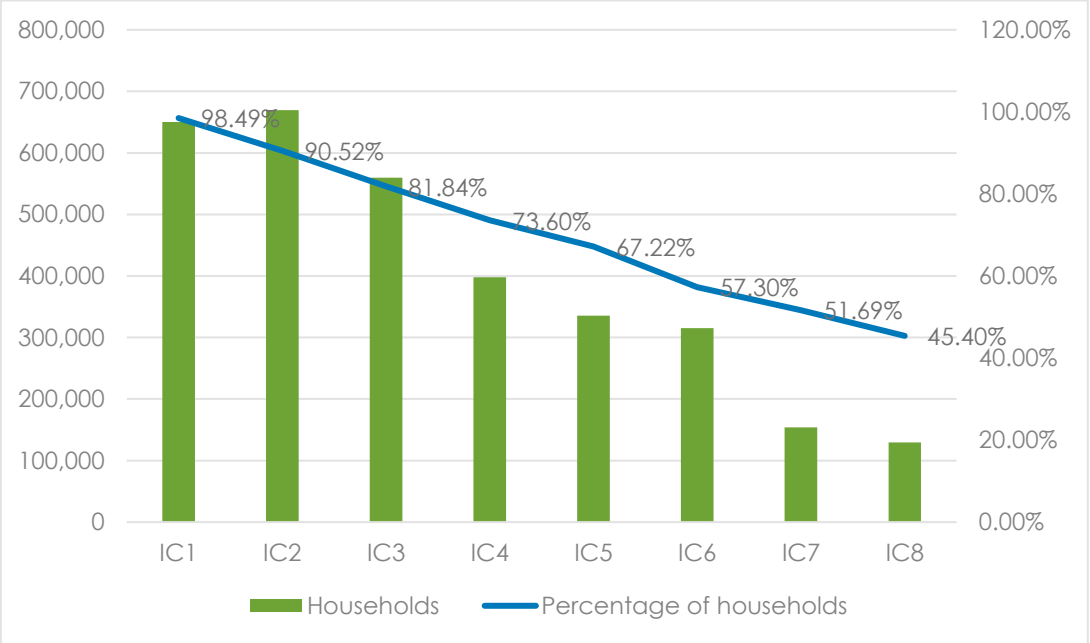
### 2.1.1 Vulnerability indicators to comply with the SCF definition

#### Inability to renovate

Based on the vulnerability indicator for households with the inability to renovate their building, Figure 6 illustrates that for the first four income categories (with a monthly household income below 1,800€), almost 2.28 million households are unable to renovate their dwellings, reaching 86% of the total households in these income categories. For the other income categories, the percentages are almost half of the

households that cannot afford to renovate, although they are outside the scope of the definition of vulnerable households under the SCF Regulation.

**Figure 2. Number of households with the inability to renovate**

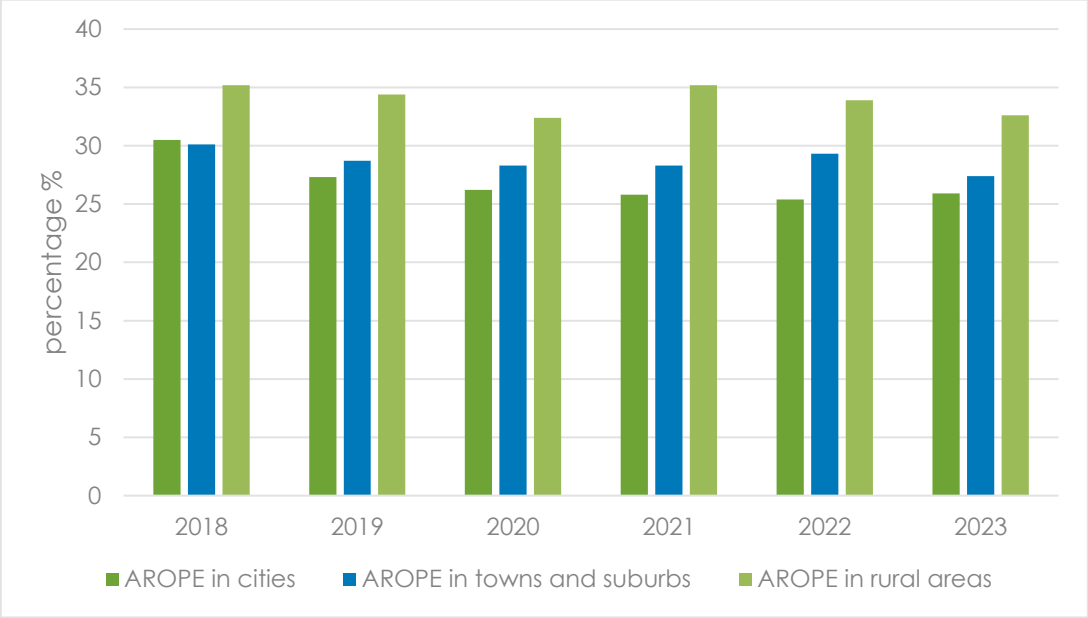



Based on the income approach (as described in Oikonomou et al. 2025), the income thresholds for energy and transport poverty are calculated separately from the ones for household and transport vulnerability, based on the indicators for poverty and vulnerability (described in the previous sections). The income thresholds are set on the ground of the average income (from the percentage of households that fall under each poverty or vulnerability indicator), which are derived from the HBS calculation. Taking the indicator of the inability to renovate as the one determining the vulnerability of households, the income thresholds (unitary per household member) would be 10,700-11,000 Euros below which every household is falling under energy vulnerability. For the first income classes, this would correspond to 1,620,000 households in this category, where about the half (853,000) would be affected by ETS2.

### At risk-of-poverty (AROPE) by degree of urbanisation

The data collected following this indicator illustrate that a significant percentage of the Greek population is at risk of poverty across the various settings of the country. Figure 3 depicts that although the AROPE group rates in cities were reduced by 5% during the last 5 years, they still account for almost one-fourth (25%) of the urban population. At the same time, the AROPE rates in towns and suburbs have remained at high levels over the last 5 years (28 to 30% of the population), while the AROPE percentages in rural areas account for around 32 to 35% of the population.

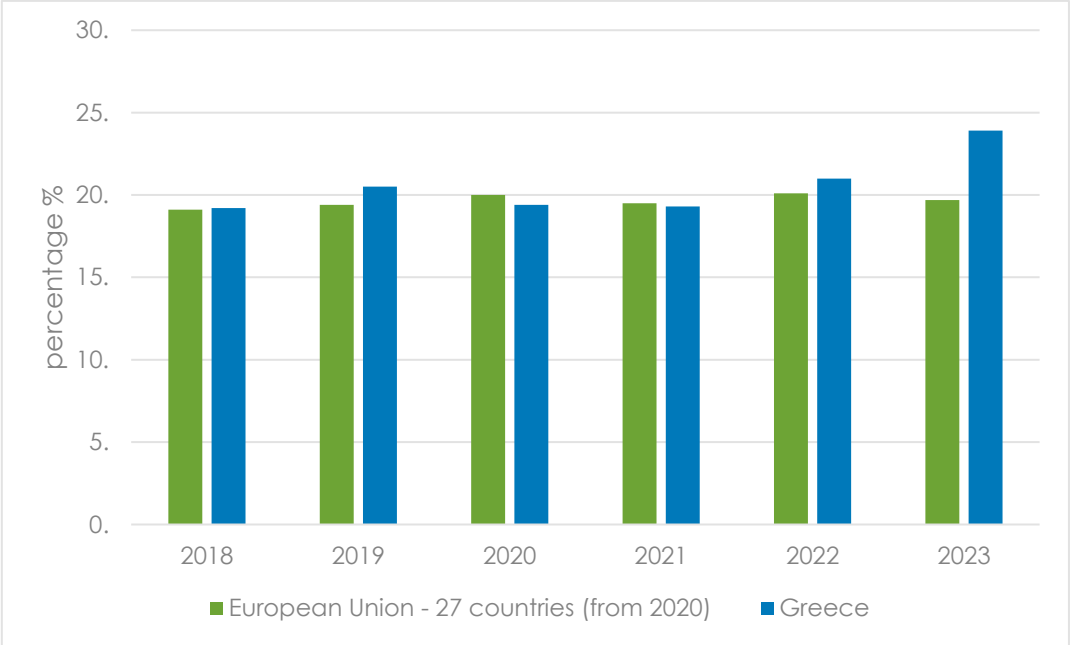
**Figure 3. AROPE by degree of urbanization in Greece**




## At risk-of-poverty (AROPE) in elderly people

The analysis of the data referring to this indicator depicts that the AROPE groups of elderly people (over 65 years old) in Greece have been following trends similar to those recorded on an EU level during the last 5 years and refer to around 20% of the elderly population. The following graph shows that these rates increased sharply in 2023, accounting for around 24% of the Greek senior citizens.

**Figure 4. AROPE in elderly people in Greece**



## 2.2 Transport poverty and vulnerability indicators

Departing from interactions with the experts from the multi-country project of DG REFORM, we have developed a conceptual framework for transport poverty based on an extensive literature review[16]. Figure 5 shows this conceptual framework that highlights the importance of the three "A"s of transport poverty: availability, accessibility, and affordability.

**Figure 5. Conceptualization of transport poverty. Source: European Commission / DG EMPL report on transport poverty**

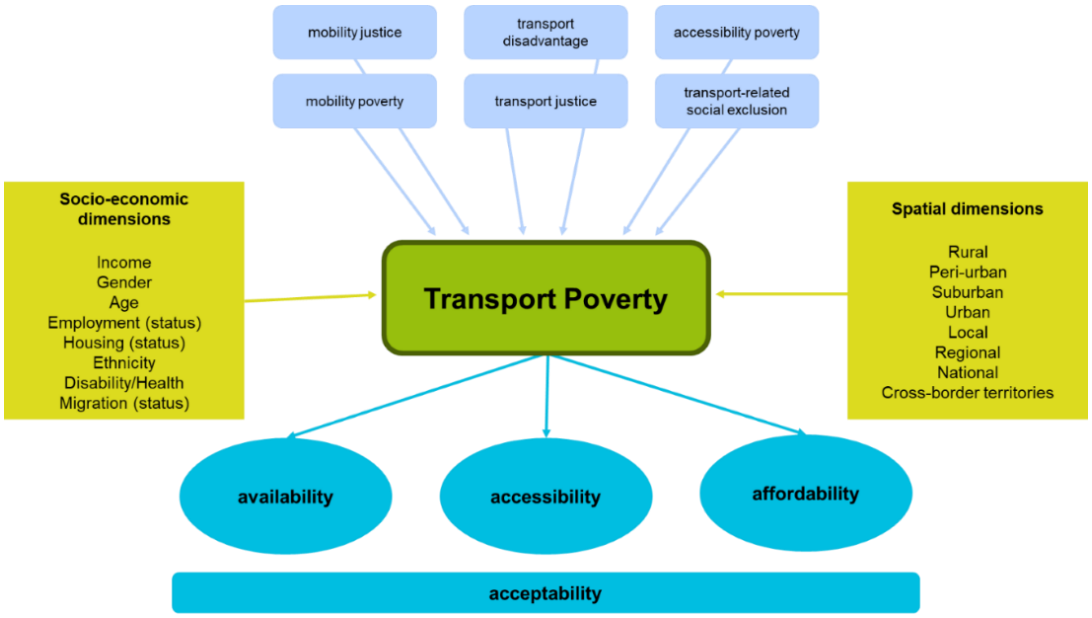



Table 5 presents the suitable transport poverty indicators derived and estimated in the study in line with the conceptual framework and based on the available EU-level data. The available data consists of the survey datasets: EU- Statistics on Income and Living Conditions (SILC) (yearly and ad-hoc modules), Household Budget Survey (HBS), Labour Force Survey (LFS) and European Quality of Life Surveys (EQLS). At the national level, there was no additional data that allows further reflection on the relevant concepts in a more granular fashion, for example by estimating additional indicators or adjusting the indicators presented here. This applies in particular to accessibility, for which indicators are ideally estimated using spatial data with information on the location of essential services, the transport network (both public and private), timetables (ideally dynamic) and journey times. Complementary to the estimations derived with the help of the vulnerability indicators, spatial and administrative data

[16] See also this 2022 JRC report for an in-depth literature review on the topic: Mejía Dorantes, L. and Murauskaite-Bull, I. (2022): Transport poverty: A systematic literature review in Europe (JRC Science for Policy Report). European Commission. Luxembourg. Online available at https://op.europa.eu/de/publication-detail/-/publication/0422e50e-6a35-11ed-b14f-01aa75ed71a1/language-en,

are essential to allocate benefits and funds on the ground promptly and to contribute to their effective take-up.

**Table 5. Outcomes derived from the Transport vulnerability indicators (in %)**

| Indicator Code | 2013 | 2014 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | Hds |
|---|---|---|---|---|---|---|---|---|---|---|
| **TI.1** Population that is materially and socially deprived and owns a car | | | 48.2 | 46.3 | 43.2 | 43.3 | 44.6 | 44.4 | 43.7 | 1,860,193 |
| **TI.2** Population for which the next public transport stop is 'too far away' | 2.6 | 2.0 | | | | | | | | 87,203 |
| **TI.3** Population with 'very difficult' access to public transport | | | | | | | | | | |
| **TI.4** Population with 'too difficult' access to public transport because of reduced mobility | 1.3 | 1.0 | | | | | | | | 40,631 |
| **TI.5** Population with a one-way commute to work of more than 30 min | | | | | | | | | | |
| **TI.6** Population facing enforced lack of a car (answering 'No-cannot afford' | | | 10.1 | 9.1 | 8.5 | 8.2 | 7.8 | 8.2 | 7.7 | 327,709 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| to the question of whether they own a car) | | | | | | | | | | |
| **TI.7** Population for which public transport is 'too expensive' | 3.5 | 3.1 | | | | | | | | 130,685 |
| **TI.8** Share of the (household) population that spends more than 6% of total expenditures on transport (only including recurrent expenditures such as fuels, tickets)[11] and household is in the bottom half of expenditure distribution | | | 38.1 | 35.6 | 36.4 | 27.4 | 30.0 | 36.5 | | 1,555,508 |
| **TI.9** Share of the (household) population for which the share of transport expenditures in total expenditures exceeds twice the national median and household is in the bottom half of expenditure distribution | | | 14.8 | 18.2 | 15.6 | 19.0 | 14.8 | 15.7 | | 669,885 |
| **TI.10** Share of households with | | | 51.7 | | 54.7 | | 66.0 | | | 2,810,068 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| no use of public transport from no member on an annual basis | | | | | | | | | | |

The **TI.1** indicator rates illustrate a dropping rate of the "*share of the population that is materially and socially deprived and owns a car*", from 48.2% in 2017 to 43.7% in 2023. This rate reduction can imply recurring financial difficulties for a significant number of people to retain private means of transportation due to fuel price rises. Indicators **TI.2** and **TI.4** reflect the "*share of the population for which the next public transport is too far away*", and the "*share of the population with too difficult access to public self-transport due to reduced mobility*". The low rates presented for the two indicators in 2013 and 2014 reflect that a small percentage of the population dealt with issues regarding accessibility and proximity to public transport. However, the lack of recent data constitutes an obstacle to making solid assumptions, highlighting the difficulties in capturing data that relies on personal testimonies.

The same applies to indicators **TI.3** and **TI.5**, referring to the "share of the population with very difficult access to public transport" and the "share of the population with a one-way commute to work of more than 30 minutes", where there is a total lack of information. The **TI.6** indicator rates depict a dropping percentage of the population who faced an "enforced lack of a car (cannot afford)" in the past years, at 7.7% in 2023. This rate reduction might imply a potential resort of the population to private automobiles due to unavailability or inaccessibility to public transport, despite the fuel costs that follow the use of privately owned means of transport.

According to the **TI.7** outputs, a low percentage of the population, just above 3% in the years 2013 and 2014, stated that "*public transport is too expensive*", implying that Greek public transport at that period was considered an economically feasible option. The outputs derived from the **TI.8** indicator, describe that a significant share of the population, respectively 38.1% in 2017 and 36.5% in 2022, spends "more than 6% of total expenditures on transport (fuels, tickets)", while it becomes apparent that during the years of the global COVID19 pandemic (2020 and 2021), those rates dropped significantly. This indicator accentuates the influence of fuel prices and transport expenses on financially vulnerable Greek households' budget allocation.

**TI.9** outputs depict that, on average, for one-fourth of the households in the bottom half of the expenditure distribution "the share of transport expenditures in total exceeds twice the national median". This rate proves again the high exposure of this household category to rising fuel prices and implies their reliability on an accessible and economically affordable public means of transportation. Finally, **TI.10** demonstrates that a higher number of households are not using frequently public transport, and this could relate to accessibility issues.

More than 1 million and a half of households is considered transport poor

For the calculation of transport poverty, we include the indicators of both affordability and accessibility (excluding the ones with data before 2020). The average of these indicators results in a percentage of **33.3% of households (1,416,964 in total) considered as transport poor households**. In general though and in the absence of a national definition, A systemic challenge to the effective application of the definition of transport poverty at the national level is the lack of relevant, recent, and reliable data on the existing transport services and mobility of the population, especially in non-urban areas. Data from EU-SILC, used to identify the baseline in the absence of other relevant data at NUTS 2 and NUTS 3 levels, is not entirely suitable to assess and monitor the impact of potential measures to be included in the SCP (or other policy documents), due to the low frequency and quality of the data collection (subjective and not properly specified survey questions/answers).

A lack of systematic and sufficiently frequent collection of transport- and mobility-related data in Greece is one of the key challenges in taking a more structured approach to transport poverty. The application of the transport poverty definition will - in the short term - be hindered by the current limited availability and accessibility of relevant data. It is highly recommended that a data-collection system be established that is aligned with the necessary data for implementing the energy efficiency first principle at a national level. That should be done in conjunction with the new binding renewable energy targets for the EU for 2030. Additionally, a responsible entity should be designated at the national level, similar to what is required for the revisions of the Energy Efficiency Directive (EED) and the Energy Performance of Buildings Directive (EPBD). That will enable the collection, monitoring, and interpretation of relevant data needed to understand better the transport poverty patterns at different spatial levels and within demographic groups.

### 2.2.1 Vulnerability indicators for compliance with SCF definitions

#### Persons who cannot afford a private vehicle

Figure 6 illustrates the analysis of the data following this indicator. As it is depicted, around 1 million Greek citizens are constantly unable to afford a private vehicle, proving that a significant number of people are relying greatly on affordable and reliable public means of transportation.

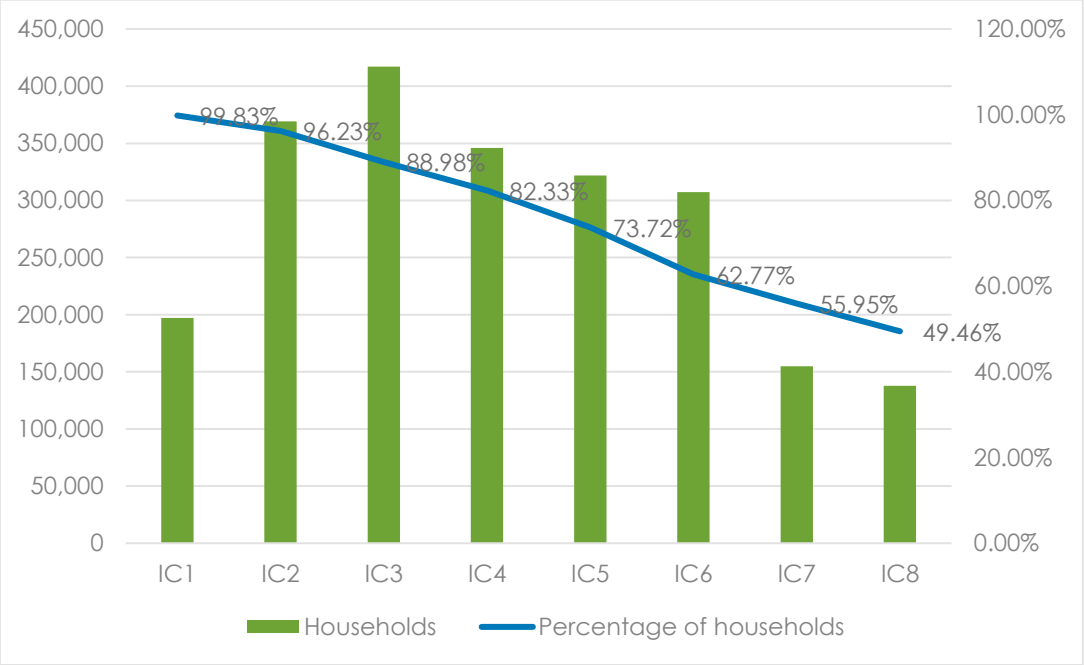
**Figure 6. Population that can afford a private vehicle**

## Inability to purchase a new zero-emission vehicle

This indicator is generated from the HBS 2022 datasets and refers to the inability of a household to purchase a new zero-emissions vehicle to avoid the increased fossil fuel costs. It is calculated by subtracting all expenses from the total income and then comparing the remaining disposable income to the investment cost for such a vehicle. As these costs cannot be covered directly in one instalment from vulnerable transport users, we assume ten annual instalments of 3,000 € (in the form of a loan), considering current market prices of small good-quality zero emissions vehicles in Greece that start at around 30,000 €, according to the electric vehicle support scheme "Move electrically" ("Κινούμαι Ηλεκτρικά").[17] If the household's remaining disposable income cannot suffice to cover this amount, then we consider that this household falls under transport vulnerability (following the definition of the SCF Regulation). Additionally, for the preparation of SCP measures, the authorities can assess the possibility of households to switch to alternative sustainable modes of transport, including public transport, due to lack of statistical data. This could be assessed on a case-by-case basis during the implementation phase of the SCP. Based on the vulnerability indicator for households with the "inability to purchase a new zero-emissions vehicle", Figure 7 depicts that for the first four income categories the large majority of households belonging to each category (90% of higher) are unable to purchase a new emissions free vehicle. This translates to a total of 1.33 million households with private vehicles who are unable to purchase a new one (reaching 90% of the total households in these income categories).

[17] https://kinoumeilektrika3.gov.gr/index.html

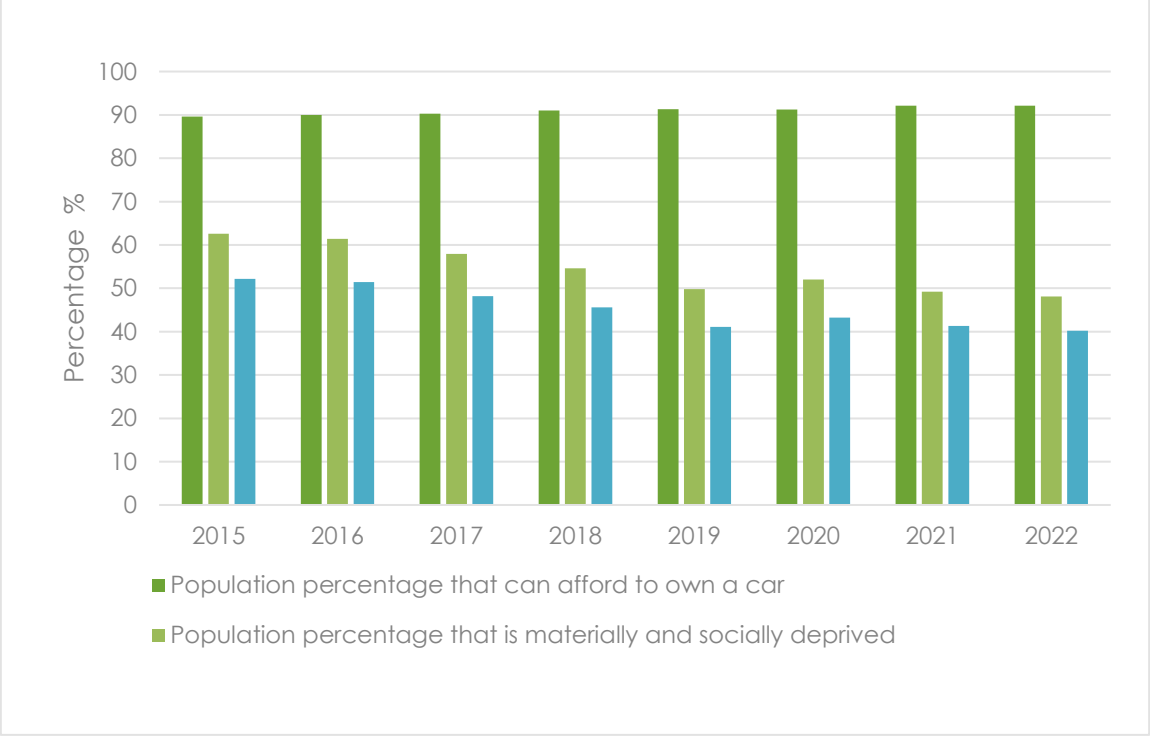
**Figure 7. Households with the inability to purchase new emissions-free vehicle**




## Persons who are materially and socially deprived and can own a car

The illustration following the analysis of this indicator's datasets (Figure 8) shows that the percentage of the population that is materially and socially deprived, and still can own a private vehicle has been in a declining trend, from 2015 to 2022.

**Figure 8. Population percentage that is materially and socially deprived and can own a private vehicle**



### Persons who are materially deprived by degree of urbanisation, and can own a private vehicle

The analysis of the datasets comprising this indicator is illustrated below. The graphs show that the percentage of the materially deprived population in different settings (urban, suburban, rural) that can afford a private vehicle has been declining during the last decade.

**Figure 9. Materially deprived by degree of urbanisation**

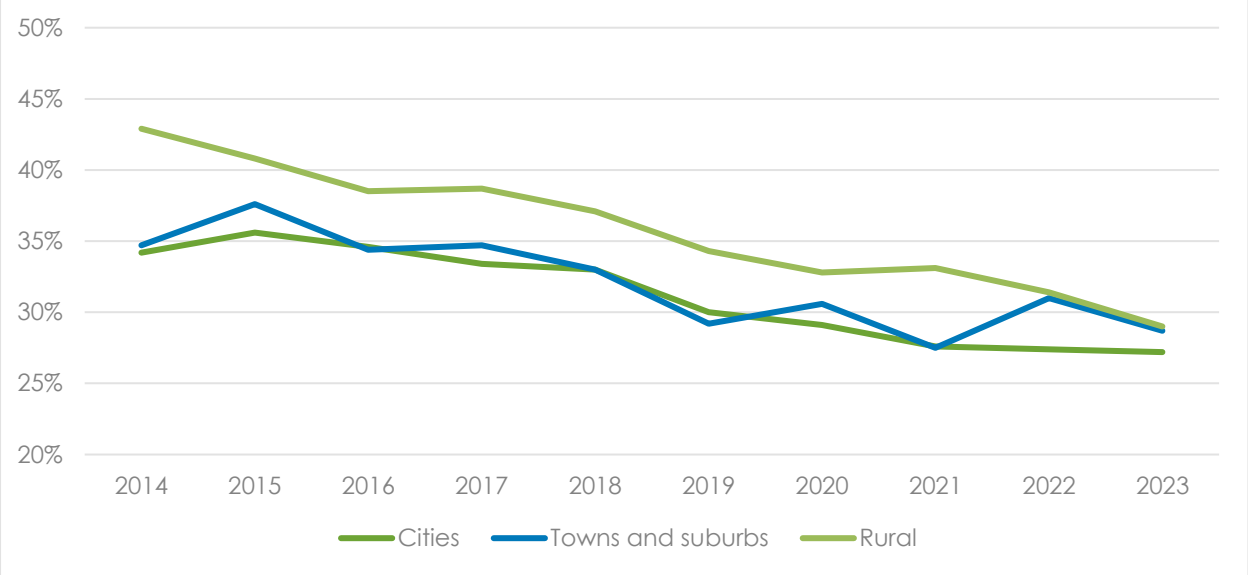
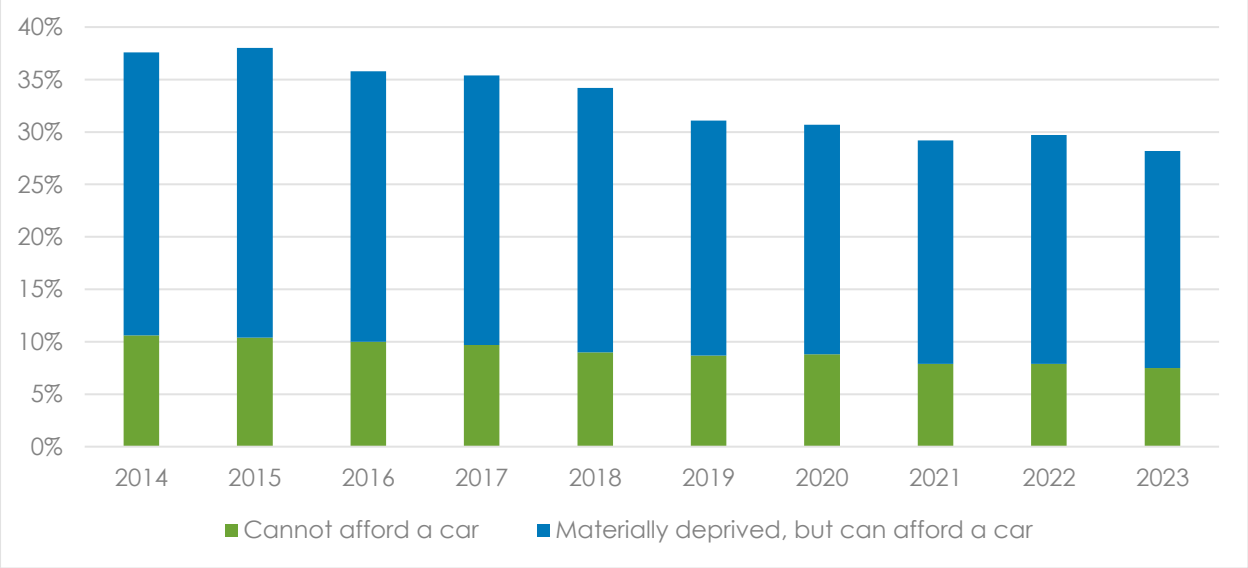


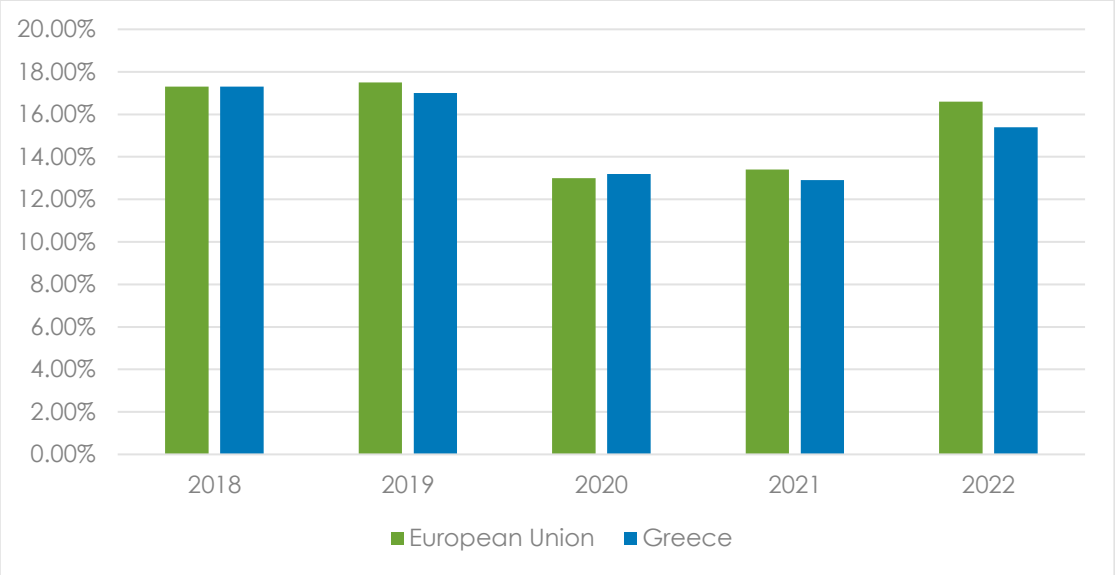

**Figure 10. Materially deprived in all degrees of urbanisation, by capability of owning a car**



**Share of trains and buses available for public transport in total passenger traffic**

The datasets presented in Figure 11 based on this indicator depict that the percentages of the mass transportation vehicles available in Greece have been fluctuating in similar trends to those recorded at an EU level. According to this data, only 15% of the trains and buses available facilitated public mobility in Greece.

**Figure 11. Share of trains and buses available for public transport**




Based on the income approach (as described in Oikonomou et al. 2025), the income thresholds for energy and transport poverty are calculated separately from the ones for household and transport vulnerability, based on the indicators for poverty and vulnerability (described in the previous sections). **The income thresholds are set on the ground of the average income (from the percentage of households that fall under each poverty or vulnerability indicator),** which are derived from the HBS calculation. Taking the indicator of the inability to purchase a zero emissions vehicle as the one determining the vulnerability in transport of households, the income thresholds (unitary per household member) would be 11,000 Euros below which every household is falling under transport vulnerability. For the first income classes, this would correspond to 1,420,000 households in this category, where about **less than the half (965,600) would be affected by ETS2**.

## 2.3 Vulnerability indicators for micro-enterprises

**Vulnerable Micro-Enterprises (Article 2, Paragraph 11):** Micro-enterprises that are significantly affected by the price effects of including greenhouse gas emissions from buildings or road transport within the scope of Directive 2003/87/EC and which, for the purposes of their activity, do not have the means either to renovate the building in which they are located, or to purchase zero- and low-emission vehicles, or to switch to alternative sustainable modes of transport, including public transport, by case.

The indicators of vulnerability for micro-enterprises (M-E) are used to operationalize the definition of vulnerability, with the objective of detecting the number of vulnerable M-E that will allow a proper future policy scope. In the process of target group determination, the eligibility criteria can be further developed. As a basic definition, a micro-enterprise is an enterprise that employs fewer than 10 persons and whose annual turnover or annual balance sheet does not exceed 2 million (€), calculated in accordance with Articles 3 to 6 of Annex I to European Commission Regulation (EU) 651/2014.

As described in Section 2.2., the SCF regulation defines vulnerable micro-enterprises as **those that are significantly affected by the price impacts** of the inclusion of greenhouse gas emissions from buildings or road transport within the scope of Directive 2003/87/EC and that, for the purpose of their activity, **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, including public transport, as relevant.

Within this framework, the following elements must be considered:

- Micro-enterprise Definition: number of employees (< 10) and turnover (< 2 million *€)*
- Price Impact of GHG Emissions*: vulnerability to carbon price increases under ETS2 and assessment of being significantly affected by ETS2*
- Lack of *financial means for building renovation*,
- Lack of *financial means to purchase zero- or low-emission vehicles*,
- Inability to *switch to sustainable transport modes*.

To quantify these components and obtain the number of micro-enterprises (M-E) seriously affected by the ETS2 introduction, our methodology is based on the following:

1. **On-site fossil fuels consumption** by micro-enterprises under the ETS2 scope for buildings and transport:
    - fuel combustion in commercial buildings (space heating, warm water, catering, etc.).
    - fuel use in road vehicles such as cars, light- and heavy-duty vehicles such as trucks, buses, etc.
    - Selection of micro-enterprises according to NACE codes (with on-site consumption of fossil fuels in buildings and transport and potentially affected by ETS2).

The micro-enterprises selected from this screening will be further analysed in the second indicator.

2. **Company lacks the means to invest** either in renovations of the occupied building, or in purchasing zero- and low-emission vehicles, or in switching to alternative sustainable modes of transport. This point of the definition is measured as follows:

- Percentage of companies where a micro-enterprise presents a profit (net turnover) lower than the annual cost of building renovation. Percentage of companies where a M-E has a profit (net turnover) below the annual cost of purchasing a zero- or low-emission vehicle. However, this cannot be a restricting condition as many micro-enterprises share the building and vehicle used with the household owning it.

**Note that the definition for the inability of micro-enterprises to switch to alternative modes of transport, including public transport, cannot be determined in the absence of available statistics.*

To target vulnerable micro-enterprises, the definition of the energy vulnerability of businesses must first be investigated and operationalised by using different metrics. Vulnerability is linked not only to the characteristics of the company itself. Companies with the same characteristics can have different levels of vulnerability because of the context in which they operate. For example, a company that is active in a rural area where the population is decreasing can experience lower turnover without significantly lowering energy costs; one that is active in an area with low population density and/or low density of transport infrastructure/services can be exposed to higher transport costs, etc. There is no data available for this division though, but new data such categorisations can take place. Regarding the fuel combustion in buildings of microenterprises, it is worth noting that the term "Buildings" precisely refers to the Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community (where from CRF 1A4a & CRF 1A4b: fuel combustion in commercial/institutional and residential buildings):

- CRF 1A4a includes emissions from fuel combustion in commercial and institutional buildings (space heating, warm water, cooking, etc.);
- CRF 1A4b includes all emissions from fuel combustion in households (space heating, warm water, cooking, off-road vehicles and machinery used in this sector, lawnmowers, etc.);
- exclusions: main uses to be separated from the above are other stationary and mobile combustion, in particular excluding any emissions from fuel combustion in agriculture, forestry, fishing, and fishing industries such as fish farms (CRF 1A4c).

The following Table 6 includes (i) Mandatory indicators (1, 2, 4)— in bold and with * in the tables below —representing direct impacts from ETS2 , as well as (ii) Supportive indicators (3, 5, 6, 7, 8, 9) for assessing specific vulnerabilities. Each indicator offers options for use, including mandatory preconditions and additional, more precise criteria.

**Table 6. Indicators for detecting vulnerable micro-enterprises**

| **(i) Company can be significantly impacted by the change in energy expenditure with the introduction of the ETS2 due to consumption side** | | |
|---|---|---|
| ✓ **Indicator** | ✓ **Explanation** | ✓ **Metrics used** |

| | | | |
|---|---|---|---|
| ✓ 1 | ✓ Significant energy expenditure for the on-site fossil fuels use/ consumption in M-E after introduction of the ETS2* | ✓ Precondition: vulnerable companies use oil, natural gas or similar fossil fuels. *Companies using only biomass/electricity or exclusively e-vehicles are excluded*.<br>✓ Option 1: All companies with above precondition are included<br>✓ Option 2: There is a threshold above median energy expenditure for fossil fuels in the company *compared to sectoral median*.<br>✓ Option 3: /other threshold | ✓ Share of the energy expenditure increased |
| ✓ 2 | ✓ Significant energy expenditure for transport in M-E after introduction of the ETS2* | | |
| *Info: new energy expenditure of micro-companies per sector will come from -modelling.* | | | |
| ✓ 3 | ✓ Energy performance of building below threshold (significant needed investments) | ✓ Precondition: Only companies that have no means to invest in buildings or vehicles are included. This excludes all companies that have premises in buildings that are aligned with current EPBD regulation.<br>✓ Option 1: All companies that satisfy this precondition are included.<br>✓ Option 2: There is a threshold below certain energy performance (C/D) or MEPS | ✓ Energy consumption kWh / $m^2$ |
| **(ii, iii) Company can be significantly impacted by the change in energy expenditure due to revenue side** | | | |
| | **✓ Indicator** | **✓ Explanation** | **✓ Metrics used** |
| ✓ 4 | ✓ Financial capacity (means to renovate and/or purchase a zero-emissions vehicle * | ✓ Precondition: the company is considered unable to invest due to its financial situation.<br>✓ Option 1: only companies below a certain turnover/employee are included.<br>✓ Option 2: only companies below a certain profit/employee are included. | ✓ Financial capacity (EUR – €) |
| *Info: in determining the number of vulnerable M-E, where the turnover value is identified as the easier threshold, the profit value is more precise.* | | | |
| ✓ 5 | ✓ Limited access to capital (possible optional indicator) | ✓ Precondition: national financing market for energy efficiency and renewable energy investment (private loans and alternatives) is unavailable for certain companies' size/sector/type. Also, in previous financing rounds, these sectors have | ✓ - |

| | | | |
|---|---|---|---|
| | | not been targeted. | |
| (iv) Company is significantly affected due to external impacts | | | |
| ✓ **Indicator** | | ✓ **Explanation** | ✓ **Metrics used** |
| ✓ 6 | ✓ Composition of the market and competitiveness | ✓ Options:<br>✓ The company belongs to a sector which has a high level of competitiveness and therefore every expenditure change significantly influences the position of the company.<br>✓ The company belongs to a sector which depends on products linked to production in the EU or MS which is also affected by ETS2.<br>✓ The company belongs to a sector highly affected by the price changes due to their position in the supply market | ✓ Share per sector |
| *Info: country can choose specific sectors to be included due to the ETS2 disproportionately affecting them because of their position in the market, or in the supply chain where most of their profit loss would affect final consumers.* | | | |
| ✓ 7 | Regional development (NUTS2 or lower level) | ✓ Companies are in the less developed regions by national development indicators[18] | ✓ No companies |
| ✓ 8 | ✓ Availability, accessibility and affordability (AAA) of public transport or transport alternatives or inability to switch. | ✓ Companies are dependent on vehicles due to type of activity or are in the distant areas with less transport alternatives[1] | ✓ No companies |
| *Info: this is a dual indicator, as it can identify sectors that are dependent on owning/renting vehicles and for the sectors that can switch modality.* | | | |
| ✓ 9 | ✓ Sector - distribution of micro-enterprises (vulnerable sectors) | ✓ <u>Option:</u> Is the specific sector (if not included above) vulnerable due to fuel dependence?<br>✓ <u>Additional:</u> Enterprises who have asked for energy assistance during energy crises (type, NACE, size of companies) | ✓ No or share companies |

[18] Indicators 7 and 8 later serve to also define "an explanation of how geographic specificities, such as islands, outermost regions and territories, rural or remote areas, less accessible peripheries, mountainous areas or areas lagging behind, have been taken into account in the Plan;"

*Info: This indicator is "freer" to give you supportive information on which sectors might be specifically vulnerable.*

For these indicators, the means of comparison of fossil fuel costs in buildings will be at the level of total expenses as well as revenues of the companies. IEECP has circulated a survey to the Chambers of Commerce in Greece for identifying some qualitative elements for complementing the datasets. The results of the survey will also serve later for the evaluation of the adequacy of the chosen measures for the most vulnerable M-E. Furthermore, bilateral contacts with the sectoral associations will be established to receive estimations of costs from their companies in the absence of disaggregated data in sub-sectors. In the absence of national data at this stage, the first screening of the micro-enterprises in various NACE codes is carried out on the grounds of the ones potentially affected by the ETS2 in their fuel combustion on-site and in their transport means (Table 7). This will provide a link between national and EU-level data, and can be used for impact analysis and policy formulation:

- **Business variables**: a company is part of the sector that is more intensive (needs more transport, needs more office space), a company is part of the country- relevant sector,
- **Energy variables**: Depending on the on-site fossil fuels, dependence on fossil fuels for transport, expenditure high in comparison to sector,
- **Financial variables**: Turnover or profit (to be defined) under certain threshold, high (fossil) energy expenditure proportion to revenue,
- **Technical information**: Building type, tenant status, heating system, efficiency of the building envelope, vehicle types, vehicle efficiency
- **External**: NUTS2, regional development, transport regional development, employment

**Table 7. Eligible micro-enterprises with details in the ETS2[19]**

| INDIC_SBS (Labels) | Enterprises number | Average persons employed per enterprise - number (average) | Net turnover - million euro | Net turnover per person employed - thousand euro |
|---|---|---|---|---|
| Construction | 71,254 | 2 | 6,685 | 59.47 |
| Wholesale and retail trade; repair of motor vehicles and motorcycles | 216,714 | 2 | 49,780 | 112.93 |
| Transportation and storage | 62,794 | 1 | 6,122 | 67.65 |

[19] Eurostat Enterprise Statistics by size and class (from 2021 onwards)

| | | | | |
|---|---|---|---|---|
| Accommodation and food service activities | 93,764 | 3 | 5,162 | 21.65 |
| Information and communication | 24,451 | 2 | 1,783 | 48.28 |
| Financial and insurance activities | 16,653 | 1 | 1,288 | 53.91 |
| Real estate activities | 15,956 | 1 | 2,087 | 91.78 |
| Professional, scientific and technical activities | 161,532 | 1 | 7,759 | 36.12 |
| Administrative and support service activities | 25,364 | 2 | 2,422 | 51.97 |
| Education | 20,453 | 2 | 446 | 10.04 |
| Human health and social work activities | 64,997 | 2 | 2,587 | 23.84 |
| Arts, entertainment and recreation | 18,617 | 2 | 3,495 | 92.65 |
| Repair of computers and personal and household goods | 6,817 | 1 | 270 | 27.31 |
| Other personal service activities | 28,437 | 2 | 767 | 13.35 |
| **TOTALS** | **827,803** | **1,485,280** | | |

Based on the chosen indicators (detailed in Chapter 3.3.), a simulation and approximation of the number of vulnerable micro-enterprises is provided.

More specifically, based on indicator **M1** "*Energy expenditure from fossil fuels*", from the total sum of eligible micro-enterprises (IDEES database), the buildings that belong to the tertiary sector and use natural gas refer to a rate of 10%, while those using oil account for 2%. Hence, we estimate that 12% of these microenterprises, or roughly 99,300 companies, could be eligible to be classified as vulnerable based on this criterion. A portion of these micro-enterprises is based in a new or refurbished building. As explained in Section 3.3, based on JRC IDEES 2021 available dataset, around 1.2% of all companies are in new or refurbished buildings, which reduces this number to around 98,108 companies.

Based on the indicator **M2** *"Lack of means to renovate or purchase new vehicle"*, from the ORBIS dataset, we estimate the number of all companies with significant energy expenditure.

### Indicator 1: Energy expenditure on fossil fuels

From an initial screening, it can be argued that the non-energy intensive sectors that are subject to significant impacts from the ETS2 (due to their higher use of fossil fuels in building and transport uses) are the ones that burn fossil fuels in their building uses (where from JRC IDEES we have 8% using natural gas and 2% oil). The transport dimension of the ETS2 for micro-enterprises is analyzed in the second component of the indicator 2 below (as there is no such data for micro-enterprises available).

### Indicator 2: Lack of means to renovate or purchase new zero-emissions vehicle

Micro-enterprises that 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: this indicator estimates the number of micro-enterprises that are unable to invest in building renovations or purchase clean vehicles and burn fossil fuels in their buildings and transport (either with cars or transport intensive micro-enterprises). These are identified when their Profit/Loss account is lower than the yearly depreciation of investment in a) *the building* or b) *the building and vehicles*. Only micro-enterprises that use fossil fuels for a) *building* or b) *building and vehicles* are affected by the ETS2 introduction. To determine the means, micro-enterprises have to renovate buildings or to purchase zero- and low-emission vehicles, the financial capability of affected micro-enterprises to invest can be assessed using the following methodology:

- Renovation costs are calculated based on data on renovation costs for non-residential buildings as provided by the Long-Term Renovation Strategy (LTRS). Since this data is from 2020, the investment costs provided in the LTRS are then adjusted using a construction analytics index for the period considered in this analysis (2025–2032). The total investment cost is then divided in annual instalments for the SCP implementation period (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 into six instalments.

Companies that cannot invest are those whose annual profits are lower than the additional energy expenditure and investment together.

$$\textit{Annual instalment} + \textit{energy expenditure} > \textit{Profit/Loss account (net)}$$

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

- **Limited access to capital:** Considers companies' access to financial resources, and how this may impact their ability to invest in necessary improvements or

expansions. For example, this may result in some micro-enterprises being excluded from the count of vulnerable micro-enterprises (as they are able to access investment capital at good terms) or included in the count (they may make sufficient profits over the timeline considered, but they may not have access to finance to support them with the upfront investment costs).

- **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 availability and reliance on public transport affects companies' operational costs or limit their access to obtaining and selling goods and services.
- **Additional indicators:** This category covers other country-specific factors, such as the number of companies located in distant or island locations, or sectors that are particularly vulnerable because they are affected by unique challenges or risks.

There are some significant limitations to determining the impact of ETS2 on micro-enterprises and the final number of vulnerable micro-enterprises:

- 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 generalize or standardise data.
- The definition of vulnerability of micro-enterprises related to energy does not exist in any of the countries.
- The level of 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. 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. A similar lack of data availability applies to vehicles ownership and usage, and use of other modes of transport.

- 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.

Regarding the means to purchase a new zero-emissions vehicle for transport, we carry out separate calculations for micro-enterprises with Light Duty Vehicles, Heavy Duty Vehicles, Buses and Taxis (as these are the most relevant for the Micro Enterprises impacted by ETS2). The total number of these vehicles per fuel is presented in Table 8 (2014 data from national statistics). As these figures refer to total number of vehicles (hence belonging to small but also larger companies), we refine them by incorporating the percentage (20.4%) of employees in micro-enterprises in the service sector within the total number of enterprises in the sectors that fall under this category (1,380 million employees in microenterprises in the service sector, as indicated in Eurostat). The only exceptions are taxi companies, where all existing companies have less than 9 employees.

**Table 8. Total number of vehicles per fuel type**

| Type | Fuel | Number of vehicles (in thousands) | Number of micro-enterprises (in 1,000) |
|---|---|---|---|
| LDV | Gasoline | 329 | 67.1 |
| LDV | Diesel | 140.2 | 28.6 |
| HDV | Diesel | 88.1 | 18.0 |
| Taxis | Diesel | 13.9 | 2.8 |
| Touristic buses | Diesel | 2.2 | 0.5 |

From the ORBIS dataset, the sample of vehicles in companies that cannot afford to purchase a new clean vehicle is presented in the table below (Table 9).

**Table 9. Sample of vehicles in companies that cannot afford to purchase a new clean vehicle**

| Sector | NACE | ORBIS database level 4 - total no of companies | ORBIS database M-E level 4 - total no of M-E | Investment in 6 years (2027-2032) | Calculation of investment /year | Vulnerable M-E (Cannot afford investment) - profit is less than investment | Percentage |
|---|---|---|---|---|---|---|---|
| Construction of residential and non-residential buildings (design excluded) | F4120 | 8,147 | 2,345 | 1 truck | 41,667 | 592 | 25% |
| Urban and suburban passenger transport | H4931 | 149 | 13 | 1 bus | 66,667 | 3 | 23% |
| Taxi operations | H4932 | 324 | 53 | 1 car | 8,333 | 7 | 13% |
| Other passenger transport by land | H4939 | 580 | 100 | 1 bus | 6,666.7 | 37 | 37% |
| Freight transport by road | H4941 | 2,941 | 484 | 1 freight | 4,166.7 | 200 | 41% |
| Other postal and currier activities | H5320 | 603 | 62 | 1 LDV | 1,250.0 | 11 | 18% |
| Event catering activities | I5621 | 198 | 29 | 1 LDV | 1,250.00 | 4 | 14% |
| Tour operator activities | N7912 | 303 | 59 | 1 bus | 66,666.7 | 25 | 42% |

Based on these percentages, we extrapolate the sample to the total number of vehicles of the eligible ME being affected by ETS2, as explained in Table 10.

**Table 10. Sample to the total number of vehicles under the eligible ME**

| Type / Fuel | Number of vulnerable M-E (in 1,000) | Notes |
|---|---|---|
| LDV-Gasoline | 27.7 | Total number of LDV * 41% ability to purchase vehicle *20.4% employees/M-Es |
| LDV-Diesel | 11.8 | Total number of LDV * 41% ability to purchase vehicle *20.4% employees/M-Es |
| HDV- Diesel | 7.43 | Total number of HDV * 41% ability to purchase vehicle *20.4% employees/M-Es |
| Taxi- Diesel | 3.7 | Total number of Taxi * 13% ability to purchase vehicle[20] |
| Bus – Diesel | 7.6 | Total number of Buses * 42% ability to purchase vehicle *20.4% employees/M-Es |

This brings us to the total number of transport–vulnerable micro- enterprises of 55,624, around 7% of total micro-enterprises included in the analysis.

[20] For taxis we do not reduce them with the rate of number of employees/M-E, as the majority of them in Greece are sole proprietorship or very small companies (with less than 9 employees).

# 3 IMPACTS OF ETS2 ON VULNERABLE GROUPS IN GREECE

The impacts of the ETS2 are calculated based on price projections (expressed in €/kWh) of the ETS2 as provided by the European Commission for the TSI projects (Table 9). The prices influence each fuel based on the emission factor and are different depending the end use, based on the NECP projections and the EU reference scenario, as well as the Greek Fuels Observatory (2025) and Eurostat (S2 2024).

**Table *11*. ETS2 prices for households provided by the European Commission**

| Year | ETS2 prices (€/tCO₂) | NG price after ETS2 (€/kWh) | LPG price after ETS2 (€/kWh) | Oil price after ETS2 (€/kWh) |
|---|---|---|---|---|
| 2027 | 30 | 0.116 | 0.190 | 0.135 |
| 2028 | 50 | 0.120 | 0.195 | 0.140 |
| 2029 | 55 | 0.121 | 0.196 | 0.141 |
| 2030 | 60 | 0.122 | 0.197 | 0.143 |
| 2031 | 60 | 0.122 | 0.197 | 0.143 |
| 2032 | 60 | 0.122 | 0.197 | 0.143 |

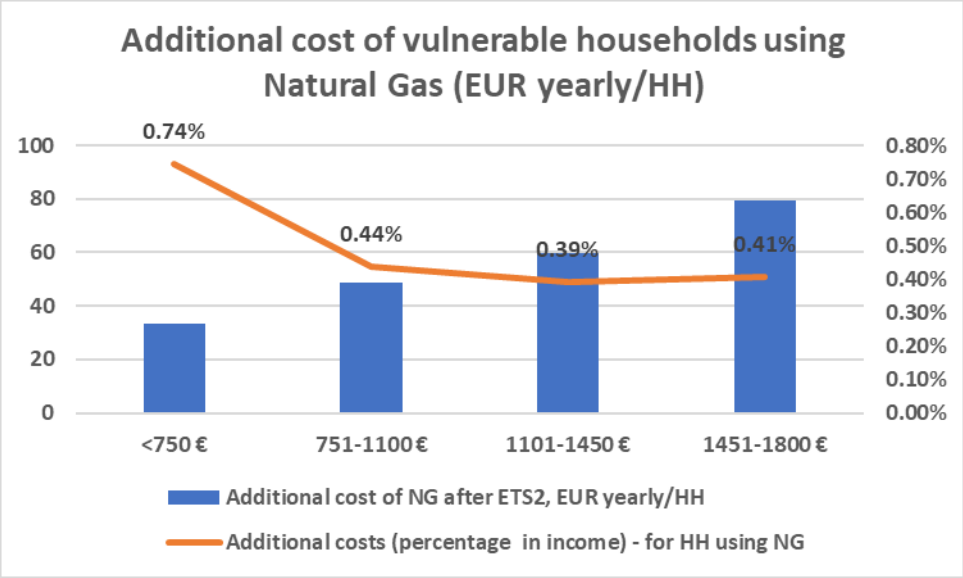
**Table 12. ETS2 prices for transport provided by the European Commission**

| Year | ETS2 prices (€/tCO₂) | Gasoline price after ETS2 (€/kWh) | price after ETS2 (€/kWh) | Diesel price after ETS2 (€/kWh) |
|---|---|---|---|---|
| 2027 | 30 | 0.200 | 0.146 | 0.200 |
| 2028 | 50 | 0.205 | 0.151 | 0.205 |
| 2029 | 55 | 0.207 | 0.152 | 0.207 |
| 2030 | 60 | 0.208 | 0.153 | 0.208 |
| 2031 | 60 | 0.208 | 0.153 | 0.208 |
| 2032 | 60 | 0.208 | 0.153 | 0.208 |

## 3.1 Vulnerable Households

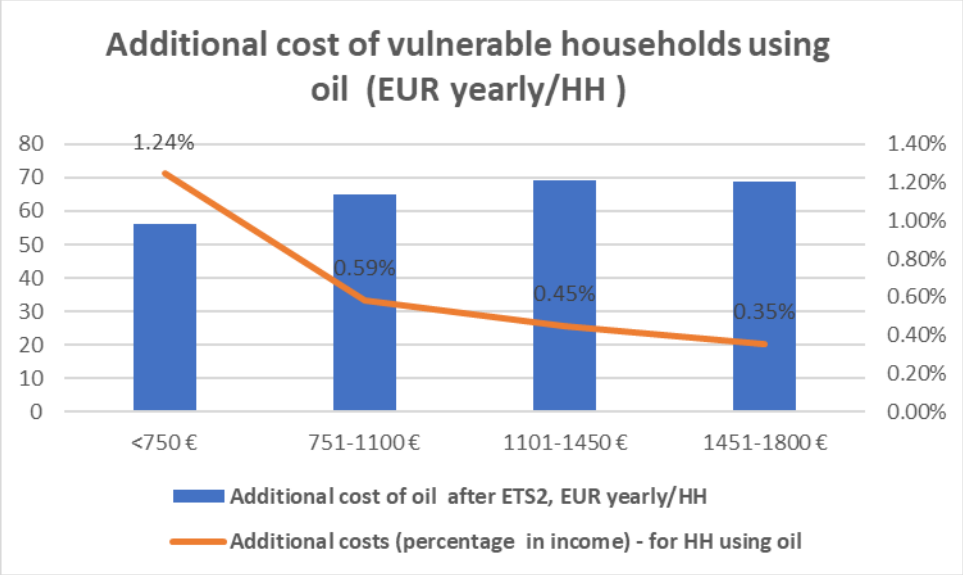
For the household income categories that are considered vulnerable and make use of natural gas, additional costs are expected after the introduction of ETS2. As illustrated in Figure 12, the 1st income category is going to be affected the most in relative terms, with additional yearly costs of almost 35 € that amount to 0.74% of the households' income.

**Figure 12. Additional annual cost for households using Natural Gas after ETS2**



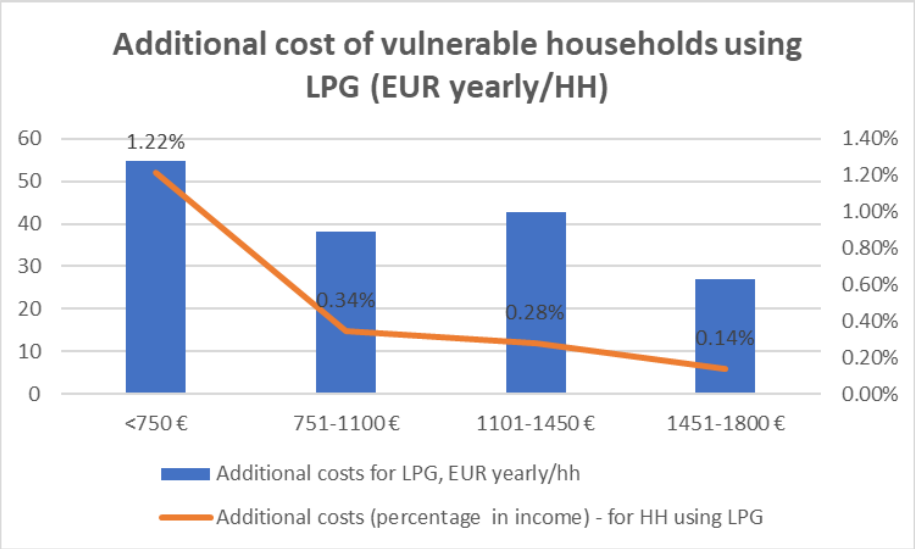

Furthermore, Figure 13 indicates that for the households using heating oil for space heating and water heating, the 1st income category will also be affected the most in relevance to their income (1.24%), while in absolute terms the third and fourth income categories will incur a cost of 70€.

**Figure 13. Additional annual cost for households using heating Oil after ETS2**



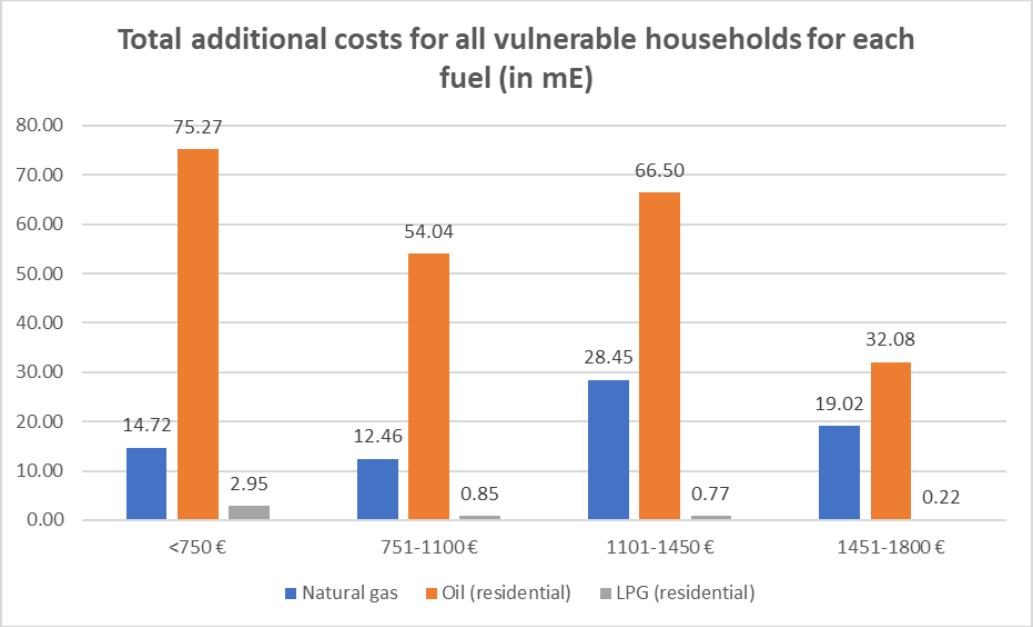
Finally, for the households using LPG mainly for heating and cooking (Figure 14), the additional costs are going to majorly affect the 1st income category, with yearly increased expenses of around 55 €, which account for 1.22% of this category's household's annual income

**Figure 14. Additional annual cost for households using LPG after ETS2**




With the introduction of the ETS2, **the total and additional costs for households** in each income category in absolute numbers and percentages are presented below. **Vulnerable households** under the ETS2 for the first four income categories will incur an **additional cost of 307 million €** for all fuels in the total 3.6bn € for fossil fuels for heating, cooking and DHW for these groups. More specifically, the highest costs will be incurred to households with heating oil (228m €, with a contribution of 9% as additional cost) and natural gas (75m €).

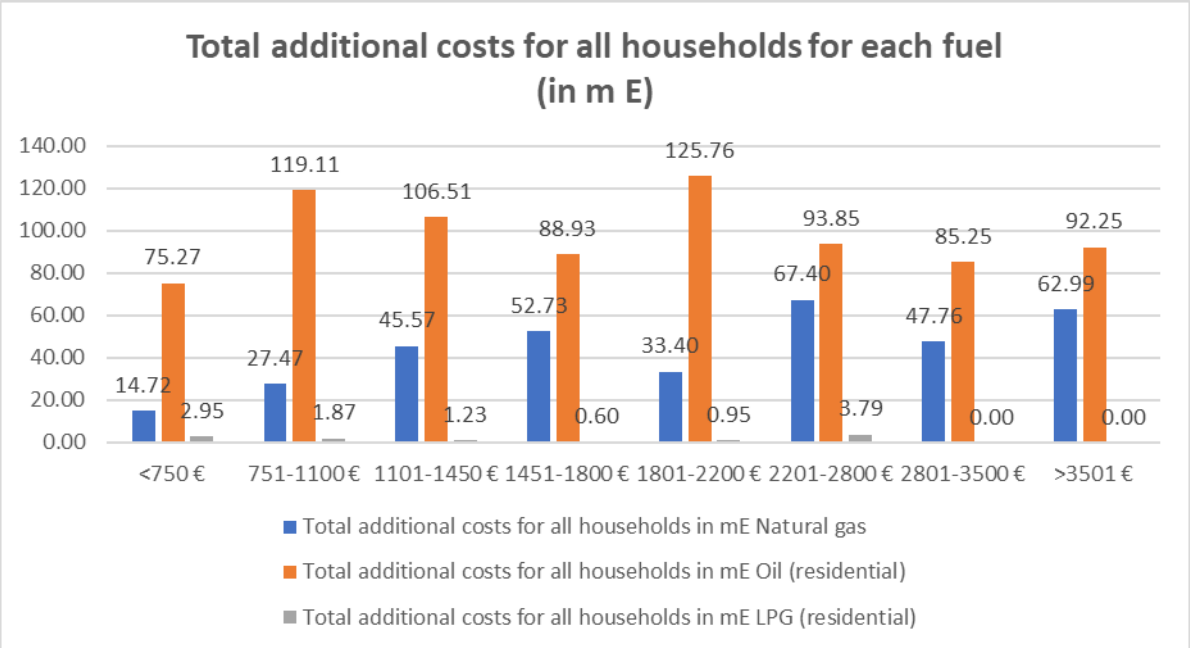
**Figure 15. Total additional costs for all vulnerable households after the introduction of ETS2**




The total costs of fuels after ETS2 for all households will be 13.6 bn €

Regarding the **entire population**, the impacts of the ETS2 on all households in Greece regarding the **additional costs on all fuels will be 1.15bn €.** The highest costs will be in households using heating oil 786m € and then to natural gas 352m €. The **total costs of fuels after ETS2 for all households will be 13.6bn €** with the highest costs in 8.9bn € for heating oil and 4.5bn € for natural gas.

**Figure 16. Total additional annual cost for all households after the introduction of ETS2**



## 3.2 Vulnerable transport users

Additional annual costs are also expected for households using gasoline for their transport. Figure 17 presents that the households belonging to the 4th income category are going to be affected the most, with extra annual expenses of almost 100 €, accounting for 0.5% of the households' income.

**Figure 17. Additional annual cost for households using gasoline for their transport after the introduction of ETS2**

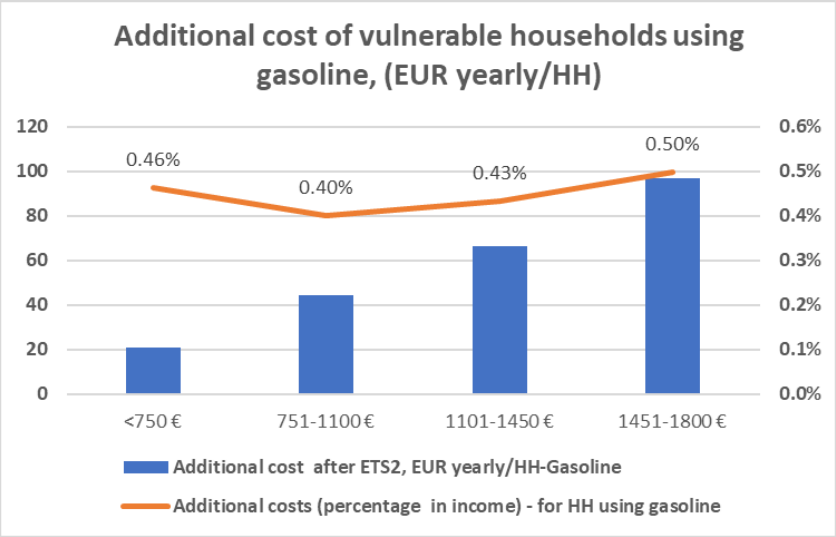
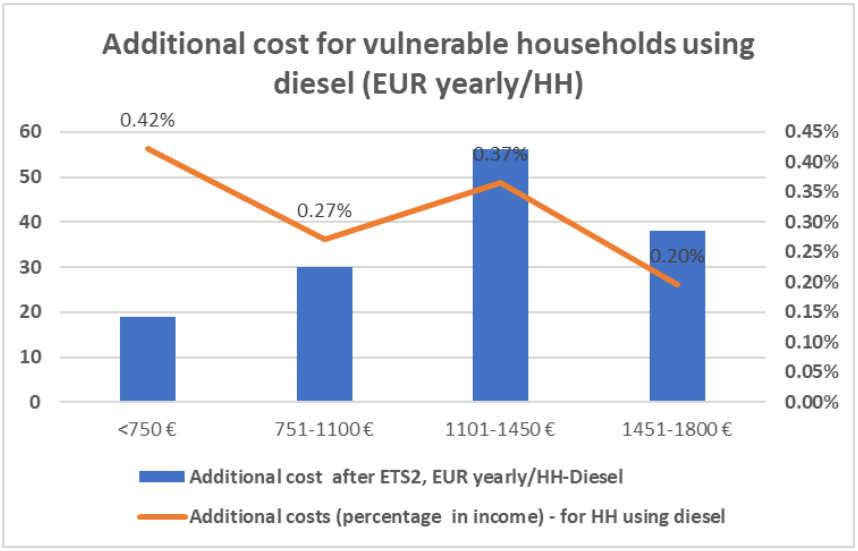


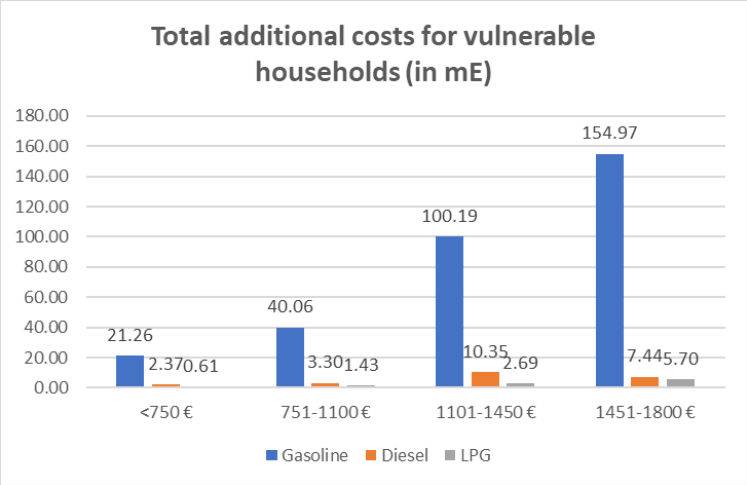

Figure 18 depicts that for households using diesel in their vehicles in the 3rd income category will be charged with over an extra 5 € annually, equal to 0.37% of their income. Notably, the relative additional costs (as expressed in % of disposable income) range from 0.2-0.4% across the four income categories highlighting inelastic demand for such fuels in transport across income categories.

**Figure 18. Additional annual cost for households using diesel for their transport after the introduction of ETS2**



With the introduction of the ETS2, the total costs and additional costs for households in transport in each income category in absolute numbers and percentages are presented below. **Vulnerable households in transport** under the ETS2 for the first four income categories will incur an additional cost of **350 million €** for all fuels in the total 6.4bn € for fossil fuels for transport for these groups. More specifically, the highest costs will be incurred to households with gasoline in their vehicles (316m €) and diesel (23m €).

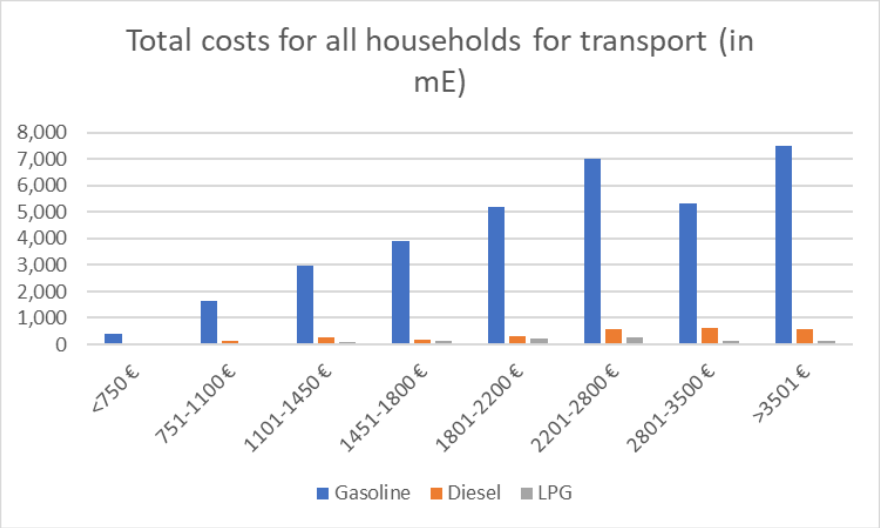
**Figure 19. Total additional annual cost for vulnerable households for their transport after the introduction of ETS2**




Regarding the entire population in transport, **the impacts of the ETS2 on all households** in Greece regarding the additional costs on all fuels will be **2.1bn €.** The highest costs will be in households using gasoline in their vehicles 1.8bn € and then diesel 169m €. **The total costs of fuels in transport after ETS2 for all households will be 37.5bn €** with the highest costs in 34bn € for gasoline in vehicles and 2.6bn € for diesel.

The costs of fuels in transport after ETS2 for all households will be almost 37.5 billion €

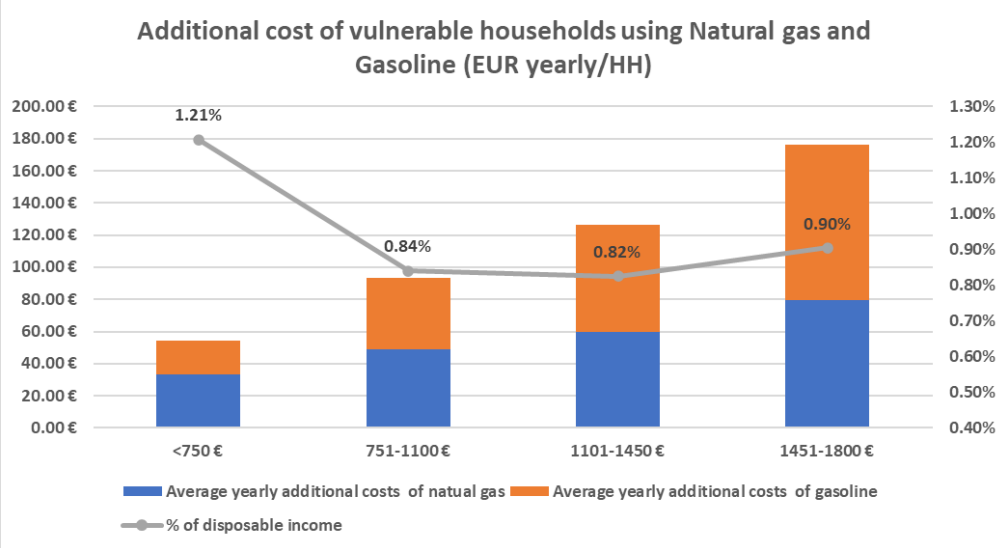
**Figure 20. Total costs for all households for their transport after the introduction of ETS2**




## 3.3 Households and transport uses

For households and transport users that are using natural gas for heating and cooking and gasoline for their transport, the 4th income category is going to be affected the most, with additional yearly costs of over 180 € for both fuels, which equals to 0.9% of the households' income (Figure 21). When expressed in relative terms, households in the first income category face the highest additional burden in relation to their disposable income (1.21%).

**Figure 21. Households using natural gas for heating and gasoline for transport**




For households that are utilising again natural gas for heating and cooking, however, diesel for their transport, the combined average yearly additional costs are smaller. As presented in Figure 22Figure , the 1st out of the 4 income categories is going to be affected with around 50 € for both, which equals 1.17% of the household's income.

**Figure 22. Households using natural gas for heating and diesel transport**

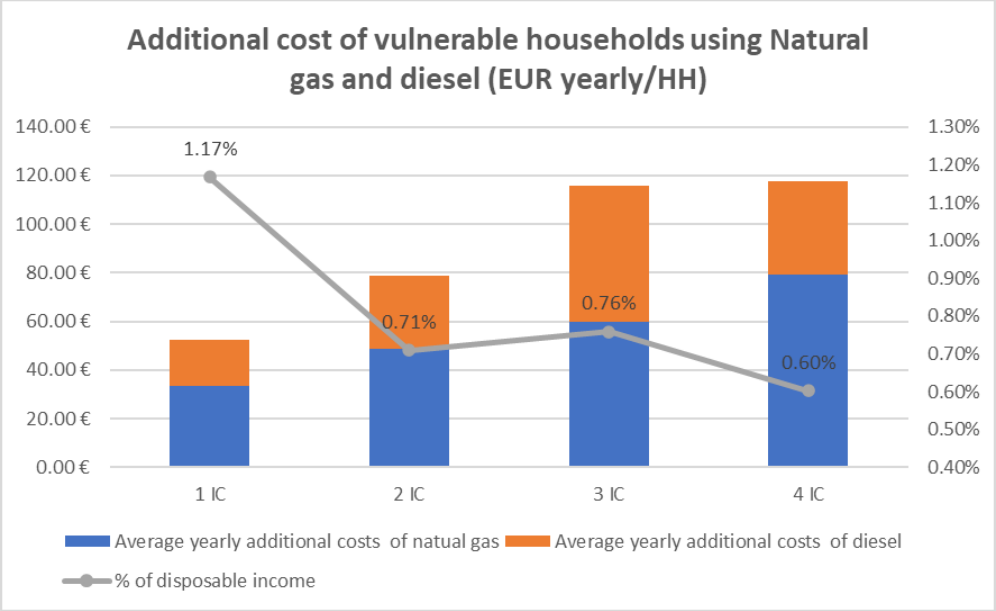



Figure 23 depicts that the households belonging to the 1ST and 4th income category and using natural gas and LPG are expected to be subject to an additional economic burden of 1.21 and 1.05% of their annual income respectively.

**Figure 23. Households using natural gas for heating and LPG for transport**

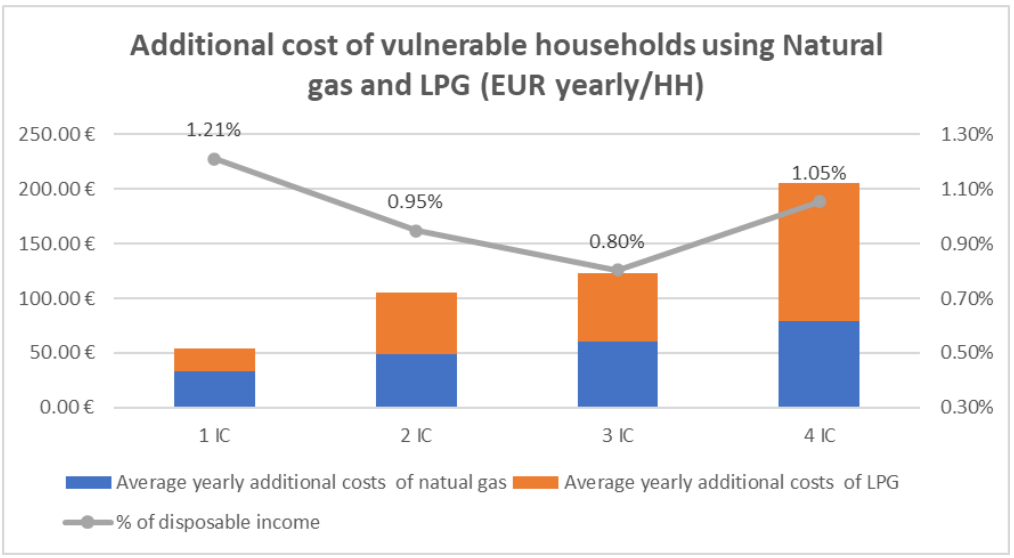



Figure 24 shows that the households belonging to the 1st income category that use heating oil and gasoline for their transport will be affected by additional costs that refer to 1.71% of their annual income, and amount to just under 80€, while the 3rd and 4th income categories will be around 160€.

**Figure 24. Households using oil for heating and gasoline for transport**

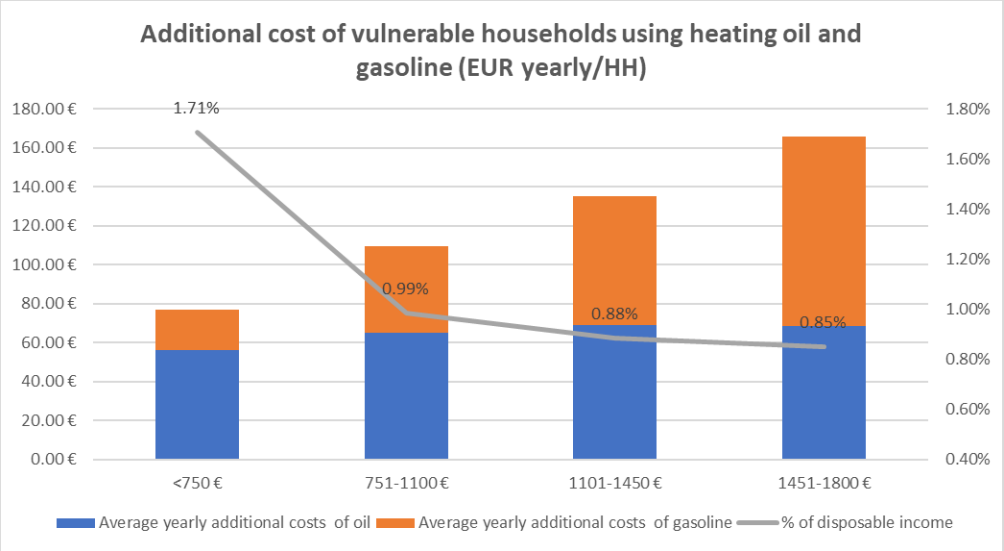



Figure 25 indicates that the households of the 1st income category that use oil for heating and diesel for transport are going to be burdened with around 70€ annually, which accounts for 1.67% of their income, while the 3rd income category will carry over 120€.

**Figure 25. Households using oil for heating and diesel for transport**

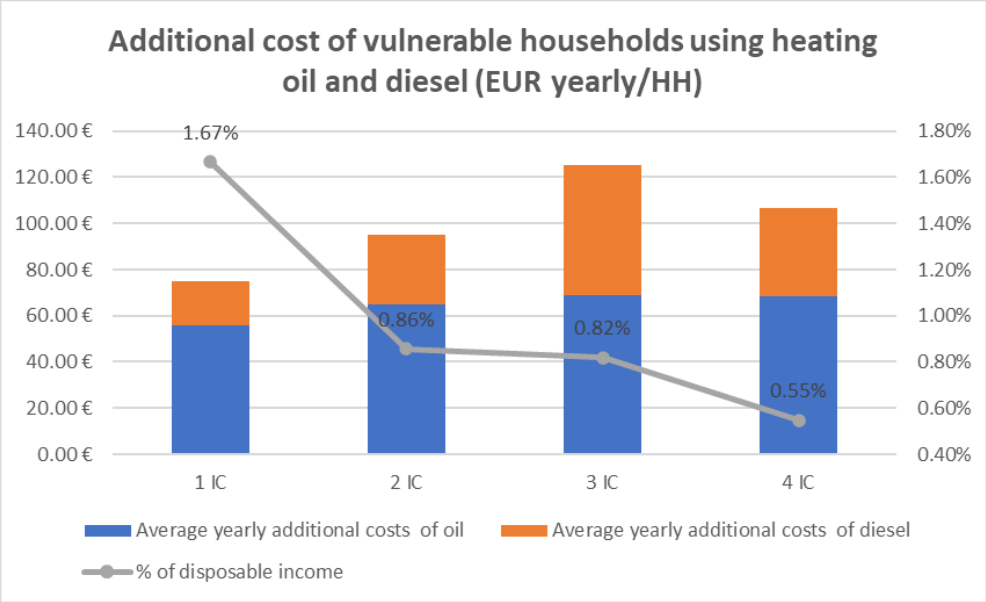
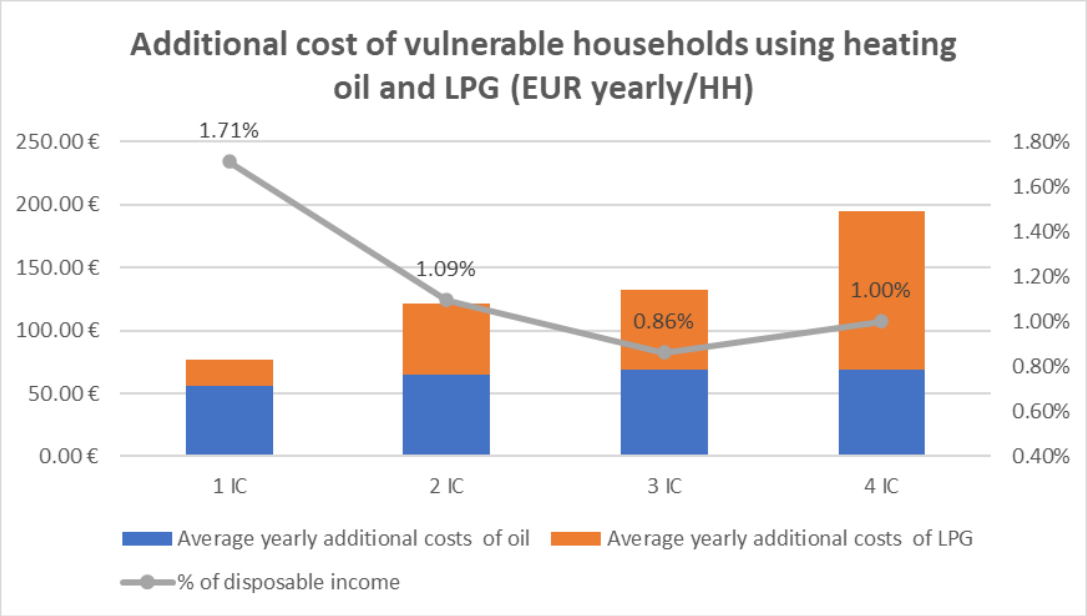


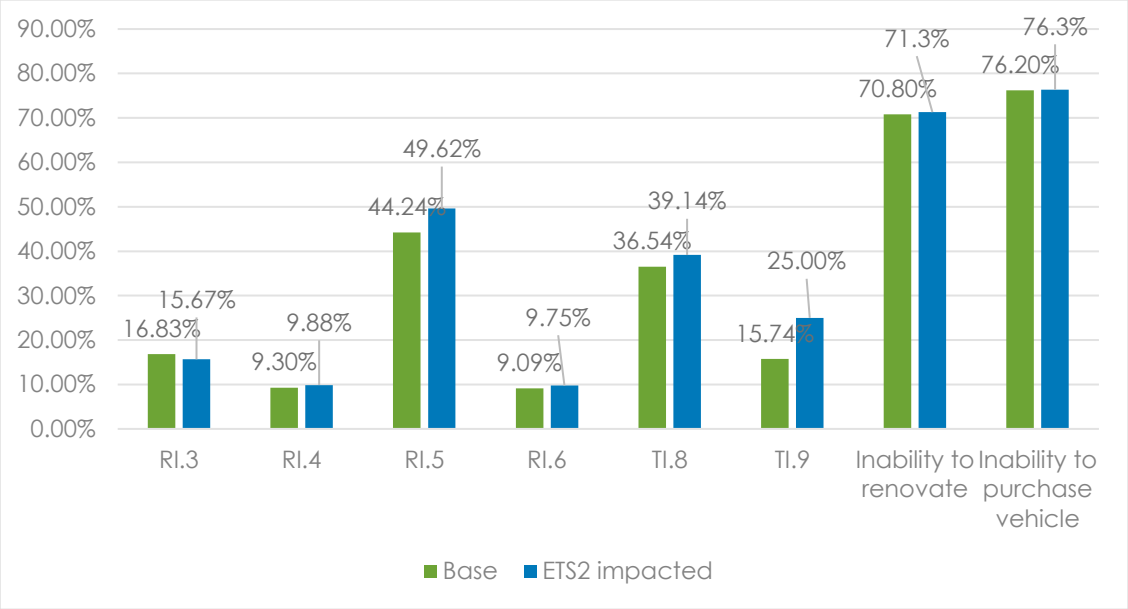

Figure 26 illustrates that the households included in the 4th income category are going to be burdened with the relatively greatest amount of additional costs due to the use of oil and LPG. These costs amount to over 180 € and refer to a share of 1% of their annual income.

**Figure 26. Households using oil for heating and LPG for transport**



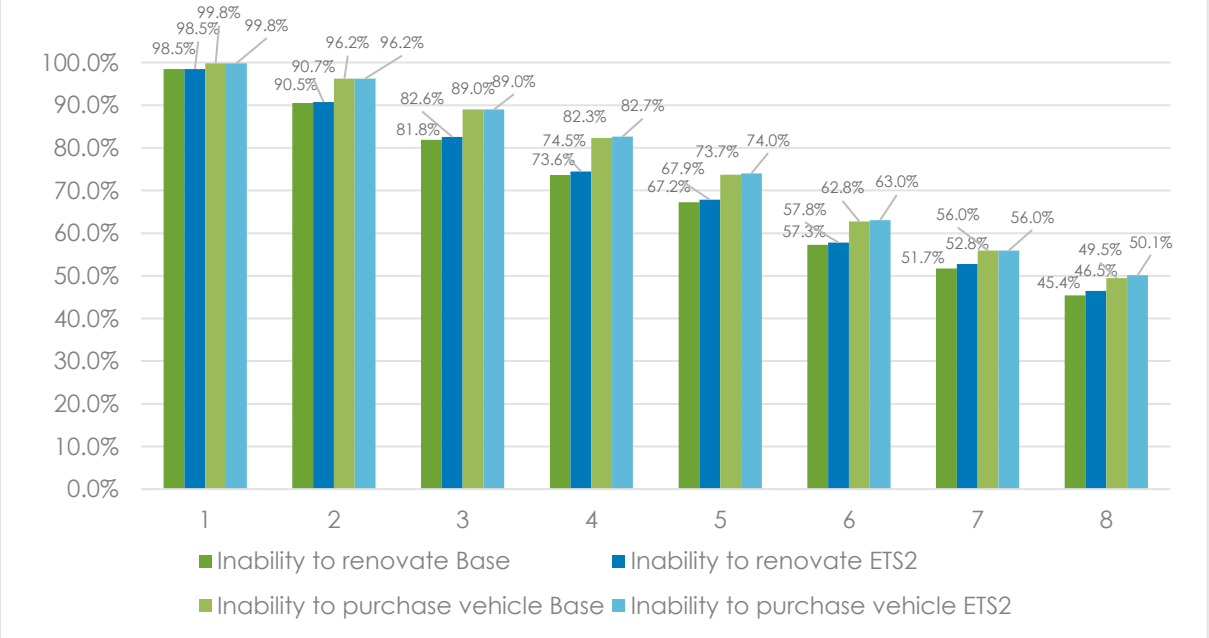

On a final note, departing from the definition of the vulnerable groups as the ones most significantly affected by the ETS2 in buildings and transport, respectively, the indicators of both energy and transport poverty and vulnerability are recalculated as follows. The indicators include the income aspects and expenditures of households and transport, and to identify the changes from the ETS2, we added the new ETS2 cost (Figure 27), as calculated above, as additional cost to the overall expenses. This generates new values for all indicators and respective percentages of total households under energy poverty and vulnerability (see Figure 27 on the changes of indicators for the indicators calculated from HBS, where this calculation can take place – hence not the indicators from SILC). The following significant increases are remarked: 5% more households have higher energy spending that is more than 10% of their budget (RI.5), 3% more households spend more than 6% of total expenditures on transport from the bottom half of expenditure distribution and almost 10% more households have more than twice the national median higher share of transport expenditures in total expenditures.

**Figure 27. Change of poverty and vulnerability indicators due to ETS2 (% households)**




More specifically, for the vulnerability indicators (see Figure 28) the average change across indicators is less than 1% additional households for the first four income categories that cannot renovate or purchase a new vehicle, but still the percentages of the population are over 65-70%. A slightly higher percentage change is noticed for the higher income groups (5 to 8) where an additional 1-2 % of households fall under these indicators.

**Figure 28. Change of vulnerability indicators across income groups due to ETS 2 (% households)**



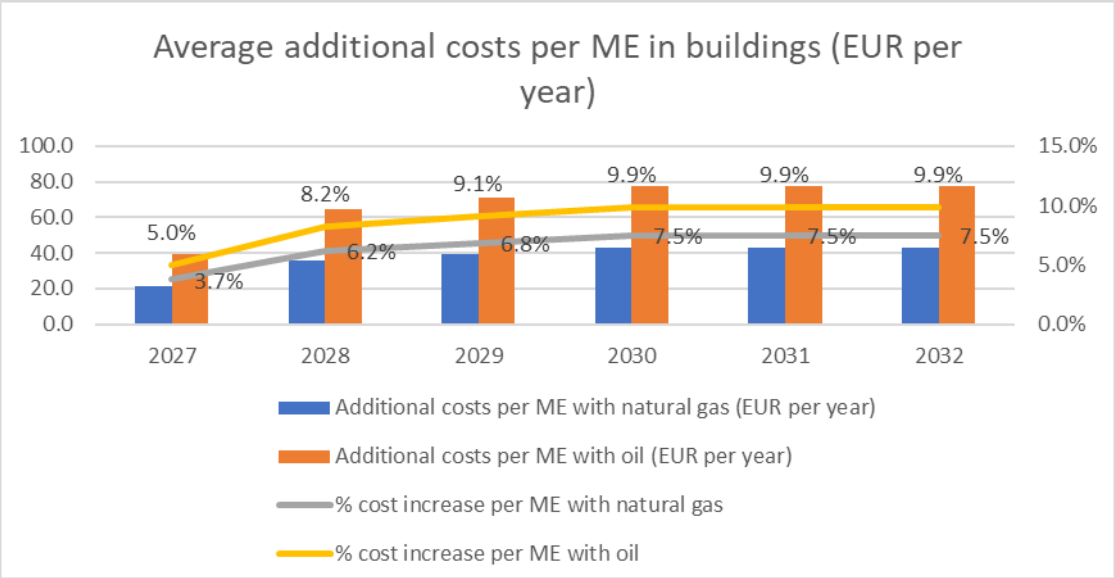

In essence, thus, the impact of ETS2 in terms of population size does not change significantly (hence not a substantial additional number of households can be

considered vulnerable due to ETS2), but still, it is important to evaluate the depth of the impact to the existing vulnerable groups.

## 3.4 Vulnerable micro-enterprises

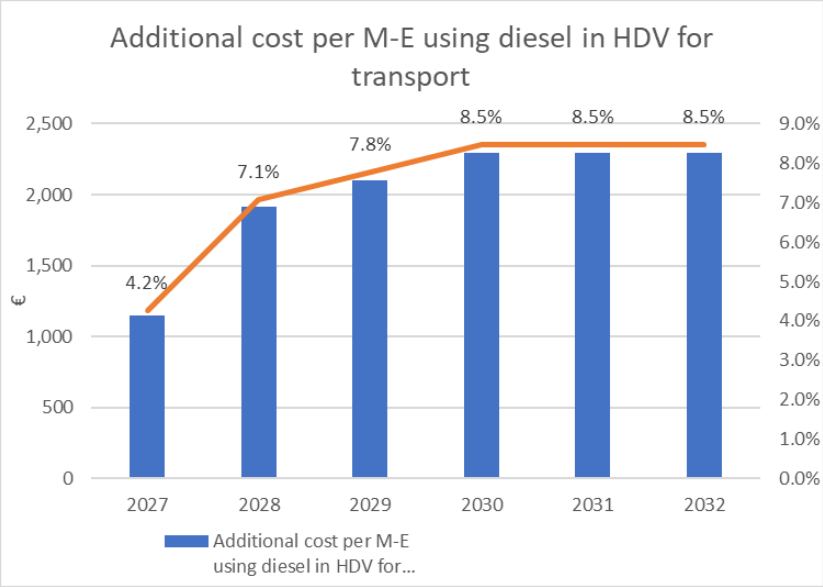
The impacts on the micro-enterprises are presented in terms of their fuel use in the buildings and in transport. Regarding the buildings where vulnerable microenterprises operate (analysed in Section 2.3 – 25,515 enterprises in the case of buildings), the average additional cost per vulnerable micro-enterprise is substantially higher for those with heating oil than gas (due to the carbon content and prices) and they reach a maximum of 80 € annually (see Figure 29).

**Figure 29. Average additional costs per micro-enterprise in buildings**



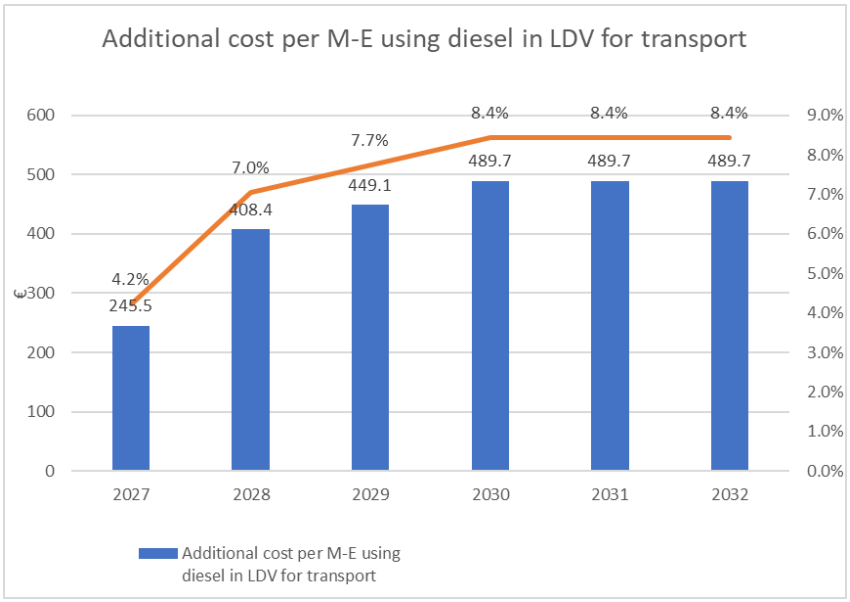

In the case of transport vehicles of vulnerable micro-enterprises (distinguished between LDV, HDV, taxis, and buses), the outcomes differ regarding the size of the fleet and the fuel. More specifically, for the vulnerable micro-enterprises owning HDVs that operate on diesel, additional costs are expected by the year of the ETS2 introduction, reaching up to almost 2,300 € in 2030, as illustrated in Figure 30.

**Figure 30. Additional cost per micro-enterprise using diesel in HDV for transport**



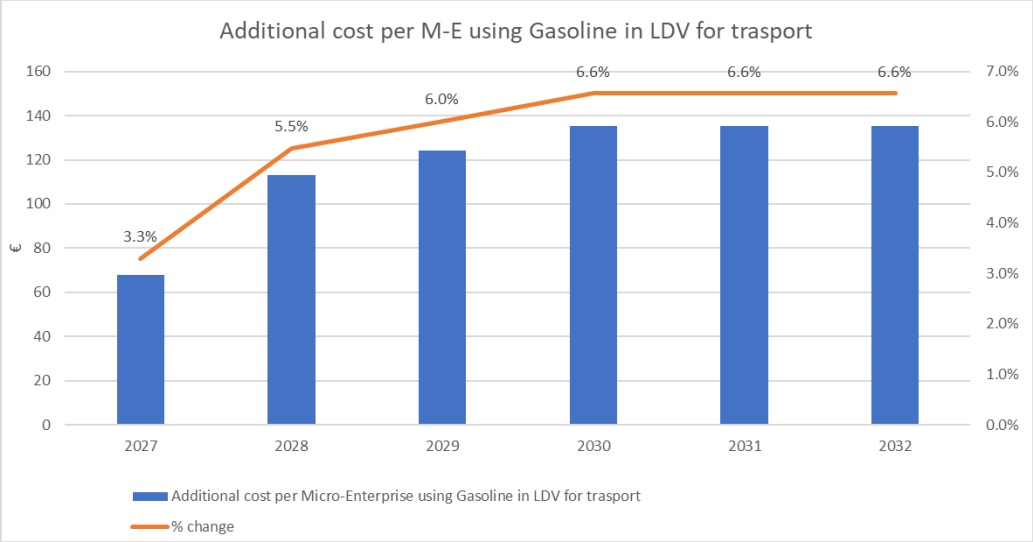

For the micro-enterprises owning diesel-powered LDV (see Figure 31), additional costs amounting to just under 500 € are expected from 2030 and onwards.

**Figure 31. Additional cost per micro-enterprise using diesel in LDV for transport**



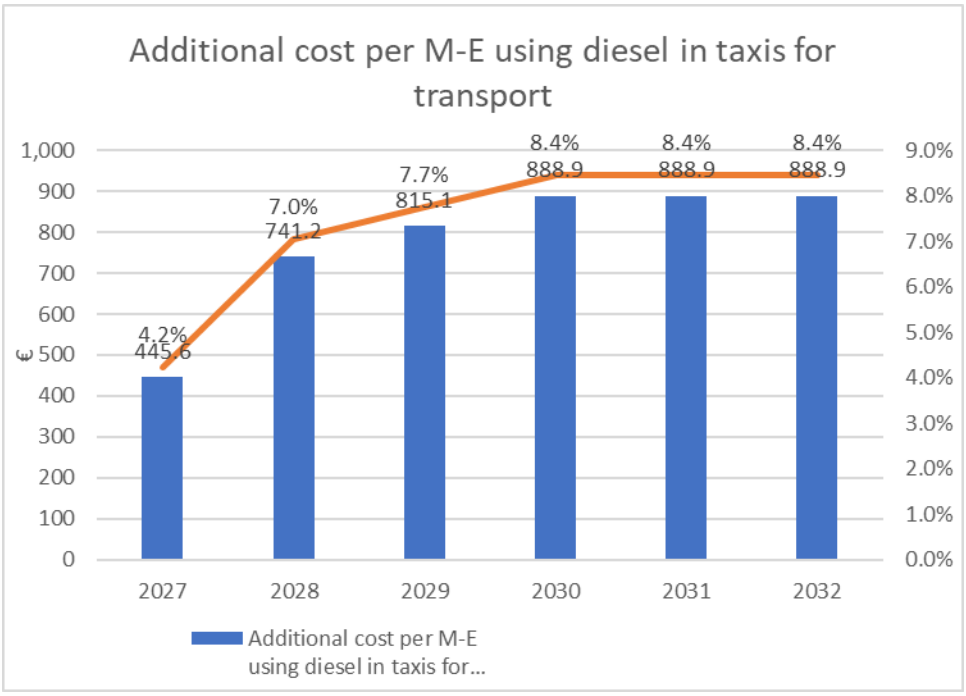

Similarly, for the micro-enterprises that use gasoline in their LDV, the economic burden is expected by the time of the ETS2 introduction, which will top to almost 140 € by the year 2030 (see Figure 32).

**Figure 32. Additional cost per micro-enterprise using Gasoline in LDV for transport**



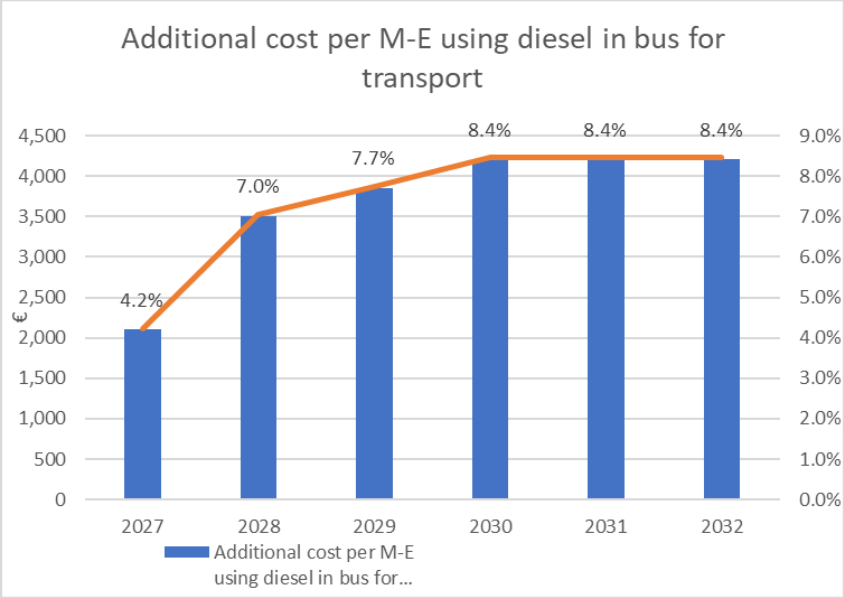

Micro-enterprises that operate as taxis and use diesel for their activities are also going to be burdened with extra costs after 2027, with expenses that will reach up to almost 900 € by the year 2030 (see Figure 33).

**Figure 33. Additional cost per micro-enterprise using Diesel in taxis for transport**




Micro-enterprises that include diesel-powered buses in their activities are expected to be burdened with additional costs after 2027, which will surpass the amount of 4,000 € by the year 2030 (see Figure 34**).** Micro-enterprises that operate as taxis and use diesel for their activities are also going to be burdened with extra costs after 2027, with expenses that will reach up to almost 900 € by the year 2030 (see Figure 33).

**Figure 34. Additional cost per micro-enterprise using Oil in buses for transport**

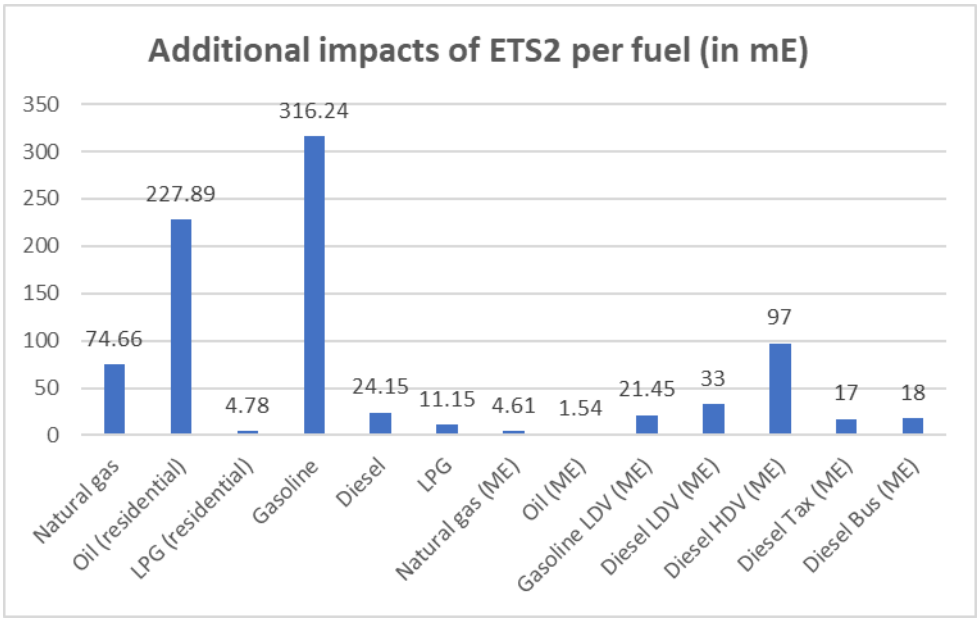



In general, vulnerable micro-enterprises making use of oil in buses will have the highest additional costs after the introduction of the ETS2 across all types of vehicles.

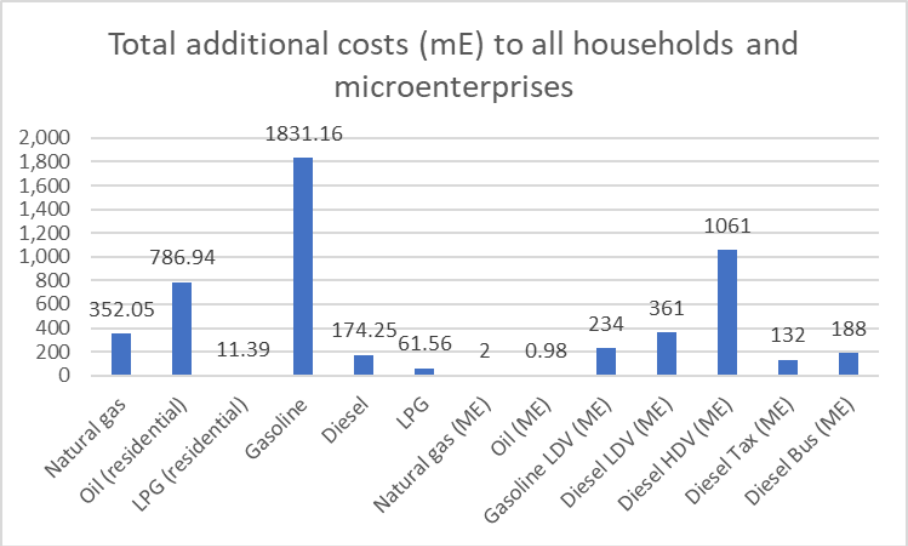
## 3.5 Summary of total impacts

In total, the expected impacts of the ETS2 on the vulnerable households and micro-enterprises are higher for households with gasoline in vehicles and heating oil in the households. In terms of micro-enterprises, the impacts will be higher in transport intensive companies.

**Figure 35. Additional costs from ETS2 per fuel for vulnerable households and microenterprises**



For the **sum of households and microenterprises** that will be influenced by the ETS2 (regardless if they are vulnerable or not), the **total additional costs are estimated at 5.2 bn €** cumulatively, which are almost **870 m € annually**. In terms of total costs (including the fuel prices and the additional costs), these can amount to **81.2 bn €,** almost **13.5 bn € annually**. More specifically, households will be burdened additionally with 1.15 bn € for their fuel uses in the buildings, and an extra 2.1 bn € for their transportation. Microenterprises will have an additional cost of 2 bn € for their fuels. The total fuel use costs for **households can reach to 2.3 bn € and 6.2 bn € annually for their fuels in houses and transportation**.




## 3.6 Sensitivity analysis with higher ETS2 prices

The core assumption in this analysis is the projection of the ETS2 price, which was provided to all Member States as an indicative price path, in order to carry out preliminary calculations with the Social Climate Plans. The stated ETS2 prices are on the low end (starting from 30 and reaching 60 Euro/tCO2). An alternative price pathway can be to start with the proposed capped price at 45 Euro/tCO2) and gradually increase towards 100 Euro/tCO2 in 2031 and 2032, when the ETS2 will be possibly linked or following to some extent the pricing of ETS1. In terms of fuel price effects, the new envisaged values would be as follows

**Table *13*. Higher ETS2 prices for households**

| Year | ETS2 prices (€/tCO$_2$) | NG price after ETS2 (€/kWh) | LPG price after ETS2 (€/kWh) | Oil price after ETS2 (€/kWh) |
|---|---|---|---|---|
| 2027 | 45 | 0.119 | 0.193 | 0.139 |
| 2028 | 55 | 0.121 | 0.196 | 0.141 |

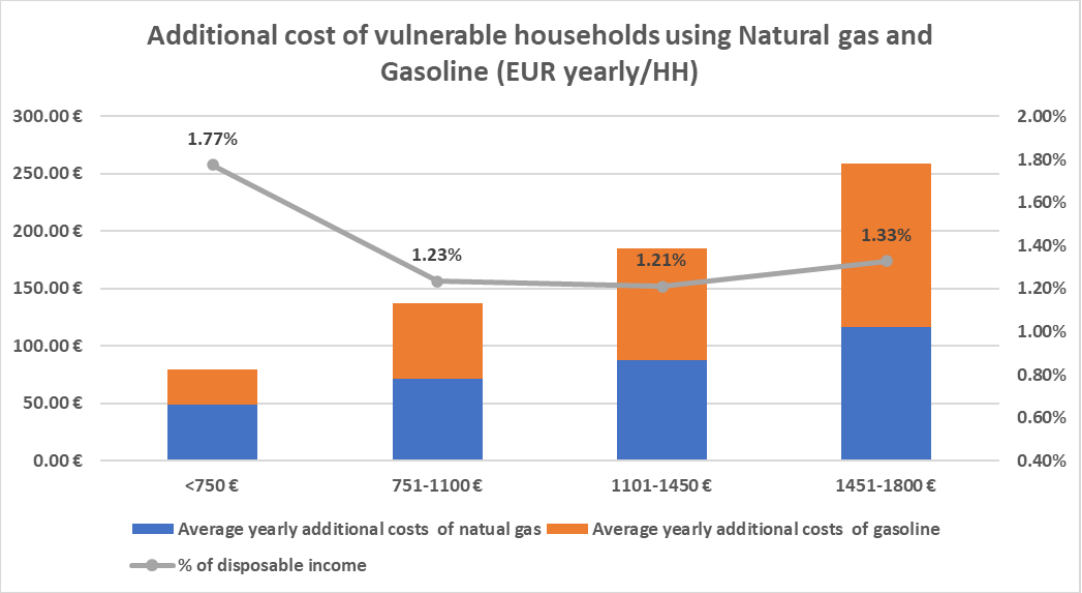
| | | | | |
|---|---|---|---|---|
| 2029 | 75 | 0.125 | 0.200 | 0.147 |
| 2030 | 90 | 0.128 | 0.204 | 0.151 |
| 2031 | 100 | 0.130 | 0.206 | 0.153 |
| 2032 | 100 | 0.130 | 0.206 | 0.153 |

**Table *14*. Higher ETS2 prices for transport**

| Year | ETS2 prices (€/tCO$_2$) | Gasoline price after ETS2 (€/kWh) | LPG price after ETS2 (€/kWh) | Diesel price after ETS2 (€/kWh) |
|---|---|---|---|---|
| 2027 | 45 | 0.204 | 0.149 | 0.168 |
| 2028 | 55 | 0.207 | 0.152 | 0.170 |
| 2029 | 75 | 0.212 | 0.156 | 0.176 |
| 2030 | 90 | 0.216 | 0.160 | 0.180 |
| 2031 | 100 | 0.218 | 0.162 | 0.182 |
| 2032 | 100 | 0.218 | 0.162 | 0.182 |

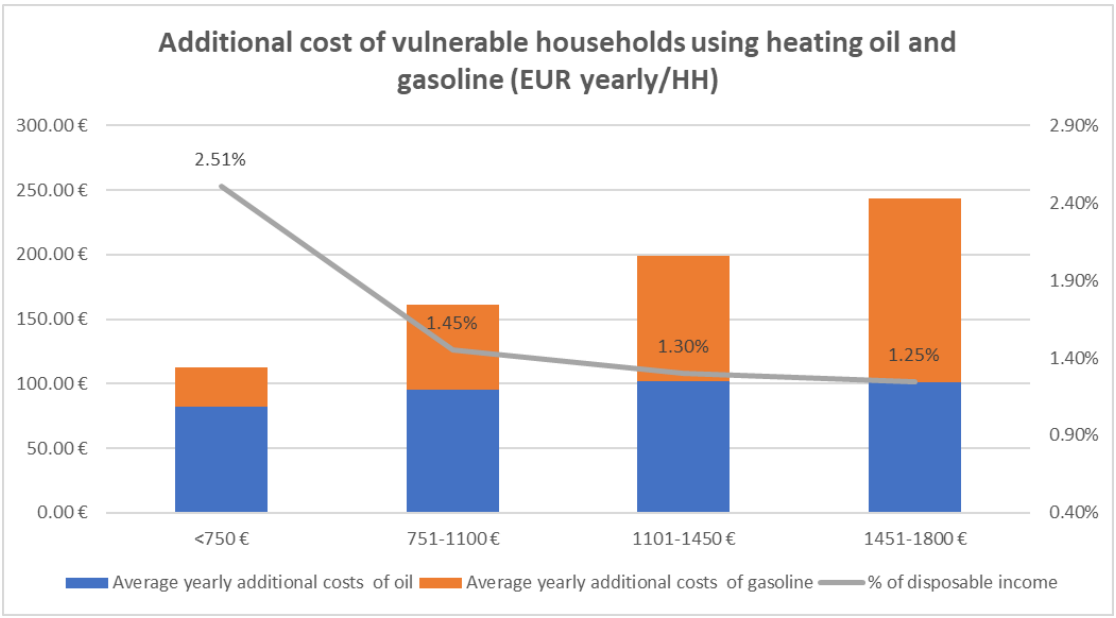
For the combined fuels in heating and transport for the households, the costs are estimated substantially higher, and they impact the disposable income at more than 1% per household. More specifically, for households with natural gas in heating and gasoline for their vehicles, the first income category will have 80 Euros additional costs and the fourth 250 Euros, while the impact on the disposable income will be 1.77% for the lower income groups.

**Figure 36. Additional costs of vulnerable households using natural gas and gasoline**



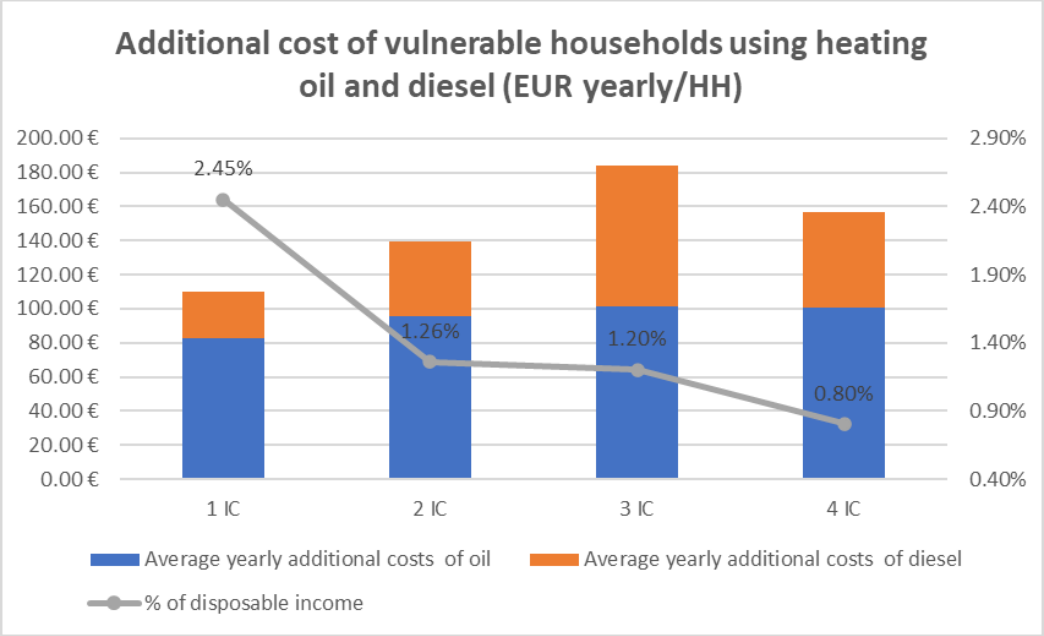

Furthermore, for households using heating oil and gasoline for their transport, the costs would increase at a relative scale, while this additional increase would eat up almost 2.51% of the disposable income of the poorer households.

**Figure 37. Additional costs of vulnerable households using heating oil and gasoline**



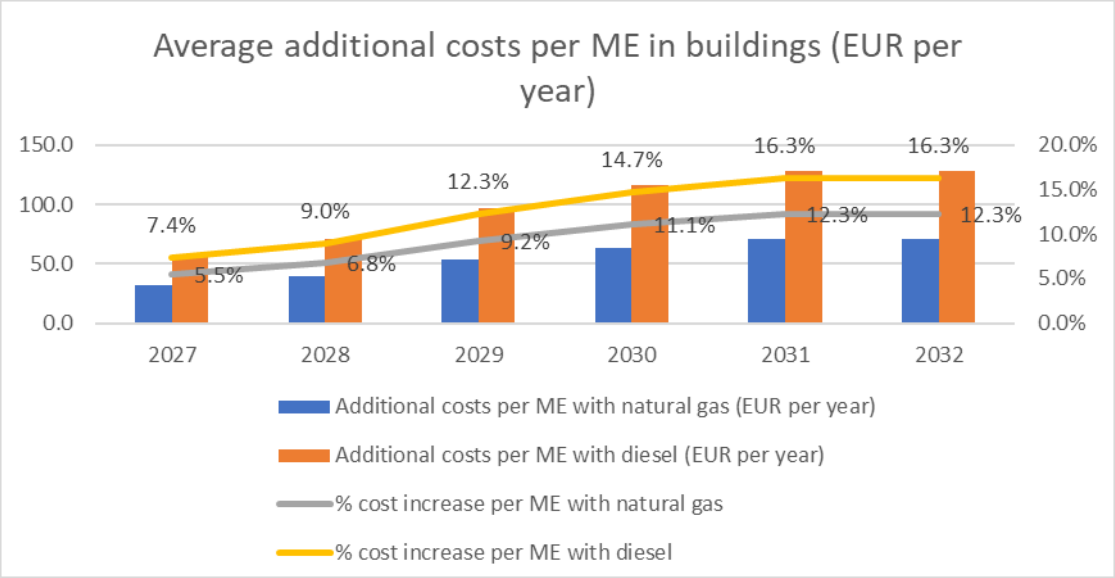

Likewise, for households for households using heating oil and diesel for their transport, the costs would increase at a relative scale, while this additional increase would consume 2.45% of the disposable income of the poorer households.

**Figure 38. Additional cost of vulnerable households using heating oil and diesel**



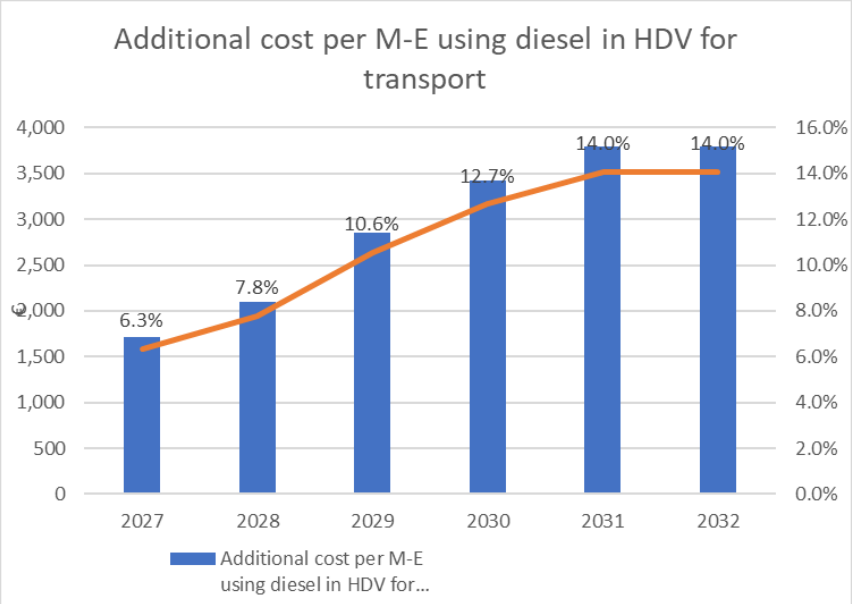

Regarding microenterprises, the higher ETS2 prices can lead to 12-16% cost increase in 2032 regarding the fossil fuel use in the buildings.

**Figure 39. Average additional costs per micro-enterprise in buildings**

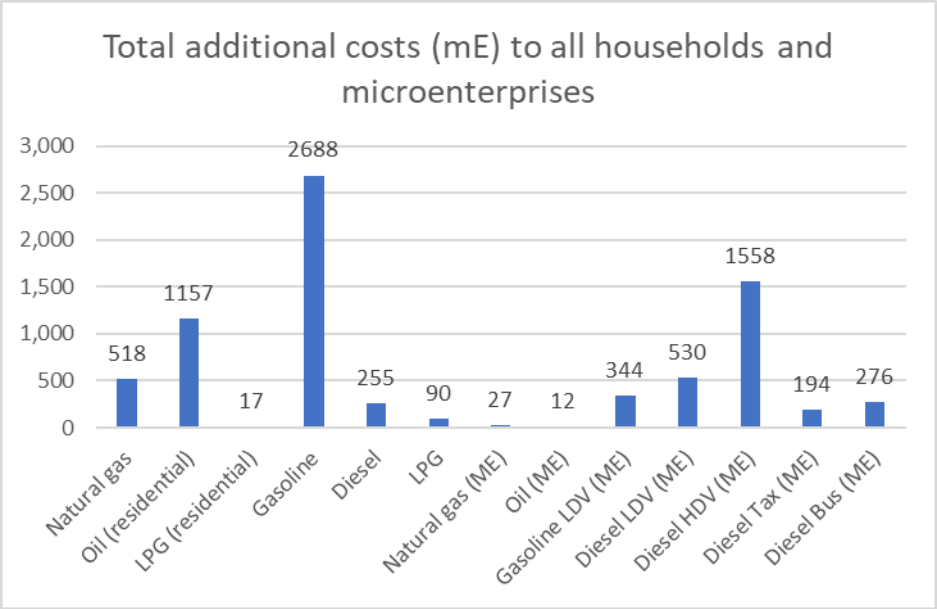



For the transport intensive micro-enterprises with HDV, the additional costs are higher, reaching 3,800 E annually up to 14.2% increase. This is more than 50% increase from the lower ETS2 prices, which can cause serious financial risks to such micro-enterprises.

**Figure 40. Additional costs per micro-enterprise using diesel in HDV for transport**




For the **sum of households and microenterprises** that will be influenced by the ETS2 (regardless of if they are vulnerable or not), the **total additional costs are estimated at 7.67 bn €** cumulatively, which are almost **1.3 bn € annually**. In terms of total costs (including the fuel prices and the additional costs), these can amount to **83.6 bn €,** almost **14 bn € annually**. More specifically, households will be burdened additionally with 1.7 bn € (288 m € annually) for their fuel uses in the buildings, and an extra 3 bn € (503 m € annually) for their transportation. Microenterprises will have an additional cost of 2.9 bn € for their fuels. The total fuel use costs for **households can reach 2.4 bn € and 6.4 bn € annually for their fuels in houses and transportation**.



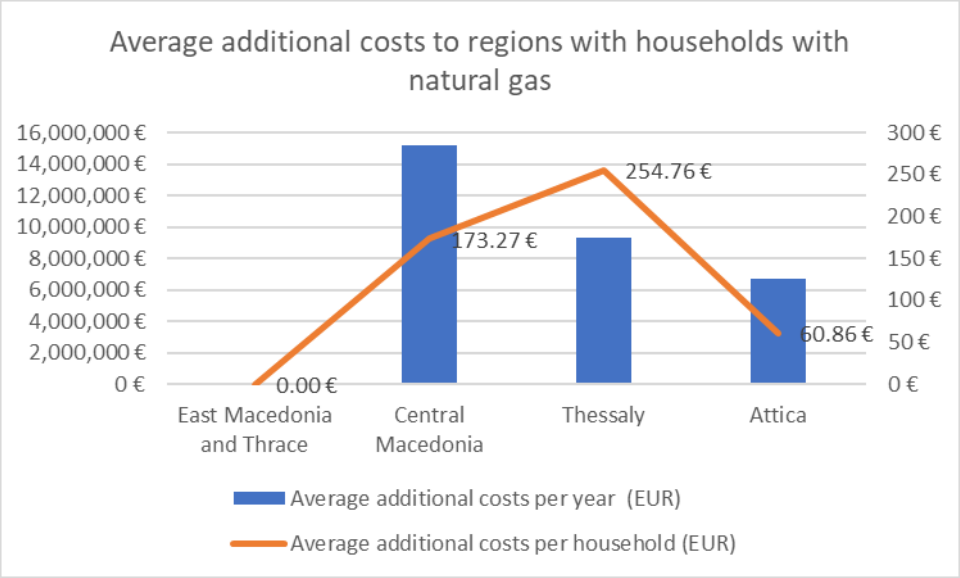
# 4 CALCULATION OF ETS2 IMPACTS AT REGIONAL LEVEL

The impacts of the ETS2 for households and transport are also presented in their regional dimensions, through similar methodological steps (Annex) (note that there is no regional allocation of micro-enterprises, hence the analysis is based only on households and transport).

## 4.1 Vulnerable Households

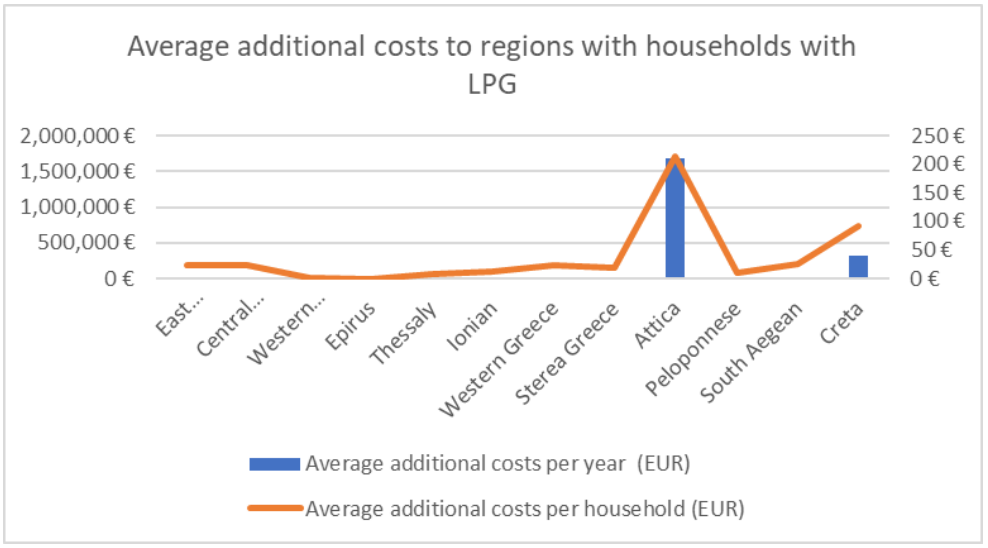
In the case of households using natural gas for space and water heating and cooking, these are detected primarily in four regions with natural gas connections. As presented in Figure 41, households in central Macedonia and Thessaly will be more affected by the ETS2 introduction (about 150 € per household on average), with an increase of 10%.

**Figure 41. Average additional costs to regions with households with natural gas**



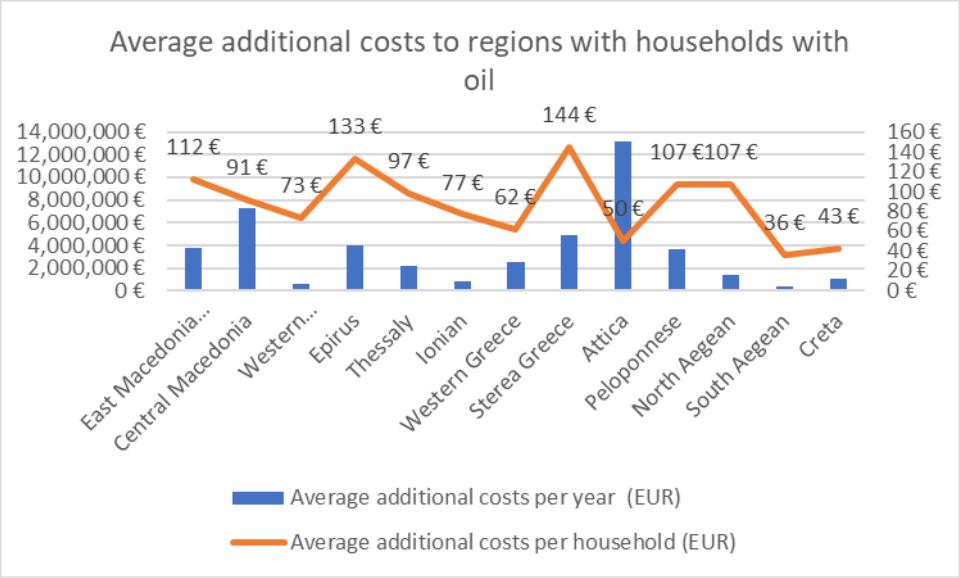

For LPG (for heating and cooking) the highest average costs are detected in the region of Attica, where the highest use is observed due to the size of the region (see Figure 42) and an overall increase of about 6.8%.

**Figure 42. Average additional costs to regions with households with LPG**




Finally, for households using oil for space and water heating, which is the predominant source in Greek households, the highest additional costs per household are presented in Thessaly, while in absolute values it is in Attica, where the largest part of the population resides (see Figure 43). The percentage cost increase is around 11%.

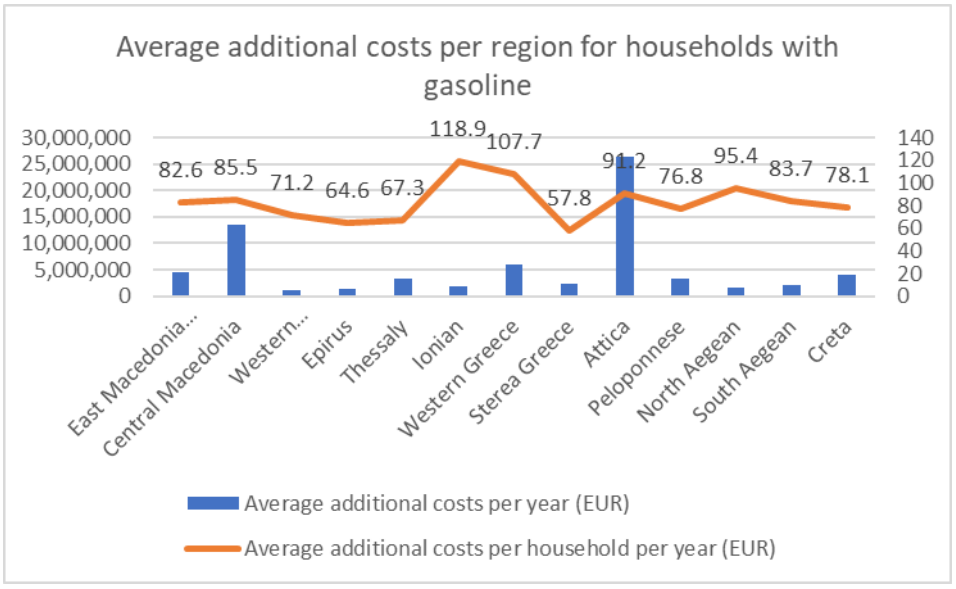
**Figure 43. Average additional costs to regions with households with oil**




## 4.2 Vulnerable transport users

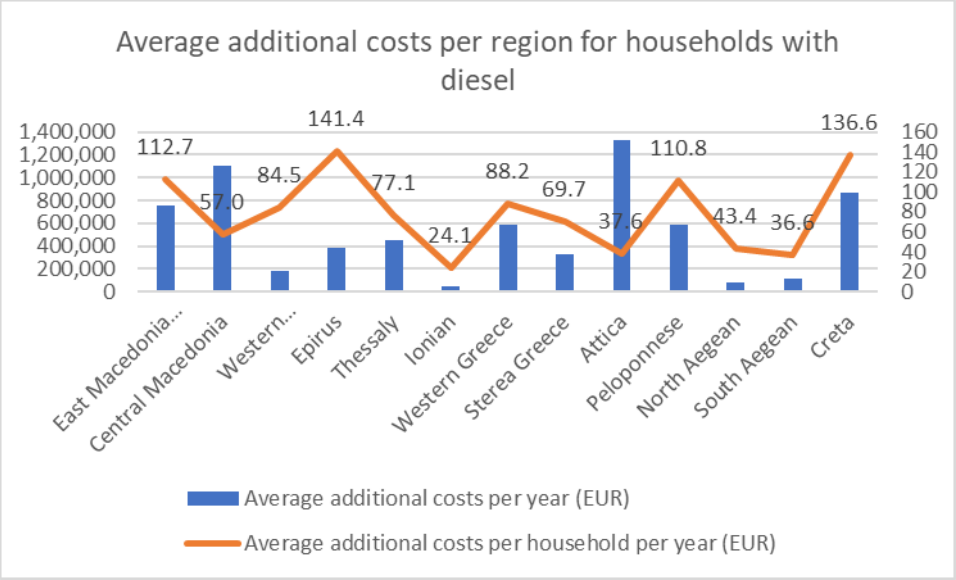
In the case of vulnerable transport users, a similar methodology as above is used. For households in transport with vehicles with gasoline, which is the main fuel in transport in private vehicles, the highest additional costs per household will be in the Ionian, Attica and Central Macedonia (see Figure 44) with an average cost increase of 7%.

**Figure 44. Average additional costs per region for households with gasoline**



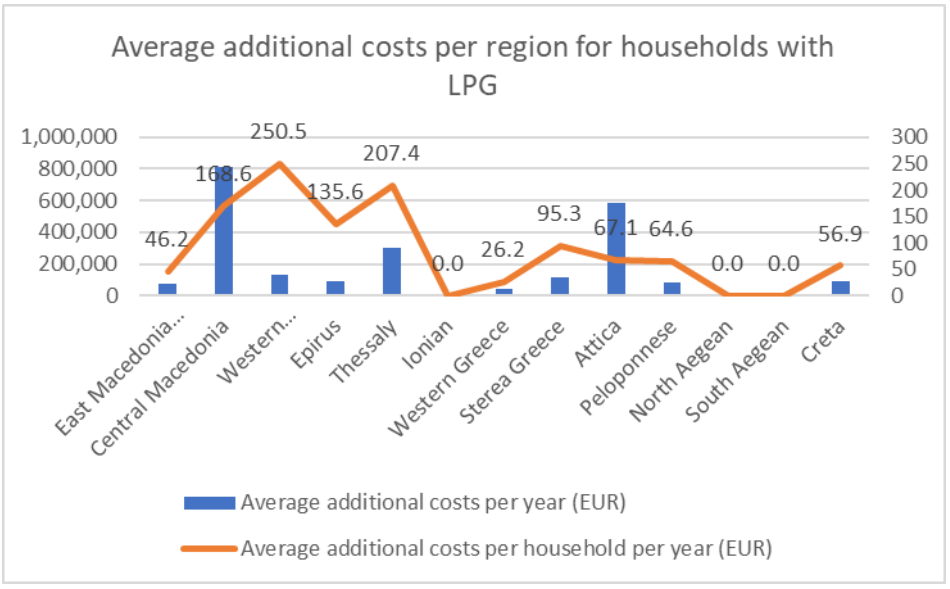

Furthermore, for the average household using diesel in private vehicles, the additional costs will be higher in Peloponnese, Creta, and Epirus, while in total, the highest costs are expected in Central Macedonia, Attica and Creta (see Figure 45) with a percentage increase of 8%.

**Figure 45. Average additional costs per region for households with diesel**




Finally, for the relatively small fleet of private vehicles with LPG, the highest additional expenditure per household is found in Western Macedonia and Central Macedonia (see Figure 46) with an increase of 7.8%.

**Figure 46. Average additional costs per region for households with LPG**



# 5 PROPOSALS FOR MEASURES TO ALLEVIATE THE COSTS

Regulation (EU) 2023/955 of 10 May 2023 establishing a Social Climate Fund[21] (SCF Regulation) establishes a Social Climate Fund (SCF) for the period from 2026 to 2032. According to Article 1 of this Regulation, the SCF shall provide financial support to Member States for the measures and investments included in their Social Climate Plans (SCP).

The measures and investments supported by the SCF shall benefit households, micro-enterprises and transport users, which are vulnerable and particularly affected by the inclusion of greenhouse gas emissions from buildings and road transport in the new EU Emissions Trading System (ETS2), in particular households in energy poverty or households in transport poverty.

Article 3(2) of the SCF Regulation provides that SCF shall support vulnerable groups through temporary direct income support and through measures and investments intended to increase the energy efficiency of buildings, decarbonisation of heating and cooling of buildings, including through the integration in buildings of renewable energy generation and storage, and to grant improved access to zero- and low-emission mobility and transport.

Article 4(1) foresees that the SCP shall contain a coherent set of existing or new national measures and investments to address the impact of carbon pricing on vulnerable groups in order to ensure affordable heating, cooling and mobility, while accompanying and accelerating necessary measures to meet the climate targets of the Union.

According to Article 4(4) of the SCF Regulation, Social Climate Plans shall include national and, where relevant, local and regional measures and investments, in accordance with Article 8, to:

a) carry out building renovation, and decarbonise heating and cooling of buildings, including the integration of renewable energy generation and storage;
b) increase the uptake of zero- and low-emission mobility and transport.

In addition, the SCP may also include national measures providing temporary direct income support to vulnerable households and vulnerable transport users to reduce the impact of the increase in the price of fossil fuels resulting from the ETS2 (Article 4(3)). Such support shall be temporary and decrease over time. Member States may provide temporary direct income support if their SCP contain structural measures or investments that reduce fossil fuel consumption for vulnerable groups. Such support

[21] Regulation - 2023/955 - EN - EUR-Lex

shall be limited to the direct impact of the ETS2. The costs of measures providing temporary direct income support shall not represent more than 37,5 % of the estimated total costs of the SCP.

Article 6 includes specific requirements regarding the integration of measures and investments in the SCP. In particular, measures and investments have to be concrete, reduce the effects of ETS2 on energy prices for vulnerable groups, contribute to the objectives of the SCF within the overall setting of a Member State's relevant policies and do no significant harm to environmental objectives according to the EU Taxonomy Regulation 2020/852.

In the framework of the Greek Social Climate Plan and taking into account the impacts of ETS2, we present below a set of measures that can alleviate the burden to the vulnerable groups and can be eligible under the SCF.

## 5.1 Buildings

### 5.1.1 Energy efficiency upgrades of residential buildings for vulnerable households

**Target group**: The investment targets a wide range of vulnerable citizens, including low-income households, elderly people living alone, persons with disabilities, single-parent families, unemployed, and underemployed. Special attention is given to rural, remote, and island areas, where building conditions are often worse and access to renovation services more limited. Special attention will also be given to residents in mountainous areas, where climatic conditions increase energy needs and vulnerability. All in all, the investment focusses on households that cannot afford the cost of renovations, even though they live in buildings with very low energy performance. These households are at risk of significantly higher bills under ETS2. The investment targets at the renovation of 160,000 vulnerable households across all eligible income categories (1st to 4th), with higher grant intensities for those in the lowest income brackets.

**Objective**: This investment aims to support the structural and long-term alleviation of energy vulnerability by promoting comprehensive energy renovations in residential buildings, particularly those housing vulnerable and low-income households. Its primary objective is to reduce fossil fuel consumption and enhance energy autonomy by significantly improving the energy performance of buildings—achieving at least a three-class upgrade in energy efficiency (over 30% reduction in Primary Energy Demand) for targeted groups, mainly within the first- and second-income categories. Eligible interventions include upgrades to the building envelope, installation of energy-efficient heating, cooling and domestic hot water systems, deployment of smart appliances, and integration of renewable energy systems for self-consumption. The investment responds to the increasing energy burden faced by households in low energy performance buildings who, without intervention, are exposed to disproportionately high energy costs. In this context, the measure aims to reduce their financial vulnerability through cost-effective, technically robust renovations that lower

energy demand and ensure long-term savings. Eligibility criteria are based on the National Action Plan for Tackling Energy Poverty (Government Gazette B' 4447/28.09.2021), which defines the population groups most affected. Furthermore, the investment contributes to the objectives of the National Energy and Climate Plan (NECP), targeting primary energy savings of at least 21 ktoe annually, while also promoting digitalisation and the electrification of final energy consumption in the residential sector. Vulnerable households will receive increased grant support based on their income category.

**Description and Challenges Addressed**: This investment focuses on supporting vulnerable households who are expected to face increased energy costs from ETS2, by promoting targeted energy efficiency interventions in the residential sector.

It supports the improvement of the energy performance of residential buildings by addressing both technical inefficiencies and the inability of certain population groups to afford renovation works. The eligible interventions include: a) Upgrading the building envelope, such as insulation of external walls, roofs, lofts, and floors; replacement of windows and doors; air sealing; installation of solar shading; and use of passive design solutions like natural ventilation and solar heating or cooling, b) Replacing outdated heating, cooking and domestic hot water systems, mainly fossil fuel-based heating, with efficient electric alternatives such as heat pumps, domestic hot water systems using renewable energy, and improvements to heating distribution systems, and c) Additional actions, including the installation of smart technologies and replacement of lighting systems in shared areas of apartment buildings. The support offered aims to reduce energy use and improve comfort while easing the financial burden on these groups.

Priority will be given to the renovation of the worst-performing residential buildings, such as those rated G or H under the Energy Performance Certificate classification. The goal is to combine envelope interventions (e.g. insulation, window replacement, air sealing) with the installation of efficient systems for heating, cooling, and domestic hot water production, thus achieving both environmental impact and social equity.

This investment is in essence an extension of the national longstanding "Exoikonomo" programme, with a strengthened focus on supporting vulnerable households who are expected to face a higher energy cost burden due to ETS2. In addition to continuing the existing approach of "Exoikonomo," this investment introduces new financing tools, such as on-bill financing and higher subsidy rates for the most vulnerable groups. This ensures greater accessibility to energy renovation and supports both national climate targets and social equity. It also allows the repayment of renovation costs through energy bills. These tools can be deployed either independently or in combination with direct grants, increasing flexibility and accessibility for households with limited upfront capital.

**Financial Support**: The investment includes the provision of grants and loans and mixed financing schemes with subsidized interest rates similar to the "Exoikonomo" programmes. More in detail, these can cover the 80-100% of the costs for the

vulnerable groups of the first two income categories, and 60 to 80% of the remaining income categories' costs. The implementation can be designed and implemented in the following steps: Design by defining eligibility criteria (minimum energy savings, eligible interventions, M&V standards); implementation by launch of open call for projects by households and/or public/private entities (for the case of auctions or on-bill financing); Financing by using ETS2 revenues along with national funds and finally Monitoring & Reporting by using M&V protocols.

Additional, at a second stage, the investment can include partnerships under agreements with electricity/gas suppliers and credit institutions, user onboarding by offering pre-approved packages and certified installer networks, billing and repayment with ensured savings, stimulating also the private market of ESCOs in delivering energy savings and making use of on-bill financing schemes, energy saving auctions and incumbent Energy Efficiency Obligation schemes.

The programme can be implemented in a similar manner and structure as the "Exoikonomo" programme, in which there are direct grants covering in average 80% of the costs depending on the vulnerability level. Those can be combined with low-interest loans, free energy audits and support by One Stop Shops (see related measures) or engineers to the application process. For the implementation of the investment, the NSRF Structure of the Ministry of Environment and Energy will be responsible for the program development, while for the implementation, an Implementation Body will manage programme applications or supervise the on-bill financing scheme and the ESCO investments, while Greek lending institutions will finance the subsidized loans. The total costs are estimated at € 2,048,000,000 taking into account several factors, including the number of target households, average renovation cost per unit, and the coverage level of the subsidy.

### 5.1.2 Supporting the installation of energy efficient heating, cooling and domestic hot water production systems in existing residential buildings

**Target group**: Vulnerable households in eligible income categories with inability to co-finance interventions in heating and cooling (1-4 income categories), as well as inhabitants that live in mountainous areas, which depend on oil or biomass boilers for heating and where climatic conditions increase energy needs and vulnerability. Subsidies can take the form of direct grants, or partial reimbursements, and may be scaled based on income level, building performance, or geographic priority areas (like the national programme "Change of heating system and boiler"). The investment can target a total number of expected beneficiary households of 230,000 for heat pumps and 180,000 for solar water heaters.

**Objective**: The objective of this investment is to promote the decarbonisation and energy efficiency of the existing residential building stock. It aims to achieve this by providing financial subsidies for the installation of high-performance, energy-efficient heating, cooling, and domestic hot water (DHW) systems, substituting incumbent oil and gas boilers. These subsidies will support homeowners, tenants, and residential

property owners in upgrading or installing energy-efficient heating, cooling, and DHW systems in their existing residential buildings.

**Description and challenges addressed**: This investment involves the provision of targeted subsidies to homeowners, tenants and residential property owners for the installation or upgrade of energy-efficient heating, cooling, and domestic hot water (DHW) production systems in existing residential buildings (substituting the fossil fuel-based systems). The goal is to accelerate the shift toward low-carbon, high-efficiency technologies such as heat pumps (air-source, ground-source), solar thermal systems and smart thermostats and controls. In the case of installation of heat pumps, the challenge posed is the increase of the costs (with a higher electricity price), hence leading to new lock-ins. To address that, the measure can be complemented, not mandatorily, with the integration of energy from renewable sources, including energy storage to reduce operational costs of the heat pumps. This would require also a reform for simplification of procedures for accessing finance, permitting, and connection to the grid. Subsidies can take the form of direct grants, or partial reimbursements, and may be scaled based on income level, building performance, or geographic priority areas (like the national programme "Change of heating system and boiler").

The main challenges that can appear consider the high upfront costs, the aging of the building stock, the lack of awareness by the citizens and finally market barriers like the slow market uptake of efficient technologies due to lack of demand or supply chain readiness. It should be taken into account that the CAPEX for purchasing and installing a heat pump is high and certainly difficult to afford for the affected households. Therefore, the subsidy rate should be high to enable the largest possible number of beneficiaries to take advantage of the investment. The same applies in the event that the potentially beneficiary household chooses to purchase and install a photovoltaic panel (PV) panel, the possibility of choice will be provided in the subsidy program and will not be a mandatory expense. In contrast, a solar water heater is considered an affordable expense, and the subsidy rate may be lower.

**Financial Support:** The investment includes the provision of grants, similar to the national "Change of heating system and boiler" program. These will be covering the 80% but with a potentially increased funding rate (from 80-100%) for at least the first two income categories for substituting old boilers with heat pumps and solar water heaters.

For the implementation of the investment, the following tools are proposed:

- Direct subsidy on the budget per project in addition to the following measures, if deemed necessary, especially to those affected by salary categories 1 and 2.
- Incentivising existing mechanisms for actions in affected households - Energy Efficiency Obligation Schemes
- On-bill Financing

- In addition, the mix of subsidies may include interest-free loans, guaranteed by the Greek State.

Estimating the required investment for this programme involves assessing the number of eligible vulnerable households, the average cost of replacing heating systems with heat pumps and solar water heaters, and the subsidy coverage level. The total budget will depend on the final number of beneficiaries and grant intensity across income categories. Higher financing rates for lower income groups will ensure equitable access and targeted impact. The total costs can reach € 1,001,200,000

### 5.1.3 Provision of energy efficient low rent apartments

**Target group**: Low-income households at risk or in vulnerability in their households due to ETS2 and students (lower income categories).

**Objective**: The investment aims to support the development and energy upgrade of energy-efficient and affordable housing for vulnerable groups, including students, by prioritizing the renovation and, where necessary, the construction of fossil fuel–free housing. The goal is to improve living conditions for low-income households and students by reducing energy costs, minimizing environmental impact, and ensuring long-term sustainability and accessibility. This includes the development of new energy-efficient rental housing that is affordable for households at risk of energy poverty, with a particular focus on supporting municipal housing and social housing owned by corporations or social service providers through appropriately designed financial instruments, such as soft loans. In cases where support is directed toward the construction of housing units in privately owned multi-generational buildings, it is essential to link new construction with energy-efficient renovation measures that achieve tangible energy savings. Across all supported projects, clear conditions must be set for rental arrangements, including rules on duration and limits on annual rent increases, to ensure fairness and affordability over time.

**Description and challenges addressed:**

**Subprogramme 1 – Construction of new and renovation of existing public / municipal properties for Social Housing**

The proposed investment concerns the creation of a targeted social housing program through the utilisation of public real estate or land for the construction or energy upgrade of zero-energy footprint housing, which will be available for rent on preferential terms to socially and economically vulnerable groups. More specifically, this investment concerns:

- The construction of new energy efficient housing units intended for social housing, offered at low rent, which will remain under public or municipal ownership.
- The energy efficient renovation of existing buildings intended for social housing, offered at low rent, which will also remain under public or municipal ownership. Priority will be given to the renovation of existing buildings.

This action targets vulnerable groups who will be relocated from energy-inefficient buildings to high energy-efficiency buildings with social rent. At the same time, it utilizes public properties that have untapped potential for social housing. The investment is a new national initiative that does not directly build on a previous programme but can be strategically integrated into existing housing and green transition policies. It is proposed to be implemented and financed with the support of the Social Climate Fund, due to its direct link to the need to support households disproportionately affected by the ETS2. The proposed action will serve as a pilot initiative, supported by the relative and necessary reforms in the social housing framework for enabling long term lease, in order to demonstrate the benefits and added value of such public property usage.

Eligible interventions include:

- Construction of new zero energy homes with high energy efficiency standards and the use of Renewable Energy Sources (RES).
- Renovation and energy upgrade of old state-owned buildings, with interventions such as:
  - Thermal insulation of external walls, roofs, floors.
  - Replacement of frames and installation of shading systems.
  - Upgrade of heating/cooling systems with heat pumps, solar water heaters and RES technologies.
  - Installation of smart meters and energy management automations.

The action will be accompanied by institutional reform for the formulation of a national social housing framework with sustainability criteria, as well as the creation of a register of available public properties and transparent mechanisms for rent subsidies or support for beneficiaries. The scope of the subprogramme is foreseen as a pilot in the first phase, with the aim of its gradual escalation throughout the country, giving priority to urban centres with a housing crisis, as well as to island and rural areas where population decline and energy poverty are observed.

The action aims to be an integrated tool for social policy and green transition, combining:

- Environmental protection through emission reduction.
- Financial relief for households.
- Boosting growth in the construction sector with an emphasis on sustainability.

The expected effectiveness is enhanced by its dual character – social and environmental – and the provision of accompanying measures that will ensure its targeted implementation, social acceptance and long-term sustainability.

### Subprogramme 2- Provision of energy-sustainable student residences to vulnerable young people

The investment for the "Provision of energy-sustainable student residences for vulnerable young people" focuses on the energy and functional upgrade of the

buildings of 11 public student residences throughout the country. The majority of the buildings of the public student residences are of considerable age, with low energy efficiency and increased maintenance needs. The aim of this investment is to ensure access to safe, affordable and sustainable housing for thousands of students from vulnerable households. **The most important criterion for eligibility is that the residents are paying the utility bills of these residences**, and this requires research with each university own regulation in the country.

This investment includes large-scale interventions for the complete renovation of student residences, which will contribute to the modernization and increase of the capacity of the dormitories, as well as to improve the energy efficiency of their buildings.

**Subprogramme 3 - Renovation of vacant residential private properties with a requirement for long-term lease to vulnerable households and students ("Renovate-Rent")**

The proposed measure will be an extension of an existing national initiative, previously implemented through national resources, which is now proposed for scaling up with support from the SCF to broaden its impact and reach more beneficiaries. The "Renovate–Rent" program targets private owners of vacant homes, incentivizing them to renovate and lease their properties under long-term contracts.

The programme primarily targets private owners of unoccupied dwellings, prioritizing buildings that have remained officially vacant for at least the past three years. To receive the subsidy, owners must execute a digitally registered lease agreement of at least three years and submit proof of electronically settled renovation invoices.

This approach activates dormant housing stock, expands affordable rentals and reduces energy poverty. By linking renovation support with social outcomes, the program offers a cost-effective, targeted solution aligned with national housing goals (country's housing strategy) and the EU's climate transition objectives. The measure addresses energy poverty and housing scarcity by expanding the supply of affordable rentals. It aligns with Greece's National Energy and Climate Plan and Housing Policy Strategy, aiming to reduce fossil fuel dependence in residential heating.

It also supports the development of new housing units in vacant apartment complexes. This initiative may also include upgrading the energy efficiency of student residences. Many individuals and households experiencing energy poverty live in rental apartments within properties that cannot be renovated to reduce energy consumption, or they may reside in substandard housing, or temporary accommodations like shelters. Often, these households lack the means to change their living situations, whether by moving to more expensive rental options or purchasing a home. Municipalities can receive support to renovate the buildings they own by covering the upfront renovation costs. Once renovated, these properties can be rented out at social rates to low-income households. In all these initiatives, next to energy efficiency and fossil fuel free heating, integration of renewable energy

generation and storage to the extent possible will be provided. Additionally, financial institutions that own such buildings and are unable to use them can be offered similar incentives to encourage their renovation and rental.

It can include the Construction of new and renovation of existing public / municipal properties for Social Housing (around 3,000 units), Provision of energy-sustainable student residences to vulnerable young people (to accommodate around 7,000 vulnerable students) and renovation of vacant residential private properties with a requirement for long-term lease to vulnerable households and students ("Renovate-Rent") (around 25,000 housing units).

**Financial support:** Combination of subsidy and soft loans for municipalities and housing corporations. For the subprograms 1 and 3, the action will be implemented in distinct phases (e.g. three cycles lasting 24 months), with the possibility of feedback based on an evaluation of effectiveness and social acceptance. The funding will include direct grants of 60–100% depending on the vulnerability category (100% for subprogram 1 and 60% for subprogram 3), with possible additional support through low-interest loans or social economy tools.

For the subprogram 2, the financing of the project will be carried out through the resources of the SCF, while the public procurement assignments for the implementation of the required projects of the action will fully comply with the provisions of Law 4412/2016 on public contracts of works, contracts and suppliers. Each Beneficiary Body (entities that own the selected student residence buildings) will have an obligation to implement all the required procedures for the award of public contracts for the buildings under their jurisdiction.

The total investment required will depend on the final mix between newly constructed and deeply renovated units, the number of target beneficiaries, and the type and location of the buildings involved. The program cost can reach € 630,000,000.

### 5.1.4 Energy efficiency upgrades and substitution of fossil fuel heating systems in non-residential buildings for micro-enterprises

**Target group**: Vulnerable micro-enterprises with the inability to renovate their building, and mainly micro-enterprises established in islands and less advantageous areas are targeted. Vulnerable micro-enterprises with oil and gas heating systems are supported to replace their heating and hot water systems with heat pumps and solar water heaters. Additionally, they are supported to upgrade their buildings (strictly used for the enterprise, headquarters, offices, production facilities, service provision facilities, and warehouses), focusing on energy efficiency, even if they own the buildings or are under a long-term lease.

**Objective**: This investment aims to strengthen the economic resilience and competitiveness of vulnerable micro-enterprises, particularly those operating in the secondary and tertiary sectors and located in islands or economically disadvantaged areas, by financially supporting the energy renovation of their buildings and the

installation of energy-efficient heating and domestic hot water systems. Through targeted energy efficiency upgrades and the integration of renewable energy technologies, the measure seeks to reduce operating costs, improve environmental performance, and ensure the long-term viability of small businesses that are often disproportionately affected by rising energy prices and the impacts of the ETS2. By addressing structural energy poverty in the business sector, especially for micro-enterprises with limited financial or technical capacity, the investment promotes energy equity and supports a fair transition to more sustainable operations. In the medium to long term, this initiative is expected to contribute to lower energy costs, enhanced competitiveness, increased employment, and a reduced environmental footprint, establishing high energy efficiency standards that foster lasting economic resilience and sustainability in the tertiary and secondary sectors. The estimated beneficiaries are 10,000 micro-enterprises undertaking energy upgrades primarily for their own facilities.

**Description and challenges addressed**: Micro-enterprises often face significant financial and operational challenges due to limited resources, especially when it comes to investing in costly but necessary infrastructure upgrades like energy-efficient heating, cooling, and hot water systems. The investment (with a co-financing of at least 60%) intends to support the energy improvement of buildings, the supply and installation of energy-efficient equipment and systems for energy saving, and their daily operations within the building they use. Specifically, the eligible interventions consist of a) the energy upgrade of the building envelope, b) the installation of energy-efficient lighting systems, c) the installation of energy-efficient fossil fuel free space heating, space cooling, ventilation and production of hot water systems, d) the installation of RES systems for energy production and storage for self-consumption and up to the amount of energy that heat pumps consume, e) the installation of Building and Energy Management Systems and f) the conduction of supporting actions (energy audit, energy and technical consulting, monitoring and management of the implementation of the investment plan).

**Financial Support**: The investment is complementary to the programmes "Allazo Siskevi-Epicheiriseis" and "Exoikonomo Epicheiro" that were founded through RRF. The highest co-financing rates will apply to enterprises facing documented difficulties in access to finance, as well as those operating in island, mountainous, or remote areas, where energy costs and infrastructure limitations are more acute. The grant will support interventions such as the energy upgrade of the building envelope, replacement of inefficient systems with high-performance equipment, integration of renewable energy technologies, and necessary technical support services. The total budget including private finding will be around € 500,000,000. The projects of micro-enterprises could be financed as follows:

a) Grants (percentage of total investment): 60% direct funding (additional funding may be foreseen based on sectoral or regional criteria).

b) Guaranteed loans: The remaining investment could be covered through a specialised financial instrument, with the possibility of subsidizing both the guaranteed fee and part of the interest rate. Guarantees are estimated at 80% per loan with a portfolio cap of 30%, thus the leveraged amount for € 200,000,000 will exceed € 500,000,000 including national and private investments.

### 5.1.5 One-Stop- Shops for vulnerable citizens and micro-enterprises with parallel support to Citizen Led Initiatives and Energy Communities

**Target group**: Vulnerable households, vulnerable transport users, households in energy and transport poverty (all income categories) and micro-enterprises

**Objective**: This investment aims to provide centralised, accessible, and comprehensive advisory services to households at risk of energy and transport price increases due to ETS2, with a focus on supporting the most vulnerable. It will complement the work of the National Energy Poverty Observatory and local energy poverty alleviation offices by establishing dedicated One-Stop-Shops (OSS) for energy and transport, which can be hosted at municipal community offices and chambers of commerce across Greece. These OSS will promote energy efficiency and the deployment of renewable energy among households and micro-enterprises, ultimately contributing to the reduction of fossil fuel dependency and supporting a fair and inclusive energy transition. They will act as a supporting instrument to initiatives led by citizens and organisations, such as Energy Communities (with the focus to decarbonize the heating systems) and also Citizen Led Renovation initiatives.

**Description and challenges addressed**: The proposal includes the establishment of "Support and Information Offices" for vulnerable micro-enterprises within the premises of Chambers of Commerce, spatially organized and distributed nationwide to ensure complete coverage of the country. Also, it includes the transformation of the Community Centers, along with their branches and mobile units, as key hubs for extended one-stop shop-type services for vulnerable households and transport users. The purpose of those hubs will be to support municipalities in implementing social protection policies and to develop a local reference point for receiving, serving, and connecting citizens with all social programs and services implemented in their area of operation. Finally, it will be complemented with a required reform. Analytically:

**Subprogramme 1: Energy support one-stop shop for vulnerable micro-enterprises.** This subprogramme includes the establishment of "Support and Information Offices" within the premises of Chambers of Commerce, spatially organized and distributed nationwide to ensure complete coverage of the country. These Offices would have the following responsibilities (indicatively, not exhaustively):

- Inform businesses—especially very small and energy-vulnerable enterprises—about available funding opportunities for energy renovation of buildings, systems, and vehicle replacement.

- Provide consultative support regarding eligibility criteria and application procedures for accessing funding.
- Offer information and advisory services regarding relevant national and EU legal and regulatory frameworks.
- Share updates on seminars and related events that enterprises can attend.
- Optionally, organize seminars and training activities directly through the Office for local businesses.

In general, those "Support and Information" Offices could eventually evolve into one-stop-shop services, offering a comprehensive suite of services to enterprises. Each Office will be staffed with specialised personnel as well as administrative and secretarial support.

Given the nationwide presence of the Chambers of Commerce and their representative role within the business community, the immediate benefits from the operation of these Offices are substantial. They will spread awareness of funding opportunities and provide practical support, addressing the urgent needs of the business community. Even more significantly, the Offices—through their affiliation with the Chambers—are expected to contribute decisively to the creation of a "green culture" within the business sector, especially among Small and Medium-Sized Enterprises (SMEs), which represent the vast majority of the country's business fabric.

It is considered important for the Chambers to conduct consultation activities with their member businesses regarding the establishment and operation of these Offices. This will ensure both the acceptance of the initiative by the business community and the immediate commencement of services.

**Subprogramme 2: Local one-stop shops for energy and transport poverty for vulnerable population: Community Centers, along with their branches and mobile units, serve as key hubs for extended one-stop shop-type services.** They operate as complementary structures to the social services of the respective first-level local authorities (municipalities) and are supervised by them. The purpose of the Community Centers is to support municipalities in implementing social protection policies and to develop a local reference point for receiving, serving, and connecting citizens with all social programs and services implemented in their area of operation.

Currently, a total of 276 structures are operating across all 13 regions of the country. These employ professionals from various disciplines, including social workers, psychologists, and legal advisors. In total, approximately 1,598 people, including scientific and support staff, are employed on fixed-term contracts. The proposal is to expand the responsibilities of Community Centers so they act as one-stop shop services for the provision of targeted, accessible, and affordable information, education, awareness, and counselling on cost-effective measures and investments in energy saving.

Beneficiaries of the Community Centers include residents of the areas where the Centers operate. Priority is given to beneficiaries of the Minimum Guaranteed Income

Program, individuals and families living in poverty and social exclusion, the unemployed, children and individuals experiencing exclusion, legally residing migrants, asylum seekers and recipients of international or temporary protection, people with disabilities, Roma communities, and generally all vulnerable population groups as defined in the National Strategy for Social Inclusion.

The purpose of the Community Centers is to function as a local point of reference within the community and to support citizens access all social services available within their area of operation.

The purpose is to expand the responsibilities of the Community Centers to include duties of a one-stop-shop service by providing targeted, accessible, and affordable information, awareness, and counselling regarding cost-effective measures and investments in energy and transport savings.

In total, 59 OSS will be provided in Chambers of Commerce (one OSS per existing Chamber of Commerce) and 138 in Community Centers (based on the number of municipalities). The OSS will be able to support the energy communities, which are vital for the implementation of the SCP plan. The energy communities could range from RES support communities with the aim to decarbonize heating and cooling in the households, with a more prominent role of Citizen Led Renovation initiatives.

**Financial support:** The OSS in community centers is complementary to the action supported by ESF+ "SOCIAL CENTRES" that is funded by regional programs of ESPA 2021-2027, while the "Support and Information Offices" could be funded directly by national funds derived from SCF. Initially, the OSS will operate under the guidance of national and regional authorities, which necessitates financial support from the NSRF. In the second phase, funding could be provided by the Social Climate Fund, particularly to support micro-enterprises. Additionally, this initiative could be integrated into the services offered by their chamber. The total number for the operation of OSS depends on the extra persons that will be needed to be considered as staff to the municipal community offices and the chambers of commerce as well as the needed training. The total national funding for subprogramme 2 can reach up to € 13,420,000, while for subprogramme 1 € 5,310,000.

## 5.2 Transport

### 5.2.1 Financial incentives for the purchase or leasing of electric vehicles and bicycles

**Target group**: Vulnerable transport users, including individuals and households with disposable incomes below the national median, people with disabilities, single parent households and vulnerable transport users living in remote, rural and peri-urban areas, and vulnerable micro-enterprises.

**Objective**: The proposed measure will facilitate the purchase or leasing of zero-emission vehicles and bicycles by vulnerable transport users and micro-enterprises through the implementation of four different sub-programmes.

**Description and challenges addressed:**

**Subprogramme 1: Leasing schemes of electric vehicles for vulnerable transport users:** The first sub-programme foresees the provision of subsidies to vulnerable transport users to lease (through a potential social leasing scheme) electric passenger vehicles. The proposed Social Leasing Scheme aims to address challenges by offering subsidised access to zero-emission vehicles for vulnerable households and individuals who cannot otherwise afford them. Beneficiaries will have the option to lease these vehicles at significantly reduced monthly rates, with the cost gap covered by the Social Climate Fund. The subsidy will cover a significant portion of the monthly lease cost, making clean mobility accessible to those who would otherwise be excluded from the electric vehicle market.

The specification of the subsidy rate will be performed taking into consideration the potential contribution of own funds from the vulnerable transport users maximizing the overall leverage of the overall sub-programme. The potential provision of a higher subsidy rate will be examined in case the electric passenger vehicle will replace a conventional one through a scrappage scheme. Moreover, the potential exclusion of vulnerable transport users using electric passenger vehicles from paying road toll fees will be assessed as a supplementary measure within the framework of the first sub-programme.

**Subprogramme 2: Incentives for clean transport to micro-enterprises:** The second sub-programme intends to provide a combination of financial incentives to vulnerable micro-enterprises to purchase or lease electric light-duty vehicles and heavy-duty vehicles through a scrappage scheme. The incentives provided will include the provision of either a subsidy, or a low-interest loan or a subsidized leasing scheme for a predefined period with flexible contract terms. The replacement of the existing light-duty vehicles and heavy-duty vehicles will be mandatory. Moreover, the potential exclusion of vulnerable micro-enterprises using zero-emission vehicles from paying road toll fees will be assessed as a supplementary measure within the framework of the second sub-programme. Funding can include charging infrastructure and may also offer the option to lease such vehicles. Eligible enterprises also include very small and small enterprises in that provide transportation services (transportation of people or goods). Such companies, especially in rural areas usually operate in cooperatives or individually and have limited access to funding and loans. Another dimension of this subprogram could be the support to purchase or lease green taxis and buses, which will be significantly affected by ETS2.

**Subprogramme 3: Micromobility solutions for vulnerable households and micro-enterprises**: The third sub-programme supports the further penetration of (electric) bicycles, electric scooters and other micro-mobility vehicles through subsidies to households and micro-enterprises (for instance for logistics), which provide transport services, fostering also the further enhancement of modal shift.

For the social leasing scheme, the investment foresees the provision of up to 12,500 vehicles over a four-year period (2027–2031), focusing on rural and peri-urban regions

with high concentrations of transport poverty, adding also 3,000 e-bicyles. Transport intensive micro-enterprises will benefit from 3,000 new electric LDV/HDVs and 2,300 cargo e-bikes.

The lack of targeted measures for reducing fossil fuel consumption and improving energy efficiency can be recognized as the main barrier for the transport sector. Generally, the decarbonisation of the transport sector should be considered as a priority because it currently relies mainly on imported fuels. In that perspective, the aim is to finance the substitution of individual transport fleets (i.e. electric vehicles and charging stations). This will ensure the development of flexible and efficient individual transport and thus optimise accessibility in regions where standard public transport is inefficient or insufficient. One of the main challenges is that the investment is not fully subsidised, meaning that vulnerable transport users are still required to cover part of the costs. For many, even a relatively modest personal contribution can be financially burdensome. As a result, limited public funding, combined with these user contributions, could significantly reduce the number of vulnerable households able to benefit from the investment. This may be mitigated through increased funding, exploring alternative financing models, and prioritising the most effective interventions. Awareness of the programme among target groups may also be low, which could be improved through local outreach and communication via trusted community channels. Lastly, the growing demand for EVs may place additional pressure on the electricity grid. This could be managed by investing in grid modernisation, promoting smart charging, and increasing the use of renewable energy sources.

**Financial support:** The initial budget estimation is around € 284 million including subsidies for EV cars, LDV/HDVs and E-bikes and cargo bikes.

### 5.2.2 Providing incentives to use affordable and accessible public transport

**Target group:** Low-income households and individuals entitled to social benefits with a prioritization in not well-connected regions, rural, peri-urban, mountainous and remote areas.

**Objective:** The proposed measure will primarily promote the modal shift in transport and improve the effectiveness, safety and reliability of public transport facilitating the increased usage both by vulnerable transport users and vulnerable micro-enterprises through the implementation of four different sub-programmes. It targets vulnerable transport users, including transport poor households. There is already a system of reduced fares for this target group in place in large cities, such as Athens and Thessaloniki. The measure refers to the reduction of fare prices for public transport in large to average sized cities.

**Description and challenges addressed**:

**Subprogramme 1: Enhancement and expansion of the public transport infrastructure in urban and rural areas with on demand transport services**: This subprogramme aims to provide accessible, sustainable, and affordable mobility solutions by both

enhancing existing public transport systems and developing new infrastructure, particularly in areas suffering from transport poverty such as rural, mountainous, insular, peripheral, and remote regions of Greece. The initiative combines the modernization of current networks with the strategic development of new services and multimodal solutions, addressing the mobility needs of vulnerable populations and responding to the challenges posed by rising fuel costs and limited access to services.

The first priority is the reinforcement, maintenance, and modernization of existing public transport infrastructure at regional and local levels. This includes the replacement and upgrade of aging bus and train fleets, improving station and stop infrastructure, and increasing the punctuality and reliability of services through actions such as extending operating hours, increasing route frequency, and improving intermodal integration. Investments will also be made in smart public traffic management systems, the construction of dedicated and dynamic bus lanes, and the installation of surveillance systems to support enforcement and improved traffic flow. Special attention will be given to flexible and cost-effective solutions that deliver improvements without requiring major new construction, such as dynamic bus lanes that operate during peak hours and integrate safely with pedestrian and cycling infrastructure.

At the same time, the programme addresses the absence or inadequacy of public transport infrastructure in underserved areas, by supporting the development of new bus and rail lines that improve connectivity between urban centres and remote communities, aligned with current residential and commercial developments. This includes the provision of on-demand public transport services tailored for rural villages, islands, and small mountainous municipalities, where traditional fixed-route systems are often infeasible. By simultaneously improving existing networks and establishing new systems where none currently exist, this integrated subprogramme directly contributes to reducing transport poverty, improving quality of life, and advancing climate and energy transition goals under the Social Climate Plan. It also enables greater social inclusion by supporting elderly residents, low-income households, and seasonal workers in accessing essential services and employment opportunities.

**Subprogramme 2: Affordable use of public transport by vulnerable transport users**: The second sub-programme facilitates the affordable use of public transport infrastructure by vulnerable transport users. The intention is to reduce the cost of transport for the residents of these areas by providing fare discounts through vouchers, dedicated travel cards, or, if possible, free passes for specific groups of residents such as students and elder people. A viable solution to this issue can be also specific transport schemes for specific needs and community preferences. It is also essential to engage with local residents to ensure that services meet their needs and preferences. By combining these strategies, it's possible to create a more robust and accessible transportation network in areas, improving the quality of life for residents and fostering economic development.

The aim is to reduce the cost of using public means of transport with different alternatives such as the provision of fare discounts, the distribution of pre-paid payment options and/or concessionary travel passes and the potential free of charge or discounted parking facilities for vehicles in micro-mobility. Moreover, the implementation of additional measures, such as the development of integrated ticketing systems and the provision of real-time service information, can further enhance the attractiveness and convenience of public transport. Regarding the last sub-programme, for train transport, discounts are applied for children up to 6 years (zero fare), for students up to 26 years after registration (zero fare, a quota of how many zero fare tickets can be issued for each train is set) or a discount of 50% in general, and for pensioners above 62 years (zero fare). For bus transport, discounts depend on the ordering institution. In general, discounts are applied for children up to 6 years (usually zero fare), students up to 26 years (usually a discount of 50%), pensioners above 62 years (50% discount most often). A reduced fare is also applied for people with health disabilities in train and bus transport, including an accompanying person. Compared to the existing system of discounts, this measure is additional for high-school students in the situation of material deprivation and for adults in the situation of material deprivation. We suggest introducing:

- Discount of 100% of fare for students attending primary or high school or other forms of the educational process.
- Discount of 50% for adults (age 18 years and above) and citizens above 15 years of age when not enrolled at an education institution based on the criteria set in the bullet above.

The existing system of discount fares exists only in Athens and Thessaloniki, and it can be promoted to all cities above 50,000 inhabitants, which are often cities with a student and elderly population. This measure will affect citizens in material deprivation by enabling travel via public transport for the selected citizens, so that the basic needs of transport are met.

For expansion of public transport, the target is to develop 150 new on demand services for rural and peri-urban areas for transport vulnerable groups in the regions where there is the highest necessity due to the absence of local transport for residents. For the social fare system, the total envisaged beneficiaries can reach 300,000, which are mainly residents in peri-urban and rural areas with higher transport costs for the daily activities.

**Financial support:** For the first subprogram there can be a grant with 100% support for 15,000,000 for demand responsive transport. For the second subprogram, a discount of 100% of fare for students attending primary or high school or other forms of the educational process and discount of 50% for adults (age 18 years and above) and citizens above 15 years of age when not enrolled at an education institution based on the criteria described above. The total budget can reach 70m €.

### 5.2.3 Creation of active mobility infrastructure (cycle paths, health/walking paths) – Develop micromobility infrastructure by connecting cities with nearby populated areas

**Target group**: Vulnerable transport users

**Objective**: The goal is to create a comprehensive network of active mobility infrastructures, including cycle paths and health/walking paths, aimed at promoting micro-mobility and active transportation options.

**Description and challenges addressed**: The measure aims to promote the efficient and safe use of bicycles and walking as an affordable alternative to car ownership and usage in areas with poor public transport accessibility, implemented through the local administration. The core element is the creation of the required infrastructure for cycling and walking. It serves as a solution for individuals lacking access to public transport or needing a reliable way to connect with the transit system. Measure includes investments in cycling infrastructure and equipment to create functional, comfortable and safe local and regional cycling networks, capable of supporting daily commuting of vulnerable users, in particular in the above-mentioned counties. The measure particularly aims at establishing high-capacity cycling infrastructure connections between peri-urban and urban areas (namely regional centres), thus providing cheap and efficient mobility option for users without a car, with low accessibility to public transport or those especially impacted by ETS2. The measure will fund the construction or improvement of cycling infrastructure, introducing or extending bike sharing systems, introducing or extending bicycle safe storage systems, and the preparation of technical designs that precede construction and equipment purchase. Ultimately, most cities in Greece with higher transport poverty should have an adequate system for e-mobility. Indicatively, a starting period of 280-300km per three years new lanes could end up in 600km in the period of SCF.

**Financial support:** 100% funding rate of a total of € 106,400,000 for 280 km interventions extending proportionally to the next years.

### 5.2.4 Temporary direct income support

We do not advocate for including the temporary income direct support schemes as eligible measures. The main reasoning is that the budget of the proposed measures and investments under the buildings and transport components is already insufficient to cover the entire vulnerable population in Greece. For this reason, an optimal allocation of the budget to the most cost-efficient measures and investments which structurally reduce energy and transport vulnerability should be prioritized over direct income support measures. In addition, the SCF Regulation imposes strict conditions for the use of temporary direct income support, which in practice will render the implementation of direct income support measures impractical and inefficient. In particular, direct income support must be temporary and decrease over the duration of the SCP. This means that direct income support could be provided during the initial

years of the ETS2 when carbon prices are expected to be low (and therefore expected to have a negligible impact on vulnerable groups) and must be phased out during the later years when carbon prices will have increased. In addition, direct income support can only be used to address the additional costs due to ETS2. These might vary significantly between individual households, depending on the type and quantities of fossil fuels they consume. Households that do not consume any fossil fuels would need to be excluded from direct income support. In any case, ETS2 costs will represent only a small part of the fuel costs of vulnerable groups, at least within the duration of the SCP until 2032. Direct income support must also be additional and cannot be a substitute for already existing recurring national expenditure, such as heating subsidies. Finally, direct income support would need to be embedded in structural measures and investments, i.e. the recipients would also need to be targeted by structural measures and investments aimed at effectively reducing their fossil fuel consumption. In the words of the SCF Regulation, direct income support "does not address the root causes of energy poverty and transport poverty", but only its symptoms. For this reason, it cannot be considered as a sustainable solution for mitigating the impact of ETS2 on vulnerable groups in Greece.

## 5.3 Costs and savings of proposed measures

| Title | Number of interventions | Unitary cost (EUR) | Funding rate | Funding (EUR) |
|---|---|---|---|---|
| Energy Efficiency upgrades of residential buildings for vulnerable households | 160,000 (buildings) | 16,000 | 80% | 2,048,000,000 |
| Supporting the installation of energy efficient heating, cooling and domestic hot water production systems in existing residential buildings (Solar Thermal Systems) | 180,000 (appliances) | 850 | 40% | 61,200,000 |
| Supporting the installation of energy efficient heating, cooling and domestic hot water production systems in existing residential buildings (Heat Pump Systems) | 230,000 (appliances) | 5,000 | 80% | 920,000,000 |
| Supporting the installation of energy efficient heating, cooling and domestic hot water production systems in existing residential buildings (Smart thermostats) | 100,000 (appliances) | 400 | 50% | 20,000,000 |
| Construction and renovation of existing public / municipal properties for Social Housing | 3,000 (buildings) | 85,000 | 100% | 255,000,000 |
| Provision of energy-sustainable student residences to vulnerable young people | 11 (buildings) | | 100% | 30,000,000 |
| Renovation of vacant residential private properties with a requirement for long-term lease to vulnerable households and students ("Renovate-Rent") | 25,000 (buildings) | 23,000 | 60% | 345,000,000 |

| | | | | |
|---|---|---|---|---|
| Energy efficiency upgrades and substitution of fossil fuel heating systems in non-residential buildings for micro-enterprises | 10,000 (buildings) | 50,000 | 60% | 300,000,000 |
| Energy support one-stop shop for vulnerable micro-enterprises. | 59 (OSS) | 90,000 | 100% | 5,310,000 |
| Local one-stop shops for energy poverty for vulnerable population, including communication and awareness raising activities for sustainable transport | 138 (OSS) | 90,000 | 100% | 12,420,000 |
| Leasing schemes of electric vehicles for vulnerable transport groups | 12,500 (vehicles) | 50,000 | 40% | 250,000,000 |
| | | | | 0 |
| Incentives for clean transport to micro-enterprises | 3,000 (vehicles) | 50,000 | 40% | 60,000,000 |
| Micromobility solutions for vulnerable households and micro-enterprises | 2,300 (vehicles) | 20,000 | 60% | 27,600,000 |
| Reform for electric vehicle charging infrastructure | 3,000 (vehicles) | 1,800 | 60% | 3,240,000 |
| Enhancement and expansion of the public transport infrastructure in urban and rural areas with on demand transport services | 150 (services) | 100,000 | 100% | 15,000,000 |
| Affordable use of public transport infrastructure by vulnerable transport users | 200,000 (pp) | 140 | 100% | 28,000,000 |
| | 100,000 (pp) | 300 | 100% | 30,000,000 |
| | | | | |
| Creation of active mobility infrastructure (cycle paths, health/walking paths) - Develop micromobility infrastructure by connecting cities with nearby populated areas | 280 (km) | 380,000 | 100% | 106,400,000 |

| Title | Unit | Unitary saving | ktCO2 annual savings |
|---|---|---|---|
| Energy Efficiency upgrades of residential buildings for vulnerable households | toe | 0.42 | 788.5 |
| Supporting the installation of energy efficient heating, cooling and domestic hot water production systems in existing residential buildings (Solar Thermal Systems) | kWh | 1750 | 131.6 |
| Supporting the installation of energy efficient heating, cooling and domestic hot water production systems in existing residential buildings (Heat Pump Systems) | kWh | 6000 | 368.5 |
| Supporting the installation of energy efficient heating, cooling and domestic hot water production systems in existing residential buildings (Smart thermostats) | kWh | 1500 | 37.5 |
| Construction and renovation of existing public / municipal properties for Social Housing | kWh | 7500 | 9.7 |
| Provision of energy-sustainable student residences to vulnerable young people | GWh | 2.2 | 6.8 |

| | | | |
|---|---|---|---|
| Renovation of vacant residential private properties with a requirement for long-term lease to vulnerable households and students (“Renovate-Rent”) | kWh | 7500 | 80.8 |
| Energy efficiency upgrades and substitution of fossil fuel heating systems in non-residential buildings for micro-enterprises | kWh | 15000 | 40.0 |
| Energy support one-stop shop for vulnerable micro-enterprises. | kWh | 440 | 11.2 |
| Local one-stop shops for energy poverty for vulnerable population, including communication and awareness raising activities for sustainable transport | kWh | 440 | 130.4 |
| Leasing schemes of electric vehicles for vulnerable transport groups | kWh | 6300 | 33.9 |
| | | | 0.0 |
| Incentives for clean transport to micro-enterprises | kWh | 10000 | 12.9 |
| Micromobility solutions for vulnerable households and micro-enterprises | kWh | 2500 | 1.5 |
| Enhancement and expansion of the public transport infrastructure in urban and rural areas with on demand transport services | toe | 15000 | 74.0 |
| Affordable use of public transport infrastructure by vulnerable transport users | | | |
| Creation of active mobility infrastructure (cycle paths, health/walking paths) - Develop micromobility infrastructure by connecting cities with nearby populated areas | kWh/km | 58.5 | 0.06 |

# 6 CONCLUSIONS

The implementation of the Emissions Trading System 2 (ETS2) in Greece presents both challenges and opportunities, in particular for vulnerable populations, including low-income households, transport users, and micro-enterprises. While the primary objective of ETS2 is to reduce greenhouse gas emissions by incorporating market-based mechanisms, its socioeconomic consequences, especially on affordability of energy and transport, require appropriate mitigation strategies. In any case, **the SCP will act as a roadmap to support vulnerable households, transport users, and micro-enterprises via the financing of structural measures and investments in energy efficiency and renovation of buildings, clean heating and cooling and integration of renewable energy,** as well as **in zero- and low-emission mobility solutions** that need to adequately target and effectively support the most vulnerable groups. The findings of this report underscore the need for a comprehensive approach to address the price impacts of the ETS2 on vulnerable groups, ensuring that the transition towards a low-carbon economy remains equitable and inclusive.

A key takeaway from this assessment is that, although significant progress has been made during the past decade, **energy poverty remains a pressing issue in Greece**. Despite national efforts to alleviate energy vulnerability through social protection schemes and energy efficiency programs, a significant portion of the population still faces difficulties in maintaining adequate heating and cooling in their homes. The inclusion of buildings and road transport within ETS2 further exacerbates these challenges, as increased fuel costs directly impact household budgets, disproportionately affecting those with lower incomes. The data-driven vulnerability indicators presented in this report highlight the compounded difficulties faced by households that rely on fossil fuels for both residential energy and mobility, effectively demonstrating the importance of appropriate targeting of vulnerable groups

The Social Climate Fund (SCF) offers an important mechanism to counteract the regressive impacts of ETS2. Greece's Social Climate Plan (SCP) must focus **on targeted financial assistance and investments in sustainable solutions to alleviate these challenges.** Priority areas should include energy efficiency upgrades including the replacement of the heating and cooling system, subsidies for vulnerable households, and measures that enhance access to affordable, clean transportation. Investments in public transport infrastructure, incentives for zero-emission vehicle adoption, and financial support for micro-enterprises transitioning to sustainable business models are critical to mitigating the long-term socioeconomic consequences of fossil-fuel dependence in buildings and transport, exacerbated by ETS2. Those activities, as mentioned above, will be funded by the Social Climate Fund and if smartly invested, will be transformed into measures and investments that will adequately target and effectively support the most vulnerable groups. In addition, Greece will be able to

benefit from significant additional resources from the auctioning of emissions allowances under the ETS2. According to an analysis of the CLIMA+ project, the **additional resources from the ETS2 for Greece could amount to around 3.3 billion €** between 2027 and 2032. These revenues could be used for the national contribution to the implementation of the SCP as well as for additional climate and energy investments, in particular those addressing the social impacts of the ETS2, in line with the requirements of the ETS Directive.

Stakeholder engagement has played a crucial role in shaping this report's conclusions, ensuring that diverse perspectives, including those of government agencies, NGOs, research institutions, and the private sector—are incorporated. The insights gathered through consultation events and surveys reveal a consensus on the urgent need to enhance social support schemes while aligning policies with broader climate objectives. These findings reinforce the importance of continuous monitoring and adaptation of policy measures to ensure that no group is left behind in the transition to a decarbonized economy.

Regional disparities further complicate the equitable implementation of ETS2 in Greece. Certain areas, particularly rural, peripheral, mountainous and island regions, exhibit heightened vulnerabilities due to limited access to alternative energy sources and transportation options, both within these regions as well as between these regions. Addressing these disparities requires region-specific interventions, such as enhanced public transportation networks in remote areas and targeted subsidies for energy-efficient home improvements in low-income regions. The **establishment of a national energy poverty observatory serves as a vital tool** in tracking progress and refining policy measures to better address the evolving needs of affected populations.

The study identified that taking the average of the population sample from the HBS, 20.2% of the corresponding households fall under energy poverty. In absolute terms and extrapolating the percentage from the HBS sample to the entire population (4,257,034 households), approximately **860,000 households are considered energy poor**. Based on the NECP, in 2021 were 12.4%, amounting to 513,000 households. In terms of vulnerability indicators for the ETS2, the numbers of vulnerable households from the four first income categories (considered vulnerable as being unable to renovate their building and using fossil fuels for heating, cooking and hot water) are **853,000 (20% of the population)**, while for transport, the number of vulnerable households is **965,600 (about 22.3% of total households).**

In terms of **micro-enterprises**, the study revealed that nearly **25,500 (regarding their inability to renovate their building**, about 2.3% of total micro-enterprises in the ETS2 sectors) and **55,600 (the ones that cannot afford to switch to clean modes of transport/mobility** micro-enterprises, about 7% of micro-enterprises) can be considered as vulnerable. Many of these businesses operate in sectors such as transport, retail, and small-scale manufacturing, where energy-intensive operations leave them highly exposed to the additional costs imposed by ETS2. **Without appropriate financial relief measures, these businesses face potential closures or**

**severe economic strain**. However, there is a significant lack of data and disaggregation per NACE code, which is required in order to better understand the degree of the cost increase in relation to turnover and profit of these micro-enterprises.

The estimated impact on household energy costs varies based on energy source and location. For households using natural gas, **the additional cost burden from ETS2 could reach up in average to €60 annually (for low-income households) and €120 for middle-higher categories, while those relying on oil-based heating could see an increase of approximately €70 per year**. Transport-related energy costs are also projected to rise, with gasoline and diesel expenses increasing by €60–€100 per household annually, adding substantial financial strain on lower-income families.

For micro-enterprises, the annual additional costs vary depending on their fuel dependency. **Businesses using diesel for heavy-duty vehicle transport are projected to incur an extra €2,000–€2,500 annually, while those relying on gasoline or diesel for light-duty vehicles may experience increases ranging from €400 to €500 per year.** These added costs threaten the economic viability of numerous small businesses, particularly in rural and island regions with limited access to alternative means of transport.

The methodology applied in this study provides a robust foundation for assessing the direct and indirect impacts of ETS2. However, continued data collection and refinement of vulnerability indicators will be necessary to ensure policy effectiveness. Expanding access to reliable data sources, improving transparency in energy pricing, and developing adaptive policy frameworks will enhance Greece's capacity to mitigate the negative consequences of carbon pricing on vulnerable groups.

In conclusion, while ETS2 represents a significant step toward achieving the EU's decarbonization goals, its successful implementation in Greece hinges on the integration of social safeguards and targeted mitigation measures. The findings of this report emphasize the **need for a multi-faceted approach that combines financial support, energy efficiency investments, and transportation reforms to protect vulnerable populations**. By leveraging the Social Climate Fund and aligning national policies with EU directives, Greece can foster a just transition that balances environmental sustainability with social equity, ensuring that the shift towards a low-carbon economy does not disproportionately burden its most vulnerable citizens.

# ANNEX – METHODOLOGY FOR CALCULATING ETS2 IMPACTS

This section summarizes the modelling approach used to identify the potential impacts of ETS2 on vulnerable households, transport users and micro-enterprises. The impacts refer primarily to an increase in the total energy costs for these groups as a result of the surcharge to be set on the fuels used in buildings and transport. In the sections below, the analytical steps for these calculations for each sector are presented. The analytical steps for determining the impacts are the following:

1. Determination of the total final energy consumption of all households in Greece by fuel/end-use (and transport) according to the available data on the detailed final energy consumption of households.
2. Estimation of the unitary final energy consumption for an average household per end/use related to the scope of the ETS2 in domestic buildings (i.e. gas and oil) and transport fuels.
3. Calculation of the unitary final energy consumption of an average household in Greece by end/use and fuel, and allocation by income category based on the distribution of household expenditure by type, fuel, and end use, **across all income categories and transport**.
4. **Estimation of the increase in energy prices** for households using the targeted fossil fuels due to the introduction of ETS2 (based on the carbon content of each fuel with the price increase resulting from the ETS2 prices).
5. **Quantification of the expected reduction in consumption for the affected stakeholders,** taking into account both the increase in energy prices and the elasticity of household energy demand.

## Households

Regarding vulnerable households, the methodological approach for modelling the impacts triggered by the introduction of the ETS2 consists of the following steps. The basis of the calculation follows the indicators selected for identifying vulnerable households.

Primarily, we estimate the unitary final energy consumption of the average household for the different end-uses that relate to fossil fuels (space heating, hot water, and cooking) according to the available data on the disaggregated final energy consumption of households as published by Eurostat (2023).

**Table 15. Unitary final energy consumption in Greece per Standard International Energy Product Classification (SIEC) in TJ**

| TJ total | Final consumption - other sectors - households - energy use | Final consumption - other sectors - households - energy use - space heating | Final consumption - other sectors - households - energy use - water heating | Final consumption - other sectors - households - energy use - cooking |
|---|---|---|---|---|
| Total | 157,317 | 83,061 | 25,496 | 10,907 |
| Solid fossil fuels | 1,254 | 1,254 | 0 | 0 |
| Natural gas | 15,251 | 13,756 | 1,399 | 96 |
| Oil and petroleum products | 37,562 | 33,964 | 3,002 | 597 |
| Liquefied petroleum gases | 4,542 | 3,903 | 0 | 639 |
| Other kerosene | 81 | 81 | 0 | 0 |
| Gas oil and diesel oil | 32,940 | 29,965 | 2,975 | 0 |
| Renewables and biofuels | 47,713 | 32,006 | 13,281 | 2,426 |
| Solar thermal | 13,525 | 244 | 13,281 | 0 |
| Ambient heat (heat pumps) | 4,595 | 4,595 | 0 | 0 |
| Primary solid biofuels | 29,593 | 27,167 | 0 | 2,426 |
| Biogases | 0 | 0 | 0 | 0 |
| Electricity | 54,465 | 1,089 | 7,734 | 7,789 |
| Heat | 1,071 | 991 | 80 | 0 |

In the second step, as depicted in Table 15, we calculate the unitary final energy consumption of the average households, which belong to the first four income categories (from the total eight, following the SCF Regulation that refers to low up to

lower middle-income classes), for the different end-uses taking into consideration the energy expenses as declared within the framework of the Household Budget Survey for each income category separately. The calculation is based on the Household Budget Survey (2022)[22], which has monetary values of the consumption per fuel for each income category.

$$FEC_{HHIC} = \frac{FEC_{NG}}{HH_{NG}} X \frac{EE_{HHIC}}{EE_{HHAV}}$$

$FEC_{NG}$ Final natural gas consumption for heating in households

$HH_{NG}$ Number of households using natural gas

$EC_{HHAV}$ Energy expenditure on natural gas in average household

$EC_{HHIC}$ Energy expenditure for natural gas in specific income category

$FEC_{HHIC}$ Energy consumption of natural gas in specific income category

The weighted final energy consumption for each end-use originates from the FEC (see table above), converted from TJ to kWh (multiplied by 277777.77777778) and then attributed to each fuel. This attribution is depicted in HBS 2022 (3.01 Regional classification of households), under the final consumption of each fuel for all households. The weighted unitary final energy consumption for the different end-uses, as will be estimated for the average households that belong to all income categories, will be equal to the unitary final energy consumption, which has been calculated in Step 1, for the case of the average household in Greece. To better demonstrate the weighted average concept, the total use of natural gas and the equivalent percentages per income category are presented. The logic followed is that as SCF refers to the first four income categories (based on the guidance of the EC provided to the contract), we will focus in the next steps only on the consumption of those categories. We consider the impacts only for the first four income categories, where the SCP will be focussing on and considering as ETS2 vulnerable groups.

[22] https://www.statistics.gr/documents/20181/fae98df5-d44a-6a13-a681-75d24561fac4

Table 16. Total use of natural gas

| Euros | Total IC | 1st | 2nd | 3rd | 4th | 5th | 6th | 7th | 8th |
|---|---|---|---|---|---|---|---|---|---|
| Natural gas | 10.96 | 5.26 | 7.65 | 9.41 | 12.45 | 10.77 | 14.13 | 17.04 | 21.55 |
| Weighted average | % | 48% | 70% | 86% | 114% | 98% | 129% | 155% | 197% |

As an example, for space heating, the FEC for each of the four income categories is calculated by multiplying the total FEC per fuel by the weighted average of this fuel per income category (as the final consumption with the respective percentage). The same approach is used for the other end uses.

Table 17. Consumption per fuel type

| FEC - kWh per household | Final consumption - other sectors - households - energy use - space heating | IC1 | IC2 | IC3 | IC4 |
|---|---|---|---|---|---|
| Natural gas | 5,021 | 2,410 | 3,505 | 4,311 | 5,704 |
| Liquified petroleum gases | 3,587 | 4,419 | 3,088 | 3,458 | 2,182 |
| Gas oil and diesel oil | 4,766 | 3,629 | 4,214 | 4,483 | 4,453 |

In the next step, we depart from HBS 2023 (3.03 Surveyed households per income categories) depicting the number of households per income category that use specific fossil fuels for specific services (see for instance Table 18 for heating).

Table 18. Number of households per income category

| | All households | IC1 | IC2 | IC3 | IC4 |
|---|---|---|---|---|---|
| Natural gas | 760,961 | 73,246 | 94,026 | 126,803 | 110,889 |
| Liquefied petroleum gases | 42,428 | 8,980 | 8,171 | 4,800 | 3,704 |
| Gas oil and diesel oil | 1,746,423 | 224,130 | 305,432 | 256,762 | 215,840 |

From these figures, we then apply the percentage of vulnerable households within each income category (based on the income thresholds methodology) to the total

number of households that use each fuel type (as defined in Section 5). For the case of the income threshold of 10,782 euros (Section 3), the number of vulnerable households under ETS2 in the four income categories for all end-uses using fossil fuels is 826,826, as presented in Table 19.

**Table 19. Number of vulnerable households per income category and fuel-type**

| | Vulnerable households | IC1 | IC2 | IC3 | IC4 |
|---|---|---|---|---|---|
| Natural gas | 235,075 | 73,246 | 42,660 | 79,164 | 40,005 |
| Liquefied petroleum gases | 17,020 | 8,980 | 3,707 | 2,997 | 1,336 |
| Oil | 600,782 | 224,130 | 138,575 | 160,298 | 77,868 |

In the next step, we model the increase in energy prices due to the introduction of the ETS2 for households using the related fossil fuels in buildings. The calculation is based on the carbon content of each fuel with the surcharge on the price as a result of the ETS2 prices provided by the EC for each year. With the new prices, we calculate the increased energy cost before and after the ETS2 introduction, as well as the decrease in energy consumption due to the higher price, in line with the elasticity of the energy consumption of the household. Energy demand elasticities are related to the response in energy consumption to the change in energy price, disposable income or any other relevant variable. They generally depend on the types of consumers and their possibility to react, whether the consumption is a necessity in its total quantity and what are the alternative possibilities. This means that if the elasticity is higher, then the final consumed energy is more sensitive to the change in price. By all means, the elasticity values are not the same for each of the used energy carriers. In theory, these values would vary for households of different income quantiles. However, in practice, this kind of data distribution is not available, and we are also avoiding the situation where elasticities of very poor households would derive from the loss of thermal comfort. It is important to note that due to the absence of studies, we assume the same short run elasticity[23] for all income categories and for all fuels. For this study we used a -0.1 elasticity for fossil fuels used in buildings (Temursho, U. & Weitzel, M. (2024)[1] Oeko-Institut (2020)). These calculations take place for both natural gas, heating oil and LPG. Nevertheless, we acknowledge that different elasticities should

[23] The short-run price elasticities applied in the micro modelling are very different from a long-run elasticity that would also capture investment activity by households. The SCF was set up because it is likely that higher-income households can invest and shift away from fossil fuels more easily and thus have a higher long-run CO2 price elasticity.

normally apply for fuels (for instance there was a -0.43 elasticity for natural gas given in a 2012 study (IOBE 2012), but it would require updating with potential new studies).

1. The first step is to calculate energy price increase:

$$\delta P_{Exn} = EF_x \times \delta P_{ETS2(n,n-1)}$$

- $\delta P_{Ex}$ = (Fuel x) energy price increase
- EFx= Fuel x emission factor (kg CO2/kWh)- available data
- $\delta P_{ETS2}$ = ETS2 price increase (€/t CO2) – calculated
- n= year

2. Using baseline energy consumption and price elasticities, final energy consumption for every year is calculated as:

$$FEC_{x,n} = FEC_{x,n-1} \times (1 + \delta P_{Ex} \times \frac{PED}{P_{Ex,n-1}})$$

- $FEC_{D,n}$ = Final energy consumption of fuel x for year n– calculated
- $FEC_{x,n}$ = Final energy consumption of fuel x for year n-1– calculated
- $\delta P_{Ex}$ = (Fuel x) energy price increase
- $P_{Ex}$ = (Fuel x) energy price– calculated
- PED = price elasticity of demand- available data

In terms of costs, the decrease in consumption leads to absolute cost savings following the elasticity range of each fuel. However, these should be translated to additional costs required for the households to retain their energy consumption for their energy needs in every use. There is no technology substitution effect embedded in this analysis, and especially for the lower-income households, this is normal given their inability to finance technologies or investments for structurally reducing their fossil energy consumption. These additional costs must be considered for setting the thresholds in each income category as a form of eligibility for promoting measures in the SCP. In fact, the SCP will act as a roadmap to support vulnerable households, transport users, and micro-enterprises via the financing of structural measures and investments in energy efficiency and renovation of buildings, clean heating and cooling and integration of renewable energy, as well as in zero- and low-emission mobility solutions that need to adequately target and effectively support the most vulnerable groups.

## Transport

Regarding vulnerable transport users, the methodological approach for modelling the impacts triggered by the introduction of the ETS2 consists of the following steps. The basis of the calculation follows the indicators selected for identifying vulnerable transport users and the logic is the same as with the vulnerable households.

The methodological approach for modelling the impacts triggered by the introduction of the ETS2 consists of the following steps. Primarily, we estimate the unitary final energy consumption for the different types of vehicles (gasoline, diesel,

LPG, natural gas) of the average household according to declared distance within the framework of the Household Budget Survey (2022). These estimations are presented in Table 20.

**Table 20. Estimation of the unitary final energy consumption of the average household for the different types of vehicles**

| | Gasoline | Diesel | LPG |
|---|---|---|---|
| kWh per vehicle | 7,050 | 5,398 | 9,293 |

As a second step, we calculate the unitary final energy consumption of the average households, which belong to the different income categories (four out of the eight in total), for the different types of vehicles taking into consideration the energy expenses as declared within the framework of the Household Budget Survey for each income category separately. The weighted unitary final energy consumption for the different types of vehicles, as will be estimated for the households that belong to all income categories, will be equal to the unitary final energy consumption, for the case of the average household. From the HBS (2023), the weighted average is derived as the proportion of the consumption of each income category to the total consumption of fuels for transport for the households (Table 21).

**Table 21. Weighted Average of consumption for each fuel category per income category**

| Euros € | FEC all households | 1st | 2nd | 3rd | 4th | 5th | 6th | 7th | 8th |
|---|---|---|---|---|---|---|---|---|---|
| Diesel oil | 11.02 | 3.46 | 5.41 | 9.79 | 6.26 | 11.3 | 16.29 | 29.36 | 25.24 |
| Weighted average | | 31% | 49% | 89% | 57% | 103% | 148% | 266% | 229% |
| Gasoline | 87.59 | 22.29 | 47.14 | 68.07 | 93.65 | 111.4 | 124.47 | 151.28 | 199.54 |
| Weighted average | | 25% | 54% | 78% | 107% | 127% | 142% | 173% | 228% |
| Other fuels | 2.05 | 0.46 | 1.22 | 1.32 | 2.49 | 3.47 | 3.57 | 2.9 | 2.49 |
| Weighted average | | 22% | 60% | 64% | 121% | 169% | 174% | 141% | 121% |

From the above weights and the final energy consumption, we derive the unitary final energy consumption of the average household in each income category (see Table 22).

**Table 22. Calculation of the unitary final energy consumption of the average household for the different types of vehicles**

| FEC - kWh per vehicle | FEC - other sectors - households - energy use | IC1 | IC2 | IC3 | IC4 |
|---|---|---|---|---|---|
| Gasoline | 7,055 | 1,795 | 3,797 | 5,483 | 7,543 |
| Diesel | 5,244 | 1,646 | 2,574 | 4,658 | 2,979 |
| LPG | 8,689 | 1,950 | 5,171 | 5,595 | 10,553 |

In the next step, we align the number of households with the number of private vehicles, as declared in HBS 2023 – the data is available for all eight categories but we present the first four as a focus of the study on vulnerability.

**Table 23. Alignment of the number of households with the number of private vehicles**

| | Total | IC1 | IC2 | IC3 | IC4 |
|---|---|---|---|---|---|
| Households | 2,951,261 | 197,575 | 383,562 | 468,782 | 420,135 |
| Private vehicle | 3,718,674 | 209,512 | 411,416 | 517,896 | 494,088 |
| Vehicles per household | | 1.06 | 1.07 | 1.10 | 1.18 |

From the HBS 2023, the percentage of private vehicles that use gasoline is 86.1%, diesel 10.5%, and LPG 2.6%. The number of private vehicles is apportioned accordingly following the table above (see Table 23) in totals and per income category (see Table 24).

**Table 24. Number of households per fuel type used**

| Number of households | IC1 | IC2 | IC3 | IC4 |
|---|---|---|---|---|
| Percentage of gasoline | 170,112 | 330,247 | 403,621 | 361,736 |
| Percentage of diesel | 20,745 | 40,274 | 49,222 | 44,114 |
| Percentage of LPG | 5,137 | 9,973 | 12,188 | 10,924 |

In the next step, to estimate the number of vulnerable households in transport (taking into account the inability to purchase a zero-emission car as criterion, we multiply the proportion of the vulnerable households in each income category by the number of households (from the table above).

**Table 25. Vulnerable Households in Transport**

| Vulnerable households | Total | IC1 | IC2 | IC3 | IC4 |
|---|---|---|---|---|---|
| Gasoline | 838,063 | 170,112 | 149,834 | 251,983 | 266,134 |
| Diesel | 102,203 | 20,745 | 18,272 | 30,730 | 32,455 |
| LPG | 25,307 | 5,137 | 4,525 | 7,609 | 8,037 |

To calculate the impact of the ETS2 prices, we follow the same logic as with vulnerable households. Primarily, we model the increase of fuel prices due to the introduction of the ETS2 for the households in transport using the related fossil fuels. The calculation is based on the carbon content of each fuel with the surcharge on the price as a result of the ETS2 prices provided by the EC for each year. With the new prices, we calculate the increased fuel transport cost before and after the ETS2, as well as the decrease in fuel consumption due to the higher price, in line with the elasticity of the fuel consumption in transport. It is important to note that due to the absence of studies, we assume the same short run elasticity[24] for all income categories and for all fuels (-0.1 for residential and -0.2 for transport) (Temursho, U. & Weitzel, M. (2024)[1] Oeko-Institut (2020) and we adapted them based on JRC elasticities).

In terms of costs, the decrease in consumption (based on the elasticity of each fuel) leads to absolute cost savings for each fuel. However, that should be translated into additional costs required for households to cover their needs with the same vehicle use. There is no technology substitution effect embedded in this analysis, especially for households in the lower income category, given their inability to finance technologies or investments for structurally reducing their fossil energy consumption.

## Micro-enterprises

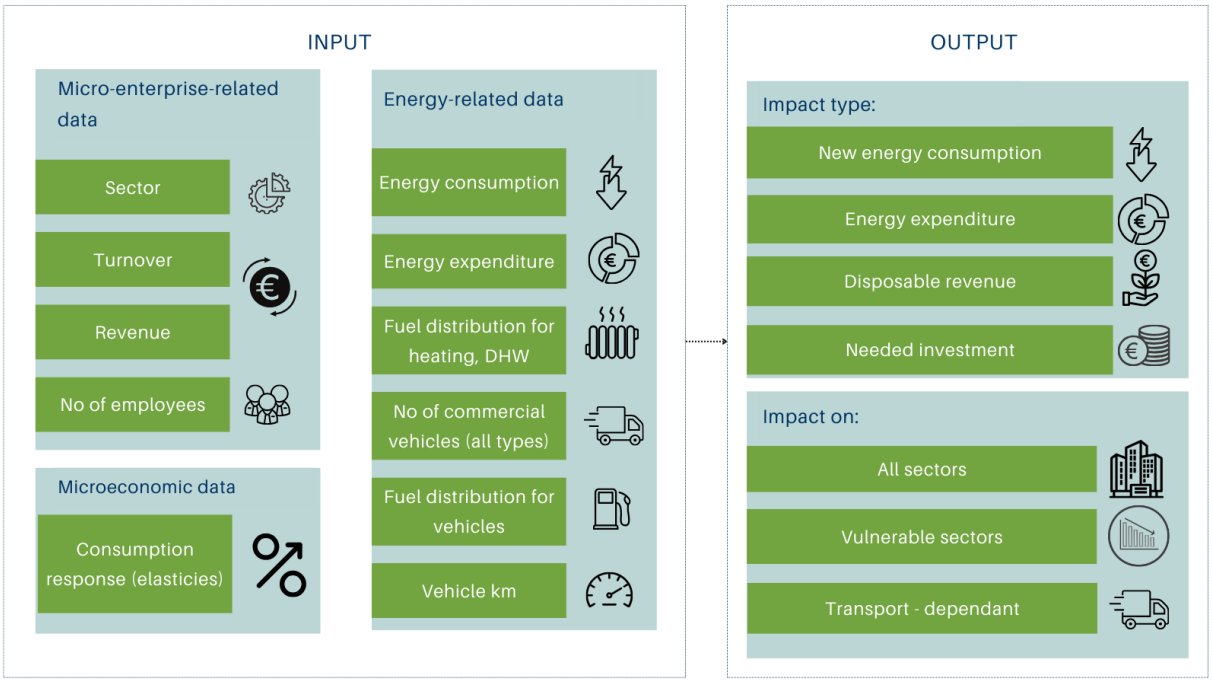
In order to assess the impacts of ETS2 on micro-enterprises, we used IEECP's tool (see Figure 47), which was developed based on work conducted to assess the impact of policies on vulnerable energy consumers. The datasets used in all countries include JRC IDEES 2021[25] data on energy consumption in the service and transport sectors and the EUROSTAT SBS 2022 dataset on companies, complemented with the ORBIS database.

[24] The short-run price elasticities applied in the micro modelling are very different from a long-run elasticity that would also capture investment activity by households. The SCF was set up because it is likely that higher-income households can invest and shift away from fossil fuels more easily and thus have a higher long-run CO2 price elasticity.

[25] Joint Research Centre Data Catalogue - JRC-IDEES-2021 - European Commission

The IDEES database gives us information on energy consumption in buildings of the tertiary sector but does not differentiate between the size of the companies. To be able to evaluate the energy consumption in the sectoral buildings in micro-enterprises, we first calculate the average final consumption per employee and per building (which is then converted to final consumption per micro-enterprise through the ratio of micro-enterprise per employee (1.8 based on the statistics)[26]. Through our methodology we assign investment, and 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.

**Figure 47. Illustration of the modelling and analysis methodology**




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.

[26] From the same source used for the calculations of micro-enterprises in the previous section (Enterprise statistics by size class and NACE)

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.

The estimate 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.

The baseline energy consumption in buildings 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 in Greece 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.

$$FEC_{E(HNG)} = UEC_{E(HNG)} \times Eff$$

- $FEC_E$ = Final energy consumption/employee- calculated
- $UEC_E$ = 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 26. Example of resulting table**

| Natural gas use for space heating, DHW & catering | |
|---|---|
| Energy consumption by end-uses (kWh per employee) | NG |
| Space heating | 3,746 |
| Cooling | N/A |
| 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.

$$FEC_{ME(HNG)} = FEC_{E(HNG)} \times \left[ {no\ of\ employees} \Big/ {(ME)} \right]$$

- $FEC_{ME}$ = Final energy consumption/ME- calculated
- $FEC_{E}$ = Final energy consumption/employee- 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 + LPG for cooking, 3. only oil for heating, with other fuels such as electricity for cooking, 4. LPG for cooking and other fuels such as electricity for heating and DHW[27]. Th fuel mix depends on the country.

- $F_P$ = Percentage of buildings using certain energy carrier for different energy us -available data ($F_{PHeat}$, $F_{PDHW}$, $F_{PCook}$)- available data

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.

[27] Note: some of the fuels used in buildings are ineligible for the purposes of the SCF Regulation

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 own a vehicle;
- Transport – intensive micro-enterprises, which are likely to own several vehicles.

As a first step, the data on vehicle distribution has been categorized 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 (gasoline, diesel, LPG, other) and distinguishing between private ownership and corporate or public fleet usage. This initial classification provides a foundational structure for further analysis, enabling targeted insights into energy consumption patterns and emissions based on ownership and fuel characteristics.

### GROUP1: Average micro-enterprises

Based on the total fleet of commercially owned cars, we estimate the proportion of vehicles 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.

$$FEC_{car} = \frac{D_{car}(km)}{100} * C_{fg}\left(\frac{liter}{100km}\right) * F_{fg}\left(\frac{liter}{100km}\right) * F_{fg}\left(\frac{liter}{100km}\right) * F_{fg}$$

- $FEC_{car}$= Final energy consumption/car- calculated
- $D_{car}$= Average distance/car in a year – available data
- $C_{fg}$ = Fuel consumption per car - available data
- $F_{fg}$ = Fuel factor (kWh/l) - available data
- G= gasoline (used as example)

### GROUP2: Transport-intensive micro-enterprises

We define as transport-intensive micro-enterprises those operating in a 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 (see Table 27).

**Table 27. 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 carrier 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 with 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.

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 28. 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 (Eurostat) |
| Country level information | Example: VAT rates for various fuels in Greece |

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 utilize 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:

3. The first step is to calculate energy price increase:

$$\delta P_{EDn} = EF_D \times \delta P_{ETS2(n,n-1)}$$

- $\delta P_{ED}$ = (Diesel) energy price increase
- $EF_D$= Diesel emission factor (kg $CO_2$/kWh)- available data
- $\delta P_{ETS2}$ = ETS2 price increase (€/t$CO_2$) – calculated
- n= year

4. Using baseline energy consumption and price elasticities, final energy consumption for every year is calculated as:

$$FEC_{D,n} = FEC_{D,n-1} - (1 + \delta P_{ED} \times \frac{PED}{P_{ED,n-1}})$$

- $FEC_{D,n}$ = Final energy consumption of diesel fuel for year n– calculated
- $FEC_{D,n}$ = Final energy consumption of diesel fuel for year n-1– calculated
- $\delta P_{ED}$ = (Diesel) energy price increase– calculated
- $P_{ED}$ = (Diesel) energy price– calculated
- PED = price elasticity of demand- available data

The elasticities for micro-enterprises are drawn from the comparative study of Labandeira et al. (2017)[28]

[28] Labandeira, X., Labeaga, J, Lopez-Otero, X. 2017. A meta-analysis on the price elasticity of energy demand. Energy Policy 102, 549-568 https://doi.org/10.1016/j.enpol.2017.01.002

**Table 29. Price elasticities used in the ETS2 impact scenario**

| Price elasticity for the commercial sector | |
|---|---|
| Natural gas (and LPG) | -0.299 |
| Heating oil | -0.188 |
| Gasoline | -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 ($Additional\ expenditure = FEC_{D,n} \times P_{ED,n}$). 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).