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Unpacking energy equity: a UK expert and public elicitation scoping study

COLLECTION: CONSUMPTION, BEHAVIOUR AND ATTITUDES

PEER-REVIEWED PAPER

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ABSTRACT

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The UK energy system continues to transform in response to attempts to mitigate climate change. Growing scepticism towards the energy transition has prompted calls from researchers, practitioners and political bodies for equitable, inclusive and just transitions to overcome existing inequities and avoid future unfair distribution of costs and benefits of attempts to reach net zero greenhouse gases. While energy poverty, justice and sufficiency are established terms in energy research, energy equity is not clearly defined. This is despite equity being a core part of other disciplines including public health and environmental research.

We undertook 15 semi-structured interviews with two subsamples (eight members of the public and seven academic experts) in 2025 to better understand meanings of energy equity, its conceptual value, the impact of equity approaches, and how these might be measured in the UK context. This work additionally serves as a scoping study for a wider Delphi study to create consensus on energy equity.

Participants outlined meanings of energy equity separate to energy justice, centred around equitable needs-based distribution of energy services. Energy equity was defined by a range of energy activities wider than simply demand, and temporal, spatial, societal and political scales. Participants also outlined a range of impacts of, and factors that might influence, inequities and approaches to addressing them, as well as metrics to measure these in the UK context. Findings from this study offer insight into the conceptual potential of energy equity as a goal, process, analytical framework and tool for fair, inclusive energy transitions.

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INTRODUCTION

The UK must reform its energy system to achieve its legally binding net zero carbon emissions target by 2050. Alongside the physical changes to the system and energy market that are envisioned (Watson et al., 2022), addressing the plethora of inequities that persist in the current UK energy system, and in the transition itself, is vital. A range of inequities exist, impacting on individuals' and households' ability to, for example, access energy services and affordability of energy, exhibiting a range of financial, environmental, and health impacts (European Commission, 2022).

While inequities are commonly described, meanings and measurement of energy equity are often unclear, or conflated with other terms in the literature, such as energy justice (Alarcón Garavito et al., 2026). Energy justice and energy poverty have become well-developed concepts; meanwhile, energy equity has not. This is despite equity approaches being used in other disciplines including public health and education (Levinson et al., 2022; Whitehead, 1992), and clear understandings of general differences between equality, equity and justice from social justice literature and in the political zeitgeist (Minow, 2021).

This study investigates meanings of energy equity, its value, and how it might be measured, in the UK context. It aims to develop a preliminary, high-level definition, metrics and assessment framework of energy equity, as well as evaluating its potential value in energy social science (ESS) research grounded in both public and expert voice. To investigate this, eight members of the public and seven academic experts (total n = 15) were interviewed in Summer/Autumn 2025. This work also serves as a scoping study, feeding into a wider project using a Delphi study method to create expert consensus on meanings, impact, and measurement of energy equity in the UK.

BACKGROUND

Energy is fundamental to daily life. Rather than simply being a physical resource, energy entails the provision of a range of energy services, the "functions performed using energy which are means to obtain or facilitate desired end services or states" that people benefit from personally, professionally and as a society, though the exact activities which 'count' as energy are loosely-defined (Fell, 2017, p. 137). In the UK, low-carbon energy generation and energy demand levels are not on track to reach net zero greenhouse gas emissions by 2050 (Lockwood, 2023). Energy use levels and access to various forms of energy services are uneven between socio-demographic groups. The mismatch between benefits gained and costs accrued to households with different characteristics (e.g. socio-economic status) from the energy system highlight the many inequities present in the UK (Bouzarovski et al., 2022). In the wake of growing climate scepticism and negativity towards the net zero transition, there are growing calls for a focus on inclusive, just and equitable transitions (Owen and Barrett, 2020).

A range of terms have already been defined and used analytically to recognise, evaluate and address the human-centred nature of energy systems and inequities that exist within them (Ferrall-Wolf et al., 2023; Sovacool, 2014), including *fuel/energy poverty*, *energy vulnerability*, *energy justice*, *energy sufficiency, energy equality* as well as *energy equity*. Many of these terms show overlap (Ferrall-Wolf et al., 2023). Energy poverty is defined by Reddy et al. (2000) as "the absence of sufficient choice in accessing adequate, affordable, reliable, high-quality, safe, and environmentally benign energy services to support economic and human development". In the UK, 'fuel poverty', in the US 'energy burden' and more recently 'energy poverty', is predominantly focused on households, energy demand, and inability to afford sufficient domestic energy services or material deprivation (Boardman, 1991; Bouzarovski and Petrova, 2015). Recent work on double energy vulnerability has included a wider frame of energy inequality, including both energy poverty and transport poverty, which often interact with one another (Bouzarovski et al., 2025). Both *energy poverty* and *energy vulnerability* are descriptive terms, describing states that people and groups experience and live within compared to other terms such as energy justice and energy equity.

Energy justice, energy sufficiency, energy equality and energy equity are terms that can be both descriptive of states people experience *and* hold explicit goals and/or intended end-states. Energy justice is defined by Ren et al. (2025, p. 4) as "a framework for analyzing the

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fair and impartial accessibility and opportunity for all individuals involved in energy systems". Historically, it has consisted of three core tenets: distributional (where injustices emerge), procedural (which processes exist to address these) and recognition justice (how included are affected people in the process of addressing them) (Jenkins et al., 2021; McCauley et al., 2013).

Other tenets have been added more recently, though their application remains inconsistent across research and practice (Van Uffelen et al., 2024). Sovacool et al. (2016) underline that cosmopolitan justice is central to energy justice, including normative tenets of individualism, universality, responsibility and identity, and supporting consideration of international and intergenerational harms. Heffron and McCauley (2017) argue that restorative justice should also be treated as an important dimension of energy justice due to its capacity to address historical injustices and move past simple descriptiveness of harms. While these five tenets are the most commonly-considered (Van Uffelen et al., 2024), Bouzarovski and Simcock (2017) have additionally advanced spatial justice as a dimension of energy justice, recognising the influence of spatial differences on justice and that place-based and spatial perspectives must be integrated within energy justice perspectives.

Sovacool and Dworkin (2015) characterise energy justice as a conceptual, analytical and decision-making tool, initially emerging from environmental justice among other disciplinary perspectives (Jenkins et al., 2016). Energy justice research attention has sharply increased in recent years (Basil and Heffron, 2025), but much energy justice work suffers from a set of normative assumptions or uncertainties about scales and subjects of justice, knowledge(s) used, and timeframes which are often overlooked (Van Uffelen et al., 2024). The plural and wide-ranging nature of the concept itself opens it up to potential vagueness, corruption in use, and lack of specific applicability (Ferrall-Wolf et al., 2023). Energy justice can be politically divisive in Global North contexts (Alarcón Garavito et al., 2026). As a result, interest in energy equity as an alternative, or complementary, term has grown, particularly in non-academic environments (Ferrall-Wolf et al., 2023).

Energy sufficiency has been used to describe environmentally-sustainable end goals, namely "a state in which people's basic needs for energy services are met equitably and ecological limits are respected" (Darby and Fawcett, 2018, p. 8). Burke (2020) sees energy sufficiency as a way of rebalancing overall energy use through the creation of upper and lower limits of total energy demand, at national and individual levels. While originally developed as a response to critiques that energy efficiency and technological energy demand solutions will not adequately address climate change (Wilhite and Norgard, 2004), energy sufficiency now incorporates energy equity as a key component aiming to challenge social and economic norms and systems (Morley, 2026). Specifically, energy sufficiency scholars seek to reduce overusers' consumption to allow for greater energy consumption among those who underuse energy (Fournier et al., 2020), which resembles equity definitions in other fields.

Energy equality is divided into two main forms: substantive and formal equality (Pellegrini-Masini et al., 2020). Formal equality aims to ensure that all are treated in the same way. Substantive equality ensures that interventions account for inequalities to ensure non-discrimination, providing space for positive discrimination to support equal outcomes for marginalised groups (Pellegrini-Masini et al., 2020). While recent work examines substantive energy equality, traditionally 'equality' perspectives are conceptualised through the lens of formal equality. The challenge with formal energy equality is that, in treating all in the same way, interventions do not account for individual difference, context-specific needs, and existing inequities (Minow, 2021).

In contrast to traditional equality approaches which provide the same level of resources and/or support to all, equity involves recognition of differentiated needs between individuals and groups in interventions and policies. Equity as a concept, state and goal has been studied in different disciplines, including public health and environment. Health equity is a well-established term concept, defined as "everyone [having] a fair and just opportunity to be as healthy as possible" (Braveman et al., 2018, p. 2), and achieved by overcoming a set of barriers and social determinants of health. Health equity is conceptualised as an instrumental principle that addresses fairness, ethics, rights and dignity challenges. In the context of climate policies, equity is conceptualised by the distribution of costs and benefits based on responsibility or consequences for the involved actors (Ringius et al., 2002). Often, fairness and equity are mentioned in one breath. Rawls (1999) can be interpreted as characterising equity as a method through which fairness, thought of as a normatively-determined end goal, is achieved. Even between disciplines, therefore, there is division as to the meaning of 'equity'.

Energy equity has no agreed-upon definition, framework or set of indicators (Alarcón Garavito et al., 2026). Ren et al. (2025) see energy equity as the goal of a broader framework of energy justice, addressing states such as energy poverty, energy vulnerability, and energy insecurity. Cong et al. (2022, p. 3) define achieving energy equity as "giving everyone the same tools to achieve a desired level of energy consumption", the definition of health equity outlined by Braveman et al. (2018), but not necessarily that within environmental equity (Ringius et al., 2002). While often conflated with energy justice, recent work has outlined differences between the terms (Ferrall-Wolf et al., 2023). Energy equity, unlike energy justice, is often associated with a range of specific interventions and measures, tending to predominantly consider overcoming access and affordability issues (Alarcón Garavito et al., 2026). Energy equity is a growing topic of focus that has yet to be adequately defined, especially across cultural and spatial boundaries. This paper investigates initial meanings of energy equity to provide a preliminary definition, as well as predicted value and impact, and measurement, of the term.

METHODS

We conducted semi-structured interviews with members of the public and academic experts. This approach is commonly used in ESS research to elicit qualitative responses to a series of open and closed questions. It allows depth of responses that goes beyond traditional surveys, including extracting meaning and subtext from responses.

15 participants were recruited in summer 2025, from members of the UK public and UK-based academic experts. These subsamples were chosen to ensure public voice at the beginning of our wider research project (a consensus Delphi study), and to allow for comparison between the two groups. This study is treated as a scoping study. While the sample size does not allow generalisability and representativeness across the wider population (Galvin, 2015), it was practical based on time considerations and allows interpretation and differentiation between samples though likely not reaching data saturation (Corbin and Strauss, 2014).

Eight members of the public were recruited as part of a convenience sample via online platforms. Participants were offered a Love2Shop gift card worth £25 for their participation. Each participant was assigned a unique code (P01-P08) which is used to refer to them in direct quotes. Overall, 63% of the public subsample identified as male; most common age groups were 30–34 and 25–29, and all were of ethnic minority background (88% Black, Black British, Caribbean or African). 38% of participants had caring responsibilities, and 88% earned between £25,001 and £43,500 per year. No participants self-identified as disabled or neurodivergent.

The seven academic experts were purposively recruited via the researchers' existing networks. This expert subsample was selected for their knowledge and experience around energy systems, energy justice, equity and ethics, energy policy and transport topics. 57% identified as women; five of the seven participants being professors. Academic expert participants were also assigned a participant code which is used to refer to them here (A01–A07). To ensure anonymity, the subsample description is deliberately vague and not linked to demographic characteristics.

We conducted semi-structured interviews, using the same research schedule for both subsamples other than one additional question asked to academic experts on energy sufficiency. Prior to the interview, participants were presented with an information sheet on the project, and inform consent was obtained via a form. Participants were also asked to fill in a demographic questionnaire in advance (see Appendix 1). Interviews lasted an average of 34 minutes, conducted online via Microsoft Teams between July and September 2025. Interviewees were asked questions on the following topics within three core areas (see Appendix 2 for research schedule):

1. Meanings of energy equity (and inequity), knowledge of the term, perceptions of other common terms, and energy-relevant activities within energy equity;
2. Value of energy equity, predicted impacts, goals, prioritisation, realism, challenges of achievement, energy sufficiency comparisons and impact on climate change and vice versa;

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3. Measurement and indicators of energy equity, including factors entrenching inequity, barriers to addressing inequities.

These core areas (meanings, value and impact, and measurement) were selected to reflect established approaches to scoping studies, investigating complex, debated concepts that are consistent with concept analysis methodologies and logical conceptual characterisations (Arksey and O'Malley, 2005; Ren et al., 2025; Walker and Avant, 2005), as well as being developed from feedback from our wider team including energy systems modellers.

Interviews were recorded and transcribed within Microsoft Teams. Transcripts were cleaned and sent to interviewees to review and provide their permission to analyse. The transcripts were then inductively coded by a single coder in NVivo. We used thematic analysis to identify and group core themes. The study received ethical approval by the UEMS & Health and Care Professions Research Ethics Committee at the University of Exeter, reference number 9338813.

RESULTS

MEANINGS OF ENERGY EQUITY

Participants were first asked to explain what energy equity meant to them conceptually. Across both samples, most participants had heard of energy equity; for the public sample (6/8) this was often in more general terms, whereas five academic experts had heard of the actual concept. When asked about what energy inequity meant, public participants commonly raised themes of *lack of access* to energy and *imbalances in energy affordability*, followed by *unfair distribution of energy services and infrastructure*. The most common theme defining energy inequity among academic experts involved *energy service needs not being met*, followed by *unequal distribution and access to energy services*, *financial cost*, and *environmental inequalities*. Energy inequities' linkage to themes of imbalanced, unfair distribution, and unequal access was core to representations across both subsamples. Regarding additional considerations that define energy inequity, the public sample discussed structural, temporal and intergenerational considerations in inequities, while academic experts underlined the interconnectedness and reproduction of inequities as core to the concept itself.

When asked to describe what energy equity meant to them, the most common theme across both subsamples involved *access to energy services*, including access to infrastructures and technologies, the same level of access outcomes across different groups, providing opportunity for all to consume what they need based on circumstance and fair distribution of energy and resources. The second-most common theme mentioned was *affordability of energy*, with the eradication of energy poverty seen as a vital outcome to achieving energy equity. Both subsamples underlined the perceived inextricable link between energy equity and addressing *environmental* goals.

The public subsample was more likely than academic experts to raise ideas of *fairness and respect*; that energy equity must be rooted in goals of fairness and justice while promoting respect and individual dignity in the energy system. Academic experts underlined that equity approaches needed to cater to individual- and/or household-specific needs, centred on relative provision of support based on need, satisfying basic needs that are context-specific in ways that work well for everybody.

Both subsamples mentioned certain *considerations* or *influences* when describing equitable energy futures. Academic expert subsample themes mentioned included *spatial considerations*, including geographical impacts on ability to provide equitable distribution of energy services, and place-based context. Both subgroups underlined that *socio-demographic characteristics* and people's unique needs must be incorporated, alongside the need to consider *lived experience* of inequity, humanising the issues at hand, including supporting good jobs and skills. Both subgroups raised *power* as a consideration. For academic experts, this revolved around the need for equity approaches to recognise systems of oppression. For public participants, *public voice* as a tool to share power and be included in any energy transition was seen as core to equity ideas.

Participants were asked to envision which energy activities fit within their idea of energy equity (see Table 1). While many definitions of 'energy' exist, understanding the frame of activities to

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be examined through an equity lens was deemed vital to providing precise meaning to the term in the UK context. Respondents either provided more conceptual, high-level ideas at different scales, or referenced specific activities. Most raised people-centred conceptualisations, but many academic experts were keen to underline the need for whole system change, rather than piecemeal focus. The most common theme involved *household energy demand* activities, including appliances and devices, building quality and fabric efficiency, cooking, cooling, flexibility of energy demand, heating, lighting and general power usage. Participant P05 described the 'everyday' nature of these activities:

> I think that most of the activities is like warming the house, cooking, maybe the use of electric household items. That's the major activities that everyone has to carry out every day.

Both subsamples saw energy equity as being 'more than' simply energy demand. *Energy generation and supply* was a core focus of energy equity conceptualisations. This included a wide range of energy or fuel types, especially non-polluting modes such as home energy generation through heat pumps and renewable energy sources but also nuclear power, and more generally as the energy needed to provide access to energy services required by households.

The third common theme involved *transport and mobility*. For the public subsample, this was most commonly referring to electric vehicles, whereas for academic experts this also included other transport services such as public transport, and other mobility forms.

Academic experts also included more activities, including *energy infrastructure and materials*, such as the energy grid and other transmission infrastructure, energy technologies, materials needed, and resultant waste. Participant A03 summarises this relationship between energy infrastructure and materials and energy demand and supply well:

> How we see energy equity should also be a reflection of the systems networks for the cables as well as the generation that we have inherited.

Academic experts also underlined the people-centred nature of activities within energy equity, raising that *community engagement* and *energy jobs* were also relevant.

	THEME MENTIONED BY SUBSAMPLE GROUP	
	PUBLIC SUBSAMPLE	ACADEMIC EXPERT SUBSAMPLE
Energy activities relevant to energy equity		
Household energy demand	✓	✓
Energy generation and supply	✓	✓
Transport and mobility	✓	✓
Energy infrastructure and materials		✓
Community engagement		✓
Energy jobs		✓

Table 1 Summary of themes relating to energy activities relevant to energy equity, divided between the public and academic expert subsamples. A tick indicates that interviewees in this subsample mentioned an activity that was coded into this theme.

When conceptualising the remit of energy equity and relevant energy activities, *scale* was often raised. Academic expert responses were inconsistent about the level at which energy equity should be focused on (e.g. household, local, regional, national and/or international scales) and interactions between them. Participant A02 saw the remit of energy equity as particularly focused on direct energy engagement:

> So, like, [the public] don't have agency over how farming's done [...] It might well be energy-intensive, but I don't really see that that's something that you can pin on people because of their diet, but people are bothered about what they spend on heating their homes and driving their cars or using the train or whatever. So those are probably the big-ticket items of consumption of energy that connect to people directly.

Both subgroups were asked to explain the difference between energy equity, equality and justice terms (see Table 2). Almost all participants focused on differences between energy equity and energy justice. Most of the public subgroup had heard of energy justice, and believed

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there were differences between energy justice and equity. Academic experts (43%) commonly answered that there was no difference between the terms.

The public subsample identified five differences: (1) Energy justice is more focused on process, while equity on outcomes; (2) Energy justice was a more abstract, high-level concept and energy equity more practical; (3) Energy justice considered systemic topics including reparation, inclusion and power, whereas equity was more concerned with energy distribution and bills more explicitly; (4) Energy equity recognised individual difference, which energy justice did not, and (5) Energy equity was more politically neutral and acceptable than energy justice.

Among the academic experts, six themes emerged: (1) Energy equity was more cognisant of catering for individual differences with energy justice characterised as overlooking the relationship between the individual and collective; (2) Energy justice focused on systems-level topics, and more abstract and higher-level issues within which energy equity sits. There was some dissensus to this view in the sample; (3) Energy equity was more acceptable to the public and in political spaces than energy justice; (4) Energy equity was easier to objectively measure than energy justice, which was described by one participant as more value-laden; (5) Energy equity conceptualisations include public participation in the process, which energy justice did not necessarily, and (6) Energy equity was more conceptually valid than energy justice, with critiques of justice including that the concept itself was limited, including by its own tenets, that it has become static and ahistoric, as well as institutionally appropriated, that it has a strong anchoring in normative ethics and reproduces global North understandings of justice.

Table 2 Summary of themes relating to differences in the focus of the terms ‘energy equity’ and ‘energy justice’. A tick indicates that interviewees in this subsample mentioned an activity that was coded into this theme.

	THEME MENTIONED BY SUBSAMPLE GROUP	
	PUBLIC SUBSAMPLE	ACADEMIC EXPERT SUBSAMPLE
Differences in focus between energy equity and energy justice		
Process vs outcome	✓	
Catering to individual vs collective needs	✓	✓
Abstract vs specific	✓	✓
Systemic vs isolated	✓	
Public and political acceptability	✓	✓
Measurability		✓
Inclusion of public participation		✓
Conceptual validity		✓

The academic expert subsample was additionally asked about the relationship between energy equity and energy sufficiency. Energy sufficiency was characterised as having a focus on a band of ‘acceptable’ energy consumption levels within which individuals and households must remain, with minimum and maximum levels of energy use. Participants described the concept as broadly being focused on ‘what’s needed’ and more focused on minimum energy requirements to live and general energy consumption than on comfort, social norms or energy practices, with assumptions about ‘normality’ baked into the term. Energy sufficiency was seen as being more focused on reducing high consumers’ energy use and reducing overconsumption. Participants also saw energy sufficiency as a concept that employs abundance framings of energy supply due to its traditional focus on demand reduction than on supply itself.

When examining the relationship between energy equity and sufficiency frames, some participants believed the terms’ foci had some overlap, while others stated that they were incompatible, particularly regarding measurements. The most mentioned difference between the terms was that while energy sufficiency focused on reducing overconsumption, energy equity’s main priority was supporting those with insufficiency, with less attention paid to overconsumers. Energy equity’s additional integration of practices and norms rather than focusing on final energy demand in a more general and abstracted sense was not seen as commonly in conceptualisations of energy sufficiency. Participants questioned whether an energy sufficient society would necessarily always be an equitable one. Energy equity was seen as addressing different, and perhaps more, scales than energy sufficiency, which was often conceptualised as operating at a more abstract and high-level scale.

VALUE AND IMPACT OF ENERGY EQUITY

Participants were subsequently asked questions regarding the value and impact of energy inequities and equity approaches, and challenges to addressing inequities. When asked about predicted impacts of energy equity, academic experts mentioned direct impacts, indirect, longer-term impacts, and the considerations needed when examining impacts. While members of the public did not conceptualise impacts in this way, many of their responses fit in the thematic categories outlined by the academic expert subsample, particularly regarding longer-term impacts, and have been categorised as such in-text and in Table 3. Almost all impacts mentioned in this study were positive in their predicted effects.

When considering direct impacts, the most mentioned impact across both subsamples involved *financial impacts*, particularly greater energy affordability, addressing energy poverty, reduced general poverty and positive impacts on disposable income. When describing a theoretical equitable energy system 'end state', Participant P08 commented:

> No one has to choose between paying their energy bill and paying for food or rent. No one has to live in a home that is cold and die because they can't afford it.

Energy access impacts, such as greater public access to novel energy technologies and energy services were also mentioned by both subgroups. Similarly, both subgroups predicted *energy supply impacts*, including access to novel energy technologies and energy services, and personal ownership of renewable forms of energy supply; *transport and mobility impacts*, including transport service access and affordability, and *energy infrastructure and materials impacts*, including housing stock quality improvement, electrification of the energy system and energy reliability. Academic experts also predicted direct *energy demand impacts*, including reduced overall energy demand and increased flexibility.

Indirect, longer-term impacts predicted by both subgroups included:

- *Wider economic impacts*, including general poverty and affordability crisis alleviation, ability to take up economic opportunities, and macroeconomic benefits;
- *Environmental impacts*, including air pollution and climate change;
- *Social impacts*, including greater accessibility to engage with the energy system, a better social environment, social justice, and greater uptake and longevity of community initiatives and organisations;
- *Educational impacts*, including greater knowledge of the energy system and greater ability to take up educational opportunities;
- *Health impacts* including mental and physical health including reduced vulnerability to air pollution and climate-exacerbated heat hazards, and reduced stress.

The public subsample also mentioned *geopolitical impacts*, including national pride, supporting Global South nations' development, and global cooperation. Academic experts mentioned the potential of *unintended or unexpected trade-offs* as a result of impacts or equity interventions, and that equity approaches could have *political impacts*, challenging existing negative perspectives on energy transitions due to their potential to improve quality of life and increasing policy support.

Table 3 Summary of themes relating to impacts of energy equity mentions by the public and academic expert subsamples, divided between direct and indirect, longer-term impacts. A tick indicates that interviewees in this subsample mentioned an impact that was coded into this theme.

	THEME MENTIONED BY SUBSAMPLE GROUP	
	PUBLIC SUBSAMPLE	ACADEMIC EXPERT SUBSAMPLE
Direct impacts of energy equity		
Financial impacts	✓	✓
Energy access	✓	✓
Energy supply	✓	✓
Transport and mobility	✓	✓
Energy infrastructure and materials	✓	✓
Energy demand		✓

(Contd.)

	THEME MENTIONED BY SUBSAMPLE GROUP	
	PUBLIC SUBSAMPLE	ACADEMIC EXPERT SUBSAMPLE
Indirect, longer-term impacts of energy equity		
Wider economic impacts	✓	✓
Environmental	✓	✓
Educational	✓	✓
Health	✓	✓
Geopolitical	✓	
Unintended impacts		✓
Political		✓

Members of the academic subsample raised several considerations that must be accounted for when examining potential impacts of energy equity: *spatial considerations*, including geography, location, and other factors that might influence energy practices, affordability, ability to change, needs, and impact of interventions; *scale considerations*, whether at the local, regional, national or international level, and whether they might act in concordance or discordance with one another, and *temporal considerations,* namely whether impacts are felt by those presently experiencing them, future generations, and/or whether impacts are felt for a certain time period – generally, 'impacts for whom' was discussed.

ENERGY EQUITY MEASUREMENT

Regarding factors that create and/or entrench energy inequities (see Table 4), *financial factors* were most commonly mentioned both subsamples. For the public subsample, *financial factors* included household costs, energy affordability, socio-economic status and household income levels. For the academic expert subsample, this included income distribution, energy poverty, access to financial support, energy service affordability, wealth and contractual relationships to homes.

The joint-most mentioned theme among the academic expert subsample was *infrastructural factors*, including physical properties of the home including poor quality and energy efficiency of the UK housing stock, building age and ability to make changes to the home, and general infrastructural challenges to upgrading technologies or addressing inequities created or exacerbated by existing infrastructure. Only one member of the public mentioned this theme, in relation to housing quality.

The second-most common theme mentioned by the public subsample were *spatial and geographical factors*, both as a factor and a mediator of other factors creating and/or entrenching energy inequities. The public sample highlighted the role of rural vs urban energy service provision, remoteness, weather and climate differences, spatial differences in influence of environmental factors on vulnerability and access and geographical variations in forms of energy service supply. *Spatial and geographical factors* was the joint third-most common theme among academic participants. These included locational impacts, place-based inequities and population density. *Informational factors* and *social and individual-level factors* were also third most mentioned (for the public sample, these were third and sixth-most mentioned respectively).

Informational factors were conceptualised at macro- and individual levels by the academic subsample, with poor or inconsistent data quality and availability for decision-makers to address inequities, and difficulty of information access for those wishing to address energy-related issues personally mentioned. The public subsample focused much more on individual-level *informational factors,* including public knowledge and awareness around energy use, poor or unreliable sources of information, and low topic-specific education and domain-specific knowledge.

Social and individual-level factors mentioned by academic participants included social practices, caring responsibilities and similar responsibilities, socio-demographic factors and individual health issues. The public sample was particularly focused on discrimination and bias, including racism and other discriminatory practices towards marginalised groups.

The final thematic factor mentioned by both subsamples was *political priorities*, with academic experts also mentioning the media environment, and members of the public underlining lack of policies. Public participants also mentioned *access to energy services*, *poor maintenance*, *energy system reliability*, and *skills gaps*. The academic subsample outlined that the current setup of the *energy system itself* acted as a factor creating and/or entrenching existing energy inequities.

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Table 4 Summary of themes relating factors creating and/or entrenching energy inequities, divided between the public and academic expert subsamples. A tick indicates that interviewees in this subsample mentioned a factor that was coded into this theme.

	THEME MENTIONED BY SUBSAMPLE GROUP	
	PUBLIC SUBSAMPLE	ACADEMIC EXPERT SUBSAMPLE
Factors creating and/or entrenching energy inequities		
Financial factors	✓	✓
Infrastructural factors	✓	✓
Spatial and geographical factors	✓	✓
Informational factors	✓	✓
Social and individual-level factors	✓	✓
Political priorities	✓	✓
Access to energy services	✓	
Poor maintenance	✓	
Reliability	✓	
Skills gaps	✓	
Energy system itself		✓

When asked about how they would measure energy equity, participants again split these into direct indicators and longer-term, indirect measures of energy equity, alongside considerations needed when measuring energy equity. Public participants mentioned measures grouped into nine themes, whereas the academic expert subsample's responses were categorised into 11 theme groups (see Table 5). Not all themes mapped on directly to specific energy activities or inequities discussed earlier.

For direct, first-order measurements of energy equity, *cost metrics* were most commonly mentioned among both subsamples. The public predominantly saw this through energy burden to individuals and households, including energy poverty rates and energy bill price, whereas for academic experts these included cost per mile travelled mediated by energy used, energy bill cost, energy poverty rate, income inequality metrics and Gini index, and income levels. Both subsamples mentioned *access metrics*, though this was more commonly cited by members of the public. Specific metrics included rate of access to energy, access to sufficient energy services such as heating, access to energy technologies including rates of heat pump and solar panel uptake, and access to, and accessibility of, transport. The public subsample was more likely to discuss *demand metrics*, such as energy consumption rates, household consumption of (renewable) energy and general household consumption, while one academic expert participant mentioned miles per gallon as an energy consumption metric. Both subsamples outlined potential *energy infrastructure metrics*. For the public, this included wide range of measures including amount of backup energy supply and flexibility, appliance quality, power outage duration, and housing quality. For the academic experts, measures were predominantly focused on housing quality measures, including dwelling characteristics, dwelling type, energy efficiency and EPC rating, exposure to excess cold temperatures, exposure to moisture, and warmth of home. Both subsamples mentioned *energy supply metrics*, such as overall renewable energy production levels, energy source type, public access to renewable energy supply and technologies, and location of energy generation.

For indirect energy equity measurements, members of the public most commonly mentioned *wider economic metrics*, such as environment-conscious GDP measures, job creation numbers, and metrics examining the share of costs and benefits of equity approaches across society. Academic experts also raised wider economy benefits measures, including shifts in employment. *Environmental metrics* were mentioned by both groups, emissions produced mentioned as an indicator by the public sample, while the academic expert sample listed greenhouse gas

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emissions, pollution rates and land use. Both groups mentioned *social metrics*. For public participants, this took the form of levels of public participation, including voice in energy project decisions and levels of community engagement and participation, public perceptions, feelings of inclusion in decision-making, levels of knowledge and awareness, and disconnection rates. For the academic experts, *social metrics* consisted of deprivation level, educational attainment, public perceptions, feelings of fairness and policy support levels. The final set of metrics that both subgroups mentioned involved *health metrics*. Academic experts also mentioned *waste metrics*, such as nuclear waste produced, and *intervention metrics*, namely examining the impact of different policy interventions.

Table 5 Summary of themes relating to energy equity measurements and metrics, split into direct and indirect energy equity measurements. A tick indicates that interviewees in this subsample mentioned a measurement, metric or indicator that was coded into this theme.

	THEME MENTIONED BY SUBSAMPLE GROUP	
	PUBLIC SUBSAMPLE	ACADEMIC EXPERT SUBSAMPLE
Direct energy equity measurements		
Cost metrics	✓	✓
Access metrics	✓	✓
Demand metrics	✓	✓
Energy infrastructure metrics	✓	✓
Energy supply metrics	✓	✓
Indirect energy equity measurements		
Wider economic metrics	✓	✓
Environmental metrics	✓	✓
Social metrics	✓	✓
Health metrics	✓	✓
Waste metrics		✓
Intervention metrics		✓

While participants mentioned many themes for measuring energy equity listed above, both subsamples also underlined certain considerations needed when measuring energy equity. Consideration of *geographical and/or spatial differences* was seen as important, alongside the need for the collection, analysis and use of *both quantitative and qualitative measures* to examine the equitable nature of the energy system. For academic experts, three underlined that thinking about the *scale of the measure* was an important consideration, for example whether it measures individual/household level, local, regional, national or international scales, and how these might interact with one another. Academic experts also raised considerations of the need to include *both input and outcome measures*, and the need for *data accessibility and transparency*.

DISCUSSION

Overall, participants saw energy equity in the UK as separate to similar terms such as energy justice, equality, and sufficiency. Energy equity was defined by its goals and processes, particularly around ensuring equitable distribution of energy services that cater to individual needs, are delivered fairly across populations and include the role of public voice and lived experience. Echoing past critiques of energy justice and its inability to effectively incorporate cosmopolitan and spatial justice effectively (Bouzarovski and Simcock, 2017; Van Uffelen et al., 2024), participants saw energy equity as more cognisant of individuals, their lived experience, and social relations than energy justice. Energy equity was also perceived as more socially and politically acceptable than energy justice, confirming previous assertions of Alarcón Garavito et al. (2026).

This characterisation of energy equity is not dissimilar from the way Ren et al. (2025) define energy equity from existing literature, underlining its people-centred nature and as a goal rather than a framework. The discussion of scale(s) and relevant energy activities adds new depth to the term in our preliminary definition. Here, scale(s) include temporal, spatial, societal and political scales that interact with one another, delineate and define the bounds of equity, and may determine the extent to which equity is possible in energy systems. Energy activities relevant to energy equity went beyond traditional energy demand and consumption-focused activities alone described in Cong et al.'s (2022) and Ren et al.'s (2025) definitions of energy equity, instead including energy generation and supply, transport and mobility, energy infrastructure and materials, and people-centred activities including community engagement and energy jobs. While broadly referred to as the 'energy system', reaching from mining through to consumption and waste (Jenkins et al., 2016), this conceptualisation goes further to include transport and mobility, but does not include pre-generation activities. Broadly speaking, this definition surpasses ideas of 'energy services' to include energy generation and transmission (Fell, 2017). This description of energy equity is presented in Figure 1.

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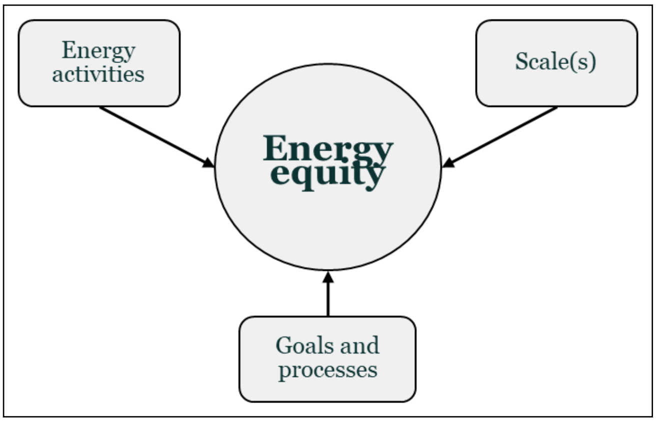

Figure 1 Preliminary visualisation of energy equity, determined by the types of energy activities included; the temporal, spatial, societal and political scales; and the approach grounded in goals and processes aimed at ensuring equitable distribution of energy services tailored to individual needs, delivered with fairness and respect and cognisant of public voice and lived experience.

Study participants predicted equity approaches to predominantly have positive direct and indirect impacts. Direct financial, access, supply, transport and mobility, energy infrastructure and materials, and energy demand were mentioned. Wider indirect impacts included wider economic, environmental, educational, health, political and geopolitical impacts. These conceptualised impacts, documented in Figure 2, go far beyond well-established potential equity impacts outlined by Tarekegne et al. (2021), but need deeper investigation of differentiated immediate and long-term energy equity impacts in different spatial contexts.

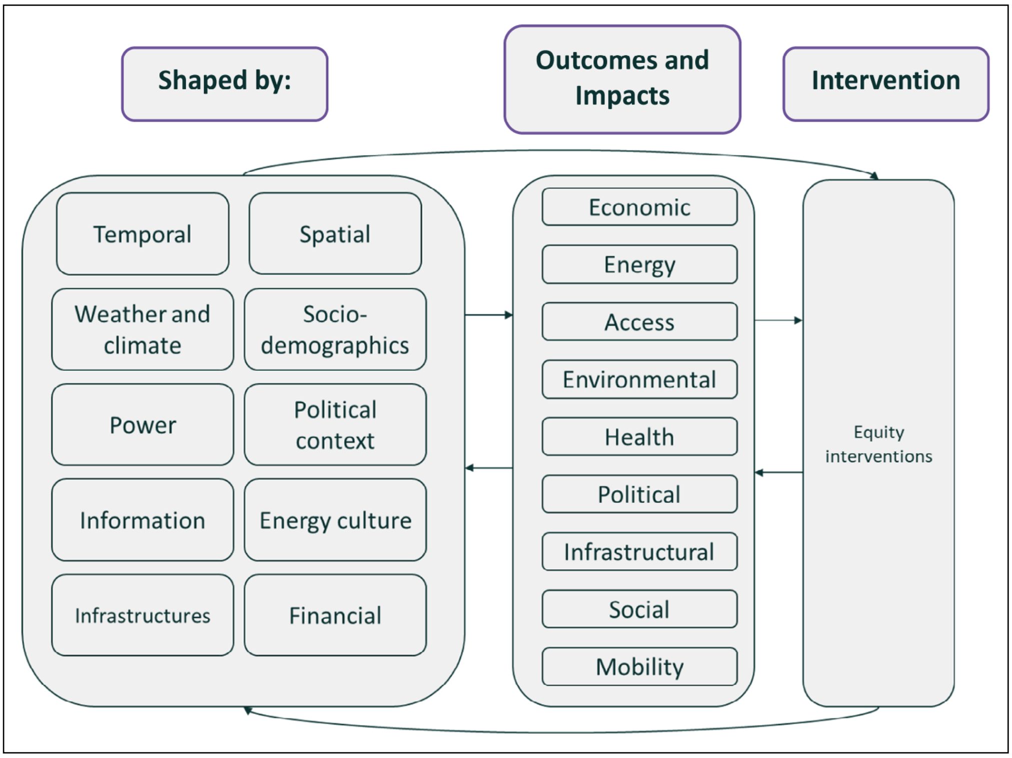

Figure 2 Preliminary shaping determinants, outcomes and impacts, and interventions of energy equity showing a non-exhaustive list of variables as determined by participants in this study. The structural and social determinants interact with outcomes and impacts, as well as interventions, and reproduce with one another.

Participants were quick to outline a range of factors that might shape the extent to which these positive impacts might appear, as well as the social and structural determinants that shape or entrench the existence of inequities and the nature (and success) of any intervention (see

Figure 2). These include temporal, spatial and climatic factors, socio-demographics, power, political context, information, energy culture, infrastructures and financial situation. This is by no means an exhaustive list: we propose that these kinds of factors (whichever are relevant) will interplay with the existence of energy inequities themselves, their impacts, any equity interventions created to address these inequities, and the success or failure of these approaches. This conceptualisation is inspired by visualisations outlining the structural, social and intermediary determinants of health inequities (Solar and Irwin, 2010), applied in an energy context.

In this study, a series of measures and indicators were mentioned by participants. Broadly speaking, these included direct energy measurements (cost, access, demand, infrastructure, and supply metrics) and indirect measurements (wider economic, environmental, social, health, waste, and intervention/policy metrics). These go beyond common reliance in the literature on quantitative measures and common financial and/or access indicators such as Gini coefficients alone (Barlow et al., 2022; Ren et al., 2025). Future work must evaluate the extent to which these indicators are quantifiable; a concern raised by Barlow et al. (2022).

CONCLUSION

Compared to other terms such as energy justice and energy sufficiency, energy equity has received less attention as a tool to support equitable energy transitions and address existing energy inequities. This research aimed to provide a preliminary delineation and conceptualisation of energy equity to understand its meaning, including in relation to other common terms in the discipline, its potential value and impact, and how it might be measured particularly in the UK context. Energy equity is an important target to achieve, shaped by its goal and process (needs-based, fair provision of energy services that include public voice), the activities included which consider more than simply energy demand, and the temporal, spatial, societal and political scale(s) that delineate and define the bounds of equity and the levels of the energy system itself.

As a result of the interviews with public and academic expert participants, we present an initial conceptualisation of energy equity, accounting for the many shaping determinants, outcomes and impacts, and interventions to address these, that all interact with one another to create, address, or entrench energy inequities. This initial conceptualisation of energy equity can be applied to energy systems models aiming to understand inequities in energy systems, as well as those developing policy proposals to address these. This work also serves as a scoping study for a Delphi study examining this with UK-based energy experts. Future research on the topic should aim to validate these findings among a wider cohort of energy experts, particularly focusing on meanings of energy equity and measurement, metrics and indicators. This could be enhanced by focusing on specific place-based inequities, allowing for more specificity in responses.

DATA ACCESSIBILITY STATEMENT

Upon project completion, the data will be deposited in the UK Data Service. If anyone cannot find the data there or would like earlier access, they should contact the corresponding author.

ADDITIONAL FILES

The additional files for this article can be found as follows:

- **Appendix 1.** Demographic Questionnaire. DOI: https://doi.org/10.66506/essp.1-046-26.s1
- **Appendix 2.** Research Schedule. DOI: https://doi.org/10.66506/essp.1-046-26.s2
- **PowerPoint Slides.** PowerPoint Slides relating to this article. URI: https://eceeeproceedings.org/articles/3/files/6a5104fc2d6aa.pptx

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COMPETING INTERESTS

The authors have no competing interests to declare.

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