Policy prescriptions to address energy and transport poverty in the United Kingdom

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Policy prescriptions to address energy and transport poverty in the United Kingdom

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Tens of millions of households across Europe struggle to afford adequate electricity and heating services and reliable transportation, while recent high fuel prices could lead to an increase in excess winter deaths. Tackling energy and transport poverty is thus of paramount policy importance. Here we document the drivers and lived experiences of energy and transport poverty in the United Kingdom, based on public focus groups and expert interviews. We find a set of policies that resonate with both expert planners and members of the public, implying they have a level of political and social acceptability that other measures may be lacking, notably: mandatory landlord energy efficiency upgrades, increasing the extent of financial assistance to households, cheaper (or even free) bus and train fares and restarting and expanding bus services. We buttress these findings with further suggestions for energy and transport system redesign that better meets emerging principles of energy and social justice.

Europe faces a daunting, recurring and progressively worsening energy poverty challenge. The European Union reports that the number of its citizens living in energy poverty could be as high as 125 million.[1] The situation is dire across Europe, and the *Economist* recently predicted that high fuel prices could kill more Europeans than the war in Ukraine[2].

Energy and transport poverty are particularly acute in the United Kingdom. There, an estimated 6.7 million households were in energy poverty in October 2022, a sharp increase from 4.5 million households in October 2021[3]. Assessments of transport poverty—the inability to afford adequate mobility services[4]—are harder to come by, but it could affect as many as 90% of households[5].

Low-carbon energy transitions, while necessary to meet climate goals and reduce the risks of impending climate change, could see patterns of energy and transport poverty worsen. Electric heating, for example, could increase energy poverty vulnerabilities among low-income households[6]. Heat pump adoption and energy efficiency retrofits tend to benefit those that can own their own homes but benefit less so those who rent their homes or live in temporary accommodation, such as students[7]. Residential solar photovoltaics can result in homes with lower incomes subsidizing feed-in-tariffs for wealthier households, and problems such as inverters failing or panels breaking can become a financial burden for lower-income adopters[8]. Battery electric vehicle adoption requires the building of expensive charging infrastructure, roads and parking lots, which divert public funds to benefit those driving private cars but not mass transit systems such as buses, trams and trains[9].

Debates on low-carbon transitions increasingly pay attention to questions of justice and equity[10–12], highlighting important dimensions that techno–economic analyses, which have long dominated these debates, ignore[13,14]. Mapping different justice dimensions (distributive, procedural, epistemic), as others have done, is an important first step[15]. However, while we agree with the importance of these analyses of just transitions and the equity implications of decarbonization pathways, such work needs to attend to the increasingly important policy mechanisms that have high degrees of both policy efficacy and social acceptability.

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Table 1 | Personal experiences of energy and transport poverty

Focus group location and number	Quote
England group 2	"Well, as I say, I'm part-time in the supermarkets and look after my aunt. And then, I found that free time during the day, I would go somewhere public so that there's like heating or go for a walk. And then, in evening's time, … I would go to bed with hot water bottles."
England group 2	"At winter this year, we struggled because I've had to reduce my working days because we have a disabled child. So, money's not like it used to be, unfortunately. So, yeah, we've really struggled and are still struggling, if I'm honest. It's only going to get worse for us."
Northern Ireland group 2	"And we were kind of doing okay, you know, cutting back…but now maternity's over I'm between jobs. It's scary, thinking to fill up the oil tank again. Luckily we filled it up about a week before the price went up… but we've actually been thinking about taking just…you know, little, small containers and going down to the Go garage and just being able to afford maybe smaller top-ups of the oil, because we just can't afford to go and buy 300 litres or whatever in one go now, because of the prices."
Scotland group 2	"The company I was with went bust. And they put me with a new company. And my payment to the old company was £49. But the new company they put me with, they are wanting £132. Which is nearly triple to what I was paying monthly. And it's a good job that my daughter got me a good deal. And they are meant to hold for four years. They can't shift the price for four years. And I'm glad that I've done it before all the prices have went sky high."
Scotland group 2	"We've definitely cut back on the power. The heating goes off at eight o'clock at night. It's only on for a couple of hours in the morning. Because I'm a pensioner. And it's only on from five o'clock to eight o'clock at night. Then that way—curtains and the doors—the curtains are closed on the windows with the Venetian blinds. Anything to stop heat going out."
Scotland group 1	"Much the same. I don't drink, don't smoke, don't eat out, don't go on nights out, see friends less regularly so you're not using the petrol as well. Yeah, pretty much the same as everyone else. Wear warm clothes rather than heat the house."

Energy poverty has gradually entered national and regional policy agendas in Europe, reflected in regulatory documents and policy proposals, but its combination with transport poverty remains neglected. We advance here a notion of combined energy and transport poverty, or 'double energy vulnerability,' which denotes the situation of experiencing energy poverty and transport poverty at the same time[16,17]; it is most likely to affect people with low incomes, those people who are older, households with children or dependents, people with pre-existing health conditions or disabilities, women and people from ethnic minorities[18–20]. Measures to alleviate energy and transport poverty can be viewed as a form of social welfare (protection) policy, such that understanding public support for the former will probably benefit from an understanding of the latter. This also enables us to better comprehend emerging contours of energy 'precarity' in the United Kingdom[21].

To address these issues, we explore which policy options experts and members of the public view as having the greatest bearing on energy and transport poverty and why. We do this via eight focus groups with members of the public ($N = 49$ participants) and expert interviews ($N = 42$). Not all of those questioned fully participated in the scoring. On the basis of these data, we argue that policies of (1) increasing mandatory landlord energy efficiency upgrades and more stringent enforcement of these; (2) increasing the extent of financial assistance to households; (3) cheaper or even free bus and train fares and (4) restarting and expanding bus services are feasible first steps that can garner widespread public and expert support to alleviate energy and transport poverty.

Background and context

Though many may take it for granted, having a warm, comfortable, well-lit home or being able to travel to meet daily needs are central to a good quality of life. When people cannot afford adequate warmth or mobility, they often adopt coping strategies that can damage their health or further entrench poverty, such as tightly rationing home energy consumption and transport usage or cutting back on other essential expenses (for example, food or medical care)[22,23]. Energy and transport poverty affect certain sociodemographic groups more (for example, those with low income, those from ethnic minorities, those who have health issues or disabilities, people who live in rural or isolated areas and families with children)[24].

In the current cost-of-living crisis facing the United Kingdom, families are using fast food restaurants as their living rooms to provide warmth and hot water, people are washing in their kitchen sinks because they cannot afford a hot shower, parents are skipping meals to feed their children, pensioners are travelling on a bus all day to avoid a cold home and people with disabilities are forgoing vital equipment if it costs too much to run it[25]. With the price of a full tank of petrol for a family car surpassing £100 for the first time in history[26], lower-paid healthcare workers in the National Health Service could not afford to commute to work and had to call in sick[27]. Energy poverty results in higher rates of mortality among the elderly, a greater prevalence of circulatory and respiratory diseases in adults, reduced physical and emotional well-being and an increased risk of falls, mental health illness, social isolation and hospital admissions[28]. Energy poverty can result in thousands of excess winter deaths every year[29,30], more than the number of people who die from breast or prostate cancer, and hypothermia and cold, damp, homes cost the National Health Service more than £2.5 billion a year[31]. Transport poverty can limit access to employment, education, school, healthcare and leisure, force reliance on unaffordable cars, decrease well-being and increase exposure to negative externalities such as transport pollution[19].

Energy bills are rising in the United Kingdom to be the highest they have been in half a century, and a staggering two-thirds of homes could be in fuel poverty by the end of 2023[32]. Home energy costs will amount to 7% of national gross domestic product, or more than education and defence expenditures combined. UK energy prices have grown by 178% from October 2021 to October 2022, 35 times faster than wages and 57 times faster than the standard welfare benefits payment. This impacts especially low-income households, with 4 million households in the United Kingdom with prepayment meters expected to spend 44% of their monthly disposable income on energy bills during the coming winter[33].

In this study, the United Kingdom is taken as a four-country, qualitative case study of perceptions by members of the public and expert stakeholders on policy mechanisms to reduce energy and transport poverty, with an emphasis on exploring perceptions of related policy in the context of decarbonization. By 'perceptions,' we refer generally to the views, beliefs, attitudes and underlying rationales held by individuals. We look for areas of concurrence and divergence and consider the implications for public support of low-carbon transitions policy.

The United Kingdom's four nations have differentiated geography and energy and transport challenges, within which we explore public and stakeholder views of UK government policies. The study contributes to the literature of sociotechnical transitions politics, including relationships between elite and mass politics[34] and the need to avoid a 'backlash' against transitions policy[35]. Both are increasingly relevant in

Table 2 | Anxieties about energy costs among the public

Focus group location and number	Quote
Wales group 1	"Yeah, I feel like unless you're very well off, I feel like it's gonna affect everyone, isn't it? Everyone's worried about it. My boyfriend's parents, they've both got good wages, but they do struggle quite a bit … even a year ago before all the price rises, they were struggling. So genuinely I can't imagine how much they're gonna struggle, but I feel like unless you're rich or very well off, [laughs] everyone's gonna feel the pressure aren't they?"
Scotland group 1	"I would agree, it can be absolutely anybody. You just don't know when your situation is going to change and where one small thing can erupt. You're going along your daily life—you have an accident, things completely change. One of you loses your job, things completely change. But there's also—you've got to think of the people on a middle income. I'm thinking of like I've got relatives and things. And yes, they're covering their bills just now. But come April when the rise comes, with childcare—everything, across the whole spectrum they're spending more. And their wages aren't going up to meet with that. It's impossible, isn't it?"
Scotland group 1	"It can be anybody [at risk of energy and transport poverty]. My wife and I have lived quite comfortably, but at the moment we're still having to struggle. We're trying to find where we can cut back and where can we save from for this hike that's coming in April. Because we know we've only got a wee bit of savings. Once that goes in these high bills, then we can be in trouble. As I say, we've always lived quite comfortably. If we suffer, then there's people who are worse off than me who are really going to suffer. Yeah, so I agree with [others in this group], we should take it back, get the pricing sorted out and help the people. Not just of Scotland, but of the whole UK."
Northern Ireland group 1	"I agree with that, yes. It is for the elderly, but we also have to think of the other end of the scale where there's single parents. Even two-parent families are struggling to make ends meet because everything's going up, it isn't just on heating alone, everything is taken away from the balance that people have had with their budgets."
Northern Ireland group 2	"I think more people are going to rent. I know so many people who are selling because they just can't keep up with, like we said…and they're not particularly really low income. They're sort of working class as well, but with everything going up, they're going to rent and…I know a lot of people who've sold their house because the housing market's been up, to clear…to get the cash."

contexts where political populism is on the rise and concur with the call for sociotechnical transitions analysts to engage with social, political and other trends that run counter to more sustainable directions[36].

The just transitions literature provides two main rationales for why transitions to lower carbon economies need to be, and be seen to be, 'just'. The first is the intrinsic importance of justice: theorists have distinguished different types of justice in the context of energy transitions in general[37], with transport increasingly considered alongside energy[20]. The second rationale is more instrumental, relates more closely to the concerns of this paper and also to the origins of the term 'just transitions' in the labour movement:[38,39] without public support, achieving low-carbon transitions will be more difficult. From this perspective, justice is not simply an objective construct—it is also a matter of perception[40]. The study also relates to the longstanding question of the relationships between forms of welfare state, national sustainability performance and the nature of just transitions[41].

We take into account here the wider economic context. As of 2021–2022, economies and government finances internationally are recovering unevenly from steep declines in gross domestic product related to the COVID-19 pandemic[42]. In the United Kingdom, COVID-19 has particularly impacted public transport usage and hence its financial sustainability, with the prospect of service cuts or price increases likely to greatly impact those people on low incomes who remain reliant on public transportation. Increased demand after COVID-19 lockdowns caused a peak in demand and prices for daily car use, and the government's commitment to public transport is unclear, despite policy statements. At the same time, substantial increases in petrol prices are driving a considerable percentage of the UK population (perhaps 11%) into transport poverty[43]. COVID-19 and Russia's invasion of Ukraine have only worsened trends in oil and gas prices and subsequent inflation and anticipation of impact on future food prices—all of which have fuelled rapid rises in energy and transport poverty.

Although our focus is on the United Kingdom, our study has international relevance. The United Kingdom still remains largely dependent on natural gas, and some research has identified the presence of a strong fossil fuel regime that supports long-lived investment in gas supply, gas pipelines and gas boilers, which make shifting heating or building practices difficult[44]. Our study is therefore partly generalizable to the difficulties of addressing energy and transport poverty in fossil fuel regimes. Furthermore, demographic projections from Eurostat have predicted that due to rapid immigration coupled with population growth, the United Kingdom could overtake Germany to become the most populous country in Europe by mid-century[45]. This means our findings have regional importance to European policy. Lastly, the United Kingdom has pushed heavily a market-based ideology typified by liberalization and competition, one that 'picks no winners' and relies on free market forces to set energy supply and demand[46,47]. This model has been exported around the world in a wave of electricity (and other utility) market restructuring, driven by international actors such as the World Bank and other development banks[48]. The trends we identify in the United Kingdom may thus be a harbinger of things to come in other liberalized energy markets that also emphasize competition and cost-recovery for energy suppliers. The United Kingdom is consequently a paradigmatic example of the twin challenges of decarbonizing energy and transport systems and meeting carbon targets but also ensuring the viability and profitability of energy firms.

Shared notions (and emotions) of vulnerability

We carried out eight focus groups with members of the public to examine people's views on energy and transport policies, with a bearing on policies related to energy poverty and transport poverty that were taken from UK government policy documents (Methods). Several of the public participants were experiencing difficulties in paying for their transport and, particularly, domestic energy costs. One surprising aspect of this finding was the ubiquity of indirect and direct experiences and fear of energy-related hardship, despite the sample of public participants not having been drawn from primarily lower-income households or rural areas. Table 1 presents some of the illustrative quotations from our dataset concerning the lived experiences of energy or transport poverty. Accounts include going to bed with hot water bottles rather than space heating, difficulty in supporting a disabled child, people having to decide between energy and other essential household goods or services and selling homes to get clear of energy debts. The extent to which some of the focus group participants were affected was striking, given that our public samples were of the general population (including some participants who identified themselves as being in the middle to upper class) and not selected for low-income representation. It should also be noted that the focus groups were held before the April 2022 increase in the energy price cap and therefore situations may have worsened.

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Table 3 | Stakeholder perceptions of advantages and disadvantages of policy options for energy and transport poverty

Policies	Arguments for	Arguments against
Energy		
Landlords obligated to improve energy efficiency (to EPC band C*).	Targets low-income households (LHIs), who tend to be in rented accommodations. Could reduce LHI energy expenditure. Begins to address poor condition of UK (particularly private rental) housing stock.	EPC system is flawed generally and for this purpose. Without additional subsidy, landlords may sell their properties, depressing sale prices locally. Landlords likely to pass costs on to tenants unless prevented. Enforcement required; current resourcing is inadequate.
Expand eligibility for financial assistance (Warm Home Discount, WHD).	Could be immediate and have some, even if limited, impact.	The level of WHD (£140–150 yr^{-1}) is far too low to offset annual home energy costs of £2,000–3,000). It is not clear how well targeted the WHD is, and in any case, arguably too high a proportion of the population is now affected for even a limited-income subsidy to be affordable if financed from consumer tariffs (as the WHD is). Other finance-related options mooted: more frequent payments to LHIs; universal basic income; wider welfare system reform; entitlement to a minimum energy service level (universal basic service); social tariffs; fairer distribution of wealth.
New homes to be more energy efficient.	Reduces the energy demand of future householders. Necessary for net zero.	LHIs generally occupy older houses, so of little to no short- or medium-term benefit to them.
Consumers offered smart meters.	Interface provides information that can underpin behaviour change. Data flow necessary for smart grid functioning.	LHIs already budget extremely carefully and rather need tailored support packages that address multiple needs. Observing expenditure and engaging with additional controls likely to further stress LHIs. Smart grids with time-of-use tariffs risk penalizing those who cannot adjust for health reasons; similarly, those who cannot afford tariff-related technology (for example, EV, battery, PV panels).
Landlords able to offset higher spending on energy efficiency.	As the energy efficiency (EPC band C) obligation.	As the energy efficiency (EPC band C) obligation.
Increase finance to large energy suppliers to help fuel poor.	Large energy suppliers know who is struggling to pay their energy bills among their customers and have the organizational and skill base to administer and deliver energy efficiency measures.	Conflict of interest. Mistrust of these suppliers. Large suppliers do not need external financial support, particularly during times of high energy costs. Several interviewees critiqued the existing UK Energy Company Obligation scheme as not being well targeted at energy poverty.
Transport		
Bus and train ticketing cheaper and simpler.	LHIs often cannot afford to buy or run a car: improving public transport is therefore key to addressing transport poverty. Outside of London, deregulation of public transport in the United Kingdom is considered by many to have led to a deterioration of services.	Politically challenging: requires some adjustment of national expenditure priorities away from motorways and highways.
Ban sales of new petrol and diesel cars.	Necessary to meet decarbonization objectives; new vehicles will become more affordable in a developing second-hand market.	Even with price reductions, LHIs will still not be able to afford EVs, new or used. Diverts resources and attention from active travel, public transport and planning for accessibility ('20-minute neighbourhoods').
Increase support to local authorities for EV recharging.	As above.	As above.
Expansion of cycling infrastructure.	Has health and environmental benefits.	Few LHIs unlikely to use cycling infrastructure. UK starts from a low base. Better to construct '20-minute neighbourhoods' that are walkable. Barriers constructed to keep motorbikes and cars from using cycle lanes are also obstructing disabled access.
Restoring bus routes post-COVID-19.	LHIs often cannot afford to buy or run a car: improving public transport is therefore key to addressing transport poverty.	Politically challenging: requires some adjustment of national expenditure priorities away from motorways and highways.
Increasing the sustainability of aircraft fuel.	Important as part of maintaining connectivity for geographically peripheral regions.	LHIs cannot afford to fly: not directly relevant to transport poverty.

Note: LHI = low-income households. WHD = Warm Home Discount. PV = solar photovoltaic. EPC = energy performance certificate. EV = electric vehicle. *In the United Kingdom, EPCs grade a building based on its relative energy efficiency, ranging from A (very efficient) to G (very inefficient). An EPC grade of C means generally average performance.

Even if they were not personally impacted at the time of the focus groups, many participants also stated their belief that energy poverty can *potentially* affect the vast majority of the population except the most affluent and that even middle-class households were likely to struggle given ongoing energy price rises (Table 2). They also felt that households can enter energy or transport poverty at any moment, due to an accident or precarious circumstance.

Overall, when considering which social groups are likely to experience energy and transport poverty, there was a strong theme across the focus groups of '*this could be me*', even though the focus group participants were screened to be nationally representative for particular quotas such as age, gender and location (rather than be in energy and transport poverty). Therefore, participants generally felt that effective and just policy responses could be designed not only to help those in

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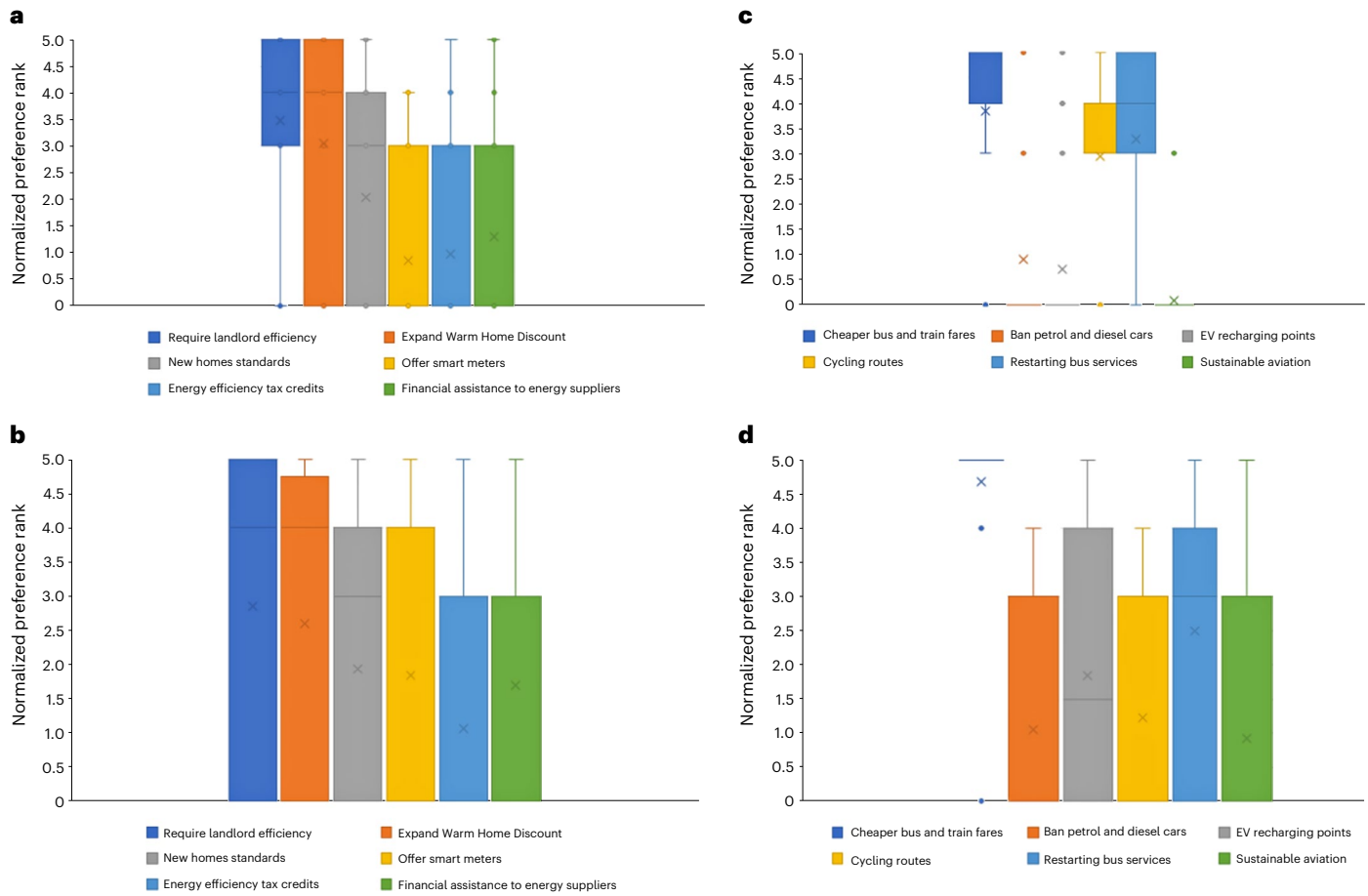

Fig. 1 | Preferences for policy interventions targeting energy and transport poverty. a, Expert preferences for energy poverty. **b**, Public preferences for energy poverty. **c**, Expert preferences for transport poverty. **d**, Public preferences for transport poverty. On the basis of expert interviews ($N = 39$ of our 42 participants) and focus groups ($N = 48$ of 49 participants for the energy questions and 45 of 49 participants for the transport questions). Note: the dots represent outlier data points from our expert interviews or focus groups, and the whisker lines the maximum and minimum values without outliers. The central box shows the interquartile range including the median (line in the middle of each central box) and the upper and lower quartiles (the remainder of the box). Some of the box and whisker plots show no range because more than half of the values were the same, and the boxes demarcate the upper and lower quartiles, emphasizing stronger consensus across the data. This consensus can be approving or disapproving of an option: for example, positive in the case of public ranking of cheaper bus and train fares and negative where experts agreed that neither banning petrol and diesel cars, nor increasing local authority resourcing for EV charge points would be positive for transport poverty. A normalization method has been applied to the raw values, because without this, the higher ranks would produce lower bar chart columns. In the interviews and focus groups, we asked for participants' top three ranks of six policy options (six options for energy policy, six options for transport policy). Of these, their most preferred option is allocated a value of 1, their least preferred of the three is given 3 and their non-ranked options are all given 6. These values were then normalized by subtracting each value from 6, such that the top rank are scored 5, the second rank are scored 4 and the unranked options are scored 0. This accentuates the difference between ranked and non-ranked options, narrowing the range of possible scores.

need *now* but also those who are at risk of energy or transport poverty *in the future*—that is, those who are not currently struggling but might find themselves in that situation.

The special circumstances of rural areas

Both the focus group participants and the expert stakeholders recognized geographical variation in vulnerability to energy and transport poverty, with rural areas noted as having special circumstances. First, rural areas often lack access to a main gas network, with a substantial proportion of people dependent on oil for heating. This has a volatile price that is unregulated in the United Kingdom (contrary to electricity prices for consumers) and has a 'lumpy' purchase pattern in terms of oil tank fill-ups being irregular and costly. Second, rural areas often lack a dense, reliable and frequent public transport network, with long distances between settlements and services that make active travel (walking and cycling) less feasible. Thus, in more rural areas, travel by car was viewed as likely to continue to be a necessary and important part of people's lives. This, in turn, increases the importance of moving to electric vehicles and potentially offering some form of subsidy or payment that could help rural households afford the cost of running such vehicles—essentially a kind of 'social tariff' for car running costs available to rural households using electric mobility.

While several interviewees questioned whether new electric vehicles would ever be accessible to those vulnerable to energy and transport poverty, there was some discussion of the developing market in second-hand electric vehicles (although some stakeholders felt this would not occur until 2030 at the earliest) and the option of subsidizing this in ways that did not simply lead to sellers raising purchase costs. For similar reasons, some expert stakeholders from Northern Ireland and Scotland also felt that maintaining some domestic flights was important for enabling those living in more remote areas to connect with wider society—as such, they were supportive of the policy option of improving the sustainability of aircraft fuel as a way to reduce the environmental impacts of this.

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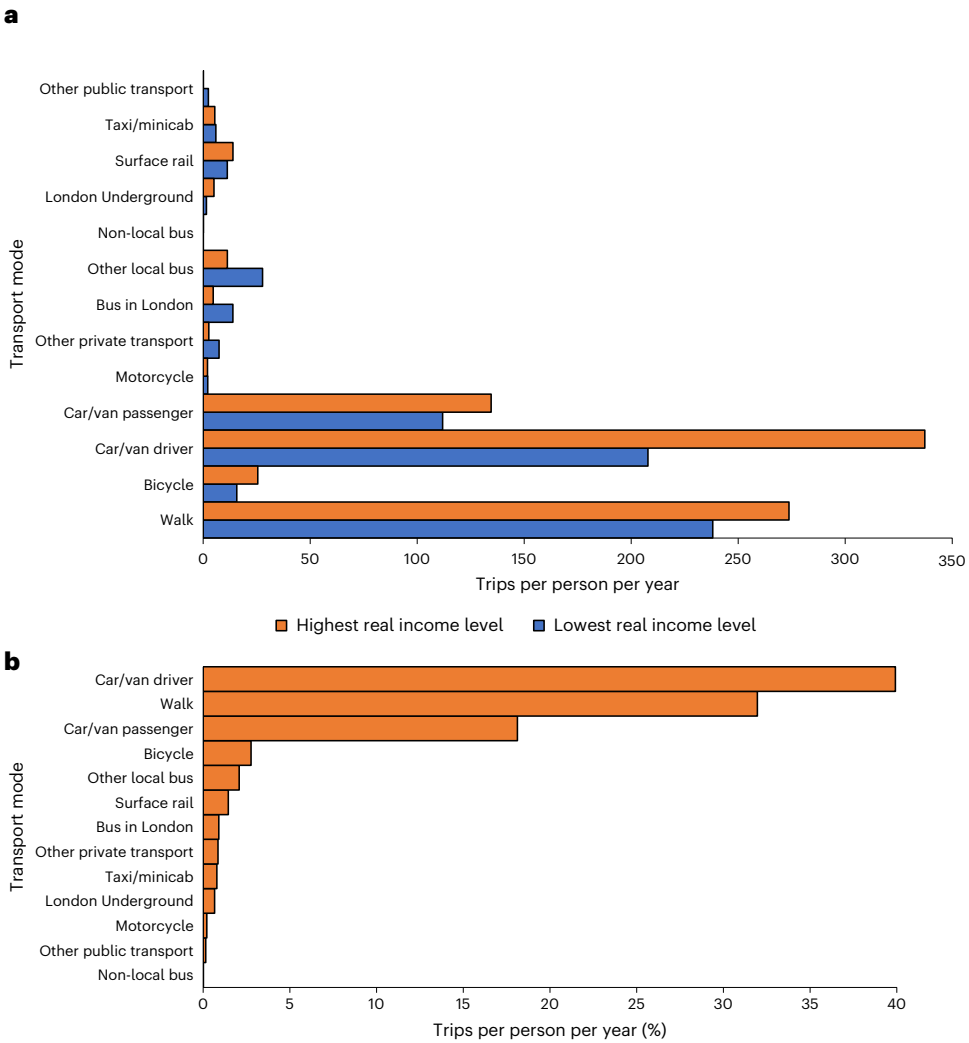

Fig. 2 | Travel and mobility patterns in the United Kingdom. a, Trips per person per year (2020) by main mode and household income quintile (highest and lowest quintiles only), all UK households. **b**, Trips per person per year by main mode (2020), all UK households (%). Data from ref. [63].

Perceptions of policy options

In addition to public focus groups, we interviewed 42 expert stakeholders to seek their views on the same energy and transport policy options taken from UK government policy documents that were presented to the focus groups (Methods). Areas of consensus notwithstanding, stakeholders offered a variety of views of mitigation policies. Although there was some reference to the importance and need for regulatory support of new business models that in turn protect vulnerable households and decarbonization simultaneously, most of the discourse was in terms of social protection per se, that is, not explicitly within a neoliberal frame, despite the prevalence of market-based instruments in UK environmental policymaking[49].

This suggests that energy and transport poverty are viewed—at least by those expert stakeholders questioned—as features closely related to social welfare, despite the increasing connections with decarbonization policy. In this respect, there is correspondence with a different UK regulatory sector—telecommunications—in which individuals and households have long been viewed not only as consumers but also as citizens[50]. Table 3 provides reasons for favouring and disfavouring the policy options presented to our experts. As such, they indicate areas of consensus and dissensus.

Notably, the focus group participants generally favoured obliging landlords to improve the energy efficiency of the homes that they let. However, many were also sceptical of enforcement and whether landlords would pass the costs on to tenants. As indicative quotes, one participant said: "Yeah, certainly that's a good place to start because if the landlords are duty bound to make the properties more insulated and economical to run, it's going to help people in the long run. I know landlords probably wouldn't agree with that, but they've got off with it for too long" (from Northern Ireland group 2), and another said, "I just think as a tenant, there's nothing that you can do once you're in the property. It's all outside of your control, apart from turning the heating on. I think if landlords just had more responsibility to get their properties that they are renting up to standard, then you would be spending less to heat it, for example. So, I think that can only be a good thing" (from Wales group 2).

Expanding the Warm Home Discount scheme—both in terms of increasing the payment amount, but also widening eligibility criteria so a much larger section of people could access support—was also generally favoured by members of the public. The reasons for this related strongly to the notion of shared vulnerability, discussed above; the idea that most people were at risk of hardship due to rising energy prices and that more would be. As one participant from Scottish group 1 said when justifying their support, "That could indeed be anyone. I reckon there must be thousands, if not hundreds of thousands in Scotland that are suffering from this [energy and transport poverty]."

Table 4 | Alternative policies proposed by the interviewees and their justifications

Policy suggestion	Explanation
Revise marginal pricing in wholesale electricity markets.	Marginal pricing means that the cost of electricity sold on the wholesale market is set by the most expensive source (currently natural gas). This means that the lower cost of renewable energy is not passed on to consumers. Allowing renewable energy to be sold at less than marginal cost would reduce consumer bills.
Shift environmental levies on to general taxation.	Shifting environmental levies away from electricity bills on to general taxation would be more progressive and incentivize the electrification of heating.
Expand energy advice and other support services.	Energy advice and other integrated support, delivered by trusted experts, can provide ongoing support for people at risk of fuel poverty.
Prioritize and dramatically upscale the installation of domestic energy efficiency measures through a national infrastructure programme, focusing especially on insulation and measures relating to the building fabric.	Energy efficiency is the most cost-effective way to reduce emissions and consumer bills.
The widespread expansion of bus services, with lower ticket prices and simplification of ticketing options (both for buses and rail).	Expanding public transport provides a way to reduce transport emissions in a way that benefits people with low incomes. The specific idea of 'inter-modal' ticketing was mentioned by several stakeholders.
Stronger enforcement of energy efficiency regulations in the private-rented sector of housing, with extra financial resources provided to local authorities to enable this.	The private-rented sector is particularly problematic in terms of fuel poverty and inadequate housing conditions, but current regulations are difficult to enforce because local authorities do not have the necessary resources.
Universal basic income and universal basic services.	Providing a guaranteed income level or free essential energy services as basic rights would ensure every citizen can achieve a decent living standard.
Greater use of social tariffs (that is, lower priced energy tariffs) for those on low incomes.	Social tariffs can ensure energy is affordable while targeting support at those deemed to be more vulnerable to energy poverty.

Less popular among focus group participants was the policy option of increasing financial support to the large energy firms so that they can support people struggling with their bills via energy efficiency measures. Participants would rather see these firms help from their own resources, and there was some conflation with energy suppliers and distributors. Reasons given by the public include anger at being ripped off, being manipulated by energy providers and providers pocketing money they should be putting into efficiency or more affordable heating members. As a Northern Ireland group 2 participant commented, "It's ridiculous when the same energy companies are recording record profits, it's absolutely ridiculous. We're being ripped off. I could understand it if those companies were struggling for money or they were going bankrupt, but they're not. They're recording record profits…. It's criminal in a way."

Moreover, there are striking areas of convergence between some expert suggestions and focus group perceptions about the desirability and acceptability of particular policy options. Figure 1a,b shows consensus among both experts and the public concerning the most preferred policy options for addressing energy poverty: requiring landlord energy efficiency followed by expanded Warm Home Discount schemes. The public also evidenced more support for new homes standards. Conversely, options such as smart meters, energy efficiency tax credits or greater financial assistance to energy suppliers had lower levels of support among both experts and the public. For transport poverty, Fig. 1c,d shows similar convergence. Both experts and the public agreed upon the need for cheaper bus and train fares, followed by restarting bus services and expanding cycling routes. Conversely, there was very low agreement or support for banning cars, electric vehicle charging and sustainable aviation. The finding about more affordable bus and mass transit fares is apt, given recent experience, for example, in Germany: significant lowering of public transit fares in 2022 increased public transport use notably. Going further, some cities in the United States such as Boston (Massachusetts), Olympia (Washington), Kansas City (Missouri), Richmond (Virginia) and Washington DC have even begun to offer bus and public transit fares for free, on grounds of equity and justice, and consequent increases in ridership. New York City's 'Fair Fares Program' also offers low-income residents half-priced subway fares.

Prescriptions for system redesign

Many of the stakeholders view the cost-of-living crisis in the United Kingdom as an opportunity for different types of system redesign for just transitions. While stakeholders viewed energy and transport poverty as amenable to alleviation in a variety of ways, at a surface level, they generally viewed energy poverty as the result of an interaction between the income of individuals or households, the energy efficiency of the building in which they live and the cost of energy. Transport poverty is similarly viewed as an interaction of income and cost but with additional dimensions of availability and accessibility, in turn, partially related to geography (rural locations increasing the cost and availability of supply). Cycling, which would be promoted under one of the policy options that we included, is viewed as unlikely to have a significant take up by low-income households in the short to medium term. Figure 2a shows low-income households currently cycling less than high-income households, using buses more and otherwise apparently being less mobile; Fig. 2b shows how reliant the United Kingdom is on cars and walking.

The public were generally uncertain as to how to address the problems that, in some cases, research participants were experiencing. Both they and the experts obliged in prioritizing among our government-sourced policies, but neither group was fully convinced by most of them. For example, most of the expert stakeholders saw the need for a more extensive, arguably visionary system redesign involving changes that go beyond the options we presented. Several of these were mentioned by multiple expert interviewees, shown in Table 4.

There was general agreement among stakeholders on the need for more than marginal change as digitalization and electrification converge and extend into the areas of transportation and heating, entailing both considerable capital investment and digital literacy. The need for simplicity, inclusivity and accessibility of schemes and their communication was variously referred to, with show homes in each community being seen as one way of helping with familiarization.

Others referred to a need for business models that are lease- or service-based, shifting and spreading the cost and risk of investment away from households alone and towards companies. A caveat repeated in this context is the need to avoid lower-income households being used as guinea pigs in technology trials, including those in social housing,

Table 5 | Alternative policies proposed by the focus group participants

Policy	Example quote(s)
Abandoning automobiles for walking and cycling.	"There's a lot more people walking and cycling stuff nowadays in the towns and that. I quite agree with keeping the cyclists away from the main traffic and from pedestrians … it's quite important that we get rid of all the petrol and diesel cars … we need to do something and take all the new cars off the road" (Scotland group 2). "So if there's different routes that are away from traffic, more people may cycle. Making it easier for people to get to places… Because, it'd be a lot safer for people to cycle to work if there were direct routes and separate routes for them, rather than having to go through traffic at the minute" (England group 2).
Banning petrol and diesel vehicle sales.	"Because, I do think that emissions of cars is quite bad. That's why I'm not using mine, if I'm honest. And, I do think they are going to make it low, aren't they? That everyone's going to have to have an electric car. You're only going to be able to buy second-hand petrol and diesel cars by…I think that's coming in quite soon" (England group 2).
Using solar energy to meet all of your own energy needs.	"To me, it just needs to be the way forward. Not really for us, but for our kids and their future and looking at their well-being" (Northern Ireland group 1).

when there are technologically simpler and more immediate ways of helping with energy costs (particularly through energy efficiency measures).

Finally, although not mainstream, particular focus group participants did suggest or support more fundamental policy changes that would transform either energy or transport systems—by breaking norms about automobility[51] or engendering greater self-consumption or prosuming[52]. Examples are shown in Table 5. These statements, although anecdotal, do reveal some support for more ambitious policies among the UK public.

Discussion and conclusion

Our study set out to examine different stakeholder views on the policy options most relevant to energy and transport poverty in the United Kingdom. We interviewed 42 experts and held eight public focus groups (the latter with a representative sample of the UK public). Focus group participants shared personal experiences of hardship and deprivation, particularly in relation to domestic energy use. Among participants, there was also a widespread perception of shared vulnerability—a belief that, due to energy price increases, large sections of the UK population were likely to be at risk of energy and transport poverty in the future. This relates to recent research[53,54] determining that vulnerable low-income households may start to reduce their energy use considerably to avoid financial difficulties when energy prices rise.

It will be necessary to put in place policies to mitigate these issues, while also enabling the United Kingdom to meet its decarbonization goals. We therefore also asked members of the public and a range of expert stakeholders about their preferred policy solutions, based on existing government proposals and ambitions. While the public questioned generally did not have detailed knowledge of policy options, they nonetheless broadly concurred in their policy priorities with those with more specialist knowledge and experience. Both groups favoured obligations relating to energy efficiency in the private rental sector and of new homes; public transport provision and income supplementation, while being sceptical of enforcement of the first and the adequacy of the third. The public were, however, more positive about the value of electric vehicles and charging points than expert stakeholders as measures relating to transport poverty. The expert stakeholders were more explicit about the need to address underlying inequalities in incomes and the importance of inclusivity going forward to ensure that low-carbon innovations and measures are accessible to lower-income households in terms of information and cost.

Support or rejection by the public were largely related to perceived performance in terms of efficacy, need and self-interest; that is, policies should (cost) effectively and efficiently produce the desired result in terms of reducing energy or transport poverty, respectively (efficacy); policies should prioritize help to those struggling to meet their needs (need); policies should be beneficial to oneself, kin or friends (self-interest). In general, there was broad similarity in reasoning used by the public and stakeholders, although expert stakeholders more frequently referred to efficacy and tended to substantiate their opinions and reasoning in more detail. Similarly, the public tended to express views relating to self-interest relatively more frequently. There were often moral and emotional tones to the conversation: many people were angry and affronted by the perceived roles of the large energy firms and the UK government in the energy and wider cost-of-living crisis in the United Kingdom.

Despite the epistemic differences between the group of experts and the members of the public, they had similar views on the following, in particular, for tackling energy poverty: policies aiming at mandatory energy efficiency requirements for landlords and expanding financial assistance (whether via the Warm Home Discount scheme or some other measures). In our findings, appeal was also given to cheaper bus and train fares and expanding bus services, the latter having strong legitimacy among both groups for tackling transport poverty.

These options (mandatory energy efficiency requirements for landlords, expanding financial assistance, cheaper bus and train fares and expanding bus services) are seen by our participants as the most feasible and desirable and could provide appropriate first steps in future national and local policy to address double energy vulnerability and the institutional arrangements that exacerbate these issues. Both groups, especially the expert stakeholders, also proposed alternative policies to the ones we presented, indicating that there is ample appetite for more extensive and fundamental changes.

The energy and transport poverty reality facing millions of households in the United Kingdom forcefully reminds us that both fossil fuels and low-carbon technologies are intricately connected to issues of social welfare and protection. Fossil fuels, especially those such as natural gas and oil that are subject to supply constraints and the vagaries of global markets, can degrade social well-being and lead to living crises, whereas interventions such as energy efficiency and smart meters can empower households to become more resilient and energy secure. Future energy-transition policy, therefore, needs to be consistent with versions of social welfare policy that the public subscribe to.

Methods

Focus groups

We collected original, new data via two online focus groups in each of the UK devolved nations of England, Wales, Scotland and Northern Ireland (49 participants spread over eight focus groups, with 48 of these participants engaging in our ranking exercise for energy and 45 engaging for the exercise on transport), one rural and one urban per nation and semi-structured interviews with expert stakeholders ($N = 42$ for the full sample, although not all respondents participated in the ranking exercise—only 39 interviewees did). Focus groups were deemed an appropriate tool given their ability to capture the 'multiple realities' that members of the public may hold and also given the premise that public participation in policymaking or policy development aids legitimacy and truth grounding[55]. The value of online relative to physical

focus groups is reduced cost and lower in-person social influence, while maintaining the dimension of interactivity and group discussion[56]. A basic assumption in focus group research is that participants have a shared experience[57].

The date of the data collection is important; for the focus groups, they began during the first half of March 2022 and then April 2022, just before a much-publicized raising of the cap on UK 'standard variable' consumer tariffs for electricity and gas in later April 2022[58]. The expert interviews were undertaken immediately afterwards in April and early May 2022.

The eight focus groups were recruited and facilitated by a market research firm. Sampling was broadly representative of the general population in terms of a mix of level of income (Supplementary Table 1), though participants were required to own or have access to an internet-connected device. Focus group members were drawn from rural areas for one group and from urban areas for the second, per nation. Soft quotas were applied across age, gender and region in each focus group. For the focus groups, we had planned on needing to inform the participants of forthcoming home energy price rises, but sustained media coverage and their own experience of substantial price rises for home energy and transport fuel meant that the topic was already salient for most participants. Although the sample was representative of the national population for gender, age and location, our findings are not fully representative of 'the public', given inherent limitations in our research design centred around a small number of focus groups in each devolved nation.

Expert interviews

The expert stakeholders interviewed were participants to a personalized email invitation drawing on a database of about 200 cross-sectoral contacts held by the multi-institution research team. Their basic characteristics are provided Supplementary Table 2. The interviews were semi-structured but supplemented with a questionnaire at the end that had them rank various policy options.

Policy options

To collect original data on policy options relating to energy and transport poverty, we presented both the public focus groups and expert stakeholders with six policies (either already existing or aspirational) with a bearing on energy poverty and transport poverty, all of which were taken from UK government policy documents (including the Department for Business, Energy and Industrial Strategy; the Department for Transport and the Prime Minister's Office). We selected existing UK government policy aspirations relating to both transport and energy poverty and decarbonization policy, choosing those policies that we expected to be readily comprehensible. We also chose existing government policies or ambitions, rather than proposals from outside of government, to assess perceptions of measures that are likely to be introduced. This arguably means that the policy options we chose are relatively incremental and reformist in nature, and more ambitious or fundamental policies from outside of government were not explicitly presented to the participants. While our choice of policies did steer the focus group and interview conversations in a particular direction, participants would volunteer alternative policies outside of the list we presented. This included discussion of more 'visionary' policies (for example, a universal basic income), particularly in some of the expert interviews. The importance of this stems from both public acceptability and perceived efficacy being key considerations for governments when designing and delivering decarbonization policies[59]. Public opinion of transition policy, in general and in populist forms[36,60], has the potential to either hinder or support change processes[61]. There is ample evidence that public acceptance (or tolerance) of energy technology and policy are interrelated and that support among the general public need not translate to local acceptance near communities of place for a range of legitimacy-related reasons[62].

To this end, participants were asked to rank their top three policies in each category, to explain their reasons for choosing these and their reasons for not prioritizing the other options. They were also asked for their views more generally on their understanding of the drivers of energy poverty and transport poverty and for their views on other potential policies beyond the 12 presented. The predetermined policy options presented are given in Supplementary Table 3.

Under post-hoc conditions of consent and anonymity, the interviews and focus groups were conducted, recorded, transcribed and coded with NVivo qualitative data analysis software. Themes were inferred and areas of consensus and dissensus noted, both within the interviewee group and between this group and the focus group set as a whole. Our results were then divided into the four thematic areas covered in the main text: shared notions (and emotions) of vulnerability; the special circumstances of rural areas; perceptions of policy options; prescriptions for system redesign.

Reporting summary

Further information on research design is available in the Nature Portfolio Reporting Summary linked to this article.

Data availability

The data generated and/or analysed during the current study are not publicly available for legal/ethical reasons (it would compromise the anonymity of participants) but are available from the corresponding author on reasonable request. Source data are provided with this paper.

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Author contributions

B.K.S.: funding acquisition, data collection, formal analysis, validation, writing–review and editing. P.U.: data collection, formal analysis, validation, writing–review and editing. M.M.: funding acquisition, validation, writing–review and editing. K.E.H.J.: funding acquisition, data collection, formal analysis, validation, writing–review and editing. G.A.T.C.: data collection, formal analysis, validation, writing–review and editing. N.S.: funding acquisition, data collection, formal analysis, validation, writing–review and editing.

Ethics statement

The research has been approved by the Social Sciences and Arts Cross-Schools Research Ethics Committee (C-REC) at the University of Sussex, number ER/MM311/5. All participants provided informed consent to participate in the study. No children under the age of 16 were involved in data collection. To protect participant anonymity, we do not attribute any of the qualitative quotes used in the article.

Competing interests

The authors declare no competing interests.

Additional information

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Study description	Qualitative
Research sample	Focus groups (N=8, with 49 participants) and expert interviews (N=41), with more details on the sample and justification of the method provided in the study itself
Sampling strategy	Focus groups were deemed nationally representative and conducted by a marketing firm called Norstat. The expert interviews utilized a convenience sample with snowballing to other participants.
Data collection	Computer as well as video recordings (and transcription) for all focus groups and interviews. Nobody was present besides the participants(s) and the researcher, and the researcher was blinded to experimental condition and/or the study hypothesis.
Timing	Described in manuscript, although all data is recent, being collected in March to May 2022
Data exclusions	None
Non-participation	Eligible participants were screened by Norstat before participation in the focus groups
Randomization	Was not deemed necessary by Norstat

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Methods

n/a	Involved in the study
☒	☐ ChIP-seq
☒	☐ Flow cytometry
☒	☐ MRI-based neuroimaging

Human research participants

Policy information about studies involving human research participants

Population characteristics	Focus groups were deemed nationally representative and conducted by a marketing firm called Norstat. The expert interviews utilized a convenience sample with snowballing to other participants.
Recruitment	Selection was undertaken by Norstat
Ethics oversight	Ethics approval was granted by the CREC Board at the University of Sussex, and is mentioned in the study itself

Note that full information on the approval of the study protocol must also be provided in the manuscript.