PUTTING THE ETS 2 AND SOCIAL CLIMATE FUND TO WORK

IMPACTS, CONSIDERATIONS, AND OPPORTUNITIES FOR EUROPEAN MEMBER STATES

adelphi
Öko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology
WiseEuropa

POLICY REPORT

Putting the ETS 2 and Social Climate Fund to Work

Impacts Considerations, and Opportunities for European Member States

Authors:

Alexander Eden, Iryna Holovko – adelphi,
Johanna Cludius, Nelly Unger, Victoria Noka, Katja Schumacher – Öko-Institut,
Andreea Vornicu-Chira – Center for the Study of Democracy,
Piotr Gutowski and Krzysztof Głowacki – WiseEuropa

Suggested citation:

Eden et al. 2023 "Putting the ETS 2 and Social Climate Fund to Work: Impacts, Considerations, and Opportunities for European Member States"

This report was produced under the project "Facilitating Socially Just Carbon Pricing in Central and Eastern Europe", a part of the European Climate Initiative (EUKI) of the German Federal Ministry for Economic Affairs and Climate Action (BMWK). The opinions put forward in this policy report are the sole responsibility of the author(s) and do not necessarily reflect the views of the Federal Ministry for Economic Affairs and Climate Action (BMWK).

Supported by:

Federal Ministry for Economic Affairs and Climate Action

European Climate Initiative EUKI

on the basis of a decision by the German Bundestag

EXECUTIVE SUMMARY

In early 2023, landmark legislation was passed by the EU, establishing a new emissions trading system (ETS 2) for the buildings and road transport sectors. As the resulting rise in energy costs is expected to have uneven social impacts, the ETS 2 is paired with the Social Climate Fund, a mechanism to channel a share of revenues from ETS 2 allowances to the most vulnerable.

The ETS 2 carbon price is scheduled from 2027, and the SCF from 2026, setting an ambitious timeline for implementation. Member States need to develop national Social Climate Plans, which entail analysing patterns of vulnerability and developing a set of nationally appropriate measures. This report contributes to the discussion of the ETS 2 and Social Climate Fund implementation by a) examining the rules and processes outlined in the legislation; b) analysing national patterns of impacts and vulnerability; and c) discussing key policy design challenges in the light of international good practice.

- Our modelling shows that **an ETS 2 carbon price of €70 will on average have a limited impact on household expenditures** across Europe. However, without revenue use, on its own the carbon price will be regressive, disproportionately affecting low-income households and on average representing a greater cost burden for lower-income Member States.
- **SCF funding should target the vulnerable**, defined as **households in energy or transport poverty**, as well as those facing **a significant cost burden without the means to adapt**. In the context of each Member State, low incomes, dependence on fossil fuels, and the rural-urban divide, all contribute to national patterns of vulnerability.
- Across a range of indicators, **energy poverty is shown to be more prevalent in lower-income Member States**, while **transport poverty levels are similar across Europe.** These conditions typically affect households in the bottom three income deciles, yet extend into higher deciles in some countries, such as Poland and Romania. All EU Member States are home to some share of vulnerable populations.
- A key challenge of the SCF is **the requirement to target vulnerable groups with green investment and direct income support measures**. Effective targeting poses challenges of data availability, methodology, and feasibility. Work is needed to develop accurate yet practical indicators that can integrate local-level socio-economic data within each Member State, to define eligible groups, locate households, and find channels for delivery.
- Sub-national actors, such as municipalities, will play a central role in implementation. **Stakeholder engagement and communications** are therefore key to building engagement, awareness, support, ownership, trust, and commitment. Policymakers should work collaboratively and engage stakeholders early in the process.
- **A selection of good practice examples can inform policy design**, especially from existing carbon pricing systems in Europe and North America. While no single approach may perfectly fit the SCF framework, many aspects may be drawn on or adapted.

CONTENTS

1. THE ETS 2 AND SOCIAL CLIMATE FUND 1

1.1 Background 1

1.2 The aims of this report 2

1.3 Introducing the ETS 2 and the Social Climate Fund 3

1.3.1 How the ETS 2 will work 4

1.3.2 Why the Social Climate Fund is necessary 6

1.3.3 How the Social Climate Fund will be financed 7

1.3.4 Who should benefit from the Social Climate Fund 9

1.4 A focus on Central and Eastern Europe 10

2 MODELLING THE IMPACTS OF ETS 2 ON EUROPEAN HOUSEHOLDS 12

2.1 Modelling methods and data 13

2.2 The distribution of ETS 2 costs across EU Member States 15

2.3 Exploring vulnerability in the context of the SCF 18

2.3.1 Energy poverty related to household heating costs in the EU 21

2.3.2 Transport poverty related to mobility costs in the EU 22

2.4 Income and remoteness as drivers of vulnerability 23

2.4.1 Vulnerability and income 24

2.4.2 Vulnerability and the urban-rural divide 25

2.5 Impacts within Central and Eastern Europe: the examples of Poland and Romania 27

2.5.1 Impact of the ETS 2 across income deciles in Poland and Romania 28

2.5.2 Energy and transport poverty indicators by income decile in Poland and Romania 30

2.6 Discussion of the modelling results 31

3 POLICY DESIGN OPTIONS, CHALLENGES, AND PRACTICES 33

3.1 Implementing the Social Climate Fund 34

3.1.1 National-level Social Climate Plans 35

3.2 Measures and investments under the Social Climate Fund 37

3.2.1 Green investment measures in the buildings sector 40

3.2.2 Green investment measures in the transport sector 42

3.2.3 Direct income support measures 44

3.2.4 Supporting services for information, advice, and implementation 46

3.3 Key considerations in designing policy measures 47

3.3.1 The challenge of targeting 47

3.3.2 Maintaining the carbon price signal 51

3.3.3 Complementary regulations, legal frameworks, and safeguards 52

3.3.4 Stakeholder engagement and communications 53

3.4 Discussion of policy design options and recommendations 55

4 CONCLUSIONS AND RECOMMENDATIONS 58

5 References 60

6 Annex: Data and Methods 65

TABLE OF FIGURES

Figure 1: Revenues from auctioning ETS 2 allowances split between Member States and the Social Climate Fund 8

Figure 2. CO_2 emissions per capita for heating and road transport of private households in 2019..... 16

Figure 3. Additional expenditure for the ETS 2 at a carbon price of €70/tCO2 17

Figure 4. Share of population identified as energy poor and likely vulnerable to the introduction of a carbon price on emissions from direct home heating in the context of the ETS 2..... 22

Figure 5. Share of population identified as transport poor and therefore likely vulnerable to the introduction of a carbon price on emissions from transport in the context of the ETS 2..... 23

Figure 6. The relationship between vulnerability and income in EU MS for the share of the population identified as energy poor according to the LIHC indicator for heating energy and electricity costs..... 24

Figure 7. The relationship between vulnerability and income in EU MS for the share of the population identified as energy poor according to the LIHC indicator for mobility costs..... 25

Figure 8. The relationship between vulnerability and the urban-rural divide in EU MS for the share of the population identified as energy poor according to the LIHC indicator for heating energy and electricity costs.....26

Figure 9. The relationship between vulnerability and the urban-rural divide in EU MS for the share of the population identified as energy poor according to the LIHC indicator for mobility costs. 27

Figure 10. Additional expenditure for heat and mobility due to the ETS 2 (€70/tCO2) for Polish and Romanian income deciles..... 29

Figure 11. LIHC indicator for heat and transport for income deciles in Poland and Romania..... 30

Figure 12. The scope of potential eligible measures, investments, and supporting activities under the Social Climate Fund 38

1. THE ETS 2 AND SOCIAL CLIMATE FUND

1.1 Background

Europe's new carbon pricing mechanism, the ETS 2, will be a powerful tool to drive the low-carbon transition and meet ambitious climate targets. However, on its own, the carbon price incentive cannot be truly effective, and there is a risk that significant swathes of European society – primarily low-income families and small businesses – may be negatively and unfairly impacted by rising energy costs. This does not come as a surprise, as a carbon price in industrialized countries is often regressive, disproportionally affecting low-income households (Berry, 2019; Haug et al., 2018). The European Commission's impact analysis confirms that this effect can also be expected from the ETS 2; it highlights the risk of negative social impacts, particularly in lower-income Member States (European Commission, 2021b). Moreover, recent EU climate policies come at a time when issues of energy poverty and social vulnerability are high on the political agenda, as countries deal with cost-of-living pressures while also taking measures to improve energy efficiency, affordability, and accessibility. For the former communist bloc countries of Central and Eastern Europe (CEE), these pressures are particularly acute, and the carbon price will likely have an outsized impact.

A socially just low-carbon transition needs more than just an economic incentive. Targeted supporting policies, regulations, and investment opportunities are all required to make the carbon price work as intended so that no one is left behind. It makes sense that carbon price revenues should be used to fund the measures needed to make the policy truly progressive. This is precisely why the ETS 2 is being paired with the Social Climate Fund (SCF), a mechanism to collect and channel revenues to those who may be strongly affected and need support. Together, these policies are an opportunity to transform European society for the better – to achieve a cleaner, healthier, fairer, and more prosperous Europe for all its citizens. But, although the opportunity is there, it will not simply materialize on its own. Effectively implementing the SCF is a considerable challenge that needs to be taken up not just by EU policymakers, but by governments, academics, civil society groups, and diverse stakeholders at all governance levels. All actors must be equipped with the knowledge and tools necessary to understand and effectively address the impacts of the new carbon pricing mechanism.

1.2 The aims of this report

This report aims to provide policymakers, experts, and other stakeholders with an initial basis of knowledge relevant to the implementation of the ETS 2 and the SCF. We firstly seek to unpack the EU policies and related processes to understand the scope, objectives, and obligations of the new mechanisms. We also analyse the potential impact of the carbon price on households across European Member States and illustrate methods to identify patterns of vulnerability in the context of energy and transport poverty. Finally, we aim to discuss the main considerations in designing and implementing policy measures that leverage the SCF to the benefit of vulnerable households, while accelerating efforts to reach the EU's climate targets.

There are two key parts to the SCF implementation challenge:

The first is **understanding and identifying national patterns of vulnerability**. It is important to understand where and to whom funds should be directed, to monitor progress, and to check whether the funds are making a difference where they need to. This information forms the basis of the national Social Climate Plans, and the analyses that we conduct in Section 2 provide a first insight into the kinds of data, indicators, and methods that will be required.

The second is to **design and implement nationally appropriate measures** that can direct the available financing to create lasting benefits for vulnerable groups. The scope, objectives, and types of eligible measures are outlined in the SCF Regulation. The design and implementation of measures, however, will be up to national governments, in coordination with diverse implementing partners at the local level. A broad range of measures and investments, embedded in the national context, will be needed to meet the objectives of the SCF. In Section 3 we delve into the challenge of SCF policy design and implementation.

In this study, our analysis of the economic impacts of ETS 2 focuses primarily on private households, accounting for their spending on home heating and transport. In 2020, there were more than 35 million EU citizens (about 8% of the total EU population) living in energy poverty (European Commission, n.d.–b). The situation is likely to have deteriorated even further since then, aggravated by the energy price crisis, inflation at a historical high, and the Russian invasion of Ukraine. By focusing on household data, we do not explicitly cover micro-enterprises, the other main affected group covered by the SCF. When it comes to designing policy measures, there is broad overlap between households and micro-enterprises – for this reason, additional work should build on this report to investigate how to identify and target of measures towards vulnerable micro-enterprises.

Across Europe, household incomes and expenditures differ greatly, both within individual countries and when comparing Member States. Beyond income effects, socio-economic and cultural factors play a role in determining patterns of vulnerability and developing strategies to protect the most vulnerable. One group of countries with common historical and socio-economic conditions, including typically lower average incomes, are the former communist

states of CEE. For these countries it may be particularly challenging to embark on a low-carbon transition and address its negative social effects. Our analysis therefore seeks to highlight some of the common concerns surrounding the implementation of ETS 2 and the Social Climate Fund in these countries. We investigate the cases of Poland and Romania to develop a country-specific perspective.

The remainder of the report is structured as follows:

- In **Section 1.3,** we provide an overview of the policy frameworks of the ETS 2 and SCF, examining the rules and processes outlined in the legislation.
- In **Section 2** we illustrate the expected impacts of the ETS 2 on households across EU Member States based on incomes and expenditures. We examine existing patterns of energy and transport poverty both across the EU and within the case study countries of Poland and Romania, two countries expected to be among the most affected by the introduction of the ETS 2.
- In **Section 3**, we then provide an overview of considerations and good practice approaches to designing the policy response, in line with the requirements of the SCF and broader international experience.
- **Section 4** concludes and sets forward policy recommendations.

1.3 Introducing the ETS 2 and the Social Climate Fund

The European Green Deal strategy sets out an ambitious goal of making Europe a climate-neutral continent by 2050, signifying deep decarbonization and fundamental changes in the economy in the coming decades. The European Climate Law that entered into force in June 2021 makes the target legally binding and raises the ambition of EU climate policy in the mid-term by increasing the 2030 emission reduction targets from 40% to at least 55% compared to 1990. In view of the EU's increased climate ambition, all sectors now need to accelerate emissions reductions.

The "Fit for 55" legislative package, proposed by the European Commission in summer 2021, introduced legislative changes and new policy measures to deliver on this ambition. As part of the package, the Commission put forward a proposal for the EU Emission Trading System (EU ETS) reform, which among other changes, establishes an emissions trading system in the buildings and road transport sectors (ETS 2) as a key instrument in achieving the EU's targets in these sectors.

According to the Commission's analysis, both the buildings and road transport sectors have a large cost-effective potential to reduce emissions. Currently, the buildings sector is responsible for 12% of EU's total GHG emissions, whereas road transport accounts for 20%. Alongside a range of measures, the ETS 2 aims to increase and harmonise economic incentives

and give more certainty to emission reductions in those sectors. It is intended to complement the Effort Sharing Regulation (ESR) which establishes overall EU-wide and national GHG reduction targets, as well as binding annual 2030 targets for the sectors outside the EU ETS (European Commission, 2021a).

In mid-2022, the EU Parliament and the EU Council tabled their amendments to the Commission's proposal, and a heated negotiation process (trialogue) between the three EU institutions followed. The ETS 2 was one of the most extensively debated elements of the proposed reform, as several countries, political groups in the EU Parliament, and civil society organizations feared the ETS 2 could hit their economies and vulnerable citizens hard. Especially concerned were the Member States with high emissions in buildings and road transport sectors such as France, Hungary, Poland, and Romania. In April 2023, the final text was ultimately approved by both the EU Parliament and the Council based on the provisional agreement reached in December 2022. The new **Directive (EU) 2023/959** was then signed and published in May 2023. It introduces the ETS 2 carbon price in 2027, one year later than initially proposed by the Commission, with a possibility to delay its start for one more year 'in case gas and oil wholesale prices are exceptionally high compared to historical trends'[1].

1.3.1 How the ETS 2 will work

The new ETS 2 is set to cover carbon dioxide (CO_2) emissions from fuel combustion in buildings, road transport and additional sectors, corresponding to industrial activities not covered by the existing EU ETS. In the buildings sector, the ETS 2 covers only emissions from direct fuel combustion, such as from an oil or coal boiler in a private house. It does not concern emissions from electricity used in buildings or heat supplied by district heating plants, as these generators are already covered by the existing EU ETS.

The point of regulation for the new system will be upstream, at the level of fuel suppliers, so the obligation to buy, hold, and surrender certificates will fall on the distributors of coal, natural gas, heating oil, gasoline, and diesel - generally a small number of large firms. This makes the policy administratively feasible, given the huge number of individual emitters using heating and transport fuels (European Parliament and the Council, 2023a). Fuel suppliers will calculate their CO_2 emissions based on the amount of fuel "released for consumption" in the reported year multiplied by a fuel-specific emission factor and will then be obliged to surrender certificates. It is, however, expected that these firms will pass on most or all of their compliance costs to consumers by raising their fuel prices, translating directly to an increase in the prices that households and small businesses will have to pay (Cornago, 2022)[2].

The new system will start operating in 2025 with an obligation for the regulated entities (fuel suppliers) to report their verified emissions starting from 2026[3]. The compliance obligation and the issuance of allowances will then start from 2027, with the first allowances to be

[1] In cases when the average TTF gas price of the six months ending 30 June 2026 is higher than the average TTF gas price in Feb-March 2022, and/or if the average Brent oil price of the six months ending 30 June 2026 is more than twice the average Brent oil price during the five preceding years.

[2] The pass through of carbon costs to households and businesses under the ETS 2 is an expected and desired outcome, as the rise in fossil fuel prices should incentivise a change in consumer behaviour Cornago (2022).

[3] For 2024 regulated entities shall report their historical emissions.

surrendered for 2027 emissions by 31st of May 2028. Consequently, 2027 will be the first year when the ETS 2 carbon price will effectively be felt by consumers.

To minimize the administrative burden, some of the rules of the EU ETS will apply to the ETS 2, such as those regarding allowances circulation, penalties, compliance authorities, and reporting obligations of Member States (Recital (86) of the Directive (EU) 2023/959). To avoid double-coverage, regulated entities subject to a national carbon tax may be exempted from allowance surrender obligations under ETS 2 until the end of 2030, provided that the Commission is timely informed, such carbon tax is effectively paid, and its rate is higher than the average auction clearing price under ETS 2 (Article 30e (3) of the Directive (EU) 2023/959).

The total amount of allowances and cap reduction trajectory for the ETS 2 is to be set in line with the buildings and road transport sectoral target of 42% emissions reduction by 2030 compared to 2005 as per the EU's Effort Sharing Regulation. By January 2025, the Commission will announce the total amount of allowances for 2027 based on sectoral reference emissions for 2005 and 2016-2018. From 2028 onward, the allowance quantity should be determined based on average reported emissions for 2024-2026. The total number of allowances shall decrease linearly every year starting from 2024. At the start of the system, an annual linear reduction factor of 5.10% shall apply, which will then increase to 5.38% from 2028 on. Auctioning will be the sole method of allocation and will start in 2027. The ETS 2 is therefore expected to generate significant auctioning revenue. The revenue shall be distributed between the newly established SCF and Member States. It is important to note that majority of ETS 2 allowances, and hence revenue, will be given to Member States (see Figure 1: Revenues from auctioning ETS 2 allowances split between Member States and the Social Climate Fund), who in turn are obliged to use all those revenues for purposes related to decarbonization and addressing the social impacts of the policy.

As per Article 30d (6) Directive (EU) 2023/959, ETS 2 revenues shall be used by Member States for:

- **Climate and energy-related purposes** as specified for the existing EU ETS with priority given to activities that address social aspect of ETS 2 introduction (also recital (84) of the same directive).
- **Decarbonisation of the heating and cooling of buildings,** or the **reduction of energy used by buildings**, including the integration of renewables.
- **Acceleration of the uptake of zero-emission mobility,** including refuelling and recharging infrastructure, shifting to use of public transport and improve multimodality.
- M**easures to provide financial support** for low-income households in worst-performing buildings and to address the social impacts of the ETS 2 carbon price on low-and middle-income transport users.
- **Co-financing Social Climate Plans** (see Section 3.1.1)

To address concerns about high carbon prices, and the challenge consumers face to quickly adapt their technology and behaviour, two price stability measures are envisaged. These quantity-based measures are intended to mitigate high prices by increasing the supply of allowances to the market. A first measure will trigger the release of an additional 20 million allowances from the Market Stability Reserve (MSR) if the carbon price exceeds EUR 45 for two consecutive months. In place until the end of 2029, this measure can be triggered up to twice a year.[4] A second long-term measure will release further allowances from the MSR if the price reaches more than twice that of the previous 6 months. The MSR will be initially endowed with 600 million allowances. The measures aim to restrict the carbon price to EUR 45 for at least the first few years of the system's operation. However, the measures do not constitute a hard cap, so prices will likely fluctuate and could at times be well above this level. This underlines the importance of implementing measures to shield vulnerable consumers and to reduce their exposure to the carbon price as early as possible.

1.3.2 Why the Social Climate Fund is necessary

A carbon price on fossil fuels used in the buildings and road transport sectors aims to incentivize changes in consumer behaviour and spark low-carbon investments, both private and public. These could include energy efficiency refurbishment of buildings, a switch to renewable heating energy, electric vehicles and their supporting infrastructure, the extension of the public transport network, and more. However, a household's ability to afford such measures, together with non-pricing barriers such as information gaps and split incentives, constrain the potential for the price to incentivise action. Especially poorer households, those already suffering energy poverty, or otherwise vulnerable, may be unable to react to the carbon price. Moreover, it takes time for low-carbon investments to generate energy savings. In the meantime, such households will be burdened by the additional costs, potentially preventing them from meeting their basic needs and thereby exacerbating energy poverty.

To alleviate the negative social impacts of the ETS 2, a dedicated Social Climate Fund (SCF) will be created. In preparing the ETS 2 legislation, the European Commission conducted an impact analysis that highlighted the potential distributional effects of the carbon price (European Commission, 2021b).

> The Commission's proposal then acknowledges the need for the SCF because "the increase in the price of fossil fuels will have significant social and distributional impacts that may disproportionally affect vulnerable households, vulnerable micro-enterprises and vulnerable transport users" (European Commission, 2021a).

The SCF is therefore a key response to this issue. It has been conceived specifically to cushion the impacts of the carbon price on vulnerable groups by providing targeted green investment opportunities to help them reduce fossil fuel use, such as the decarbonization of heating and

[4] The EU Commission may consider allowing to activate the mechanism again if the conditions for it are met in the second half of the period of 12 month after it has been initially triggered.

cooling systems in buildings, and the roll out of zero and low-carbon mobility options. As these investments will take time to be effective, it will also provide direct income support to those most affected during the transition period. In Section 3.1, we take a close look at the scope and objectives of the SCF and outline the process for Member States to develop national **Social Climate Plans** for its implementation.

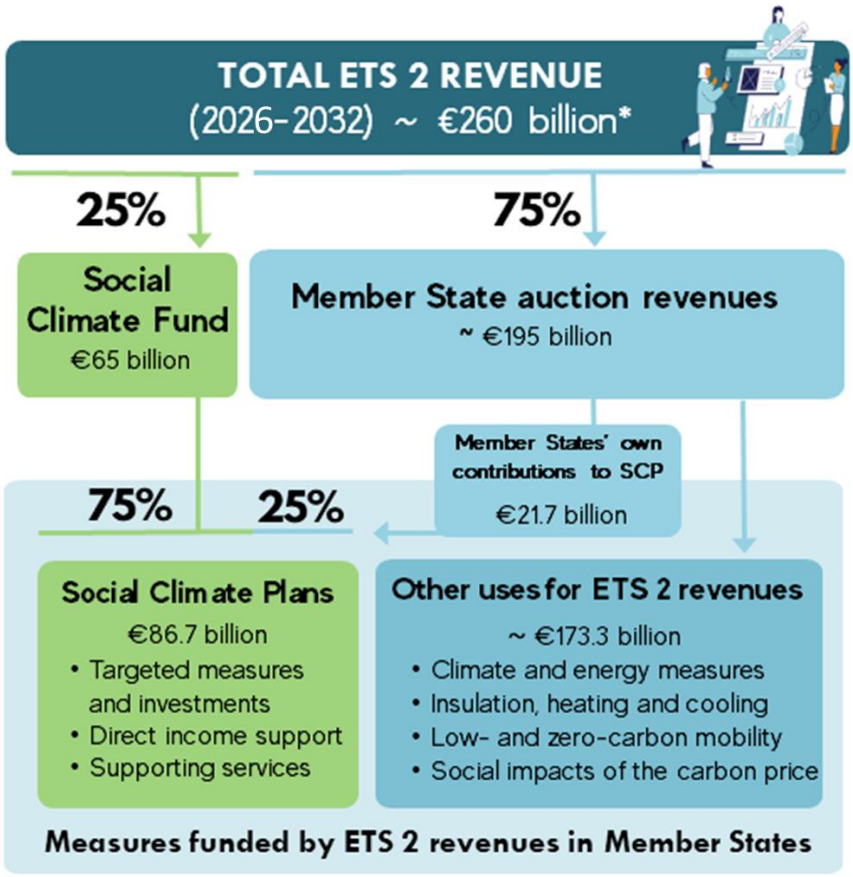
1.3.3 How the Social Climate Fund will be financed

The Social Climate Fund is established by the **Regulation (EU) 2023/955** (the SCF Regulation - European Parliament and the Council, 2023b). It is meant to finance "measures and investments" that shall benefit households, micro-enterprises, and transport users who are 'vulnerable and particularly affected' by the introduction of the ETS 2 carbon price, in particular those in energy and transport poverty (Article 1). The first allocations from the fund will be possible in 2026, one year before the carbon price comes into effect.

The SCF aims to provide a total financial envelope of **€65 billion** over the 2026-2032 period, with the financing based on approx. 25% of the revenues from the auctioning of allowances under ETS 2 and an initial endowment from auctioning of allowances under the EU ETS.[5] This amount shall constitute external assigned revenue of the EU budget (a revenue specifically provided for a certain item of expenditure), and not an EU own resource as initially proposed by the Commission. In addition to the funding Member States will receive from the SCF, they will be required to **co-finance at least 25% of their national Social Climate Plans.** To do so, Member States can use part of the revenues raised from auctioning their allowances under ETS 2 (see Figure 1). Hence, the SCF is set to mobilise approx. **€86.7 billion** in total, specifically for addressing the social impacts of the ETS 2 on vulnerable citizens (European Parliament, 2022).

[5] In the case that the start of the system is delayed by one year to 2028, the total financial envelope will be €54.6 billion.

Figure 1: ***Revenues from auctioning ETS 2 allowances split between Member States and the Social Climate Fund***



**For the period 2026-2032, it is estimated that a total of 5,736 million allowances will be auctioned within the ETS 2. Assuming an average price of EUR 45, total revenues would be EUR 258.6 billion (pg.11, Oeko-Institut 2022)*

The SCF Regulation lists the maximum amount that each Member State can receive from the SCF based on a formula with the following variables: total population, population at risk of poverty living in rural areas, percentage of households at risk of poverty with arrears on their utility bills, GNI per capita measured by the purchasing power standard, overall GHG emissions, and CO_2 emissions from fuel combustion by households. The allocation formula is designed to be progressive, meaning that Member States that are economically less affluent and with higher rates of energy poverty will receive a larger proportion of SCF funds.

Based on this formula, in absolute terms, the greatest beneficiaries of SCF funding will be Poland **(17.60%), France (11.19%), Italy (10.81%), Spain (10.52%), and Romania (9.25%)**. Yet considering their much smaller populations, other CEE countries such as **Czechia (2.4%), Hungary (4.33%), and Slovakia (2.35%)** will also benefit considerably. Together with the ETS 2 revenues that Member States will receive from auctioning allowances, these countries will receive a net positive transfer, greater than the carbon price they will pay under the ETS 2.

1.3.4 Who should benefit from the Social Climate Fund

The national Social Climate Plans of each Member State should detail the measures and investments to be financed. Eligible measures are based on two overarching considerations:

Firstly, measures should be specifically **targeted at vulnerable groups**, as opposed to broad-based measures that benefit the whole population.

- Under the SCF Regulation, **eligible measures should *primarily* target the vulnerable**. Vulnerability is thereby defined in relation to the impact or burden of the ETS 2 carbon price. Specific definitions are outlined for 'vulnerable households', 'vulnerable transport users', and 'vulnerable micro-enterprises'.
- According to the SCF definitions, the vulnerable are those that already experience **energy poverty or transport poverty**, as well as low-income households and micro-enterprises that are **significantly affected by the carbon price and lack the means to adapt their consumption patterns**, for example, by renovating their building, purchasing low-emissions vehicles, or switching to alternative sustainable modes of transport.[6]

Secondly, there are two main types of eligible measures – **green investments** that reduce fossil fuel consumption over the long term and **temporary direct income support** to cushion the price impacts until the green investments are effective.

It is therefore important for policymakers to be able to identify vulnerable populations and justify how the measures outlined in their Social Climate Plans target these groups. In Section 2, we delve into the concept of vulnerability as it relates to the SCF and use a range of indicators to identify and examine vulnerable groups across Europe, with a special focus on CEE countries. In Section 3, we then look closely at the types of targeted measures that are eligible for inclusion in Social Climate Plans and discuss some of the key considerations for designing and implementing these policies.

[6] The regulation is clear in this objective: "[t]he increase in the price for fossil fuels can disproportionally affect vulnerable households, vulnerable micro-enterprises and vulnerable transport users who spend a larger part of their income on energy and transport, who, in certain regions, do not have access to alternative, affordable mobility and transport solutions, and who may lack the financial capacity to invest in the reduction of fossil fuel consumption." (Article 1(11) of the Regulation (EU) 2023/955)

1.4 A focus on Central and Eastern Europe

The region of Central and Eastern Europe (CEE), comprises the group of European Member States formerly of the communist bloc. Despite their rich and diverse cultures, languages, and peoples, their common historical setting means they share several political and socio-economic characteristics and are therefore typically treated as a common region in academic and political analyses. When discussing energy poverty and the potential impact of ETS 2, there are several factors particular to this region.

Low average income is one common factor. According to EU data (see Section 2), average levels of disposable income in CEE countries all fall below the EU median. Only Portugal and Greece also fall in this group. The lowest average income levels are found in Romania, Bulgaria, Hungary, and Poland. Moreover, income inequality is also highest in the former communist countries, such as Bulgaria and Romania (Eurostat, 2021). Beyond income levels, several other factors play a role. Compared with other EU countries, households in the CEE region are often characterised by poor energy efficiency of buildings and appliances, inefficient consumption behaviour, old and run-down building stock, and large rural populations, all of which contribute to energy poverty in the region (Sinea et al., 2021).

Behind these factors, CEE countries carry the burden of their communist past, when massive industrialization programmes were accompanied by large-scale urbanization schemes that relied on the construction of multi-family panel building blocks that were assembled fast but required high amounts of energy for heating (Ministerstwo Rozwoju i Technologii, 2023). The fall of communism also resulted in property transfers, with residents of the multi-family building block apartments becoming owners. For example, Romania has the highest property ownership ratio in the EU (over 90%) (Eurostat, 2022). However, the owners can rarely afford the thermal rehabilitation of their homes necessary for decent living conditions. This translates into the 'owner dilemma' (Sinea et al., 2021, p. 8) when apartments are inhabited by people that cannot afford to manage them. All these factors have further lead to overcrowding, with multiple generations living under the same roof. Eurostat data (2023b) indicates that between 30-40% of the population of Bulgaria, Slovakia, Poland, and Romania lives in overcrowded space. Recent developments in the real estate market have not altered this trend (Główny Urząd Statystyczny, 2023).[7]

While communist urbanization dislocated parts of the population from the countryside to the new cities, in CEE countries a large share of the population still lives in rural areas. Households in rural areas face structural challenges that make them particularly vulnerable to high energy prices: limited access to modern energy and transport services, poor housing conditions (old houses made of low-value natural materials), low incomes, and limited administrative

[7] From 2014 to 2022 the number of new dwellings completed each year in Poland increased significantly, from 143 thousand in 2014 to almost 239 thousand in 2022 (Główny Urząd Statystyczny (2023)).

capacity. These conditions are conducive to 'hidden energy poverty', whereby households are forced to reduce their energy consumption as a coping mechanism (Sinea et al., 2021).

The factors that underpin energy poverty in the region increase the vulnerability to impacts of the ETS 2 carbon price. Furthermore, CEE countries share similar characteristics and challenges when it comes to institutional capacity, which could make the implementation of the SCF and related measures more difficult. The situation shows the high priority for engaging with a range of actors in the CEE region, to build knowledge, awareness, and capacity, so that the SCF can reach its full potential in these countries. National characteristics and patterns need to be considered in designing measures, and barriers to implementation need to be identified and addressed at all levels.

2 MODELLING THE IMPACTS OF ETS 2 ON EUROPEAN HOUSEHOLDS

As noted above, the ETS 2 will put a carbon price on fossil fuels used in the buildings and road transport sectors. While it is the large fuel suppliers that will face compliance obligations, the cost will be passed onto consumers through a rise in the price of coal, oil, and natural gas for home-heating, as well as gasoline and diesel used for transport. As the carbon market will be EU-wide, households in different countries will face approximately the same uniform price per tonne of CO_2 emitted. Impacts will differ greatly depending not just on how much a household uses, but how much they can afford, and what their options are to adapt.

In this section, we therefore seek to use modelling analyses to shed light on the question of which European households are vulnerable to the carbon price and therefore most in need of targeted support from the SCF. We use a range of analyses to identify and examine patterns of household vulnerability to the ETS 2 carbon price, considering factors such as emissions intensity, energy expenditures, energy and transport poverty, income levels, and the rural-urban divide. Our analyses take two main perspectives:

Firstly, we examine how households across Europe are impacted by the additional costs associated with the ETS 2, whether they present more or less of a burden. Our analyses focus on the direct increase in energy-related expenditure that households face for the fossil fuels used in heating and mobility. Our aim is to identify and compare the relative economic burden that these additional costs will place on the average households of different EU Member States.

Secondly, we explore existing patterns of energy and transport poverty that underpin vulnerability to the carbon price and investigate how these patterns interact with household income deciles and geographic location (whether rural or urban).

All else being equal, if a household uses fossil energy to heat their poorly insulated home or needs to drive an old and inefficient car, additional carbon costs from ETS 2 introduction are likely to be high. On the other hand, if the household uses a heat pump or wood stove to heat their home and has the option to cycle or take the train, additional carbon costs will be much lower. However, a given level of carbon cost may be less problematic for one household and very burdensome for the next. In all EU countries, households with higher incomes generally use more (fossil) energy, because they have larger homes and travel more kilometres by car. But does this mean they face a larger burden from the ETS 2? And is the

absolute Euro amount spent on carbon costs a good measure for the burden a country or a household face?

Income level is one key factor in understanding how burdensome the ETS 2 costs will be. Although households with higher incomes tend to spend more on (and consume more) basic goods and services, including home heating and transport, these expenses represent a smaller proportion of their income. Households on lower incomes, on the other hand, often already spend much of their discretionary income on basic necessities and have little leeway for accommodating additional expenses (Görlach et al., 2022). Income also plays a role when it comes to responding to the carbon price by making green investments that help reduce energy consumption, such as home insulation, efficient heating systems, or electric vehicles. Making such investments is more feasible for households with higher discretionary incomes, as they can redirect non-essential spending and are more likely to have savings (Braungardt et al., 2022).

While income is a key factor in determining vulnerability to carbon costs, other factors also play a role. These include high energy needs due to inefficient buildings, for example, as well as barriers to reducing energy consumption, such as not being able to switch to public transport in a rural area. To identify households vulnerable to carbon costs, it is therefore important to look beyond incomes and consider other factors that may make households more exposed to cost increases or less able to respond to them.

At the country level, the same mechanisms apply. The ETS 2 will cover all 27 EU Member States with the same price per tonne of CO_2. Here, average income levels diverge by a factor of nearly 10 between the lowest and highest income countries. A uniform carbon price will mean very different things for an average household in different Member States.

2.1 Modelling methods and data

To gain insights into how the cost burden of ETS 2 will be borne by different socio-economic groups across the EU, we examine a range of factors related to household costs, income, expenditures, geographic location, and energy/transport poverty. Firstly, we calculate the additional costs associated with the ETS 2, based on a given carbon price of €70/tCO_2 and the emissions intensity of the heating and mobility sectors in each country. To get an idea of the burden that these costs entail, we then relate the additional costs to household expenditures - how much households spend on fossil fuels for heating and mobility as a share of their total expenses. This view puts the additional costs related to the carbon price in the context of increasing expenditures that take up a greater share of the household budget.

We then broaden our analysis to examine patterns of vulnerability, looking at the main factors alongside income level that make households vulnerable to rising energy prices. We here investigate several indicators that are typically used to identify and measure energy poverty. By then focusing on one indicator, low-income-high-cost (LIHC), we examine how this measure of vulnerability overlaps with income deciles and population density within each European Member State.

We select Poland and Romania as two case countries for further investigation. Both CEE countries exhibit relatively high carbon intensity in their home heating and mobility sectors, as well as average income levels well below the EU median. In investigating these case countries, we gain a better understanding of how the ETS 2 burden and vulnerabilities relate to the specific country context. Identifying national patterns of vulnerability is a key challenge policymakers face in developing their national Social Climate Plans, as in the end, measures to tackle vulnerabilities must take place at the country level and be tailored to national circumstances and needs.

The modelling analysis has the following structure:

In **Section 2.2** we examine the expected carbon cost burden both in absolute and relative terms, by analysing:

- The emissions intensity of household fossil fuel use in the road transport and buildings sectors per capita across EU Member States.
- The relative cost burden faced by households in different Member States, resulting from a carbon price of €70/tCO_2, as a share of their expenditures.

In **Section 2.3** we look beyond costs and income levels to examine vulnerability to ETS 2 impacts in the context of energy and transport poverty a in EU Member States. We here examine:

- The concepts of energy poverty and vulnerability and how they are framed in the context of the SCF.
- The share of vulnerable households in each Member State according to four typical indicators from the energy poverty literature.

In **Section 2.4**, considering one key indicator (LIHC), we examine the overlap between vulnerable households and income deciles and explore the relationship between vulnerability and the urban-rural divide.

In **Section 2.5** we then delve into the analysis of our two CEE case study countries of Poland and Romania. We investigate the distribution of the burden imposed by the ETS 2 across income groups, as well as the share of vulnerable households in each income group and provide insights into the drivers of this distribution.

Our analysis draws on microdata from Household Budget Surveys both at the EU-wide level and the Polish and Romanian national levels. These surveys provide detailed information on income and expenditures of households. We also use data from the EU Statistics on Income and Living Conditions (EU-SILC), as well as aggregate data on incomes, expenditures and emissions per country compiled by Eurostat. For all these data sources, we use the latest available release (ranging from 2015 to 2021 data) and update information where possible. We calculate ETS 2 costs by assuming a carbon price of €70/tCO_2 - this is higher than the planned €45/tCO_2 trigger for price control intervention, but as noted above, the actual price can at times be expected to go higher than this trigger price.

To be able to compare our results across EU Member States,[8] we arrange countries according to their median income level,[9] ordered from lowest to highest. In 2019, the median equivalised incomes across Europe ranged from €3,854 in Romania to €36,367 in Luxemburg, while the median value is Spain with €15,015. In discussing the results, we refer to those countries with income levels below the EU median as 'lower-income' and countries with income levels above the EU median as 'higher-income'. To note, this arbitrary distinction is only meant to help the discussion in the scope of this paper and should not be used to compare the standard of living of European countries.

It should be noted that the scope of our modelling is restricted to direct household expenses for fossil fuels used for heating the home and for personal transport. We do not assess costs for heating the workplace or for commercial transport, such as used by small businesses and micro-enterprises. Data on household emissions does not cover emissions from district heating, electricity supply, or public transport – emissions from these sources are generally already covered by the EU ETS, meaning a carbon cost is already built into their price and households will not face additional costs from the ETS 2. An exception is fossil-powered public transport, such as diesel buses, the price of which may rise in response to the ETS 2 and therefore indirectly increase costs for households. By focusing on direct cost impacts on households, we also exclude price interactions and inflationary effects. As we have seen from the energy price crisis, rising energy prices can have a flow-on effect on alternatives, for example, as high gas prices also affected the price of wood-fuel (Porojnicu, 2021). While these effects are beyond the scope of our modelling analysis, they are noted in the discussion and case studies where appropriate.

2.2 The distribution of ETS 2 costs across EU Member States

In this section, we explore how the additional costs from the ETS 2 will fall on different Member States. To do so, we first look at the CO_2 emissions intensity of household activities in the buildings and road transport sectors in 2019. Specifically, we look at the emissions that arise from household use of fuels for home heating that will be covered by the ETS 2, i.e., natural gas, heating oil and coal, as well as on fuels used for private transportation, specifically private vehicles.[10]

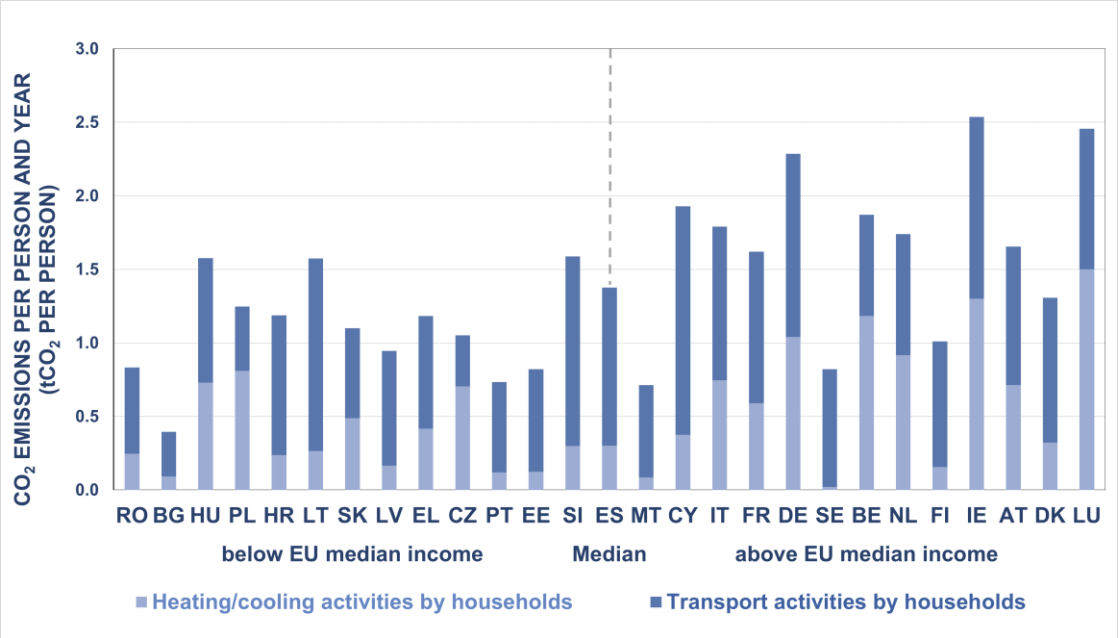
The average CO_2 emissions per capita from these activities are important in determining the ETS 2 cost impacts in absolute terms and comparing them across EU Member States. Figure 2 shows the average annual CO_2 emissions per capita stemming from household fossil fuel use for heating, cooling, and mobility in each country.

[8] List of EU Member States and their abbreviations: Austria (AT) Belgium (BE) Bulgaria (BG) Croatia (HR) Cyprus (CY) Czechia (CZ) Germany (DE) Denmark (DK) Estonia (EE) Finland (FI) France (FR) Greece (EL) Hungary (HU) Italy (IT) Ireland (IE) Latvia (LV) Lithuania (LT) Luxembourg (LU) Malta (MT) Netherlands (NL) Poland (PL)Portugal (PT) Romania (RO) Slovakia (SK) Slovenia (SI) Spain (ES) Sweden (SE)

[9] Median equivalized disposable (net) income per household based on 2019 data is used to this end. Equivalised income as a measure of per capita income takes into account economies of scale at the household level, i.e. that several household members can use one bathroom, one fridge, see also Annex, Section 6.3.

[10] As noted above, we do not include indirect effects through a rise in prices for public transport powered by fossil fuels.

Figure 2. ***CO_2 emissions per capita for heating and road transport of private households in 2019***



Source: Eurostat - Air emissions accounts by NACE Rev. 2 activity [env_ac_ainah_r2]; Population on 1 January [TPS00001]; Mean and median income by household type - EU-SILC and ECHP surveys [ILC_DI04]; see Annex, Section 6.1, Table 6-1

Note: Eurostat provides CO_2 emissions for heating and cooling activities by household. However, this excludes emissions from the production of electricity purchased by households. Therefore, the operation of electric air conditioners is excluded. Similarly, the emissions from transport stem mainly from the operation of private vehicles, but also include operation of private boats or aircraft. See Annex, Section 6.1 for further information.

Note: List of EU Member States and their abbreviations: Austria (AT) Belgium (BE) Bulgaria (BG) Croatia (HR) Cyprus (CY) Czechia (CZ) Germany (DE) Denmark (DK) Estonia (EE) Finland (FI) France (FR) Greece (EL) Hungary (HU) Italy (IT) Ireland (IE) Latvia (LV) Lithuania (LT) Luxembourg (LU) Malta (MT) Netherlands (NL) Poland (PL)Portugal (PT) Romania (RO) Slovakia (SK) Slovenia (SI) Spain (ES) Sweden (SE)

For both the heating and road transport sectors, we observe a large variation in CO_2 emissions per capita between Member States. However, we can see **emissions per capita are generally greater in higher-income countries,** with a few notable exceptions. The highest per capita emissions are found in Belgium, Cyprus, Germany, Ireland, and Luxembourg.

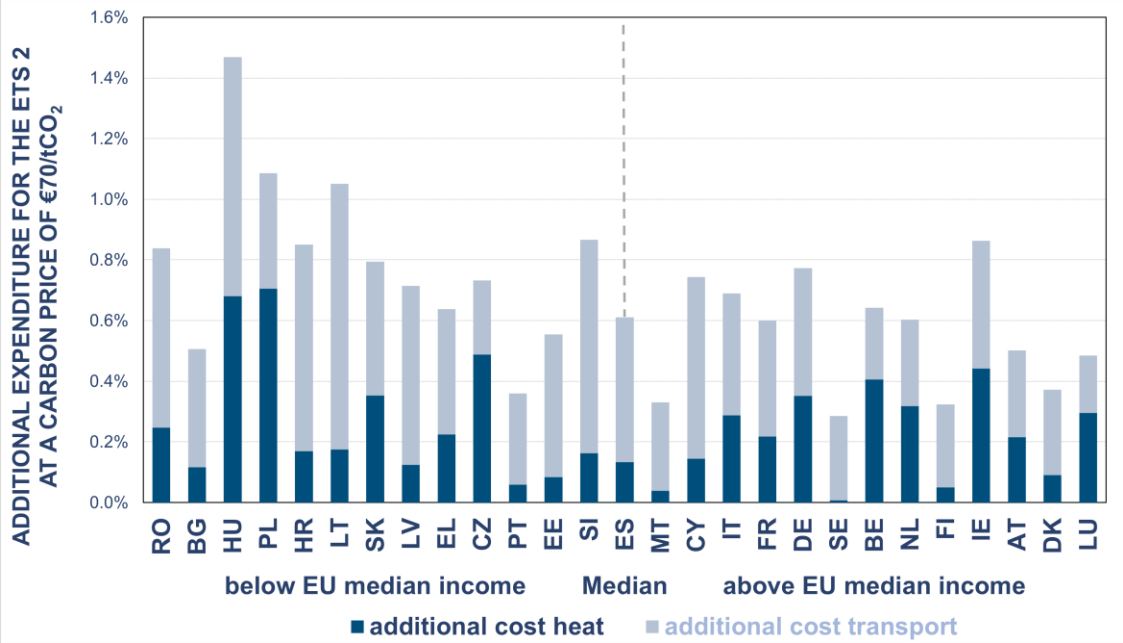
Particularly high per capita emissions from home heating can be seen for Belgium, Czechia, Germany, Hungary, Italy, Ireland, the Netherlands, Luxembourg, and Poland. In all these countries, the share of fossil fuels used in heating is high. Other countries have very low emissions per capita in the buildings sector. This includes countries where heating energy is mostly provided by district heating plants, for example, Bulgaria, Finland, and Sweden, as well as countries with lower heating needs, such as Portugal or Malta. As mentioned in the introduction, district heating plants are already covered by the existing EU ETS and will not incur additional direct costs under the ETS 2. The **per capita emissions in private road transport are at least as high as those of the buildings sector in most countries.** They are particularly high in Cyprus, Germany, Ireland, Lithuania, Slovenia, and Spain.

The absolute emissions per capita, and therefore costs related to the ETS 2, are greatest in those Member States that have a very high emissions intensity in the buildings and road transport sectors. But the relative burden of the ETS 2 will likely be greatest in those countries

with the lowest average incomes. To explore this effect, we next examine additional household expenditures for heat and mobility due to the ETS 2 relative to total expenditures. The additional cost is represented by the fraction of total consumption expenditure that the average household needs to spend due to the introduction of the ETS 2. This measure can be seen in Figure 3, which shows the impact of a carbon price of €70/tCO_2. The relative burden of the ETS 2 carbon price is generally **greater in lower-income member states**. The greatest additional expenditure for heat and mobility are expected for households in Hungary (1.5%), Poland (1.1%), and Lithuania (1.1%).

This analysis shows how **relative household expenditures provide a clearer insight into the carbon price burden than just assessing emissions intensity**. Comparing the two analyses, we see a marked difference between lower- and higher-income Member States; a difference that is particularly striking for CEE countries. Romania, for example, has relatively low per capita emissions (Figure 2) but is amongst the countries most burdened by the ETS 2 carbon price (Figure 3). Poland has average emissions per capita, yet the estimated burden in Poland is the second largest amongst all EU countries.

Figure 3. ***Additional expenditure for the ETS 2 at a carbon price of €70/tCO2***



Source: Own calculations based on Eurostat - Air emissions accounts by NACE Rev. 2 activity [env_ac_ainah_r2]; Final consumption expenditure of households by consumption purpose (COICOP 3 digit) [NAMA_10_CO3_P3__custom_120424]; see Table 6-1

These results correspond to those found in the literature. FEST and FOES (2022), Maj et al. (2021), and Oeko-Institut (2022) also show that average impacts in lower-income Member States are often twice that of higher-income Member States. The impact in the heating sector shows greater variation across Member States than the impact in the transport sector. This is because, as noted above, the impact in the heating sector is particularly low in those countries where heating energy is supplied by district heating plants. The impact in the

transport sector, on the other hand, is more evenly distributed across Member States. Also this result has been noted in the literature (FEST & FOES, 2022).[11]

We have shown that the cost burden of the ETS 2 can be expected to be greater in lower-income Member States, in particular those in the CEE region. Our results indicate that the approach to allocating SCF funding between Member States, which accounts for income-related factors, is justified[12]. It also shows that relative expenditure is a more relevant indicator of the burden imposed by the ETS 2 than emissions per capita. However, when examining the impacts in individual countries, country-specific characteristics in the buildings and transport sectors need to be considered. Furthermore, while lower-income countries face greater relative impacts, all EU Member States host some vulnerable populations, so the implementation of the SCF needs to be urgently pursued across all of Europe.

2.3 Exploring vulnerability in the context of the SCF

We have shown that both emissions intensity and average incomes are important factors in assessing the economic burden of the ETS 2 on households. However, there are many other reasons why a household may be vulnerable to rising energy prices. For instance, if they live close to the poverty line, in a remote area, in a poorly insulated building, or otherwise cannot react to the price signal. We here examine aspects of vulnerability as they relate to the SCF and apply a range of indicators from the energy poverty literature to identify and examine patterns of vulnerability across Europe.

Vulnerability, as it relates to energy and transport poverty, has increasingly been the subject of academic study and debate, and commonly accepted definitions are still being developed (Bouzarovski et al., 2014). Early studies of energy poverty (called fuel poverty in the UK) highlight the role of high cost burdens and provide the basis for current measurements (Boardman, 1991; Isherwood & Hancock, 1979). As the concept garnered attention and was increasingly integrated into EU documentation (Noka & Cludius, 2021; Pye et al., 2015) the need arose for EU-wide definitions and indicators. This cumulated in the EU Energy Poverty Recommendation (2020), which outlines a definition of energy poverty and methods for

[11] Most studies analysing the impact of the ETS 2 do not account for a possible change in household behaviour. In the short term, this should be a good representation of reality, since elasticities in the heat and transport sectors are very low. This means that households will not save a lot of energy due to the introduction of a carbon price in the short term (Feindt et al. (2021); Gore (2022)) calculate a scenario where households adjust their energy consumption and find that this does not change the key findings on the distribution of the impact between Member States and households.

[12] The formula includes factors such as GNI per capita and poverty rates.

measuring it. The SCF Regulation provides definitions of energy and transport poverty that are closely related to this recommendation:

> '**Energy poverty**' means a household's lack of access to essential energy services that underpin a decent standard of living and health, including adequate warmth, cooling, lighting, and energy to power appliances, in the relevant national context, existing social policy and other relevant policies.
>
> '**Transport poverty**' means individuals' and households' inability or difficulty to meet the costs of private or public transport, or their lack of or limited access to transport needed for their access to essential socio-economic services and activities, taking into account the national and spatial context.

As noted in Section 1.3.4, measures financed by the SCF should target 'vulnerable households, transport users, and micro-enterprises'. Key to the SCF definition of vulnerability is that this firstly (but not only) includes households that already experience energy and transport poverty. But while the SCF Regulation provides definitions for energy and transport poverty, it does not determine which indicators should be used to measure these. There is an ongoing discussion within the academic community about establishing and updating suitable indicators. A set of indicators has been established at the EU level for measuring energy poverty, developed through the EU Energy Poverty Observatory (EPOV) (Thomson et al., 2017; UK BEIS, 2020). However, work is ongoing to improve measurements and circumvent limitations in the available data.

The discussion around transport poverty, on the other hand, has not come as far in terms of finding common definitions or indicators. Generally, transport poverty as a concept grew from work on transport exclusion, which focuses on how a lack of access to essential services and availability of transport options leads to social exclusion (Lucas, 2012). While some initial studies have been conducted on transport poverty at the national or local level (Lucas & Martens, 2019; Lucas et al., 2019; Mattioli, 2017; Mattioli et al., 2019) specific indicators for transport poverty are still being explored. Annex 1.) gives and overview of indicators that have been established in the context of the energy poverty debate and some insights from the transport poverty debate. Box 1 outlines the indicators that we use to explore energy and transport poverty, and therefore vulnerability to ETS 2, in the context of this study.

Box 1. ENERGY AND TRANSPORT POVERTY INDICATORS USED IN THE CONTEXT OF THIS STUDY

For the heating sector, we use two self-reported indicators that are collected based on the Statistics on Income and Living Conditions (EU-SILC). A household can answer that they are not able to keep their home as warm as they would like **(inability to keep home warm indicator)** or that they are in arrears on paying their energy bills **(arrears on utility bills indicator).** We further use two expenditure-based indicators calculated using data from the Household Budget Survey (HBS) for both the heating and transport sector (See Annex 6.5 for the variables and steps involved in estimating these indicators for this study):

LOW INCOME HIGH COST (LIHC) INDICATOR has two elements. To qualify as vulnerable, a household has to:

i) spend a larger fraction of their income on energy than the national median and

ii) fall below the poverty line after energy expenses have been paid for.

That is, the household spends relatively more on energy than the average household and the large expenditure on energy puts the household into a situation of energy poverty.

10% THRESHOLD INDICATOR means that a household spends more than 10% of their income on energy. While this indicator has been less popular in the literature on energy poverty in recent years, in our comparison across member states, it is useful as it does not relate to a national median value but uses the same reference value for all member states. (See Annex 6.5 for the variables and steps involved in estimating these indicators for this study).

Using a number of indicators alongside each other is standard in the energy poverty literature. The idea is that these indicators highlight different aspects of energy poverty and using several alongside each other gives a fuller picture of the situation. For example, the self-reported indicator of not being able to keep the home adequately warm reflects a situation where the heating needs of the household are not met, whereas the Low-income high-cost (LIHC) indicator shows that high energy bills put the household in a situation of financial hardship.

More information on the data sources, indicators, and their estimation can be found in the Annex (Sections 6.2, 6.4 and 6.5).

While the SCF Regulation provides definitions of vulnerability and energy/transport poverty, no specific indicators have been established to directly measure vulnerability to the ETS 2. Since energy poverty is one of the main concepts of the SCF definition, we apply four indicators from the energy and transport poverty literature to explore patterns of vulnerability to the ETS 2, as based on household expenditures for heating and transport from the latest available survey.[13] In this context, a household is considered energy or transport poor, and therefore vulnerable to the ETS 2, if it is picked up by one of the indicators.

When using the different indicators for our analysis, we uncovered inconsistencies in the datasets regarding the separation of heating and electricity costs.[14] We therefore use the

[13] Note that the latest available HBS data is from 2015, i.e., pre-energy crisis. It is likely that applying today's prices would mean that an even larger fraction of the population is picked up as energy or transport poor by the LIHC and 10% indicators. In that sense, our analysis is likely to present a lower bound to the levels of energy and transport poverty.

[14] The self-reported indicator 'inability to keep the home warm' from the EU-SILC refers directly to heating costs, while the self-reported indictor 'arrears on utility bills' and the two expenditure-based indicators based on the HBS also include the electricity expenditure of a household. As our analysis is focused on the ETS-2 and associated carbon cost, it would be desirable to only look at heating expenditure of a household related to natural gas, heating oil, and coal. Due to poor data quality, however, such a disaggregation is only possible for a few Member States.

combined household expenditure for all heating fuels and electricity used for appliances to estimate the energy poverty indicators. This corresponds to the EPOV definitions of energy poverty. Due to data limitations, our indicators also include expenditures for district heating. The transport expenses used when estimating transport poverty include household expenditure for fuels and lubricants for personal vehicles, as well as for transport services like public transport or taxis.

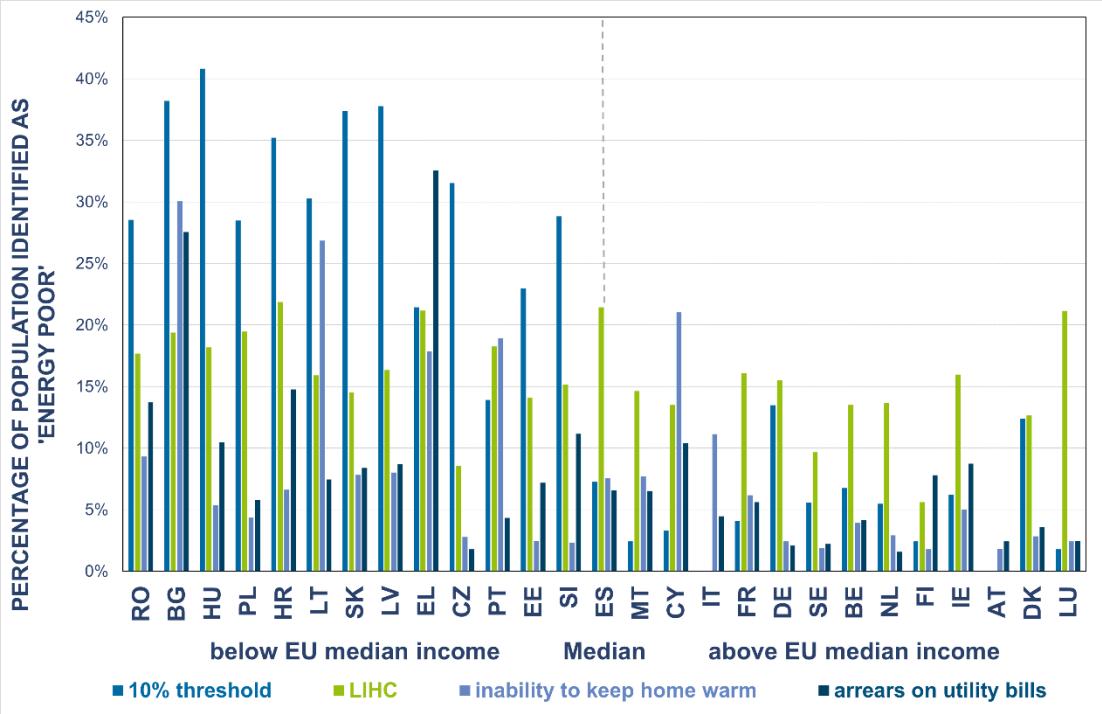
As noted above, the indicators that are available today, using the EU-SILC and HBS data, cannot capture all aspects of vulnerability mentioned in the SCF legislation. For example, neither the availability or accessibility of public transport, nor the lack of investment opportunities into low-carbon technology can be addressed with these indicators. Further effort should therefore be put into comprehensively translating the definitions of energy and transport poverty into indicators and collecting the relevant data.

2.3.1 Energy poverty related to household heating costs in the EU

In this section, we use a range of indicators to explore energy poverty, and therefore vulnerability to ETS 2, in the context of home heating expenditures. Figure 4 presents the share of the population that is classified as energy poor in each Member State, according to four indicators. In general, the share of energy poor and therefore vulnerable persons is greater in lower-income countries. We also observe that the share of the population identified as energy poor varies strongly across the four indicators and, partly, across the Member States. This variation stems from the fact that each indicator highlights a different aspect of vulnerability, and these aspects vary from one country to another.

The 10% threshold-indicator, for example, reflects high expenditures for heating and electricity compared to overall expenditures of the household. In many lower-income countries, 30% to 40% of households spend at least this much on heating and electricity, whereas in most higher-income countries, the share is below 10%. The LIHC-indicator, on the other hand, is more stable between Member States. This indicator goes a step further than the 10% threshold to examine not only whether heating energy and electricity costs take up a large share of expenditures, but also whether a household falls below the poverty line after paying their bills. The share of households thus identified as energy poor lies between 15% and 22% in lower-income countries and reaches 15% in several higher-income countries.

Figure 4. ***Share of population identified as 'energy poor' and likely vulnerable to the introduction of a carbon price on emissions from direct home heating in the context of the ETS 2***



Source: Own calculation based on Oeko-Institut's SEEK-EU micromodel (cf. Annex, Section 6.2) using EU HBS data (2015) for the 10% threshold indicator and the LIHC indicator and EU SILC data (2019) for the indicator looking at the inability to keep the home warm and the indicator looking at arrears on utility bills; HBS data missing for Italy and Austria; Vulnerability displayed as share of persons in total population.

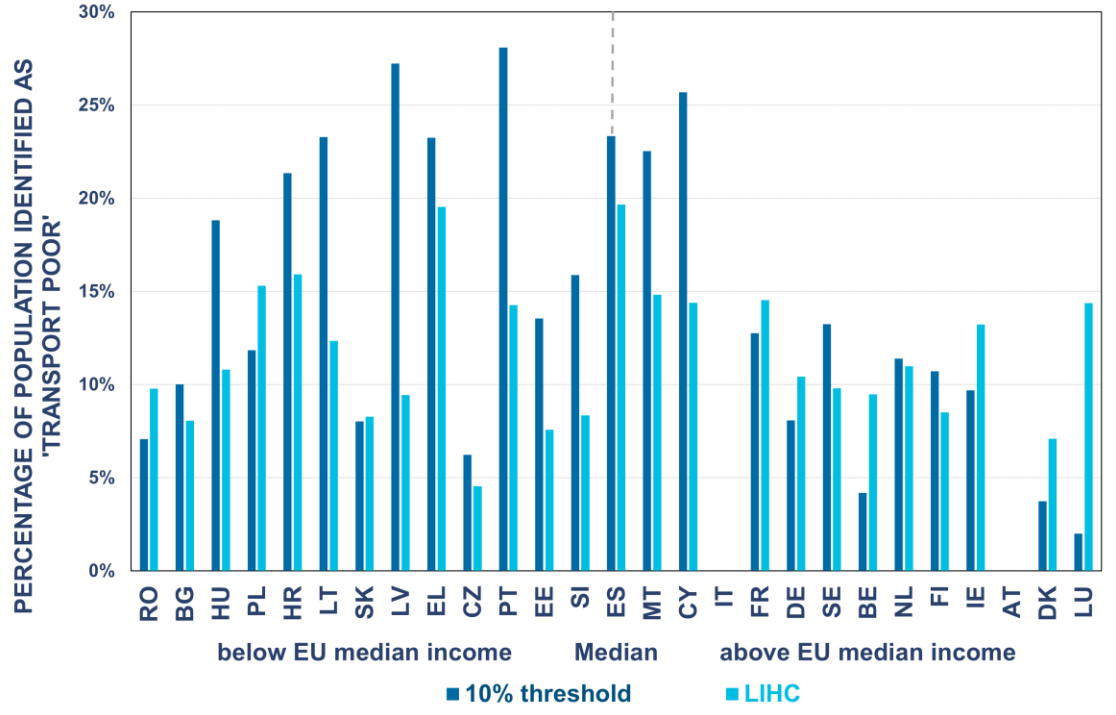
The self-reported indicator 'inability to keep the home warm' aims at capturing whether the heating needs of a household can be met. A particularly large share of the population report that they cannot keep their homes warm in Bulgaria, Cyprus, Greece, Lithuania, and Portugal. The other self-reported indicator, 'arrears on utility bills', highlights situations where a household reports that they do not have the means to pay for the energy they use. This is often the case in Bulgaria and Greece (28% and 33% of households, respectively).

2.3.2 Transport poverty related to mobility costs in the EU

When examining levels of transport poverty across the EU, we use two standard indicators, 10% threshold and LIHC, as they relate to household expenditures for personal transport. In Figure 5, the 10% threshold indicator shows that in most Member States, between 10% and 25% of the population spends at least 10% of their income on transport fuels and services. In Latvia, Portugal, and Cyprus the share of the 'transport poor' population is greatest, exceeding 25%. According to the LIHC indicator, high costs for transport fuels and services are an excessive burden for between 5% and 15% of the population in most Member States. At more than 15%, the share of transport poor according to the LIHC indicator is highest in Croatia, Poland, Greece, and Spain. Compared to the same indicators measuring heating costs (see Section 2.3.1), the share of the population classified as transport poor is more consistent

across Member States and we see less of a difference between lower- and higher-income countries.

Figure 5. ***Share of population identified as 'transport poor' and therefore likely vulnerable to the introduction of a carbon price on emissions from personal transport in the context of ETS 2***



Source: Own calculation based on Oeko-Institut's SEEK-EU micromodel (cf. Annex, Section 6.2) using EU HBS data (2015); HBS data missing for Italy and Austria; Vulnerability displayed as share of persons in total population.

2.4 Income and remoteness as drivers of vulnerability

In the following sections, we examine two potential drivers of energy and transport poverty in EU Member States: household income level and the urban-rural divide. Both factors are highlighted in the SCF definitions of vulnerability (Section 1.3.4). It is therefore useful to explore the overlap between vulnerability, income, and location. We firstly examine how vulnerability is distributed across income deciles, to see whether energy and transport poverty is restricted to the poorest members of society, or whether wealthier households are also affected. We then examine how vulnerability is distributed across rural and urban areas based on population density, to see whether households in energy and transport poverty are more likely to be found in the city or the countryside. This information can help countries identify patterns of vulnerability and design appropriate targeted policies under their Social Climate Plans (cf. Section 3.3.1).

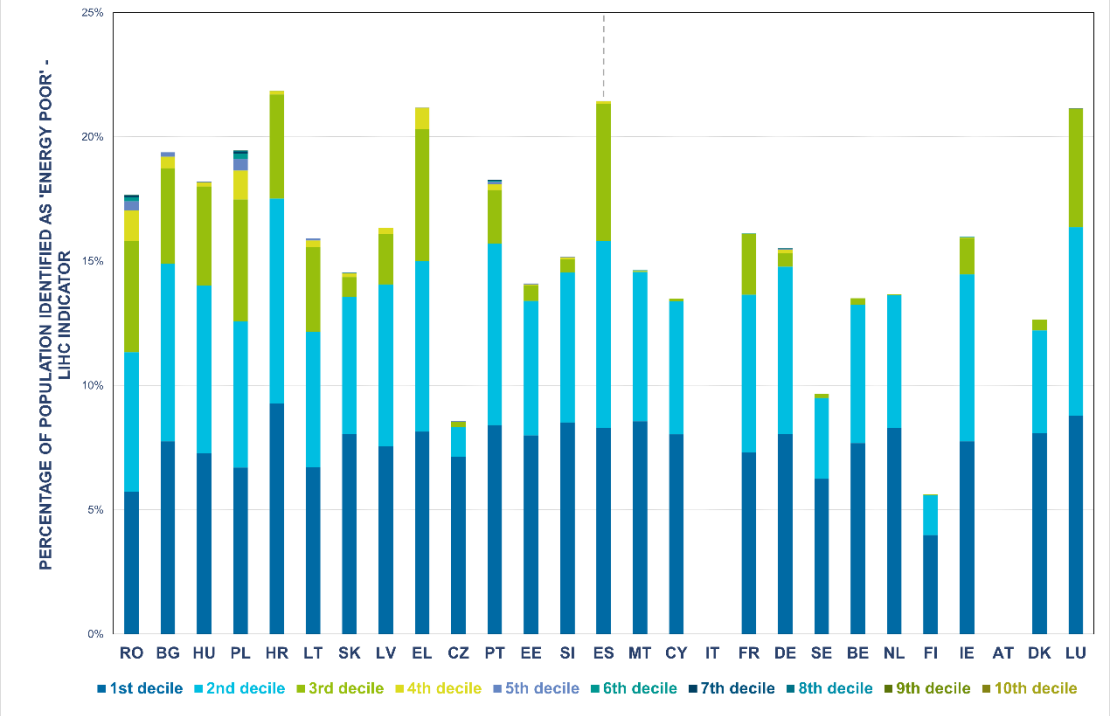
For the analyses, we take the share of the population classified as vulnerable according to the LIHC indicator and examine how this indicator overlaps with a household's income decile and the population density of their neighbourhood. We consider the LIHC indicator suitable for

these analyses, as it reflects both household income and high energy expenditures, in relation to the national poverty line, describing a situation that would be exacerbated by a carbon price.

2.4.1 Vulnerability and income

We here examine the income levels of households classified as 'energy poor' and 'transport poor'. Figure 6 shows the distribution across income deciles[15] of those households that are identified as energy poor according to the LIHC indicator. It becomes clear that across Europe, households that face excessive costs from heating energy and electricity mainly belong to the bottom 20% of the income distribution (the 1st and 2nd decile). However, this tends to extend to the 3rd income decile in lower-income countries. In a few countries, most notably Poland and Romania, energy poverty even extends into higher deciles. A similar distribution can be seen for the LIHC indicator in the transport sector (Figure 7). The 'transport poor' tend to belong to the 1st and 2nd income deciles, extending into the 3rd decile more often in lower-income countries.

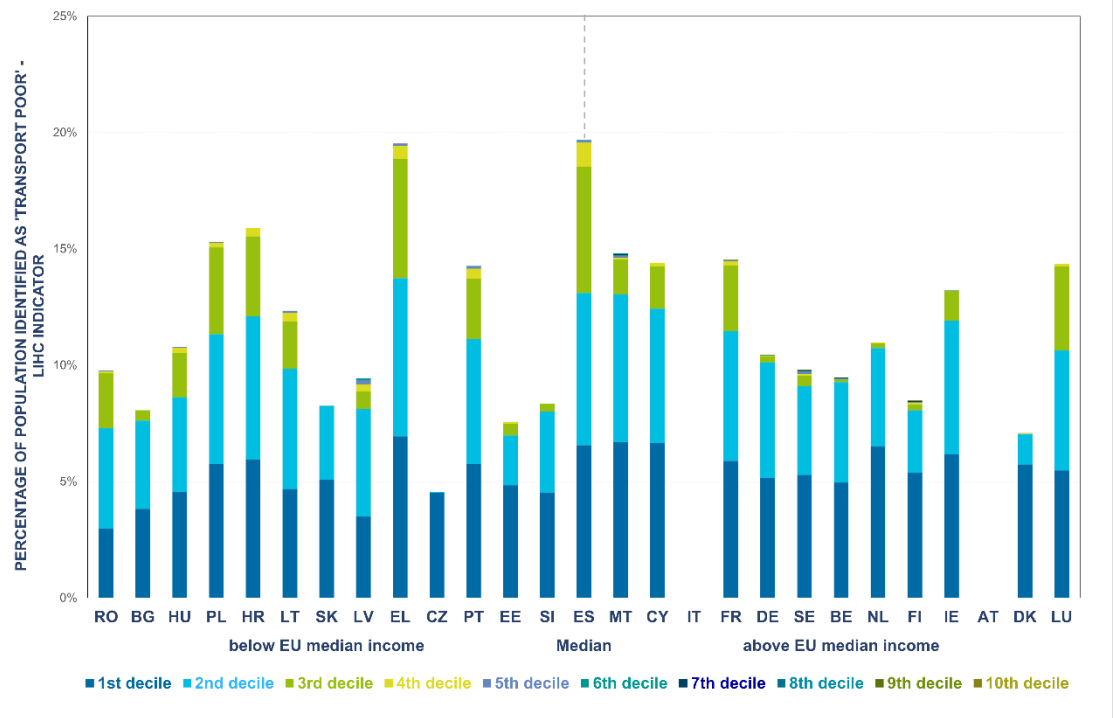
Figure 6. ***The relationship between vulnerability and income in EU MS for the share of the population identified as 'energy poor' according to the LIHC indicator for heating energy and electricity costs.***



Source: Own calculation based on Oeko-Institut's SEEK-EU micromodel (cf. Annex, Section 6.2) using EU HBS data (2015); Data missing for Italy and Austria; Vulnerability measured using the Low Income – High Cost (LIHC) Indicator displayed as share of persons in total population; Income deciles are based on net equivalised incomes; same number of persons in each decile.

[15] The income deciles are derived according to the method explained in Annex, Section 6.3. They divide households into 10 equally sized income groups that take into account household composition and potential economies of scale at the household level (e.g. several household members can use the same kitchen).

Figure 7. ***The relationship between vulnerability and income in EU MS for the share of the population identified as 'transport poor' according to the LIHC indicator for mobility costs.***



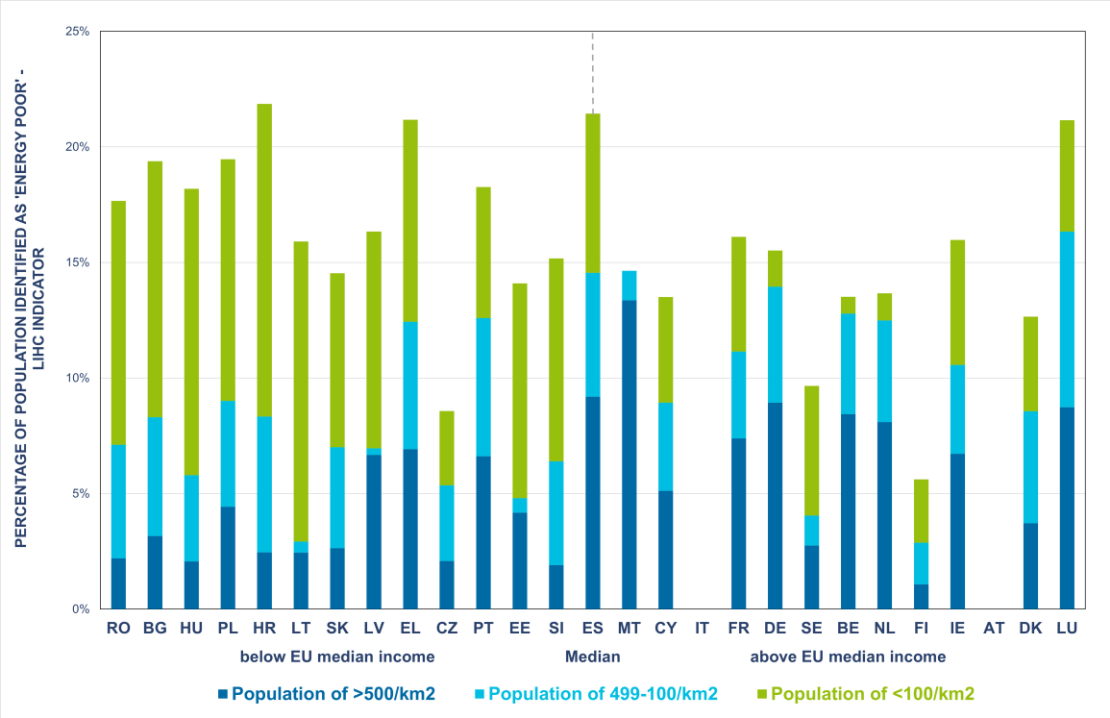
Source: Own calculation based on Oeko-Institut's SEEK-EU micromodel (cf. Annex, Section 6.2) using EU HBS data (2015); Data missing for Italy and Austria; Vulnerability measured using the Low Income – High Cost (LIHC) Indicator displayed as share of persons in total population; Income deciles are based on net equivalised incomes; same number of persons in each decile.

2.4.2 Vulnerability and the urban-rural divide

Another important driver of energy and transport poverty is the location of the home along the urban-rural divide. Information on the overlap between vulnerability and the place of residence is also important if policies are to be targeted to certain areas (cf. Section 3.3). Households in rural areas tend to have much higher energy consumption than those in urban areas (Gore, 2022). For one, their consumption of transport fuels is typically higher, as they live more remotely with poorer access to public transport. Furthermore, rural households generally also use more energy for heating, as their houses tend to be bigger and more exposed (Feng et al., 2010).

Figure 8 uses population density as a proxy for the degree of urbanization of the area where the household is located. Again, we use the LIHC indicator to identify the share of energy and transport poor persons in each country. We then break down this group according to three levels of population density, urban (>500 persons/km^2), semi-urban (100-499 persons/km^2), and rural (<99 persons/km^2). We find that in lower-income countries people living in rural areas are more likely to qualify as energy poor compared to those living in urban areas. This is not always the case for higher-income countries.

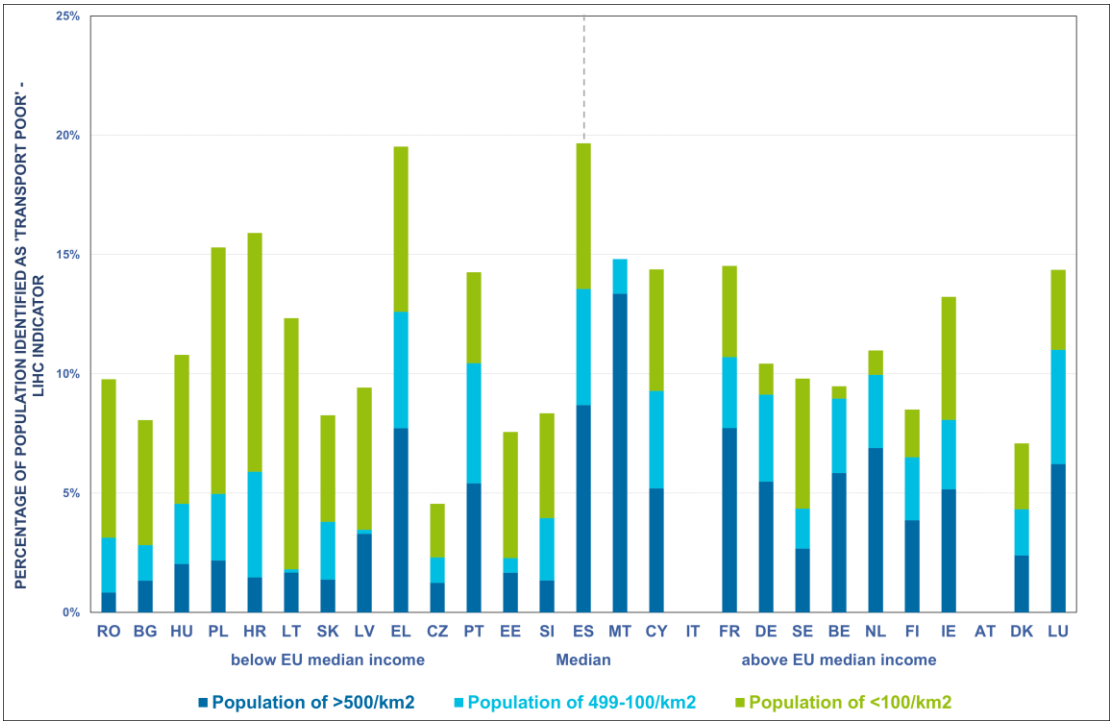
Figure 8. ***The relationship between vulnerability and the urban-rural divide in EU MS for the share of the population identified as 'energy poor' according to the LIHC indicator for heating energy and electricity costs.***



Source: Own calculation based on Oeko-Institut's SEEK-EU micromodel (cf. Annex, Section 6.2) using EU HBS data (2015); Data missing for Italy and Austria; Vulnerability measured using the Low Income – High Cost (LIHC-heating) Indicator displayed as share of persons in total population; Regional characteristics inside vulnerable groups displayed for each EU member state.

We find similar results for the transport sector in Figure 9. In lower-income countries, households that are identified as transport poor according to the LIHC indicator are more likely to live in rural areas. In higher-income countries, on the other hand, it is often households in urban areas that are identified as transport poor.

Figure 9. ***The relationship between vulnerability and the urban-rural divide in EU MS for the share of the population identified as 'transport poor' according to the LIHC indicator for mobility costs.***



Source: Own calculation based on Oeko-Institut's SEEK-EU micromodel (cf. Annex, Section 6.2) using EU HBS data (2015); Data missing for Italy and Austria; Vulnerability measured using the Low Income – High Cost Indicator (LIHC- transport) displayed as share of persons in total population; Regional characteristics inside vulnerable groups displayed for each EU member state.

2.5 Impacts within Central and Eastern Europe: the examples of Poland and Romania

The previous chapters have shown that lower-income Member States will experience a higher impact of the ETS 2 on average. They also generally have a higher share of the population that classifies as energy or transport poor and therefore vulnerable to the introduction of the ETS 2. As discussed in Section 1.4, the Central and Eastern European (CEE) Member States of the EU are typically lower-income countries with additional structural challenges underpinning vulnerability to rising energy costs. These include factors such as, large rural populations, poorly insulated housing stock, and barriers to green investment.

Based on the calculations using EU-level data above, the average additional household expenditure resulting from an ETS 2 price of €70/tCO_2 ranges from 0.7% to 1.5% for households in CEE Member States, while for most other Member States additional costs will stay below 0.7% (Section 2.2). As an example of vulnerability, in CEE countries often 30-40% of households spend more than 10% of their income on energy, while in higher-income countries this share mostly stays below 10% (Section 2.3.1). Our analyses show that CEE

countries will face a much higher burden from the ETS 2 introduction, which risks exacerbating an already significant energy poverty issue.

CEE countries therefore need special attention when assessing the potential impacts of the ETS 2 carbon price and designing nationally appropriate measures to deal with them. This is reflected in the fact that CEE countries are allocated a higher share of SCF funding than other Member States.

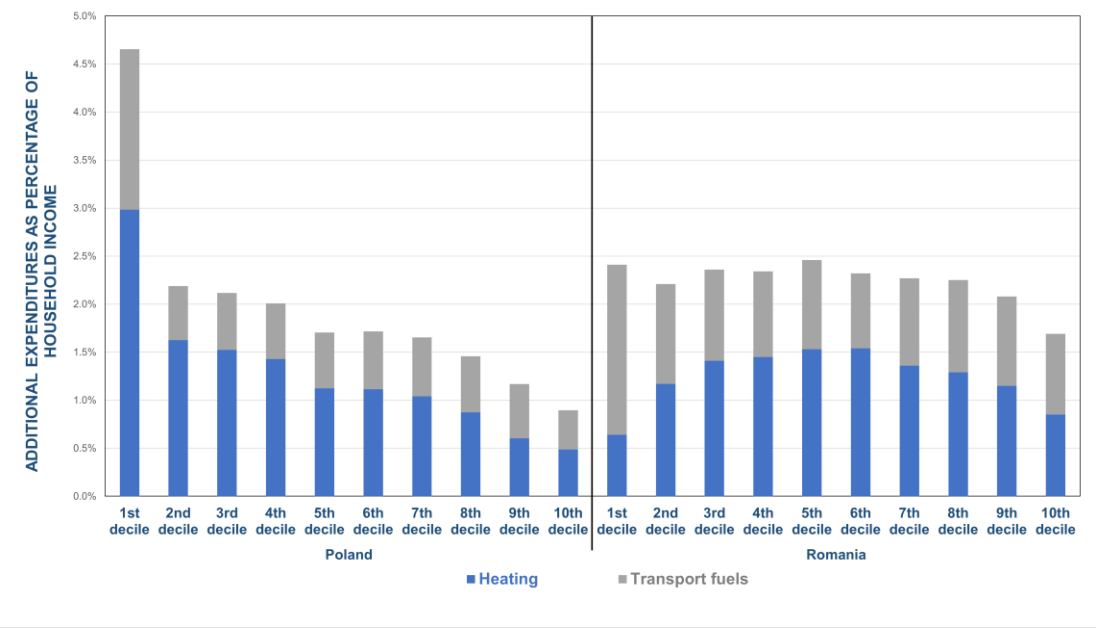
To illustrate the situation in the CEE region and highlight the need to examine the national context, we here delve into the cases of Poland and Romania. Poland is the country with the second-highest estimated additional burden for the average household (Section 2.2), while Romania is one of the countries with the lowest income levels in the EU (Section 2.1). In the following, we first look at the projected impact of the ETS 2 carbon price in Romania and Poland, and then examine energy and transport poverty indicators as distributed across income deciles within each country. To note, these country-specific analyses will be extended in the upcoming 'Country Reports' for Poland and Romania, whose publication will follow shortly after this report.

2.5.1 Impact of the ETS 2 across income deciles in Poland and Romania

Looking at the additional expenses associated with the ETS 2 carbon price in Poland and Romania, we see significant impacts can be expected for the poorest sections of society. Figure 10 shows that, in fact, the poorest 10% of the population in Poland are expected to face additional costs in the order of 5% of their incomes under an ETS 2 carbon price of €70/tCO_2. In the second to fourth deciles, the additional costs equal about 2% of available income, declining to below 2% for the rest of the population. In Romania, the expected ETS 2 costs are distributed more evenly across income deciles. The costs equal about 2.5% of available income in the lowest eight income deciles, and only declines in the top two deciles of the population. [16]

[16] For Romania, the impact estimated using data from the national Household Budget Survey (HBS) 2020 is higher than the impact estimated using EU-level aggregate data from 2019 above. This is because for the aggregate data, we have used total household expenditure as a proxy for household income. It also highlights the fact that results can be sensitive to the data sources (EU, national) and years available.

Figure 10. Additional expenditure for heat and mobility due to the ETS 2 (€70/tCO2) for Polish and Romanian income deciles



Source: Polish and Romanian Household Budget Survey (HBS) 2020

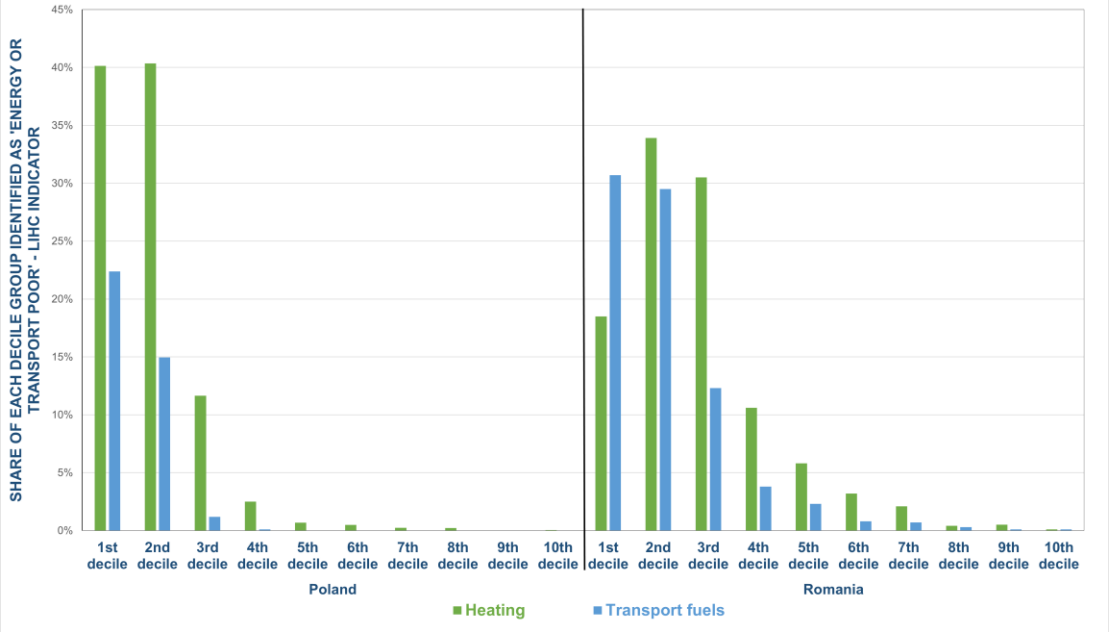
Note: Please refer to Annex, Section 6.3 for information on how equivalised income is derived and income groups are constructed. Refer to Anne, Section 6.6 for the steps involved in the estimation.

The additional costs for home heating are more salient than those for transport fuels in Poland. This is only the case in a minority of EU countries that have particularly CO_2 - intensive heating systems, such as Poland, Hungary, Czechia, and Belgium (Section 2.2). In Romania, the additional costs for heating are also greater than for transport, but the distribution between deciles is different. Contrary to Poland, the average carbon cost for heating in the poorest income decile is much lower. This is because more than 80% of Romanian households in the first income decile use wood as their primary heating source, which is not covered by the ETS 2. The share of households using gas for heating rises significantly with income and the trend is the same for total gas consumption. However, although the average ETS 2 impact may be lower in the bottom income deciles, those low-income households that do use gas for heating face a particularly high burden.

2.5.2 Energy and transport poverty indicators by income decile in Poland and Romania

We here look at the distribution of the LIHC indicator used to measure energy and transport poverty across income deciles in Poland and Romania. We find that the poorest individuals in Poland are more likely to be energy poor and therefore more likely to be vulnerable to a carbon price in the buildings sector (Figure 11). In Poland, the first two deciles are particularly affected, with energy poor individuals representing around 40% of all individuals in these deciles. The third decile also holds a large share of energy poor individuals. In Romania, the first three deciles are all heavily affected, with energy poor individuals representing between 25 and 35% of all individuals in these deciles. Comparing results for the first three income deciles in Poland and Romania, the share of energy poor individuals in the first two deciles is much higher in Poland than Romania, while it is lower in the third decile. This is likely because so many households in the first income decile in Romania use wood as their main heating fuel – which is often sourced for free.

Figure 11. ***LIHC indicator for heat and transport for income deciles in Poland and Romania***



Source: Polish and Romanian Household Budget Survey (HBS) 2020

Note: Due to data availability reasons and as in the estimation for all EU Member States (cf. Annex, Section 2.3), the LIHC indicator for heating is estimated based on expenditures for both heat and electricity. Please refer to Annex, Section 6.3 for information on how equivalised income is derived and income groups are constructed.

We find that the share of transport poor individuals in Poland and Romania is generally lower than the share of energy poor. In Poland, the share of transport poor stands at 22% in the first and 15% in the second income decile, then declines sharply to 1% in the third decile. In Romania, the share of transport poor is particularly high among the bottom two deciles, with 30-31% of individuals. It declines sharply to 12% in the third decile, but then persists at lower levels throughout the middle-income deciles.

2.6 Discussion of the modelling results

Our analysis has looked at the potential impact of the ETS 2 from a variety of angles. We have examined how the expected burden of the carbon price will be distributed among households across Europe. We have also examined existing patterns of vulnerability, using a range of indicators for energy and transport poverty. Digging deeper, we have taken a first look into how these impacts and patterns of vulnerability play out in two countries of Central and Eastern Europe. From our findings we can raise several points for discussion.

A 70 Euro per tonne carbon price in the ETS 2 will have **on average a limited impact on household expenditures.** Additional household expenditures for heat and mobility from a carbon price of €70 will range from 0.3% of household expenditures in Sweden to 1.5% in Hungary. The expected impact in the buildings sector varies between Member States due to distinct climate zones, national patterns of fossil fuel use, and the fact that some countries use a large share of centralised district heating, which does not fall under the ETS 2. In comparison, the impact in the transport sector is more consistent across Member States. Should carbon prices in the ETS 2 rise significantly above the €70 per tonne used in our estimation, impacts become more significant.

While the average household of higher-income countries will pay more in absolute terms, **the economic burden of the ETS 2 carbon price will be greater in lower-income Member States.** On its own, the carbon price therefore shows characteristics of a regressive policy – while the average household in lower-income countries will pay less in absolute terms, these costs make up a larger share of their expenditures. This pattern is not just present at the household level, but also plays out at the level of EU Member States. It is therefore important and justified that the SCF not only targets low-income households, but through its income-related criteria it also directs a larger share of finances towards lower-income countries.

Across a range of vulnerability indicators, based on the last available data, we find that existing **energy and transport poverty rates are greater in lower-income Member States.** The share of the population facing energy poverty is much greater in lower-income countries (at around 20-30%) than in higher-income countries (at around 10-15%). However, levels of transport poverty are similar across Europe, at around 15%. It is therefore important to note that **a certain share of households within all Member States are vulnerable to the carbon price** and will require targeted support.

The indicators that we use come from the energy poverty literature and are calculated using available data. Our approach demonstrates that there is **no "one-size-fits-all" indicator capturing all dimensions of vulnerability in all Member States.** While the SCF Regulation provides definitions, it does not determine which indicators to use. Furthermore, data is sometimes inconsistent or missing, and especially for transport poverty, there are still no commonly agreed indicators available. Therefore, more efforts are needed both at EU and national level to define suitable indicators and make the necessary data available to identify the vulnerable and provide them with targeted support.

By focussing on one indicator, our results show that **energy and transport poverty mainly affects households in the 1st, 2nd, and 3rd deciles**, i.e., the bottom 30% of the income distribution. However, in some countries, vulnerability extends into higher deciles. Our analyses indicate that **vulnerability to the carbon price is not restricted to the poorest members of society**, but also affects lower-middle income households, particularly in Poland and Romania.

The urban-rural divide can also be seen in the patterns of vulnerability. **In lower-income countries households in rural areas are more likely to face energy and transport poverty. This pattern is typically reversed in higher-income countries.** It should be noted that our analyses use a conservative indicator, and they do not account for recent energy price increases, or the projected additional expenses related to the carbon price, such that the share of energy and transport poor may well be higher than estimated in this report.

The cases of Poland and Romania show that **country-specific context influences patterns of impacts and vulnerabilities**. For example, Romanian households in the low-medium to high-medium income deciles (3rd to 7th decile) appear to face the greatest burden from the carbon price related to home heating. In Romania, the poorest households typically already suffer from energy poverty, yet have less direct exposure to the carbon price as they tend to use wood to heat their homes, rather than oil or gas. Polish households are more exposed to the carbon price for heating than most, due to their reliance on coal, with the poorest decile facing the greatest burden. In both countries, vulnerability in terms of transport is closely linked to low incomes with the poorest two deciles the most vulnerable.

3 POLICY DESIGN OPTIONS, CHALLENGES, AND PRACTICES

The ETS 2 follows the basic principle of polluter pays, penalizing polluting practices and incentivizing low carbon behaviour. However, the ETS 2 carbon price has the potential to unfairly impact a small but significant section of society. A coherent response to this problem is the dedicated use of ETS revenues. By channelling the proceeds of the carbon price back to society, the price impact can be moderated where it is needed, and investment barriers can be overcome. This has the potential not just to correct the regressive effect of the carbon price, but to help address social problems of energy and transport poverty.

Revenue recycling has been applied in the context of carbon pricing, both ETS and carbon tax, in many jurisdictions around the world, including in Europe. The range of potential applications is huge, and largely depends on the unique circumstances and specific policy objectives of the jurisdiction. Typically, as a climate policy, ETS revenues are directed broadly towards climate action. Elements of socio-economic development, particularly related to achieving social justice and a just transition, are becoming more common themes, as policymakers acknowledge both the uneven impacts of a carbon price and the opportunities that revenue recycling present to achieve these goals. In the EU, the focus has been shifting to socio-economic uses of revenues also because carbon pricing coverage is moving from electricity generation and industry into sectors that directly impact households' heating and mobility costs.

> The framework of the ETS 2, together with its obligations for revenue recycling and the specific role of the Social Climate Fund (SCF), follows the current consensus on international good practice in carbon pricing policy. Implemented well, it presents a comprehensive approach to achieving ambitious climate targets, while spurring an inclusive, society-wide low-carbon transition.

The framework is set in law and funding is assured. The work now needs to turn to the challenge of implementation, which will be no small feat for the national agencies of each Member State tasked with submitting their Social Climate Plans, as well as the many subnational agencies, experts, civil society organizations, and other stakeholder groups that will need to contribute to the successful planning and implementation of measures.

In the following chapters, we seek to provide a basis for discussion about the implementation of revenue recycling within the framework of the ETS 2 and the SCF:

In Section 3.1, we first look to the SCF legislation and the requirements for national Social Climate Plans.

In Section 3.2, we outline a range of potential policy types and measures that could be applied, drawing on examples of good practice policy measures from within Europe and around the world.

In Section 3.3, we then delve into some of the key considerations and challenges of designing and implementing nationally appropriate policy measures within this framework.

3.1 Implementing the Social Climate Fund

Under the framework of the European Green Deal and Climate Law, most revenues gathered from the auctioning of emissions allowances will go to Member States. These revenues provide a substantial resource for national governments to use, within some broad criteria. All revenues from the ETS 2 should be used for climate and energy purposes, while actions that address social aspects of the carbon price should be prioritized. Approximately 25% of the revenues will go to the SCF, and about another 8% may be used to meet the Member State contributions to activities under the Fund. So, Member States will still have approximately two thirds of their ETS 2 revenues to use broadly on climate and energy initiatives as they best see fit (see Figure 1). The range of potential measures is broad, as is the range of potential recipients. By using ETS 2 revenues to prioritize social impacts there may be an overlap with the measures of the SCF. Moreover, measures that do not fit within the scope of the SCF may otherwise be good candidates for funding via the Member State ETS 2 revenues, or other funding mechanisms.

On the other hand, the scope and objectives of the SCF are narrowly focused. The main objective is addressing the direct social impacts of the ETS 2 carbon price, to ensure that the ETS 2 is just and inclusive. Funding is therefore restricted to measures that target vulnerable populations with specific types of policies. There are several good reasons for this approach. One basic reason is efficiency - the need to prioritize the allocation of resources for the maximum benefit. The more explicit objective is to ensure that the policy is fundamentally fair and progressive. In the competition for scarce public resources, vulnerable and marginalized groups tend to be excluded. Targeting requirements are therefore necessary, otherwise the tendency is to fund measures that are easier to administer or have wider political appeal. Still, under strict targeting criteria, most of the population do not receive benefits. For some, this may seem unfair, as some other households may feel that they bear unreasonable costs without support. However, support should be extended to all that need it. The definition of vulnerability under the SCF is not restricted to the poorest, but also includes those that are significantly impacted and lack the means to adapt. As we see in Section 2.4.1, for some countries and sectors, vulnerability to the ETS 2 carbon price extends well into the middle-

income deciles. With these definitions of vulnerability, the SCF aims to ensure that at least some ETS 2 revenue flows to the most vulnerable.

Measures that grant the same amount to households, regardless of their energy usage or income levels, can make carbon pricing progressive, although the more that support is targeted, the more progressive the policy becomes (Haug et al., 2018). Even so, the SCF does not foresee broad-based payments or tax rebates. There is, however, the opportunity for Member States to use their other ETS 2 revenues for broad-based financial and fiscal measures to support lower- and middle-income households, such as tax reforms and the reduction of renewable electricity fees. This approach has been taken by Germany, for example, where revenues from the German National ETS for Fuels have been used to reduce the EEG surcharge (German Federal Government, 2022).

3.1.1 National-level Social Climate Plans

The SCF will provide support to Member States by financing measures and investments envisaged in dedicated national Social Climate Plans. The plans are to be designed by Member States and be submitted to the European Commission by 30 June 2025 for revision and approval. The SCF Regulation provides a template with an overview of the requirements to guide Member States through the preparation and implementation processes (European Parliament and the Council, 2023b - Annex V).

National Social Climate Plans should contain the following information:

- **Specific new and existing national measures and investments,** to reduce the burden on households resulting from the inclusion of buildings and road transport within the scope of the ETS Directive, and how these measures help to address social impacts of carbon price and contribute to fair transition to climate neutrality. Where relevant, local, and regional measures shall also be included (Article 4(4), Article 6(1a, d)).
- **Estimated costs of the plan's implementation**, including the country's own contribution.
- **Targets, milestones, and an indicative timetable** for implementation (Article 6(1h)).
- **A summary of public consultations** and how stakeholder input has been considered (Article 5(2), Article 6 (1n)).
- An **estimate of the effects on households** of the energy price increase resulting from ETS 2 introduction, focusing on energy and transport poverty, and accounting for national and regional specifics (Article 6 (1d)).
- The **estimated number of vulnerable households and transport users**, including information on how the identification process was organized and how the SCF definitions of energy and transport poverty were applied (Article 6 (1e)).
- **Criteria for the eligibility of final recipients of direct income support**, as well as time limits for such support, its justification, and the role of the measure in reducing energy and transport poverty.

As we can see from the requirements for the Social Climate Plans, Member States need to provide a range of supporting analyses and justifications for the measures included into their plans. These analyses will provide decision-makers with a necessary knowledge base and ensure the Social Climate Plans provide well-targeted and effective support.

The preparation and implementation of the plans should also comply with EU requirements and commitments made by Member States under existing relevant plans and funds, including on coherence, additionality, and public consultations, and to envisage monitoring and evaluation procedures.

Among other requirements, Social Climate Plans should:

- **Be coherent with National Energy and Climate Plans (NECPs)** and other applicable directives, regulations, and plans, such as the Directive on energy efficiency, the European Pillar of Social Right Action Plan, national long-term building renovation strategies under the Directive 2010/31/EU and other relevant legislation (Article 4, Annex V).
- **Be subject to public consultations** with local and regional authorities and all other relevant stakeholders (Article 5).
- Ensure that the included measures or investments **do not contradict the "do no significant harm" principle** in the meaning of the Regulation (EU) 2020/852.
- Contain justifications of how the measures included are **additional and do not substitute** recurring budgetary financing.
- Contain arrangements for effective monitoring and implementation, including a **set of targets, milestones, and use of common indicators** provided in the SCF Regulation for these purposes.

To assist Member States to prepare and implement their Social Climate Plans, **the Commission will provide support and guidance**, tentatively by mid-2024, through the following:

- Organizing **'an exchange' of good practices**, including on cost-efficient measures and investments to be included in the plans (Article 6 (4))
- Providing **technical guidance on the compliance of measures and investments with the 'do no significant harm'** principle in the meaning of the Regulation (EU) 2020/852 (Article 6 (5)).
- Providing examples of **good practices of public consultations** on the plans (Article 5 (4)).

Member States will also be able to apply for technical assistance under existing frameworks, such as European Local Energy Assistance (ELENA) Facility and Technical Support Instrument under Regulation (EU) 2021/240 (Article 6 (4)). Such assistance will be key to completing the vulnerability analyses and stakeholder consultations that will form the basis of the Social Climate Plans, as well as building the technical capacities needed to implement them.

The Commission will assess and approve (or reject) the Social Climate Plans based on their relevance, effectiveness, efficiency, and coherence, and 'taking into account the specific challenges and the financial allocation of the Member State concerned' (Article 16 of the SCF

Regulation). It will disburse the SCF funding to the Member States conditional on their achievement of the milestones and targets for effective implementation as set out in the Social Climate Plans. Payments may be requested twice a year, with the first payments eligible in 2026.

The process of developing Social Climate Plans is intended **to give Member States the flexibility to plan nationally appropriate measures.** The concrete measures to tackle energy and transport poverty need to be firmly rooted in the national context and diverse sub-national stakeholders need to play an active role in their design and implementation. Member States are obliged to consult with a range of stakeholders, including sub-national administrations, civil society groups, and others, in the development of their Social Climate Plans. Successful implementation will involve diverse actors from different fields and involve a range of sub-national agencies and public and private organisations, such as social housing providers, to deliver benefits to the target groups.

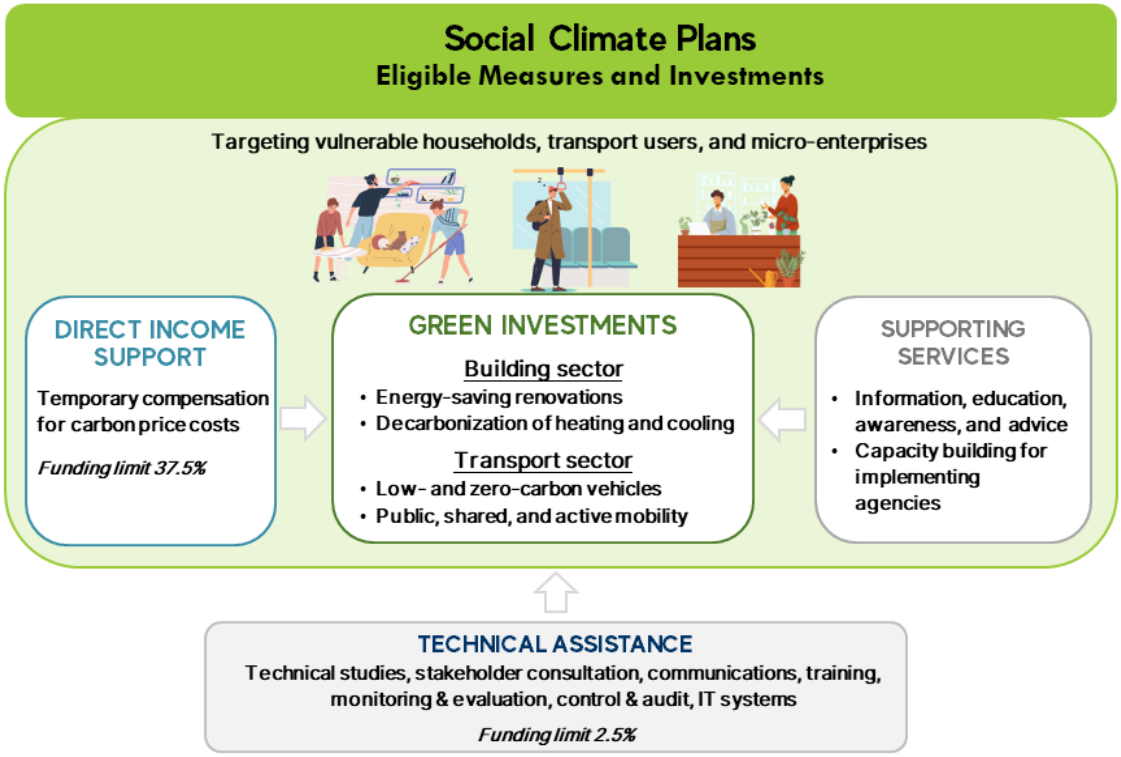
3.2 Measures and investments under the Social Climate Fund

Member States are restricted in the scope of policy measures that can be included in their Social Climate Plans. However, within this scope, there is still great variety of approaches that may be pursued. The SCF was debated extensively in the major EU institutions, and the resulting regulation goes into detail on the definitions, processes, and obligations of Member States. It thereby provides a framework for considering the types of measures and activities that the SCF should finance. When it comes to developing concrete and eligible policy measures, several overarching considerations emerge from the regulation, including:

- All measures need to primarily **target vulnerable households, transport users, and micro-enterprises.** Special attention should be given to include different types of households, including tenants, property owners, and households in geographically remote areas.
- **Priority should be given to 'green investments'**, being measures and investments that reduce energy consumption in the target groups.
- **Temporary direct income support** may be provided to those groups also targeted by green investments. Such support should be understood as accompanying measures, being temporary and declining until the cost-saving benefits of energy-saving measures can be realized.
- **Supporting policies and actions** should facilitate the planning and implementation of measures. For example, information and advisory services are foreseen to drive the uptake of green investments. Technical support is also required to build the knowledge, capacity, and networks, needed to implement Social Climate Plans.

Figure 12 summarises the types of measures that are foreseen, based on the list of 'eligible measures and investments to be included in the Social Climate Plans' (Article 8 of the Regulation (EU) 2023/955).

Figure 12. ***The scope of potential measures, investments, and supporting activities eligible under the Social Climate Fund***



At the core of the fund are **green investments** for the buildings and transport sectors:

Support for the renovation of buildings: Retrofits and deep renovations to improve insulation and thereby reduce the energy needed for heating and cooling over the long term. Such measures should target vulnerable households and micro-enterprises occupying the worst-performing buildings. Special attention should be given to tenants and social housing occupants. Alongside renovations, the Fund should support access to affordable energy-efficient housing, including access to social housing.

Support for decarbonisation of buildings: Providing access to affordable, energy-efficient systems for heating, cooling, and cooking. The focus should be on electrification, integrating renewable energy generation and storage, both on buildings and beyond. This may be via renewable energy communities, citizen energy communities, and other customer networks, such as energy sharing and peer-to-peer trading, that promote the uptake of renewables for self-consumption. It also advocates connecting buildings to smart grids and district heating networks for energy savings and combating energy poverty.

Access to zero- and low-emission vehicles and bicycles: Financial and fiscal measures for purchasing zero- and low-emission vehicles and developing private and public infrastructure. There is an emphasis on promoting the purchase of

zero-emission vehicles (i.e., electric cars, vans, and trucks), the funding of recharging infrastructure, and the development of a second-hand e-vehicle market, where these are affordable and deployable.

Incentives for using public transport and other mobility options: Measures should incentivise the use of affordable and accessible public transport, together with the development and provision of sustainable mobility-on-demand (MoD), shared mobility services (e.g., car-sharing and car-pooling), and active mobility options.

To facilitate the uptake of green investments, supporting services may be funded to provide information and advice, as well as implementation support capacities. These include:

Information, education, awareness, and advice services. These should be accessible and affordable to use, enabling the target groups to better access the available support for building renovations and energy efficiency, as well as mobility and transport alternatives.

Support for implementing agencies, such as social housing providers and public-private cooperatives, to develop and deliver energy efficiency solutions and appropriate funding instruments to the target groups.

Alongside the green investment and supporting services, funding is available for direct income support measures:

Temporary direct income support measures: Up to 37.5% of the funds detailed in the Social Climate Plans can be used for income support. Measures should be targeted at the same vulnerable groups to benefit from green investments and reduced over time. It should thereby act as temporary support until the investments can be effective. Furthermore, such support is restricted to addressing the direct impacts of the ETS 2, meaning only the additional costs of covered fuels for heating and transport should be addressed. In principle, this excludes payments or discounts for electricity or district heating costs, as well as alternatives such as wood fuels.[17]

Funding is also available for technical assistance, being those activities necessary for the development, administration, and implementation of the Social Climate Plans and their measures and investments.:

Technical assistance: Up to 2.5% of the funds applied for in the Social Climate Plans should be used for the management of the Fund and the effective administration and implementation of measures. Activities that support the development and assessment of Social Climate Plans include commissioning studies and organising expert meetings, as well as conducting public stakeholder consultations and communications activities (see Section 3.3.5). Activities that enable the management and

[17] However, where these indirect costs overlap with energy poverty, there may be flexibility to address these issues through green investment measures. For instance, according to the regulation, connections to district heating networks can reduce exposure to the carbon price and thereby help to address energy poverty. To note, though, the extension of district heating networks is not specified as an eligible activity.

administration of the Fund include training, programming, monitoring, control, audit, and evaluation activities, as well as the development of IT-services and tools.

In the following sections, we investigate the three main types of policy measures that are eligible for funding – green investments, direct income support, and supporting services. We examine some of the main considerations when developing measures and provide a range of case studies and examples to illustrate current good practices.

3.2.1 Green investment measures in the buildings sector

Targeting building renovations and low-carbon energy systems at vulnerable households will be a core set of measures eligible under SCF. It has huge potential to save energy and improve the lives of vulnerable families across Europe. There are several considerations and challenges in designing and implementing these measures. Targeting vulnerable households in the housing sector holds specific challenges related to identifying eligible recipients and communities (see Section 3.3.1). The sector is made more complex with diverse living situations, such as social housing, rentals, and multi-family housing. We further discuss barriers such as split incentives and the tenant-landlord dilemma in Section 3.3.4.

Related to this is the question of who is best placed to implement programs, whether central government, municipalities, public housing providers, private sector actors, or a collaboration of these. Measures should also be designed to maximize uptake among the target groups, overcoming barriers that typically stop low-income households from making long-term investments. Implementing agencies with an understanding of the target groups – local actors such as municipalities and local social service providers - are generally better placed to tailor delivery to the local circumstances and increase their uptake. Effective implementation calls for diverse strategies, such as engaging social workers, to ensure inclusive outreach based on vulnerability needs.

The European Urban Initiative has identified a range of common challenges in implementing housing programs in Europe (European Urban Initiative, n.d.). They particularly emphasize the importance of strong support from stakeholders and stable leadership during project implementation (see Section 3.3.5) for a discussion on stakeholder engagement). Participatory co-implementation is considered vital for empowering beneficiaries yet requires clear organizational arrangements to efficiently coordinate multiple actors. Furthermore, potential risks of displacement should be addressed through legal frameworks that place safeguards on affordable housing policies (see Section 3.3.4).

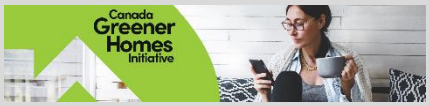
maprimerénov'
Mieux chez moi, mieux pour la planète

Effective strategies can be recognized in housing renovation projects that focus on vulnerable households. **'MaPrimeRénov'** is a nation-wide financial aid created by the French government for owner-occupiers of residential properties (République Française, 2023). It assists them in financing energy renovation works, including insulation, heating, ventilation, and energy audits. Initially favouring the most modest households, the eligibility conditions for 2023 have been expanded to include all households. The program offers different funding categories based on

income ceilings and allows combining incentives and local grants, enabling the most modest homeowners to receive support of up to 90% of the total project cost. To benefit from the grant, citizens visit the government's website, create an account, follow the application steps, provide necessary documents (latest income tax return, valid email address, etc.). However, the work must be financed and completed in advance of the subsidy, which is then paid after invoices are submitted.

At the local level, the city of Gent in Belgium has implemented the **Gent Knapt Op** pilot project, which offers a unique housing renovation scheme for vulnerable citizens of Ghent (Urban Innovation Action, n.d.). Ghent Knapt Op addresses the issue by awarding a €30,000 grant per house for renovation works through an innovative financial system, the 'recurring fund'. Normally, housing funds provide financial support to eligible activities, but to access subsidies or tax incentives, these activities must be completed and paid for beforehand. Unfortunately, this condition typically excludes vulnerable groups, as they lack initial investment financing. Gent Knapt Op offers an alternative solution. It requires repayment, but unlike traditional loans, there are no fixed monthly or yearly instalments. Instead, repayment occurs when the renovated house is sold, using the house's value to repay the fund. Target groups include elderly homeowners, captive renters, and captive co-owners, defined as people who live in poor quality houses and who do not have the means to renovate them.

International examples show approaches to targeted support for retrofitting homes of low-income households, comprising both renovations and energy-efficient heating and cooling systems. A well-established example is **California's Low-Income Weatherization Program**, operational since 2012, and funded from the revenues of the California Cap-and-Trade Program. The program funds energy efficiency upgrades, rooftop solar panels, and community solar installations for low-income single-family and multi-family housing. Through the 'Multi-Family Energy Efficiency and Renewables' component, there are a range of options available for households living in multi-family housing, both homeowners and tenants, including heating/cooling systems, water heating, lighting, appliances, building insulation, and solar PV and thermal systems shared among the housing community. Eligibility is based on the household income of the residents. Buildings may be eligible if at least 66% of the units are occupied by households with incomes at or below 80% of the Area Median Income. (California Department of Community Services & Development, n.d.).



A new program, in place since June 2023, the **Canada Greener Affordable Housing (CGAH)** program aims to modernize affordable multi-unit residential buildings. The program targets indoor air quality, comfort, and quality of life through retrofits, including efficient heating, cooling systems, and energy-efficient appliances. It comprises two funds: pre-retrofit funding for activities such as an energy audit, energy modelling study, or assessment report; and retrofit funding to complete deep energy retrofits. Eligible property types include mixed-income rental or mixed-use properties, community housing, indigenous community housing, shelters, and single-room occupancy facilities. (Canada Mortgage and Housing Corporation, n.d.).

3.2.2 Green investment measures in the transport sector

With a carbon price set to increase the price of transport fuels, a range of green investments are needed to ensure vulnerable households and small businesses can reduce their dependence on fossil fuels. A range of low-carbon transport solutions are needed, addressing not just personal private vehicles, but also publicly available services and infrastructure.

The SCF outlines two main approaches to eligible measures and investments in the transport sector. The first is extending private ownership and access to e-vehicles. The second is providing incentives for using public transport and other shared mobility options. Many of the challenges in the sector relate to identifying and engaging vulnerable transport users through appropriate indicators and channels, also considering local and regional geographies (see Section 3.3.1).

There are diverse options for subsidizing the uptake of low- and zero-emission vehicles, both financial and fiscal. Examples typically include buy-back schemes to scrap and replace old vehicles with newer and more efficient ones. Even so, purchasing a new e-car is likely unaffordable for many low-income and vulnerable households. Promotion of a second-hand market for e-vehicles may be promising, especially in countries such as Poland that already have large second-hand markets for fossil-fuel vehicles (Chrzanowski et al., 2021). However, as the roll-out of new e-vehicles in Europe is still progressing, the current supply of used cars is still small, with limited available vehicle sizes and battery capacity. Furthermore, new public and private recharging infrastructure needs to be installed, dedicated to serving the target groups. Whether these options are suitable for vulnerable households and communities will require a thorough understanding of local needs, preferences, and capacities.

Increasing the use of public transport among vulnerable groups is a low-hanging fruit in many cases, yet there are many challenges related to the affordability and accessibility of services, especially for rural and semi-rural communities. A simple approach may be to subsidize cheap or free public transport tickets - but they will only be useful where public transport routes are easily accessed, safe, and reliable. It should be noted that funding for the extension of public rail or roading infrastructure is not listed as an eligible measure. However, dedicated cycling infrastructure may be newly built or significantly upgraded.[18] Mobility on demand and shared mobility services have potential to unlock personal transport options for lesser connected communities. Digital technology can potentially support their uptake with coordinated and real-time information. Together with active mobility options, such as walking and cycling, they can help to make existing public transportation systems more accessible. Designing measures will require an assessment of local community needs in the context of urban planning and regional development, aiming to improve accessibility and connectivity across multiple modes of transportation.

[18] See Annex IV for a list of common indicators related to the SCF support.

California has several good examples of targeted green investment measures in the transport sector. The California Cap-and-Trade Program covers transport fuels since 2014, and by law, revenues must go to projects that target low-income households and disadvantaged communities, which has sparked the development of a portfolio of clean-transport initiatives (California Air Resources Board, 2022b). Among these, the **Clean Cars 4 All** program (California Air Resources Board, 2023) provides direct subsidies for the purchase of low- and zero-carbon vehicles as a replacement scheme for old fossil fuel vehicles. It targets low-income residents living within or near to disadvantaged communities, with the objectives of reducing air pollution, transportation costs, and GHG emissions. Recipients can retire their old vehicle in exchange for up to a $9,500 discount on the purchase of a new or used plug-in hybrid or electric vehicle, or they may choose up to $7,500 for alternative options such as e-bikes, vouchers for public transit, shared mobility services, or a combination of clean transportation options. To support the uptake of e-vehicles, funding is also available for installing home charging stations, or vouchers for public charging services.

Similar programs exist in Europe to incentivize purchases of low or zero-emission vehicles. However, they are generally not targeted specifically at vulnerable households. For example, the Netherlands offers financial and fiscal subsidies for leasing or buying new or second-hand zero-emission vehicles. Poland also provides subsidies to households for purchasing or leasing new electric vehicles through the **Mój elektryk (My Own Electric Car)** program (Elektromobilność, 2023). The subsidy is only for new vehicles and is granted irrespective of income level. Rather, it is targeted at households with large families and an annual milage greater than 15,000 km (approx. 41km per day). The size of the subsidy ranges from PLN 18,750 to PLN 27,000 (€4,100 to €5,900), with the highest amount available to families with at least three children.

With a focus on publicly available transport and shared mobility services, there are a few good examples. Under the California Climate Investments program, the **Sustainable Transportation Equity Project (STEP)** funds community-based solutions to local transport challenges, with the objective to promote socio-economic benefits in low-income and disadvantaged communities (California Air Resources Board, 2022a). STEP supports whole communities to fund larger-scale investments integrating multiple modes of clean transportation and tailored to the specific community needs. One central aim is to increase access to key destinations (e.g., schools, grocery stores, workplaces, daycare facilities, community centres, and medical facilities). Eligible organizations can request funding via two grant types: planning and capacity building grants, and implementation grants. Facing the challenge of public transport access in remote regions, California has also implemented the **Rural School Bus Pilot Projects** initiative. The pilot projects provide funds to public schools in designated small and remote districts with limited funding. It is meant to promote the expansion of zero-emission school bus fleets, as well as the replacement of old busses with hybrid and low-emission alternatives (California Climate Investments, 2022).

The development of digital platforms that integrate multiple modes of transport can play an important role in enabling access and connectivity. Moreover, such platforms can serve as a driver for the promotion of low- or zero-emissions vehicles, through the integration of mobility on demand, shared mobility services, and micro-mobility options such as e-scooters and e-bikes. An example of such a platform is **FREENOW**, a mobility app across Europe that integrates a broad range of mobility brands and payment methods into a single platform (FREENOW, 2021). The app focusses on personal on-demand and shared mobility services and is currently expanding to include public transport. However, access to public transport networks on the app is still limited, with so far only the Rhine-Ruhr Public Transport Association (VRR) in Germany as a partner (FREENOW, 2021).

3.2.3 Direct income support measures

There are several overlapping considerations when designing direct income support measures. The first is how to target measures, specifically how to identify recipients and set eligibility thresholds. Recipients of income support should be aligned with recipients of green investments. This means popular broad-based measures, such as universal lump-sum payments or tax reforms, are generally not targeted enough for the SCF (see Section 3.3.1).

A second and related issue is how to effectively distribute support, including both the type of payment and the channel used to reach the target group. Utilizing existing social transfer schemes based on income levels or other criteria can provide a basis for targeting and simplify administration. The method of distribution may also determine how often support is provided (e.g., one-off, monthly, quarterly, annually). However, approaches using existing transfer payments as proxy indicators do not accurately target energy or transport poverty (see Section 3.3.1).

A third consideration is the level of payment. This depends on the objectives of the policy, e.g., whether the payment should be commensurate with the impacts of the carbon price. However, payment is also fundamentally limited by size of the available funds. Some existing policy approaches either distribute all available funds equally or based on given formulas and thresholds. Others do not disclose how payment levels are decided, but rather rely on impact assessments and evaluations to show whether they are/were sufficient to meet policy objectives.

Only a few existing carbon pricing mechanisms apply revenue recycling for targeted direct income support. In 2008, the Canadian province of British Columbia introduced a carbon tax on fossil fuels. The rate is currently CAD 65 (ca. €44) per tonne of CO_2 in line with Canadian Federal carbon pricing policy. The government uses part of the revenue to fund the **Climate Action Tax Credit (2023)** for low- and moderate-income households. The credit is calculated based on the makeup of the household[19] and the income level. An income threshold is set at

[19] Individuals get CAD 444, a partner or first child (in single-parent family) CAD 223.50, and each other child CAD 111.50

approximately 65% of the province's medium income. Families below the threshold receive the full amount, and the credit is reduced by 2% of the income above the threshold until it reaches zero. The tax credit is paid quarterly together with other federal-level tax credits and delivered through the income tax system by the Canada Revenue Agency (Government of British Columbia, 2023).

Austria provides an example of lump-sum payments that are partially targeted based on access to public transport and other social infrastructure. The Austrian National Emissions Trading System (NEHG 2022), in force since 2022, puts a carbon price on fuels not covered by the EU ETS, therefore having a similar coverage to the ETS 2 (Federal Ministry of the Republic of Austria, 2022). All revenues are returned to citizens as a climate dividend in the form of an **'climate bonus'** granted to everyone with their main residence in Austria. In 2023-2024, payments are made once a year to individual publicly registered bank accounts, or in the form of a voucher per post. On top of a universal base rate of €110, a 'regionally staggered' allowance is granted with four different levels - €0, €40, €75, or €110 - depending on the place of residence. Those in regions with poorer public transport connections or public service infrastructure (e.g., schools and hospitals) receive more. Mobility-impaired people always get the full amount and children get half.

Similar measures from the fields of climate, energy, and social welfare, can also shed light on good practices. Many countries across Europe provide direct financial support for energy costs to low-income or otherwise socially vulnerable groups. Measures include specific funds established to support low-income households with energy bills, including provisions for favourable debt conditions or repayment plans. Many countries, such as Bulgaria, Denmark, Ireland, Italy and Poland make these types of dedicated payments available, sometimes focussed on the winter months (e.g. Bulgaria) or on certain groups (e.g. Denmark) (Noka & Cludius, 2021). Other countries, such as Germany, provide a heating allowance for recipients of transfer payments by way of the social security system, such as through housing allowances. Germany's response to the energy price crisis also earmarked one-off payments to existing groups, such as students, welfare recipients, and pensioners (Cludius et al., 2022). While existing transfer payment systems can help to target socially vulnerable groups, such an approach may neglect other households vulnerable to the ETS 2 carbon price (see Section 3.3.1).

An example of data-driven targeting for housing welfare benefits is the **UK's Warm Home Discount Scheme** (Lausberg & Croon, 2023; UK Government, 2012). The scheme provides a one-off discount on electricity or gas bills during the winter for low-income households living in sub-standard housing. Recipients are identified by matching data on property characteristics (taken from the property register and valuation office) with government data on household income, social transfers, and modelled energy costs. The method uses proxy indicators to estimate the energy efficiency of buildings, such as floor area, property age, and property type. (Lausberg & Croon, 2023; UK Government, 2012)

3.2.4 Supporting services for information, advice, and implementation

The success of policies aimed at reducing energy poverty hinges on readily accessible information for the target groups, especially low-income households. Information and awareness schemes combine online information platforms with in-person advice to provide tailored advice to households based on their specific needs and local conditions. In parallel to public information services, implementing agencies need the knowledge and capacity to develop and deliver services in a coordinated way. Both public awareness and implementation capacity will be crucial to ensure the diverse and locally tailored measures of the SCF are taken up by the target groups.

Peer-to-peer personal consultation has been recognized as a particularly effective tool in this context. For exemple, the **French SLIME program (Service Local d'Intervention pour la Maîtrise de l'Energie)** (*Slime*, 2023) has effectively reached vulnerable households through localized, sustained, peer-to-peer, and personalized advice. Across Europe, there are several energy-efficiency advisory services, demonstrating various structures, with different roles taken by national and sub-national actors (Cludius et al., 2018). There is no one-size-fits-all approach as each service needs to work within its national and local context. In the UK and Ireland, charity organizations and NGOs collaborate with government-run websites and helplines to disseminate information and offer grants. On the other hand, the French approach relies on top-down, nation-wide policies, with information provided by government and industry actors. Germany's prominent program for advising low-income households, called the **Stromspar-Check**, is funded by the government yet uses national networks of NGOs to train energy-saving consultants at local advisory centres.

To overcome barriers and increase uptake of measures among the target groups, information services should also ideally integrate funding measures, to directly provide guidance on a broad range of available financial incentives and subsidies. The range of potential measures under the SCF is already broad and there are many national and EU funding sources that may also be locally available. Advisory programs could combine diverse measures and funding sources, to offer tailored packages for home energy-efficiency and transport solutions.

In this vein, **the "one-stop-shop" (OSS) approach** is a promising practice that aims to integrate diverse supporting services in one convenient location (Bertoldi et al., 2021). The aim is to increase uptake of measures by providing individual households with tailored advice, funding options, and implementation support, greatly simplifying the process. OSS initiatives are typically funded by public authorities in partnership with public and private service providers. Depending on their structure, they may use various channels to reach customers, including physical help desks, online platforms, and local events. With different business models possible, OSS can potentially offer a range of services, from simple energy-saving advice to fully integrated technical support for implementation.

In Europe, the development of OSS has been building in recent years.[20] Guidelines for OSS have been published and several pilot projects have been established (Cicmanova et al., 2020). For example, the **Oficina de l'Energia** in Valencia operates as a physical office providing information and consultations on energy-saving opportunities, support for energy bill payment, assistance in setting up renewable energy communities, and more. In California, the new program **Access Clean California** also applies the OSS approach to coordinate outreach and improve access to the State's portfolio of clean transportation and energy projects (California Air Resources Board, n.d.).

3.3 Key considerations in designing policy measures

The SCF provides opportunities for a raft of measures to be financed. Before specific interventions are implemented, several overarching design issues should be considered. These relate to the scope and objectives of the SCF, as well as the challenges of tackling energy and transport poverty in Europe.

3.3.1 The challenge of targeting

Targeting of measures is key to ensuring the progressive objectives of the SCF. While the regulation provides definitions for target groups and national-level indicators, it does not specify how vulnerable groups should be targeted. This task is left to Member States to develop and elaborate in their Social Climate Plans. Effective targeting thus poses several challenges, related to defining which groups are eligible, locating the households within those groups, and finding appropriate channels for delivering them support. Policymakers thereby need to weigh up practical issues of data availability, methodological design, and administrative feasibility. Under the SCF, the task is made more complex by the requirement to align the target groups for different types of measures – specifically, direct income support should target those that benefit from green investments.[21] A balance is needed between accuracy and administrative feasibility to allow measures to target the necessary groups while remaining accessible and practical to implement.

A key challenge of developing a targeting strategy is turning limited data into practical methods. The vulnerability indicators and other expenditure-based analyses outlined in Section 2.3 provide a first step towards identifying national patterns of vulnerability related to income and other factors, using existing national-level data, such as the Household Budget

[20] OSS has been highlighted in the recast EPBD Directive, as an option to help compliance with minimum energy performance standards

[21] Within their Social Climate Plan, Member States should provide a "Description of how the groups of recipients of temporary direct income support are also targeted by structural measures and investments…" and a "…description of the complementarity of temporary direct income support with structural measures and investments…"

Surveys. These methods are in line with the national-level indicators developed by the Energy Poverty Advisory Hub (formerly the Energy Poverty Observatory), as well as the set of indicators provided in Annex IV of the SCF Regulation "Common indicators for indicative milestones and targets for the Social Climate Plans". Despite the lack of some commonly agreed indicators, such national-level analyses are a good start for identifying which groups to target within the national context of each Member State. In the context of Social Climate Plans, they are necessary for describing nationally specific challenges, setting the scope of targeted measures, monitoring progress, and evaluating national-level outcomes.

However, national-level indicators cannot simply be used to target specific households. This type of data is not detailed enough to accommodate the local context, and usually lacks key information, not least the current household address. Additional information is therefore needed to locate vulnerable people and neighbourhoods, identify their needs, and engage them with measures. Efforts are needed to integrate local-level data, indicators, and implementation channels into the national-level approaches of the Social Climate Plans. This can potentially build on the work done at the municipal level, where policies to tackle energy poverty and foster social development are already being implemented. Municipalities are key holders of relevant local data, including building stock quality, energy consumption, public transport routes, and social housing access. As an example, the Energy Poverty Advisory Hub, together with the Covenant of Mayors of European cities, is working to develop local-level energy poverty indicators, as well as guidelines for project implementation and impact monitoring (European Commission, n.d.).

Targeting direct income support

A strict targeting approach excludes broad-based measures that provide general financial support to all households, regardless of their specific needs (Cludius et al., 2022). Broad-based policies are popular and considered relatively easy to administer. However, as broad-based measures do not specifically target the vulnerable, they are most likely not eligible under the SCF. They can, however, provide examples of targeting using existing channels, such as the Swiss carbon tax that returns revenues to citizens and businesses via a reduction in mandatory health insurance payments.

One approach to targeted income support would use household income level as an indicator for targeting. Low-income households may potentially be located through tax records or other socio-economic data. As shown in Section 2.4, while income level overlaps with vulnerability to some degree, it is not only the poorest who are vulnerable, so differentiation based solely on income may not address differences within income thresholds, for example between rural and urban households. As a stand-alone indicator, therefore it is not sufficiently accurate. Furthermore, in some country's relevant information, such as tax records, may not be shared between authorities, and therefore not linked to a channel for disbursement. Work would then still be needed to connect eligibility criteria to payment methods. If income level is used as an indicator, then discussions should be held to decide on an appropriate income threshold for eligibility, and whether this would be a single cutoff threshold, or rather a progressive payment scheme pegged to income levels.

A similar approach would be to use existing transfer payment channels, such as social welfare or pension schemes, to reach potential recipients. While such an approach certainly narrows the target group, the overlap with vulnerability, as defined by the SCF, is not complete. Many of those vulnerable to energy poverty will not be welfare recipients, and transfer payments also often miss particularly marginalized groups, who are not part of the system (Cludius et al., 2018). At the same time, recipients of social transfers may not be as impacted by the carbon price due to their existing payments related to the cost of housing or transport. Even so, it is a popular approach to dealing with energy poverty in parts of Europe. While in some European countries issues of energy poverty and vulnerability are directly linked to targeted energy and climate policy, others see their social security system as the main way in which to deal with these issues (Noka & Cludius, 2021).[22] There is, however, growing recognition that the system of transfer payments should take into account climate impacts (cf. Schneller et al., 2020; Schumacher & Noka, 2021 on including a climate component into the calculation of these payments).

Special policies may be needed to reach the poorest and most vulnerable members of society. These could include low-tech direct subsidies for basic needs, such as food vouchers, fuel vouchers, or simply cash transfers. Such straight-forward approaches have proven to be effective in countries and regions where institutional structures are less developed, or for targeting particularly vulnerable groups such as refugees. The main advantage is they can reach individuals that are 'outside of the system' and lacking formal arrangements, such as energy supply contracts, or social security registrations.

Targeting green investments

As green investments are meant to address the underlying drivers of vulnerability, a more nuanced approach to targeting is necessary, which considers geographic factors such as housing type, location, and access to services. Individual households are most easily targeted if they are the sole residents of their house. However, measures that benefit one household will also often also benefit others, such as retrofits for multi-family apartment buildings, public transport initiatives, and connections to district heating. It therefore makes sense for some measures to target local groups of households, such as housing complexes, neighbourhoods, or remote communities. In these cases, strict targeting of individual households is not possible, as both vulnerable and non-vulnerable households will benefit from the measures.

In any case, geographic specificities need to be assessed in developing national Social Climate Plans.[23] Our analysis in Section 2.4 shows that geographic patterns of rural and urban populations overlap with vulnerability in different ways depending on the national context. A deeper analysis is needed to uncover regional and local drivers of vulnerability that can be targeted by specific measures. Integrating socio-economic data, such as income and expenditures, with locally specific data such as building quality or transport connectivity, could

[22] Also refer to the way in which energy poverty is addressed in the NECPs of different Member States

[23] When assessing the impact of the carbon price "…effects are to be analysed at the appropriate territorial level as defined by each Member State, taking into account national specificities and elements, such as access to public transport and basic services, and identifying the areas mostly affected".

provide a basis for more accurate and viable targeting approaches. An example of a geographical approach to targeting carbon pricing revenues is found in California (see Box 2).

Box 2 – The Californian approach to targeting disadvantaged communities

A world-leading example of a geographical approach to targeting carbon pricing revenues for social objectives can be found in California. The legislation underpinning the California Cap-and-Trade Program determines that at least 35% of the carbon price revenues should go to projects that target 'priority populations'. Specifically, a share of projects should be located within the boundary areas of communities designated as disadvantaged and low-income. To target measures at disadvantaged communities, **the geographic tool CalEnviroScreen** (California Air Resources Board, n.d.) **was developed, which integrates data on more than 20 socio-economic and environmental indicators.** The methodology uses census tracts to provide nationally consistent small, statistical geographic units with stable boundaries, suitable for applying eligibility criteria in line with the legislation. Based on this tool, projects are implemented by multiple state agencies, with the California Air Resources Board providing overarching guidance on targeting priority populations and monitoring outcomes.

Such methods could be adapted to the requirements of the Social Climate Plans using a relatively small number of relevant indicators for energy poverty and vulnerability, for example using local data on household incomes, the energy performance of buildings, public transport links, or access to basic services. Mentioned above, the UK's Warm Home Discount Scheme already shows some success with integrating different types of data to target individual households with income support payments. By incorporating area-based data, this approach could be broadened to target green investments. Depending on the indicators used and the degree of accuracy required, such an approach could address different levels of detail, and aggregate data at different scales.[24] The degree to which this kind of targeting is possible, depends strongly on data availability and the possibility to combine different data sources, especially considering data privacy laws. In its basic form, such an approach could be a useful tool to analyse regional and local patterns of vulnerability. In an advanced form, it could apply thresholds for eligibility under the SCF and be used for targeting specific measures at communities as well as individuals.

[24] As an example of fine-scale geographic analysis, an interactive energy poverty map has been developed for the Romanian city of Cluj-Napoca: Energy Poverty Project (2020)

Accuracy, eligibility, and administrative burden

In policy design, there is often a trade-off between accuracy and administrative feasibility. In this case, very strict and accurate eligibility criteria may make the delivery of support slower and less accessible. Accurate targeting requires a high level of data accuracy and can limit the reach of measures, reduce their political appeal, and make them more difficult to administer. For the policy to be effective, measures need to be accessible to all those that need them, also in a timely manner. Reducing the administrative burden may mean settling for sufficient, yet not perfectly accurate targeting.

In time, targeting challenges may be addressed through persistent outreach, innovative uses of local data, and integrated analyses that can combine different types of data and make these available to policymakers. At the most detailed level, local actors such as social welfare workers have direct contact to vulnerable households and can help to fill the gaps. However, considering the relatively short timeline for the ETS 2, and the long lag time for many energy-saving investments to take effect, it would be prudent to allow some flexibility at first, so that support can reach those that need it in time.

> One approach would be to start with less accurate methods that can work with the available data and utilize existing channels. Over time, as methods, capacities, and data quality develop, criteria could then be tightened, and accuracy improved.

Underpinning any flexible approach to targeting is a question of the stringency of eligibility criteria. The SCF Regulation includes language that could indicate a degree of flexibility. For example, green investments may be funded "...provided they *principally* target..." the vulnerable. While this may indicate some flexibility for Member States to identify and target the vulnerable in their national context, more guidance could be necessary to interpret the eligibility criteria and develop good practice approaches to targeting.

3.3.2 Maintaining the carbon price signal

The ETS 2 is designed as a deliberate intervention in the price of higher-carbon goods and services. The economic incentive, in the form of a carbon price signal, is intended to reach across the economy to influence production and consumption decisions. The SCF, and other measures funded by ETS 2 revenues, are supposed to work alongside the price signal, to address the fact that some households cannot react to the carbon price without help.

In this scope, the delivery of measures funded through ETS revenues should, as far as possible, not interfere with the carbon price signal. Support should go to those that need it, but in a way that households still weigh up their options and choose the low-carbon option that is right for them. Generally, the focus of subsidies should be on investment in low-carbon alternatives rather than support for consumption. However, where consumption support is needed, measures should be designed to maintain the price incentive. This can generally be

achieved through policy design, by separating the direct income support payment from the purchase decision. For example, rather than lowering the price of fuels, a monthly or yearly lump-sum payment or energy bill rebate could be paid to households directly. As the amount is fixed, not related to consumption levels, the household still has an incentive to save. While this approach enables consumers to realize savings where possible, it should be balanced with the need to protect vulnerable consumers, so that they are not pushed into short-term hardship.

3.3.3 Complementary regulations, legal frameworks, and safeguards

Alongside the subsidies, grants, and services that should be financed by the SCF, a range of complementary policies create the right conditions for successful implementation. These include, for example, energy efficiency standards for buildings and cars, or obligations for landlords and tenants to share the costs of renovations (Braungardt et al., 2021). Other regulations may protect vulnerable households from disconnection or safeguard against eviction following renovations (FEANTSA, 2022). Such complementary regulations are not specific to the SCF and are typically enacted via national social development policy in line with broader national and EU policy frameworks. For the measures in the Social Climate Plans to work, they need to consider the existing legal framework – or in some cases, the framework itself may need to be reformed.

Complementary regulations can help vulnerable households overcome non-financial barriers. In the buildings sector, this particularly affects tenants and occupants of multi-family housing. Measures targeting these groups need overcome the split-incentive problem typical of the tenant-landlord dilemma and a common barrier to cooperation among owners of multi-family apartment buildings (Imga et al., 2013). Policies need to address incentives to tenants and their landlords, and involve other actors, such as property managers and market intermediaries, in a fair and equitable way that allows all parties to realize the benefits of investments. Approaches include coordinated financial support or fiscal incentives, such as the deductibility of renovation costs from the rent, or tax rebates for landlords that implement improvements.

Alongside the SCF, regulatory frameworks may also be needed to safeguard vulnerable households from rising energy prices or housing costs. One common approach at the national level is to provide legal protection against power or gas disconnection. Other EU-level policy frameworks may provide the basis for establishing safeguards for vulnerable tenants. One of the key frameworks for tackling housing-related energy poverty in Europe is the Energy Performance of Buildings Directive (EPBD), which sets targets for building renovations and may include Minimum Energy Performance Standards (MEPS), particularly for worst-performing buildings.[25] Under the upcoming revision of the EPBD, Member States will be required to submit Building Renovation Plans together with their NECPs and Social Climate Plans, outlining national policies to empower and protect vulnerable households, alleviate energy poverty, and ensure housing affordability.

[25] At the time of writing the recast of the EPBD is debated in the trialogue between the European Commission, the Parliament, and the Council.

3.3.4 Stakeholder engagement and communications

Stakeholder engagement is fundamental to the success of the SCF. Member States are considered best placed to design, implement, and amend their national Social Climate Plans, but only in consultation with local and regional authorities, economic and social actors, and relevant civil society groups. The approach enables tailor-made solutions for each Member State that consider local contexts and specific needs. Our analyses of Poland and Romania in Section 2.5 confirm the need for Social Climate Plans to fully reflect the national context of energy and transport poverty. Moreover, measures should be based on the analysis of vulnerability with a sufficient level of regional disaggregation, thus requiring national authorities to consider regional differences within a Member State.

> Tailored local solutions require national policymakers to engage with sub-national actors at many levels. This is why obligations for stakeholder consultation are explicitly included in the SCF Regulation and must be demonstrated every time a Social Climate Plan is submitted for assessment.[26]

Simply complying with formalities, however, will likely not be enough to ensure success. Energy poverty is a cross-cutting issue in such diverse fields as climate protection, energy systems, public health, economic development, housing policy, and social security. The successful implementation of the SCF will require the active participation and collaboration of actors in all these fields, contributing at different levels from national to local. At the national level, different ministries and public authorities will need to coordinate political objectives and responsibilities. Regional and local governments, particularly municipalities, hold the key to local information and channels for funding, and need to play an active role in the design, targeting, planning, and implementation of measures. Public and private organizations, from social housing providers to utility managers, are in direct contact with vulnerable households, and will play a key role both in targeting and delivering measures. Civil society organizations also play a key role both in advocating for vulnerable groups and in reaching them with measures. Bridging these different interests, experts and academics are needed to integrate information and provide methodological input. Constructively engaging such a diverse set of stakeholders requires a well-organised and structured process.

Experience in ETS policy design has yielded a range of good practices in stakeholder engagement (ICAP & PMR, 2021, p. 35), many of which are relevant for the implementation of the Social Climate Fund. Starting early, consultations should first focus on building the awareness, knowledge, expertise, and networks that are needed to enable all relevant stakeholders to become constructive participants in the process. On this basis, the formal process of consultation

[26] Refer to Recital 18 and Article 5 for scope, objectives, and obligations for public consultation. Consultations must at least comply with the rules that Member States must abide in developing their NECPs.

should be as open and transparent as possible, to lend credibility and build trust among participants. Establishing regular and predictable meetings that align with the decision-making process, potentially through a dedicated forum, has shown to greatly improve trust and engagement, as it allows participants to plan and prepare for events in advance, while also giving time for the government to process inputs afterwards. A regular and ongoing forum also creates continuity and allows stakeholders to contribute to reviews and improve measures over time.

> The scope and value of consultation should not be underestimated. Consultation should begin early and continue on a regular basis, even after the submission of the Social Climate Plans. Importantly, it should follow a participatory and collaborative approach that goes beyond the one-sided consultation typical of top-down policy making.

The process needs to empower stakeholders to take part in the design, implementation, and improvement of the policy, and give the opportunity for them to explore their own innovative and tailored approaches. Not only should a diversity of views be heard, but the scale of collaboration required to design and implement measures demands a thorough, inclusive, and participatory approach.

Communications strategy

In parallel to stakeholder engagement, policymakers should consider their communication strategy. Good communication helps make good policy more successful. It engages the broader public, making citizens aware of the availability and benefits to them of the policy, in line with their values and those of society (Partnership for Market Readiness & Carbon Pricing Leadership Coalition, 2018). The Social Climate Fund, based on principles such as fairness and solidarity, has the potential not only to mitigate carbon emissions, but to generate significant material benefits for individuals and society.

Tackling issues of energy poverty will have positive effects for local jobs, public health, gender equality, regional development, and more. Such tangible benefits tend to be more salient to individuals than meeting climate targets, so also monitoring and communicating these outcomes is important. Examples from North America systems such as **RGGI (The RGGI Initiative, 2023) and California (California Climate Investments, 2023)** show how the benefits of carbon pricing and revenue recycling can be communicated in ways that people understand and appreciate. On a practical level, a proactive communication strategy can greatly increase the uptake of measures, while helping to build and maintain the broad political support that the policy needs for long-term success.

3.4 Discussion of policy design options and recommendations

The framework of the ETS 2, together with its obligations for revenue recycling, and the specific role of the SCF, follows current international good practice in carbon pricing policy. The main objective of the SCF is to address the direct social impacts of the ETS 2 carbon price, to ensure that the policy is fundamentally fair and progressive. Along with measures funded from broader ETS revenues and other national and EU level mechanisms, the SCF aims to ensure that a portion of climate funding flows to where it is most needed.

As one instrument in an array of climate, energy, and social development policies, the SCF is not the only mechanism for addressing undesired impacts of ETS 2. Directly alongside the SCF, revenues from auctioning ETS 2 allowances will be available to Member States for broad-based measures or non-targeted investment support. It is up to the Member States to allocate these funds to climate and energy initiatives as they see fit; the range of potential measures and recipients is thus broader than that of the SCF. This means that there is potential to use ETS 2 revenues to reinforce positive outcomes of the SCF and spread benefits more broadly across society.

The framework of the SCF defines the scope, objectives, and types of measures that may be funded. Still, there are many options for a wide range of eligible measures, investments, and supporting activities. Each type of measure entails a specific policy intervention with its own realm of actors, responsibilities, and expertise. At the core are green investments. In the housing sector, these include housing renovations, decarbonization, social housing, and integrated renewables. In the transport sector, these can include e-vehicle purchase, use of public transport, and integrated mobility options. Green investments should be supplemented with temporary direct income support and facilitated by advisory and capacity building services. Furthermore, complementary policies and frameworks need to be considered, both to overcome specific challenges, and to align the measures with other relevant policy frameworks. Despite the diversity of measures, the overall package outlined in the Social Climate Plan should be integrated and consistent, targeting the same groups with diverse yet mutually reinforcing measures.

Policy design can draw on a wide range of good practice examples from Europe and the rest of the world. While no single approach may perfectly fit the SCF framework, examples demonstrate a broad range of current practices, which may be drawn upon or adapted. More importantly, they can inform the discussion around designing and implementing measures for the SCF. Each case provides practical examples on how to deal with the challenges of targeting, setting eligibility criteria, engaging vulnerable groups, supporting implementation, and delivering support via different channels.

A key challenge in developing eligible measures under the SCF is targeting vulnerable households, transport users, and micro-enterprises. Strict targeting excludes many of the broad-based measures that are popular in other revenue recycling and energy cost support approaches due to their political appeal and ease of administration. Considering the SCF definitions that outline target groups based on energy poverty indicators and vulnerability to the carbon price, the intended target groups do not fit neatly into any one commonly used indicator, such as income level. Even so, income is shown to be a practical indicator for

targeting other measures, with the option to set eligibility thresholds for progressive payment schemes at different levels. Another practical approach is to target groups that receive support via existing transfer payments, such as welfare recipients or pensioners, to leverage administratively low-cost and feasible channels. However, while such approaches are popular in some European countries, on their own, they are not able to capture important aspects of vulnerability, often excluding the very poor and those exposed to high energy costs.

An accurate and integrated targeting approach would require a combination of indicators measuring exposure and vulnerability to the carbon price. As a further complication, this poses practical challenges related to data availability, methodology, and administrative feasibility. National level indicators are not suitable for targeting specific groups, as additional information is needed to locate vulnerable people and neighbourhoods, identify their needs, and engage them with measures. Work is therefore needed to transform local level data and indicators into practical targeting strategies at the national level. Such information is more readily available at the municipal level, where policies to tackle energy poverty and foster social development are typically implemented. The availability and quality of data varies from country to country. When several data sets are to be combined, national policies on data privacy also play a role.

Geographic aspects need to be factored into the targeting approach. In many cases, single measures may benefit multiple households or whole communities, such as those targeting multiple-family buildings or public transport access. A more nuanced targeting approach is thereby needed, considering both socio-economic data, such as income and expenditures, and local geographic data on energy poverty and vulnerability, such as the energy performance of buildings, connections to district heating, public transport networks, and proximity to basic services. The California Cap-and-Trade Program provides an example of integrated geographic analysis with multiple socio-economic indicators, designed to target disadvantaged communities, including rules and thresholds for eligibility. Austria also incorporates a geographic element in the targeting of carbon pricing rebates, as does the UK with income support measures. Such methods could inform the targeting strategies of Member States to be elaborated in their Social Climate Plans, either used simply to uncover patterns of vulnerability or as an integrated tool to determine eligibility.

Developing a targeting strategy implies a trade-off between accuracy and administrative burden. Measures need to sufficiently target the necessary groups while remaining accessible and administratively feasible. Strict targeting requires high levels of data accuracy and complex methods for outreach, making them slower and more costly to administer. Considering the need to reach households with support in a timely manner, policymakers could begin using available data and existing channels, then improve methods, data, and accuracy over time. Any such approach would require a degree of flexibility for Member States to determine eligibility criteria. The European Commission is finally responsible for approving the Social Climate Plans. Further discussion and guidance would be needed to interpret the eligibility criteria and develop good practice approaches.

Several other considerations are important in developing measures. For one, the measures of the Social Climate Plans will overlap with existing legal and policy frameworks, and work will be needed to ensure complementarity and to protect vulnerable consumers. Most important is the role of sub-national actors in successful implementation. This is reflected in the fact that the Social Climate Plans should be developed by each Member State, with the

targeting strategy, design, and implementation of measures tailored to the national context. Tailored local solutions require national policymakers to engage with sub-national actors at many levels. Municipalities play a key role, with access to local data and channels for delivery. This is why there is an obligation to conduct stakeholder consultation in the development of Social Climate Plans. However, the scale of coordination demands a proactive and sustained consultation that goes beyond the normal top-down process. Importantly, it should follow a participatory and collaborative approach that enables stakeholders to take ownership of the design and implementation of the SCF. Technical assistance funding is available for stakeholder consultation, and the Commission will provide some limited guidance. However, more guidance may be required for Member States to succeed in their stakeholder consultation and communications activities.

4 CONCLUSIONS AND RECOMMENDATIONS

Regulations for the ETS 2 have been published and now need to be implemented by Member States. The carbon price is therefore imminent, bringing with it both risks and opportunities. The SCF is the main instrument to tackle the worst social impacts of the ETS 2 carbon price. Its successful and timely implementation will help address energy poverty and improve the lives of the most vulnerable. **Member States now need to begin developing their national Social Climate Plans**, by identifying and understanding national patterns of vulnerability, and then developing appropriate policy measures. The process of developing, checking, and implementing the Plans will take considerable effort and is not to be underestimated.

The upcoming ETS 2 in the buildings and road transport sectors will affect households across Europe. The effect will likely be regressive, posing a greater relative burden on poorer individual households and lower-income Member States. At a carbon price of €70/tonne, the average impact on household expenditures is expected to be limited. **However, lower-income Member States, composed mostly of CEE countries, will face a greater burden.** This is driven by two key factors. Firstly, carbon costs tend to make up a larger share of household expenditure in these regions. Secondly, energy and transport poverty are already more prevalent in these countries.

The main objective of the SCF is **to ensure the ETS 2 is fair and progressive, leaving no one behind.** It has been conceived specifically to cushion the impacts of the carbon price on vulnerable groups through targeted green investments, supplemented with temporary direct income support. In a mark of European solidarity, the funds are allocated to Member States based on a progressive formula.

The national context, including historical dependencies, is crucial in understanding which groups are most vulnerable, for what reasons, and where to find them. While a few common trends can be identified across Europe, related to income levels, fossil fuel intensity, and the rural-urban divide, the national context is the main factor determining patterns of vulnerability.

In developing Social Climate Plans, **each country needs to identify its own patterns and drivers of vulnerability, to be able to then design and implement appropriate policy measures.** Our analyses demonstrate how national patterns of vulnerability to the carbon price can be identified, by examining household expenditures on energy and transport, income levels, and the urban-rural divide. Generally, lower- and lower-middle income households are most vulnerable to the carbon price. However, income is not the only factor, as there are many facets to energy and transport poverty. While lower-income countries face greater

challenges, **all EU Member States are home to vulnerable populations**, and the implementation of the SCF needs to be pursued across all of Europe.

The SCF provides for a range of different policy measures to address the drivers of vulnerability by considering both short- and long-term needs, accounting for local conditions, and addressing the most relevant aspects of vulnerability within the national context as defined in each country's Social Climate Plan. **Member States will have additional revenues from auctioning ETS 2 allowances** to pursue broad-based measures or non-targeted investment support, thus complementing the SCF and spreading the benefits more broadly across society.

Targeting is central to the SCF, and a key challenge is to develop a targeting strategy that can identify vulnerable groups and then reach them with appropriate measures. Both green investments and direct income support need to target the same groups. Considerable work is needed to develop accurate yet practical indicators that integrate local-level socio-economic data on vulnerability and apply these to the real world. There is no one-size-fits-all approach, so Member States need the flexibility to select and apply the most suitable indicators for their national circumstances. International experience provides a range of good-practice examples to draw on. However, **Member States will likely need further guidance from the European Commission to develop targeting strategies** that are in line with the scope and objectives of the SCF.

Accurate and effective targeting of measures entails administrative burden and will take time to implement. Policymakers should start simple and improve over time, beginning with available indicators (such as income levels) and applying existing channels for disbursement, before moving to more nuanced indicators as data and methods improve. Income level is shown to be a useful first indicator but is not sufficient on its own to reach all vulnerable households. If income level is to be used as a main eligibility criterion, our analysis indicates that support should **at least target households in the bottom 30% of the income distribution.**

The national-level implementation of Social Climate Plans needs the active participation of sub-national actors to provide data on vulnerability, to open channels to target groups, and to take an active role in implementing measures. Stakeholder engagement and communications are key to building engagement, awareness, support, ownership, trust, and commitment. Policymakers should work collaboratively and engage the most relevant stakeholders from the very beginning of the process. It will take many actors working in concert to make the policy a success. The combination of the ETS 2 and the SCF has the potential to deliver considerable benefits to households across Europe. But these benefits are not a given – only a sincere and coordinated effort on behalf of European Member States, their partners, and constituents, can realize this potential.

5 References

Berry, A. (2019). The distributional effects of a carbon tax and its impact on fuel poverty: A microsimulation study in the French context. *Energy Policy*, *124*, 81–94.

Bertoldi, P., Boza-Kiss, B., Della Valle, N., & Economidou, M. (2021). The role of one-stop shops in energy renovation - a comparative analysis of OSSs cases in Europe. *Energy and Buildings*, *250*, 111273. https://doi.org/10.1016/j.enbuild.2021.111273

Boardman, B. (1991). *Fuel poverty: From cold homes to affordable warmth*. Belhaven Press London.

Bouzarovski, S., Petrova, S., & Tirado-Herrero, S. (2014). *From Fuel Poverty to Energy Vulnerability: The Importance of Services, Needs and Practices* (Working Paper SWPS 2014-25). University of Essex.

Braungardt, S., Bürger, V., & Köhler, B. (2021). Carbon Pricing and Complementary Policies—Consistency of the Policy Mix for Decarbonizing Buildings in Germany. *Energies*, *14 (21)*, p. 7143. DOI: 10.3390/en14217143

Braungardt, S., Schumacher, K [Katja], Ritter, D., Hünecke, K [Katja], & Philipps, Z. (2022). *The Social Climate Fund – Opportunities and Challenges for the buildings sector*. Freiburg, Berlin. Öko-Institut e.V. https://www.oeko.de/fileadmin/oekodoc/ECF_Social_Climate_Fund.pdf

California Air Resources Board. (n.d.). *One-Stop-Shop. Access Clean California*. Retrieved August 30, 2023, from https://ww2.arb.ca.gov/our-work/programs/accessible-clean-transportation-options-sb-350/one-stop-shop

California Air Resources Board. (2022a). *LCTI: Sustainable Transportation Equity Project (STEP).* https://ww2.arb.ca.gov/our-work/programs/sustainable-transportation-equity-project-step/lcti-sustainable-transportation

California Air Resources Board. (2022b). *Moving California: cleaner transportation for all communities*. https://ww2.arb.ca.gov/sites/default/files/movingca/movingca.html

California Air Resources Board. (2023). *Clean Cars 4 All*. https://ww2.arb.ca.gov/sites/default/files/movingca/vehiclescrap.html

California Climate Investments. (2022). *Rural School Bus Pilot Projects*. https://www.caclimateinvestments.ca.gov/rural-school-bus-pilot-project

California Climate Investments. (2023). *Cap-and-Trade Dollars at Work: 2023 California Climate Investments Annual Report Highlights*. https://gis.carb.arb.ca.gov/portal/apps/storymaps/stories/60940e8d2d844b6d8f8f2e04812430ea

California Department of Community Services & Development. (n.d.). *Multi-Family Energy Efficiency and Renewables*. Retrieved August 30, 2023, from https://www.csd.ca.gov/Pages/Multi-Family-Energy-Efficiency-and-Renewables.aspx

Canada Mortgage and Housing Corporation. (n.d.). *Canada Greener Affordable Housing*. Retrieved August 30, 2023, from https://www.cmhc-schl.gc.ca/professionals/project-funding-and-mortgage-financing/funding-programs/all-funding-programs/canada-greener-affordable-housing-program

Chrzanowski, P., Fabiszewska-Solares, J., Śniegocki, A., & Zawieska, J. (2021). *Reverse Gear. Social and economic effects of imports of used vehicles to Poland*. Warsaw. WiseEuropa. https://wise-europa.eu/wp-content/uploads/2021/10/Reverse-Gear.pdf

Cicmanova, J., Eisermann, M., & Maraquin, T. (2020). *How to set up a one-stop-shop for integrated home energy renovation? A step-by-step guide for local authorities and other actors*. Energy Cities. https://energy-cities.eu/wp-content/uploads/2020/07/INNOVATE_guide_FINAL.pdf

Cludius, J., Hünecke, K [K.], Noka, V [Viktoria], Schumacher, K [Katja], Förster, H., Kunert, D., & Fries, T. (2018). *Policies and measures to alleviate energy poverty in Germany - learning from good practices in other European countries* (No. 4). Oeko-Institut e.V. https://www.oeko.de/fileadmin/oekodoc/WP-Energy-Poverty-2018.pdf

Cludius, J., Vornicu-Chira, A., Gutowski, P., & Eden, A. (2022). *Supporting Households in the Energy Price Crisis: A comparative analysis of approaches in Germany, Poland and Romania: Policy Brief*. adelphi; Öko-Institut e.V.; WiseEuropa; CSD.

Cornago, E. (2022). *The EU emissions trading system after the energy price spike*. Center for European Reform. https://www.cer.eu/sites/default/files/pbrief_ets_EC_4.4.22.pdf

Elektromobilność. (2023). *O programie - Elektromobilność - Portal Gov.pl: [About the program - Electromobility]*. https://www.gov.pl/web/elektromobilnosc/o-programie

Energy Poverty Project. (2020). *Interactive Energy Poverty Map for Cluj-Napoca*. https://www.energy-poverty.eu/en/interactive-energy-poverty-map-cluj-napoca

European Commission. *Energy*. https://energy.ec.europa.eu/index_en

European Commission. (n.d.–a). *Energy Poverty Advisory Hub (EPAH)*. Retrieved August 31, 2023, from https://energy-poverty.ec.europa.eu/index_en

European Commission. (n.d.–b). *Energy poverty in the EU*. Retrieved August 30, 2023, from https://energy.ec.europa.eu/topics/markets-and-consumers/energy-consumer-rights/energy-poverty-eu_en

European Commission. (2021a). *Proposal for a Directive of the European Parliament and of the Council amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union: COM/2021/551 final*. https://eur-lex.europa.eu/resource.html?uri=cellar:618e6837-eec6-11eb-a71c-01aa75ed71a1.0001.02/DOC_1&format=PDF

European Commission. (2021b). *Staff Working Document. Impact Assessment Report: SWD (2021) 601 final*. https://eur-lex.europa.eu/resource.html?uri=cellar:7b89687a-eec6-11eb-a71c-01aa75ed71a1.0001.01/DOC_4&format=PDF

European Parliament. (2022). *Deal on establishing the Social Climate Fund to support the energy transition* [Press release]. https://www.europarl.europa.eu/news/en/press-room/20221212IPR64528/deal-on-establishing-the-social-climate-fund-to-support-the-energy-transition

European Parliament and the Council. (2023a). *Directive (EU) 2023/959 of the European Parliament and of the Council of 10 May 2023 amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union and Decision (EU) 2015/1814 concerning the establishment and operation of a market stability reserve for the Union*

greenhouse gas emission trading system. European Parliament and the Council. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32023L0959&qid=1693387115396

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

European Urban Initiative. (n.d.). *The European Hub for sustainable urban development*. Retrieved August 31, 2023, from https://www.urban-initiative.eu/

Eurostat. (2015). *Manual for air emissions accounts*. Luxembourg. https://ec.europa.eu/eurostat/documents/3859598/7077248/KS-GQ-15-009-EN-N.pdf/ce75a7d2-4f3a-4f04-a4b1-747a6614eeb3?t=1447948110000

Eurostat. (2021). *Living conditions in Europe - income distribution and income inequality.* https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Living_conditions_in_Europe_-_income_distribution_and_income_inequality&oldid=528159#Income_inequality

Eurostat. (2022). *House or flat – owning or renting*. https://ec.europa.eu/eurostat/cache/digpub/housing/bloc-1a.html

Eurostat. (2023a). *Glossary: Equivalised income*. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Equivalised_income

Eurostat. (2023b). *Overcrowding rate by age, sex and poverty status - total population - EU-SILC survey*. https://ec.europa.eu/eurostat/databrowser/view/ILC_LVHO05A__custom_1513630/bookmark/table?lang=en&bookmarkId=5c55dfba-c13c-4e7a-9d5e-d637eb61bf04

FEANTSA. (2022). *How to avoid a renoviction wave. Report on the social impacts of the Renovation Wave*. https://www.feantsa.org/public/user/Resources/reports/2022/1_How_to_avoid_a_Renoviction_wave.pdf

Federal Ministry of the Republic of Austria. (2022). *Climate policy Green budgeting Initial information on the 2022 national emissions certificates trading law (NEHG 2022)(current page) FAQ regarding the national emissions certificates trading law 2022 (NEHG 2022) Combating Fraud Customs Digitalisation Financial Sector Taxation Mining Security & Technology Initial information on the 2022 national emissions certificates trading law (NEHG 2022).*

Feindt, S., Kornek, U., Labeaga, J. M., Sterner, T., & Ward, H. (2021). Understanding regressivity: Challenges and opportunities of European carbon pricing. *Energy Economics*, *103*, 105550. https://doi.org/10.1016/j.eneco.2021.105550

Feng, K., Hubacek, K., Guan, D., Contestabile, M., Minx, J., & Barrett, J. (2010, May). Distributional Effects of Climate Change Taxation: The Case of the UK. *Environmental Science & Technology*, *Volume 44*(10), 3647–4032. DOI: 10.1021/es902974g

FEST, & FOES. (2022). *Assessment of the EU Commission's Proposal on an EU ETS for buildings & road transport (EU ETS 2) - Criteria for an effective and socially just EU ETS 2* (Report 1/2022). FEST / FOES. https://foes.de/publikationen/2022/2022-01_Study-Assessment-EU-ETS2.pdf

FREENOW. (2021). *Sustainability Report.* FREENOW. https://www.free-now.com/fileadmin/Content/B2B/Sustainability_B2B/Sustainability-Report-EMEA-June2021__1_.pdf

German Federal Government. (2022). *Elimination of EEG levy relieves electricity consumers*. https://www.bundesregierung.de/breg-en/federal-government/renewable-energy-sources-act-levy-abolished-2011854

Główny Urząd Statystyczny. (2023). *Budownictwo mieszkaniowe w okresie styczeń-grudzień 2022 roku: [Central Statistical Office. Housing construction in January-December 2022].* https://stat.gov.pl/obszary-tematyczne/przemysl-budownictwo-srodki-trwale/budownictwo/budownictwo-mieszkaniowe-w-okresie-styczen-grudzien-2022-roku,5,134.html

Gore, T. (2022). *Can Polluter Pays policies in the buildings and transport sectors be progressive? Research report.* Institute for European Environmental Policy. https://ieep.eu/wp-content/uploads/2022/12/Can-polluter-pays-policies-in-buildings-and-transport-be-progressive_IEEP-2022.pdf

Görlach, B., Jakob, M., Umpfenbach, K., Kosch, M., Pahle, M., Konc, T., Moore, Nils aus dem, Brehm, J., Feindt, S., Pause, F., Nysten, J., & Abrell, J. (2022). *A Fair and Solidarity-based EU Emissions Trading System for Buildings and Road Transport.* Kopernikus-Projekt Ariadne, Potsdam. https://ariadneprojekt.de/media/2022/06/Ariadne-Report_ETS2-SCF_June2022.pdf

Government of British Columbia. (2023). *Climate action tax credit*. https://www2.gov.bc.ca/gov/content/taxes/income-taxes/personal/credits/climate-action

Haug, C., Eden, A., & Montes de Oca, M. (2018). *Addressing distributional impacts of carbon pricing policies.* adelphi. https://adelphi.de/en/system/files/mediathek/bilder/Addressing%20distributional%20impacts%20of%20carbon%20pricing%20policies%20-%20adelphi.pdf

ICAP, & PMR. (2021). *Emissions Trading in Practice: A Handbook on Design and Implementation (2nd Edition).* https://icapcarbonaction.com/system/files/document/ets-handbook-2020_finalweb.pdf

Imga, N. N., Tutuncu, Y., Tuna, M. M., Doğan, B. A., Berker, D., & Guler, S. (2013). Idiopathic spontaneous adrenal hemorrhage in the third trimester of pregnancy. *Case Reports in Medicine*, *2013*, 912494. https://doi.org/10.2790/912494

Isherwood, B. C., & Hancock, R. M. (1979). *Household expenditure on fuel: Distributional aspects.* London. Economic Adviser's Office.

Juhrich, K. (2016). *CO2 Emission Factors for Fossil Fuels.* German Environment Agency (UBA). https://www.umweltbundesamt.de/sites/default/files/medien/1968/publikationen/co2_emission_factors_for_fossil_fuels_correction.pdf

Lausberg, P., & Croon, T. (2023). Europe must fight energy poverty more effectively. *European Policy Center*. https://www.epc.eu/en/publications/-Europe-must-fight-energy-poverty-more-effectively~4da8dc

Lucas, K. (2012). Transport and social exclusion: Where are we now? *Transport Policy*, *20*, 105–113. https://doi.org/10.1016/j.tranpol.2012.01.013

Lucas, K., & Martens, K. (Eds.). (2019). *Measuring Transport Equity* (First edition). Elsevier.

Lucas, K., Stokes, G., Bastiaanssen, J., & Burkinshaw, J. (2019). *Future of mobility: inequalities in mobility and access in the UK Transport System.* Government Office for Science. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/784685/future_of_mobility_access.pdf

Maj, M., Rabiega, W., Szpor, A., Cabras, S., Marcu, A., & Fazekas, D. (2021). *Impact on households of the inclusion of transport and residential buildings in the EU ETS*. Warsaw. Polski Instytut Ekonomiczny. https://pie.net.pl/en/the-potential-carbon-cost-of-transport-and-residential-buildings-for-eu27-households-in-2025-2040-is-eur-1-112-billion/

Mattioli, G. (2017). 'Forced Car Ownership' in the UK and Germany: Socio-Spatial Patterns and Potential Economic Stress Impacts. *Social Inclusion*, *5*(4), 147–160. https://doi.org/10.17645/si.v5i4.1081

Mattioli, G., Philips, I., Anable, J., & Chatterton, T. (2019). Vulnerability to motor fuel price increases: Socio-spatial patterns in England. *Journal of Transport Geography*, *78*, 98–114. https://doi.org/10.1016/j.jtrangeo.2019.05.009

Ministerstwo Rozwoju i Technologii. (2023). *Budownictwo wielkopłytowe – Raport o stanie technicznym: [Ministry of Development and Technology. High-rise apartment buildings - Status report].* https://budowlaneabc.gov.pl/budownictwo-wielkoplytowe-raport-o-stanie-technicznym/

Noka, V [V.], & Cludius, J. (2021). *Energy Vulnerability and Energy Poverty: Experience and Approaches in the EU.* Oeko-Institut. https://www.oeko.de/fileadmin/oekodoc/WP-EnergyVulnerability_EnergyPoverty.pdf

Oeko-Institut. (2022). *The Social Climate Fund – Opportunities and Challenges for the buildings sector*. https://www.oeko.de/fileadmin/oekodoc/ECF_Social_Climate_Fund.pdf

Partnership for Market Readiness, & Carbon Pricing Leadership Coalition. (2018). *Guide to Communicating Carbon Pricing*. World Bank, Washington, DC. https://openknowledge.worldbank.org/entities/publication/7437cbad-03a9-5cec-b978-f20f8b3ea31c https://doi.org/10.1596/30921

Porojnicu, D. (2021). Prețul lemnului de foc s-a dublat față de anul trecut din cauza creșterii tarifelor la energie și gaze, dar și a blocajelor din administrația silvică: [The price of firewood has doubled since last year due to rising energy and gas tariffs and bottlenecks in the forestry administration]. *G4Media*. https://www.g4media.ro/pretul-lemnului-de-foc-s-a-dublat-fata-de-anul-trecut-din-cauza-cresterii-tarifelor-la-energie-si-gaze-dar-si-a-blocajelor-din-administratia-silvica.html

Pye, S., Dobbins, A., Baffert, C., Brajkovic, J., Miglio, R., & Deane, P. (2015). *Energy poverty and vulnerable consumers in the energy sector across the EU: analysis of policies and measures.* Insight_E. https://www.researchgate.net/publication/282358589_Energy_poverty_and_vulnerable_consumers_in_the_energy_sector_across_the_EU_analysis_of_policies_and_measures

République Française. (2023). *MaPrimeRenov*. https://www.maprimerenov.gouv.fr/prweb/PRAuth/app/AIDES_/BPNVwCpLW8TKW49zoQZpAw*/!STANDARD

The RGGI Initiative. (2023). *The Investment of RGGI Proceeds in 2021*. https://www.rggi.org/sites/default/files/Uploads/Proceeds/RGGI_Proceeds_Report_2021.pdf

Schneller, A., Kahlenborn, W., Töpfer, K., Thürmer, A., Wunderlich, C., & Fiedler, S. e. a. (2020). *Sozialverträglicher Klimaschutz -Sozialverträgliche Gestaltung von Klimaschutz und Ener-giewende in Haushalten mit geringem Einkommen. Abschlussbericht: [Socially compatible climate protection - socially compatible design of climate protection and energy transition in low-income households. Final report.]*. Text 66/2020. adelphi; FOES; GWS; FNK; Martin-Luther-Universität Halle-Wittenberg. https://www.umweltbundesamt.de/sites/default/files/medien/479/publikationen/texte_2020_66_sozialvertraeglicher_klimaschutz_final.pdf

Schumacher, K [K.], & Noka, V [V.]. (2021). *Sozialverträgliche Wärmewende in Berlin. Herausforderungen und Lösungen für Haushalte mit geringem Einkommen.: [Socially acceptable heat transition in Berlin. Challenges and solutions for low-income households.]*. Berlin. Forschungsverbund Ecornet Berlin. https://ecornet.berlin/sites/default/files/2021-12/EcornetBerlin_Report14_Sozialvertr%C3%A4gliche%20W%C3%A4rmewende%20Berlin%20-%20Haushalte%20mit%20geringem%20Einkommen.pdf, checked on 12/17/2021.

Sinea, A., Vornicu, A., & Pozsar, M. (2021). *Energy poverty in cee and see*. Cluj. Center for the Study of Democracy. https://democracycenter.ro/application/files/5216/2686/1735/energy_poverty_CEE_SEE.pdf

Slime: Homepage. (2023). https://www.lesslime.fr/

Thomson, H., Bouzarovski, S., & Snell, C. (2017). Rethinking the measurement of energy poverty in Europe: A critical analysis of indicators and data. *Indoor + Built Environment : The Journal of the International Society of the Built Environment*, *26*(7), 879–901. https://doi.org/10.1177/1420326X17699260

UK Government. (2012). *Warm Home Discount Scheme*. https://www.gov.uk/the-warm-home-discount-scheme

UK Government Department for Business, Energy and Industrial Strategy. (2020). *Fuel poverty methodology handbook (Low Income High Cost): Statistical Methodology*. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/966521/Fuel_Poverty_Methodology_Handbook_2020_LIHC.pdf

Urban Innovation Action. (n.d.). *ICCARus (Gent knapt op) - Improving housing Conditions for Captive Residents in Ghent*. Retrieved August 30, 2023, from https://www.uia-initiative.eu/en/uia-cities/ghent-call3

The pictures and the icons used in this document were designed or bought from www.canva.com, and www.shuterstock.com

6 Annex: Data and Methods

6.1 Eurostat data used in analysis

Table 6-1. Eurostat data used in analysis

Member state		Population 2019	Heating and cooling 2019	Transport 2019	Total household expenditure 2019	Median household income 2019
		Millions	*Mt CO_2*	*Mt CO_2*	*Billion Euro*	*Euro*
Austria	AT	8.9	6.3	8.4	204.7	25 729
Belgium	BE	11.5	13.6	7.9	233.6	24 608
Bulgaria	BG	7.0	0.6	2.1	38.2	4 224
Croatia	HR	4.1	1.0	3.9	39.8	7 306
Cyprus	CY	0.9	0.3	1.4	15.9	16 215
Czechia	CZ	10.6	7.5	3.7	107.2	9 995
Denmark	DK	5.8	1.9	5.7	142.9	30 717
Estonia	EE	1.3	0.2	0.9	13.7	11 458
Finland	FI	5.5	0.9	4.7	120.5	24 879
France	FR	67.3	39.7	69.3	1271.8	22 583
Germany	DE	83.0	86.3	103.6	1717.9	23 504
Greece	EL	10.7	4.5	8.2	139.2	8 200
Hungary	HU	9.8	7.1	8.3	73.4	5 872
Ireland	IE	4.9	6.4	6.1	100.9	25 528
Italy	IT	59.8	44.6	62.4	1087.4	17 165
Latvia	LV	1.9	0.3	1.5	17.8	8 169
Lithuania	LT	2.8	0.7	3.7	29.3	7 585
Luxembourg	LU	0.6	0.9	0.6	21.8	36 367
Malta	MT	0.5	0.0	0.3	7.5	15 354
Netherlands	NL	17.3	15.8	14.2	348.9	24 627
Poland	PL	38.0	30.8	16.6	305.1	7 142
Portugal	PT	10.3	1.2	6.3	146.6	10 023
Romania	RO	19.4	4.8	11.4	135.2	3 854
Slovakia	SK	5.5	2.7	3.3	52.8	8 119
Slovenia	SI	2.1	0.6	2.7	26.7	14 067
Spain	ES	46.9	14.2	50.4	739.9	15 015
Sweden	SE	10.2	0.2	8.2	206.4	24 490

Source: Eurostat - Population on 1 January [TPS00001]; Air emissions accounts by NACE Rev. 2 activity [env_ac_ainah_r2]: Heating/cooling activities by households and transport activities by households; Final consumption expenditure of households by consumption purpose (COICOP 3 digit) [NAMA_10_CO3_P3__custom_120424]; Mean and median income by household type - EU-SILC and ECHP surveys [ILC_DI04__custom_4073514]

In their manual for air emission accounts, Eurostat[27] clarifies:

[27] Eurostat (2015)

- "**Heating/cooling** (incl. cooking): This category covers actual air emissions by private households that derive from the combustion of fuels for heating/cooling houses and flats as well as from the fuel combustions for cooking and producing hot water. Heating/cooling emissions are allocated to private households when they use the fuels themselves, e.g. gas for central heating boilers and cooking ovens. Emissions from the production of electricity purchased by households are not allocated to private households but to the electricity producers/suppliers
- **Transport:** This category includes actual air emissions by households related to the combustion of fuels for transportation purposes. Transport emissions are allocated to private households only when they arise from the private use of motor vehicles; emissions caused by public transport are to be assigned to the respective transportation industry. Emissions from households' use of private leisure boats and aircrafts should also be classified under this purpose category."

6.2 SEEK-EU micromodel used to estimate vulnerability indicators

In Chapter 2.3, the Oeko-Institut's microsimulation model SEEK-EU is used to estimate the share of the population considered vulnerable in relation to a number of vulnerability indicators. The model is based on detailed household survey data and covers all EU member states. Input data include the Household Budget Survey (HBS) and the EU Statistics on Income and Living Conditions (EU-SILC).

SEEK-EU has a modular structure. In a first module, the database is prepared and thus made usable for the model. In the course of the preparation, among other things, missing values are imputed, or, in some cases, extreme values are corrected. In a further step, groups relevant for the evaluation of measures, such as income groups or different household types, are identified.

The **Household Budget Survey (HBS)** is a national survey carried out by the Member States. It contains information on households' expenditure on goods and services, as well as other important household characteristics, such as income group and household type. Eurostat collects and compiles the national datasets and publishes them every five years. The last publication uses data that was collected in 2015.

https://ec.europa.eu/eurostat/web/household-budget-surveys

The **EU Statistics on Income and Living Conditions (EU-SILC)** is a dataset that is collected based on a household survey by all EU Member States in each year. It contains information on household income, living conditions, poverty and social exclusion indicators. The national datasets are compiled by Eurostat and published on a yearly basis.

https://ec.europa.eu/eurostat/web/microdata/european-union-statistics-on-income-and-living-conditions

These are the datasets usually used for determining impacts of and vulnerability to the introduction of an EU-wide carbon price (Braungardt et al., 2022; Feindt et al., 2021; FEST & FOES, 2022; Gore, 2022; Görlach et al., 2022)

6.3 Equivalised income and income deciles

Equivalised income takes into account the composition of a household when dividing households into different income quintiles or deciles. Equivalised income is constructed by dividing (net) household income by a factor that is the sum of individual factors assigned to each household member: 1 for the first person in the household, 0.5 for the second and each subsequent person aged 14 years or older and 0.3 for each person under the age of 14.[28]

Income deciles are then derived by ordering all households in the country according to their equivalised income and sorting them into ten groups that each contain the same amount of persons.

[28] Eurostat (2023a)

6.4 Additional insights from the energy and transport poverty debates

Energy poverty indicators can be broadly separated into two categories: self-reported and expenditure based. 'Self-reported' indicators are based on individual perceptions and experiences of energy poverty, such as arrears on energy bills or and the ability to keep the living spaces warm. 'Expenditure based' indicators are based on household incomes and energy expenditures. We list indicators from both categories below that are currently in used by the EU Energy Poverty Advisory Hub (EPAH) when assessing the energy poverty in the EU. The main data sources underlying these indicators are the EU Statistics on Income and Living Conditions (EU-SILC) and the Household Budget Survey (HBS).

Self-reported indicators, based on households answering yes to the relevant questions in the EU-SILC survey, include:

- Arrears on energy bills
- Inability to keep the home warm
- Presence of leaks, damp, and rot

Income and expenditure indicators, based on HBS data, include:

- High share of energy expenditure in income (2M) – Household energy expenditure is higher than double the national average.
- Low share of energy expenditure in income (M/2) – household energy expenditure is lower than half the national average.

In the context of this project, we also apply two traditional indicators that are not used by the EPHA/EPOV, which are nonetheless valuable when making comparisons across countries.

- 10% threshold - Household spends more than 10% of their income on energy bills – This indicator represents one of the earliest approaches to capturing energy poverty and can still be found in use.
- Low income – high cost (LIHC) – A household falls below the poverty line after paying energy bills and their energy expenses are higher than the national median. This indicator was developed in the UK and provides another useful proxy for measuring levels of energy poverty

In relation to transport poverty the key aspects to be measured are availability, accessibility, and affordability. How to capture these aspects in indicators is still a matter for the research community to debate. Research has shown that transport poverty is a highly spatial phenomenon, meaning that geographical factors, including access to goods and services or proximity to the workplace play a strong role. These spatial dimensions are, however, difficult to capture in individual EU-wide indicators. Expenditure-based approaches are more straightforward by comparison. This is why, several studies have already turned to energy poverty indicator approaches to model the affordability of transport, including the LIHC indicator (Mattioli et al. 2017) nd the 2M indicator (Büchs 2021).

6.5 Estimation of expenditure-based energy poverty indicators

Low income – high cost (LIHC) - Household falls under the poverty threshold after paying energy bills and energy expenses are higher that national median

In order to construct this indicator, we need the following variables:

- net equivalised income after paying energy bills = (household net income – energy expenditure)/equivalence weight
  We first deduct energy expenditure from household net income and then apply an equivalence weight (using the new OECD scale, see Annex 6.3)
- relative energy expenditure of the household = Energy expenditure divided by household net income
- weighting factor of household in micro dataset (needed to make the calculations representative for all households in the country)
- at-risk-of-poverty threshold of the respective country. This threshold is equal to 60 % of the median equivalised disposable income after social transfers (see Annex 6.3)
- net equivalised income = household net income / equivalence weight (new OECD scale) (see Annex 6.3)

Steps for the construction of the LIHC-indicator

1.) for each country we find the median of relative energy expenditure over all weighted households
2.) we compare the relative energy expenditure of every household with the weighted median in the household's country
3.) we compare the net equivalised income of every household with the at-risk-of-poverty threshold in the respective country
4.) if the household's relative energy expenditure is higher than the median in the household's country AND the household's net equivalised income after paying energy bills falls below the at-risk-of-poverty threshold, we identify the household as vulnerable

6.6 Polish and Romanian national data used in analysis

Expected ETS2 costs and impacts and vulnerability at the national level was estimated using the National Household Budget Surveys (HBS) from the Polish and Romanian statistical offices. In the HBS, there are only data for household expenditures, broken down by different energy sources. To calculate consumption quantities of the respective households, the respective energy prices in the corresponding year under consideration must be applied. With this information, the consumption quantities can be calculated using the following formula:

Consumption [kWh] = Energy expenditure [EUR] / Price [EUR/kWh]

The consumption of the fuels can be converted to corresponding CO_2 emissions and then the price per ton of CO_2 can then be assigned. The German Federal Environment Agency (2016) has published corresponding emission factors for various energy sources, converted to kg CO_2/kWh for the relevant energy sources :

Fuel	**Emissions factor (EF) [kgCO_2 / kWh]**
Petrol	0.263
Heating oil light /diesel	0.266
Natural gas	0.202
Hard coal*	0.335
Lignite*	0.364

* may vary depending on used coals

To calculate the amount of emissions, the following formula is used:

CO_2 quantity [t] = (Consumption [kWh] * EF [kg CO_2 / kWh]) / 1000

To calculate the CO_2 costs, the following formula is used:

CO_2 cost [€] = CO_2 quantity [t] * price [€/t].

This project is part of the European Climate Initiative (EUKI). EUKI is a project financing instrument by the German Federal Ministry for Economic Affairs and Climate Action (BMWK). The EUKI competition for project ideas is implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. It is the overarching goal of the EUKI to foster climate cooperation within the European Union (EU) in order to mitigate greenhouse gas emissions.

Supported by:

on the basis of a decision
by the German Bundestag