



Original research article

Towards an intersectional justice approach to carbon taxation: Energy poverty, vulnerable households, and revenue recycling in Ireland

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ARTICLE INFO

Keywords:

Carbon tax
Intersectionality
Climate justice
Ireland
Carbon pricing

ABSTRACT

This article adopts an intersectional lens as an analytical framework to examine how overlapping demographic dimensions, such as age, ability, ethnicity, geography, gender, and home ownership status, shape the diverse experiences of energy poverty among low-income households in Ireland. Despite extensive research on the vertical impacts of carbon taxes across income groups, scholarship examining horizontal impacts on non-income groups remains limited, with few studies employing qualitative methods to investigate intersectional justice implications. Addressing this gap, our study conducted twenty-one semi-structured interviews with key informants to identify vulnerabilities often overlooked in conventional economic analyses. Our findings reveal that while Ireland's carbon tax policy has implemented progressive revenue recycling measures that benefit households in the bottom five income deciles, certain vulnerable groups, particularly renters, Travellers, and disabled persons, are not fully recognised in both policy design and economic modelling. The study demonstrates that qualitative research methods can complement quantitative approaches by uncovering vulnerabilities that are statistically difficult to capture in econometric studies due to data limitations or small sample sizes. We argue that carbon tax policies informed by intersectional analysis can more accurately mitigate adverse impacts on vulnerable populations and foster more equitable transitions to a low-carbon economy. Potentially, this can also improve public acceptability of carbon taxes. This research contributes to the emerging literature on horizontal impacts of carbon pricing and offers insights for policymakers seeking to design more inclusive climate policies that address the complex interplay between carbon pricing and non-income vulnerabilities.

1. Introduction

The urgency of addressing climate change has prompted countries to introduce multiple policy measures aimed at reducing greenhouse gas (GHG) emissions. Among these measures, carbon taxes have emerged as a prominent instrument, with thirty-nine jurisdictions having implemented a carbon tax worldwide [1]. While often effective at reducing GHG emissions [2], carbon taxes can negatively impact segments of the population, such as consumers and workers in targeted industries. Identifying these impacts is an important step towards addressing them effectively to ensure a just transition and, potentially, increase political support for the instrument.

Research on the impacts of carbon taxes has focused primarily on the

impacts of carbon pricing on different income groups (so-called *vertical* impacts),¹ and ways to address these, especially through revenue use [4]. Scholarship on the negative effects of carbon pricing that looks at impacts on non-income groups (so-called *horizontal* impacts) is rarer. Scholarship on the horizontal impacts of carbon pricing has looked at differences between rural and urban households [5–10], older persons [7,11], Indigenous groups [12], and gendered differences [13].

This article contributes to this scholarship using a case study approach to analyse the intersectional impacts of the Irish carbon tax from an energy poverty perspective.² The case study approach is well-suited for this analysis because the non-income differences between households vulnerable to energy poverty are context specific. Through twenty-one semi-structured interviews with key informants, we identify

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¹ Vertical distributive impacts can be defined as economic impacts on households based upon their income level, while horizontal distributive impacts can be defined as economic impacts based on differences between households of the same income level. See [3].

² Energy poverty is the inability of households to access or afford a comfortable and safe standard of energy supply [14]. While energy poverty is often understood as a lack of energy to warm the home, it can also encompass the full energy needs of households (lighting, heating, cooling, appliances, transportation, etc.) [14].

these vulnerabilities. Our key argument is that carbon tax policies informed by intersectional analysis can more accurately mitigate adverse impacts on vulnerable populations and foster equitable transitions to a low-carbon economy.

Our study differs from the existing literature on carbon taxation and the just transition in several ways. While some papers have quantitatively examined the horizontal impacts of carbon taxes [4,15,16], and others have considered issues of intersectionality in climate policy [17–19], this study contributes a qualitative case study of the intersectional justice implications of a carbon tax, based on interview data. The study confirms some existing findings in the Irish case regarding negative impacts on older persons and rural households [7,20,21]. Our analysis further enables us to explore what is missing from the Irish carbon tax, particularly for households whose vulnerabilities are not revealed through econometric studies. Our results confirm the findings from existing just transition studies, which show that vulnerability under a low-carbon transition extends beyond income issues, and also considers the capacity of different groups to adapt to changes in fuel prices [22–24]. Existing literature on the just transition has highlighted that without a justice-oriented approach, there is a risk of deepening existing inequalities, excluding certain groups from decision-making, or failing to recognise the diverse impacts on various communities, which could ultimately undermine the effectiveness and legitimacy of the transition [25–27]. Similarly, existing literature emphasises the impact of the fairness of carbon taxes, suggesting that policies which effectively hypothecate revenues for climate action or social protection measures garner greater acceptability than climate policies which are perceived to be unfair [28–32]. Our study therefore has implications for policy design, highlighting the need for more multifaceted and better-targeted policies to improve both justice outcomes and, potentially, the public acceptability of carbon taxes. This paper also contributes to research on the Irish carbon tax [20,21,32,33].

This study proceeds as follows: Section 2 provides an overview of the literature on intersectional justice and justice and equity under a carbon price. Section 3 describes the study's methodology. Section 4 summarises the results, while Sections 5 and 6 discuss the implications of our findings.

2. Literature review

2.1. A just transition

The just transition has been defined as a transition to a low-carbon economy which considers all stakeholders in the transition and avoids reproducing existing environmental and social inequalities within our energy infrastructure [25,27]. Existing literature on the just transition emphasises that this shift should not negatively impact groups vulnerable to job losses, energy poverty, or disproportionate environmental burdens. The concept was first discussed in reference to labour concerns as part of the labour environmentalism movement in the 1970s [22]. Scholars have indicated the need for policies to support workers transitioning from fossil fuel industries to new, sustainable energy sectors, ensuring fair labour practices and retraining programmes [22,34]. The literature has since expanded to encompass other vulnerabilities, such as energy poverty [22,34], and to highlight that groups beyond workers are affected by the low-carbon transition [27]. Scholars assert that equitable access and affordability of energy are essential components of a just transition [24,35].

As the just transition literature has developed, several authors have highlighted the need to more accurately identify and target vulnerable groups who are impacted by the transition. For instance, Wang and Lo [27] and Carley and Konisky [36] argue that much of the existing literature on the just transition is not comprehensive enough to consider multiple vulnerabilities. The authors observe that much of the literature is labour-focussed such that largely male workers in high-emissions industries are considered at the expense of other groups, such as women,

people with health conditions and rural households [27]. In addition, Sovacool [23,24,26] argues that existing policies to support a just transition fail to recognise the specific vulnerabilities of different groups under policy design. For instance, Sovacool et al. [24] conduct several country case studies of transition policies and observe that, while some respondents interviewed could not identify any negative impacts of transition policies, solar energy policies in Germany, nuclear energy policies in France and SMART technology policies in UK negatively impacted specific demographics. The authors found that low-income renters or urban households in Germany were unable to avail of government aid for installing solar panels due to limited roofing access in apartment dwellings. In France, owner-occupiers in rural areas, owner-occupied elderly households, low-income renters, and single parents with children in urban areas became more vulnerable to rising energy costs during the push towards nuclear energy. In the UK, uneducated or poor households with mental health issues were made worse-off by the introduction of SMART metres for household energy use due to the complexity of the SMART metres and negative impacts they had on the mental health of residents [24].

The scholarship above highlights growing discussions on how to accurately identify and target vulnerable groups impacted by energy and climate policies across multiple dimensions. We now turn to the literature on intersectional justice and explore its usefulness as a lens for better understanding and shaping policy design to address different vulnerabilities in the low-carbon transition.

2.2. Intersectional justice

Intersectionality was originally used to criticise feminist discourse that does not recognise differences in gendered vulnerability between black women and white women [37]. The theory has evolved to encompass different identity types (race, class, ethnicity, gender, sexuality, ability, religion, age, geography, etc.) and how the interaction of these identity types creates differences in the vulnerabilities experienced by individuals [38]. The intersectional lens has been increasingly utilised in public policy studies to understand how policies targeted to address singular aspects of vulnerability may fail to address other aspects [39].

However, intersectionality is only a burgeoning area discussed in the climate change literature [38,40]. Some authors have called for an increase in intersectionality studies on climate change and climate policy, arguing that these studies could improve the targeting of policy measures to mitigate or adapt to climate change risks [40,41]. Several studies have examined climate and energy policy through an intersectional lens. Okyere & Lin [42] and Alda-Vital et al. [43] have explored women's access to energy in different national contexts, concluding that policies accounting for multiple intersectional dimensions beyond gender are more impactful. In addition, three studies consider the intersectional dimension of vulnerability to climate disasters [17–19]. These studies indicate that vulnerability is higher at specific cross-sections of demographics, such as class, gender, ethnicity and geography, and call for policy interventions on climate risk to be better targeted towards specific at-risk groups [17–19]. Finally, several studies consider climate adaptation policies from an intersectional justice perspective [44,45]. Two studies of climate adaptation policies in South Africa and Turkey conclude that policies addressing climate vulnerability do not reach some marginalised groups, and that an intersectional approach is necessary to ensure that different dynamics of vulnerability are addressed in adaptation policy design [44,45].

The above studies indicate that intersectional justice can be a useful analytical lens to identify and potentially address multiple layers of vulnerability to climate change and climate change policy. Our article seeks to expand the body of literature on intersectionality and climate policy to improve policymakers' understanding of how best to target supports for vulnerable groups. As such, we consider in Section 2.3 how the literature on justice and equity in carbon pricing can benefit from an

intersectional study of carbon pricing impacts.

2.3. Justice and equity under a carbon price

Justice and equity under a carbon price may be broadly understood under the auspices of distributive justice (who is made better-off or worse-off under a carbon price) and procedural justice (whether impacted groups and individuals are able to express their views or concerns in the policy design process) [46,47]. This paper focusses on the distributive justice elements of carbon pricing policy design.

Much of the empirical literature which evaluates the distributive impacts of a carbon tax focusses on costs for households [16]. Many studies of carbon taxation in developed countries indicate that, unless carbon taxes are designed to address the issue, carbon taxes can have a regressive effect on low-income households because a carbon price increases the price of using fossil fuels, and energy generated with them [7,16,21,48,49]. While many studies focus on regressiveness for low-income households in developed countries, a comparatively smaller body of literature discusses distributive impacts of carbon taxation based on horizontal or non-income measures [4,15,16]. Studies have found differences in horizontal impacts of carbon prices for rural compared to urban households [5–10], older persons [7,11], Indigenous groups [12], and gendered differences [13]. Studies have also shown that workers in high-emissions sectors or communities built around these high-emissions sectors (i.e., coal mining towns) may be disproportionately impacted [50,51].

Several jurisdictions have implemented solutions to address horizontal inequalities under a carbon tax. Under the California ETS, a portion of revenues from the sale of emissions allowances is allocated to improving local air quality in communities of colour, addressing concerns about the concentration of localised co-pollutants under an ETS [52]. In addition, Bubna-Litic and Chalifour [12] find that income-tax credits do not benefit Indigenous households in British Columbia, whereas reinvesting revenues into climate change mitigation or job reskilling offers greater benefit. Further, the Canadian government has announced an increase in the share of federal carbon tax revenues returned to Indigenous peoples from 1 % to 2 % to support self-determined priorities, including climate action initiatives within Indigenous communities [53].

While research on the vertical impacts of carbon pricing and how to address them is well-established, scholarship on the horizontal impacts of carbon pricing is steadily growing. Alongside the expanding body of work on the just transition and intersectional justice in climate and energy policy, our case study contributes to both strands of literature by examining the impacts of revenue recycling policies on vulnerable households under the Irish carbon tax from an intersectional lens.

This paper adopts an intersectional lens as an analytical framework to examine how overlapping demographic dimensions such as age, ability, ethnicity, geography, gender, and home ownership status shape the diverse experiences of energy poverty among low-income households. These experiences are not fully reflected in the distribution of carbon tax revenues. As outlined in Section 3.1, an intersectional approach was chosen over quantitative measures like multidimensional poverty in order to enable a more qualitative and nuanced understanding of vulnerability, particularly within the Irish context, that might otherwise remain obscured.

3. Methodology

3.1. The case study approach

The case study is a well-established approach in the social sciences. It is helpful to collect multiple sources of data and triangulate the information used to analyse and understand complex phenomena [54]. We developed this case study using a combination of semi-structured interviews with key informants and corroborating secondary data. Given

the technical nature of carbon pricing instruments, this study is limited to interviews with key informants who are proficient in the design implications of carbon pricing in Ireland. We recruited key informants for this study from government departments, think tanks researching climate policy development in the national context, labour unions or union-funded think tanks, businesses or business interest groups, nongovernmental organisations (NGOs), and academics contributing to carbon pricing policy development in the national context.

We selected interviewees based on their expertise with the carbon tax or their knowledge of interest groups affected by it. The first author conducted online research to find initial candidates and sent outreach emails to relevant government departments and groups that had made submissions or public statements about the carbon tax. She also contacted authors of reports, studies, and conference proceedings on the carbon tax or Irish climate policy. She recruited additional participants through snowball sampling, with interviewees referring others. Interview respondents were asked about the development of their national carbon tax, including the inclusiveness of the consultation process for design of the tax and the fairness of the tax and revenue impacts (see Appendix 2 for a full list of questions).

To triangulate the information gathered in the interviews, we collected secondary data, including policy documents or policy evaluations on the Irish carbon tax, policy documents about Ireland's wider climate policy, minutes from Oireachtas³ meetings, NGO and business reports on climate or energy policy, academic literature, and news coverage of the carbon tax consultation and design process. Initial data was collected from online searches prior to the interviews. Interview respondents provided supplementary materials and recommendations for further reading.

The data collected from the interviews and secondary data were compared using data triangulation and we found no discrepancies between the two sets of data. Data triangulation is the use of multiple sources of data to ensure the quality of findings in a qualitative study and is well-established in the social sciences [56]. Because social phenomena are complex and involve both objective facts and subjective attitudes, triangulation of qualitative data can ensure that the phenomena under study are more thoroughly understood [56,57].

The first author conducted twenty-one semi-structured interviews for the Irish case study, involving twenty-three participants.⁴ The balance of interview groups involved is shown in Fig. 1 below. Since the interviews are referenced frequently in the results of the study, each interview respondent is assigned a number designation 1–23. For a detailed breakdown of the affiliation, job titles and areas of sector expertise of the interviewees, please see Appendix 1.

The data for this study were analysed using an intersectional lens. This study explores several dimensions of intersectionality in the context of energy poverty, including age, ability, ethnicity, geography, and home ownership status. We investigate how these dimensions relate to low-income households' different experiences of energy poverty, while revenues targeted under the carbon tax do not account for these differences. There are similar methodological approaches which can be used to assess non-income measures of vulnerability, such as multidimensional poverty, which is used in the literature to assess non-income determinants of energy poverty or vulnerability to climate risks [58–61]. While multidimensional poverty is useful as a quantitative method, we have chosen intersectional justice as the analytical lens for this study because this lens favours qualitative approaches, disclosing impacts that quantitative studies may not reveal. We are particularly concerned with groups whose dimensions of vulnerability are not

³ The Oireachtas, or the bicameral parliament of Ireland, is composed of two houses of parliament: a house of representatives called Dáil Éireann and a senate called Seanad Éireann [55].

⁴ In two cases, participants preferred to conduct the interviews with their organisation in pairs.

Interviewees by affiliation: Irish case study

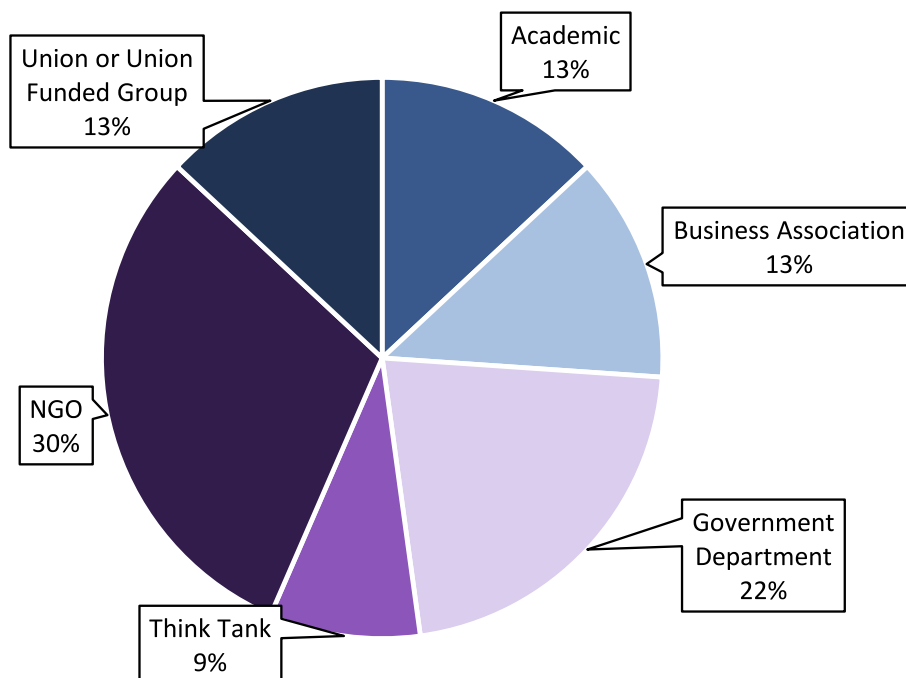


Fig. 1. Affiliation of interview respondents.

statistically disclusive in the Irish case. In addition, there are other justice lenses which have been used to assess the implications of climate and energy policies, such as procedural [62,63] or restorative [64,65] justice. However, as noted in Sections 2.2 and 2.3, this study is limited in scope to considering a specific aspect of the distributive implications of revenue use under the carbon tax.

The data were coded using both a deductive strategy informed by intersectional justice theory and an inductive strategy guided by the data itself. The first round of coding was descriptive, aimed at determining how specific identities were referenced. Top-down codes were applied to identify households based on the intersection of income with identity factors such as age, ability, gender, ethnicity, and geography.⁵ Home ownership status emerged inductively as an additional identity factor during this round. Descriptive coding was also used to track references to the various recycling measures funded by the carbon tax (see Table 2). The measures most frequently identified as impacting households were fuel allowances, energy efficiency upgrades, greenways, and EV charging infrastructure. Axial coding was then subsequently employed to explore how different identity dimensions interact with the available recycling measures. Themes emerged deductively, indicating that 1) eligibility for different measures, 2) barriers to applying for or utilising them, and 3) the perceived usefulness of these measures varied according to the identities coded for. Further rounds of coding were conducted to more precisely categorise these themes within a structured framework. The refinement and analysis of themes informed the arguments presented in the findings below.

The study contributes to the literature by offering a qualitative, justice-oriented case study on carbon taxation, which confirms existing findings on the impacts on older persons and rural households in Ireland and also highlights vulnerabilities not captured by statistical analyses.

⁵ For the identity factors for whom not enough data was found (gender, ethnicity beyond Travellers), see the Limitations section.

3.2. The Irish carbon tax

The Irish carbon tax was first implemented in 2010 [1]. The main objective of the carbon tax when it was introduced was to raise revenues used to reduce public debt incurred during the recession [66]. In 2017, a citizens' assembly was convened to address the issue of climate change policy. One of the recommendations from this assembly was that the existing carbon tax should be raised to help meet Ireland's emissions reduction targets [67]. Since 2019, the carbon tax has been a tool used primarily for emissions reductions [68].

During the tax increase period of October 2023–May 2024, the tax increased from an overall rate of €48.50/tCO₂ to €56/tCO₂, with legislation in place to raise the carbon tax to €100/tCO₂ by 2030 [69]. The tax applies to emissions from residential, commercial and road transport sectors [1]. The impact of the October 2023–May 2024 tax increase on different fuel types is reported in Table 1 below.

The Irish government has recognised that its decision to increase the carbon tax rate may increase households' vulnerability to energy poverty due to the increase in fossil fuel prices [70–72]. The government has discussed energy poverty risks in several of its climate policy documents and recognised the potential of recycling carbon tax revenues to reduce energy poverty in Ireland [14,72,73].

The rate of energy poverty in Ireland (as measured in 2022) is around 29 % [70]. Households most at risk of energy poverty in Ireland as

Table 1
Impact of carbon tax increase October 2023–May 2024.

Fuel type	Typical fuel bundle	2023 (€48.50)	2024 (€56.00)	Impact of +€7.50
Petrol	60 l fill	8.28	9.56	+1.28
Auto diesel	69 l fill	9.58	11.06	+1.48
Kerosene	900 l tank	125.47	144.87	+19.40
Peat	12.5 kg bale	1.26	1.46	+0.20
Coal	40 kg bag	5.80	6.70	+0.90
Gas	11,000 kWh	109.49	126.47	+16.98

(Source: Budget 2024).

Table 2

Carbon tax revenue investments 2020–2024.

Measures funded	2024 allocation (€ in million)
Fuel allowance	21
Energy poverty efficiency upgrades	13
Aggregated housing upgrade scheme ^a	0
Just transition	6
Peatlands rehabilitation	5
Greenways/urban cycling	9
Providing Grants for EVs	8
EV charging infrastructure	3
ODA – green climate fund	2
Green agricultural pilots	3
Total	70

^a This was a once-off pilot scheme. On its conclusion, the funding provided for the scheme was re-prioritised.

(Source: Budget 2024).

result of the rising carbon tax have been identified as low-income households, single parents, households with children, older persons, and rural households [14]. Further figures highlight the complexity of access to renewable energy alternatives in Ireland. In 2019, 31.4 % of Ireland's population resided in rural areas, exceeding the European Union average of 27.3 % at that time, reflecting a high prevalence of dispersed settlements across the country [74]. Natural gas infrastructure in Ireland is more concentrated in urban areas, with approximately 53 % of urban households using natural gas as their main heating fuel, compared to only 4 % of rural households. This disparity results in a high dependence on heating oil and solid fuels in rural areas [75]. Additionally, as of 2022, as many as 68,000 households had a high dependence on peat for home heating [76].

Recognising the impacts of the tax on the identified groups, the Irish government agreed to hypothecate revenues from the increased carbon tax rate, estimated to generate €9.5bn in additional government spending from 2021 to 2030 [77]. The revenues are hypothecated towards: 1) targeted social welfare payments to mitigate regressive impacts of the tax (€3 billion from 2021 to 2030); 2) funding of a socially progressive national retrofitting programme (€5 billion from 2021 to 2030); and 3) funding programmes for farmers to improve the sustainability of farming practices (€1.5 billion from 2021 to 2030)⁶ [77]. A detailed breakdown of revenue allocations is published annually as part of the government budget report. Table 2 illustrates the allocations as of the 2024 budget.

Several features of the Irish carbon tax make it a useful case study to examine intersectional justice implications of revenue recycling measures. First, the government has explicitly agreed to hypothecate revenues with the intention of making the carbon tax progressive. This makes the tax a valuable example to assess how well policies focussed on low-income households work when considering non-income types of vulnerabilities. Second, the hypothecated revenues outlined above have been distributed since 2020, providing several years for the interviewees to consider how the increasing tax rate and redistributed revenues impact vulnerable households. Consequently, we were able to collect sufficient data on the perceived impacts of the carbon tax revenues on households facing non-income vulnerabilities.

⁶ While the carbon tax has a minimal direct effect on workers in high-emitting industries, including the peat harvesting and agricultural sectors, the Irish government has agreed to hypothecate a portion of carbon tax revenues to assist farmers and workers in peat-fired coal plants to mitigate the negative impacts of other policies on these sectors [69]. Since this paper focuses on the impact of revenue recycling measures on households, the impacts on workers in these industries are not discussed at length here.

4. Results: carbon tax revenues

4.1. Limitations of existing measures of social impacts

The Irish government has designed the carbon tax to address its regressive impacts; research shows that the recycling of 35 % of tax revenues on social welfare measures has made Irish households in the bottom five income deciles better off than they were without the carbon tax [78]. The targeting of tax revenues is based in part on analyses of distributive impacts conducted by the Economic and Social Research Institute (ESRI), a publicly funded independent think tank in Ireland (3, 4, 5, 15, 19, 20) [72,78–81]. Using a mix of ESRI analyses and consultation submissions from academics, NGOs, business associations and concerned citizens during the policy design process, the carbon tax has been designed to recycle revenues to protect low-income households from rising energy costs and to protect rural regions and communities surrounding high-emitting industries who are negatively impacted by the low-carbon transition (4, 5) [68,78,82]. While econometric data are helpful in identifying vulnerable groups under a carbon tax, three respondents noted its limitations. They stated that some groups are too small to be statistically disclosive, and that certain patterns of vulnerability cannot be fully captured through economic modelling or household survey data (8, 15, 21).

4.2. Intersectional dimensions missing from the policy design

The participants in this study, along with groups who have produced reports on energy poverty in Ireland, did not oppose the use of the carbon tax or question the government's intention to support a just transition for vulnerable groups. However, evidence from interview responses and policy reports suggests that the current revenue recycling strategy fails to fully support certain vulnerable groups at risk of energy poverty. One overarching issue with existing fuel allowances and retrofits funded under the carbon tax is that they are primarily based on financial eligibility.⁷ This approach results in payment rates which do not account for intersecting inequalities. Several respondents argued that recycling revenues in this way creates a gap for groups on the margins of welfare eligibility, or who face additional risks of falling into energy poverty due to factors such as living in older or more poorly insulated homes, differences in lifestyle, dependency on solid fuels, or vulnerability to health issues that increase their home heating needs [85–88].

In the results below, several intersectional dimensions have been identified which (at least one of) the interviewees have indicated as not being adequately addressed by the current design of carbon tax revenue recycling. These identities are rural households, renters, older persons, people with disabilities or long-term illnesses, and the Irish Travellers.^{8,9}

⁷ Households qualifying for the fuel allowance or for free retrofit grants must satisfy a means test, whereby the applicant and household members may have a combined assessable income of up to €200/week or must already be receiving a qualifying social welfare payment which has already passed a means test (such as jobseeker's allowance, state pension, and widow/widower's pension) [83]. Households who do not qualify under the means test can apply for grants covering 50 % of the retrofit costs. For households eligible for free retrofits, there was, as of 2023, an approximate backlog of 9000 applicants, with a waiting list of 27 months, while households who cover 50 % of the costs experienced much shorter waiting times [73,84].

⁸ The Irish Travellers are an ethnic minority in Ireland who were formally recognised by the Irish government in March 2017. A set of distinct cultural values makes Travellers an ethnic minority, with nomadism being an important cultural factor distinguishing them from the settled population. There are an estimated 31,000 Travellers in Ireland, approximately 1 % of the Irish population [89].

⁹ As part of this study, respondents were asked to comment on the intersecting vulnerability of low-income women. However, the availability of data on this group was limited, so impacts of the Irish carbon tax on women are not discussed at length in this paper.

Some of these identities, such as rural households, are explicitly identified in government targeting of revenues, but some interview respondents indicated that existing revenue measures did not meet the needs of these groups. The remaining groups reviewed below do not appear in the final policy design but are discussed to various extents in the policy discourse. Of the intersectional dimensions discussed below, the vulnerability of these households can be understood as those who are both low-income *and* fall into one of these other groups. For instance, rural households or older persons who are well above the poverty line are not at risk of energy poverty.

4.2.1. Rural households

A key issue for low-income rural households is that they are more likely to be dependent on solid fuels, which tend to be more GHG intensive than fuels used in urban households. An academic interviewee pointed out that rural households are less likely to be covered by the national gas grid, making them more likely to be dependent on oil, coal and peat for home heating and cooking (11). Census data from 2022 shows that 68,000 households have a high dependence on peat for home heating [76]. Moreover, an NGO representative noted that for low-income households dependent on oil, which requires upfront payment to top up the oil tank, the monthly fuel allowance may be insufficient to cover their required payment rate (23).

Since the fuel allowances funded by the carbon tax revenues are based on household income rather than patterns of fuel use, two NGO officials argued that rural households are more vulnerable due to their dependence on solid fuels, which emit more GHGs per unit of energy produced than other fuels (7, 10). As such, due to the lack of substitution goods available to rural households, these households pay more to consume energy, but do not receive a higher rate of revenues to meet the same level of energy needs (7, 10). In addition to limited access to alternative fuel sources, people in rural areas are more likely to be living in older housing stock, or in households that were constructed without proper insulation, particularly in the Midlands and in the north-east of Ireland [90]. Because eligibility for free retrofits does not consider the issue of *discretionary* income, households who are not eligible for the free retrofits based on their income but who are still reliant on solid fuels and lack the capital to invest in partially funded retrofits are missing from retrofit grants [91].

In addition, several respondents from NGOs, academia and think tanks agreed that rural households have limited access to both the public transportation network and to the available infrastructure for electric vehicles (i.e., charging points) (10, 11, 15). Similarly, funding for greenways is of limited use to long-distance commuters (11), meaning that rural households are less able to avail of substitution goods for transportation (10, 11, 15). One NGO official argues that the rate of development of public transportation in rural areas is insufficient to meet the rising cost of fuel prices (10). Without further development of affordable alternative transportation options and renewable energy infrastructure for rural areas, the carbon tax will likely exacerbate existing social inequalities between geographic areas.

4.2.2. Renters

Low-income renters are particularly vulnerable to rising energy costs and lack the agency to choose more sustainable energy options. The Central Statistics Office calculates that the at-risk-of-poverty rate is highest for households who are renting, and higher for households currently receiving housing assistance payments (HAP) [92]. To compound the risks of energy poverty, over half of privately rented households in Ireland have a low energy efficiency rating (building energy rating of D or lower) [93]. One NGO respondent described the experience of low-income renters, many of whom can only afford lower-quality homes with poorly sealed windows and doors, low-quality storage heaters, or malfunctioning boilers, all of which lead to higher heating costs (23). While low-income renters who qualify for the means test do receive the fuel allowance, this allowance does not account for

the energy efficiency or energy needs of the household, meaning that the payments are unlikely to meet these households' energy requirements. The respondent also observed that fuel allowances do not take into consideration the purchasing power of households receiving both the HAP and the fuel allowance (23). According to a 2019 survey, 48 % of households receiving the HAP paid additional 'top-ups' directly to their landlord—an informal agreement where tenants pay extra money to landlords when the HAP does not cover the full rent, or when the rent has been raised beyond the HAP level [94]. The survey further showed that, for those willing to disclose the amount of their top-ups, 20 % of respondents paid more than 30 % of their net income on rent and 10 % spent over 40 % of their net income on rent [94]. The respondent concluded that for some households receiving both the HAP and the fuel allowance, these payments do not reflect the actual purchasing power of households paying top-ups, leaving them unable to pay or experiencing financial difficulty in paying their energy bills (23).

Even as low-income renters face the double-burden of lower incomes and higher energy costs for heating their homes, two NGO respondents, raised the issue of split incentives between renters and landlords on the issue of retrofitting (10, 23) [73,86,87,94]. The problem of split incentives arises when costs of heating an inefficient home accrue to renters, while retrofits must be undertaken by landlords who have little incentive to pay for retrofits (10) [73,86]. An NGO respondent described low-income renters as lacking the financial means to make even minor adjustments or updates to appliances in rented accommodation, or the security of tenure to be willing to invest in updates (23). In addition, tenants may be reluctant to raise issues such as renovations, efficiency updates or repairs with landlords due to the precarity of their tenancy and the limited availability of alternative housing options (23). In cases where landlords are willing to retrofit rented accommodation, some tenants are subject to 'renovictions', where improvements lead to prohibitive increases in rental prices (23) [94]. As retrofits and energy efficiency improvements become more widespread, there is a risk of gentrification, forcing low-income households into a smaller pool of affordable properties with lower energy efficiency ratings [95]. Moreover, an NGO respondent stated that even when landlords are willing to undertake retrofits in consultation with the tenant, in some cases the tenant cannot afford to vacate the property while deep retrofits take place (23).

Further, because low-income renters lack the agency to shift to more sustainable energy alternatives, they will remain dependent on fuel allowances and social welfare payments [14,90]. This dependency poses two problems. Firstly, since provision of fuel allowances does not differentiate for the energy efficiency of the household, renters living in energy inefficient households are receiving the same rate of payment as low-income households with lower electricity costs, and may be at a higher risk of energy poverty. Secondly, continuing to make welfare payments to offset rising energy costs resolves the immediate problem of regressiveness but does not achieve the policy goal of shifting households to more sustainable energy usage, leaving some households perpetually dependent on welfare payments for energy [87]. One NGO respondent argued that government plans to update private and council rental accommodation are not comprehensive enough and lack sufficient funding to bring Ireland's rental stock to an adequate level of energy efficiency (23). To achieve a just transition, respondents asserted that the state should provide households with equitable access to sustainable energy alternatives, which goes beyond merely mitigating the rise in fossil-fuel energy costs (10, 23).

4.2.3. Older persons

Respondents from NGOs, unions and think tanks agreed that older persons are acutely vulnerable to rising energy costs due to higher energy needs (7, 9, 10, 15, 21) [81]. Several studies of energy use patterns in Europe indicate that aging households increase their electricity usage due to medical needs or more time spent at home (21) [96,97]. One NGO respondent acknowledged the recent actions of the government in

increasing the Living Alone Allowance and using carbon tax revenues to expand the fuel allowance for households over 70, describing the existing fuel allowance for older persons as “quite generous” (21) [77,78,98,99]. Nonetheless, the respondent contended that there are older persons who are not being reached by existing fuel allowances, or that these allowances do not meet the energy needs of some older households (21). For instance, as of 2022 it was estimated that around 86,200 additional elderly households were at a high risk of energy poverty due to their high energy needs but did not meet the eligibility requirements for the fuel allowance [85].

Although older individuals are more likely to be living in energy-inefficient homes, several barriers limit their access to retrofit grants. The process for applying for household retrofits is largely online, yet only 1 in 4 persons aged 65 to 74 in the EU have basic digital skills, and 41 % of those over 75 in Ireland have never used the internet (21) [100,101]. An NGO respondent further observed that there is a higher rate of illiteracy and innumeracy among older people, making retrofit grant applications more difficult for this group (21) [102]. Additional costs associated with retrofitting, such as the cost of movers if older individuals are physically unable to move and store furniture during the retrofitting process, are also cited as a barrier to older persons given their limited incomes (21). Moreover, the respondent cited risk and uncertainty as an obstacle for older persons applying for partial retrofit grants. As older persons are often on a fixed income which is not renewable, many are reserving their savings for anticipated costs, such as funerals, nursing homes, homecare, or medical expenses (21).

Many older adults face barriers to accessing fuel allowances or fully funded home retrofits, making them more vulnerable to energy poverty than other households with similar financial resources. Designing revenue distribution systems that account for the challenges faced by older individuals can be important to address the energy needs of older individuals. This approach will help prevent the transition to a low-carbon economy from exacerbating existing inequalities.

4.2.4. People with disabilities or long-term illnesses

People with disabilities or long-term illnesses are more likely to incur higher heating costs due to their medical conditions and the fact that they spend more time at home because of mobility difficulties (21, 23) [90,103]. Ivanova & Middlemiss [104] estimated in 2021 that, in Europe, 24 % of disabled households were in energy poverty, and 17 % were at risk of energy poverty compared to 16 % and 12 % rates for economically inactive households without a disability. This discrepancy arises from the need for higher household temperatures or the use of electricity-powered medical devices [104]. In Ireland, it has been estimated that only approximately 50 % of individuals eligible for a disability allowance are also receiving the fuel allowance, despite many of the remaining 50 % having lower incomes and spending at least 10 % more on energy costs, putting them at greater risk for energy poverty (22) [105,106]. In addition, an NGO respondent highlighted barriers for households with a disability in accessing retrofit grants. For those eligible for free retrofits, it is often difficult or expensive to vacate the premises for a deep retrofit if the occupier requires a fully accessible housing alternative (22). The respondent also describes instances where retrofits have occurred without consulting the occupier and without considering universal design (22). Without proper consideration for universal design, a reduction in turning space for individuals in wheelchairs can create new challenges for the person(s) living in the house (22).

Further, investments in renewable transportation, such as greenways and EV infrastructure, may be of limited use to disabled persons. Households with a disability are more likely to rely on private transportation, as some are unable to use public transport (22). In many cases, greenways are not a viable alternative for people with physical disabilities (22). Advocacy groups have also raised concerns about the suitability of EV charging points in Ireland for disabled persons. Even when space to fit a wheelchair is provided, other factors, such as lack of

cover from the elements, the weight of the charger, and height of the screen and the payment touchpad can create accessibility barriers [107].

In conclusion, while some disabled persons do not qualify for fuel allowances or have access to fully funded retrofits, their energy needs put them at a higher risk of energy poverty compared to households of similar means who are not disabled.

4.2.5. The Irish Traveller community

Travellers are both more likely to be living in energy poverty and more likely to be dependent on solid fuels due to their propensity to live in mobile homes (7, 10) [108]. Nonetheless, a think tank official stated that ESRI analyses of impacts of the carbon tax are unlikely to include Traveller households because they are too small a sample size to measure with statistical precision (15). While Travellers' vulnerability to energy poverty and unique style of living have been reported to policymakers through advocacy channels (7), existing government policy documents on the use of carbon tax revenues make no mention of the unique situation of Travellers [77,78,109], and the way in which revenues are distributed have, de facto, largely excluded the Traveller community.

Neither free retrofits nor partial grants for retrofits are extended to mobile homes (7). In addition, most mobile homes available for purchase in Ireland do not meet residential standards of appropriate insulation for year-round living [88]. An NGO respondent asserted that due to energy cost increases, individuals and families residing in mobile homes often struggle to meet these costs and have no way to avoid rising costs, since their homes do not hold heat, and they do not have access to available retrofitting supports (7). While it is possible to acquire residential standard mobile homes, install insulation into mobile homes below a residential standard or install solar panels at halting sites, these activities were not subsidised or funded by the government as of 2023 when this interview took place (7) [108].

Moreover, Travellers' difficulty in communicating with the local and national government has caused them to be excluded from energy credits (7). In the case of electricity credits provided to households, these are distributed to a unique meter point reference number (MPRN).¹⁰ Culturally, many members of the Traveller community reside in group accommodation on halting sites throughout Ireland (7).¹¹ Each halting bay has its own unique MPRN number, but commonly multiple families are using the same halting bay, either to maintain family ties or because some family members cannot afford to rent a separate halting bay (7). Since electricity credits are provided at a fixed rate per household, multiple families living in the same halting bay may be splitting an energy bill which reflects the cost of electricity for multiple households, even though the credits available only reflect credits entitled to one household (7).

An NGO official described how her organisation raised this issue with the office of the Minister for Environment, Climate and Communications, who referred their organisation to the Residential Tenancy Board, who do not have remit over Traveller issues and referred them to the local authorities, who referred them to the Sustainable Energy Authority (SEAI) (7). As the respondent says:

“You were kind of going from pillar to post and no one wanted to deal with the problem. It was kind of like ‘Oh god, people don’t live in houses and have an ESB bill’, like it was brand new information to

¹⁰ The provision of electricity credits is not directly funded by carbon tax revenues, but is a budget measure from the Irish government to address rising energy prices, which may be a result of a diversity of factors including the increasing carbon tax rate [110].

¹¹ A halting site is a residential area which has been designated by a local authority on which members of the Traveller community can park mobile homes. These sites allow Travellers to express the values of their cultural identity, including the practice of residing together with large extended families and the practice of residing without permanent accommodation.

them. The Government has been aware, it's not a new phenomenon" (7).

While NGOs are in conversations with government departments to determine how to better reach Travellers who have been excluded from electricity credits or retrofit grants, no firm policy has yet materialised, and as of 2023 when these interviews took place, some households on halting sites still had not received their electricity credits. Ensuring that Travellers have access to sustainable resources during the transition may require more consideration for their cultural living practices.

4.3. Recommendations to improve revenue targeting

Recycling carbon tax revenues through means-tested fuel allowances makes the bottom five income deciles in Ireland better off and is administratively efficient in addressing regressivity of energy costs. However, there are better, more targeted approaches that address intersectional energy poverty. Interviewees suggested improvements within the government's capacity, such as an energy guarantee providing tiered kilowatt-hour allowances based on income and household insulation (21) [111]. Initially proposed for older persons, the energy guarantee could be expanded to other vulnerable groups, considering their specific energy needs and fuel sources.

Additionally, one respondent discussed ongoing talks between her NGO and the SEAI about extending household retrofits and BER standards to mobile homes (7). Similarly, a 2023 Dublin City Council pilot upgraded 28 group homes to high energy ratings, and there are plans to expand this retrofit programme to all Traveller group housing in Dublin during the 2025–2029 period [112,113]. Including mobile homes in these retrofit schemes would ensure that Traveller households benefit from measures aimed at mitigating energy poverty. Another NGO respondent recommended improving renters' access to retrofitting through a 'one-stop-shop' scheme targeted at landlords. This scheme would provide financial advice and grants to help landlords renovate properties while tenants remain in situ, with protections in place to ensure tenancy security (23).

To enhance the measurement of revenue impacts, a government respondent highlighted efforts to integrate equality metrics into performance reporting (19). He observed that the forthcoming Irish Equality Data Strategy would be helpful in improving the available data on how budget policies impact specific groups, since government departments running programmes funded by the carbon tax revenues currently do not collect data granular enough to evaluate how groups with intersectional vulnerabilities are affected (19). The Irish Equality Data Strategy aims to refine subgroup impact analysis, with a consultation on voluntary reporting planned for 2025 following reports from the Central Statistics Office [114]. Once more government departments become proficient in using equality metrics, they will be better able to evaluate the impacts of government policies on specific subgroups, such as those who have been identified in this study.

5. Discussion

5.1. Intersectional and non-income targeting of carbon tax revenues

The study above indicates that the Irish government has made efforts to design a socially progressive carbon tax policy, as ESRI research shows that the recycling of 35 % of tax revenues on social welfare measures has made Irish households in the bottom five income deciles better off than they were without the carbon tax [78]. Further, the policy has accounted for non-income elements of disadvantage to some extent, as policy documents acknowledge differences between urban and rural areas, and reports commissioned by the government on the impacts of the carbon tax have observed that single-parent households and older persons are vulnerable to regressive impacts. However, there are groups that this study identifies as at risk of energy poverty who are missing

from either projections on carbon tax impacts or the policy plans for revenue use (see Table 3). The groups least acknowledged in the policy discourse are renters, Travellers, and disabled persons. These groups are both overlooked in policy design and missing from economic analyses of vulnerability under the carbon tax.

The differences in lifestyle and patterns of energy use for renters, Travellers and people with disabilities or long-term illnesses as compared to low-income households who are not from these groups are not discussed in the policy documents on the tax design or shown in econometric models of the carbon tax impacts; however, their unique differences are understood by some advocacy groups who state that policymakers have been made aware of these issues (7, 8). NGOs have advocated for policies that benefit these groups. Nonetheless, economic projections on carbon tax impacts or in the final design of the carbon tax do not recognise some groups. While these groups may receive support through the low-income targeted fuel allowances, the de facto exclusion of some households from retrofit grants and the inadequacy of fuel allowances in addressing their specific energy needs and dependence on solid fuels means that the supports fall short of compensating for the added burden of increasing fuel prices, thereby exacerbating their income precarity.

Finally, for the vulnerable groups who are recognised in the policy documents, such as rural households and older persons, the question that arises is, whether the carbon tax revenues benefit them? Overall, low-income households are better off due to revenue recycling, however, there is a sense from some respondents that programmes being funded are not sufficient for certain groups. That home heating costs are addressed through electricity credits based on household meters and that lowering of home energy costs is being done through retrofitting programmes does suggest that many revenues are being targeted towards homeowners-in-residence. This gives some merit to the criticism that current retrofit plans and energy credits are not best suited to those in energy poverty or at risk of energy poverty. In addition, while a fuel allowance is helpful to mitigate regressiveness under the carbon tax, it falls short of incentivising the energy transition because many households who remain dependent on the fuel allowance still do not have access to or cannot afford sustainable energy alternatives.

5.2. Value of qualitative studies in tax design and evaluation

The study highlights how qualitative data can help to identify the impacts of climate change mitigation policies. These data better inform the policy design to protect households from rising energy costs and accurately reflect their energy needs. In particular, qualitative data can be a helpful complement to quantitative analysis to identify vulnerabilities that, for statistical reasons or lack of data, are difficult to capture in an econometric study.

In assessments of the distributive impacts of the carbon tax using CGE modelling or household survey data, economists in Ireland have measured impacts based on age, education level, regional location, size of household, properties of the dwelling¹² and some patterns of fuel usage (appliances in household, water or space heating, cooking methods, etc.) [20,81]. Members of think tanks who have conducted such studies have highlighted some non-income vulnerabilities such as older households, rural households and single parent households [13,15]. However, measures such as racial and ethnic identity are either not tracked or considered too small to be statistically significant.

The need for qualitative research to support the design and ex-post evaluation of GHG policies will vary across policy contexts. For instance, some countries collect relatively granular data on different ethnic and racial groups, while others tend to collect less of these data. In addition, in contexts where data is available, impacts on some groups may not appear in an econometric study, if the group is too small

¹² Apartment, attached house, semi-detached house, etc.

Table 3
Identity factors acknowledged in the carbon tax policy discourse.

Identity factors acknowledged in the carbon tax policy discourse				
	Identified in policy documents on design of the tax	Identified in ESRI modelling of carbon tax impacts	Discussed by interview respondents	Discussed in wider policy discourse (NGO reports, citizens assemblies, etc.)
Low-income households	X	X	X	X
Rural households	X	X	X	X
Renters	–	–	X	X
Older persons	–	X	X	X
Disabled persons	–	–	X	X
Travellers	–	–	X	X

X = discussed.

– = not discussed.

compared to the population considered. Even in contexts where data are available and groups studied are sufficiently large, qualitative studies can provide insights on problems encountered by specific segments of the population, and insights on how these may be addressed through policy design or complementary measures.

6. Limitations and future research

This study focuses on household impacts of the Irish carbon tax and does not address effects on workers, businesses, or specific sectors such as transportation. Moreover, while the Irish carbon tax covers emissions from transportation and buildings, other climate policies affect areas like agriculture and peat-fired plants to a greater extent. Therefore, further research is needed to examine the intersectional justice implications of the Irish energy transition across different sectors and climate policies.

Furthermore, while this study focuses on intersectional justice, its examination of carbon tax design meant that data collection was limited to interviews with key expert informants familiar with the elements of tax design. As such, the voices of vulnerable households were not directly represented in this study, but were instead conveyed through expert informants advocating on their behalf. This suggests scope for further research that directly engages with households identified as vulnerable to energy poverty. Similarly, as this study focuses on the distributive impacts of revenue recycling measures, other aspects of intersectional justice were not investigated, such as structural or procedural barriers to participation in policy design, or recognition elements, including whether different identities and worldviews were acknowledged or respected in the development of revenue recycling measures [47].

Additionally, more research is needed to understand how carbon pricing affects ethnic minorities in Ireland beyond the Traveller community. Although data on racial and ethnic poverty is scarce [115], Lawlor and Visser [14] suggest that migrants and ethnic minorities may be at greater risk of energy poverty, yet impacts on these groups remain underexplored in policy discussions. Gendered impacts of carbon pricing in Ireland also require further study, as there is limited data on how energy poverty affects men and women differently. For example, evidence from Canada [13] suggests that factors like unpaid care responsibilities limit women's access to sustainable transport, but similar data have not been collected in Ireland.

7. Conclusion

This study argues that carbon tax policies informed by intersectional

analysis can more accurately mitigate energy poverty risks for vulnerable populations and foster equitable transitions to a low-carbon economy. Although many empirical studies across various countries have examined the impacts of carbon pricing on low-income households [5,7,11,50], qualitative research focussing on the horizontal impacts for different vulnerable populations is still emerging. Expanding the literature with more studies on the horizontal impacts of carbon tax policy design can help capture context-specific challenges and vulnerabilities, ultimately enabling policymakers to improve the fairness and public acceptance of carbon taxes. In the Irish case, where hypothecating revenues for social protection played a strong role in mitigating political opposition to carbon tax increases, improving the targeting of these revenues could reduce the likelihood of opposition parties using the carbon tax as a strategy to sustain media attention around its controversy [32].

As the literature on the horizontal or non-income impacts of carbon pricing evolves, this study demonstrates how an intersectional justice lens can inform the design of national carbon tax policies. By considering intersectional justice, policymakers can gain a deeper understanding of how carbon pricing interacts with various non-income vulnerabilities, particularly in the design of measures like revenue recycling. Comparing our findings from the Irish context with those from other contexts, such as developing countries, would be valuable to determine how the impacts of carbon pricing may vary across different settings. This comparison could offer insights into how policies can be adapted to address the unique needs and vulnerabilities of diverse populations.

CRediT authorship contribution statement

Jeanne Magnetti: Writing – review & editing, Writing – original draft, Visualization, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Danny Marks:** Writing – review & editing, Validation, Supervision, Methodology. **Goran Dominioni:** Writing – review & editing, Validation, Supervision, Methodology.

Declaration of competing interest

No potential conflict of interest was reported by the author(s).

Acknowledgements

The authors acknowledge the interview respondents whose participation was critical for developing this paper.

Appendix 1. Profile of interview respondents in the Irish case study

Case	Job title	Affiliation	Sector	Recommended documents
1	General secretary	Business association	Agriculture	[116–119]
2	Senior executive	Business association	Energy and climate policy	[120–122]
3	Senior executive	Business association	Energy and climate policy	[123–125]
4	Officer	Government department	Tax policy	[68,77,78,109,126–128]
5	Officer	Government department	Tax policy	[68,77,78,109,126–128]
6	Scientific officer	Government department	Climate and environmental policy	[78,129,130]
7	Policy officer	NGO	Travellers' rights	[88,108]
8	Head of policy	NGO	Climate and environmental policy	[88,131]
9	Policy researcher	Union	Social and labour policy	[82]
10	Department manager	NGO	Climate policy and law	[73,132–135]
11	Associate professor	Academia	Climate and environmental policy	[67,72,81]
12	Assistant professor	Academia	Climate policy	[67,68]
13	Research affiliate	Think tank	Economics	[79,136,137]
14	Research assistant	Academia	Climate science	[138–142]
15	Research officer	Think tank	Economics	[3,72,143]
16	Economist	Union	Labour and economics	[144,145]
17	Policy officer	NGO	Agriculture	[118,134]
18	Campaigns coordinator	Union	Social and labour policy	[118,146]
19	Principal officer	Government department	Tax policy	[69,130,147–151]
20	Assistant principal officer	Government department	Tax policy	[69,130,147–151]
21	Senior policy analyst	NGO	Social policy	[73,111,152]
22	Policy advocacy manager	NGO	Social policy	[106,153,154]
23	Research and policy officer	NGO	Social policy	[94,155,156]

Appendix 2. Interview questions

1. What is your background and knowledge of the Irish carbon tax?
2. What are the key reasons why people have supported the use of the carbon tax?
3. What are the key reasons why people have opposed the use of the carbon tax?
4. Please describe the consultation process for development of the Irish carbon tax. Which stakeholders/stakeholder groups were involved and how was their feedback incorporated?
5. When designing the carbon tax, was there any engagement or consultation done to better understand the impact of carbon pricing on specific vulnerable groups? Specifically:
 - a. Vulnerabilities specific to urban or rural households
 - b. Travellers
 - c. Women
6. Communities living in areas supported by high-emitting industries (i.e. peat fired energy plants)
7. Were any groups exempted from the carbon tax? Did any groups lobby for exemptions who did not get them?
8. How are revenues from the carbon tax distributed? Which groups benefit from the use of revenues?
9. What does fairness mean to you in the context of the Irish carbon tax? How should it be designed to be considered fair?
10. How much impact has the carbon tax had on reducing emissions compared to a scenario with no carbon price? How impactful is the carbon tax projected to be in the future?
11. Who benefits the most from the implementation of the carbon tax? Who, if anyone, is negatively impacted by its implementation?
12. Please describe the challenges in implementing the carbon tax once the policy is designed and the price is set. What are the trade-offs, and are there gaps between the policy that is decided and what you are able to implement in practice?
13. When a carbon tax is implemented, post facto evaluations are conducted to determine the effectiveness of the tax and any unintended consequences it may have had on different groups. How are the impacts of the carbon tax on different groups evaluated? How often is the tax evaluated to measure these impacts?
14. Are there any documents or reports that you think would be useful to read further on these issues?
15. Is there anyone else you recommend I talk to about this?

Data availability

The authors do not have permission to share data.

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